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**A revised taxonomic account of the fern genus
Woodwardia (Blechnaceae) in Thailand**

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ABSTRACT. The genus *Woodwardia* Sm. is revised and is now represented in Thailand by two species, *W. harlandii* and *W. japonica*. These are described and illustrated. A key to the species is presented.

INTRODUCTION

The genus *Woodwardia* Sm. belongs to Blechnaceae subfam. Blechnoideae. So far 14 species have been recognised. These are predominantly distributed in the northern hemisphere, especially in eastern Asia (Kramer et al., 1990). Holttum (1960) in his *Ferns of Malaya* recorded only one species from tropical Southeast Asia, namely *W. auriculata* Blume from the Cameron Highlands, Malaysia. He also noted that this species is closely allied to *W. japonica* (L. f.) Sm. Devol (1980) recorded five species, namely *W. harlandii* Hook., *W. kempii* Copel., *W. japonica*, *W. orientalis* Sw., and *W. unigemmata* (Makino) Nakai from Taiwan. Hô (1991) noted four species from Vietnam, viz. *W. cochinchinensis* Ching, *W. harlandii*, *W. japonica* and *W. unigemmata*.

In mainland Asia, Chiu (1974) regarded *W. cochinchinensis* Ching as a separate species. However, he also noted that this species is similar to *W. auriculata*, *W. magnifica* Ching & P. S. Chiu and *W. japonica*. In his key the major difference between *W. cochinchinensis* and *W. japonica* is the number of pairs of pinnae (*japonica*: 10–15 pairs, *cochinchinensis*: 20–30 pairs). Raymond Cranfill (pers. comm.) treated *W. cochinchinensis* and *W. magnifica* as synonyms of *W. japonica*. He commented that “*W. japonica* is the most highly variable species of the genus, the variation is nevertheless not purely random. There are tendencies toward an increase in size, an elaboration of pinna segments and an increase in the number of such segments per pinna as one approaches the southern and eastern distributional limits of the species”. *W. japonica* and *W. auriculata* are morphologically similar, but can be distinguished by the combination of (1) the number of pairs of pinnae per frond (*W. japonica*: 9–21 pairs, *W. auriculata*: 17–23 pairs) and (2) the number of pairs of lobes per pinna (*W. japonica*: 10–23 (25) pairs, *W. auriculata*: 25–30 pairs).

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WOODWARDIA IN THAILAND

In Thailand, Tagawa & Iwatsuki (1988) recorded only one species, *W. cochinchinensis* Ching. They noted that Ching (1931) used large oblong turgid sori, the membranous brown indusia and the larger size of plants (see Tagawa & Iwatsuki, 1988) as diagnostic characters to distinguish *W. cochinchinensis* from *W. japonica*. Moreover, they added that only the indusia and size of Thai plants agreed with the characteristics of *W. cochinchinensis*.

Thai material and material under *W. cochinchinensis* from existing herbarium specimens deposited at BCU, BM, BK, BKF, K, L, and P were re-examined. It was found that all Thai specimens have lateral pinnae in 7–20 pairs, with 12 pairs being the most common. From the information above it can be seen that Thai specimens have numbers of lateral pinnae which match the diagnostic characters of *W. japonica* (L. f.) Sm. as was pointed out by Chiu (1974) and R. Cranfill (unpublished data). Therefore all Thai specimens of *W. cochinchensis* are re-determined here as *W. japonica*.

Some time ago during a field trip to Phu Luang, a newly recorded species, *W. harlandii* Hook. was found in hill evergreen forest. Its occurrence in north-eastern Thailand is in agreement with its previously known geographical distribution in Vietnam, Taiwan, South China and South Japan.

KEY TO THE SPECIES

1. Rhizome creeping, stipe distant; frond dimorphic, fertile fronds with 3–5 pairs of lateral pinnae, pinnae shallowly lobed. Sori linear-oblong, along costa and costular areoles **1. *W. harlandii***
1. Rhizome stout, erect, stipe tufted; frond monomorphic, with 7–20 pairs of lateral pinnae, pinnae deeply lobed. Sori oblong, discrete, along costular areoles **2. *W. japonica***

1. *Woodwardia harlandii* Hook., Fil. Exot.: t. 7. 1867; P. S. Chiu, Acta Phytotax. Sin. 2: 237–248. 1974; C. E. Devol, Fl. Taiwan 1: 156. 1980; P. H. Hô, Illustr. Fl. Vietnam 1: 259. 1991; K. Iwats., Ferns and Fern Allies of Japan 157, pl. 90. 1992. Figs. 1–2A–B.

Rhizome creeping, covered with small scales; scales broadly lanceolate, entire; stipes distant in mature plants, covered with small narrowly lanceolate scales at base. *Frond* dimorphic. *Stipe* brown-black at base, stramineous in upper portion, scaly at base, grooved; sterile stipe 12–24 cm long, fertile stipe up to 45 cm. *Sterile lamina* up to 24 cm long, simple, lanceolate, or tri-palmately lobed, terminal lobe the longest, base rounded, margin serrate near apex and shallowly lobed below, coriaceous, light green to light brown when dry. *Fertile lamina* up to 40 cm long, simply pinnate, with an elongated terminal pinna, lateral pinnae 3–5 pairs similar to the terminal one, pinnae sessile, forming a winged rachis with the opposite lateral pair, oblong, 2.5–3 by 20–25 cm; veins anastomosing. *Sori* linear, along costal and costular areoles; indusia linear, narrow, thin, opening towards costa or costule.

Thailand.— NORTH-EASTERN: Loei [Phu Luang, *T. Boonkerd* 579 (BCU!), 730 (BCU!) & 1644 (BCU!).]

Distribution.— South Japan, South China, Taiwan and Vietnam.

Ecology.— Terrestrial, on dry hill slope in hill evergreen forest, semi-shade at 1,200 m altitude.

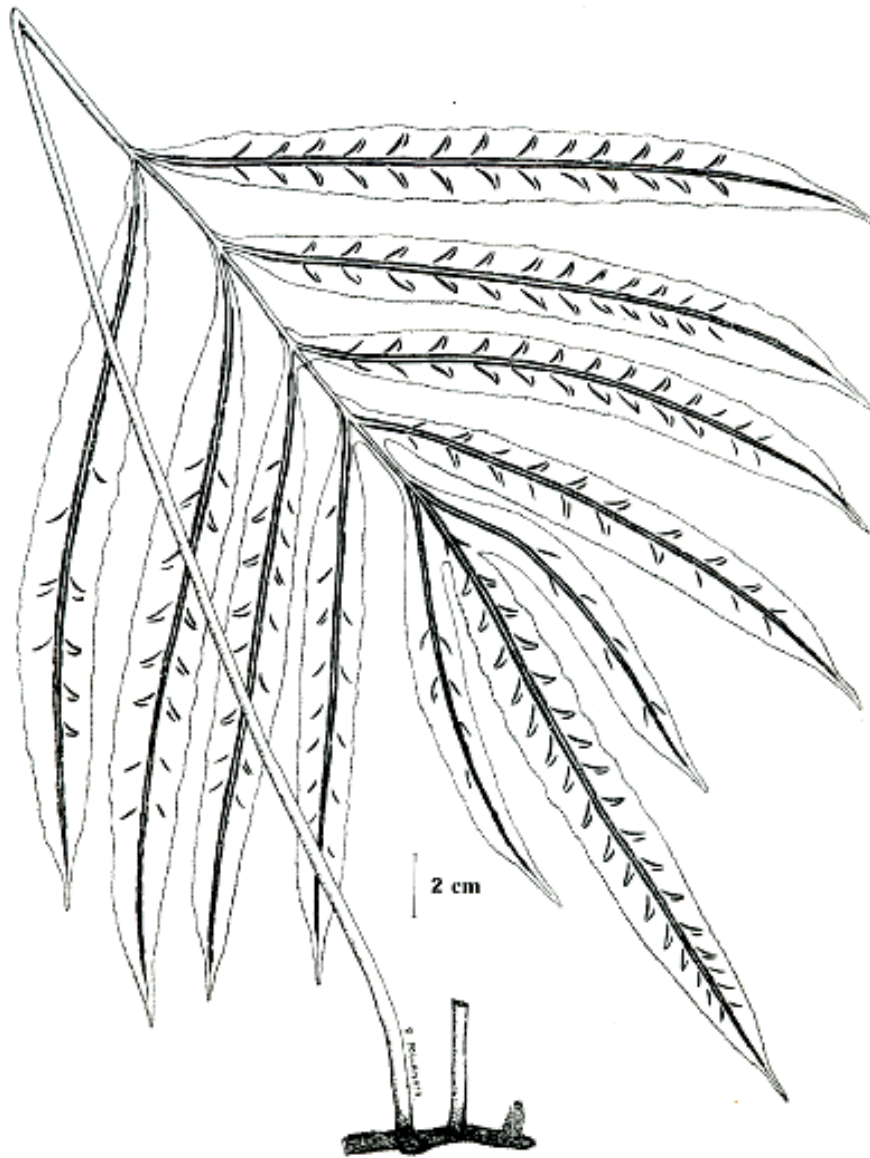


Figure 1. *Woodwardia harlandii* Hook.: habit and fertile pinnae. From T. Boonkerd 579.

2. *Woodwardia japonica* (L.f.) Sm., Mém. Acad. Imp. Sci. Turin 6. 411. 1793; P. S. Chiu, Acta Phytotax. Sin. 2: 237–248. 1974; C. E. Devol, Fl. Taiwan 1: 159. 1980; P. H. Hô, Illustr. Fl. Vietnam 1: 259. 1991; K. Iwats., Ferns & Fern Allies of Japan: 156, pl. 89. 1992.— *Blechnum japonicum* L.f., Suppl.: 447 (1781).— *W. cochinchinensis* Ching, Sinensia 3: 334. 1933; Tagawa & K. Iwats., Fl. Thailand 3: 301, pl. 24. 1988. Fig. 2C–D.

Rhizome short, erect, covered with large red-brown scales at bases. *Stipe* 25–50 cm long, scaly at base; scale large, reddish-brown, lanceolate, entire. *Fron*d large, monomorphic, 1-pinnate-pinnatifid; lamina oblong-lanceolate, 50–90 by 28–40 cm, truncate to rounded at base, acute to acuminate at apex; pinnae oblong-lanceolate, sessile, base truncate, lateral pinnae 7–20 pairs, lobed about $\frac{3}{4}$ way to costa, segments on either side of costa of equal length; median pinnae 14–20 by 2–6 cm. *Sori* oblong, in 2 rows along costules, 2–4 mm long, sunken; indusia discrete, membranous, brown, opening towards costa and costules.



Figure 2. *Woodwardia harlandii* Hook.: A. habit; B. part of fertile pinnae; *Woodwardia japonica* (L.f.) Sm.; C. habit; D. part of fertile pinnae. Photographed by S. Suddee and S. Samransuk, Phu Luang, Loei.

Thailand.— NORTHERN: Chiang Mai [Pang Bo, *T. Smitinand* 8719 (BKF!, L!); Doi Ang Khang, *T. Boonkerd* 1366 (BCU!); Doi Pui, *T. Boonkerd* 1358 (BCU!); Doi Suthep, *W. Eiadthong* 226 (BKF!); Chiang Rai [Khun Korn Forest Park, *Khun Korn* 1394 (BCU!); Phu Langka, *T. Smitinand* 1769 (BKF!); Doi Langka, *K. Iwatsuki* & *N. Fukuoka* T-3569 (BKF!); Doi Pa Na Tu, *H. B. G. Garrett* 745 (BKF!); Doi Luang, *J. F. Maxwell* 97-565 (BKF!); Doi Tung, *K. Iwatsuki*, *N. Fukuoka*, *M. Hutoh* & *D. Chaiglom* T-11093 (BKF!); *R. Geesink*, *P. Hiepko* & *C. Phengklai* 8288 (BKF!); *T. Boonkerd* 1543 (BCU!); NORTH-EASTERN: Loei [Phu Luang, *T. Boonkerd* 1646/1 (BCU!)].

Distribution.— Korea, Japan, China, Taiwan and Vietnam.

Ecology.— Terrestrial, on dry hill slopes in hill evergreen forest, in semi-shade at 900–1,550 m altitude.

ACKNOWLEDGEMENTS

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REFERENCES

- Chiu, P. S. 1974. On the genus *Woodwardia* Sm. from the mainland of Asia. *Acta Phytotax. Sin.* 12: 237–248.
- Devol, C. E. 1980. Blechnaceae. In: Hui-lin Li et al. (eds), *Flora of Taiwan* 1: 149–160.
- Iwatsuki, K. (ed.). 1992. *Ferns and Fern Allies of Japan*. Heiboncha Ltd., Publishers, Tokyo.
- Hô, Phạm-Hoàng 1991. *An illustrated Flora of Vietnam*. Mekong Printing.
- Holttum, R. E. 1960. *A Revised Flora of Malaya II. Ferns of Malaya*. Government Printing Office, Singapore.
- Kramer, K. U., Chambers, T. C. & Hennipman, E. 1990. Blechnaceae. In: K. Kubitzki et al. (eds), *The Families and Genera of Vascular Plant: I Pteridophytes and Gymnosperms*, pp. 60–68. Springer-Verlag, Berlin.
- Tagawa, M. & Iwatsuki, K. 1988. Pteridophytes. In: Smitinand, T. & Larsen, K. et al. (eds), *Flora of Thailand*, 3: 297–302.

Additions to the pteridophyte flora of Thailand

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ABSTRACT. Recent fieldwork and a review of specimens previously collected from Thailand deposited at BCU, BKF and K has resulted in the discovery of 19 pteridophyte species previously unrecorded for Thailand.

INTRODUCTION

The pteridophytes were completed for the Flora of Thailand in four parts (Tagawa & Iwatsuki, 1979, 1985, 1988, 1989). 630 species were recognised as occurring in Thailand. Subsequently a number of papers have been published in which new taxa have been described or new records have been added to the pteridophyte diversity of Thailand (Mitsuta, 1985; Parris, 1998; Hovenkamp et al., 1998; Boonkerd & Nooteboom, 2001; Rachata & Boonkerd, 2001; Boonkerd & Pollawatn 2002a, 2002b; Lindsay & Middleton, 2004; Lindsay et al., 2004; Suksathan, 2004). Boonkerd & Pollawatn (2000) compiled a list with distribution maps and many photos of all the pteridophytes of Thailand in which an additional 27 species were included. This rate of addition of new taxa and new records to a recently completed flora account reflects the fact that pteridophytes are often neglected on traditional collecting trips and we urge all collectors in Thailand (and indeed elsewhere) to pay more attention to them.

The senior author of this paper has worked on Thai pteridophytes for many years. The other authors have been engaged in a collecting programme in southern Thailand where some of the specimens for these new records have been collected.

The following list includes only taxa not previously recorded as occurring in Thailand. For each we have listed the place of publication, the basionym where necessary, type details, and any collections of this taxon from Thailand. Most previous additions of new taxa for families already completed for the Flora of Thailand include descriptions. We have not done this because there are so many new taxa and because many of the other citations of new pteridophyte records for Thailand also lack descriptions thereby already breaking the completion of coverage. With so many taxa to be added to the Flora of Thailand what is needed is a comprehensive revision of the pteridophyte volumes, possibly in an interactive key and plant information format that will allow for frequent electronic updates.

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NEW PTERIDOPHYTE RECORDS FOR THAILAND

Type details are given below but we have not made any attempt to lectotypify taxa.

ADIANTACEAE

Adiantum latifolium Lam., *Encycl.* 1: 43. 1783. Type: French Caribbean, Guadeloupe, *Proctor* 20110 (neotype A!; photo LP; isoneotype US).

Thailand.— PENINSULAR: Narathiwat [Amphoe Su Ngai Kolok, *Niyomdham et al.* 944 (BKF, K)].

Doryopteris allenae R.M. Tryon, *Contr. Gray Herb.* 191: 91, f. 1–4. 1962. Type: Malaya, Perak, Gunong Idong, *Molesworth-Allen* 4736 (holotype GH!).

Thailand.— PENINSULAR: Yala [Amphoe Bannang Sata, *T. Boonkerd & R. Pollawatn* 216 (BCU)].

Taenitis interrupta Hook. & Grev., *Icon. Filic.* t. 63. 1828. Type: Singapore, *Wallich* 142 (K-W!).

Thailand.— PENINSULAR: Surat Thani [Ko Tao, *Kerr* 16043 (K)].

ASPLENIACEAE

Asplenium finlaysonianum Wall. ex Hook., *Icon. Pl.* 10: t. 937. 1854. Bangladesh, Sylhet, *Wallich* 2682 (K-W!).

Thailand.— PENINSULAR: Pattani [Ban Sai Khao, *Eryl Smith* 1961 (K)].

ATHYRIACEAE

Diplazium procumbens Holttum, *Gard. Bull. Straits. Settle.* 11(1): 95, f. 4. (1940). Type: Malaysia, Frasers Hill, *Holttum* S.F.N. 36503 (MICH!).

Thailand.— SOUTH-WESTERN: Phetchaburi [Kaeng Krachan National Park, trail from Khao Phanoen Thung Ranger substation to Than Thip Waterfall, *Middleton et al.* 1762 (A, BKF)].

CYATHEACEAE

Cyathea moluccana R. Br., *Mém. Soc. Linn. Paris* 6: 322. 1827. Type: Moluccas, *C. Smith* s.n. (BM!).

Thailand.— PENINSULAR: Narathiwat [Amphoe Waeng, Sirindhorn Falls, *T. Boonkerd & R. Pollawatn* 263 (BCU)].

DAVALLIACEAE

Davallia embolostegia Copel., Philipp. J. Sci. 1(Suppl. 2): 147, t. 3. 1906. Type: Philippines, Luzon, Lepanto, Bagnen, *Copeland* 1914 (MICH!).

Thailand.— EASTERN: Nakhon Ratchasima [Amphoe Pak Chong, Khao Yai National Park, *T. Boonkerd & R. Pollawatn* 349 (BCU)].

DRYOPTERIDACEAE

Arachniodes conifolia (T. Moore) Ching, Acta Bot. Sin. 10: 257. 1962.— *Lastrea conifolia* T. Moore, Index Filicum (T. Moore) 88 (1857). Type: Nepal, *Wallich* 341 (K-W!).

Thailand.— SOUTH-WESTERN: Kanchanaburi [Amphoe Thong Pha Phum, Thong Pha Phum National Park, *A. Sathapattayanon* 32 (BCU)].

Dryopteris diffracta (Baker) C. Chr., Index Filic. 262. 1905.— *Nephrodium diffractum* Baker, Kew Bull. 1898: 230. 1898. Type: China, Yunnan, Mengtze, *Henry* 9028 (K!).

Thailand.— NORTHERN: Phitsanulok [Phu Hin Rong Kla National Park, *T. Boonkerd & R. Pollawatn* 62 (BCU)].

Polystichum scariosum (Roxb.) C. Morton, Contr. U.S. Natl. Herb. 38(7): 359. 1974.— *Polypodium scariosum* Roxb., Calcutta J. Nat. Hist. 4: 494. 1844. Type: Amboyna (but see Morton's discussion of the collecting locality), *Roxburgh* s.n. (BR, G).

Thailand.— PENINSULAR: Kanchanaburi [Amphoe Thong Pha Phum, Thong Pha Phum National Park, *A. Sathapattayanon* 143 (BCU)].

GLEICHENIACEAE

Gleichenia hirta Blume, Enum. Pl. Javae 250. 1828. Type: Moluccas, Island of Tidore, *Reinwardt* s.n. (L!).

Thailand.— PENINSULAR: Trang [Amphoe Yan Ta Khao, Khao Banthat Mountains, summit area of Phu Pha Mek, *Middleton et al.* 2028 (A, BKF)].

LINDSAEACEAE

Lindsaea dissectiformis Ching, *Sinensia* 1(4): 52. 1930. Type: China, Hainan, Hung Mo Shan, *F.A. McClure* 18312 (A!).

Thailand.— PENINSULAR: Trang [Amphoe Yan Ta Khao, Khao Banthat Mountains, trail to summit of Phu Pha Mek, *Middleton et al.* 1970 (A, BKF)].

MARATTIACEAE

Angiopteris angustifolia C. Presl, *Suppl. Tent. Pterid.*, 21. 1845. Type: Philippines, Luzon, *Cuming* 18 (K).

Thailand.— PENINSULAR: Narathiwat [Amphoe Waeng, Sirindhorn Falls, *T. Boonkerd & R. Pollawatn* 235 (BCU)].

OSMUNDACEAE

Osmunda javanica (C. Presl) Blume, *Enum. Pl. Javae*. 252. 1828.— *Plenasium javanicum* C. Presl, *Abh. Böhm. Ges. Wiss.* 5: 325. 1848. Type: Indonesia, Java, Gunung Salak, *Anon.* s.n. [Leiden accession number 908310172] (L!).

Thailand.— PENINSULAR: Narathiwat [Amphoe Waeng, Sirindhorn Falls, *T. Boonkerd & R. Pollawatn* 251 (BCU)].

POLYPODIACEAE

Aglaomorpha drynarioides (Hook.) Roos, *Blumea* 31(1): 153. 1985.— *Acrostichum drynarioides* Hook., *Sp. Fil.* 5: 284. 1864. Type: Malaysia, Penang, *Norris* s.n. (K!).

Thailand.— PENINSULAR: Narathiwat [Amphoe Bacho, Budo-Su-ngai Padi National Park, *T. Boonkerd & R. Pollawatn* 340 (BCU)].

Belvisia spicata (L. f.) Mirbel ex Copel., *Gen. Fil.* 192. 1947.— *Acrostichum spicatum* L. f., *Suppl. Pl.* 444. 1781. Type: Mauritius, *Commerson* s.n. (P!).

Thailand.— SOUTH-WESTERN: Kanchanaburi [Amphoe Thong Pha Phum, Thong Pha Phum National Park, *A. Sathapattayanon* 67 (BCU)].

Microsorium insigne (Blume) Copel., *Univ. Calif. Publ. Bot.* 16(2): 112. 1929.— *Polypodium insigne* Blume, *Enum. Pl. Javae* 127 (1828). Type: Indonesia, Java, *Zippelius* s.n. (L!).

Thailand.— NORTHERN: Phitsanulok [Phu Hin Rong Kla National Park, *T. Boonkerd* 1732 (BCU)].

Pyrrosia rasamalai (Racib.) K. H. Shing, Amer. Fern J. 73(3): 78. 1983.—*Polypodium rasamalai* Racib., Pteridoph. Buitenzorg 99. 1898. Type: Indonesia, Java, Telagabodas, *Raciborski* 83 (BO, K!, L!, M, P!, US).

Thailand.— NORTHERN: Tak [Amphoe Umphang, *T. Boonkerd* 1250, 1332 (BCU, L)]; SOUTH-WESTERN: Phetchaburi [Amphoe Kaeng Krachan, Kaeng Krachan National Park, Khao Phanoen Thung Lookout, *Middleton et al.* 1803 (A, BKF)].

Selliguea stenophylla (Blume) B.S.Parris in Parris, Beaman & Beaman (eds), The Plants of Mt Kinabalu I. Ferns & Fern Allies 151. 1991.—*Polypodium stenophyllum* Blume, Enum. Pl. Javae 124. 1828. Type: Indonesia, Java, *Blume* s.n. (L!).

Thailand.— PENINSULAR: Narathiwat [Amphoe Bacho, Budo-Su-ngai Padi National Park, *T. Boonkerd & R. Pollawatn* 209 (BCU)].

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REFERENCES

- Boonkerd, T. & Nooteboom, H. P. 2001. A new species of *Microsorium* (Polypodiaceae) from Thailand. *Blumea* 46: 581–583.
- Boonkerd, T. & Pollawatn, R. 2000. Pteridophytes in Thailand. Office of Environmental Policy and Planning, Bangkok.
- _____. 2002a. *Leptochilus minor* Fée (Polypodiaceae), a new record for Thailand. *The Natural History Journal of Chulalongkorn University* 2: 1–3.
- _____. 2002b. The first record of *Pteridium aquilinum* (L.) Kuhn var. *latiusculum* (Desv.) Underw. ex A.Heller (Dennstaedtiaceae) in Thailand. *Thai Forest Bulletin (Botany)* 30: 72–74.
- Hovenkamp, P. H. et al. 1998. Polypodiaceae. In: Kalkman, C. et al. (eds), *Flora Malesiana, Series II, Ferns and Fern Allies, Volume 3*, Rijksherbarium/Hortus Botanicus, Leiden.
- Lindsay, S. & Middleton, D. J. 2004. *Adiantum phanomensis* (Adiantaceae), a new fern species from Peninsular Thailand. *Harvard Papers in Botany* 8: 137–140.
- Lindsay, S., Suddee, S., Middleton, D. J. & Pooma, R. 2003, publ. 2004. Matoniaceae (Pteridophyta) - a new family record for Thailand. *Thai Forest Bulletin (Botany)* 31: 47–52.

- Mitsuta, S. 1985. Nine new records of ferns to Thailand flora. *Acta Phytotaxonomica et Geobotanica* 36(4–6): 148.
- Parris, B. S. 1998. The addition of *Acrosorus streptophyllus* (Baker) Copel. (Grammitidaceae: Pteridophyta) to the flora of Thailand. *Fern Gazette* 15(6): 215–216.
- Rachata, P. & Boonkerd, T. 2001. *Selaginella ciliaris* (Retz.) Spring (Selaginellaceae), a new record for Thailand. *Thai Forest Bulletin (Botany)* 29: 38–39.
- Suksathan, P. 2004. A new species of *Adiantum* (Pteridaceae) from Thailand. *American Fern Journal* 94(2): 77–80.
- Tagawa, M. & Iwatsuki, K. 1979. In: Smitinand, T. & Larsen, K. (eds), *Flora of Thailand*, Vol. 3, part 1. Royal Forest Department, Bangkok.
- _____. 1985. In: Smitinand, T. & Larsen, K. (eds), *Flora of Thailand*, Vol. 3, part 2. Royal Forest Department, Bangkok.
- _____. 1988. In: Smitinand, T. & Larsen, K. (eds), *Flora of Thailand*, Vol. 3, part 3. Royal Forest Department, Bangkok.
- _____. 1989. In: Smitinand, T. & Larsen, K. (eds), *Flora of Thailand*, Vol. 3, part 4. Royal Forest Department, Bangkok.

***Sciaphila nana* Blume (Triuridaceae), a new record for Thailand**

SAHUT CHANTANAORRAPINT* & OBCHANT THAITHONG*

ABSTRACT. *Sciaphila nana* Blume, a new record for Thailand is described and illustrated.

Sciaphila Blume is the largest genus of the family Triuridaceae with more than 30 species. Four species were previously known in Thailand (Larsen, 1972; Triboun & Larsen, 1999; Maneenoon & Sirirugsa, 2002). *Sciaphila nana* Blume is a new record for Thailand and was found during a botanical trip to Thong Pha Phum National Park, Kanchanaburi Province. The description below is based on the Thai material.

Sciaphila nana Blume, Mus. Bot. 1: 322, fig. 48. 1851; Meerendonk in Fl. Males. I. 10: 117. 1984.— *Andruris nana* (Blume) Giesen, in Engler, Pflanzenr. iv. 18 (Heft 104): 18, fig. 2 (1–3). 1938. Fig. 1.

Monoecious, mycotrophic herb, violet. *Stem* delicate, erect ca. 4–10 cm tall, few-branched, glabrous. *Leaves* scale-like, entire, appressed to stem, ovate-lanceolate, acute, ca. 0.5 mm long. *Inflorescence* subcorymbose ca. 1 cm long, flowers unisexual, 7–15, male flowers above, female ones below. *Male flowers* ca. 1 mm in diam.; perianth with 6 unequal lobes, 3 larger alternating with 3 smaller, oblong, patent to reflexed; the larger perianth segments acute, ca. 0.7 by 0.4 mm without appendages; the smaller with ellipsoid knob at apex, 0.8 by 0.3 mm; stamens 3, filaments short, 4-lobed anthers. *Female flowers* ca. 1 mm in diam.; perianth with 5–6 equal lobes, oblong, acute, ca. 0.6 by 0.4 mm, apex without appendages; carpels ca. 25–40, ovate, upper half verrucose; style awl-shaped, 0.5 mm long, inserted laterally near the top, apex acute. *Fruits* obovoid, aggregated.

Thailand.— SOUTH-WESTERN: Kanchanaburi [Thong Pha Phum National Park, *S. Chantanaorrapint* 824 (BCU)].

Distribution.— Malaysia, Indonesia, Philippines.

Ecology.— Growing on humus, under shade of bamboo, 1,000 m altitude. Flowering in November.

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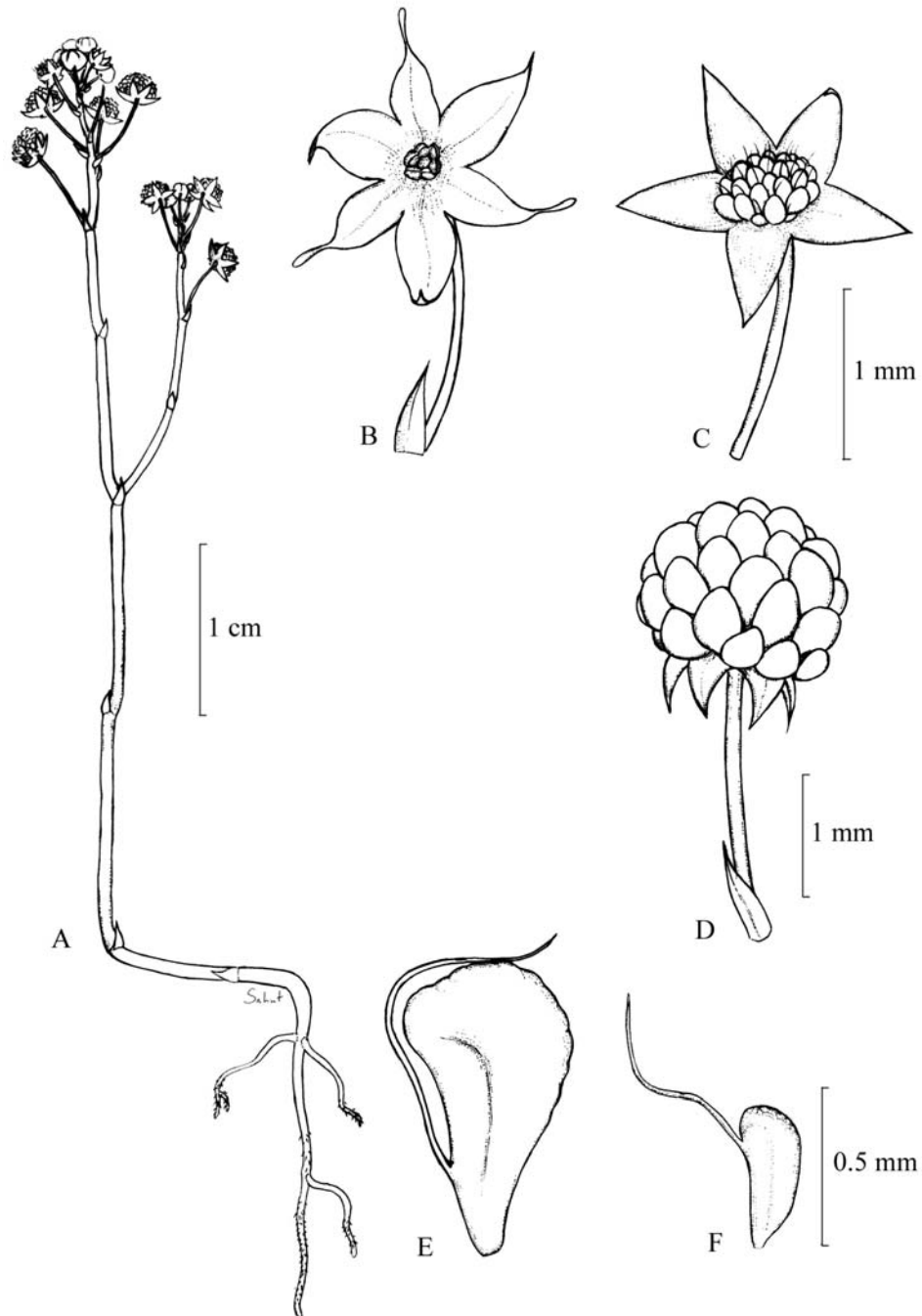


Figure 1. *Sciaphila nana* Blume: A. habit; B. male flower; C. female flower; D. aggregate fruit; E. fruit; F. ovary. All from *S. Chantanaorrapint* 824. Drawn by S. Chantanaorrapint.

Our plants match well with the clear description of *S. nana* in Meerendonk's work (1989). *S. nana* differs from *S. arfakiana* Becc. in having apical appendages only on the three smaller male perianth segments, the three larger one being inappendiculate. We suggest the following addition and modification to the key from Maneenoon & Sirirugsa (2002).

KEY TO THE SPECIES

- | | |
|--|----------------------------------|
| 1. Plants with bisexual flowers. Apex of perianth segments long-bearded | 1. <i>S. maculata</i> |
| 1. Plants with unisexual flowers. Perianth segments not bearded | |
| 2. Male perianth segments with a knob-like structure at the apex | 2. <i>S. arfakiana</i> |
| 3. All perianth segments with a knob | 3. <i>S. nana</i> |
| 3. Only the 3 smaller perianth segments with a knob; the 3 larger without appendages | |
| 2. Male perianth segments without a knob-like structure at the apex | |
| 4. Stems ca. 5 cm tall, branched from the base. Racemes 1–15 cm long. Flowers 4–5 mm in diam. Male flowers with 6 perianth segments | 4. <i>S. thaidanica</i> |
| 4. Stems ca. 15 cm tall, first branching ca. 4.5 cm from the base. Racemes 5 cm long. Flowers 8–10 mm in diam. Male flowers with 4–8 perianth segments | 5. <i>S. secundiflora</i> |

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REFERENCES

- Larsen, K. 1972. Triuridaceae. In: T. Smitinand & K. Larsen (eds), Flora of Thailand 2: 175–176.
- Maneenoon, K. & Sirirugsa, P. 2002. Two species of *Sciaphila* Blume (Triuridaceae), new record for Thailand. Thai Forest Bulletin (Botany) 30: 39–42.
- Meerendonk, J. M. P. van de. 1989. Triuridaceae. In: van Steenis C. G. G. J. & de Wilde W. J. J. O. (eds), Flora Malesiana I. 10: 109–121.
- Triboun, P. & Larsen, K. 1999. *Sciaphila secundiflora* Thwaites ex Benth. (Triuridaceae), a new record for Thailand. Thai Forest Bulletin (Botany) 27: 47–51.

Zehneria* (Cucurbitaceae) in Thailand, with a note on the Indian *Zehneria maysorensis

W.J.J.O. DE WILDE & B.E.E. DUYFJES*

ABSTRACT. A taxonomic revision of the genus *Zehneria* Endl. in Thailand is presented. There are eight species of which four are new: *Z. brevirostris*, *Z. hermaphrodita*, *Z. sphaerosperma*, endemic to Thailand, and *Z. tenuispica* (also Myanmar). The well-known name *Z. maysorensis* for a common Thai species needed to be changed into *Z. bodinieri*; the reason for this name change is discussed.

Keywords: *Zehneria*, Cucurbitaceae, Thailand.

INTRODUCTION

The genus *Zehneria* is at present restricted to those minor cucurbits with small, white or yellow, mostly monoecious flowers, which in the male have all 3 stamens with 2-thealous anthers (Jeffrey, 1962; Keraudren, 1975). Related genera with simple tendrils like *Mukia*, *Solena*, and others not in Thailand are excluded. *Zehneria* still appears heterogeneous systematically by this definition, but pending a detailed study over the complete area of all species in Asia the generic name *Zehneria* alone is retained for Thailand.

Recent intensive collecting and study has shown that eight species are present in Thailand, of which four are new endemic ones, most interestingly one with hermaphroditic flowers, and one with very minute flowers and fruit containing only 1 (or 2) globose seeds. Because the names of these species are needed for floristic purposes, a concise treatment is presented.

ZEHNERIA IN THAILAND

ZEHNERIA

Endl., Fl. Norfolk I.: 69. 1833; Miq., Fl. Ind. Bat.: 654. 1856; C.B. Clarke in Hook. f., Fl. Brit. Ind. 2: 624. 1879; Keraudren in Aubrév. & Leroy, Fl. Camb., Laos & Viêt-nam 15: 50. 1975. Type species: *Zehneria baueriana* Endl. (Norfolk I.).— *Melothria* auct. non L.: Benth. & Hook. f., Gen. Pl. 1: 830. 1867; Cogn. in A. & C. DC., Monogr. Phan. 3: 572, p.p. 1881; in Engl., Pflanzenr. 66, 4. 275. 1: 75, p.p. 1916; Gagnep., Fl. Gén. Indoch. 2: 1058. 1921; Craib, Fl. Siam. Enum. 762. 1931; Chakrab., Rec. Bot. Surv. India 17: 138. 1959; Backer in Backer & Bakh. f., Fl. Java 1: 296. 1964; Ohwi, Fl. Jap.: 847. 1965.— *Pilogyne* Eckl. ex Schrad., Ind. Sem. Hort. Goett.: 5. 1835. Type species: *Pilogyne suavis* Schrad. (South Africa).

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Note.— According to modern opinion (Jeffrey, 1962) the genus *Melothria* can best be regarded as confined to America.

Small climbers; stems herbaceous; annual or subperennial. *Leaves* simple, petiolate; blade ovate-cordate, triangular, hastate, or palmately lobed, apex acute-acuminate. *Tendrils* simple. *Probract* absent. *Flowers* small, white or yellow, monoecious or dioecious, rarely hermaphroditic. *Male flowers* solitary or few to many in sessile or pedunculate racemiform or umbelliform clusters, pedicellate; bracts minute or absent; receptacle-tube campanulate; calyx lobes small, dentiform; petals small, free, entire, valvate or imbricate; stamens (2–)3(–4), all 2-theous; anthers on long filaments, inserted in the lower half of the tube, or anthers subsessile with filaments inserted above the middle of the tube; thecae curved or straight, connective produced or not; disc free from tube, distinct. *Female flowers* solitary or in few- to many-flowered sessile or pedunculate shortly (laxly) racemiform or umbelliform clusters, short or long pedicellate, frequently co-axillary with male; ovary subglobose, ellipsoid or fusiform, glabrous or hairy; ovules few to many, horizontal; perianth as in male flower; staminodes 3, usually present; disc prominent, annular, free from receptacle-tube, surrounding base of style; stigma (2–)3-lobed. *Fruit* solitary or clustered, globose, ellipsoid or fusiform, baccate, red, whitish or green, smooth, sometimes finely pitted when dry. *Seeds* small, elliptic to broadly ovate in outline, compressed or flat, rarely subglobose, margin obscure or distinct, faces smooth, scrobiculate or warted.

About 35 species in the Old World tropics, extending from South Africa and Madagascar through tropical Africa and Asia to Japan, Malesia, Australia and Polynesia.

Notes.— 1. A heterogenous genus in which possibly several distinct genera are to be recognised.

2. Nearly all Thai species are monoecious (except one with hermaphroditic flowers).

KEY TO THE SPECIES

- 1a. Male inflorescence a peduncled raceme. Stamens exserted, inserted in the margin of the receptacle-tube. Petals yellow. Fruit red, juicy. Seeds warted-pitted, margin grooved **5. *Z. marginata***
- b. Male inflorescence a subsessile or peduncled raceme, or male flowers single or paired. Stamens included in the receptacle-tube. Petals white or creamy-white. Fruit red, green, or white. Seeds smooth, unmarginated or margined but margin not grooved 2
- 2a. Male inflorescences a subsessile or a peduncled raceme. Stamens inserted below halfway, or near or at the base of the receptacle-tube. Fruit purple or red, globose. Seeds flat, margined 3
- b. Male flowers solitary, 1 or 2, long-pedicelled (sometimes in a short-shoot resembling a raceme). Stamens inserted in the upper half of the receptacle-tube. Fruit red or green, globose or fusiform 4
- 3a. Male raceme short; flowering part up to 1 cm long. Pedicel of female flower 3–10 mm long. Fruit ca. 1 cm diam. **1. *Z. bodinieri***
- b. Male raceme longer; flowering part 2–4 cm long. Pedicel of female flower ca. 15 mm long. Fruit less than 1 cm diam. **7. *Z. tenuispica***
- 4a. Flowers 2 mm diam. Stamens 2. Fruit globose, red. Seed 1 (or 2), globose **6. *Z. sphaerosperma***
- b. Flowers 4–7 mm diam. Stamens 3. Fruit subglobose or ellipsoid, green or whitish. Seeds many, flat 5
- 5a. Fruit (short) ellipsoid, whitish, ± shiny and translucent, apex rounded or acute, but not rostrate **4. *Z. indica***
- b. Fruit subglobose, ellipsoid or fusiform, green, dark and pale striped, apex rostrate 6
- 6a. Flowers hermaphrodite **3. *Z. hermaphrodita***
- b. Flowers unisexual 7
- 7a. Plant glabrous. Fruit short ellipsoid, when dry apex shortly narrowly beaked, beak to 0.5 cm long **2. *Z. brevirostris***
- b. Plant sparingly soft-hairy. Fruit fusiform, when dry apex longly beaked, beak 1–2 cm long **8. *Z. wallichii***

1. *Zehneria bodinieri* (H. Lév.) W. J. de Wilde & Duyfjes, **comb. nov.**— *Melothria bodinieri* H. Lév., Fl. Kouy-Tcheou: 122. 1914. Type: China, Kouy-Yang, *Bodinier* 1957 (lectotype E, here chosen; isotype P). — *Melothria perpusilla* (Blume) Cogn. var. *subtruncata* Cogn. in A. & C. DC., Monogr. Phan. 3: 608. 1881. Type: Sri Lanka, Thwaites 1613 (lectotype K, here chosen; isotype L). — *Zehneria hookeriana* auct. non (Wight & Arn.) Arn.: C.B. Clarke in Hook. f., Fl. Brit. Ind. 2: 624, p.p. 1879.— *Melothria perpusilla* auct. non (Blume) Cogn.: Cogn. in A. & C. DC., Monogr. Phan. 3: 607. 1881; in Engl., Pflanzenr. 66, 4.275, 1: 106, p.p. 1916; Gagnep., Fl. Gén. Indoch. 2: 1061. 1921; Craib, Fl. Siam. Enum. 1: 764 (incl. var. *subtruncata*). 1931; Chakrab., Ind. J. Agric. Sc. 16, 1: 69, p.p. 1946; Rec. Bot. Surv. India 17, 1: 146, p.p. 1959.— *Zehneria maysorensis* auct. non (Wight & Arn.) Arn.: Gandhi, Fl. Hassan Distr. India: 181, 1976; Matthew, Fl. Carnatic 1: 655, p.p. 1983; Keraudren in Aubrév. & Leroy, Fl. Camb., Laos & Viêt-nam 15: 51, pl. 9, 1–4. 1975; A. M. Lu & Zhi Y. Zhang in A. M. Lu & S. K. Chen, Fl. Reip. Pop. Sin. 73, 1: 173, pl. 45, 9–11. 1986; S. K. Chen in C. Y. Wu, C. Chen & S. K. Chen, Fl. Yunn. 6: 317, pl. 82, fig. 1–5. 1995; P. H. Hô, Fl. Vietnam 1,2: 716, fig. 1986. 1991. (For explanation as to why the name *Z. maysorensis* is not used, see II. Note on *Zehneria maysorensis*).— *Bryonia oxyphylla* Wall. List 6697, nom. nud.— *Bryonia cissoides* Wall. List 6698, nom. nud.

Subherbaceous climber, 2–6 m long, subglabrous, generally drying (dark) brownish; monoecious. *Leaves*: petiole 2–5 cm long; blade ovate-triangular, entire, rarely shallowly lobed, 4–12 by 3–10 cm, base subtruncate or broadly shallowly cordate, apex acute-acuminate, margin denticulate. *Inflorescences* consisting of a peduncled 3–10-flowered short or sometimes ± spike-like proliferous male raceme; peduncle 1–5 cm long, usually co-axillary with a previously developing single pedicelled female flower, rarely female flowers few, subumbellate, peduncled, or female flowers solitary. *Male flowers*: pedicel 1–4 mm long, articulate at apex; bracteole absent; receptacle-tube ca. 3 by 2 mm, with long hairs inside, especially at throat; sepals triangular, ca. 0.5 mm long; petals ovate, ca. 2 mm long, subacute, pubescent at apex and adaxially; filaments 1–2 mm long, inserted halfway up the tube or rather lower (but not at base of tube), subglabrous or long-haired about the middle; anthers circular in outline, ca. 1 mm diam., thecae curved, the two nearly forming a ring, connective ± hairy, not produced; disc depressed globose, ca. 1 mm diam. *Female flowers*: pedicel slender, 2–5 mm long; ovary ovoid-globose, ca. 3 by 2.5 mm, glabrous (except minute raised gland-dots), neck ca. 1 mm long; perianth as in male but petals longer, 2.5–3 mm long; disc ca. 0.5 mm high; style ca. 3 mm long, glabrous, stigma 3-lobed, papillose, 1.5–2 mm diam.; staminodes slender, ca. 2 mm long, the basal portion adnate with receptacle-tube. *Fruit* solitary (rarely 2 or 3), globose, 0.8–1.2 cm diam., glabrous, green, at last (purple or) red, finely netted or pitted when dry; fruiting pedicel 0.3–1 cm long. *Seeds* rather many, flat, ovate(-oblong), ca. 5 by 3–3.5 mm, narrowly margined, smooth, pale brownish when dry.

Thailand.— NORTHERN: Mae Hong Son (*Larsen et al.* 46847, 46849); Chiang Mai (*Bunchuai* 1282; *De Wilde & Duyfjes* 22147, 22165, 22171; *Garrett* 360; *Kerr* 6625; *Maxwell* 87-1115, 88-959, 89-1238, 90-1104, 92-35, 92-486, 92-6051, 95-1189, 97-554, 98-1076; *Phengnaren* 676; *Pooma et al.* 3038; *Shimizu & Hutoh* T10570; *Shimizu & Santisuk* T18705; *Sørensen et al.* 6091; *Van Beusekom & Phengklai* 2660); Chiang Rai (*Chayamarit* 1063; *Maxwell* 97-1280); Lampang (*Maxwell* 95-1195; *Petrmitr* 364); Tak (*Hansen & Smitinand* 12910); Phitsanulok (*Shimizu et al.* T11660);

NORTH-EASTERN: Loei (*Charoenphol et al.* 4633; *Koyama* T61506, T61607; *Wongprasert* 0011-19); EASTERN: Chaiyaphum (*Van Beusekom et al.* 4468); E Thailand (*Phengkhlai* 675); SOUTH-WESTERN: Phetchaburi (*Koonthunthod et al.* 333); PENINSULAR: Surat Thani (*Kerr* 12599, *Put* 880).

Distribution.— Widespread, in Sri Lanka (?) and S India (?), and from northern India to China, Indo-China, SE to Peninsular Malaysia, Sumatra, and Sabah.

Habitat & Ecology.— Disturbed places, forest edges, and scrub at 500–1,700 m altitude.

2. *Zehneria brevirostris* W. J. de Wilde & Duyfjes, **sp. nov.** *Zehneriae indicae* similis, fructu globoso aurantiaco, rostro gracili 2–3 mm longo differt. Typus: Thailand, Prachuap Khiri Khan, Sam Roi Yot NP, *Newman*, *Boontavikoon*, *Hemrat & Middleton* 1152 (holotypus BKF; isotypi A, AAU, E, K, L).

Herbaceous delicate annual climber, ca. 1 m long; early glabrescent (few gland-hairs); greenish on drying. *Leaves*: petiole 1–2.5 cm long; blade finely scabrid adaxially, (broad-)triangular, rarely sub-hastate, 2–5.5 by 3–6 cm, base truncate-cordate, apex acute-acuminate, margin shortly remotely dentate, sometimes \pm wavy, nerves sparingly minute harshly hairy. *Flowers*: perianth (3–)4 mm diam.; male flowers solitary, usually co-axillary with later developing female, on the main nodes, or in somewhat reduced lateral shoots 2–4 cm long. *Male flowers*: pedicel slender, 7–10 cm long, glabrous; receptacle-tube narrowly cup-shaped, ca. 1.5 by 1.5 mm, glabrous inside and outside; sepals \pm outcurved, 0.3–0.4 mm; petals ovate-elliptic, 1.5–2 x 0.7–1 mm, subacute (blunt), minutely papillose-hairy at apex, nerves faint; stamens 3, inserted slightly below receptacle-throat; filaments ca. 0.3 mm long, glabrous; anthers subtruncate-obovate, 0.8–1 by 0.4 mm; thecae straight, ca. 0.8 mm long, connective \pm broad, slightly produced, glabrous; disc subglobose, ca. 0.5 mm diam. *Female flowers*: pedicel 4–6 mm long; ovary ovoid-fusiform, 2–4 by 1–2 mm, glabrous, neck 1.5–2 mm long; perianth considerably smaller than in male, ca. 2 mm diam.; receptacle ca. 1 by 1 mm, glabrous (except few minute hairs in throat); sepals ca. 0.2 mm long; petals ca. 1 mm long; disc ca. 0.2 mm high; style ca. 1 mm long, glabrous; stigma deeply 3-lobed, ca. 0.5 mm diam., finely papillose. *Fruit* subglobose, 6–8 mm diam., smooth, glabrous, apex slenderly 2–3 mm beaked (beak may be broken off), orange, 5–10-seeded; fruiting pedicel (4–)8–12 mm long. *Seeds* flat, ovate, ca. 5 by 3 mm, paleish, hardly margined, with square edge, faces shallowly scrobiculate.

Thailand.— NORTH-EASTERN: Loei (*Koyama et al.* T31187); SOUTH-WESTERN: Kanchanaburi (*Den Hoed & Kostermans* 680; *Kostermans* 1096; *Put* 1821; *Van Beusekom et al.* 3983); Ratchaburi (*Larsen et al.* 1193); Phetchaburi (*Larsen et al.* 45353); Prachuap Khiri Khan (*Newman et al.* 1152, type); SOUTH-EASTERN: Prachin Buri (*Kerr* 19842).

Distribution.— Endemic to Thailand.

Ecology.— On limestone rock; 50–400 m altitude; flowering and fruiting June–December; ripe fruit orange.

3. *Zehneria hermaphrodita* W. J. de Wilde & Duyffes, **sp. nov.** *Zehneria* species *Z. wallichii* similis a congeneribus omnibus floribus hermaphroditis differt. Typus: Thailand, Phetchaburi, Kaeng Krachan NP, *W.J. de Wilde & Duyffes* 22289 (holotypus BKF; isotypus L). Fig. 1.

Slender annual or biennial creeper or climber, 1–2 m long; early glabrescent; green on drying. *Leaves*: petiole 1–3.5 cm long, sparsely short rough-hairy; blade adaxially scabrid by minute cystoliths, broadly triangular-ovate, 2.5–10 by 2–8 cm, base broadly cordate (with wide sinus), apex acute-acuminate, margin straight or faintly undulate, with sparse minute teeth (0.2 mm long). *Flowers* hermaphroditic, solitary on the nodes; perianth ca. 5 mm diam.; pedicel 3–8 mm long, glabrous or with sparse minute hairs 0.2 mm long; ovary fusiform, glabrous, at apex longer tapering than at base, 8–13 by 1.5–3 mm, neck ca. 1 mm long; receptacle-tube cup-shaped, ca. 2 by 2 mm, glabrous except few short hairs (0.1–0.2 mm long) inside at throat; sepals linear, ca. 0.5 mm long, slightly outcurved; petals valvate, ovate-elliptic, 2.5–3 by 1.5–2 mm, short papillose-hairy, apex blunt (subacute); stamens 3; filaments ca. 1 mm long, inserted halfway up the receptacle, glabrous; anthers obovoid-rhomboid, ca. 1 by 1 mm, thecae ca. 1 mm long, connective broad, glabrous, broadest at apex, shortly produced adaxially; disc carnos, ± conical, cup-shaped, ca. 1 by 1 mm; style ca. 1.5 mm long, ca. 0.3 mm thick, glabrous, stigma obconical, ca. 1.5 mm diam., situated partly below and inside the anthers, consisting of 3 largely adnate lobes, narrowed and shallowly notched at apex. *Fruit* pendent, broadly fusiform, strongly beak-like narrowed at base and apex, ca. 2.5 by 1 cm, basal and apical beaks (5–)7–10 mm long, pale green; fruiting pedicel 0.7–2 cm long. *Seeds* 15–25 per fruit, flat, ovoid-oblong, 5–7 by 3–3.5 mm, smooth, hardly margined.

Thailand.— SOUTH-WESTERN: Phetchaburi, Kaeng Krachan NP (*De Wilde & Duyffes* 22289, type; *Koonthunthod et al.* 330); Prachuap Khiri Khan, Kui Buri NP (*Middleton et al.* 1249).

Distribution.— Locally endemic to SW Thailand.

Ecology.— Roadsides in evergreen (secondary) forest; 100–600 m altitude; flowering and fruiting August–December.

4. *Zehneria indica* (Lour.) Keraudren in Aubrév. & Leroy, Fl. Camb., Laos & Viêt-nam 15: 52, pl. 9, fig. 5–8. 1975; C. Jeffrey, Cucurbitaceae of Eastern Asia, Kew: 17. 1980; Kew Bull. 34: 795. 1980; A. M. Lu & Zhi Y. Zhang in A. M. Lu & S. K. Chen, Fl. Reip. Pop. Sin. 73, 1: 170, p.p., pl. 45, fig. 1–7. 1986.— *Melothria indica* Lour., Fl. Cochinch.: 35. 1790; Ser. in DC., Prodr. 3: 313. 1828; Naud., Ann. Sci. Bot. 4, 16: 169, tab. 2. 1862; C. B. Clarke in Hook. f., Fl. Brit. Ind. 2: 626. 1879; Cogn. in A. & C. DC., Monogr. Phan. 3: 598. 1881; in Engl., Pflanzenr. 66, 4.275.1: 98. 1916; Gagnep., Fl. Gén. Indoch. 2: 1064. 1921; Craib, Fl. Siam. Enum. 763. 1931; Chakrab., Rec. Bot. Surv. India 17, 1: 150. 1959; Backer in Backer & Bakh. f., Fl. Java 1: 297. 1964.— *Eachmandra indica* (Lour.) Arn. in Hook., Journ. Bot. 3: 274. 1841; Miq., Fl. Ind. Bat. 1: 658. 1856. Type: Viêt-nam, Tourane, *Loureiro* s.n. (BM).— *Bryonia geminata* Blume, Bijdr.: 924. 1826. Type: not seen.— *Bryonia tenella* Roxb., Fl. Ind. 3: 725. 1832. Type: not seen.— *Zehneria japonica* auct. non (Thunb.) H. Y. Liu: C. Jeffrey: S. K. Chen in C. Y. Wu, C. Chen & S. K. Chen, Fl. Yunn. 6: 314, p.p., pl. 82, fig. 6–9. 1995.— *Melothria leucocarpa* auct. non (Blume) Cogn.: Craib, Fl. Siam. Enum. 763. 1931, p.p. (the other part is *Zehneria brevirostris*).

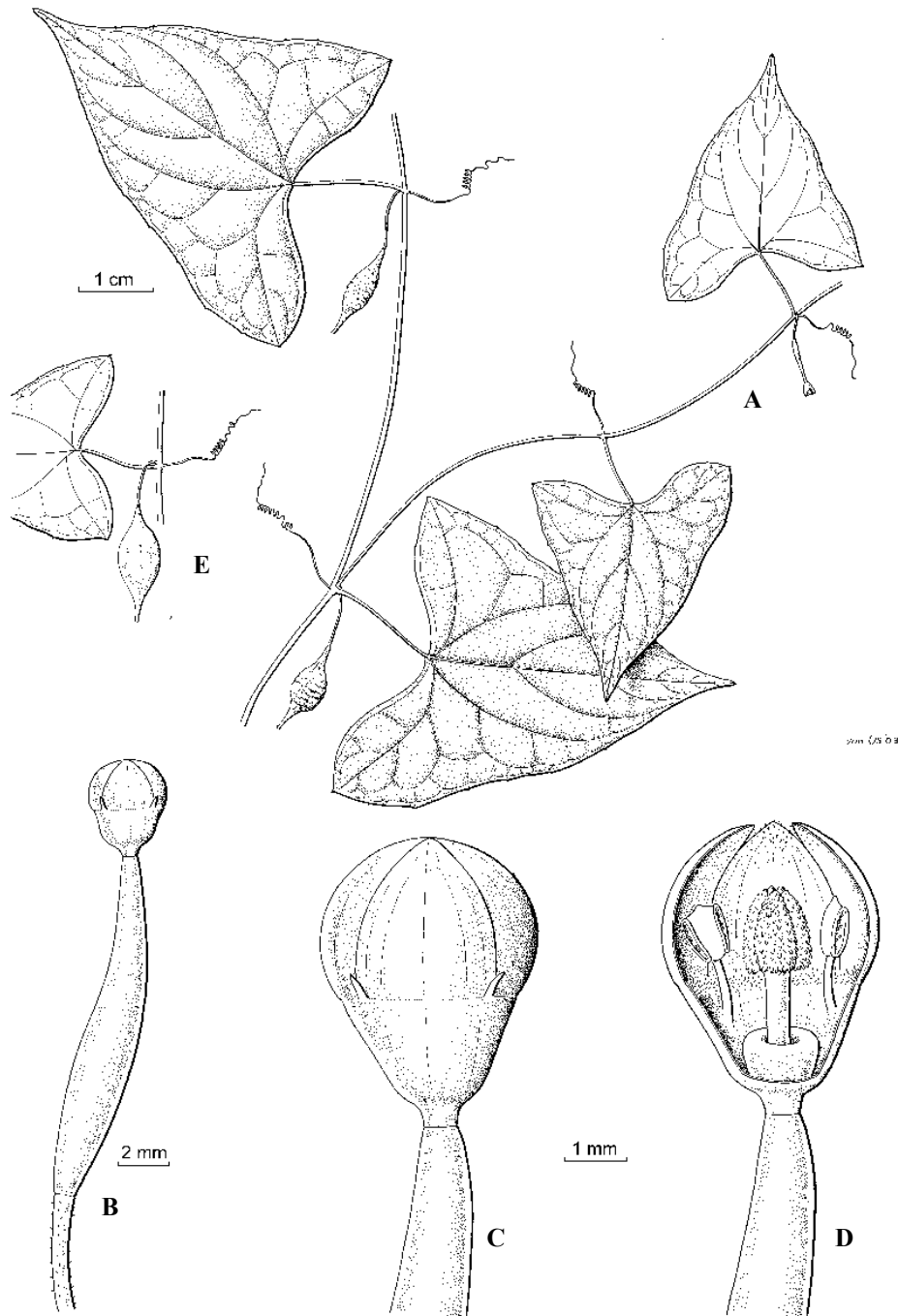


Figure 1. *Zehneria hermaphrodita* W. J. de Wilde & Duyfjes: A. habit with fruiting nodes on main branch, flower on lateral branch; B.–D. flowers; E. fruit (from alcohol material). All from *De Wilde & Duyfjes 22289*. Drawn by Jan van Os.

Slender creeper or climber, 0.5–1.5 m long; monoecious; subannual; largely glabrescent; green on drying. *Leaves*: petiole 1–3 cm long, finely hairy or glabrescent; blade triangular or (deeply) hastately 3(–5)-lobed, 2.5–7(–10) by 3–5.5(–7) cm, base broadly shallowly cordate or subtruncate, apex acute-acuminate, margin faintly dentate. *Flowers*: perianth 4–7 mm diam., male flowers solitary (or paired?), usually co-axillary with 1 or 2 previously developed, longer-pedicelled female flower(s), glabrous (sparsely gland-dotted). *Male flowers*: pedicel slender, 10–15 mm long, articulate at apex; receptacle-tube \pm narrowly cup-shaped, 1.5–2 by 1.5–2 mm, glabrous, except for hairy fringe at throat inside; sepals (0.5–)1 mm long, glabrous, recurved; petals ovate-oblong, 2–3.5 by 1.5–2 mm, minutely gland-hairy and papillose ab and adaxially; stamens 3, inserted ca. 0.5(–1) mm below throat of tube, ca. 0.5 mm long, glabrous; anthers obovoid-rhomboid, 1–1.5 mm diam.; thecae straight, ca. 1 mm long, connective broad, broadest at apex, subtruncate with short 0.2 mm projection, (partly) finely hairy; disc elongated, \pm obovate-elliptic, ca. 1 mm long. *Female flowers*: pedicel (10–)15–30 mm long; ovary ellipsoid-oblong, 3(–4) by 1.5–2 mm, neck 0.5–1 mm long, glabrous; perianth as in male flowers; staminodes linear, ca. 1 mm long, inserted halfway up the tube; disc thick-carnose, ca. 1 mm high; style 1.5(–2) mm long, stigma ca. 1 mm diam., composed of 3 apically deeply notched lobes, papillose. *Fruit* 1 or 2 per node, subglobose or (short) ellipsoid, not apiculate, 8–12 by 8–10 mm, pericarp thinly leathery or membranous (when dry often leaving the seeds shining through), glabrous; fruiting pedicel 15–30 mm long. *Seeds* 15–25 per fruit, flat, \pm obovate, 2–4 by 2.5–3 mm, pale brownish, smooth, unmarginated, with smooth, rounded edge.

Thailand.— NORTH-EASTERN: Khon Kaen (*Na Songkhla et al.* 258); CENTRAL: Bangkok (*Kerr* 4313; *Marcan* 454); PENINSULAR: Nakhon Si Thammarat (*Damsri* 34).

Distribution.— Northern India (where distinction with *Zehneria odorata* C. B. Clarke not sharp), east to Southern China (where distinction with *Zehneria japonica* (Thunberg ex Murray) C. Jeffrey not sharp), through Indo-China, Myanmar? (no material seen), into Malesia south to Java.

Ecology.— Waste ground, gardens, forest edges, shaded roadsides; 0–500 m altitude; flowering and fruiting mainly July to December; flowers white. The fruit colour is rarely recorded as whitish; apparently the fruit is short-lived or frequently early picked by animals. The species is not very showy and apparently not common in Thailand, as only few collections are known.

5. *Zehneria marginata* (Blume) Keraudren in Aubrév. & Leroy, Fl. Camb., Laos & Viêt-nam 15: 55, pl. 9, fig. 4. 1975; A. M. Lu & Zhi Y. Zhang in A. M. Lu & S. K. Chen, Fl. Reip. Pop. Sin. 73, 1: 172. 1986; S. K. Chen in C. Y. Wu, C. Chen & S. K. Chen, Fl. Yunn. 6: 316. 1995.— *Bryonia marginata* Blume, Bijdr.: 924. 1826; Ser. in DC., Prodr. 3: 305. 1828; M. Roem., Syn. Monogr. 2: 36. 1846; Miq., Fl. Ind. Bat., 1: 660. 1856.— *Melothria marginata* (Blume) Cogn. in A. & C. DC., Monogr. Phan. 3: 593. 1881; in Engl., Pflanzenr. 66, 4.275.1: 93. 1916; Backer in Backer & Bakh. f., Fl. Java 1: 296. 1964. Type: Java, Blume 920 (L).— *Bryonia epigaea* (possibly sphalm. of the herbarium label name *exigua*) Blume, Bijdr.: 925. 1826, non Rottl. Type: Blume s.n. (L, HLB 901.288-359).— *Melothria marginata* (Blume) Cogn. var. *heterophylla* (Blume) Cogn. in A. & C. DC., Monogr. Phan. 3: 594, p.p. (excl. type, incl. *Zollinger*

1136 in herb. Franqueville, P). 1881; in Engl., Pflanzenr. 66, 4.275.1: 93, p.p. 1916.— *Bryonia heterophylla* Blume, Bijdr.: 925. 1826, non Steud. Type: Java, Blume s.n. (L).— *Aechmandra blumeana* M. Roem., Syn. Monogr. 2: 33, p.p. 1846; Miq., Fl. Ind. Bat., 1: 657, p.p. 1856 [a new name for *Bryonia epigaea* Blume (sphalm. *exigua*)].— ? *Cerasiocarpum maingayi* C. B. Clarke in Hook. f., Fl. Brit. Ind. 2: 629. 1879. Type: Peninsular Malaysia, Maingay 1268 (K).— ? *Cerasiocarpum penangense* C. B. Clarke in Hook. f., Fl. Br. Ind. 2: 629. 1879. Type: Peninsular Malaysia, Penang, Wallich 6704 (K–W).— *Melothria affinis* King, Journ. Asiat. Soc. Beng. 67: 38. 1898; Mat. Fl. Mal. Penins., Calycifl.: 382. 1902; Cogn. in Engl., Pflanzenr. 66, 4.275.1: 94. 1916; Craib, Fl. Siam. Enum. 762. 1931. Lectotype: Peninsular Malaysia, Perak, King's Collector 1068 (K, selected here).— *Melothria gracilipes* Merr., Papers Mich. Acad. Sci. 19: 199. 1934. Type: Bartlett 7228 (holotype NY; isotype MICH).— *Bryonia filicaulis* Wall. List 6713, nom. nud. [mentioned under *Kedrostis rostrata* (Rottl.) Cogn. by Cogniaux (1881) 636; (1916) 142; under *Rhynchoscarpa rostrata* (Rottl.) by Kurz (1877) 105; under *Rhynchoscarpa foetida* Schrad. by C. B. Clarke in Hook. f. (1879) 627; and under *Kedrostis foetidissima* (Jacq.) Cogn. by Jeffrey (1980) 805]. Wall. 6713 (photo seen) is the only collection from Myanmar known to us. Fig. 2.

Annual or biennial, (sub)herbaceous, prostrate, sometimes creeping, or climbing, (0.5–)1–4 m long, variously scabrid hairy, stem glabrescent; monoecious; green on drying. *Leaves*: petiole 1–5 cm long; blade very variable in shape, (long) triangular, ovate, cordiform, entire or (hastately) 3-lobed, 4–16 by 3–10 cm, base truncate, rounded, or (deeply) cordate, apex acute-acuminate, margin straight with minute teeth or (coarsely) dentate, upper surface rough-hairy (strigose) and/or scabrous by (coarse) cystoliths, lower surface coarsely hairy mostly only on the nerves. *Inflorescences* glabrescent in male 1(–3) slender peduncled, short (or long) densely flowered raceme(s), usually co-axillary with 1 (or 2) previously developed long-pedicelled female flower(s); peduncle 1.5–6 cm long, ca. 0.5 mm thick; flower-bearing part 0.3–1(–2) cm long, (3–)5–10(–25)-flowered; pedicels slender, half-patent, bracts absent; peduncle and pedicels persisting after flowering. *Male flowers*: pedicel 2–7 mm long, at apex articulate; receptacle-tube cup-shaped, 1.5–2 mm diam., sparsely coarsely hairy outside, throat pubescent; sepals linear, \pm out-curved, ca. 0.5 mm long, with sparse hairs; petals imbricate, pale or bright yellow, ovate-oblong, apex rounded or (sub)obtuse-acuminate, (2–)3–4 by 2.5–3 mm, (papillose) hairy; stamens inserted in the throat of the receptacle, erect, protruding; filaments 1–1.5 mm long, glabrous; anthers ca. 1 mm diam., thecae straight, ca. 1 mm long, connective \pm narrow, not produced; disc depressed globose, ca. 1 mm diam. *Female flowers*: pedicel 0.5–3 cm long; ovary ellipsoid, with sparse hairs, subglabrescent; perianth as in male but petals larger, 4–5 mm long; staminodes linear, ca. 1 mm long, inserted at base of receptacle; disc less than 1 mm high; style ca. 2 mm long; stigma consisting of 3 feather-like arms, shallowly forked at apex, each ca. 2 mm long. *Fruit* a berry, remarkably variable in shape and texture (see note), globose, 1–1.5 cm diam., or ellipsoid(-oblong) with base and apex rounded, or fruit narrowly oblong, tapering at base and apex, 1.5–2(–3) by ca. 0.5 cm, glabrescent from few sparse hairs; pericarp on drying membranous or \pm leathery, leaving the seeds visible or not; ripe fruit red, juicy or pulpy; fruiting pedicel short or long, (0.5–)1–5 cm long. *Seeds* (few or) many, (1–)5–35 per fruit, whitish, flattened, ovate-oblong, (3–)4–5 by (1.5–)3.5 by ca. 1.5 mm, distinctly \pm square-margined, faces (deeply) coarsely scrobiculate.

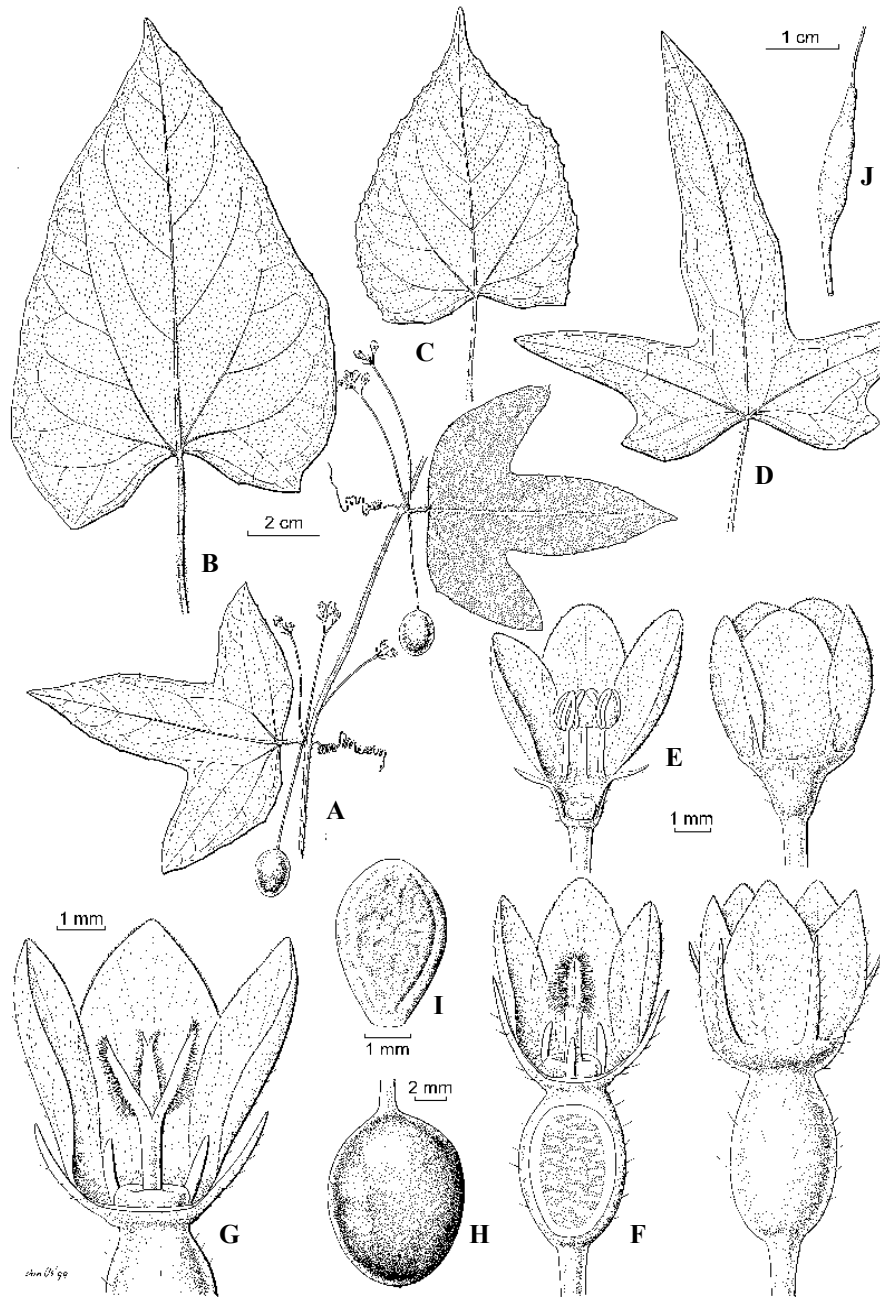


Figure 2. *Zehneria marginata* (Blume) Keraudren: A. habit; B.–D. leaves; E. male flowers; F., G. female flowers; H. fruit (informal form '*marginata*'); I. seed; J. fruit (informal form '*affinis*'). A. from Awong Kaya s.n. (Barcode: L 0130026) (Brunei); B. from De Wilde & Duyffes 12614 (Sumatra); C. from De Wilde & Duyffes 21794 (Sumatra); D. from Iwatsuki c.s. 1732 (Sumatra); E.–H. from De Wilde & Duyffes 21756 (Sulawesi); I. from De Wilde & Duyffes 21699 (Java); J. from De Wilde & Duyffes 22182 (Thailand). Drawn by Jan van Os.

Distribution.— East Myanmar (*Wallich* 6713, photo seen), China (Yunnan, no material seen), through Thailand, Laos, Cambodia, Vietnam and SE to Sumatra, Peninsular Malaysia, West Java, Borneo (mainly Sabah), Philippines, and Central Sulawesi.

Ecology.— Open and shaded places, mostly along forest edges, roadsides, at 0–1,500 m altitude; flowering and fruiting mostly June to December.

Notes.— 1. Both Cogniaux (1881) and King (1898) described the fruit as velvety, but this aspect is obviously caused by drying; in fact the fruit is early glabrescent.

2. King (l.c.) described the tendril, erroneously, as bifid, a condition which never occurs in *Zehneria*.

3. Apart from the very variable habit of the plant, mainly due to variation in leaf-shape and indumentum, this species exhibits a remarkable and unlikely variation in fruit-shape and length of fruiting pedicel (fruit globose with long pedicels or fruit oblong-fusiform with short pedicels), a variation unknown in any other Asian cucurbit. Although most herbarium specimens have a constant fruit form, there are several collections indicating that both forms occur in one plant, and sometimes they can be found connected on one herbarium sheet. The difference in this aspect has led to the description or recognition of this species under several names even by single authors. Because of the striking differences in fruit shape one could, for convenience, recognise two poorly segregated informal forms. The form with elongate, fusiform fruit may be related to poor soils and be precociously flowering, because most specimens are relatively small plants, but this idea needs further study.

The informal form '*marginata*' (Fig. 2, A–I) represents the type (*Blume* 920, in L) of the oldest available name. It has fruit narrow, ellipsoid-oblong, \pm fusiform, 1.5–3 by ca. 0.5 cm, base (sub)acute, apex narrowly obtuse, acute-acuminate, or rostrate, juicy when ripe; fruiting pedicel shorter than the fruit, ca. 0.5 cm long; seeds (1–)5–12 per fruit. It has distribution the same as the species. Specimens seen: NORTHERN: Lamphun (*Maxwell* 93-1283); SOUTH-WESTERN: Kanchanaburi (*De Wilde & Duyfjes* 22182).

The informal form '*affinis*' (Fig. 2, J) has fruit globose or (short) ellipsoid, 0.8–1.5 cm diam., base and apex obtuse or (broadly) rounded, pulpy or juicy when ripe; fruiting pedicel longer than the fruit, 1–5 cm long; seeds 20–30 per fruit. Its distribution is, like the form '*marginata*', the same as the species; it is the commonest form, and common all over Thailand. Selection of specimens seen: NORTHERN: Chiang Mai (*De Wilde & Duyfjes* 22176); Lampang (*Maxwell* 97-410); EASTERN: (*Larsen et al.* 31538); SOUTH-WESTERN: Phetchaburi (*Newman et al.* 1032); PENINSULAR: Chumphon (*Khantchai* 1113); Phangnga (*Niyomdham & Puudjaa* 3320); Yala (*Maxwell* 86-1050).

6. *Zehneria sphaerosperma* W. J. de Wilde & Duyfjes, sp. nov. a congeneribus omnibus cognitis in fructu 1 (vel 2) seminibus subglobosis differt.— Differs from all other known *Zehnerias* by fruit 1 (or 2) seeded, seed subglobose. — Typus: Thailand, Saraburi, *Pooma*, *De Wilde, Duyfjes, Chamchumroon & Phattarahirankanok* 3043 (holotypus BKF; isotypus L). Fig. 3.

Tiny slender climber, ca. 1 m long, young parts with fine glandular hairs, early glabrescent; annual. *Leaves*: petiole 1–3 cm long, sparsely hairy, blade triangular, 3.5–5 cm long and broad, base subtruncate, shallowly retuse, apex acute-acuminate, margin

shallowly repand-dentate, adaxially with small cystoliths, nerves sparsely scabrous-hairy. *Flowers* minute, petals 4 or 5, (sub)valvate-imbricate. *Male flowers*: single, co-axillary with single female flower; pedicel 2–4 mm long, the portion below the articulation sparsely with glandular hairs; open perianth 2–2.5 mm diam.; receptacle-tube cup-shaped, ca. 1 by 1.5 mm, finely hairy at throat inside; sepals oblong-linear, 0.5–0.7 mm long, slightly out-curved; petals \pm elliptic, 1–1.2 mm long, subobtusate, with a few hairs on the margin and adaxially papillose, nerves (3–)5; stamens (2 or) 3, inserted about level with the apex of the disc; filaments slender, slightly shorter than anthers, 0.4–0.6 mm long; anthers ca. 0.8 by 0.6 mm, connective at apex truncate or slightly produced; disc comparatively large, \pm obovoid-globose, 0.5–0.7 mm diam. *Female flowers*: solitary or co-axillary with male; pedicel ca. 3 mm long, receptacle-tube ca. 0.8 by 0.8 mm; sepals ca. 0.3 mm long; petals ca. 1.2 by 0.7 mm; disc conspicuous, ca. 0.3 by 0.6–0.7 mm, faintly 3-lobed; style ca. 0.8 mm long, stigma ca. 0.5 mm across, consisting of 3 subsessile lobes, papillose hairy; staminodes oblong or narrowly spatulate, 0.3–0.4 by ca. 0.2 mm, inserted towards the base of the receptacle-tube; ovary subglobose-ellipsoid, ca. 2.5 by (1.5–)1.7 mm, glabrous, very finely papillose, neck ca. 0.5 mm long; ovules 3, enclosed in watery pulp. *Fruit* solitary, depressed globose, 5–7 mm diam., not or narrowly very shortly beaked, glabrous, exocarp membranous, smooth, red; fruiting pedicel 3–4 mm long. *Seeds* 1 or 2, creamy, enclosed in scant watery pulp, (sub)globose, 3.5–4 mm diam., smooth, with distinct equatorial ridge, faces hemiglobose swollen, at base sagged.

Thailand.— CENTRAL: Lop Buri (*Mitsuta et al.* T 38223); Saraburi (*Smitinand & Sleumer* 1339, *Pooma et al.* 2990; 3043).

Distribution.— Locally endemic to Thailand, ca. 100 km N of Bangkok.

Ecology.— Trailing in light shade over eroded limestone rock; 100–350 m altitude. Fruits bright red when ripe and \pm juicy with big creamy-white seeds, which are carried away into crevices by dark-brown ants, obviously facilitating local dispersal; flowering and fruiting in August and October.

Note.— *Zehneria sphaerosperma* is distinct from all other species in its glandular hairs, very small 4- or 5-merous flowers, only 2 (or 3) stamens, a reduced number of ovules and seeds, and comparatively large seeds with conspicuously swollen faces rendering these large and globose. The aestivation is difficult to ascertain due to the very small dimensions of the corolla lobes.

7. *Zehneria tenuispica* W. J. de Wilde & Duyfjes, **sp. nov.** *Zehneriae bodinieri* affinis, gracillima, racemis masculis gracilibus spiciformibus, floribus ca. 3 mm diam. notata. Typus: Thailand, Kanchanaburi, *Maxwell* 93-1209 (holotypus L).

Delicate annual climber, 50–100 cm long, subglabrous; monoecious; green on drying. *Leaves*: petiole 1.5–3.5 cm long; blade thinly membranous, subovate, (3–)5-angular or shallowly lobed, scabrid by minute cystoliths adaxially, 3–9 by 2.5–8 cm; base shallowly or deeply cordate, apex acute-(long)acuminate, margin sparsely shallowly dentate. *Inflorescences* in male a solitary slender peduncled spike-like raceme; peduncle 1.5–4 cm long, flower-bearing portion 2–4.5 cm long, with 5–15 patently short-pedicelled, spaced flowers, the basal ones usually paired; flowers 2.5–3 mm diam., whitish; bracts absent. *Male flowers*: pedicel 2.5–4 mm long, at apex articulate,

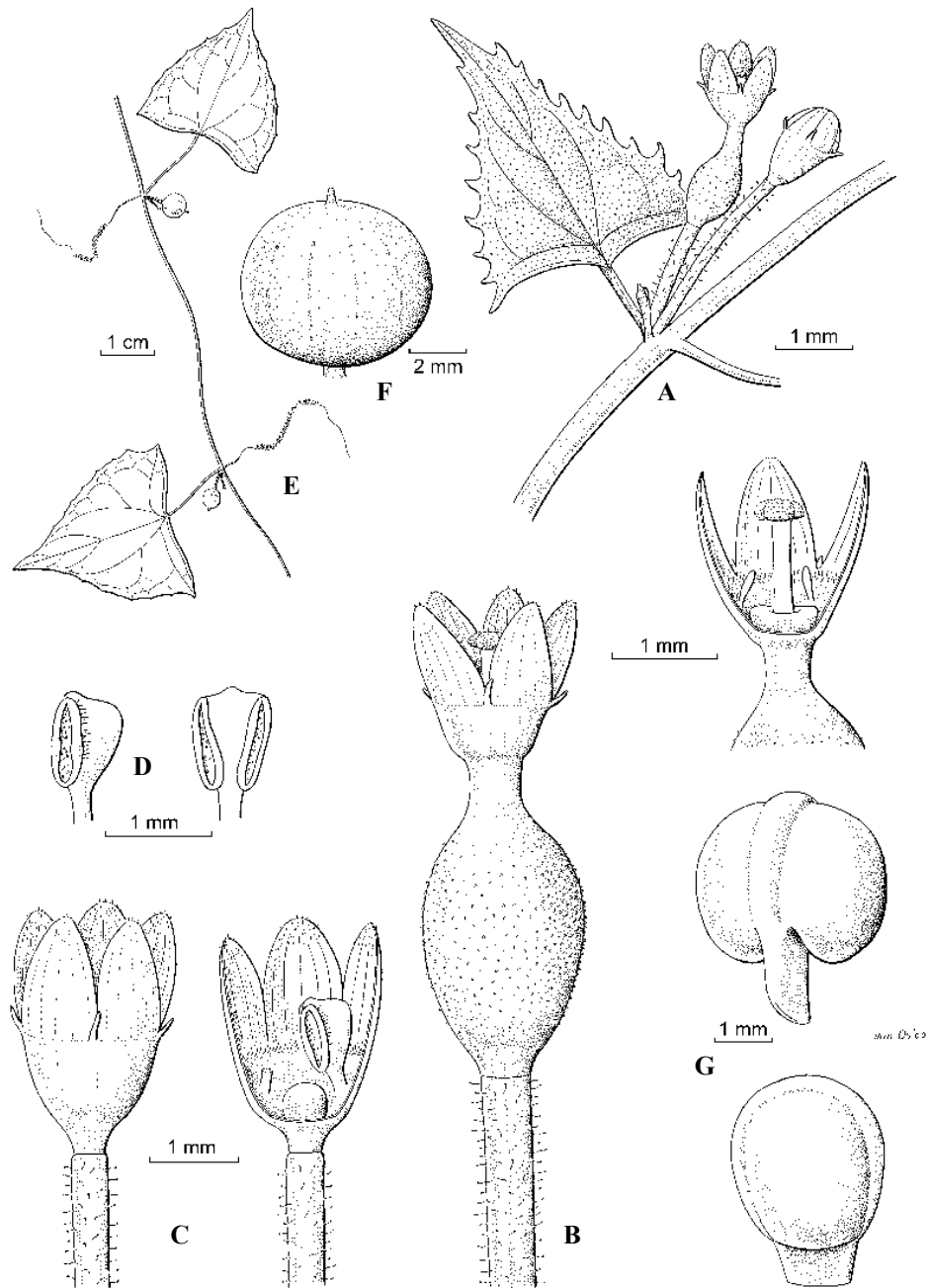


Figure 3. *Zehneria sphaerosperma* W. J. de Wilde & Duyfjes: A. habit of flowering node; B. female flowers; C., D. male flowers and separate stamens; E. portion of stem with fruits; F. fruit; G. seeds. All from Pooma et al. 3043. Drawn by Jan van Os.

glabrous; receptacle tube (broad) cup-shaped, 1.5–2 by 2–3 mm, glabrous except for a few slender hairs inside; sepals ca. 0.2 mm long; petals ovate-elliptic, 0.8–1 by 0.8–1 mm, subobtusate, minutely papillose towards apex; stamens 3; filaments 1.5–1.8 mm long, glabrous, inserted near the base of receptacle; anthers ca. 0.3 mm diam.; thecae vertical, somewhat curved, 0.2–0.3 mm long, connective slightly swollen, with few stiff hairs; disc depressed globose, ca. 0.5 by 1 mm. *Female flowers*: solitary on the node or co-axillary with male raceme; pedicel filiform, 12–15 mm long; ovary fusiform-ellipsoid, ca. 1.5 by 1.2 mm, glabrous, neck nearly 1 mm long; perianth like male; disc conspicuous, a \pm 3-lobed ring, ca. 0.5 mm high, at base partly connate with receptacle; staminodes not seen; style 1–1.2 mm long; stigma 0.7 mm diam., consisting of 3 sessile subglobose papillose free lobes. *Fruit* immature, globose; fruiting pedicel at least 2.5 cm long. *Seeds* not seen.

Thailand.— NORTHERN: Chiang Rai, Doi Tung, (*Iwatsuki et al.* T10980); SOUTH-WESTERN: Kanchanaburi, Thung Yai Naresuan Wildlife Sanctuary (*Maxwell* 93-1209, type).

Distribution.— Myanmar.

Ecology.— Grass field in open places, rugged limestone terrain; at 400–500 m altitude; flowering in September and October.

8. *Zehneria wallichii* (C. B. Clarke) C. Jeffrey, Kew Bull. 34: 802. 1980; Cucurbitaceae of eastern Asia, Kew: 18. 1980; A. M. Lu & Zhi Y. Zhang in A. M. Lu & S. K. Chen, Fl. Reip. Pop. Sin. 73, 1: 172. 1986; S. K. Chen in C. Y. Wu, C. Chen & S. K. Chen, Fl. Yunn. 6: 317. 1995.— *Melothria wallichii* C. B. Clarke in Hook. f., Fl. Brit. Ind. 2: 626. 1879; Cogn. in A. & C. DC., Monogr. Phan. 3: 592; 1881; in Engl., Pflanzenr. 66, 4.275.1: 91. 1916; Craib, Fl. Siam. Enum. 765. 1931; Chakrab., Ind. J. Agric. Sc. 16, 1: 72. 1946; Rec. Bot. Surv. India 17, 1: 156, fig. 71. 1959. Type: Myanmar, Prome, Wallich, 6706D (K-W). Fig. 4.

Slender annual climber, 1–4 m, finely soft pale glandular-hairy and with hairs 1–2 mm long, tardily glabrescent; greenish on drying. *Leaves*: petiole 1–6 cm long, \pm harshly whitish hairy; blade (sub)triangular, 4–11 by 3.5–10 cm, base truncate or very shallowly retuse, apex acute-acuminate, margin straight or faintly undulating, dents (?) minute; older leaves adaxially with dense cystoliths; nerves \pm patently hairy. *Flowers* ca. 7 mm diam. *Male flowers*: long-pedicelled, solitary or co-axillary with a solitary slightly later developing female flower, on the nodes of the leafy stem, or male flowers slightly shorter pedicelled and arranged in loose short-shoots to 5 cm long from the nodes; pedicel 10–20 mm long, filiform, sparsely pale hairy; receptacle-tube \pm narrowly cup-shaped, ca. 2.5 by 2 mm, glabrous but inside densely finely long-haired (ca. 0.5 mm) at throat; sepals linear, ca. 1 by 0.2 mm, recurved; petals 3–5 by 2–2.5 mm, ovate-elliptic, apex obtuse or subacute, abaxially and at apex papillose and glandular-hairy; stamens 3, inserted slightly below the apex of the tube; filaments 0.8–1 mm long, glabrous; anthers ca. 1.2 by 0.7 mm, \pm obtriangular; thecae straight, ca. 1 mm long, connective broad, widening towards apex, slightly produced; disc obovoid, 1–1.2 by 0.6–0.7 mm. *Female flowers*: pedicel 5–8 mm long; ovary narrowly fusiform, (10–)20–30 by (1–)2–3 mm, long-tapering towards apex into a narrow neck ca. 1 mm long, glabrous (except very fine sparse papillae), ovules many; perianth as in male; staminodes 3, linear, ca. 1 mm long, inserted halfway up the receptacle-tube; disc carnos,

nearly 1 mm high; style ca. 3 mm long; stigma consisting of 3 deeply notched papillose lobes, together ca. 1.5 mm diam. *Fruit* pendent, oblong-fusiform, 4–6 by ca. 1 cm (on drying narrowed into slender beaks ca. 1.5 cm long, at base and apex, leaving the middle portion with seeds thick), pale green and dark green striped; fruiting pedicel 1–2 cm long. *Seeds* many, flat, whitish, \pm ovate, ca. 5 by 3 mm, smooth, margin faint.

Thailand.— NORTHERN: Mae Hong Son (*Iwatsuki & Fukuoka* T10339; *Larsen et al.* 2249); Chiang Mai (*De Wilde & Duyffes* 22149, 22153, 22157, 22168, 22177; *Kerr* 1942; *Koyama* T61152; *Maxwell* 87-919, 88-844, 90-799, 90-824; *Palee* 314; *Petrmitr* 90; *Tagawa et al.* T9793, T10619); Chiang Rai (*Palee* 428); Nan (*Larsen et al.* 43664); Lampang (*Maxwell* 95-539, 96-1151); Tak (*Shimizu et al.* T10792); Nakhon Sawan (*Kerr* 4619); SOUTH-WESTERN: Prachuap Khiri Khan (*Shimizu* 7749); CENTRAL: Saraburi (*Maxwell* 74-618).

Distribution.— E Myanmar; also reported from China (Yunnan) but no material seen.

Ecology.— Open deciduous forest; gullies, damp shaded sites; on granitic, shale, or limestone bedrock; 200–1,500 m altitude; flowering and fruiting (June) July–October.

A NOTE ON *ZEHNERIA MAYSORENSIS*

The species here named *Zehneria bodinieri* is one of several closely related species, part of which can be united into one extremely variable species with a very wide distribution in Africa and Asia, and of which the oldest name is *Bryonia scabra* Linn. f., typified by a specimen of Thunberg from the Cape, South Africa, and placed in *Zehneria* by Sonder (1862). Here, however, we regard the African taxa as distinct from those of Asia. Members of this group, at least in Asia, are generally (dark) brown on drying, in contrast to greenish in other species.

The present species, *Zehneria bodinieri*, has, in recent decades, been known as *Zehneria maysorensis* (Wight & Arn.) Arn., with which we do not agree. This latter species was originally described as *Bryonia maysorensis* Wight & Arn. (Wight & Arnott, 1834) together with the related *B. hookeriana* Wight & Arn., both from peninsular India. The essential difference between the two peninsular Indian species is in the shape of the ovaries and fruit: ellipsoid in *B. maysorensis* and globose in *B. hookeriana*. Both names were combined under *Zehneria* by Arnott (1841), and both names were placed in the synonymy of older Asian epithets of Blume by Cogniaux (1881, 1916) and Chakrabarty (1959). In the explanation to the plates Wight (1844) united both species under one species *Bryonia mysorensis* (sphalm. for *maysorensis*). This was followed by many recent authors, including Jeffrey (1962) who accepted for Asia three species, viz. *Z. scabra* L. (also in Africa), *Z. mucronata* (Blume) Miq., and *Z. maysorensis* (incl. *Z. hookeriana*).

As regards the unifying of *Z. maysorensis* and *Z. hookeriana*, we think that this is not warranted; following Cogniaux (1881, 1916) we maintain that both species are distinct. In fact, contrary to recent belief, for (southern) peninsular India we accept three distinct species in this alliance, viz.

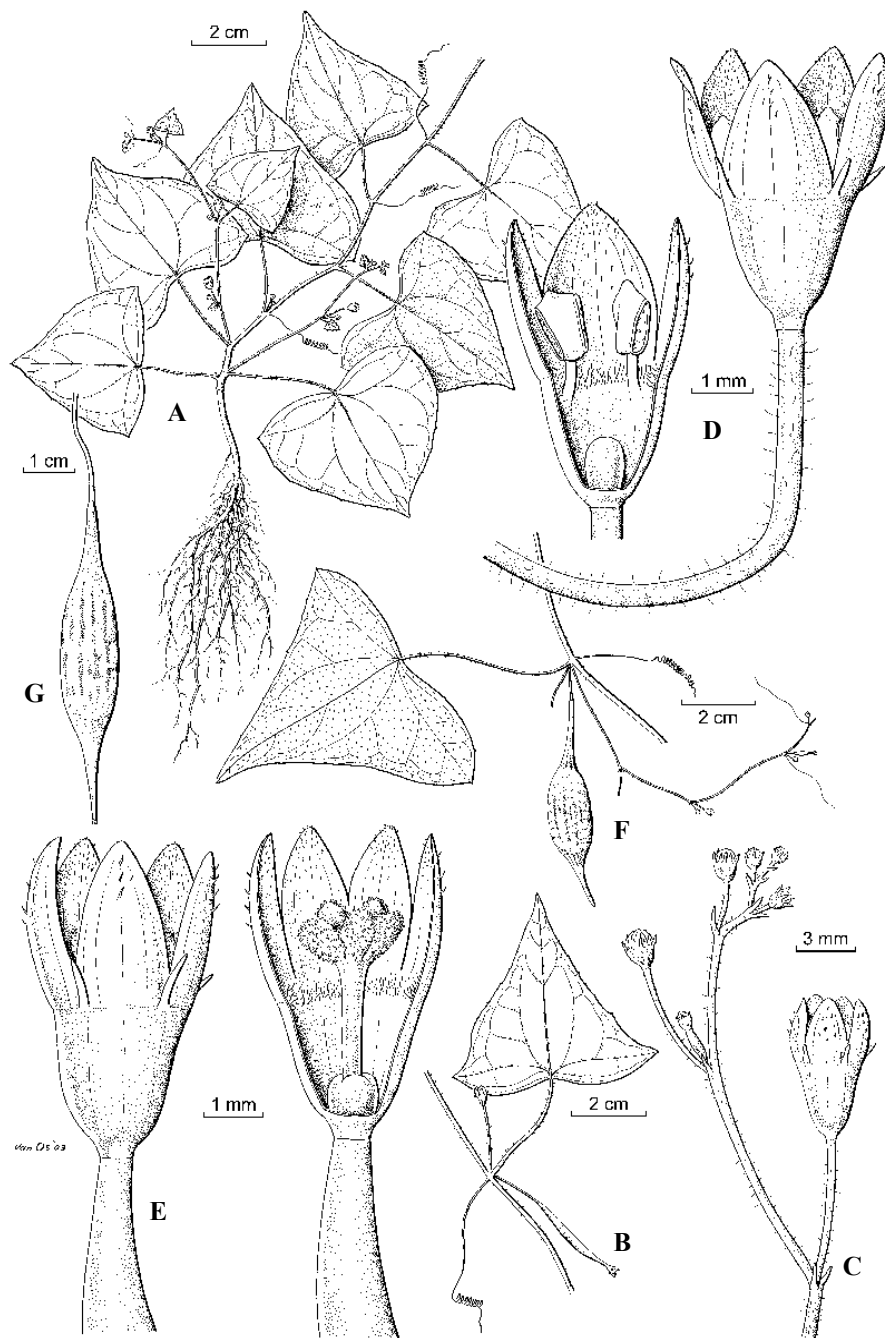


Figure 4. *Zehneria wallichii* (C. B. Clarke) C. Jeffrey: A. habit of base of plant; B. node of older plant with male and female flower; C. tip of flowering lateral twig; D. male flowers; E. female flowers; F. node with fruit and flowering lateral twig; G. fruit (from alcohol material). A. from Maxwell 90-799; B.–G. from De Wilde & Duyffes 22149. Drawn by Jan van Os.

1. *Zehneria maysorensis* (Wight & Arn.) Arn. Type: S India, *Wallich* 6702 A–D, *Wight* 1116.— *Zehneria maysorensis* (Wight & Arn.) Arn. var. *oblonga* V. P. Prasad & M. Prasad, J. Econ. Taxon. Bot. 17 (2): 471. 1993. Type: S India, *Vivekananthan* 45710 (MH, not seen).— Monoecious or dioecious. Ovary and fruit ellipsoid, longer than broad. Distribution: confined to southern peninsular India, at low altitudes.

2. *Zehneria bodinieri* (Lévl.) W. J. de Wilde & Duyfjes. Lectotype: China, *Bodinier* 1957 (E).— Monoecious. Ovary and fruit globose. Distribution: widespread, in Sri Lanka and southern peninsular India, and from N India to S China, Indochina and Malesia, at low and medium altitudes

3. *Zehneria hookeriana* (Wight & Arn.) Arn. Type: S India, *Wight* 1117.— Monoecious. Ovary and fruit globose. Distribution: endemic to southern India, in montane area.

For the whole SE Asian region we recognise further (see Simmons, 2000):

4. *Zehneria mucronata* (Blume) Miq. Type: Java, *Blume* s.n.— Monoecious or dioecious. Ovary and fruit ellipsoid. Distribution: widespread in SE Asia and Malesia, at low and medium altitudes. *Zehneria maysorensis* is very similar to the older *Zehneria mucronata*, and is possibly only a synonym of it.

5. *Zehneria repanda* (Blume) Simmons. Type: Java, *Blume* s.n.— Dioecious (always?). Ovary and fruit globose. Distribution: a mountainous species in Malesia.

6. In mountainous New Guinea there is still an undescribed species, belonging to the group of the above mentioned ones. In the Pacific one or possibly more species could be recognised, including *Z. baueriana* Endl., the type species of the genus, from Norfolk Island.

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REFERENCES

- Arnott, G. A. W. 1841. On the Cucurbitaceae. In: Hooker, W. J., Journal of Botany 3: 271–280. Longman, Orme & Co, London.
- Chakrabarty, H. L. 1959. Monograph on Indian Cucurbitaceae. Records of the Botanical Survey of India 17: 1–234.
- Clarke, C. B. 1879. Cucurbitaceae. In: Hooker, J.D., The flora of British India, 2: 604–635. L. Reeve & Co., London.
- Cogniaux, C. A. 1881. Cucurbitaceae. In: de Candolle, A. & C., Monogr. Phan. Prodr. 3: 325–951. S. G. Masson, Paris.

- Cogniaux, C. A. 1916. Cucurbitaceae-Fevilleae et Melothrieae. In: Engler, A., Pflanzenreich 66, IV.275.1: 1–277. W. Engelmann, Leipzig. d'Hist. Nat. Paris.
- Jeffrey, C. 1962 ('1961'). Notes on Cucurbitaceae, including a proposed new classification of the family. Kew Bulletin 15: 337–371.
- _____. 1980. Further notes on Cucurbitaceae V. The Cucurbitaceae of the Indian Subcontinent. Kew Bull. 34: 789–809.
- Keraudren-Aymonin, M. 1975. Cucurbitacées. In: Aubréville, A. & Leroy, J.-F. (eds), Flore du Cambodge, du Laos et du Viêt-nam 15: 1–114.
- King, 1898. Materials for a flora of the Malayan Peninsula. Cucurbitaceae. Journal Asiatic Society Bengal, Part 2, 67: 25–42.
- Kurz, S. 1877. Contributions towards a knowledge of the Burmese flora. Cucurbitaceae. Journal Asiatic Society of Bengal 46, 2: 47–58.
- Linnaeus, C. von, filius. 1781. Supplementum plantarum: 423. Braunschweig.
- Simmons, C. M. & de Wilde, W. J. J. O. 2000. Zehneria subgenus Zehneria (Cucurbitaceae) in Java and Bali. Blumea 45: 235–243.
- Sonder, O. W. 1862. Cucurbitaceae. In: Harvey, H. & Sonder, O. W., Flora Capensis 2: 482–498. Hodges, Smith & Co., Dublin.
- Wight, R. & Arnott, G. A. W. 1834. Prodromus florae Peninsulae Indiae Orientalis 1: 340–351. Parbury, Allen, & Co., London.
- _____. 1841. Icones plantarum Indiae orientalis, or figures of Indian plants: plates 496–507. J. B. Pharoah, Madras.
- _____. 1844. Icones plantarum Indiae orientalis, or figures of Indian plants 3: 3, plate 758. J. B. Pharoah, Madras.

A preliminary checklist to Thai Palms

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ABSTRACT. As part of the work towards a treatment of the palms for Flora of Thailand a checklist is provided with full synonymy, notes on distribution, vernacular names, and uses. The list comprises 161 species classified into 33 genera.

INTRODUCTION

Like most countries in the Southeast Asian region Thailand boasts a flora that is rich in palms. The present checklist, which is a precursor to the palm treatment in Flora of Thailand, accounts for 161 species classified in 33 genera. Several species are known from cultivation only and are listed under exotic palms cultivated in Thailand. Some of these are amongst the most common palms in Thailand such as African Oil Palm, Coconut Palm and Sago Palm.

Recently, Hodel & Vatcharakorn (1998) published a profusely illustrated book on Thai palms, accounting for 36 genera and 164 species. The book has been criticised for being written in haste and introducing numerous superfluous names (Lim 1998; Dransfield, 2000). Although the checklist presented here includes more or less the same number of species, there are major differences in genera such as *Calamus*, *Licuala* and *Iguanura*. Many of the names that Hodel (1997a; 1997b, 1998) published in a series of papers preceding the publication of book are synonymised. Furthermore several newly published species have been added, such as *Calamus griseus*, *C. laosensis*, *C. oligostachys* and *C. solitarius* (Dransfield, 2000; Evans et al., 2000; 2001; Evans, 2002).

Biogeography

The highest concentration of palm species within Thailand is found on the Peninsula, especially near the border with Malaysia. Thirteen species are endemic to the country: *Iguanura divergens*, *I. tenuis*, *I. thalagensis*, *Kerriodoxa elegans*, *Licuala distans*, *Licuala poonsakii*, *Maxburretia furtadoana*, *Pinanga badia*, *P. fractiflexa*, *P. watanaiana*, *Salacca stolonifera*, *Trachycarpus oreophilus*, and *Wallichia marianneae*.

The Thai palm flora is composed of an Indochinese element, a Himalayan element and a Malesian element. Several of the Malesian species occur disjunctly in Borneo,

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which most likely is due to a former continuous distribution across the Pleistocene landmass of Sundaland. This applies to species such as *Licuala triphylla*, *Calamus axillaris*, *C. tomentosus*, *Pinanga simplicifrons* and *Pinanga auriculata*.

Uses

Palms are used for a wide array of purposes based on their structural and nutritional properties. To rural people they often represent an important resource providing both shelter and food. Over the last few years a large cottage industry has developed producing artifacts carved from palm wood (mostly *Borassus flabellifer*) and the sclerified endocarps of coconut. These products are sold at the national level and also exported.

In Thailand, all rattan canes are collected from the wild. Only about a dozen species belonging to the genus *Calamus* are used commercially for production of furniture. Thailand has lost most of its rattan resources as a result of deforestation and over-exploitation. For a while imports of rattan from the neighbouring countries supported the industry, but after a cane export ban imposed by the major producing countries was implemented in 1989, both cane imports and rattan furniture exports have declined considerably. Several rattan plantations have been established in Thailand over the years but mainly on a trial basis.

Other palm species are used locally on a limited scale. A renewed attention to non-timber forest products, agroforestry and integrated product development has increased the interest in palm products worldwide (FAO 1995). In Thailand the local uses of palms are, however, still poorly documented.

Local names

The local names cited in this publication have mainly been extracted from Smitinand (2001 rev. ed.). A few new names have been added that were recorded during fieldwork in the North and on the Peninsula.

Ecology

In the humid tropics all over the world, palms form a characteristic element in forest ecosystems. They range from small rosette plants in the understorey to tall trees towering above the forest canopy. The climbing palms, the rattans, are a particular feature of the Southeast Asian forests, where they can sometimes occur in great abundance.

Some palms range into drier habitat types in northern Thailand. For example, *Phoenix loureiroi* and *Trachycarpus oreophilus* are both distributed on limestone mountains where they are exposed to several months without precipitation every year. Other palm species such as *Cyrtostachys renda*, *Licuala paludosa* and *Eleiodoxa conferta* inhabit marginal habitats such as swamp forests in Peninsular Thailand, while *Phoenix paludosa* and *Calamus erinaceus* occur on the landward fringe of mangrove forest.

Conservation

A detailed analysis of the conservation status of Thai palms will be the subject of a subsequent paper.

1. ARECA

L., Sp. Pl. 1189. 1753.— *Mischophloeus* Scheff., Ann. Jard. Buitenz. 2: 115. 1876.— *Gigliolia* Becc., Malesia 1: 171. 1877.— *Pichisermollia* H. C. Monteiro, Rodriguésia 28: 195. 1976.

Forty-eight species found in Tropical and Subtropical Asia; four species native to Thailand, one (*A. catechu*) very widely cultivated.

1. *Areca laosensis* Becc., Webbia 3: 191. 1910.

NB. Possibly not distinct from *A. triandra*.

Distribution.— Indo-China.

Vernacular name.— Mak lo ka thoen (หมากลอกะเทิน) (Trat).

2. *Areca montana* Ridl., Mat. Fl. Malay. Penins. 2: 136. 1907.— *A. latiloba* Ridl., J. Str. Br. Roy. Asiat. Soc. 86: 310. 1922.— *A. recurvata* Hodel, Palm J. 134: 28. 1997.

Distribution.— Thailand to W Malesia.

Vernacular name.— Mak pa (หมากป่า) (Peninsular).

3. *Areca triandra* Roxb. ex Buch.-Ham., Mem. Wern. Nat. Hist. Soc. 5: 310. 1826.— *A. laxa* Buch.-Ham., Mem. Wern. Nat. Hist. Soc. 5(2): 309. 1826.— *A. nagensis* Griff., Calcutta J. Nat. Hist. 5: 453. 1845.— *Nenga nagensis* (Griff.) Scheff., Ann. Jard. Bot. Buitenzorg 1:120. 1876; Becc. Malesia 1: 25. 1877.— *Ptychosperma polystachyum* Miq., Fl. Ned. Ind., Eerste Bijv. 590. 1861.— *Areca polystachya* (Miq.) H. Wendl. in O. C. E. de Kerchove de Denterghem, Palmiers: 232. 1878.— *A. triandra* var. *bancana* Scheff., Natuurk. Tijdschr. Ned.-Indië. 32: 165. 1873.— *A. borneensis* Becc., Malesia 1: 22. 1877.— *A. humilis* Blanco ex H. Wendl. in O. C. E. de Kerchove de Denterghem, Palmiers: 231. 1878.— *A. alicae* W. Hill. ex F. Muell., Gartenflora 28: 199. 1879.

Distribution.— Tropical and Subtropical Asia.

Vernacular name.— Mak cha waek (หมากชะแวก), Mak ling (หมากลิง) (Chanthaburi); Mak nang ling (หมากนางลิง) (Trat); Mak no (หมากหน่อ), Mak iak (หมากเอี้ยก) (Northern); Mak hom (หมากหอม) (Bangkok); Mak khiao (หมากเขี้ยว) (Narathiwat); Krue-do (กรู้อดอ) (Malay-Narathiwat).

4. *Areca tunku* J. Dransf. & C. K. Lim, Principes 36: 81. 1992.— *A. bifaria* Hodel, Palm J. 136: 7. 1997.

Distribution.— Peninsular Thailand to Peninsular Malaysia and Sumatra.

2. ARENGA

Labill. ex DC., Bull. Sci. Soc. Philom. Paris 2: 162. 1800, nom. cons.— *Saguerus* Steck, Sagu: 15. 1757.— *Gomutus* Corrêa, Ann. Mus. Natl. Hist. Nat. 9: 288. 1807.— *Blancoa* Blume, Rumphia 2: 128. 1843. nom. illeg.— *Didymosperma* H. Wendl. & Drude ex Hook.f. in Benth. & Hook.f., Gen. Pl. 3: 917. 1883.

Twenty-three species with three varieties, Tropical and Subtropical Asia to N Australia. Four species in Thailand and one (*A. pinnata*) very widely cultivated.

1. *Arenga caudata* (Lour.) H. E. Moore, Principes 4: 114 (1960).— *Borassus caudatum* Lour., Fl. Cochinch. 2: 760. 1790.— *Wallichia caudata* (Lour.) Mart., Hist. Nat. Palm. 3: 315. 1853.— *Blancoa caudata* (Lour.) Kuntze, Revis. Gen. Pl. 2: 727. 1891.— *Didymosperma caudatum* (Lour.) H. Wendl. & Drude ex B. D. Jacks., Index Kew. 1: 756. 1893.— *D. caudatum* var. *tonkinense* Becc., Webbia 3: 208. 1910.— *D. tonkinense* (Becc.) Becc. ex Gagnep. in Lecomte, Fl. Gen. Indo-Chine 6: 966. 1937.

Distribution.— Hainan to Indo-China and N Peninsular Malaysia.

Vernacular name.— Tan (ตาล) (Central, Chon Buri); Tan kai (ตาลไก่) (Loei); Tan rang (ตาลรัง) (Chanthaburi); Tao rang nu (เต้าร้างหนู) (Chanthaburi, Peninsular).

Use.— Ornamental.

2. *Arenga hookeriana* (Becc.) T. C. Whitm., Principes 14: 124. 1970.— *Didymosperma hookerianum* Becc., Malesia 3: 186. 1889.

Distribution.— Peninsular Thailand to N Peninsular Malaysia.

Vernacular name.— Si sayam (ศรีสยาม), Tao rang si sayam (เต้าร้างศรีสยาม) (Bangkok).

Use.— Ornamental.

3. *Arenga obtusifolia* Mart., Hist. Nat. Palm. 191. 1838.— *Gomutus obtusifolius* Blume, Rumphia 2: 131. 1843, nom. invalid.

Distribution.— Peninsular Thailand, Peninsular Malaysia, Sumatra and Java.

Vernacular name.— Maphro nu (มะพร้าวหนู) (Songkhla).

4. *Arenga westerhoutii* Griff., Calcutta J. Nat. Hist. 5: 474. 1845.— *Saguerus westerhoutii* (Griff.) H. Wendl. & Drude in O. C. E. de Kerchove de Denterghem, Palmiers 256. 1878.

Distribution.— Bhutan to Peninsular Malaysia.

Vernacular name.— Rang kap (รังกำป), Rang khai (รังค่าย) (Peninsular); Rang kai (รังไก่) (Central); La-ka (ลากะ) (Malay-Pattani); Lang kap (หลังกัม) (Yala, Pattani); Nao (เนา), I-nao (อิเนา) (Satun).

Use.— Edible young endospems, leaves for thatch.

3. BORASSODENDRON

Becc., Webbia 4: 359. 1914.

Two species, Peninsular Thailand to W Malesia. One species in Thailand.

Borassodendron machadonis (Ridl.) Becc., Webbia 4: 361. 1914.— *B. machadonis* Ridl., J. Str. Br. Roy. Asiat. Soc. 44: 203. 1905.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

Vernacular name.— Chang hai (ช้างไห้) (Pattani); Chang rong hai (ช้างร้องไห้) (Trang).

4. BORASSUS

L., Sp. Pl. 1187. 1753.— *Lontarus* Adans., Fam. Pl. 2: 25. 1763.

Five species in NE Tropical Africa, Madagascar, Tropical Asia and Malesia. One species in Thailand, possibly native, but widely cultivated.

Borassus flabellifer L., Sp. Pl. 1187 (1753).— *B. flabelliformis* L., Syst. Nat. ed. 13, 2: 827. 1770.— *B. tunicatus* Lour., Fl. Cochinch. 2: 618. 1790.— *Pholidocarpus tunicatus* (Lour.) H. Wendl. in O. C. E. de Kerchove de Denterghem, Palmiers 235. 1878.— *Borassus sundaicus* Becc., Webbia 4: 321. 1914.

Distribution.— Tropical and Subtropical Asia.

Vernacular name.— Tan (ตาล) (General); Ta-not (ตะนอต) (Khmer); Tan tanot (ตาลโตนด), Tan yai (ตาลใหญ่) (Central); Than (ถาด) (Shan-Mae Hong Son); Tho-thu (ทอตู) (Karen-Mae Hong Son); Tha-nao (ทะเนา) (Khmer-Phratabong); Thang (ท้าง) (Karen-Tak, Chiang Mai); Not (โนนด) (Peninsular).

Use.— Handicrafts, palm wine, sugar and construction material.

5. CALAMUS

L., Sp. Pl. 325. 1753.— *Palmijuncus* Rumph. ex Kuntze, Revis. Gen. Pl. 2: 731. 1891. nom illegit.— *Rotanga* Boehm., Defin. Gen. Pl. 395. 1760.— *Rotang* Adans., Fam. Pl. 2: 24. 1763.— *Zalaccella* Becc., Ann. Roy. Bot. Gard. (Calcutta) 11(1): 496 (1908).— *Cornera* Furtado, Gard. Bull. Singapore 14: 518. 1955.— *Schizospatha* Furtado, Gard. Bull. Singapore 14: 525. 1955.

Three hundred and sixty-six species, Tropical Africa, Tropical and Subtropical Asia to SW Pacific. Fifty-four species with two subspecies and four varieties in Thailand.

1. *Calamus acanthophyllus* Becc., Webbia 3: 229. 1910.

Distribution.— E Thailand to Laos.

Vernacular name.— Wai nang (หวายนัง) (Si Sa Ket).

Use.— Handicrafts, edible shoot and root can be used to treat malaria.

2. *Calamus acanthospathus* Griff., Calcutta J. Nat. Hist. 5: 39. 1845.— *Palmijuncus acanthospathus* (Griff.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus montanus* T. Anderson, J. Linn. Soc., Bot. 11: 9. 1871.— *Palmijuncus montanus* (T. Anderson) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus feanus* Becc. in Hook.f., Fl. Brit. India 6: 448. 1892.— *C. feanus* var. *medogensis* S. J. Pei & S. Y. Chen, Acta Phytotax. Sin. 27: 137. 1989.— *C. yunnanensis* var. *densiflorus* S. J. Pei & S. Y. Chen, Acta Phytotax. Sin. 27: 135. 1989, nom. invalid.— *C. yunnanensis* var. *intermedius* S. J. Pei & S. Y. Chen, Acta Phytotax. Sin. 27: 137. 1989, nom. invalid.— *C. yunnanensis* Govaerts, World Checklist Seed Pl. 3(1): 11. 1999.

Distribution.— Central Himalaya to S China and Indo-China.

3. *Calamus arborescens* Griff., Calcutta J. Nat. Hist. 5: 33. 1845.— *Palmijuncus arborescens* (Griff.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus hostilis* Wall. ex Voigt, Hort. Suburb. Calcutta 639. 1845, nom. nud.

Distribution.— Myanmar to Peninsular Malaysia.

Vernacular name.— Lam phang (ลำปาง) (Nakhon Si Thammarat); Yi-kha-se (ยี่คาเซ่) (Karen-Kanchanaburi); Wai ton (หวายตื้น) (Kanchanaburi).

4. *Calamus axillaris* Becc. in Hook. f., Fl. Brit. India 6: 456. 1893.— *C. hendersonii* Furtado, Gard. Bull. Singapore 15: 100. 1956.— *C. riparius* Furtado, Gard. Bull. Singapore 15: 103. 1956.

Distribution.— Thailand to Peninsular Malaysia, NW Borneo.

Vernacular name.— Wai ta kha nam (หวายตะกั่ว) (Narathiwat).

5. *Calamus balingensis* Furtado, Gard. Bull. Singapore 15: 240. 1956.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

Vernacular name.— Wai lue bae (หวายลิ้น) (Yala).

6. *Calamus blumei* Becc., Ann. Roy. Bot. Gard. (Calcutta) 11(1): 340. 1908.— *C. mawaiensis* Furtado, Gard. Bull. Singapore 15: 75. 1956.— *C. penibukanensis* Furtado, Gard. Bull. Singapore 15: 79. 1956.— *C. slootenii* Furtado, Gard. Bull. Singapore 15: 79. 1956.

Distribution.— Peninsular Thailand to W Malesia.

Vernacular name.— Wai khi phueng (หวายขี้ผึ้ง) (Trang).

7. *Calamus bousigonii* Becc., Rec. Bot. Surv. India 2: 209. 1902.

7a. subsp. *bousigonii*

Distribution.—Southeast Thailand to Indo-China.

7b. subsp. *smitinandii* J. Dransf., Kew Bull. 55: 713. 2000.

Distribution.— Peninsular Thailand.

Vernacular name.— Wai sae ma (หวายแซ่มา) (Trang).

8. *Calamus burkillianus* Becc. ex Ridl., Fl. Malay Penins. 5: 56. 1925.—
C. chibehensis Furtado, Gard. Bull. Singapore 15: 244. 1956.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

Vernacular name.— Wai kratat (หวายกระดาด) (Narathiwat); Ro-tae-kri-ya (รอแตกริยะ) (Malay-Narathiwat).

9. *Calamus caesius* Blume, Rumphia 3: 57. 1847.— *Palmijuncus caesius* (Blume) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Rotang caesius* (Blume) Baill., Hist. Pl. 13: 300. 1895.— *Calamus glaucescens* Blume, Rumphia 3: 65. 1847. nom illegit.— *Palmijuncus glaucescens* (Blume) Kuntze, Revis. Gen. Pl. 2: 733. 1891.

Distribution.— Peninsular Thailand to Philippines (Palawan).

Vernacular name.— Wai ta kha thong (หวายตะค้าทอง), Ro-tae-sa-kong (รอแต๊ะสะกอง), Ka-tae-sa-tong (กาแต๊ะสะตอง), Ro-tan-se-ka (โรตันเซคะ), Wa-tae-sa-ko (วาแต๊ะสะกอ) (Malay Peninsular); Wai ta khla thong (หวายตะคล้าทอง).

10. *Calamus castaneus* Griff., Calcutta J. Nat. Hist. 5: 28. 1845.— *C. griffithianus* Mart., Hist. Nat. Palm. 3: 332. 1853.— *Palmijuncus griffithianus* (Mart.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus castaneus* Griff. var. *griffithianus* (Mart.) Furtado, Gard. Bull. Singapore 15: 50. 1956.

Distribution.— Peninsular Thailand, Peninsular Malaysia, Sumatra.

Vernacular name.— Chak khao (จากเขา) (Trang); Chak cham (จากจ่า) (Narathiwat).

11. *Calamus concinnus* Mart., Hist. Nat. Palm. 3: 332. 1853.— *Palmijuncus concinnus* (Mart.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Plectocomiopsis ferox* Ridl., Fl. Malay. Penins. 5: 66. 1925.

Distribution.— Myanmar to Peninsular Malaysia.

Vernacular name.— Wai nang (หวายนั่ง) (Peninsular).

12. *Calamus densiflorus* Becc. in Hook. f., Fl. Brit. India 6: 445. 1893.— *C. neglectus* Becc. in Hook. f., Fl. Brit. India 6: 458. 1893.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

Vernacular name.— Wai khi re (หวายขี้เหร่) (Trang).

13. *Calamus diepenhorstii* Miq., Fl. Ned. Ind., Eerste Bijv. 594. 1861.— *Palmijuncus diepenhorstii* (Miq.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus singaporensis* Becc. in Hook.f., Fl. Brit. India 6: 454. 1893.— *C. diepenhorstii* var. *singaporensis* (Becc.) Becc., Ann. Roy. Bot. Gard. (Calcutta) 11: 325. 1908.— *C. pacificus* Ridl., J. Fed. Malay States Mus. 6: 59. 1915.

Distribution.— Thailand to W Malesia.

Vernacular name.— Wai khom (หวายขม) (Trang); Wai khiao (หวายเขียว) (Narathiwat).

14. *Calamus erectus* Roxb., Fl. Ind. ed. 3: 774. 1832.— *Palmijuncus erectus* (Roxb.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus collinus* Griff., Calcutta J. Nat. Hist. 5: 31. 1845.— *Palmijuncus collinus* (Griff.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus erectus* var. *collinus* (Griff.) Becc. in Hook. f., Fl. Brit. India 6: 439. 1892.— *C. schizospathus* Griff., Calcutta J. Nat. Hist. 5: 32. 1845.— *Palmijuncus schizospathus* (Griff.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus erectus* var. *schizospathus* (Griff.) Becc., Ann. Roy. Bot. Gard. (Calcutta) 11: 125. 1908.— *C. macrocarpus* Griff. ex Mart., Hist. Nat. Palm. 3: 333. 1853.— *Palmijuncus macrocarpus* (Griff. ex Mart.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus erectus* var. *macrocarpus* (Griff. ex Mart.) Becc. in Hook.f., Fl. Brit. India 6: 439. 1892.— *C. erectus* var. *birmanicus* Becc., Rec. Bot. Surv. India 2: 197. 1902.

Distribution.— Sikkim to China (Yunnan) and Indo-China.

Vernacular name.— Khi sian (ขี้เทียน) (Trang).

Use.— Edible shoot.

15. *Calamus erinaceus* (Becc.) J. Dransf., Kew Bull. 32: 484. 1978.— *Daemonorops erinacea* Becc., Rec. Bot. Surv. India 2: 225. 1902.— *Calamus aquatilis* Ridl., J. Str. Br. Roy. Asiat. Soc. 41: 43. 1904.

Distribution.— Peninsular Thailand to W Malesia and Philippines (Palawan).

Vernacular name.— Wai phang ka (หวายพังกา) (Trang).

16. *Calamus exilis* Griff., Palms Brit. E. Ind. 51. 1850. *Palmijuncus exilis* (Griff.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *C. curtisii* Ridl., Mat. Fl. Malay. Penins. 2: 204. 1907.— *C. ciliaris* var. *peninsularis* Furtado, Gard. Bull. Singapore 15: 60. 1956.

Distribution.— Peninsular Thailand to Sumatra.

Vernacular name.— Wai phra ram (หวายพระราม) (Narathiwat); Si-ha-mo (ซีฮามอ) (Malay-Narathiwat).

17. *Calamus flagellum* Griff. ex Mart., Hist. Nat. Palm. 3: 333. 1853.— *Palmijuncus flagellum* (Griff. ex Mart.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus polygamus* Roxb., Fl. Ind. ed. 1832, 3: 780. 1832. synonym. provis.— *Palmijuncus polygamus* (Roxb.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus jenkinsianus* Griff., Palms Brit. E. Ind. 40. 1850, nom. illegit.— *Palmijuncus jenkinsianus* Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus flagellum* var. *karinensis* Becc., Ann. Roy. Bot. Gard. (Calcutta) 11 (1): 129. 1908.— *C. karinensis* (Becc.) S. J. Pei & S. Y. Chen, Acta Phytotax. Sin. 27: 133. 1989.

Distribution.— Sikkim to China (Yunnan) and Indo-China.

Use.— Edible shoot.

18. *Calamus godefroyi* Becc., Ann. Roy. Bot. Gard. (Calcutta) 11(1): 267. 1908.

Distribution.— Indo-China.

Vernacular name.— Wai nam (หาญน้ำ) (Nong Khai).

19. *Calamus griseus* J. Dransf., Thai For. Bull., Bot. 28: 157. 2000.

Distribution.— Thailand, Peninsular Malaysia, Sumatra.

20. *Calamus guruba* Buch.- Ham. in C. F. P. von Martius, Hist. Nat. Palm. 3: 211. 1838.— *Daemonorops guruba* (Buch.-Ham.) Mart., Hist. Nat. Palm. 3: 330. 1853.— *Palmijuncus guruba* (Buch.-Ham.) Kuntze, Revis. Gen. Pl. 2: 732. 1891.— *Calamus mastersianus* Griff., Calcutta J. Nat. Hist. 5: 76. 1845.— *C. nitidus* Mart., Hist. Nat. Palm. 3: 334. 1853.— *Palmijuncus nitidus* (Mart.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus multirameus* Ridl., Mat. Fl. Malay. Penins. 2: 202. 1907.— *C. guruba* var. *ellipsoideus* San Y. Chen & K. L. Wang, Acta Bot. Yunnanica 24: 202. 2002.

Distribution.— India (Darjeeling) to Peninsular Malaysia.

Vernacular name.— Wai khi kai (หาญขี้ไก่) (Peninsular).

Use.— Edible shoot.

21. *Calamus henryanus* Becc., Rec. Bot. Surv. India 2: 199. 1902.— *C. balansaeanus* Becc., Webbia 3: 230. 1910.— *C. henryanus* var. *castaneolepis* C. F. Wei, Guihaia 6: 32. 1986.— *C. balansaeanus* var. *castaneolepis* (C. F. Wei) S. J. Pei & S. Y. Chen, Acta Phytotax. Sin. 27: 134. 1989.

Distribution.— S China to Indo-China.

Use.— Edible shoot.

22. *Calamus insignis* Griff., Calcutta J. Nat. Hist. 5: 59. 1845.— *Palmijuncus insignis* (Griff.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus spathulatus* Becc. in Hook. f., Fl. Brit. India 6: 459. 1893.— *C. subspathulatus* Ridl., Mat. Fl. Malay. Penins. 2: 194. 1907.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

Vernacular name.— Wai hin (หวายหิน) (Pattani); Ro-tae-ba-tu (รอเตบาตุ) (Malay-Pattani).

22a. var. longispinosus J. Dransf., Malaysian Forester 41: 342. 1978.

Distribution.— Thailand to N Sumatra.

22b. var. robustus (Becc.) J. Dransf., Malaysian Forester 41: 342. 1978.— *Calamus spathulatus* var. *robustus* Becc. in Hook. f., Fl. Brit. India 6: 459. 1893.

Distribution.— Thailand to Peninsular Malaysia (Perak).

23. Calamus javensis Blume, Rumphia 3: 62. 1847.— *Palmijuncus javensis* (Blume) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus equestris* Blume in J. J. Roemer & J. A. Schultes, Syst. Veg. 7: 1330. 1830, nom. illegit.— *C. tetrastichus* Blume, Rumphia 3: 62. 1847.— *Palmijuncus tetrastichus* (Blume) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus borneensis* Miq., Anal. Bot. Ind. 1: 4. 1850.— *Palmijuncus borneensis* (Miq.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus amplexans* Becc., Malesia 2: 78 (1884).— *Palmijuncus amplexans* (Becc.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *P. penicellatus* (Roxb.) Kuntze, Revis. Gen. Pl. 2: 732. 1891.— *Calamus javensis* subvar. *intermedius* Becc. in Hook. f., Fl. Brit. India 6: 443. 1892.— *C. javensis* subvar. *penangianus* Becc. in Hook. f., Fl. Brit. India 6: 443. 1892.— *C. javensis* subvar. *polyphyllus* Becc. in Hook. f., Fl. Brit. India 6: 443. 1892.— *C. javensis* subvar. *purpurascens* Becc. in Hook. f., Fl. Brit. India 6: 443. 1892.— *C. javensis* subvar. *tenuissimus* Becc. in Hook. f., Fl. Brit. India 6: 443. 1892.— *C. borneensis* Becc., Rec. Bot. Surv. India 2: 205. 1902, nom. illegit.— *C. filiformis* Becc., For. Borneo. 609. 1902.— *C. javensis* var. *acicularis* Becc., Ann. Roy. Bot. Gard. (Calcutta) 11(1): 185. 1908.— *C. kemamanensis* Furtado, Gard. Bull. Singapore 15: 170. 1956.

Distribution.— Peninsular Thailand to W Malesia, Philippines (Palawan).

Vernacular name.— Wai lek (หวายเล็ก) (Nakhon Si Thammarat); Wai khao san (หวายข้าวสาร) (Narathiwat).

24. Calamus khasianus Becc., Ann. Roy. Bot. Gard. (Calcutta) 11(1): 431. 1908.

Distribution.— Assam to China (Yunnan).

25. Calamus laevigatus Mart., Hist. Nat. Palm. 3: 339. 1853.— *Palmijuncus laevigatus* (Mart.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Ceratolobus laevigatus* (Mart.) Becc. & Hook. f. in Hook. f., Fl. Brit. India 6(2): 477. 1893.— *Calamus pallidulus* Becc. in Hook. f., Fl. Brit. India 6: 457. 1893.— *C. retrophyllus* Becc., Ann. Roy. Bot. Gard. (Calcutta) 11(App.): 123. 1913.

Distribution.— Peninsular Thailand to W Malesia.

Vernacular name.— Wai kri ya (หวายกรียา) (Yala).

26. *Calamus latifolius* Roxb., Fl. Ind. ed. 3: 775. 1832.— *Palmijuncus latifolius* (Roxb.) Kuntze, Revis. Gen. Pl. 2: 732. 1891.— *Calamus humilis* Roxb., Fl. Ind. ed. 3: 773. 1832.— *Palmijuncus humilis* (Roxb.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus inermis* T. Anderson, J. Linn. Soc., Bot. 11: 11. 1871.— *Palmijuncus inermis* (T. Anderson) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus macracanthus* T. Anderson, J. Linn. Soc., Bot. 11: 10. 1871.— *Palmijuncus macracanthus* (T. Anderson) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus latifolius* var. *marmoratus* Becc., Ann. Roy. Bot. Gard. (Calcutta) 12: 107. 1918.— *C. inermis* var. *menghaiensis* San Y. Chen, S. J. Pei & K. L. Wang, Acta Bot. Yunnanica 24: 202. 2002.

Distribution.— Nepal to Myanmar.

Vernacular name.— Wai pong (หวายโป่ง) (Central).

27. *Calamus longisetus* Griff., Calcutta J. Nat. Hist. 5: 36. 1845.— *Palmijuncus longisetus* (Griff.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus tigrinus* Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 43(2): 211. 1874.— *Palmijuncus tigrinus* (Kurz) Kuntze, Revis. Gen. Pl. 2: 733. 1891.

Distribution.— India (Andamans), Bangladesh, Myanmar, Southeast and Peninsular Thailand to Peninsular Malaysia.

Vernacular name.— Wai kam phuan (หวายกำพวน) (Trang).

28. *Calamus luridus* Becc. in Hook.f., Fl. Brit. India 6: 445. 1892.— *C. laxiflorus* Becc., Ann. Roy. Bot. Gard. (Calcutta) 11(App.): 13. 1913.— *C. distans* Ridl., Fl. Malay Penins. 5: 56. 1925. *C. belumutensis* Furtado, Gard. Bull. Singapore 15: 223. 1956.

Distribution.— Thailand to Peninsular Malaysia.

Vernacular name.— Wai sai (หวายทราย) (Narathiwat).

29. *Calamus manan* Miq., Fl. Ned. Ind., Eerste Bijv. 595. 1861.— *Palmijuncus manan* (Miq.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Rotang manan* (Miq.) Baill., Hist. Pl. 13: 299. 1895.— *Calamus giganteus* Becc. in Hook.f., Fl. Brit. India 6: 460. 1893.

Distribution.— Peninsular Thailand to W Malesia.

Vernacular name.— Wai kho dam (หวายข้อดำ) (Central); Ro-tae-ma-nao (รอแตมานา) (Malay-Narathiwat).

30. *Calamus myrianthus* Becc. in Hook.f., Fl. Brit. India 6: 451. 1893.— *C. leucotes* Becc., Ann. Roy. Bot. Gard. (Calcutta) 11(1): 309. 1908.

Distribution.— Indo-China.

Vernacular name.— Wai khi kai (หวายขี้ไก่) (Surat Thani).

31. *Calamus nambariensis* Becc., Ann. Roy. Bot. Gard. (Calcutta) 11(1): 433. 1908.— *C. nambariensis* var. *alpinus* S. J. Pei & S. Y. Chen, Acta Phytotax. Sin. 27: 141. 1989.— *C. nambariensis* var. *furfuraceus* S. J. Pei & S. Y. Chen, Acta Phytotax. Sin. 27: 142. 1989.— *C. nambariensis* var. *menglongensis* S. J. Pei & S. Y. Chen, Acta Phytotax. Sin. 27: 141. 1989.— *C. nambariensis* var. *xishuangbannaensis* S. J. Pei & S. Y. Chen, Acta Phytotax. Sin. 27: 141. 1989.— *C. nambariensis* var. *yingjiangensis* S. J. Pei & S. Y. Chen, Acta Phytotax. Sin. 27: 140. 1989.

Distribution.— Assam to southern central China and Indo-China.

32. *Calamus oligostachys* T. Evans et al., Kew Bull. 56: 242. 2001.— *C. pauciflorus* T. Evans et al., Kew Bull. 55: 935. 2000 (non Ridl., Fl. Malay Penins. 5:57. 1925.).

Distribution.— Northeastern Thailand and Central Laos.

Vernacular name.— Wai kra ting (ห้วยกระติง) (Northern).

33. *Calamus ornatus* Blume in J. J. Roemer & J. A. Schultes, Syst. Veg. 7: 1326. 1830. *Palmijuncus ornatus* (Blume) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Rotang ornatus* (Blume) Baill., Hist. Pl. 13: 299. 1895.— *Calamus ovatus* Reinw. ex Kunth, Enum. Pl. 3: 205. 1841.— *C. aureus* Reinw. ex Mart., Hist. Nat. Palm. 3: 341. 1853.— *Palmijuncus aureus* (Reinw. ex Mart.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus ornatus* var. *horrida* Becc. in Hook.f., Fl. Brit. India 6: 460. 1893.— *C. ornatus* var. *philippinensis* Becc., Webbia 1:346. 1905.

Distribution.— Peninsular Thailand to W and C Malesia.

Vernacular name.— Wai chang (ห้วยช้าง), Wai khao dam (ห้วยเขาดำ) (Peninsular); Wai chang yai (ห้วยช้างใหญ่) (Yala).

34. *Calamus oxleyanus* Teijsm. & Binn. ex Miq., Palm. Archip. Ind. 17. 1868.— *Palmijuncus oxleyanus* (Teijsm. & Binn. ex Miq.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Daemonorops fasciculata* Mart., Hist. Nat. Palm. 3: 330. 1853.— *Calamus fernandezii* H. Wendl. in O. C. E. de Kerchove de Denterghem, Palmiers 236 (1878).— *Palmijuncus fernandezii* (H. Wendl.) Kuntze, Revis. Gen. Pl. 2: 733 (1891).— *Calamus oxleyanus* var. *obovatus* Becc., Ann. Roy. Bot. Gard. (Calcutta) 11(App.): 112. 1913.— *C. leiopathus* Bartlett, Papers Mich. Acad. Sci. 25:8. 1939 publ. 1940.

Distribution.— Peninsular Thailand to W Malesia.

Vernacular name.— Wai dam (ห้วยดำ) (Trang); Wai lam diao (ห้วยลำเดี้ยว) (Peninsular).

34a. var. *montanus* Furtado, Gard. Bull. Singapore 15: 86. 1956.

Distribution.— Peninsular Malaysia (Terengganu).

35. *Calamus palustris* Griff., Calcutta J. Nat. Hist. 5: 60. 1845.— *Palmijuncus palustris* (Griff.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus extensus* Roxb., Fl.

Ind. ed. 3: 777. 1832.— *Palmijuncus extensus* (Roxb.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus latifolius* Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 43(2): 20. 1874.— *C. palustris* var. *amplissimus* Becc., Ann. Roy. Bot. Gard. (Calcutta) 11(1): 405. 1908.— *C. palustris* var. *cochinchinensis* Becc., Ann. Roy. Bot. Gard. (Calcutta) 11(1): 405. 1908.— *C. kerrianus* Becc. Ann. Roy. Bot. Gard. (Calcutta) 11(App.). 140. 1913.— *C. palustris* var. *longistachys* S. J. Pei & S. Y. Chen, Acta Phytotax. Sin. 27: 138. 1989.— *C. loeiensis* Hodel, Palm J. 139: 54. 1998.

Distribution.— S China to Nicobar Is.

Vernacular name.— Wai khring (หาขริง) (Trang); Wai ling (หาขลิง), Wai pok (หาขโปก) (Narathiwat); Sa-kro-ai (สะกรอไ) (Malay-Narathiwat).

Use.— Handicrafts and edible shoot.

35a. var. malaccensis Becc., Ann. Roy. Bot. Gard. (Calcutta) 11(1): 405. 1908.— *Calamus dumetorum* Ridl., Mat. Fl. Malay. Penins. 2: 211. 1907.

Distribution.— Myanmar to Peninsular Malaysia (Perak, Penang).

36. Calamus pandanosmus Furtado, Gard. Bull. Singapore 15: 217. 1956.

Distribution.— Peninsular Thailand to W Malesia.

Vernacular name.— Wai toei hom (หาเตยหอม) (General).

37. Calamus peregrinus Furtado, Gard. Bull. Singapore 15: 66. 1956.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

Vernacular name.— Wai nguai (หาขงว) (Peninsular).

38. Calamus poilanei Conrard, Notul. Syst. (Paris) 7: 28. 1938.

Distribution.— Indo-China.

Use.— Handicrafts and edible shoot.

39. Calamus radulosus Becc. in Hook. f., Fl. Brit. India 6: 443. 1892.

Distribution.— Thailand to Peninsular Malaysia (Perak).

Vernacular name.— Wai krae kri ya (หาขแกรกรียา) (Yala).

40. Calamus rudentum Lour., Fl. Cochinch. 209. 1790.— *Palmijuncus rudentum* (Lour.) Kuntze, Revis. Gen. Pl. 2: 732. 1891.— *Rotang rudentum* (Lour.) Baill., Hist. Pl. 13: 299. 1895.

Distribution.— Indo-China.

Vernacular name.— Wai yae (หาขแย้), Wai pong (หาขโป่ง) (General); Wai khi sian (หาขชีเซียน) (Peninsular).

Use.— Handicrafts, edible shoot and fruits.

41. *Calamus scipionum* Lour., Fl. Cochinch. 210. 1790.— *Palmijuncus scipionum* (Lour.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Rotang scipionum* (Lour.) Baill., Hist. Pl. 13: 299. 1895.

Distribution.— Peninsular Thailand to W Malesia, Philippines (Palawan).

Vernacular name.— Wai mai thao (หวายไม้เท้า) (Peninsular); Wai kam (หวายกำ) (Narathiwat).

42. *Calamus sedens* J. Dransf., Kew Bull. 33: 528. 1979.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

43. *Calamus setulosus* J. Dransf., Malaysian Forester 41: 343. 1978.

Distribution.— Thailand to Peninsular Malaysia (Perak).

44. *Calamus siamensis* Becc., Rec. Bot. Surv. India 2: 203. 1902.— *C. siamensis* var. *malaianus* Furtado, Gard. Bull. Singapore 15: 215. 1956.

Distribution.— Indo-China to Peninsular Malaysia.

Vernacular name.— Wai khom (หวายขม) (General); Krae-batu (แกรบาดู) (Malay-Narathiwat); Wai bun (หวายบัน) (North-eastern).

Use.— Widely cultivated for edible shoot.

45. *Calamus solitarius* T. Evans et al., Kew Bull. 55: 932. 2000.

Distribution.— NE Thailand to Indo-China.

46. *Calamus speciosissimus* Furtado, Gard. Bull. Singapore 15: 198. 1956.

Distribution.— Peninsular Thailand to Sumatra.

Vernacular name.— Wai teng (หวายเต็ง) (Narathiwat).

47. *Calamus spectatissimus* Furtado, Gard. Bull. Singapore 15: 64. 1956.

Distribution.— Peninsular Thailand to W Malesia.

Vernacular name.— Wai krae (หวายแกร) (Narathiwat); Krae-ki-ya (แกรกียะ) (Malay-Narathiwat).

48. *Calamus temii* T. Evans, Kew Bull. 57: 85. 2002.

Distribution.— NE Thailand.

49. *Calamus tenuis* Roxb., Fl. Ind. ed. 1832, 3: 780. 1832. *Palmijuncus tenuis* (Roxb.) Kuntze, Revis. Gen. Pl. 2: 734. 1891.— *Calamus amarus* Lour., Fl. Cochinch. 210. 1790. Provisional synonym.— *Palmijuncus amarus* (Lour.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus heliotropium* Buch.-Ham. ex Kunth, Enum. Pl. 3: 210. 1841.— *Palmijuncus heliotropium* (Buch.-Ham. ex Kunth) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus royleanus* Griff., Calcutta J. Nat. Hist. 5: 40. 1845.— *Palmijuncus royleanus* (Griff.) Kuntze, Revis. Gen. Pl. 2: 732. 1891.— *Rotang royleanus* (Griff.) Baill., Hist. Pl. 13: 299. 1895.— *Calamus horrens* Blume, Rumphia 3: 43. 1847.— *Palmijuncus horrens* (Blume) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus stoloniferus* Teijsm. & Binn., Cat. Hort. Bog. 75. 1844.

Distribution.— India (Uttaranchal) and Java to Indo-China.

Vernacular name.— Wai chumphon (หวายชุมพร) (Central).

Use.— Edible shoot.

50. *Calamus tetradactylus* Hance, J. Bot. 13: 289. 1875.— *Palmijuncus tetradactylus* (Hance) Kuntze, Revis. Gen. Pl. 2: 732. 1891.— *Calamus bonianus* Becc., Webbia 3: 231. 1910.— *C. cambojensis* Becc., Webbia 3: 232. 1910.

Distribution.— S China to Indo-China.

Use.— Handicrafts.

51. *Calamus tomentosus* Becc. in Hook.f., Fl. Brit. India 6: 455. 1893.

Distribution.— Peninsular Thailand to Peninsular Malaysia, Borneo.

Vernacular name.— Wai hua diao (หวายหัวเดียว), Wai khi klak (หวายขี้กลาก), Wai tao (หวายเทา) (Peninsular).

52. *Calamus viminalis* Willd., Sp. Pl. 2: 203. 1799.— *Palmijuncus viminalis* (Willd.) Kuntze, Revis. Gen. Pl. 2: 732. 1891.— *Rotang viminalis* (Willd.) Baill., Hist. Pl. 13: 299. 1895.— *Calamus fasciculatus* Roxb., Fl. Ind. ed. 1832, 3: 779. 1832.— *Palmijuncus fasciculatus* (Roxb.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus viminalis* var. *fasciculatus* (Roxb.) Becc. in Hook.f., Fl. Brit. India 6: 444. 1892.— *C. extensus* Mart., Hist. Nat. Palm. 3: 210 t. 116. f. 4. 1838, nom. illegit.— *C. pseudorotang* Mart. ex Kunth, Enum. Pl. 3: 207. 1841.— *Palmijuncus pseudorotang* (Mart. ex Kunth) Kuntze, Revis. Gen. Pl. 2: 732. 1891.— *Calamus litoralis* Blume, Rumphia 3: 43. 1847.— *Palmijuncus litoralis* (Blume) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus viminalis* var. *andamanicus* Becc., Ann. Roy. Bot. Gard. (Calcutta) 11 (1): 207. 1908.— *C. viminalis* var. *bengalensis* Becc., Ann. Roy. Bot. Gard. (Calcutta) 11(1): 206. 1908.— *C. viminalis* var. *cochinchinensis* Becc., Ann. Roy. Bot. Gard. (Calcutta) 11(1): 207. 1908.— *C. viminalis* var. *pinangianus* Becc., Ann. Roy. Bot. Gard. (Calcutta) 11(1): 207. 1908.

Distribution.— NE India to S Central China and Lesser Sunda Is (Bali).

Vernacular name.— Wai khom (หวายขม) (Central, Northern); Ro-tae-sa-po (รอเตสาโปะ) (Malay-Narathiwat).

Use.— Edible shoot and fruits.

53. *Calamus viridispinus* Becc. in Hook.f., Fl. Brit. India 6: 458. 1893.— *C. brevispadix* Ridl., Mat. Fl. Malay. Penins. 2: 207. 1907.— *C. distichus* Ridl., Mat. Fl. Malay. Penins. 2: 206. 1907.— *C. elegans* Becc. ex Ridl., Mat. Fl. Malay. Penins. 2: 207. 1907.— *C. bubuensis* Becc., Ann. Roy. Bot. Gard. (Calcutta) 11(1): 417. 1908.— *C. benomensis* Furtado, Gard. Bull. Singapore 15: 132. 1956.— *C. distichoideus* Furtado, Gard. Bull. Singapore 15: 122. 1956.— *C. koribanus* Furtado, Gard. Bull. Singapore 15: 128. 1956.— *C. oreophilus* Furtado, Gard. Bull. Singapore 15: 124. 1956.— *C. distichus* var. *shangsiensis* S. J. Pei & S. Y. Chen, Acta Phytotax. Sin. 27: 140. 1989.

Distribution.— China (Guangxi), Peninsular Thailand to Peninsular Malaysia.

54. *Calamus wailong* S. J. Pei & S. Y. Chen, Acta Phytotax. Sin. 27: 138. 1989.

Distribution.— China (Yunnan) to Indo-China.

Use.— Edible shoot.

6. CARYOTA

L., Sp. Pl. 1189. 1753.— *Schunda-Pana* Adans., Fam. Pl. 2: 24. 1763.— *Thuessinkia* Korth. ex Miq., Fl. Ned. Ind. 3: 41. 1855, nom. illegit.

Fourteen species, SC China, Tropical Asia, N Australia. Five species in Thailand.

1. *Caryota bacsonensis* Magalon, Contr. Étud. Palmiers Indoch. 128. 1930.

Distribution.— Indo-China.

Vernacular name.— Tao rang (เต่าร้าง) (Central, Peninsular); Khueang luang (เขื่องหลวง) (Northern); Choi (จอย) (Mae Hong Son).

Use.— Ornamental.

2. *Caryota kiriwongensis* Hodel, Palm J. 139: 53. 1998.

Distribution.— Indo-China.

Vernacular name.— Tao rang yak (เต่าร้างยักษ์) (Nakhon Si Thammarat).

3. *Caryota maxima* Blume in C. F. P. von Martius, Hist. Nat. Palm. 3: 195. 1838.— *C. rumphiana* var. *javanica* Becc., Malesia 1: 74. 1877.— *C. furfuracea* var. *caudata*

Blume in C. F. P. von Martius, Hist. Nat. Palm. 3 (ed. 2): 195. 1845.— *C. furfuracea* var. *furcata* Blume in C. F. P. von Martius, Hist. Nat. Palm. 3 (ed. 2): 195. 1845.— *C. ochlandra* Hance, J. Bot. 17: 174. 1879.— *C. obtusa* var. *aequatorialis* Becc. in Hook. f., Fl. Brit. India 6: 423. 1892.— *C. rumphiana* var. *oxyodonta* Becc., Philipp. J. Sci. 14: 337. 1919.— *C. rumphiana* var. *philippinensis* Becc., Philipp. J. Sci. 14: 337. 1919.— *C. aequatorialis* (Becc.) Ridl., Fl. Malay Penins. 5: 20. 1925.— *C. macrantha* Burret, Notizbl. Bot. Gart. Berlin-Dahlem 15: 197. 1940.

Distribution.— S China to Thailand and W Malesia.

Vernacular name.— Khueang luang (เขื่องหลวง), Khueang yai (เขื่องใหญ่) (Northern);

Tao rang yak (เต่าร้างยักษ์) (Central, Peninsular).

4. *Caryota mitis* Lour., Fl. Cochinch. : 697. 1790.— *C. furfuracea* Blume in C. F. P. von Martius, Hist. Nat. Palm. 3: 195. 1838.— *C. propinqua* Blume in C. F. P. von Martius, Hist. Nat. Palm. 3: 195. 1838.— *C. sobolifera* Wall. in C. F. P. von Martius, Hist. Nat. Palm. 3: 194. 1838.— *Drymophloeus zippellii* Hassk., Tijdschr. Natuurl. Gesch. Physiol. 9: 170. 1842.— *Thuessinkia speciosa* Korth., Fl. Ind. Bat. 3: 41. 1855.— *Caryota javanica* Zipp. ex Miq., Fl. Ned. Ind. 2: 41. 1856, nom. illegit.— *C. griffithii* Becc., Nuovo Giorn. Bot. Ital. 3: 15. 1871.— *C. griffithii* var. *selebica* Becc., Malesia 1: 75. 1877.— *C. nana* Linden, Ill. Hort. 28: 16. 1881.— *C. speciosa* Linden, Ill. Hort. 28: 16. 1881.

Distribution.— SE China to Indo-China and Malesia.

Vernacular name.— Tao rang daeng (เต่าร้างแดง) (Nakhon Si Thammarat); Ma deng (มะเด็ง) (Yala); Ngue-deng (เงือกแดง) (Malay-Narathiwat).

Use.— Ornamental.

5. *Caryota obtusa* Griff., Calcutta J. Nat. Hist. 5: 480. 1845.— *C. rumphiana* var. *indica* Becc., Malesia 1: 75. 1877.— *C. obtusidentata* Griff., Palms Brit. E. Ind.: t. 236A, B. 1850.— *C. gigas* Hahn ex Hodel, Palm J. 139: 51. 1998, without diagnostic latin descr.

Distribution.— Assam.

Vernacular name.— Tao rang yak (เต่าร้างยักษ์) (North-eastern).

7. CERATOLOBUS

Blume ex Schult. & Schult. f., Syst. Veg. 7: 80. 1830.

Six species, Peninsular Thailand to W Malesia. One species in Thailand.

Ceratolobus subangulatus (Miq.) Becc., Ann. Roy. Bot. Gard. (Calcutta) 11(App.): iii. 1913.— *Calamus subangulatus* Miq., Fl. Ned. Ind., Eerste Bijv.: 594. 1861.— *Palmijuncus subangulatus* (Miq.) Kuntze, Revis. Gen. Pl. 2: 734. 1891.— *Ceratolobus*

laevigatus var. *subangulatus* (Miq.) Becc., Ann. Roy. Bot. Gard. (Calcutta) 12(2): 16. 1918.— *C. laevigatus* var. *angustifolius* Becc. in Hook.f., Fl. Brit. India 6: 477. 1893.— *C. laevigatus* var. *borneensis* Becc., Ann. Roy. Bot. Gard. (Calcutta) 12(2): 16. 1918.— *C. laevigatus* var. *divaricatus* Becc., Ann. Roy. Bot. Gard. (Calcutta) 12(2): 16. 1918.— *C. laevigatus* var. *major* Becc., Ann. Roy. Bot. Gard. (Calcutta) 12(2): 16. 1918.— *C. laevigatus* var. *regularis* Becc., Ann. Roy. Bot. Gard. (Calcutta) 12(2): 16. 1918.

Distribution.— Peninsular Thailand to W Malesia.

A second species, *Ceratolobus glaucescens* Blume, was recorded by Hodel and Vatcharakorn as occurring in Peninsular Thailand, based on a specimen in cultivation in Nong Nooch Garden, said to have been collected in Thailand. However, this species is otherwise known from a very small area of West Java where it is in danger of extinction. Seed of this species was quite widely distributed from Bogor in Java in the 1970s and it seems more likely to us that the material in cultivation in Thailand originates from Javanese seed.

8. CORYPHA

L., Sp. Pl. 1187. 1753.— *Codda-Pana* Adans., Fam. Pl. 2: 25. 1763, nom illegit.— *Taliera* Mart., Palm. Fam. 10. 1824.— *Gembanga* Blume, Flora 8: 580. 1825.— *Bessia* Raf., Sylva Tellur. 13. 1838.— *Dendrema* Raf., Sylva Tellur. 14. 1838.

Six species, Tropical Asia to Australia. Two species in Thailand.

1. *Corypha lecomtei* Becc. ex Lecomte, Bull. Soc. Bot. France 63: 79. 1917.

Distribution.— Indo-China.

Vernacular name.— Lan (ลาน), Lan pa (ลานป่า) (General).

2. *Corypha utan* Lam., Encycl. 2: 131. 1786.— *Taliera sylvestris* Blume in J. J. Roemer & J. A. Schultes, Syst. Veg. 7: 1307. 1830, nom. illegit.— *Corypha sylvestris* (Blume) Mart., Hist. Nat. Palm. 3: 233. 1838.— *C. elata* Roxb., Fl. Ind. 2: 176. 1824.— *Taliera elata* (Roxb.) Wall., Rep. Calcutta Bot. Gard. to G. A. Bushby. 29. 1840.— *Gembanga rotundifolia* Blume, Flora 8: 580. 1825.— *Taliera gembanga* Blume in J. J. Roemer & J. A. Schultes, Syst. Veg. 7: 1307. 1830, nom. illegit.— *Corypha gembanga* (Blume) Blume, Rumphia 2: 59. 1839.— *C. gebang* Mart., Hist. Nat. Palm. 3: 233. 1838.— *Corypha macropoda* Kurz ex Linden, Cat. Gén. 87. 1871.— *C. macropoda* Linden ex Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 43(2): 197. 1874.— *C. macrophylla* Roster, Bull. Soc. Tosc.ortic. 29: 81. 1904.— *Livistona vidalii* Becc. Webbia 1: 343. 1905.

Distribution.— NE India to N Australia.

Vernacular name.— Lan phru (ลานพรุ), Lan (ลาน) (Peninsular).

9. CYRTOSTACHYS

Blume, Bull. Sci. Phys. Nat. Néerl. 1: 66. 1838.

Eleven species, Peninsular Thailand to Papuasias. One species in Thailand.

Cyrtostachys renda Blume, Bull. Sci. Phys. Nat. Néerl. 1: 66 (1838).— *Bentinckia renda* (Blume) Mart., Hist. Nat. Palm. 3: 316. 1853.— *Areca erythropoda* Miq., J. Bot. Néerl. 1: 6. 1861.— *Pinanga purpurea* Miq., Fl. Ned. Ind., Eerste Bijv. 590. 1861.— *Ptychosperma coccinea* Teijsm. & Binn., Cat. Hort. Bog. 69. 1866.— *Areca erythrocarpa* H. Wendl. in O. C. E. de Kerchove de Denterghem, Palmiers 231. 1878.— *Cyrtostachys lakka* Becc., Ann. Jard. Bot. Buitenzorg 2: 141. 1885.— *Pinanga rubricaulis* Linden., Cat. Pl. Hort. Contin. 1885: 61, n. 117. 1885.

Distribution.— Peninsular Thailand to W Malesia.

Vernacular name.— Mak daeng (หมากแดง) (Bangkok); Kap daeng (กะปแดง), Ka daeng (กะแดง) (Nakhon Si Thammarat); Mak wing (หมากwing) (Pattani).

Use.— Ornamental.

10. DAEMONOROPS

Blume in Roem. & Schult., Syst. Veg. 7: 1333. 1830.

One hundred and ten species, Tropical and Subtropical Asia. Fifteen species in Thailand.

1. Daemonorops angustifolia (Griff.) Mart., Hist. Nat. Palm. 3: 327. 1853.— *Calamus angustifolius* Griff., Calcutta J. Nat. Hist. 5: 89. 1845.— *C. hygrophilus* Griff., Palms Brit. E. Ind.: t. 213 C. 1850.— *Daemonorops hygrophila* (Griff.) Mart., Hist. Nat. Palm. 3: 328. 1853.— *Palmijuncus hygrophilus* (Griff.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Daemonorops carcharodon* Ridl., Mat. Fl. Malay. Penins. 2: 178. 1907.— *D. angustispatha* Furtado, Gard. Bull. Str. Settle. 9: 161. 1937.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

Vernacular name.— Wai nam (หาวน้ำ) (Peninsular); Ro-tan-ta-wa (รอตันตาวา) (Malay-Peninsular).

2. Daemonorops didymophylla Becc. in Hook.f., Fl. Brit. India 6: 468. 1893.— *Calamus didymophyllus* (Becc.) Ridl., J. Straits Branch Roy. Asiat. Soc. 30: 221. 1897.— *C. cochleatus* Miq., Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk. 11: 29. 1868, nom. nud.— *Palmijuncus cochleatus* (Miq.) Kuntze, Revis. Gen. Pl. 2: 733. 1891, nom. invalid.— *Daemonorops cochleata* Teijsm. & Binn. ex Miq., Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect. 11(5): 29. 1868, nom. nud.— *D. mattanensis* Becc., Nelle Forest. Borneo: 608. 1902.— *D. motleyi* Becc., Rec. Bot. Surv. India 2: 224. 1902.

Distribution.— Peninsular Thailand to W Malesia.

Vernacular name.— Wai khi pet (หวายขี้เป็ด) (Nakhon Si Thammarat).

3. *Daemonorops geniculata* (Griff.) Mart., Hist. Nat. Palm. 3: 329. 1853.— *Calamus geniculatus* Griff., Calcutta J. Nat. Hist. 5: 67. 1845.— *Palmijuncus geniculatus* (Griff.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.

Distribution.— Peninsular Thailand to W Malesia.

Vernacular name.— Wai ta no (หวายตานา) (Narathiwat).

4. *Daemonorops grandis* (Griff.) Mart., Hist. Nat. Palm. 3: 327. 1853.— *Calamus grandis* Griff., Calcutta J. Nat. Hist. 5: 84. 1845.— *Palmijuncus grandis* (Griff.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *P. grandis* (Griff.) Kuntze., Revis. Gen. Pl. 2: 733. 1891.— *Calamus intermedius* Griff., Calcutta J. Nat. Hist. 5: 86. 1845.— *Daemonorops intermedia* (Griff.) Mart., Hist. Nat. Palm. 3: 327. 1853.— *Palmijuncus intermedius* (Griff.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus acanthopis* Griff., Palms Brit. E. Ind.: t. 216. 1850.— *Daemonorops kirtong* Griff., Palms Brit. E. Ind. 102. 1850.— *D. malaccensis* Mart., Hist. Nat. Palm. 3: 327. 1853.— *Palmijuncus malaccensis* (Mart.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Daemonorops grandis* var. *megacarpus* Furtado, Gard. Bull. Singapore 14:67. 1953.— *D. laciniata* Furtado, Gard. Bull. Singapore 14: 75. 1953.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

Vernacular name.— Wai chak (หวายจาก) (Nakhon Si Thammarat).

5. *Daemonorops jenkinsiana* (Griff.) Mart., Hist. Nat. Palm. 3: 327. 1853.— *Calamus jenkinsianus* Griff., Calcutta J. Nat. Hist. 5: 81. 1845.— *Palmijuncus jenkinsianus* (Griff.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Calamus nutantiflorus* Griff., Calcutta J. Nat. Hist. 5: 79. 1845.— *Daemonorops nutantiflora* (Griff.) Mart., Hist. Nat. Palm. 3: 326. 1853.— *Palmijuncus nutantiflorus* (Griff.) Kuntze, Revis. Gen. Pl. 2: 732. 1891.— *Daemonorops pierreana* Becc., Rec. Bot. Surv. India 2: 220. 1902.— *D. schmidtiana* Becc., Bot. Tidsskr. 29: 98. 1909.

Distribution.— E Himalaya to Indo-China.

Vernacular name.— Wai som khao (หวายโสมขาว) (Trat).

Use.— Edible shoot and leaves used as thatch.

6. *Daemonorops kunstleri* Becc. in Hook.f., Fl. Brit. India 6: 469. 1893.— *D. vagans* Becc. in Hook.f., Fl. Brit. India 6: 469. 1893.

Distribution.— Peninsular Thailand to W Malesia.

Vernacular name.— Wai nang (หวายนั่ง), Wai din (หวายดิน) (Narathiwat); Wai khi re (หวายขี้เหร่) (Nakhon Si Thammarat); Ta-no-boe-sa (ตานาเบอซา) (Malay-Narathiwat).

7. *Daemonorops leptopus* (Griff.) Mart., Hist. Nat. Palm. 3: 329. 1853.— *Calamus leptopus* Griff., Calcutta J. Nat. Hist. 5: 73. 1845.— *Palmijuncus leptopus* (Griff.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Daemonorops congesta* Ridl., Mat. Fl. Malay. Penins. 2: 179. 1907.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

8. *Daemonorops lewisiana* (Griff.) Mart., Hist. Nat. Palm. 3: 327. 1853.— *Calamus lewisianus* Griff., Calcutta J. Nat. Hist. 5: 87. 1845.— *Palmijuncus lewisianus* (Griff.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Daemonorops pseudosepal* Becc. in Hook. f., Fl. Brit. India 6: 465. 1893.— *D. tabacina* Becc. in Hook.f., Fl. Brit. India 6: 466. 1893.— *D. bakauensis* Becc., Ann. Roy. Bot. Gard. (Calcutta) 12(1): 220. 1911.— *D. curtisii* Furtado, Gard. Bull. Straits Settlem. 9: 164. 1937.

Distribution.— Thailand to Peninsular Malaysia and Sumatra.

9. *Daemonorops macrophylla* Becc. in Hook. f., Fl. Brit. India 6: 470. 1893.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

Vernacular name.— Wai loe bae lek (หวายเลอเบเล็ก) (Narathiwat).

10. *Daemonorops melanochaetes* Blume in Roem. & Schult., Syst. Veg. 7: 1333. 1830.— *Calamus melanochaetes* (Blume) Miq., Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk. 11: 28. 1868.— *Daemonorops javanica* Furtado, Gard. Bull. Straits Settlem. 9: 170. 1937.

Distribution.— Peninsular Thailand to W Malesia.

11. *Daemonorops monticola* (Griff.) Mart., Hist. Nat. Palm. 3: 328. 1853.— *Calamus monticolus* Griff., Calcutta J. Nat. Hist. 5: 90. 1845.— *Palmijuncus monticolus* (Griff.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

12. *Daemonorops propinqua* Becc. in Hook.f., Fl. Brit. India 6: 467. 1893.

Distribution.— Peninsular Thailand to Sumatra.

13. *Daemonorops sabut* Becc. in Hook. f., Fl. Brit. India 6: 469. 1893.— *D. annulata* Becc., Rec. Bot. Surv. India 2: 227. 1902.— *D. pseudomirabilis* Becc., Rec. Bot. Surv. India 2: 226. 1902.— *D. turbinata* Becc., Ann. Roy. Bot. Gard. (Calcutta) 12(1): 225. 1911.

Distribution.— Peninsular Thailand to W Malesia.

Vernacular name.— Wai phon khon non (หวายพนชนหนอน) (Trang); Loe-bae-boe-sa (เลอเบบเอชะ) (Malay-Narathiwat).

14. *Daemonorops sepal* Becc. in Hook. f., Fl. Brit. India 6: 465. 1893.— *D. imbellis* Becc., Rec. Bot. Surv. India 2: 220. 1902.— *D. aciculata* Ridl., Mat. Fl. Malay. Penins. 2: 176. 1907.— *D. scortechinii* Becc., Ann. Roy. Bot. Gard. (Calcutta) 12(1): 81. 1911.— *D. kiahii* Furtado, Gard. Bull. Singapore 14: 73. 1953.— *D. nurii* Furtado, Gard. Bull. Singapore 14: 85. 1953.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

15. *Daemonorops verticillaris* (Griff.) Mart., Hist. Nat. Palm. 3: 329. 1853.— *Calamus verticillaris* Griff., Calcutta J. Nat. Hist. 5: 63. 1845.— *Palmijuncus verticillaris* (Griff.) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Daemonorops setigera* Ridl., Fl. Malay Penins. 5: 45. 1925.— *D. stipitata* Furtado, Gard. Bull. Singapore 14: 142. 1953.

Distribution.— Peninsular Thailand, Peninsular Malaysia, Sumatra.

Vernacular name.— Wai ta pla (หวายตาปลา) (Narathiwat).

11. ELEIODOXA

(Becc.) Burret, Notizbl. Bot. Gart. Berlin-Dahlem 15: 733. 1942.

One species, Peninsular Thailand to W Malesia.

Eleiodoxa conferta (Griff.) Burret, Notizbl. Bot. Gart. Berlin-Dahlem 15: 734. 1942.— *Salacca conferta* Griff., Calcutta J. Nat. Hist. 5: 16. 1845.— *S. scortechinii* Becc., Ann. Roy. Bot. Gard. (Calcutta) 12(3): 97. 1919.— *Eleiodoxa scortechinii* (Becc.) Burret, Notizbl. Bot. Gart. Berlin-Dahlem 15: 735. 1942.— *E. microcarpa* Burret, Notizbl. Bot. Gart. Berlin-Dahlem 15: 735. 1942.— *E. orthoschista* Burret, Notizbl. Bot. Gart. Berlin-Dahlem 15: 734. 1942.— *E. xantholepis* Burret, Notizbl. Bot. Gart. Berlin-Dahlem 15: 735. 1942.

Distribution.— Peninsular Thailand to W Malesia.

Vernacular name.— Lumphi (ลุมพี, หลุมพี) (Narathiwat, Pattani); Kra-lu-bi (กระลูบี่), Lu-bi (ลูบี่) (Malay-Narathiwat).

Use.— Edible fermented fruits.

12. EUGEISSONA

Griff., Calcutta J. Nat. Hist. 5: 101. 1845.

Six species, in Peninsular Thailand to W Malesia. One species in Thailand.

Eugeissona tristis Griff., Calcutta J. Nat. Hist. 5: 101. 1845.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

Vernacular name.— Chak khao (จากเขา) (Narathiwat); Chak cham (จากจำ) (Yala, Pattani); Sue-dae (ซื่อแด) (Malay-Narathiwat).

Use.— Young endosperm edible.

13. IGUANURA

Blume, Bull. Sci. Phys. Nat. Néerl. 66. 1838.— *Slackia* Griff., Not. Pl. Asiat. 3: 162. 1851.

Thirty-two species from Thailand to W Malesia. Seven species with one variety in Thailand.

1. *Iguanura bicornis* Becc., Malesia 3: 188. 1886.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

Vernacular name.— Mak faet (หมากแฝด) (Peninsular).

Use.— Ornamental.

2. *Iguanura divergens* Hodel, Palm J. 137: 7. 1997.

Distribution.— Peninsular Thailand.

Vernacular name.— Mak tok (หมากตอก) (Peninsular).

Use.— Ornamental.

3. *Iguanura geonomiformis* Mart., Hist. Nat. Palm. 3: 229. 1845.— *Slackia geonomiformis* (Mart.) Griff., Not. Pl. Asiat. 3: 162. 1851.— *Iguanura malaccensis* Becc., Malesia 3:123. 1886.— *I. geonomiformis* var. *malaccensis* (Becc.) Ridl., Mat. Fl. Malay. Penins. 2: 150. 1907.— *I. wallichiana* var. *malaccensis* (Becc.) Kiew, Gard. Bull. Singapore 28: 222. 1976.— *I. geonomiformis* subsp. *malaccensis* (Becc.) Kiew, Gard. Bull. Singapore 28: 222. 1976.— *I. geonomiformis* var. *ramosa* Ridl., Mat. Fl. Malay. Penins. 2:151. 1907.— *I. wallichiana* var. *elatior* Kiew, Gard. Bull. Singapore 28: 224. 1976.

Distribution.— Peninsular Malaysia.

Vernacular name.— Mak pinae (หมากปีแน) (Peninsular); Pi-nae-due-kong (ปีแนดื้อกอง), Pi-nae-bong (ปีแนบอง) (Malay-Narathiwat).

Use.— Ornamental

4. *Iguanura polymorpha* Becc., Malesia 3: 189. 1886.— *I. polymorpha* var. *canina* Becc., Malesia 3: 189. 1886.— *I. brevipes* Hook.f., Fl. Brit. Ind. 6: 416. 1892.— *I. ferruginea* Ridl., J. Straits Branch Roy. Asiat. Soc. 41: 40. 1903. — *I. arakudensis* Furtado, Repert. Spec. Nov. Regni Veg. 35: 273. 1934.— *I. speciosa* Hodel, Palm J. 134: 29. 1997.— *I. polymorpha* var. *integra* C. K. Lim, Principes 42: 112. 1998.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

Vernacular name.— Mak che (หมากเจ) (Nakhon Si Thammarat); Mak khao san (หมากข้าวสาร) (Narathiwat).

Use.— Ornamental.

5. *Iguanura tenuis* Hodel, Palm J. 136: 11. 1997.

Distribution.— Peninsular Thailand.

5a. var. *khaosokensis* C. K. Lim, Principes 42: 112. 1998.

Distribution.— Peninsular Thailand.

6. *Iguanura thalangensis* C. K. Lim, Principes 42: 114. 1998.

Distribution.— Thailand.

7. *Iguanura wallichiana* (Mart.) Becc., Malesia 3: 100. 1886.— *Areca wallichiana* Mart., Hist. Nat. Palm. 3: 178. 1838.— *Slackia insignis* Griff., J. Trav. 2: 187. 1847.— *Iguanura wallichiana* var. *minor* Becc. ex Hook. f., Fl. Brit. India 6: 416. 1892.— *Slackia geonomiformis* (Mart.) Griff., Not. Pl. Asiat. 3: 162. 1954.— *Iguanura multifida* Hodel, Palm J., 136:8. 1997.

Distribution.— Peninsular Thailand to Sumatra.

Vernacular name.— Mak tok bai yai (หมากดอกใบใหญ่) (Peninsular); Mareng (เมรึง) (Trang).

Use.— Ornamental.

14. JOHANNESTEIJSMANNIA

H. E. Moore, Principes 5: 116. 1961.— *Teysmannia* Rchb. fil. & Zoll., Linnaea 28: 657. 1858.

Four species from Peninsular Thailand to W Malesia. One species in Thailand.

Johannesteijsmannia altifrons (Rchb. fil. & Zoll.) H. E. Moore, Principes 5: 116. 1961.— *Teysmannia altifrons* Rchb. f. & Zoll., Linnaea 28: 657. 1858.

Distribution.— Peninsular Thailand to W Malesia.

Vernacular name.— Bang sun (บังสุรย์) (Bangkok); Palm khao lam tat (ปาล์มข้าวหลามตัด), Palm bang sun (ปาล์มบังสุรย์) (Peninsular); Li-pae (ลีแป) (Malay-Peninsular); Mak ta khap (หมากตะขาบ) (Narathiwat).

Use.— Ornamental.

15. KERRIDOXIA

J. Dransf., Principes 27: 4. 1983.

Endemic to Peninsular Thailand.

Kerriodoxa elegans J. Dransf., Principes 27: 4. 1983.

Distribution.— Peninsular Thailand.

Vernacular name.— Praya thalang (พระชาดกลาง), Chao muang thalang (เจ้าเมืองถลาง) (Central); Ching lang khao (ชิงหลั่งขาว), Tang lang khao (ตังหลั่งขาว) (Phuket).

Use.— Ornamental.

16. KORTHALSIA

Blume, Rumphia 2: 166. 1843.— *Calamosagus* Griff., Calcutta J. Nat. Hist. 5: 22. 1845.

Twenty-seven species, Indo-China to New Guinea. Five species in Thailand.

1. Korthalsia flagellaris Miq., Fl. Ned. Ind., Eerste Bijv. 591. 1861.— *K. rubiginosa* Becc., Malesia 2: 72. 1884.

Distribution.— Peninsular Thailand to W Malesia.

Vernacular name.— Wai sadao nam (หาวยสะเดาน้ำ), Wai dao nam (หาวยเดาน้ำ) (Narathiwat); Ro-tan-da-nae (รอตันดาแน) (Malay-Narathiwat).

2. Korthalsia laciniosa (Griff.) Mart., Hist. Nat. Palm. 3: 211. 1845.— *Calamosagus laciniosus* Griff., Calcutta J. Nat. Hist. 5: 23. 1845.— *C. wallichiiifolius* Griff., Calcutta J. Nat. Hist. 5: 24. 1845.— *Korthalsia wallichiiifolia* (Griff.) H. Wendl. in O. C. E. de Kerchove de Denterghem, Palmiers 248. 1878.— *Calamosagus harinifolius* Griff., Palms Brit. E. Ind. 29. 1850.— *Korthalsia teysmannii* Miq., Fl. Ned. Ind., Eerste Bijv. 591. 1861.— *K. scaphigera* Kurz, Forest Fl. Burma 2: 513. 1877, nom. illegit.— *Korthalsia andamanensis* Becc., Malesia 2: 76. 1884.— *Korthalsia grandis* Ridl., Mat. Fl. Malay. Penins. 2: 217. 1907.

Distribution.— Indo-China to Philippines.

Vernacular name.— Wai sadao yai (หาวยสะเดาใหญ่), Wai dao yai (หาวยเดาใหญ่) (Peninsular); Da-nae-ka-yo (ดาแนกเยาะ) (Malay-Narathiwat); Wai sadao nam (หาวยสะเดาน้ำ) (Narathiwat).

3. Korthalsia rigida Blume, Rumphia 2: 167. 1843.— *K. polystachya* Mart., Hist. Nat. Palm. 3: 210. 1845.— *Calamosagus polystachys* (Mart.) H. Wendl. in O. C. E. de Kerchove de Denterghem, Palmiers 235. 1878.— *C. ochriger* Griff., Palms Brit. E. Ind.

31. 1850.— *Korthalsia ferox* var. *malayana* Becc. in Hook. f., Fl. Brit. India 6: 476. 1893.— *K. hallieriana* Becc., Ann. Roy. Bot. Gard. (Calcutta) 12(2): 142. 1918.— *K. paludosa* Furtado, Gard. Bull. Singapore 13: 313. 1951.

Distribution.— Peninsular Thailand to Philippines (Palawan).

Vernacular name.— Wai dao nu (หวายเดาหนู) (Trang); Da-nae-ti-ku (ดาเนตตี้) (Malay-Narathiwat).

4. *Korthalsia rostrata* Blume, Rumphia, 2: 168. 1843.— *Ceratolobus rostratus* (Blume) Becc., Ann. Roy. Bot. Gard. (Calcutta) 12(2): 11. 1918.— *Korthalsia scaphigera* Mart., Hist. Nat. Palm. 3 (ed. 2): 211. 1845.— *Calamosagus scaphiger* (Mart.) Griff., Palms Brit. E. Ind. 30. t. 148 a. 1850.— *Korthalsia lobbiana* H. Wendl., Bot. Zeitung (Berlin) 17: 174. 1859.— *K. machadonis* Ridl., Mat. Fl. Malay. Penins. 2: 216. 1907.

Distribution.— Peninsular Thailand to W Malesia.

5. *Korthalsia scortechinii* Becc. in Hook. f., Fl. Brit. Ind. 6: 475. 1893.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

Vernacular name.— Wai kung (หวายกุ้ง), Wai dao lek (หวายเดาเล็ก), Wai sadao lek (หวายสะเดาเล็ก) (Narathiwat); Ro-tae-u-dae (รอเตอูแด) (Malay-Narathiwat).

17. LICUALA

Wurmb, Verh. Batav. Genootsch. Kunsten 2: 469. 1780.— *Pericycla* Blume, Rumphia, 2: 47. 1838.— *Dammera* K. Schum. & Lauterb., Fl. Schutzgeb. Südsee 201. 1900.

One hundred and thirty-four species from Bhutan to Vanuatu. Thirteen species with one variety in Thailand (Barfod & Saw 2002).

1. *Licuala distans* Ridl., J. Fed. Malay States Mus. 10: 123. 1920.

Distribution.— Endemic to Peninsular Thailand.

Vernacular name.— Ka pho si sip (กะพ้อสี่สิบ) (Peninsular); Chiang (จิง) (Trang).

Use.— Ornamental.

2. *Licuala glabra* Griff., Calcutta J. Nat. Hist. 5: 329. 1845.— *L. longipedunculata* Ridl., J. Straits Branch Roy. Asiat. Soc. 41: 42. 1903.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

Vernacular name.— Pa-la (ปาละ) (Malay-Peninsular).

Use.— Ornamental.

3. *Licuala kunstleri* Becc. in Hook. f., Fl. Brit. Ind. 6: 433. 1892.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

Vernacular name.— Tan diao (ตาลเดี่ยว), Ka pho khao (กะพ้อเขา), Ka pho nam man (กะพ้อน้ำมัน) (Narathiwat).

4. *Licuala malajana* Becc., Malesia 3: 197. 1889.

Distribution.— Thailand to Peninsular Malaysia.

Vernacular name.— Ka pho khao (กะพ้อเขา) (Narathiwat).

5. *Licuala merguensis* Becc., Webbia 5: 47. 1921.— *L. hirta* Hodel, Palm J. 136: 12. 1997.

Distribution.— S Myanmar to Peninsular Thailand.

6. *Licuala modesta* Becc., Malesia 3: 195. 1889.— *L. wrayi* Becc. ex Ridl., J. Straits Branch Roy. Asiat. Soc. 82: 201. 1920.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

7. *Licuala paludosa* Griff., Calcutta J. Nat. Hist. 5: 323. 1844.— *L. amplifrons* Miq., Fl. Ned. Ind., Eerste Bijv. 591. 1861.— *L. oxleyi* H. Wendl. in O. C. E. de Kerchove de Denterghem, Palmiers 249. 1878.— *L. paniculata* Ridl., J. Straits Branch Roy. Asiat. Soc. 41: 42. 1903. — *L. aurantiaca* Hodel, Palm J. 134: 30. 1997.

Distribution.— Indo-China to W Malesia.

Vernacular name.— Ka pho (กะพ้อ) (Peninsular); Ka pho daeng (กะพ้อแดง), Pho phru (พ้อพรุ), Khuan (ชวน) (Narathiwat); Ku-wa-mae-ro (กัวแมเราะ) (Malay-Narathiwat).

Use.— Ornamental.

8. *Licuala peltata* Roxb. ex Buch.-Ham., Mem. Wern. Nat. Hist. Soc. 5: 313. 1826.

Distribution.— Bhutan to Peninsular Malaysia.

Vernacular name.— Chao muang trang (เจ้าเมืองตรัง) (Trang); Ka phlo (กะพล้อ) (Phichit); Ka pho (กะพ้อ) (Bangkok); Ching (จิง) (Satun); Ching (ชิง) (Peninsular).

Use.— Ornamental.

8a. var. *sumawongii* Saw, Sandakania 10: 10. 1997.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

9. *Licuala poonsakii* Hodel, Palm J. 134: 32. 1997.

Distribution.— E & SE Thailand.

10. *Licuala pusilla* Becc. Malesia 3: 194. 1889.— *L. tansachana* Hodel, Palm J. 134: 34. 1997.

Distribution.— Peninsular Thailand to western central Peninsular Malaysia.

Vernacular name.— Ka pho nu (กะพ้อหนู) (Pattani); Ka pho nok aen (กะพ้อนกแอ่น), Pa-la-ti-ku (ปาละติกู) (Malay-Pattani).

11. *Licuala scortechinii* Becc., Malesia 3: 192. 1889.— *L. delicata* Hodel, Palm J. 136: 11. 1997.

Distribution.— Peninsular Thailand to NW Peninsular Malaysia.

12. *Licuala spinosa* Thunb., Kongl. Vetensk. Acad. Nya. Handl. 3: 287. 1782.— *Corypha pilearia* Lour., Fl. Cochinch. 213. 1790.— *L. pilearia* (Lour.) Blume, Rumphia 2: 42. 1838.— *L. ramosa* Blume in J. J. Roemer & J. A. Schultes, Syst. Veg. 7: 1303. 1830.— *L. horrida* Blume, Rumphia 2: 39. 1838.— *L. spinosa* var. *brevidens* Becc., Malesia 3: 74. 1886.— *L. spinosa* var. *cochinchinensis* Becc., Malesia 3: 74. 1886.— *L. acutifida* var. *Peninsularis* Becc., Webbia 5:44. 1921.

Distribution.— China (Hainan), Indo-China to Philippines.

Vernacular name.— Ka pho (กะพ้อ), Ka pho nam (กะพ้อหนาม) (Central); Ka pho khiao (กะพ้อเขียว), Pho (พ้อ) (Peninsular); Ku-wa (กูวา) (Malay-Narathiwat).

Use.— Ornamental.

13. *Licuala triphylla* Griff., Calcutta J. Nat. Hist. 5: 332. 1844.— *L. ternata* Griff. ex Mart., Hist. Nat. Palm. 3 (ed. 2): 238. 1849.— *L. triphylla* var. *integrifolia* Ridl., Mat. Fl. Malay. Penins. 2: 164. 1907.— *L. filiformis* Hodel, Palm J. 134: 32. 1997.— *L. stenophylla* Hodel, Palm J. 137: 16. 1997.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

Vernacular name.— Ka pho nu (กะพ้อหนู) (Pattani); Ka pho nok aen (กะพ้อนกแอ่น), Pa-la ti-ku (ปาละติกู) (Malay-Pattani).

Use.— Ornamental.

18. LIVISTONA

R. Rr., Prodr. 267. 1810.— *Saribus* Blume, Rumphia 2: 48. 1838.— *Wissmannia* Burret, Bot. Jahrb. Syst. 73: 182. 1943.

Thirty-three species in NE Tropical Africa, S Yemen, Bangladesh to Japan and Australia. Two species in Thailand (Dowe 2001).

1. *Livistona jenkinsiana* Griff., Calcutta J. Nat. Hist. 5: 334. 1845.— *Saribus jenkinsii* (Griff.) Kuntze, Revis. Gen. Pl. 2: 736. 1891.— *Livistona jenkinsii* Griff. ex Mart., Hist. Nat. Palm. 3 (ed. 2): 242. 1849, orth. — *L. speciosa* Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 43(2): 204. 1874. *Saribus speciosus* (Kurz) Kuntze, Revis. Gen. Pl. 2: 736. 1891.

Distribution.— China (Yunnan) and Bhutan to Peninsular Malaysia.

Vernacular name.— Kho (ค้อ) (Northern, Prachuap Khiri Khan); Ko lae (ก้อแล) (Chiang Mai); Tho (ทอ) (Karen-Mae Hong Son); Nang klang chae (นางกลางแจ้), Ma ko suam (มะก้อซัวม), Ma ko daeng (มะก้อแดง) (Northern); Lo-la (โล๊ะละ), Lu-la (หลูล่า) (Karen-Mae Hong Son); Si reng (สีเหรง) (Pattani).

Use.— Leaves for thatch, trunk for house construction.

2. *Livistona saribus* (Lour.) Merr. ex A. Chev., Bull. Écon. Indochine, n. s., 21: 501. 1919.— *Chamaerops cochinchinensis* Lour., Fl. Cochinch. 2:657. 1790.— *Saribus cochinchinensis* (Lour.) Blume, Rumphia 2:48. 1838.— *Rhapis cochinchinensis* (Lour.) Mart., Hist. Nat. Palm. 3: 254. 1838.— *Livistona cochinchinensis* (Lour.) Mart., Hist. Nat. Palm. 3(ed. 2): 242. 1849.— *Corypha saribus* Lour., Fl. Cochinch. 212. 1790.— *Saribus hasseltii* Hassk., Flora 25 (Beibl. 2) 16. 1842.— *Livistona hasseltii* (Hassk.) Hassk. ex Miq., Palm. Archip. Ind. 14. 1868.— *L. spectabilis* Griff., Calcutta J. Nat. Hist. 5: 336. 1845.— *L. diepenhorstii* Hassk., Bonplandia 6:180. 1858.— *Pholidocarpus diepenhorstii* (Hassk.) Burret, Notizbl. Bot. Gart. Berlin-Dahlem 15:327. 1941.— *Livistona hoogendorpii* Teijsm. & Binn. ex Miq., Palm. Archip. Ind.: 14. 1868.— *Saribus hoogendorpii* (Teijsm. & Binn. ex Miq.) Kuntze, Revis. Gen. Pl. 2: 736. 1891.— *Sabal hoogendorpii* (Teijsm. & Binn. ex Miq.) L. H. Bailey, Standard Cycl. Hort. 6: 3045. 1917.— *Livistona inaequisecta* Becc., Philipp. J. Sci. 4: 616. 1909.— *L. vogamii* Becc., Webbia 5: 22. 1921.— *L. tonkinensis* Magalon, Contrib. Étude Palm. Indochine France. 54. 1930.— *L. fengkaiensis* X. W. Wei & M. Y. Xiao, J. S. China Agric. Coll. 8(1): 22. 1982.

Distribution.— SE China to Indo-China and Philippines.

Vernacular name.— Rok (ร็อก) (Trang); Chathang (จะพัง) (Surat Thani); Kho soi (ค้อสร้อย) (Bangkok).

Use.— Ornamental.

19. MAXBURRETIA

Furtado, Gard. Bull. Straits Settlement. 11: 240. 1941.— *Liberbaileya* Furtado, Gard. Bull. Straits Settlement. 11: 238. 1941.— *Symphyogyne* Burret, Notizbl. Bot. Gart. Berlin-Dahlem 15: 316. 1941. nom. illegit.

Three species, Peninsular Thailand to Peninsular Malaysia. One species in Thailand.

Maxburretia furtadoana J. Dransf., Gentes Herb. 11: 195. 1978.

Distribution.— Peninsular Thailand.

Vernacular name.— Mak phra rahu (หมากพระราหู) (Bangkok); Palm phra rahu (ปาล์มพระราหู) (Surat Thani).

Use.— Ornamental.

20. MYRIALEPIS

Becc. in Hook. f., Fl. Brit India 6: 480. 1893.— *Bejaudia* Gagnep., Notul. Syst. (Paris) 6: 149. 1937.

One species, Indo-China to Sumatra.

Myrialepis paradoxa (Kurz) J. Dransf., Kew Bull. 37: 242. 1982.— *Calamus paradoxus* Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 43(2): 213. 1874.— *Palmijuncus paradoxus* (Kurz) Kuntze, Revis. Gen. Pl. 2: 733. 1891.— *Plectocomiopsis paradoxus* (Kurz) Becc. in Hook.f., Fl. Brit. Ind. 6: 488. 1893.— *Myrialepis scortechinii* Becc. in Hook.f., Fl. Brit. Ind. 6: 480. 1893.— *Plectocomiopsis scortechinii* (Becc.) Ridl., Mat. Fl. Malay. Penins. 2: 213. 1907.— *P. annulatus* Ridl., Mat. Fl. Malay. Penins. 2: 213. 1907.— *P. floribundus* Becc., Webbia 3: 235. 1910.— *Myrialepis floribunda* (Becc.) Gagnep. in Lecomte, Fl. Gen. Indo-Chine 6: 1003. 1937.— *Bejaudia cambodiensis* Gagnep., Notul. Syst. (Paris) 6: 149. 1937.

Distribution.— Indo-China to Sumatra.

Vernacular name.— Wai kung (หว่ายกุ้ง) (Trang); Wai chang (หว่ายช้าง) (Peninsular); Lae-ka-yo (แลกาเยาะ) (Malay-Narathiwat).

Use.— Edible shoot.

21. NENGA

H. Wendl. & Drude, Linnaea 39: 182. 1875.

Five species, S Indo-China to W Malesia. Two species with one variety in Thailand.

1. Nenga macrocarpa Scort. ex Becc., Malesia 3: 180. 1889.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

Vernacular name.— Mak nga chang thon (หมากงาช้างโทน) (Narathiwat); Pi-nae-due-klong (ปีแนดืออกลง) (Malay-Narathiwat).

Use.— Ornamental.

2. *Nenga pumila* (Blume) H. Wendl. in O. C. E. de Kerchove de Denterghem, Palmiers 251. 1878.— *Areca nenga* Blume ex Mart., Hist. Nat. Palm. 3:179. 1838.— *Pinanga nenga* (Blume ex Mart.) Blume, Rumphia 2: 77. 1839.— *Ptychosperma nenga* (Blume ex Mart.) Teijsm. & Binn., Cat. Hort. Bot. Bogor. 69. 1866. — *Areca pumila* Blume, Rumphia 2: 71. 1839.— *Pinanga pumila* (Blume) Blume, Rumphia 2: 77. 1839.— *Nenga wendlandiana* Scheff., Ann. Jard. Bot. Buitenzorg 1: 153. 1876.— *Areca wendlandiana* (Scheff.) H. Wendl. in O. C. E. de Kerchove de Denterghem, Palmiers 332. 1878.

Distribution.— Peninsular Thailand to W Malesia.

2a. var. *pachystachya* (Blume) Fernando, Principes 27: 61. 1983.— *Pinanga nenga* var. *pachystachya* Blume, Rumphia 2: 78. 1839.— *Nenga intermedia* Becc., Ann. Jard. Bot. Buitenzorg 2: 81 1885.— *Nenga schefferiana* Becc., Ann. Jard. Bot. Buitenzorg 2: 81. 1885.— *N. wendlandiana* f. *hexapetala* Becc., Malesia 3: 183. 1889.— *N. wendlandiana* var. *malaccensis* Becc., Malesia 3: 182. 1889.

Distribution.— Peninsular Thailand to W Malesia.

Vernacular name.— Mak nga chang (หมากงาช้าง) (Trang); Mak khiao (หมากเขี้ยว) (Narathiwat); Pi-nae-lue-do (ปีแนลือดอ) (Malay-Narathiwat).

Use.— Ornamental.

22. NYPA

Steck, Sagu 15. 1757; cf. H. E. Moore Taxon 11: 164. 1962.— *Nipa* Thunb., Kongl. Vetensk. Acad. Nya Handl. 3: 231. 1782.

One species, Sri Lanka to Nansei-shoto and the Caroline Is.

Nypa fruticans Wurm., Verh. Batav. Genootsch. Kunsten. 1: 349. 1779.— *N. fruticans* (Wurm.) Thunb., Kongl. Vetensk. Acad. Nya Handl. 3: 231. 1782.— *Cocos nypa* Lour., Fl. Cochinch. 567. 1790.— *Nipa litoralis* Blanco, Fl. Filip. ed. I. 662. 1837.— *N. arborescens* Wurm. ex H. Wendl. in O. C. E. de Kerchove de Denterghem, Palmiers 252. 1878.

Distribution.— Sri Lanka to Nansei-shoto and Caroline Is.

Vernacular name.— Chak (จาก) (General); At-ta (อัดตะ) (Malay-Peninsular).

Use.— Multipurpose.

23. ONCOSPERMA

Blume, Rumphia 2: 96. t. 82, 103. 1843.— *Keppleria* Meisn., Pl. Vasc. Gen. 355. 1842, nom. illegit.

Five species, Sri Lanka to Philippines. Two species in Thailand.

1. *Oncosperma horridum* (Griff.) Scheff., Tijdschr. Ned.-Indië, 32: 191. 1871.—*Areca nibung* Mart., Hist. Nat. Palm. 3:173. 1838.—*A. horrida* Griff., Calcutta J. Nat. Hist. 5: 465. 1845.

Distribution.— Thailand to W Malesia and the Philippines.

Vernacular name.— Lao chaon khao (หลาวชะโอนเขา), Lao chaon pa (หลาวชะโอนป่า), Tanghan (ตังหัน), Tu ngan (ตุหัน) (Pattani); Krarian khao (กระเรียนเขา), Thu rang (ทุรัง) (Peninsular); Ba-ya (บายะห์), Ba-yai (บายไย) (Malay-Yala); Ba yai (บาใหญ่) (Krabi); Bo (บะ) (Yala).

Use.— Trunk for house construction.

2. *Oncosperma tigillarium* (Jack) Ridl., J. Straits Branch Roy. Asiat. Soc. 33: 173. 1864.—*Areca tigillaria* Jack, Malayan Misc. 2(7): 88. 1820.—*Kepleria tigillaria* (Jack) Meisn., Pl. Vasc. Gen. 355. 1842; Comm. 266: 355. 1842.—*Areca spinosa* Hasselt & Kunth, Enum. Pl. 3: 185. 1841.—*Euterpe filamentosa* Kunth, Enum. Pl. 3: 185. 1841.—*Oncosperma filamentosum* (Kunth) Blume, Rumphia 2: 97. 1843.—*O. cambodianum* Hance, J. Bot. 14: 261. 1876.—*Areca nibung* Griff. ex H. Wendl. in O. C. E. de Kerchove de Denterghem Palmiers: 231. 1878.

Distribution.— Peninsular Thailand to W Malesia.

Vernacular name.— Lao chaon (หลาวชะโอน), Chaon (ชะโอน), Lao chaon thung (หลาวชะโอนทุ่ง) (Peninsular); Ni-bong (นิบง) (Malay-Pattani).

Use.— Trunk for house construction.

24. ORANIA

Zipp., Alg. Konst-Lett.-Bode 1: 297. 1829.—*Macrocladus* Griff., Calcutta J. Nat. Hist. 5: 489. 1845.—*Sindroa* Jum., Ann. Inst. Bot.—Géol. Colon. Marseille, V, 1(1): 11. 1933.—*Halmoorea* J. Dransf. & N.W. Uhl, Principes 28: 164. 1984.

Eighteen species from Madagascar, Peninsular Thailand to New Guinea. One species in Thailand.

Orania sylvicola (Griff.) H. E. Moore, Principes 6: 44. 1962.—*Macrocladus sylvicola* Griff., Calcutta J. Nat. Hist. 5: 490. 1845.—*Orania macrocladus* Mart., Hist. Nat. Palm. 3(ed. 2). 186. 1845.

Distribution.— Peninsular Thailand to Sumatra.

Vernacular name.— Mak phon (หมากพน) (Peninsular).

Use.— Ornamental.

25. PHOENIX

L., Sp. Pl. 1188. 1753.— *Elate* L., Sp. Pl. 1189. 1753.— *Palma* Mill., Gard. Dict. Abr. ed. 4. 1754.— *Dachel* Adans., Fam. Pl. 2: 25. 1763.— *Phoniphora* Neck., Elem. Bot. 3: 302. 1790.— *Fulchironia* Lesch. in R. L. Desfontaines, Tabl. École Bot., ed. 3: 29. 1829.— *Zelonops* Raf., Fl. Tellur. 2: 102. 1837.

Fourteen species, Africa, Kriti to W and Central Malesia (Barrow, 1998). Three species with one variety in Thailand.

1. *Phoenix loureiroi* Kunth, Enum. Pl. 3: 257. 1841.— *P. humilis* var. *loureiroi* (Kunth) Becc., Malesia 3: 382. 1890.— *P. pusilla* Lour., Fl. Cochinch. 614. 1790, nom. illegit.— *P. pygmaea* Raeusch., Nomencl. Bot. ed. 3: 375. 1797, nom. invalid.— *P. hanceana* Naudin, J. Bot. 17: 174. 1879.— *P. humilis* var. *hanceana* (Naudin) Becc., Malesia 3: 392. 1890.— *P. humilis* Royle ex Becc., Malesia 3: 373. 1890, nom. illegit.— *P. hanceana* var. *formosana* Becc., Philipp. J. Sci. C 3: 339. 1908.

1a. var. *loureiroi*

Distribution.— Indo-China to S China and Philippines.

Vernacular name.— Palm sipsong panna (ปาล์มสิบสองปันนา) (Bangkok); Peng doi (เป็งค้อย) (Northern).

Use.— Ornamental.

2. *Phoenix paludosa* Roxb., Fl. Ind. ed. 3: 789. 1832.— *P. siamensis* Miq., Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk. 11(5): 14. 1868.— *P. andamanensis* W. Mill., J. sm. & N. Taylor in L. H. Bailey, Stand. Cycl. Hort. 5:2594. 1916, nom. invalid.

Distribution.— Assam to Sumatra and Peninsular Malaysia.

Vernacular name.— Peng thale (เป็งทะเล) (General).

Use.— Leaflet fibere for rope and thatch.

3. *Phoenix roebelenii* O'Brien, Gard. Chron., III, 6: 475. 1889.

Distribution.— China (Yunnan) to Indo-China.

Use.— Ornamental.

26. PHOLIDOCARPUS

Blume in J. J. Roemer & J. A. Schultes, Syst. Veg. 7: 1308. 1830.

Six species, Peninsular Thailand to Malesia. One species in Thailand.

Pholidocarpus macrocarpus Becc., Malesia 3: 92. 1886.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

Vernacular name.— Ka pao (กะปao) (Peninsular).

Use.— Ornamental.

27. PINANGA

Blume, Rumphia 2: 76. 1839.— *Cladosperma* Griff., Not. Pl. Asiat. 3: 165. 1851.— *Ophiria* Becc., Ann. Jard. Buitenzorg 2: 128. 1885.— *Pseudopinanga* Burret, Notizbl. Bot. Gart. Berlin-Dahlem 13: 188. 1936.

One hundred and twenty-eight species, Tropical and Subtropical Asia to NW Pacific. Fourteen species and two varieties found in Thailand.

1. *Pinanga adangensis* Ridl., J. Straits Branch Roy. Asiat. Soc. 61: 62. 1912.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

Vernacular name.— Mak adang (หมากอาดัง) (Trang).

Use.— Ornamental.

2. *Pinanga auriculata* Becc., Malesia 3: 134. 1886.

Distribution.— Myanmar to Borneo.

2a. var. *leucocarpa* C. K. Lim, Gard. Bull. Singapore 50: 93. 1998.— *Pinanga bowiana* Hodel, Palm J. 134: 35. 1997.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

Vernacular name.— Mak bala (หมากบาลา) (Narathiwat).

2b. var. *merguensis* (Becc.) C. K. Lim, Gard. Bull. Singapore 50: 89. 1998.— *Pinanga patula* var. *merguensis* Becc., Atti Soc. Tosc. Sci. Nat. Pisa Processi Verbali 44: 125. 1934.

Distribution.— Myanmar to Peninsular Malaysia.

3. *Pinanga badia* Hodel, Palm J. 136: 16. 1997.

Distribution.— Peninsular Thailand.

Vernacular name.— Mak khao (หมากเข่า) (Narathiwat).

4. *Pinanga disticha* (Roxb.) H. Wendl. in O. C. E. de Kerchove de Denterghem Palmiers 253. 1878.— *Areca disticha* Roxb., Fl. Ind. ed. 3: 620. 1832.— *Seaforthia disticha* (Roxb.) Mart., Hist. Nat. Palm. 3: 184. 1838.— *Ptychosperma distichum* (Roxb.) Miq., Fl. Ned. Ind. 3: 28. 1855.— *Pinanga bifida* Blume, Rumphia 2: 92. 1839.— *Areca curvata* Griff., Ic. Pl. Asiat. 3: t. 248. 1851.— *Pinanga curvata* (Griff.) Becc., Malesia 3: 128. 1886.— *Areca humilis* Roxb. ex H. Wendl. in O. C. E. de Kerchove de Denterghem, Palmiers 231. 1878.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

Vernacular name.— Mak wing (หมากหวิง) (Pattani, Yala); Ri-a-su (รีอาซู) (Malay-Narathiwat); Mak che (หมากเจ), Che hang pla (เจหางปลา) (Bangkok).

Use.— Ornamental.

5. *Pinanga fractiflexa* Hodel, Palm J. 136: 19. 1997.

Distribution.— Peninsular Thailand.

6. *Pinanga malaiana* (Mart.) Scheff., Tijdschr. Ned. -Indië 32: 175. 1871.— *Seaforthia malaiana* (Griff.) Mart., Hist. Nat. Palm. 3: 184. 1838.— *Areca malaiana* (Mart.) Griff., Calcutta J. Nat. Hist. 5: 457. 1845.— *Ptychosperma malaianum* (Mart.) Miq., Fl. Ned. Ind. 3: 25. 1855.— *Areca haematocarpon* Griff., Not. Pl. Asiat. 3: 165. 1851.

Distribution.— Peninsular Thailand to Sumatra.

Vernacular name.— Mak nga chang yak (หมากงช้างยักษ์), Mak bala (หมากบาลา) (Narathiwat).

7. *Pinanga paradoxa* (Griff.) Scheff., Tijdschr. Ned. -Indië 32: 179. 1871.— *Areca paradoxa* Griff., Calcutta J. Nat. Hist. 5: 463. 1845.— *Kentia paradoxa* (Griff.) Mart., Hist. Nat. Palm. 3: 312. 1849.— *Nengella paradoxa* (Griff.) Becc., Malesia 1: 32. 1877.— *Ophiria paradoxa* (Griff.) Becc., Ann. Jard. Bot. Buitenzorg 2: 128. 1885.— *Areca curvata* Griff., Not. Pl. Asiat. 3: 164. 1851.— *Pinanga curvata* (Griff.) Becc., Malesia 3: 128. 1886.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

Vernacular name.— Mak che daeng (หมากเจแดง) (Nakhon Si Thammarat).

Use.— Ornamental.

8. *Pinanga perakensis* Becc., Malesia 3: 175. 1889.— *P. densifolia* Ridl., J. Fed. Malay States Mus. 4: 85. 1909.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

Vernacular name.— Che lueang (เจเหลื่อง) (Peninsular).

9. *Pinanga polymorpha* Becc., Malesia 3: 172. 1889.— *P. robusta* Becc. in Hook. f. Fl. Brit. India 6: 408. 1892.— *P. brewsteriana* Ridl., J. Fed. Malay States Mus. 6: 188. 1915.— *P. glaucescens* Ridl., J. Straits Branch Roy. Asiat. Soc. 86: 311. 1922.— *P. wrayi* Furtado, Repert. Spec. Nov. Regni Veg. 35: 276. 1934.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

Vernacular name.— Mak chae (หมากแจ้), Che sam hang (เจสามหาง) (Narathiwat).

10. *Pinanga riparia* Ridl., J. Straits Branch Roy. Asiat. Soc. 44: 201. 1905.— *P. patula* var. *riparia* (Ridl.) Becc., Nuovo. Giorn. Bot. Ital., n. s., 42: 71. 1935.

Distribution.— Peninsular Thailand to Sumatra.

Vernacular name.— Mak ling (หมากลิง), Chae (แจ) (Narathiwat); Mu-reng (มูเร้ง) (Malay-Narathiwat).

Use.— Ornamental.

11. *Pinanga scortechinii* Becc., Malesia 3: 170. 1889.— *P. fruticans* Ridl., Fl. Malay. Penins. 5: 9. 1925.

Distribution.— Thailand to Peninsular Malaysia.

Vernacular name.— Mak indonesia (หมากอินโดนีเซีย) (Trang); Mak nga chang khao (หมากงช้างเขา) (Narathiwat).

12. *Pinanga simplicifrons* (Miq.) Becc., Malesia 3: 124. 1885.— *Ptychosperma simplicifrons* Miq., Fl. Ned. Ind., Eerste Bijv. 590. 1861.

Distribution.— Peninsular Thailand to Sumatra.

Vernacular name.— Mak che bala (หมากเจบาลา), Che hang pla bai diao (เจหางปลาใบเดียว) (Narathiwat).

13. *Pinanga sylvestris* (Lour.) Hodel, Palm J. 139: 55. 1998.— *Areca sylvestris* Lour., Fl. Cochinch. 2: 568. 1790.— *Seaforthia sylvestris* (Lour.) Blume ex Mart., Hist. Nat. Palm. 3: 185. 1838.— *Ptychosperma sylvestris* (Lour.) Miq., Fl. Ned. Ind. 3: 22. 1855.— *Pinanga cochinchinensis* Blume, Rumphia 2: 85. 1839.— *Ptychosperma cochinchinense* (Blume) Miq., Fl. Ned. Ind. 3: 23. 1855.

Distribution.— Indo-China.

14. *Pinanga watanaiana* C. K. Lim, Principes 42: 116. 1998.

Distribution.— Thailand.

28. PLECTOCOMIA

Mart. & Blume in J. J. Roemer & J. A. Schultes, Syst. Veg. 7(2): 1333. 1830.

Sixteen species, E Himalaya to Hainan and Malesia. Four species in Thailand.

1. *Plectocomia elongata* Mart. & Blume in J. J. Roemer & J. A. Schultes, Syst. Veg. 7: 1333. 1830.— *Rotang maximus* Baill., Hist. Pl. 13: 300. 1895.— *Calamus maximus* Reinw. ex Schult. f. in J. J. Roemer & J. A. Schultes, Syst. Veg. 7: 1333. 1830.— *Plectocomia sumatrana* Miq., Fl. Ned. Ind., Eerste Bijv. 592. 1861.— *Plectocomia*

ichthyospinus auct., Gard. Chron. 5: 735. 1876.— *P. hystrix* Linden, Ill. Hort. 28: 32. 1881, synonym. provis.— *P. maxima* Kuntze, Revis. Gen. Pl. 2: 734. 1891, nom. nud.— *P. griffithii* Becc. in Hook. f., Fl. Brit. India 6: 478. 1893.— *P. elongata* var. *bangkana* Becc., Ann. Roy. Bot. Gard. (Calcutta) 12(2): 26. 1918.— *P. crinita* Gentil ex Chitt., Dict. Gard. 1605. 1956.

Distribution.— Thailand to W Malesia.

Vernacular name.— Wai kam phot (หวายกำพวด), Wai tao phro (หวายเต่าพระ), Wai tong phlong (หวายโด่งโพล่ง) (Peninsular); Wai pu chao (หวายปู่เจ้า) (Nakhon Si Thammarat).

2. *Plectocomia himalayana* Griff., Calcutta J. Nat. Hist. 5: 100. 1845.— *P. montana* Griff. ex T. Anderson, J. Linn. Soc., Bot. 11: 12. 1871.— *P. montana* Hook.f. & Thomson, Fl. Brit. India 6: 478. 1893, nom. invalid.

Distribution.— E Himalaya to N Laos.

3. *Plectocomia kerriana* Becc., Ann. Roy. Bot. Gard. (Calcutta) 12(2): 41. 1918.

Distribution.— China (S Yunnan) to N Thailand.

4. *Plectocomia pierreana* Becc. Webbia 3: 236. 1910.— *P. cambodiana* Gagnep. ex Humbert, Notul. Syst. (Paris) 6: 157. 1937.— *P. barthiana* Hodel, Palm J. 139: 54. 1998.

Distribution.— Indo-China.

29. PLECTOCOMIOPSIS

Becc. in Hook.f., Fl. Brit. India 6: 479. 1893.

Five species, Indo-China to W Malesia. Two species in Thailand.

1. *Plectocomiopsis geminiflora* (Griff.) Becc. in Hook.f., Fl. Brit. India 6: 479. 1893.— *Calamus geminiflorus* Griff., Palms Brit. E. Ind. 70. 1850.— *Plectocomia geminiflora* (Griff.) H. Wendl. in O. C. E. de Kerchove de Denterghem, Palmiers 254. 1878.— *Calamus turbinatus* Ridl., Mat. Fl. Malay. Penins. 2: 212. 1907.— *Plectocomiopsis geminiflora* var. *billitonensis* Becc., Ann. Roy. Bot. Gard. (Calcutta) 12(2): 51. 1918.— *P. geminiflora* var. *borneensis* Becc., Ann. Roy. Bot. Gard. (Calcutta) 12(2): 53. 1918.

Distribution.— Indo-China to W Malesia.

Vernacular name.— Wai kung nam phrai (หวายกึ่งน้ำพราย) (Trang); Wai khi re (หวายเขียว) (Surat Thani); Wai daeng (หวายแดง) (Peninsular).

2. *Plectocomiopsis wrayi* Becc. in Hook. f., Fl. Brit. India 6: 488. 1893.— *P. dubia* Becc., Ann. Roy. Bot. Gard. (Calcutta) 12(2): 56. 1918.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

Vernacular name.— Wai daeng (หวายแดง) (Narathiwat); Lae-mae ka-yo (แลแมกกาเี่ยว) (Malay-Narathiwat).

30. RHAPIS

L. f. in W. Aiton, Hort. Kew. ed. I. 3: 473. 1789.

Eight species, S China to Indo-China. Two species in Thailand.

1. *Rhapis laosensis* Becc., Webbia 3: 225. 1910.

Distribution.— E Thailand to Vietnam.

Vernacular name.— Chang (จิ้ง), Sang (สัง) (North-eastern).

Use.— Ornamental.

2. *Rhapis subtilis* Becc., Webbia 3: 227. 1910.— *R. siamensis* Hodel, Palm J. 136: 19. 1997.

Distribution.— Indo-China.

Vernacular name.— Chang thai (จิ้งไทย), Chang tai (จิ้งใต้) (Central).

Use.— Ornamental.

31. SALACCA

Reinw., Syll. Ratisb. 2: 3. 1828.— *Salakka* Reinw. ex Blume, Catalogus 112. 1823, orth. var.— *Zalacca* Rumph. ex Blume in J. J. Roemer & J. A. Schultes, Syst. Veg. 7: 1333. 1830, orth. var.— *Lophospatha* Burret, Notizbl. Bot. Gart. Berlin-Dahlem 15: 752. 1942.

Twenty species, Assam to S Central China and W Malesia. Four species in Thailand.

1. *Salacca glabrescens* Griff., Calcutta J. Nat. Hist. 5: 14. 1845.

Distribution.— Peninsular Thailand to Peninsular Malaysia.

Vernacular name.— Sala thai (สละไทย), Sala (สละ) (Narathiwat).

2. *Salacca secunda* Griff., Calcutta J. Nat. Hist. 5: 12. 1845.

Distribution.— India (Assam) to S central China.

Vernacular name.— Tong nam (ตองหนาม) (Mae Hong Son); Ko-ho (กะฮ้อ, ก่อเฮาะ) (Karen-Mae Hong Son).

Use.— Edible heart or cabbage.

3. *Salacca stolonifera* Hodel, Palm J. 134: 35. 1997.

Distribution.— Peninsular Thailand.

Vernacular name.— La kam khao (ละกำขาว), Sala khao (สละขาว) (Peninsular).

4. *Salacca wallichiana* Mart., Hist. Nat. Palm. 3: 201. 1838.— *Calamus zalacca* Roxb., Fl. Ind. ed. 3: 773. 1832.— *Salacca macrostachya* Griff., Calcutta J. Nat. Hist. 5: 13. 1845.— *S. beccarii* Hook.f., Fl. Brit. Ind. 6: 474. 1893.

Distribution.— Indo-China to Sumatra.

Vernacular name.— Rakam (ระกำ) (General); Cho-la-ka (เจาะละกำ) (Chong-Trat).

Use.— Edible fruits.

32. TRACHYCARPUS

H. Wendl., Bull. Soc. Bot. France 8: 429. 1861.

Eight species, Himalaya to S central China. One species in Thailand.

Trachycarpus oreophilus Gibbons & Spanner, Principes 41: 205. 1997.

Distribution.— N Thailand (Gibbons & Spanner 1997).

Vernacular name.— Kho doi (ก่อดอย), Kho Chiang Dao (ก่อเชียงดาว) (Chiang Mai).

33. WALLICHIA

Roxb., Pl. Coromandel 3: 91. 1820.— *Harina* Buch.-Ham., Mem. Wern. Nat. Hist. Soc. 5: 317. 1826.— *Wrightea* Roxb., Fl. Ind. ed. 3: 621. 1832.— *Asraoa* J. Joseph, Bull. Bot. Surv. India 14: 144. 1972 publ. 1975.

Nine species, Himalayas to S China. Three species in Thailand.

1. *Wallichia disticha* T. Anderson, J. Linn. Soc., Bot. 11: 6. 1871.— *Didymosperma distichum* (T. Anderson) Hook.f., Kew Rep. 1882: 61. 1884.— *Wallichia yomae* Kurz., Forest Fl. Burma 2: 533. 1877.

Distribution.— E Himalaya to China (Yunnan).

Vernacular name.— Mak na re suan (หมากนเรศวร) (Bangkok); Khueang bai khanang (เขื่องใบขนาง), Khueang phat (เขื่องพัด) (Central).

Use.— Ornamental.

2. *Wallichia marianniae* Hodel, Palm J. 137: 8. 1997.

Distribution.— SW & Peninsular Thailand.

3. *Wallichia siamensis* Becc., Atti Soc. Tosc. Sci. Nat. Pisa Processi Verbali 44: 175. 1934.

Distribution.— China (Yunnan) to N Thailand.

Vernacular name.— Khueang (เขือง) (Chiang Mai); Khi nang (ขี้หนาง) (Northern);

Tao rang nu (เต่าร้างหนู) (Bangkok).

Use.— Ornamental.

EXOTIC PALMS COMMONLY CULTIVATED IN THAILAND

FRUIT TREES AND OIL CROPS

Areca catechu, Betelnut Palm

Arenga pinnata, Sugar Palm

Cocos nucifera, Coconut Palm

Elaeis guineensis, African Oil Palm

Salacca zalacca, Salak Palm

STARCH TREES

Metroxylon sagu, Sago Palm

ORNAMENTALS

Actinorhynchus calapparia

Licuala grandis, Parasol Palm

Livistona rotundifolia, Foot Stool Palm

Livistona chinensis, Chinese Fan Palm

Corypha umbraculifera, Talipot Palm

Rhapis excelsa, Lady Palm

Rhapis humilis

Dypsis lutescens, Golden Cane Palm

Dypsis decaryi, Triangle Palm

Wodyetia bifurcata, Foxtail Palm

Bismarckia nobilis, Bismark Palm

Latania loddigesii, Blue Latan Palm

Acoelorrhaphe wrightii, Paurotis Palm

Sabal spp., Palmetto palms

Adonidia merrillii (syn. *Veitchia merrillii*),
Christmas Palm

Carpentaria acuminata

Ptychosperma macarthurii, Macarthur Palm

Roystonea regia, Cuban Royal Palm

Pritchardia pacifica, Fiji Fan Palm

REFERENCES

- Barfod, A. S. & Saw, L. G. 2002. The genus *Licuala* (Arecaceae, Coryphoideae) in Thailand. Kew Bulletin 57: 827–852.
- Barrow, S. 1998. A monograph of *Phoenix* L. (Palmae: Coryphoideae). Kew Bulletin 53: 513–575.
- Dransfield, J. 2000. Palm literature. Review of The Palms and Cycads of Thailand. Ed. by Donald R. Hodel. Palms 44(2): 98–100.
- . 2000. *Calamus griseus* (Arecaceae), a new species of rattan from Peninsular Thailand, Malaysia and Sumatra. Thai Forest Bulletin (Botany) 28: 157–159.
- Dowe, J. 2001. Studies in the genus *Livistona* (Coryphoideae: Arecaceae). Ph.D. thesis. School of Tropical Biology, James Cook University, Townsville.
- Evans, T. D., Sengdala, K., Viengkham, O. V., Thammavong, B. & Dransfield, J. 2000. Four new species of *Calamus* (Arecaceae: Calamoideae) from Laos and Thailand. Kew Bulletin 55: 929–940.

- Evans, T. D. et al. 2001. *Calamus pauciflorus* T. Evans et al. non Ridl. renamed *Calamus oligistachys* T. Evans et al. Kew Bulletin 56(1): 242.
- Evans, T. D. 2002. A new species of *Calamus* (Arecaceae: Calamoideae) from north-east Thailand. Kew Bulletin 57(1): 85–90.
- FAO. 1995. Tropical Palms. Non-Wood Forest Products 10. Retrieved June 2, 2003, from <http://www.fao.org/docrep/X0451E/x0451e00.htm>.
- Gibbons, M. & Spanner, T. W. 1997. *Trachycarpus oreophilus*—the Thailand Trachycarpus. Principes 41 (4): 201–207.
- Hodel, D. R. 1997a. New species of palms from Thailand. Palm Journal 134: 28–37.
- _____. 1997b. New species of palms from Thailand, Part II. Palm Journal 136: 7–20.
- _____. 1998. Two new giant *Caryota* and additional new species of palms from Thailand. Palm Journal 139: 50–56.
- Hodel, D. R. & Vatcharakorn, P. 1998. The palms of Thailand. In: Hodel, D. R. (ed.), The palms and Cycads of Thailand, pp 1–177. Kampon Tansacha, Nong Nooch Tropical Garden, Thailand.
- Lim C. K. 1998. Notes on recent palm species and records from Peninsular Thailand. Principes, 42(2): 110–119.
- Smitinand, T. 2001. Thai Plant Names (Revised Edition). The Forest Herbarium, Royal Forest Department. Bangkok. 812 pp.

Notes on *Dendrocalamus longifimbriatus* (Poaceae-Bambusoideae) from Myanmar

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ABSTRACT. *Dendrocalamus longifimbriatus* Gamble was described based on material with mixed elements. The flowering branches resemble young inflorescences of *Dendrocalamus membranaceus* Munro and the leafy branches belong to a different genus. Accordingly, *D. longifimbriatus* is typified by the flowering branches. That name is also a synonym of *D. membranaceus* Munro.

Gamble (1896) described *Dendrocalamus longifimbriatus* based on poorly documented specimens. There are four mounted specimens consisting of two flowering branches and two leafy branches, all of which make up the original material for Gamble's description. Proper labels are lacking, but there is a piece of paper with Burmese letters and the date 1/11/1891; there is no mention of a collector's name or a number. Gamble mentioned that the specimens were sent from the Kyaukshat and Maliwón forest at the extreme south of the Mergui District, Tenasserim, Myanmar. The specific name alludes to the large auricle of the leaf-blade.

In these two flowering branches, pseudospikelets are present, which are arranged in a fascicle at each node of the main or branch axes. Thus the inflorescence is indeterminate. Gamble stated that the inflorescence is too young for very accurate description, but that it comes near to *Dendrocalamus longispathus* Gamble.

After careful examination of the flowering parts, it seems that the inflorescence and its spikelet resemble those of *Dendrocalamus membranaceus* Munro. The pseudospikelet unit has two florets; the upper floret is perfect, the lower is often imperfect; the ovary has a swollen, minutely pubescent apex and a long style with one stigma.

The leafy branches match those of the bamboo collected by Parker (*Parker* 2733), and by Sukos (*Sukos* 7659) from the same region, which are terminated by inflorescences, apparently resembling those of *Neohouzeoua* A. Camus (Dransfield et al., 2003). The inflorescences of *Parker* 2733 and *Sukos* 7659 are totally different from those in the flowering specimens of *D. longifimbriatus*. Thus there is no doubt that *D. longifimbriatus* is based on a mixed collection. Here we select the flowering branches as lectotype material for the name *D. longifimbriatus*, and also accordingly reduce *D. longifimbriatus* to the synonymy of *D. membranaceus*.

Stapleton & Xia (1997) transferred *D. membranaceus* to *Bambusa* on the grounds that the leaf-blades are small and prophylls in the inflorescence are two-keeled. However, the structure of the pseudospikelet unit was not fully discussed. The authors did not mention to which species of *Bambusa* the new combination is related or resembles,

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but it is compared with *B. bambos*. *Dendrocalamus membranaceus*, however, is distantly related to *B. bambos*. In Wallich Cat. 5029 (type of *D. membranaceus*) the spikelet comprises two perfect florets lacking an uppermost vestigial floret, and the ovary has a swollen hairy apex and a long style with one stigma (undivided), two of the characters found in species of *Dendrocalamus* allied closely to the type species, *D. strictus* (Holtum 1956, 1958; Wong, 1995). In *Bambusa bambos*, as in other *Bambusa* species, the spikelets consist of 4–6 florets with a vestigial uppermost floret; the ovary has short style with three plumose stigmas.

Dendrocalamus membranaceus is not the only species in the genus possessing small leaf-blades; *D. elegans* (Ridl.) Holtum, found on limestone hills in Peninsular Malaysia and southern Thailand, also has small leaf-blades. The size of the leaf-blades cannot be used to differentiate *Dendrocalamus* from *Bambusa*, although on occasion it is useful when combined with other characters.

Elucidation of prophyll structure in Stapleton & Xia (1997), in particular that *Bambusa* can be separated from *Dendrocalamus* by the broad, 2-keeled prophyll subtending the synflorescence, may require further substantiation. In this matter, it is important that old, dried material be assessed in relation to fresh material of both genera from field studies. Given the homology between this prophyll and the prophyll subtending the branch complement at culm nodes, marked variation is not expected to occur between *Bambusa* and *Dendrocalamus* which, indeed, do belong to the same group of genera. As far as reported, no careful study of this has been carried out that is mindful of pseudospikelet and flower characters delimiting core alliances around each genus.

Branches at a mid-culm node are typical of a bamboo genus or groups of allied genera. In the closely related genera, *Bambusa*, *Dendrocalamus* and *Gigantochloa*, branches at mid-culm node comprise a dominant middle branch and two to several secondary branches. Stapleton & Xia (1997) state that branches in *Bambusa bambos* and *Bambusa (Dendrocalamus) membranaceus* are uniform. The branches at mid-culm are in fact not uniform in size, the central or primary axis being typically dominant (Soderstrom & Ellis, 1988; Wong, 1995 a & b; pers. obs.).

Therefore *Dendrocalamus membranaceus* is indeed a species of *Dendrocalamus* and should not have been transferred to *Bambusa*.

Dendrocalamus membranaceus Munro in Trans. Linn. Soc. London 26: 149 (1868).— *Bambusa membranacea* (Munro) Stapleton & N. H. Xia, Kew Bull. 32: 235–238. 1997. Type: Myanmar, Wallich Cat. 5029 (lectotype K!, selected by Stapleton & Xia, 1997).— *Dendrocalamus longifimbriatus* Gamble in Ann. Roy. Bot. Calcutta 7: 92–93, Pl. 71. 1896, **synon. nov.** Type: Myanmar, Milwon Forest, flowering branches only, *unknown collector* s.n. (lectotype K!, selected here).

Thailand.— Kanchanaburi, Sisawat, alt. 100 m, fl., 15 Jan. 1926, *Kerr* 10199 (K); Phrae, alt. 700 m, fl., 9 Jan. 1972, *Beusekom et al.* 4764 (BKF, K, L.); Mae Sariang, sterile, 27 Oct. 1997, *Dransfield et al.* SD1446 (BKF, K).

Laos.— Between Ban Thalut and the dam Nam Ngun Reservoir, sterile, 29 Oct. 1974, *Soderstrom* 2088 (K, US).

Myanmar (Burma).— Tharawaddy, Gamon-Minhla watershed, alt. 230 m, fl., 3 March, 1911, *Rogers* 45 (K); l.c., Gamon Reserve, alt. 150 m, fl., 3 March 1911, *Rogers* 46 (K).

REFERENCES

- Dransfield, S., Pattanavibool, R., & Sungkaew, S. 2003. Two new species of *Neohouzeoua* (Gramineae-Bambusoideae) from Thailand and Myanmar. *Thai Forest Bulletin (Botany)* 31: 27–33.
- Holttum, R. E. 1956. The classification of bamboos. *Phytomorphology* 6 (1): 73–90.
- . 1958. The bamboos of the Malay Peninsular. *Gardens Bulletin Singapore* 16: 1–135.
- Soderstrom, T. R. & Ellis, R. P. 1988. The Woody Bamboos (Poaceae: Bambuseae) of Sri Lanka: A morphological-anatomical Study. *Smithsonian Contributions to Botany*, 72: 1–75.
- Wong, K. M. 1995a. The bamboos of Peninsular Malaysia. *Malaysian Forest Records* no. 41. 199 pp.
- . 1995b. The morphology, anatomy, biology and classification of Peninsular Malaysian bamboos. *University of Malaya Botanical Monographs* No 1. 189 pp.

The genus *Trichosanthes* L. (Cucurbitaceae) in Thailand

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ABSTRACT. *Trichosanthes* (Cucurbitaceae) in Thailand comprises 17 species, seven of which have been described as new here: *T. dolichosperma* Duyfjes & Pruesapan, *T. erosa* Duyfjes & Pruesapan, *T. inthanonensis* Duyfjes & Pruesapan, *T. kostermansii* Duyfjes & Pruesapan, *T. pallida* Duyfjes & Pruesapan, *T. phonsenae* Duyfjes & Pruesapan, and *T. siamensis* Duyfjes & Pruesapan. Two new subspecific entities have been described: *T. pubera* Blume subsp. *rubriflos* (Cayla) Duyfjes & Pruesapan var. *fissisepala* Duyfjes & Pruesapan, and *T. tricuspidata* Lour. subsp. *javanica* Duyfjes & Pruesapan. A key to taxa, descriptions with distributional and ecological data and illustrations are presented.

INTRODUCTION

The results of the present revision of *Trichosanthes* will form part of the forthcoming treatment of the family Cucurbitaceae for the Flora of Thailand. *Trichosanthes* is an Asian genus, extending eastward to Australia. Within the Cucurbitaceae of Thailand, as well as for the whole of Southeast Asia, it is the largest genus, with 17 species in Thailand, and more than 100 species in all. It is a difficult genus, not because the species are unclear, but the herbaria materials are generally insufficient because the species are dioecious, the fragile corollas which bloom at night are difficult to collect, to preserve and to study, and the fruiting collections (fruits are quite often collected) at first sight show little relation to the flowering specimens.

Trichosanthes is known as medicinal, and has recently received comparatively much taxonomic attention in China (Yueh & Cheng, 1974, 1980). The genus has been revised for India by Chakravarty (1959), for Cambodia, Laos and Vietnam by Keraudren (1975), and for the Malesian area by Rugayah & De Wilde (1997, 1999) and Rugayah (1999).

Through intensified field collecting focused on Cucurbitaceae in Thailand several new records and new species could be added. Craib (1931) listed 13 species but several of these had to be relegated into synonymy or to a different genus. In Thai Plant Names (Smitinand 1980, 2001) five and seven species were accepted, respectively.

Trichosanthes specimens are not difficult to recognise in the field; they are climbers with a stoutish habit, mostly branched tendrils, distinctly fringed petals (which they share e.g. with *Hodgsonia*), and often brightly coloured fruits, the size of a hen's or

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goose's egg. Some general morphology of *Trichosanthes*, with emphasis on characters to be used in the determination of the species, is given below. With the treatment of the species, specimens are only cited when few specimens for Thailand are known; for other specimens one is referred to the identification list.

Subdivision of *Trichosanthes*

Trichosanthes, in subfamily Cucurbitoideae, is the largest genus in the family. It has a wide genus concept and comprises more than 100 species in (sub)tropical Asia, to the east as far as (sub)tropical Australia and the Pacific. Centres of species diversity are China and Malesia. For Malesia, Rugayah & De Wilde (1999) and Rugayah (1999) largely followed the subdivision of the genus as proposed by Jeffrey (1980) and some Chinese authors (Yueh & Cheng, 1974) for China, based primarily on characters of the male bracts, and the seeds. The 17 species in Thailand do not allow for original research on the subdivision of the genus, but a survey of their characters made it clear that the species cannot easily be placed in the sections as previously proposed by Yueh & Cheng (1974), Huang et al. (1998) or Rugayah (1999). We are of the opinion that new research comprising all species over the whole range of the genus is needed to arrive at a satisfactory division.

Pruesapan & Van der Ham (in press) investigated pollen of some 40 species, including those of Thailand, and found some resemblance with the existing subdivisions.

CHARACTERS USED IN THE KEY TO THE SPECIES AND IN THE DESCRIPTIONS OF THE SPECIES

Habit

The observation of living plants in the field is useful for the assessment of various aspects of the habit of *Trichosanthes* because these aspects may be not clear from the herbarium specimens. Most species are perennial climbers, often with tuberous roots, and some are annual. Perennial female plants frequently die after fruiting (monocarpous), but new shoots may be produced by the tubers in some species.

Sexual condition

Whether a species is monoecious or dioecious can be determined by the presence of male flowers as well as female flowers or fruits on the same herbarium specimen, or preferably by observing living plants. In other genera it may be variable but in *Trichosanthes* most species are dioecious, and only some are monoecious, e.g. *T. cucumerina* and possibly *T. siamensis*.

Indumentum, colour

Trichosanthes species are variously hairy, some are conspicuously villose or strigose, but most are subglabrous or glabrescent when the hairs disappear with age. The hairs may be grey or brown. Most species have a whitish (or black or brown), chalky punctation (cystoliths) originating from hair scars or hair bases, especially on the upper leaf surface, rendering the leaves scabrid. White cystoliths may also occur on stem, petiole and nerves of lower leaf surface in several species. The leaf-bearing stem is greenish, but in some species it is conspicuously red-tinged, a diagnostic character.

Stem

Stem thickness is rather typical for the species and measured in the leafy twigs.

Tendrils

At variance with other scandent-climbing plant families, Cucurbitaceae bear a tendril on each node, and the tendril is never (at least not in subfamily Cucurbitoidae) truly axillary, nor opposite the leaf, but always at some angle with the leaf-petiole. The node, bearing a leaf, a lateral tendril and, when fertile, a flower or an inflorescence, and often a lateral vegetative shoot is very characteristic for Cucurbitaceae, an assemblage which can be called the nodal syndrome (Rugayah & De Wilde, 1997). The morphological origin of the tendril is unknown. In subfamily Cucurbitoidae, to which *Trichosanthes* belongs, the predominantly branched tendrils became spiralling only above the point of branching; the number of branches may be specific. In a few species the tendril is unbranched.

Leaves

Leaves provide various useful characters. In *Trichosanthes* the leaves may be palmately compound (with petiolulate leaflets) or simple, with the blade either entire or variously (deeply) lobed. The lobing may be variable within a species. Hairiness and size, number and situation of glands on the lower surface may provide good characters. Leaves of juvenile plants may be greatly different from those of adult plants. The leaves of juvenile specimens of *T. tricuspidata* and related species are much dissected and look the same.

Probracts

These are nearly always present in *Trichosanthes*, one at each node, and their shape, consistency and presence or absence of glands provide good characters. Characters of the probract have been neglected by most previous authors. The probract can best be seen on young shoots. They can be conspicuous, linear-lanceolate, ovate, concave or flat, or they can be small and caducous; they are absent in some species. The morphological origin of the probract is unknown.

Inflorescences

In the dioecious species of *Trichosanthes*, male flowers are either solitary, or usually arranged into a peduncled bracteate raceme, often with a single male flower co-axillary. Female flowers develop singly at the node. In monoecious plants female flowers can be found singly at the nodes or singly (and developing previously) beside the male raceme; female flowers usually develop later than male flowers. In some species an elongated or straw-like appendage can be found at the node beside the male raceme; it represents the pedicel of an undeveloped or earlier developed single flower.

Peduncle, rachis and bracts.— The peduncle may be slender or (very) stout, and in older male inflorescences the rachis may be thickened, bearing persistent old bracts and pedicels or pedicel scars. In some species (not in Thailand) the rachis is zig-zag.

Bracts can be persistent or caducous, either placed on the rachis or in some species higher-up on the pedicels. They are very different in size, shape and consistency, varying from linear to obovate or rhomboid with the margin entire, dentate or lacinate, glabrous or sparsely to densely hairy, and with or without glands.

Flowers

The flowers, as in most Cucurbitaceae, are unisexual. In most species of *Trichosanthes*, the flowers are (partly) nocturnal, they open in the late afternoon or at night and close before sunrise when the corollas can be found fallen on the ground, but some species e.g. *T. cucumerina* are largely diurnal with flowers open at daytime. The flowers are mostly white, showy and large, possibly pollinated by moths. The perianths of male and female flowers are generally similar.

In the present study, detailed characteristics of the flowers are left out, because of the incomplete material available. Moreover, the flowers are very fragile, and not easy to analyse from boiled dry material.

Pedicel.— The pedicel is mostly persistent, articulate with the flower at the apex. The pedicel of a solitary male or female flower is much longer than the pedicel of flowers in a raceme.

Receptacle tube.— The receptacle is of a tubular shape, widened towards the apex, usually with white (long) hairs inside. In some species, e.g. *T. villosa*, and *T. phonsenae*, the receptacle tube of the male flowers forms a pseudo-ovary, the swollen base of the tube, which contains disk-like structures.

Sepals.— The five sepals are free, narrowly triangular, ovate, narrowly ovate, or narrowly elliptic with a long-acute apex; the margin is entire or dentate or (coarsely) lacinate or lobed. These characters are of important taxonomic value, but one should be aware that in some species the sepals of female flowers are entire, whereas in male flowers they are dentate or lancinate.

Corolla.— The colour of the five petals is white, in some species pinkish(-red) or only the veins or the threads are reddish; the throat of the corolla is often yellow. The petals have long (rarely short) filiform threads or dissections on the margin (fimbriate), with a very thin and delicate texture. The shape of the entire part of the petals is oblong-

ovate or obovate-cuneiform, and this part is usually finely hairy (rarely glabrous). The difference in shape of the entire part possibly has taxonomic significance, but here we have not used this. Typically rhomboid petals are found in e.g. *T. kerrii*, *T. phonsenae* and *T. villosa* (figs. 2, 3, 4), and typically oblong-ovate petals in e.g. *T. cucumerina* and *T. ovigera*.

Male flowers.— All species have three stamens, inserted in the receptacle tube towards the throat, or in some species at the base. The filaments are free, (very) short, glabrous or hairy. The anthers have S-shaped anther cells (thecae), two anthers are 2-thealous, one 1-thealous. In the Thai species they are connate (or rarely connivent, *T. phonsenae*) into a cylindrical body (synandrium), usually with stiff hairy appendages at the apex and between the thecae.

Female flowers.— The style is long, slender, with three stigmas and glabrous or hairy. The inferior ovary is wholly hairy, or glabrescent or glabrous, globose or ellipsoid of shape, three celled with three parietal placentas and numerous horizontal ovules.

Fruits

The fruit is indehiscent, various in size and shape, globose, ovoid or ellipsoid, rarely cylindrical (3–15 cm long; snake-like, to ca. 100 cm long in *T. cucumerina* var. *anguina*). Some species have a short beak at the apex which is a persistent part of the receptacle tube. Fruits are smooth or hairy when young, and hairy mature fruits occur in *T. kerrii* and *T. phonsenae*, as well as in some Chinese species. The texture of the exocarp is leathery or thinly woody, the colour mostly red or orange-red, in some species with yellow or paler longitudinal stripes, or the fruit is green with whitish bands. The pericarp is either thin or thick, with the mesocarp softer, yellow or white. The soft pulp inside contains the seeds and has a colour characteristic of the species or a group of species, i.e. whitish or reddish, or green-black. Whitish pulp may be sweet, the green-black pulp is very bitter. The fruiting pedicel (size, and surface) may provide diagnostic characters.

Seeds (Fig. 1).

Characteristics of the seeds are often decisive for the identification of *Trichosanthes* to species. The seeds are numerous, horizontal, and often densely packed. They can be turgid or compressed, rarely more or less terete. The colour is grey, black or brown. The seeds are smooth or finely sculptured on the faces, with a markedly broad or narrow margin, or they are unmarginated, with the very edge entire, or undulate, or gnawed (*T. erosa*). In turgid seeds (*T. ovigera*) there is a marked broad belt around the middle, the belt being the margin of the seed as in other species, and the bulging sides are protrusions of the faces. Compressed seeds are usually elliptic in outline; the apex is rounded, obtuse or acute or rarely emarginate; the base is broadly rounded, truncate or cuneate, rarely acuminate; the edge can be rounded or square in cross-section.

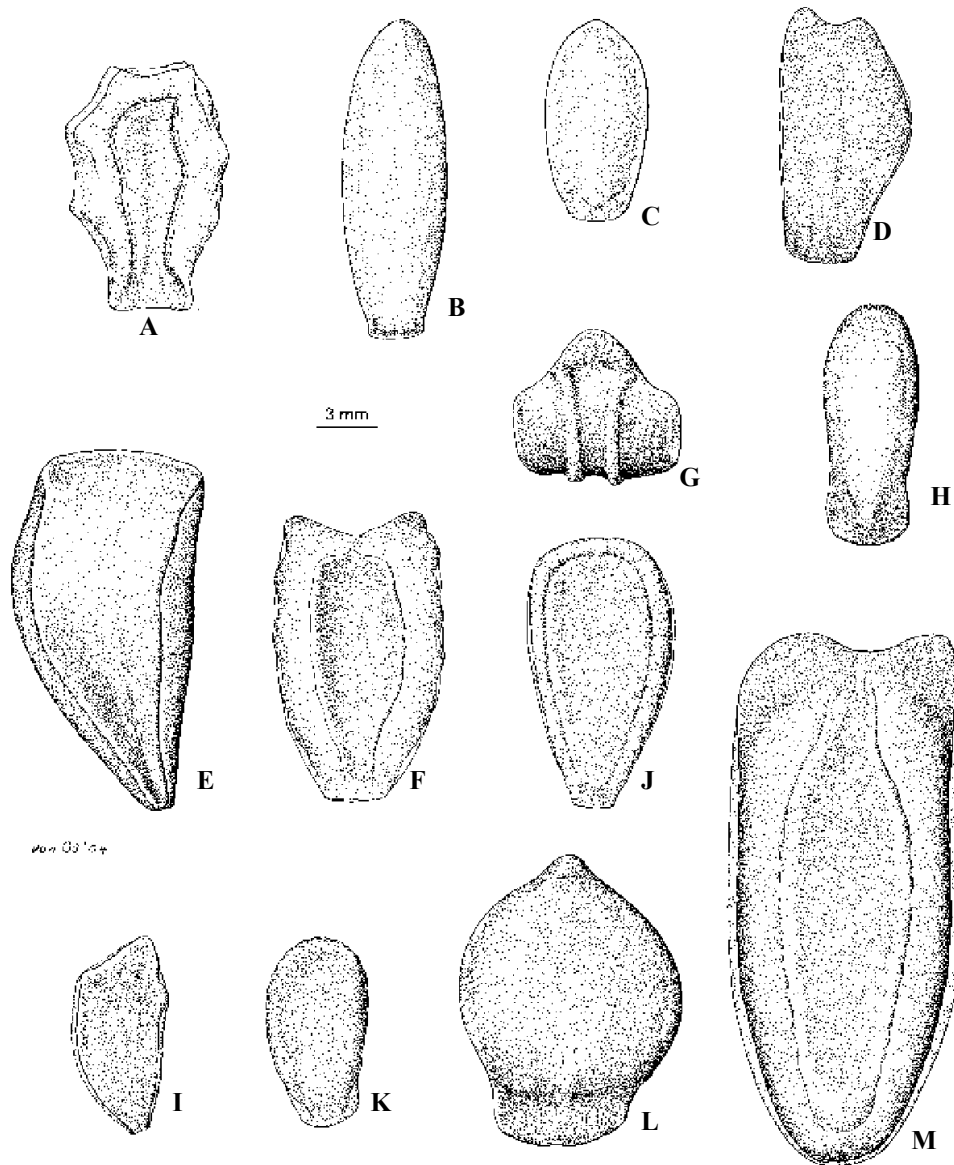


Figure 1. Seeds of various species of *Trichosanthes* in Thailand: A. *T. cucumerina* L. subsp. *cucumerina*; B. *T. dolichosperma* Duyfjes & Pruesapan; C. *T. dunniana* H. Lév.; D. *T. erosa* Duyfjes & Pruesapan; E. *T. inthanonensis* Duyfjes & Pruesapan; F. *T. kerrii* Craib; G. *T. ovigera* Blume; H. *T. pubera* Blume subsp. *rubriflos* (Cayla) Duyfjes & Pruesapan; I. *T. quinquangulata* A. Gray; J, K. *T. tricuspidata* Lour. subsp. *tricuspidata*; L. *T. wawrae* Cogn.; M. *T. villosa*. A: Meebold 3171; B: Shimizu et al. T11779; C: Chayamarit et al. 1622; D: Niyomdham 4485; E: Phonsena et al. 3958; F: Phonsena et al. 3969; G: Phonsena et al. 3521; H: Phonsena et al. 3914; I: Koonkhunthod et al. 326; J: Pooma et al. 2672; K: Maxwell 87-1224; L: Avé 94; M: Phonsena et al. 3518. Drawn by Jan van Os.

TRICHOSANTHES

L., Sp. Pl. 2: 1008. 1753; Benth. & Hook. f., Gen. Pl. 1: 821. 1867; C. B. Clarke in Hook. f., Fl. Brit. Ind. 2: 606. 1879; Cogn. in A. & C. DC., Monogr. Phan. 3: 351. 1881; E. G. O. Müll. & Pax in Engl., Natürl. Pflanzenfam. 4(5): 31. 1894; Gagnep., Fl. Gén. Indoch. 2: 1037. 1921; Craib, Fl. Siam. Enum. 1: 751. 1931; Chakrav., Rec. Bot. Surv. India 17: 28. 1959; C. H. Yueh & C. Y. Cheng, Acta Phytotax. Sin. 12(4): 415–448. 1974; Keraudren in Aubrév. & J. F. Leroy, Fl. Camb., Laos, Viêt-Nam 15: 75. 1975; S. K. Chen in A. M. Lu & S. K. Chen, Fl. Reip. Pop. Sin. 73(1): 218–257. 1986; S. K. Chen in C. Y. Wu, C. Chen & S. K. Chen, Fl. Yunnan. 6: 351–376. 1995; Rugayah & W. J. de Wilde, Reinwardtia 11(4): 227–280. 1999; Rugayah, *Trichosanthes* (Cucurbitaceae) in Malesia: 61 1999.— Type: *Trichosanthes anguina* L.— *Involucraria* Ser., Mém. Soc. Phys. Genève. 3(1): 25, t. 5. 1825.

Small or large climbers, perennial or rarely annual; glabrous or hairy; cystoliths usually obvious. *Probracts* present or absent. *Tendrils* (simple or) 2–5(–9)-branched. *Leaves*: blade simple, entire or lobed, or compound, 3–5-foliolate, margin with sparse minute teeth ca. 1 mm long; usually with glands. *Flowers* dioecious, rarely monoecious; petals usually finely hairy, white or rarely pink, or red veined, margin long-fimbriate. *Male inflorescences*: flowers solitary or mostly in bracteate, peduncled raceme (sometimes with one solitary flower co-axillary); female flower solitary at the nodes. *Male flowers*: pedicel distinct; bracts usually on the rachis, large or small (rarely absent), with or without glands; receptacle tube tubular, mostly widened towards apex; sepals 5, entire, dentate or lobed; petals 5 (corolla deeply 5-partite or lobes free), fimbriate with long filiform hairs; stamens 3, inserted in the receptacle tube near the throat, included; filaments short, free; anthers two 2-thecous, one 1-thecous, mostly united into elongate truncate synandrium, thecae linear, S-shaped; pistillode or disc present as 3 linear bodies at base of receptacle tube. *Female flowers*: perianth similar to male flowers; ovary globose or (ovoid-)ellipsoid, or (long) fusiform, ovules numerous, horizontal; style slender, stigma deeply 3(–5)-lobed; staminodes absent. *Fruits* pendent, indehiscent, ovoid, ellipsoid or (sub)globose (or cylindrical), 3–15(–100 in *T. cucumerina* var. *anguina*) cm long, fleshy-pulpy inside; exocarp leathery or woody, red or green, paler striped, smooth, glabrous or hairy; mesocarp white or yellowish (sometimes fibrous); pulp greenish black, white or reddish. *Seeds* numerous, horizontal, mostly densely packed, very various of shape, little or much compressed, or turgid with two inflated sides, usually margined, edge entire, crenate or undulate, faces not or little sculptured.

About 100 species, throughout subtropical and tropical eastern Asia: from India, S China and Japan, through Malesia, east to tropical Australia and Fiji.

KEY TO THE SPECIES

- | | |
|---|--------------------------------|
| 1. Leaves compound, 3-foliolate | 17. <i>T. wawrae</i> |
| 1. Leaves simple, entire or lobed | 2 |
| 2. Probract absent (check on young shoots) | 3 |
| 3. Male bracts less than 2 mm long. Leaf base with broad sinus. Seeds thickish, with edge undulate. Monoecious | 1. <i>T. cucumerina</i> |
| 3. Male bracts much longer than 2 mm, entire or incised (lobed). Leaf base with narrower sinus. Seeds with edge smooth, or notched, or undulate. Plants usually dioecious | 4 |

- 4. Leaves villose or velvety on both surfaces 5
- 5. Tendrils 2-or 3-branched, portion below branching short, ca. 0.5 cm long. Male bracts short, ca. 10 mm long. Fruit hairy (glabrescent); seeds with notched or gnawed margin **6. *T. kerrii***
- 5. Tendrils 4–7(–9)-branched, portion below branching 2–4 cm long. Male bracts 20–40 mm long. Fruit glabrous; seeds with entire margin **16. *T. villosa***
- 4. Leaves short hairy, or scabrous, or glabrous below 6
- 6. Seeds turgid, with broad belt. Leaves finely hairy, especially below, along the finer veins. Male bracts without glands **8. *T. ovigera***
- 6. Seeds compressed, rarely turgid, without belt. Leaves scabrous or glabrous. Male bracts with glands 7
- 7. Leaves deeply 5-lobed, scabrous by coarse sparse hairs **10. *T. phonsenae***
- 7. Leaves entire or (shallowly) 3-lobed, glabrous 8
- 8. Leaf base cuneate or rounded, veins prominent below. Tendrils 2- or 3-branched **15. *T. truncata***
- 8. Leaf base (sub)cordate or hastate, veins less prominent below. Tendrils unbranched 9
- 9. Leaves membranous, drying pale below; glands 1–1.5 mm diam.; margin entire **9. *T. pallida***
- 9. Leaves chartaceous, drying green below; glands absent or not apparent; margin sparsely finely dentate **13. *T. siamensis***
- 2. Probract present 10
- 10. Younger stems, leaves and inflorescences green, not reddish tinged. Petals completely white or white with yellow fringes. [Probract not long-linear] 11
- 11. Seeds narrowly ellipsoid, subterete, hardly compressed, ca. 15 mm long **2. *T. dolichosperma***
- 11. Seeds broader, ± elliptic, usually compressed, 8–18 mm long 12
- 12. Male bracts (sub)entire 13
- 13. Seed margin erose, not pointed at one end. Male sepals narrowly triangular, entire. [Probract linear, less than 10 mm long] **4. *T. erosa***
- 13. Seed margin entire, pointed at one end. Male sepals lobed **12. *T. quinquangulata***
- 12. Male bracts lobed or incised 14
- 14. Leaves pale below **9. *T. pallida***
- 14. Leaves green below 15
- 15. Leaf glands 2–3 mm diam. **18. *T. species* aff. *laceribractea*** (no Thai specimens seen)
- 15. Leaf glands 0.5–1 mm diam. **14. *T. tricuspidata***
- 10. Younger stems, leaves and inflorescences red or reddish tinged. Petals pale pink, or white with red veins, or with (white) reddish fringes 16
- 16. Leaves hairy below. Probract slender, long-linear, without glands. **11. *T. pubera***
- 16. Leaves glabrous (or scabrous) below. Probract elliptic or narrowly elliptic, with glands 17
- 17. Probract ca. 25 mm long **7. *T. kostermansii***
- 17. Probract less than 5–10 mm long 18
- 18. Seeds flat, 13–16 by 7–8 mm, ca. 2.5 mm thick, margined **5. *T. inthanonensis***
- 18. Seeds only little compressed, 10–12 by 5–7 mm, 3–5 mm thick, smooth, unmargined **3. *T. dunniana***

1. *Trichosanthes cucumerina* L., Sp. Pl. 2: 1008. 1753; Lour., Fl. Cochinch. ed. 1: 588. 1790; Cogn. in A. & C. DC., Monogr. Phan. 3: 357. 1881; Craib, Fl. Siam. Enum. 1: 752. 1931; Rugayah & W. J. de Wilde, Blumea 42: 478. 1997; Rugayah, *Trichosanthes* (Cucurbitaceae) in Malesia: 66. 1999. Type: (Jeffrey 1980): *Pada valam*, in Rheede, Hort. Ind. Malab. 8: 39. 1688.— *T. reniformis* Miq., Fl. Ind. Bat. 1: 675. 1856.— Type: Indonesia, Java, *Horsfield* s.n. (holotype BM).— *T. pedatifolia* Miq., Fl. Ind. Bat. 1: 677. 1856.— Type: Indonesia, Java, *Horsfield* s.n. (holotype BM; isotype U). Fig. 1A.

Climber 2–3 m long (stouter in all parts in var. *anguina*); annual or subperennial; monoecious; with (sparse) minute hairs, partly glabrescent; plant green, not reddish tinged; cystoliths not obvious; stem 1.5–2(–5) mm diam. *Probract* absent. *Tendrils* 2-or 3-branched. *Leaves*: blade either unlobed or shallowly or deeply 3–5(–7)-lobed, membranous, hairy or subscabrous below; suborbicular or broadly ovate in outline, 5–10 (–17) by 6–8(–17) cm, base cordate with broad sinus, the apex acute, the margin entire or finely dentate; glands absent; petiole 2–10 cm long. *Male raceme* 9–14(–20) cm long,

hairy, (glabrescent); peduncle 7–15 cm long, 1–2 mm thick; rachis with up to 20 flowers; bracts persistent or caducous, 1–2 mm long, without glands. *Male flowers*: pedicel 3–15 mm long; receptacle tube 15–19 mm long, at throat ca. 3 mm wide; sepals linear, ca. 2 mm long, margin entire; petals ovate-oblong, narrowly elliptic, 5–6(–10) mm long, threads ca. 10 mm long (open corolla ca. 30 mm dia.); synandrium 2(–3) mm long, filaments less than 1 mm long. *Female flowers*: pedicel 5–15(–30) mm long; ovary (narrowly) elliptic, 10(–30) mm long, finely hairy. *Fruits* green, turning orange-red, paler speckled or longitudinally banded, ovoid or narrowly elliptic, narrowed towards apex, 2.5–5 by 1.5–4 cm (up to ca. 100 cm long in var. *anguina*, see note); exocarp thinly leathery, smooth; pulp orange; fruiting pedicel 1–2(–3) cm long. *Seeds* grey or pale or dark brown, compressed, elliptic(-oblong), 6–18 by 4–9 by 2.5–3.5 mm, margin broad but faint, edge undulate.

Thailand.— NORTHERN: Phrae (Mae Yom NP), Chiang Mai (Ban Tin Doi), Phitsanulok; SOUTH-EASTERN: Chon Buri (Thung Prong), Trat (Dan Chumpon); CENTRAL: Ang Thong, Phra Nakhon Si Ayutthaya, Bangkok, Saraburi (Kaeng Khoi).

Distribution.— Widely distributed from India, Sri Lanka, and S China, through Malesia into W, N, and NE Australia. Widespread in cultivation (var. *anguina*).

Ecology.— Open places in alluvial thickets along river banks, in deciduous forest, over shale bedrock, mostly in sandy substrate; 0–500(–1,000) m altitude. Flowering and fruiting in the wet season.

Vernacular.— Nom pichit (นมพิจิตร), mak noi. (หมากนอย).

Note.— *T. cucumerina* is a widespread species, preferring a seasonal climate. The var. *anguina* (L.) Haines (1922) is widely cultivated for its snake-like edible fruits. Only one herbarium collection from Thailand, Maxwell 13-7-1969 (BKF), is known.

Field-notes.— Contrary to most *Trichosanthes* species, the flowers of *T. cucumerina* are open during the day light, the corollas falling off in the afternoon.

2. *Trichosanthes dolichosperma* Duijjes & Priesapan, sp. nov. Liana robusta. Folia trilobata infra pilis scabridis. Fructus subglobosus ca. 8 cm diam. Semina oblonga vix compressa 12–17 mm long ca. 5 mm lata. Typus: Thailand, Phetchabun, Shimizu *et al.* T 11779 (holotypus BKF; isotypus KYO, L). Fig. 1B.

Stoutish climber; wholly green; cystoliths obvious; stem 4–5 mm diam., glabrous, slightly waxy. *Probract* subovate, ca. 13 by 8 mm, entire, ± scabrous, with glands. *Tendrils* 4- or 5-branched. *Leaves*: blade 3-lobed to ca. $\frac{1}{3}$, chartaceous, glabrous above, scabrous with very short stiff hairs below, ovate-orbicular in outline, ca. 24 by 20 cm, base cordate, mid-lobe obovate, ca. 8.5 by 8 cm, apex acute-acuminate, margin with minute yellowish hard teeth; glands few to several, scattered, ca. 0.5 mm diam.; petiole 8–9 cm long. *Male and female flowers* not seen. *Fruits* subglobose, ca. 8 cm diam.; pericarp thin when over ripe; exocarp ca. 0.5 mm thick, smooth; pulp watery, greenish-blackish; fruiting pedicel ca. 2 by 0.5 cm. *Seeds* bright light brown, narrowly oblong, subcylindrical (hardly compressed), 12–16 by 5 by 4 mm, apex and base (narrowly) rounded, the faces smooth, margin obscure, edge rounded, entire.

Thailand.— NORTH-EASTERN: Phetchabun (*Shimizu et al.* T 11779-type).

Distribution.— Endemic to Thailand, known only from the type.

Ecology.— Mountain forest, at ca. 700 m altitude.

3. *Trichosanthes dunniana* H. Lév., Repert. Spec. Nov. Regni Veg. 10: 148. 1911; C. Jeffrey, Cucurbitaceae Eastern Asia, Kew: 41. 1980; S. K. Chen in A. M. Lu & S. K. Chen, Fl. Reip. Pop. Sin. 73, 1: 230, fig. 57: 1–4. 1986; S. K. Chen in C. Y. Wu, C. Chen & S. K. Chen, Fl. Yunnan. 6: 353, pl. 93: 1–4. 1995. Type: China, Guizhou, *Esquirol* 726, (holotype E; isotype K).— *T. rubriflos* auct. non Cayla: C. H. Yueh & C. Y. Cheng, Acta Phytotax. Sin. 12(4): 442, pl. 8. 1974. Fig. 1C.

Medium-sized climber; green, but flowers reddish (inflorescences not seen from Thailand); cystoliths obvious; stem 1–2(–3) mm diam., glabrous. *Probract* broadly ovate, 2–4 by 3–4 mm, subentire, glabrescent, with few glands. *Tendrils* 2-or 3-branched. *Leaves*: blade deeply 3–5-lobed, membranous, glabrous, scabrous, ovate-orbicular in outline, 8–15 by 7–12 cm, base cordate, mid-lobe narrowly elliptic, narrowed at base, up to 12 by 4 cm, apex acute-acuminate, mucronate, margin coarsely serrate-dentate; glands 2–5, large, close to the nerve axils towards the blade base, 1–1.5 mm diam.; petiole 3–5 cm long. *Male raceme* (not known from Thailand, description from *Esquirol* 726, S China) 7–10 cm long, glabrescent or finely hairy; peduncle ca. 4 cm long, 2–3 mm thick; rachis short, with ca. 10 flowers; bracts persistent, broadly obovate, 20–25 by 20 mm, glands few, ca. 1 mm diam., margin shallowly incised, 2–3 mm deep. *Male flowers* finely hairy; pedicel short, ca. 2 mm long; receptacle tube ca. 15 mm long, at throat ca. 8 mm wide; sepals long-triangular, ca. 9 by 3 mm, margin entire; petals ca. 10 by 10 mm, threads not seen; synandrium not seen. *Fruits* ellipsoid, 5–11 by 4.5–8 cm; pericarp 5–10 mm thick; exocarp coarsely wrinkled on drying; pulp greenish-blackish; fruiting pedicel 2–2.5 by ca. 0.4 cm. *Seeds* pale brown, little compressed, ovoid-ellipsoid, 10–12 by 5–7 by 3–5 mm, blunt or rounded at both ends, smooth, without margin absent, the edge rounded, entire.

Thailand.— NORTHERN: Tak (*Chayamarit et al.* 1622), Chiang Mai (*Maxwell* 89-1184).

Distribution.— S. China (type), Myanmar.

Ecology.— Rocky places or forest edges, along roadsides and streams, at 500–600 m altitude (ca. 1,500 m in China). Fruiting in July & October.

Note.— *Henry* 9494 China reportedly has dark red flowers.

Field-note.— Fresh fruit (possibly not fully mature) hard, glossy green with yellowish streaks.

4. *Trichosanthes erosa* Duyfjes & Pruesapan, **sp. nov.** *Trichosanthes quinquangulatae* similis probractea angusta 2–3 mm longa, sepalis masculis linearibus non lobatis, seminum extremis truncate emarginatis differt. Typus: Thailand, Ratchaburi, *Niyomdham* 4485 (holotypus BKF). Fig. 1D.

Climber to 20 m long; wholly green; cystoliths inconspicuous; stem 2–3 mm diam., glabrous. *Probract* sublinear, 7–10 by 1.5–2 mm, glabrescent, with glands. *Tendrils* 2-or 3-branched. *Leaves*: blade shallowly or deeply 3–5-lobed; (thinly) membranous, glabrous on both surfaces, ovate-orbicular in outline, 11–20 by 9–20 cm, base cordate with wide sinus, the lobes triangular to oblong, the mid-lobe to 16 cm long, apex acute-acuminate, the margin entire or coarsely sinuate; glands numerous, small, including few to several below the lowermost nerves close to the insertion of the petiole; petiole 5–8 cm long. *Male raceme* 15–20 cm long, glabrous, co-axillary with a ca. 10 cm long pedicelled solitary male flower; peduncle ca. 15 cm long, 1–2 mm thick; rachis with 3–5 flowers; bracts persistent, narrowly elliptic, acute at both ends, 15–20 by 10 mm, with numerous small glands, margin entire. *Male flowers* (submature) early glabrescent, hairs minute, grey; pedicel slender, 20(–30) mm long; receptacle tube ca. 25 mm long, at throat 5–6 mm wide; sepals sparsely hairy, linear, 10–15 mm long, ca. 1.5 mm wide at base, with distinct mid-nerve, the margin entire; petals wedge-shaped, ca. 10 mm long; synandrium ca. 6 mm long, filaments ca. 5 mm long, glabrous. *Female flowers* not seen. *Fruits* orange to red, subglobose, ca. 7 cm diam.; pericarp 10–15 mm thick; exocarp coarsely wrinkled on drying; pulp blackish; fruiting pedicel straight, ca. 2 by 0.4–0.5 cm. *Seeds* dark reddish-brown, compressed, irregularly elliptic (to quadrangular), 10–12 by 5–7 by ca. 1 mm, the apex and base irregularly retuse, truncate or blunt, faces smooth, the margin broad but obscure, edge square, entire or faintly undulate.

Thailand.— SOUTH-WESTERN: Ratchaburi (in Thailand only known from the type, *Niyomdham* 4485).

Distribution.— North Vietnam, Tonkin (vicinity of Hanoi).

Ecology.— Forest at ca. 900 m altitude. Flowering in August, fruiting in November.

5. *Trichosanthes inthanonensis* Duyfjes & Pruesapan, **sp. nov.** *Trichosanthes puberae* similis foliis infra glabris, probractea ovata ca. 5 mm longa viridi, seminibus maioribus ca. 15 mm longis 8 mm latis differt. Typus: Thailand, Chiang Mai, Doi Inthanon, *Phonsena*, W. J. de Wilde & Duyfjes. 3930 (holotypus BKF; isotypus L). Fig. 1E.

Trichosanthes lepiniana auct. non Naud.: S. K. Chen in A. M. Lu & S. K. Chen, Fl. Reip. Pop. Sin. 73(1): 226, pl. 56, 5–8. 1986; S. K. Chen in C. Y. Wu, C. Chen & S. K. Chen, Fl. Yunnan. 356, pl. 92, 5–8. 1995.— ?*T. wallichiana* auct. non (Ser.) Wight: Gagnep., Fl. Gén. Indoch. 2: 1048. 1921 (based on a *Kerr* collection, Doi Suthep).

Climber ca. 25 m tall; glabrous (sparse minute hairs on growing apices); purple-red in growing shoots; cystoliths obvious; stem 3–5 mm diam. *Probract* ovate-elliptic, 3–8 by 3–4 mm, entire, green, with glands. *Tendrils* 2–5-branched. *Leaves*: blade shallowly or deeply 3–5-lobed; thinly chartaceous, glabrous or scabrous; orbicular in outline, 12–24 by 11–22 cm, base (deeply) cordate, lobes ovate or oblong, mid-lobe to 12 cm long, the apex acute-acuminate, margin (sparsely) shallowly serrate-dentate; glands large, several or numerous, scattered, 0.5–1.5 mm diam.; petiole 5–9 cm long. *Male and female flowers* unknown; possibly resembling those of *T. rubriflos* subsp. *fissisepala*. *Fruits* red, ovoid, 6–8 by 4.5–6 cm, towards apex narrowed into a short beak ca. 0.3 cm long; pericarp 10(–15) mm thick; exocarp leathery, coarsely wrinkled on drying; pulp greenish-black; fruiting pedice 1.3–6.5 by 0.4(–0.5) cm. *Seeds* blackish brown,

compressed, irregularly elliptic, 13–16 by 7–10 by ca. 2.5 mm, the apex subtruncate, base cuneate, the margin distinct or faint, the edge \pm rounded, entire.

Thailand.— NORTHERN: Chiang Mai (Doi Inthanon NP, *Phonsena*, *De Wilde & Duyffes* 3930-type; 3933; *De Wilde & Duyffes* 22143); Nan (Doi Phukha NP, *Phonsena*, *De Wilde & Duyffes* 3952; 3958); SOUTH-WESTERN: Kanchanaburi (*Pruesapan* KP67).

Distribution.— S China?

Ecology.— Scrub on wet soil and in wet places in forest edges; at 1,300–1,700 m altitude. Fruiting August, September.

Vernacular.— Khi ka daeng (ขี้กาแดง).

6. *Trichosanthes kerrii* Craib, Bull. Misc. Inf. Kew: 7. 1914; Gagnep., Fl. Gén. Indoch. 2: 1047. 1921; Craib, Fl. Siam. Enum. 1: 753. 1931; C. H. Yueh & C. Y. Cheng, Acta Phytotax. Sin. 12(4): 433, fig. 6 & pl. 88: 26. 1974; C. Jeffrey, Cucurbitaceae Eastern Asia, Kew: 44. 1980; S. K. Chen in A. M. Lu & S. K. Chen, Fl. Reip. Pop. Sin. 73(1): 239, pl. 59: 1–4. 1986; S. K. Chen in C. Y. Wu, C. Chen & S. K. Chen, Fl. Yunnan. 6: 365, pl. 95: 1–4. 1995. Type: Thailand, *Kerr* 2454 (holotype K; isotype BM).— *T. tomentosa* Chakrav., J. Bombay Nat. Hist. Soc. 50: 894. 1952.— Type: India, *Watt* 11640 (holotype CAL, fide Jeffrey, l.c., no specimens seen).— *T. villosa* auct. non Blume: Keraudren in Aubrév. & J.-F. Leroy, Fl. Camb., Laos, Viêt-Nam 15: 77, p.p., pl. 13: 1–3. 1975. Figs. 1F, 2 & 6D.

Climber to 10 m; dark brown, yellowish- or reddish-brown hairy, the hairs 1–2 mm long; plant not reddish tinged; cystoliths not obvious; stem 3–4 mm diam., late glabrescent. *Probract* absent. *Tendrils* 2–7-branched, part below point of branching short, 0.5–1 cm long. *Leaves*: blade unlobed (entire); membranous, densely (grey-)rusty short villose; ovate in outline, 12–28 by 9–20 cm, the base cordate, the apex acute-acuminate, 5–10 mm mucronate, the margin entire; glands not obvious; petiole 5–11 cm long. *Male raceme* 10–20 cm long, wholly densely hairy, with co-axillary a densely hairy tail-like appendage, curved at apex, 5–13 cm long; peduncle 8–17 cm long, 2–3 mm thick; rachis with 3–6 flowers; bracts inserted on the pedicel below the middle, (late) caducous, elliptic or rhomboid, 10–20 by 3–8 mm, the glands not obvious, the margin entire or shallowly few-lobed. *Male flowers* hairy; pedicel 2–2.5 cm long; receptacle tube 10–20 mm long, at throat ca. 9 mm wide; sepals linear, 7–9 mm long, 1–2 mm wide at base, the margin entire; petals wedge-shaped, ca. 25 mm long, the threads ca. 5 mm long; synandrium 5–7 mm long, filaments 3–5 mm long, glabrous, inserted towards the base of the tube. *Female flowers*: pedicel ca. 2 cm long; ovary hairy, ellipsoid, 2–3 cm long; receptacle tube ca. 1.5 cm long; sepals hairy, long-triangular, ca. 1.5 cm long, the margin entire. *Fruits* orange(-green), longitudinally paler striped, ellipsoid, 7–10 by 6–7 cm; pericarp not distinct; exocarp ca. 0.5 mm thick, leathery or woody, not wrinkled on drying, with sparse brown hairs, glabrescent; pulp creamy, sweet; fruiting pedicel 2.5–6 by 0.6–0.8 cm. *Seeds* dark brown, compressed, elliptic, 14–16 by 9–11 mm, the base rounded, the apex truncate or notched, margin distinct, ca. 3 mm wide, the edge \pm shallowly undulate.

Thailand.— NORTHERN: Chiang Mai: (Doi Ang Khang, *Wongprasert* s.n., 27 May 1998); Nan (Doi Wao, *Kerr* 2454-type; Doi Phukha, *Phonsena*, *De Wilde & Duyffes* 3969; 3959).

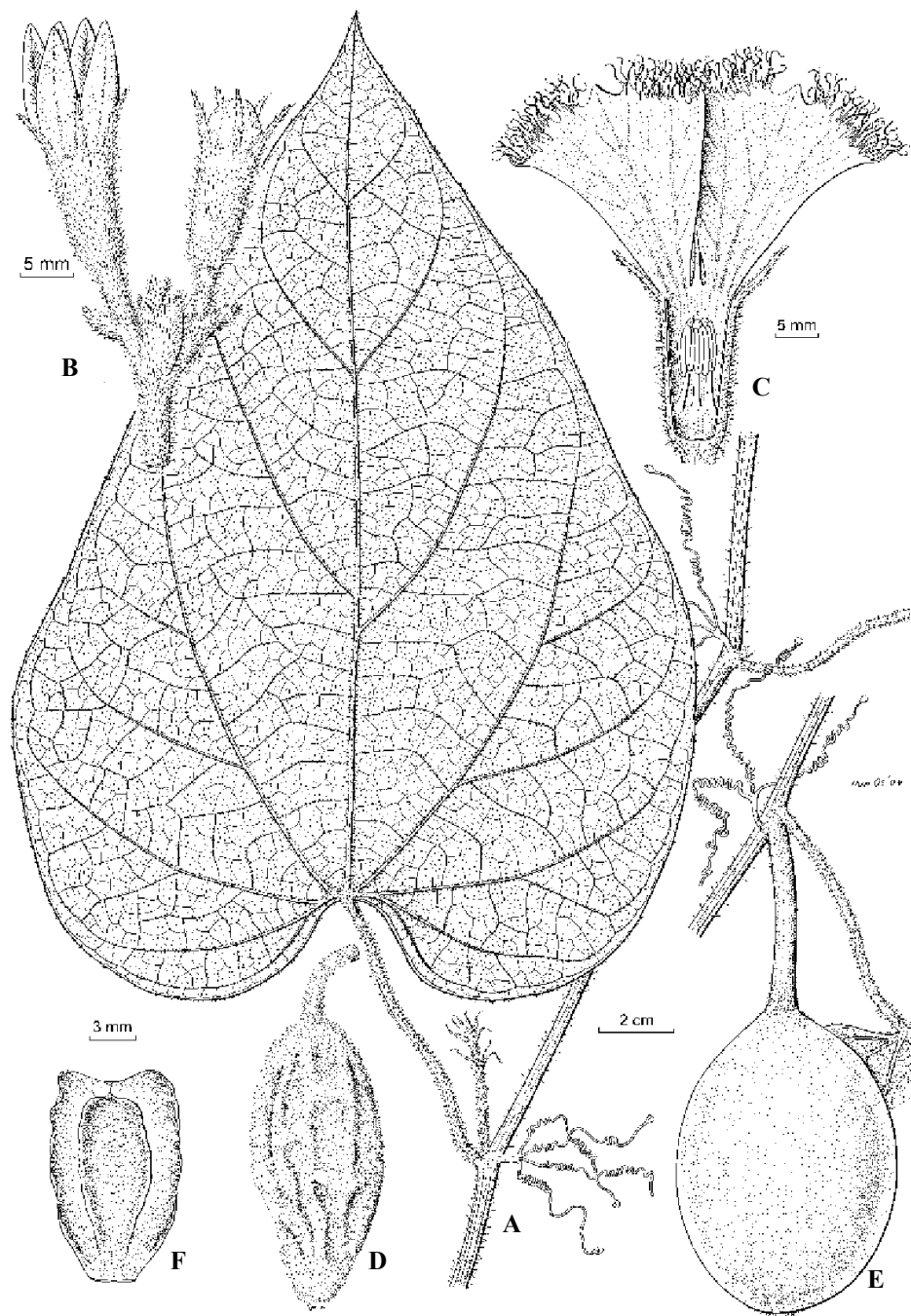


Figure 2. *Trichosanthes kerrii* Craib: A. part of twig with a developing side branch at the node; B. apex of male inflorescence; C. opened male flower; D. immature fruit, note indument; E. mature fruit; F. seed. A, E-F: *Phonsena et al.* 3969; B-C: *Pételot* 8415; D: *Wongprasert s.n.*, 27 May 1998. Drawn by Jan van Os.

Distribution.— Yunnan, Guangxi, India?, North Vietnam (Tonkin), Laos.

Ecology.— In (seasonal) mountain forest edges, along streams, at 1,100–1,500 m altitude. Flowering February, April; fruiting May, September.

Vernacular.— Khi ka mo kha (ขี้ก้ามอคาร์).

Note.— The tail-like appendage, co-axillary to the male raceme, is apparently derived from a solitary male flower, as frequently found in other *Trichosanthes* species.

7. *Trichosanthes kostermansii* Duyfjes & Pruesapan, **sp. nov.** *Trichosanthes wallichii* similis bracteis masculis grandis ca. 5 cm longis, sepalis profunde incisis lobis lateralibus angustis differt. Typus: Thailand, Kanchanaburi (Wangka), *Kostermans* 743 (holotypus L; isotypi L, SING).

Climber, ca. 20 m tall, with pendent branches, glabrous; plant somewhat reddish tinged, petals pink; cystoliths obvious; stem 3–4 mm diam. *Probract* elliptic-oblong, 23–26 by 6–8 mm, the margin finely serrate in upper half, the apex acute, with glands. *Tendrils* 2-branched. *Leaves*: blade 3–5-lobed to ca. $\frac{1}{3}$; membranous, glabrous; ovate-orbicular in outline, 11–15 by 9–13 cm, the base cordate with broad sinus, mid-lobe subovate, up to 7 by 4.5 cm, apex acute-acuminate, the margin sparsely dentate; glands numerous, scattered, small, less than 0.5 mm diam.; petiole 4–6 cm long. *Male raceme* 8–16 cm long, sparingly hairy, glabrescent, sometimes co-axillary with a ca. 30 mm long pedicelled solitary male flower; peduncle 6–8 cm long, 1.5–3 mm thick; rachis with ca. 10 flowers; bracts (sub)persistent, glabrous, membranous, ovate or elliptic, (15–)40–50 by (10–)30–40 mm, the glands numerous, small, the margin irregularly finely incised ca. 5 mm deep. *Male flowers* glabrous, except petals; pedicel caducous?, 5–10 mm long; receptacle tube ca. 15 mm long, at throat 5–7 mm wide, inside hairy; sepals (narrowly) elliptic, 10–15 by 5–8 mm, deeply finely irregularly incised (lobed), with few minute glands; petals ca. 20 by 10 mm, finely hairy, threads ca. 5 mm long, pink, red-veined; synandrium ca. 10 mm long, the filaments ca. 2 mm long, glabrous, inserted towards the base of the tube. *Female flowers* and *fruits* unknown.

Thailand.— SOUTH-WESTERN: Kanchanaburi (Wangka, *Kostermans* 743-type).

Distribution.— Endemic to Thailand, known only from the type.

Ecology.— Flowering in May.

Note. — A collection of fruits (Kanchanaburi, *Pruesapan* KP66), from a died-off plant with withered leaves possibly belong here. The red fruit measures ca. 8 by 6 cm, the fruiting pedicel is 4–7 cm long. The seeds, ca. 16 by 8 by 4 mm, have a distinct margin and a retuse apex. Compare also with *T. erosa*.

Etymology.— Named for the late A. J. G. H. Kostermans, former botanist at Bogor, Indonesia.

8. *Trichosanthes ovigera* Blume, Bijdr. Fl. Ned. Ind.: 934. 1826; Miq., Fl. Ind. Bat.: 674. 1856; Cogn. in A. & C. DC., Monogr. Phan. 3: 380. 1881; Chakrav., Rec. Bot. Surv. India 17: 51. 1959; Backer in Backer & Bakh. f., Fl. Java 1: 303. 1963; Keraudren in Aubrév. & J.-F. Leroy, Fl. Camb., Laos, Viêt-Nam 15: 85, pl. 15. 1975; C. Jeffrey, The Cucurbitaceae of Eastern Asia: 49. 1980; S. K. Chen in A. M. Lu & S. K. Chen, Fl.

Reip. Pop. Sin. 73(1): 255, pl. 63: 6–13. 1986; S. K. Chen in C. Y. Wu, C. Chen & S. K. Chen, Fl. Yunnan. 6: 374, pl. 98: 6–13. 1995; Rugayah & W. J. de Wilde, Blumea 42: 478. 1997. Type: Indonesia, Java (Mt Salak), *Blume* s.n. (holotype L; isotype P).— For synonyms see Jeffrey, l.c. 1980. Figs. 1G & 6A.

Climber 2–7 m long; subperennial; variously short hairy; plant green on drying, the petals white; cystoliths not obvious; stem 2–3 mm diam. *Probract* absent. *Tendrils* 2-or 3-branched. *Leaves*: blade membranous, unlobed or (deeply) 3–5-lobed; hairy below, at least along the (finer) veins, (broadly) ovate or suborbicular in outline, 10–19(–25) by 9–16(–19) cm; the base cordate, with broad or narrow sinus, apex acute-acuminate, short mucronate, the margin entire or sparsely finely or coarsely dentate or undulate; glands absent or few, scattered, ca. 0.5 mm diam.; petiole 3–7 cm long. *Male raceme* 15–20(–25) cm long, densely or sparsely short hairy, sometimes co-axillary with a long-pedicelled male flower; peduncle 8–17 cm long, 1–2 mm thick; rachis with 5–10 flowers; bracts caducous or persistent, membranous, (narrowly) obovate or oblong, 6–20 by 1–5 mm, without glands, the margin few-lobed or dentate. *Male flowers*: pedicel (3–)5–25 mm long (in solitary flower much longer); receptacle tube 15–45 mm long, at apex 3–5 mm diam.; sepals narrowly triangular, 3–15 mm long, 1–2 mm wide at base, the margin entire; petals ovate-oblong or oblong-lanceolate, ca. 10 by 4 mm, subglabrous, the threads 7–17 mm long; synandrium 3–4 mm long, the filaments 1–2 mm long, glabrous. *Female flowers* resembling male, 10 mm long; ovary ellipsoid-oblong, ca. 8 by 2–3 mm, hairy or subglabrous; receptacle; pedicel ca. tube to 55 mm long; sepals to 20 mm long. *Fruits* orange-red, pale flamed, ellipsoid (–oblong), 4–6 by 3–4 cm (larger outside Thailand), the apex acute, 3–5 mm beaked; exocarp leathery, smooth; pulp whitish; fruiting pedicel 1–2 by 0.2 cm. *Seeds* (dark) brown, variously barrel-shaped (tumid) with broad belt, 6–8 by 5–9 by 3–5 mm.

Thailand.— NORTHERN: Chiang Mai (Doi Suthep-summit area, Doi Suthep-Pui NP, Doi Inthanon NP, Doi Chiang Dao, Doi Angka), Chiang Rai (Khun Kon Falls), Lampang (Jae Son NP), Lamphun (Doi Khun Tan NP); CENTRAL: Nakhon Nayok (Khao Yai NP); SOUTH-WESTERN: Kanchanaburi (Thung Yai Naresuan Wildlife Sanctuary); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao Wildlife Sanctuary), Chon Buri (Hup Bon Sriracha forest).

Distribution.— Widespread in SE Asia from NE India and China southeast throughout Malesia (Java, type) to Australia and Solomon Islands.

Ecology.— Half-disturbed and secondary places and road-sides, wet places in evergreen forest, deciduous forest and seasonal hardwood forest; on shale and granite bedrock; up to 1,700 m altitude.

Vernacular.— Khi ka (กึ๋ก), khi ka khao (กึ๋กขาว).

9. *Trichosanthes pallida* Duyfjes & Pruesapan, **sp. nov.** *Mediocriter scandens glabrescens, cirrhis simplicibus, foliis trilobatis basi rotundata infra pallescentibus (viridibus) in sicco.* Typus: Thailand, Phetchaburi, *Phonsena*, W. J. de Wilde & Duyfjes 3981 (holotypus BKF; isotypus L).

Climber 5–8 m long; minutely hairy, early glabrescent; plant green, corolla white; cystoliths not obvious; stem 1–2 mm diam. *Probract* (narrowly) elliptic, subentire, ca. 3 mm long, with glands, caducous. *Tendrils* simple. *Leaves*: blade 3-lobed to $(\frac{1}{2})-\frac{2}{3}$ (of juvenile shoots entire); membranous, glabrous, drying pale green beneath; orbicular in outline, 8–14 by 10–14 cm, the base rounded, mid-lobe oblong, to 8 by 4 cm, apex (long) acute-acuminate, the margin entire; glands several, scattered, ca. 0.5 mm diam.; petiole 1.5–3 cm long. *Male raceme* ca. 15 cm long, minutely hairy, glabrescent; peduncle ca. 9 cm long, ca. 2.5 mm thick; rachis with 10–12 flowers; bracts, caducous, membranous, (narrowly) elliptic, acute, ca. 40 by 15 mm, with glands, the margin serrate, teeth, narrow, 2–3 mm long. *Male flowers*: pedicel caducous, ca. 15 mm long; receptacle-tube (slightly immature) ca. 10 mm long, ca. 4 mm wide at throat; sepals linear, 12–14 by 1.5 mm, long-acute, sparsely minutely hairy, the margin entire, without glands; petals and androecium not seen. *Female flowers* (immature) in a short 1-flowered raceme ca. 0.5 cm long, the flower axillary to a conspicuous bract resembling male bracts, 15–25 mm long; sepals hairy, linear, entire. *Fruits* green and white, elliptic-oblong, ca. 10 by 4.5 cm, exocarp thickish, smooth; pulp blackish green; fruiting pedicel ca. 1 by 0.3 cm. *Seeds* 6–10, brown, thickish, irregularly ellipsoid, not flat, 15–18 by 10 by 7 mm, base and apex rounded, margin flat.

Thailand.— SOUTH-WESTERN: Phetchaburi (*Phonsena*, *De Wilde & Duyfjes* 3981-type), Kanchanaburi (*Geesink & Phengklai* 6183).

Distribution.— S Myanmar (*Keenan et al.* 1570, fruit, E).

Ecology.— Forest edge, sandy clay or limestone, at 800–1,000 m altitude. Flowering in July and September; fruiting in September.

10. *Trichosanthes phonsenae* Duyfjes & Pruesapan, **sp. nov.** *Trichosanthes villosa* et *T. kerrii* similis foliis profunde 5-lobatis, inflorescentia laxa in ligno vetiore, ovario grosse pubescenti, fructu oblongo ca. 15 cm longo 6 cm lata sparse pubescenti differt. Typus: Thailand, Kaeng Krachan NP, *P. Phonsena*, *W. J. de Wilde & Duyfjes* 4002 (holotypus BKF; isotypus L). Fig. 3.

Climber 7–15 m long; wholly setose-hairy, hairs stiff, grey or brown, 2–4 mm long; plant green (not reddish tinged), the petals white; cystoliths not obvious; stem 3–4 mm diam. *Probract* absent. *Tendrils* 2–5-branched, the portion below point of branching ca. 1.5 cm long. *Leaves*: blade deeply-5-lobed to ca. $\frac{2}{3}$; membranous, hairy on both surfaces; suborbicular in outline, 16–31 by 13–28 cm, the base cordate with broad sinus, mid-lobe oblong, to 17 cm long, the apex acute-acuminate, to 15 mm long mucronate, the margin entire; glands several to many, less than 0.5 mm diam.; petiole 8–13 cm long. *Male inflorescences* composed of several male racemes arranged in loose lateral shoots, 50–100 cm long, on the older wood (where stem 10–12 mm thick), each raceme with a reduced leaf or linear bract 10–20 mm long and with or without a reduced tendril at the node. *Male raceme* lax, (6–)10–20 cm long, hairy, mostly co-axillary with a densely hairy pedice 15–13 cm long (without flower); peduncle (3–)12–14 cm long, ca. 2 mm thick; rachis with 3–8 flowers; bracts mostly inserted on the pedicel below the middle, persistent, membranous, \pm rhomboid, 15–25 by 5–15 mm, the apex acuminate, mucronate, with minute glands, margin entire. *Male flowers* wholly \pm densely brown hairy, the hairs 2–4 mm long; pedicel 0.5–4 cm long; receptacle tube ca. 20 mm long, at

throat ca. 10 mm diam., the base faintly swollen, forming a cup-shaped 'pseudo-ovary'; sepals narrowly triangular or linear, 15–20 mm long, 2–3 mm wide at base, the margin entire; petals finely hairy, wedge-shaped, 15–20 mm long, threads ca. 10 mm long; synandrium ca. 10 mm long, with anthers closely appressed but free, the filaments ca. 3 mm long, hairy at the base, inserted towards the base in the tube, at apex of 'pseudo ovary'. *Female flowers*: pedicel 50–80 mm long; ovary narrowly ellipsoid, ca. 35 by 10 mm, densely hairy; corolla as in male. *Fruits* (slightly immature) green, white striped, narrowly ellipsoid, ca. 15 by 6–8 cm; pericarp fleshy; exocarp thin, leathery, sparsely hairy, glabrescent; pulp whitish; fruiting pedicel ca. 11 by 0.3 cm. *Seeds* (immature) compressed, elliptic, ca. 1 cm long, margin entire.

Thailand.— SOUTH-WESTERN: Phetchaburi (Kaeng Krachan NP).

Distribution.— Endemic to Thailand, known from three collections: *Phonsena*, *De Wilde & Duyffes* 3980, 4001, 4002-type, all Kaeng Krachan NP.

Ecology.— Evergreen lower montane forest; on shales. Roadside and forest edges; at 700–900 m altitude. Flowering & fruiting in September.

Etymology.— Named in of Phongsak Phonsena, Thai botanist.

Notes.— 1. Male inflorescences are formed on almost leafless lateral shoots up to 1 m long on the older wood. The inflorescences are lax, and like the flowers, pale green, the corollas in fallen-off flowers are white. Female flowers and fruits are formed on the leafy nodes, shaded among the dense foliage.

2. Having white fruit pulp and a similar construction of the male flowers, with the stamens inserted low in the receptacle tube, and a 'pseudo-ovary' (the thick-walled basal part of the receptacle tube, without staminodes), the three species *T. kerrii*, *T. phonsenae* and *T. villosa* form a coherent, distinct group within *Trichosanthes*. The pollen of *T. phonsenae* much resembles that of *T. postari* from Borneo (Pruesapan & Van der Ham, in press). As long as the mature seeds of *T. phonsenae* are unknown we refrain from any formal grouping within *Trichosanthes*.

3. Yueh & Cheng (1974) accommodated *T. kerrii* and *T. villosa* into different sections: *T. kerrii* into section *Truncatae* C. Y. Cheng & C. H. Yueh, and *T. villosa* into section *Folio bracteola* C. Y. Cheng & C. H. Yueh.

11. *Trichosanthes pubera* Blume, Bijdr. Fl. Ned. Ind.: 936. 1826; Miq., Fl. Ind. Bat. 1, 1: 975. 1856; Rugayah & W. J. de Wilde, Blumea, 42, 2: 479, fig. 1c & c', 2c, 3c. 1997.— *T. bracteata* (Lam.) Voigt var. *pubera* (Blume) Cogn. in A. & C. DC., Monogr. Phan. Prodr. 3: 377. 1881. Type: Indonesia, Java, *Blume* s.n. (holotype L; isotype P).

A variable and widespread species with two subspecies. Subsp. *rubriflos* occurs in Thailand and is variable, particularly in the hairiness of young stems and lower leaf surfaces, the mode of incision of the margin of the male bracts and sepals (small or large, entire or with side-lobes). The variation in these characters is not unequivocal, but the differences in the male sepals are most striking. This subspecies is divided into two, more or less geographically separated, varieties. Female flowering and fruiting specimens can be placed only arbitrarily.

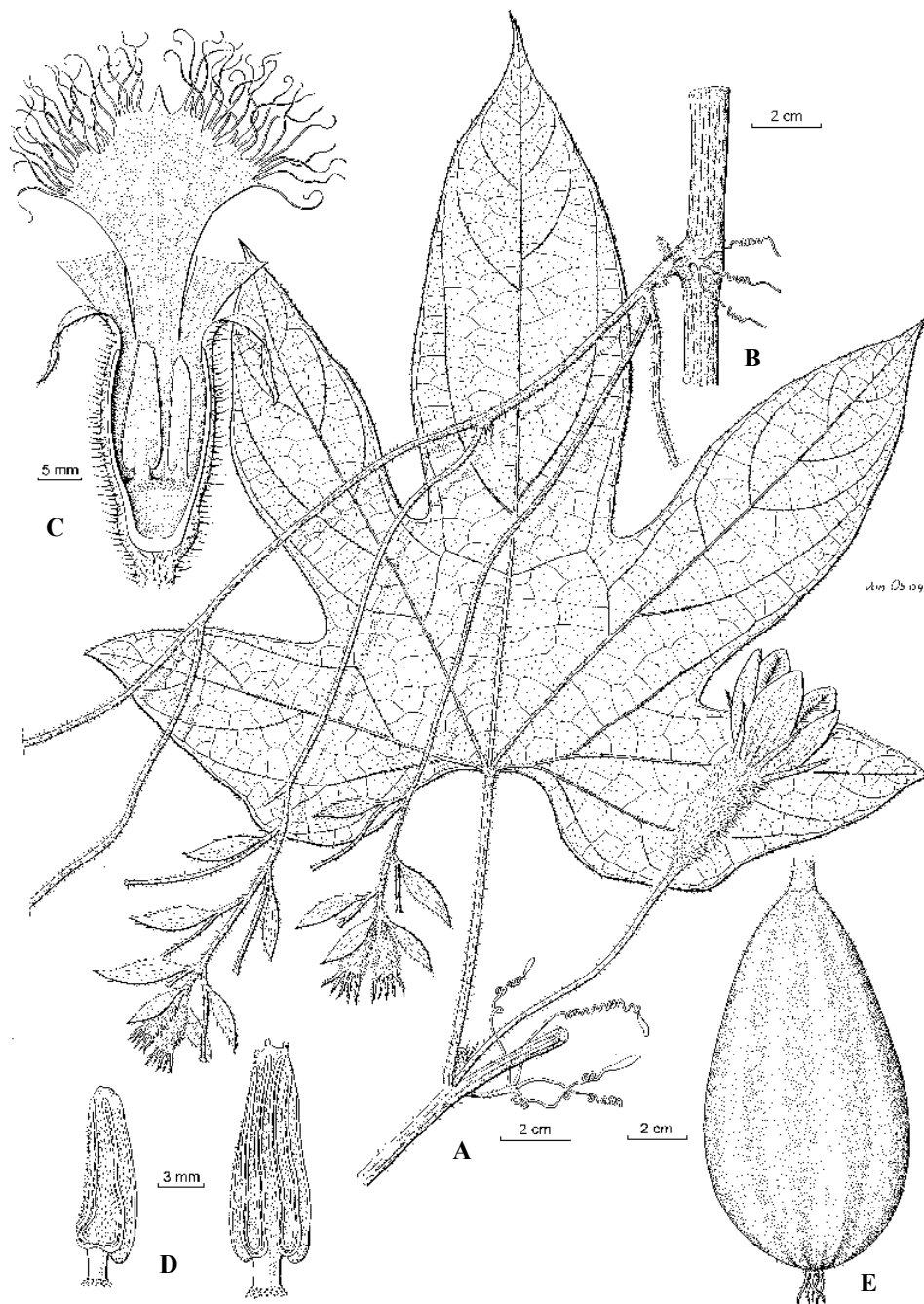


Figure 3. *Trichosanthes phonsenae* Duyfjes & Pruesapan: A. part of twig with a single female flower, petals not yet expanded; B. part of twig with compound male inflorescence, showing two partial inflorescences, note inflorescence on the older wood; C. opened male flower; D. two stamens, the left hand 1-theous, the right hand 2-theous; E. submature fruit. A, E: *Phonsena et al.* 4001; B–D: *Phonsena et al.* 4002. Drawn by Jan van Os.

KEY TO THE SUBSPECIES

1. Male bracts and flowers green, reddish tinged, but petals white, the threads pinkish at apex. (West Malesia, not in Thailand) **subsp. pubera**
 1. Male bracts and flowers deep purple red, but petals white or pink, red veined, threads red **subsp. rubriflos**

Trichosanthes pubera Blume subsp. **rubriflos** (Cayla) Duyfjes & Pruesapan, **comb. et stat. nov.** Figs. 5A–B.

Trichosanthes rubriflos Cayla, Bull. Mus. Hist. Nat. Par., 14: 170. 1908; Gagnep., Fl. Gén. Indoch. 2: 1043. 1921; Craib, Fl. Siam. Enum. 1: 753. 1931; Keraudren in Aubrév. & J.-F. Leroy, Fl. Camb., Laos, Viêt-Nam 15: 80. 1975; C. Jeffrey, Cucurbitaceae Eastern Asia, Kew: 41. 1980; S. K. Chen in A. M. Lu & S. K. Chen, Fl. Reip. Pop. Sin. 73(1): 232, pl. 57: 5–8. 1986; S. K. Chen in C. Y. Wu, C. Chen & S. K. Chen, Fl. Yunnan. 6: 358, pl. 93: 5–8. 1995. Lectotype (Keraudren 1975): Cambodia, Stung-treng, *Thorel* 2126 (lectotype P; isolectotypes P, K). Fig. 1H.

Climber 5–20 m long; hairy, partly glabrescent, the hairs 0.5–2 mm long, grey or pale rusty; growing shoots and bracts reddish, (reddish-) brown on drying, the petals pink or pink-veined rarely white; cystoliths obvious; stem 2–4 mm diam. *Probract* narrowly elliptic or linear, (10–)15–40(–50) mm long, entire, finely rusty hairy, without glands. *Tendrils* 2- or 3-branched. *Leaves*: blade unlobed or shallowly or deeply 3–5-lobed to $\frac{5}{6}$, membranous or chartaceous, scabrous above, short hairy below, broadly ovate in outline, 5–17 by 3–15 cm, the base shallowly or deeply cordate with broad or narrow sinus, the mid-lobe triangular to narrowly elliptic, up to 15 cm long, the apex acute-acuminate; margin finely or coarsely serrate; glands few or several, scattered, 0.5–1 mm diam.; petiole (sometimes conspicuously hairy when young) 5–11 cm long. *Male raceme* (4–)10–22 cm long, hairy; peduncle (3–)7–14 cm long, 2–3 mm thick; rachis with 5–15 flowers; bracts (sub)persistent, purple-red, membranous, obovate-rhomboid, 25–45 mm long, with glands, the margin coarsely or finely incised; flowers purple-red, except petals. *Male flowers*: pedicel 2–6 mm long; receptacle tube 20–55 mm long, at throat 5–7 mm diam.; sepals linear or ovate-elliptic, 7–23 mm long, the margin entire or with side-lobes; petals whitish or pale pink with reddish veins, \pm wedge-shaped, 20–30 mm long, threads ca. 10 mm long, (white or) reddish; synandrium ca. 10 mm long, the filaments 1–2 mm long, glabrous or hairy. *Female flowers*: pedicel ca. 10 mm long; ovary (narrowly) ellipsoid, 5–9 by 3–4 mm, sparsely or densely hairy; receptacle tube 25–35 mm long, at apex ca. 5 mm diam.; sepals long-triangular or narrowly elliptic, the apex acute-acuminate, 5–10 mm long, the margin entire. *Fruits* (orange-)red, subglobose or ovoid, 5–7(–8) by 4.5–5.5 cm, the apex short-rostrate; dry pericarp 5–10 mm thick; exocarp leathery, usually coarsely wrinkled on drying; pulp green-black; fruiting pedicel 1–5 by 0.3–0.4 cm. *Seeds* blackish-brown, compressed, variable in size and shape, elliptic-oblong to obliquely obovate, 9–12 by 4–5 by 1–2 mm, broadly rounded at base, (narrowly) rounded at apex, margin indistinct, edge faintly square or rounded, entire.

Distribution.— S China, NE India, Myanmar, Thailand, Laos, Cambodia & Vietnam (type).

Ecology.— In primary evergreen forest, mixed forest; in swamps, forest edges and roadsides; up to 1,700 m altitude.

Note.— subsp. *rubriflos* appears closely related to *T. wallichiana* (Ser.) Wight, a pink-flowered species of S China, India, Nepals and Bhutan (type). The latter has slender, entire male sepals as in var. *rubriflos*, but the probracts are broader, not linear.

KEY TO THE VARIETIES

1. Male sepals undivided or occasionally with a short side-lobe. Male bracts with coarsely incised margin. (C, N & E Thailand and S China & Indochina) **a. var. rubriflos**
1. Male sepals with side-lobes or deeply incised. Male bracts densely and finely incised, 5–10 mm deep. (N & W Thailand) **b. var. fissisepala**

var. **rubriflos**

Hairs on stem 0.5–1 mm long. *Leaf blade* below, along veinlets, with hairs ca. 0.5 mm long. *Male bracts* in upper half with coarsely incised margin, ca. 5 mm deep. *Male sepals* long-triangular or linear, (5–)10 mm long, entire or with an odd small side-lobe. Fig. 6C.

Thailand.— NORTHERN: Chiang Mai, Chiang Rai, Nan, Lampang, Phitsanulok; NORTH-EASTERN: Nong Khai; EASTERN: Nakhon Ratchasima; CENTRAL: Saraburi; SOUTH-EASTERN: Sa Kaeo, Chachoengsao, Chon Buri, Chanthaburi.

Distribution.— Indochina; possibly also S China, but no collections seen.

Ecology.— Forest clearings and roadsides; at 100–1,600 m altitude.

Vernacular.— Khi ka daeng (ขี้กาแดง).

var. **fissisepala** Duyfjes & Pruesapan, **var. nov.** a varietate *rubriflos* sepalis masculis latis, lobis lateralibus longis distincta. Typus: Thailand, Chiang Mai, *Van Beusekom & Phengkklai* 1250 (holotypus L; isotypus AAH, BKF, C, E, K, KYO, P).

Hairs on stem short or long, 1–2 mm long. *Leaf blade* below, especially along the veinlets, with hairs sparse or dense, short or long, ca. 0.5 or 1 mm long. *Male bracts* irregularly, densely, finely incised, 5–10 mm deep. *Male sepals* (broadly) ovate-oblong, 10–23 mm long, 3–5 mm wide, in lower half with several slender side-lobes, to 5 mm long.

Thailand.— NORTHERN: Mae Hong Son, Chiang Mai (*Van Beusekom et al.* 1250-type), Chiang Rai, Lamphun, Phrae, Tak; SOUTH-EASTERN: Kanchanaburi, Prachuap Khiri Khan.

Distribution.— Probably also in Laos, Cambodia and Vietnam, and S China, but no material seen.

Ecology.— Forest edges and roadsides; at 50–1,700 m altitude.

Vernacular.— Lee-are-tee (ลี-อา-ดี) (Karen), khi ka daeng (ขี้กาแดง).

Note.— The collection *Maxwell* 93-906 (immature fruit) is doubtful because it has glabrous leaves, and is annotated as wholly green, not reddish, but it has conspicuous long-linear probracts.

12. *Trichosanthes quinquangulata* A. Gray, Bot. U.S. Expl. Exped. 1: 645. 1854; Cogn. in A. & C. DC., Monogr. Phan. 3: 378. 1881; Craib, Fl. Siam. Enum. 1: 753. 1931; C. H. Yueh & C. Y. Cheng, Acta Phytotax. Sin. 12(4): 443. 1974; C. Jeffrey, Cucurbitaceae of Eastern Asia: 41. 1980; S. K. Chen in A. M. Lu & S. K. Chen, Fl. Reip. Pop. Sin. 73(1): 223, pl. 56: 1–4. 1986; S. K. Chen in C. Y. Wu, C. Chen & S. K. Chen, Fl. Yunnan. 6: 353, pl. 92: 1–4. 1995; Rugayah & W. J. de Wilde, Blumea 42: 479, fig. 1a, 2a, 3a. 1997; Rugayah, *Trichosanthes* (Cucurbitaceae) in Malesia: 130. 1999. Type: Philippines, Mangsi Island (Sulu Sea), *Wilkes* s.n. (holotype GH-A).— *T. bracteata* auct. non (Lam.) Voigt: Chakrav., Rec. Bot. Surv. India 17: 44, p.p. 1959.— *T. tricuspidata* auct. non Lour.: Keraudren in Aubrév. & J.-F. Leroy, Fl. Camb., Laos, Viêt-Nam. 15: 81, p.p. 1975. Fig. 11.

Climber 5–20 m; rarely monoecious; (sub)glabrous, hairs minute; plant green, blackish on drying, the petals white; cystoliths usually not obvious; stem 3–5 mm diam. *Probract* obovate-oblong, 8–12(–15) mm long, with glands. *Tendrils* (2–)3–5-branched. *Leaves*: blade 3–5-angular or lobed to ca. $\frac{1}{4}$; membranous, \pm scabrous above, suborbicular in outline, 8–21 by 7–16 cm, the base deeply cordate, lobes triangular, the apex acute-acuminate, the margin entire; glands several or numerous, close to the nerve axils, especially several in the axils of the main nerves at very base of the blade, 0.5–1 mm diam.; petiole 2.5–8(–10) cm long. *Male raceme* 10–25(–30) cm long, glabrescent; peduncle 7–14 cm long, 2–3 mm thick; rachis with 5–20 flowers; bracts late-caducous, membranous, (ob)ovate-elliptic or \pm rhomboid, 15–25 mm long, with glands near mid-nerve, the margin (sub)entire. *Male flowers*: pedicel (sub)caducous, 2–5(–10) mm long; receptacle tube 30–50 mm long, at apex ca. 7 mm wide; sepals long-triangular, 10–15 mm long, 2–3 mm wide at base, the margin with few slender side-lobes in basal part; petals very finely hairy, obovate or broadly cuneate, ca. 20 mm long, threads 10–15 mm long; synandrium 6–8 mm long, filaments 1–3 mm long, glabrous. *Female flowers*: pedicel 5–8(–20) mm long; ovary (ovoid-)ellipsoid, ca. 8 by 4 mm, glabrous; receptacle tube (25–)40–60 mm long; sepals smaller and narrower than in male, ca. 10 by 1 mm, entire. *Fruits* bright red, (depressed) globose, 5–6(–7) cm diam., the apex not beaked; dry pericarp 10–15 mm thick; exocarp leathery, smooth, coarsely wrinkled on drying or not; pulp green-black; fruiting pedicel 1–3 by 0.4–0.5 cm, usually curved. *Seeds* pale brown, compressed, elliptic-oblong, 8–10 by 4–5 by 1(–2) mm, pointed at one end, margin absent, edge square in section, entire.

Thailand.— NORTHERN: Lamphun (Doi Khun Tan NP), Chon Buri (Thung Brong); NORTH-EASTERN: Phetchabun (Phu Miang); SOUTH-WESTERN: Phetchaburi (Kaeng Krachan NP), Prachuap Khiri Khan; CENTRAL: Saraburi (Sam Lan forest); SOUTH-EASTERN: Sa Kaeo (Ang Rue Nai Wildlife Sanctuary), Nakhon Ratchasima (Korat, Pak Chong Nah Kate, near Sriracha), Chon Buri (Thung Brong); PENINSULAR: Songkhla (Hat Yai, Klong Hoi Kong), Narathiwat (Waeng), Surat Thani, Satun (Tarutao Island).

Distribution.— S China, Myanmar, Indochina, Malaysia, Indonesia, east to Philippines (type), and New Guinea.

Ecology.— A widespread species, in thickets of secondary growth, forest fringes, in bamboo and deciduous forest along streams, in evergreen forest; at 25–1,000 m altitude.

Vernacular.— Tum ka (ตุมกา), khi ka yai (ขี้กาใหญ่), khi ka khorn (ขี้กาขอน), kra dueng chang (กระดังงา), luk khi ka (ลูกขี้กา), buap liam (บวบเหลี่ยม) (Geranal).

13. *Trichosanthes siamensis* Duijjes & Pruesapan, sp. nov. *Trichosanthes ovigera* folii margine minute dentato fructu longitudinaliter pallide lineato similis, foliis infra glabris, seminibus crassis laevibus nec cupiformibus cingulo lato distincta. Typus: Thailand, Kanchanaburi, Thung Yai Naresuan Wildlife Sanctuary, Maxwell 94-546 (holotypus L; isotypus L).

Climber, several metres long; monoecious (see note); subglabrous, hairs shaggy, 0.5 mm long, largely early glabrescent; plant green, blackish on drying, the petals white; cystoliths not obvious; stem 2(–3) mm diam. *Probracts* absent. *Tendrils* simple. *Leaves*: blade unlobed or deeply 3–5-lobed to $\frac{3}{4}$, the lower lobes straight and downwards directed, membranous, (sub)glabrous; ovate or suborbicular in outline, 7–15 by 5–12 cm, base deeply cordate with narrow or broad sinus, or (sub)hastate, mid-lobe to 13 by 2.5 cm, the apex acute-acuminate, the margin entire or finely serrate-dentate; glands absent; petiole 1.5–4.5 cm long. *Male raceme* 12–14 cm long, (densely) minutely brown hairy, sometimes co-axillary with a solitary flower; peduncle 3–4 cm long, 1.5–2 mm thick; rachis with 15–20 flowers; bracts late caducous, chartaceous, subovate, 9–10 by 4–5 mm, with glands, the margin serrate-lobed. *Male flowers*: greyish hairy, glabrescent; pedicel caducous, ca. 5 mm long (10–20 mm long in solitary flower); perianth immature, presumably as in female flowers; synandrium ca. 6 mm long, the filaments ca. 3 mm long, subglabrous. *Female flowers*: pedicel ca. 15 mm long; ovary narrowly ellipsoid, much narrowed towards apex, ca. 10 by 2.5 mm, glabrous; receptacle tube 15–25 mm long, at apex ca. 4 mm wide; sepals long-triangular or linear, ca. 10 mm long, 1–1.5 mm wide, with glands, margin entire; petals ca. 12 mm long, threads ca. 6 mm long. *Fruits* green with whitish longitudinal streaks, ovoid, (narrowly) ellipsoid, narrowed at both ends, especially at apex, 7.5–9 by 3.5–4 cm; exocarp leathery, smooth; pulp unknown; fruiting pedicel 1.5–2.5 by 0.3 cm. *Seeds* (from detached material) pale brown, slightly compressed, ovoid-ellipsoid, 11–13 by 7–8 by 5 mm, the apex narrowly, the base broadly obtuse, smooth, the margin absent, edge entire.

Thailand.— SOUTH-WESTERN: Kanchanaburi (Sangkhla Buri, Thung Yai Naresuan Wildlife Sanctuary, Maxwell 94-546-type).

Distribution.— Endemic to Thailand and known only from the type.

Ecology.— Open or partly shaded, degraded, deciduous forest with much bamboo on rugged limestone area, at 400 m altitude.

Vernacular.— Bai khai tha (ใบไข่ทา) (Karen).

Note.— The two duplicate specimens seen of Maxwell 94-546, represent male flowering and fruiting material, either mounted on the same sheet, or female flowers and fruits on another sheet, but male and female are not connected. However, the plant is likely monoecious.

Field-notes.— Fruit light green with whitish-greyish vertical streaks. Leaves polymorphic, entire or lobed.

14. *Trichosanthes tricuspidata* Lour., Fl. Cochinch. 1: 589. 1790; 2: 723. 1793. Type: Vietnam, *Loureiro* s.n., lost; neotype (Keraudren 1975): Vietnam, Quang Nam, Da Nang, *J. & M. S. Clemens* 3267 (neotype P; isoneotype BM, selected by Keraudren, 1975).

Climber 5–20 m long; occasionally monoecious; minutely hairy, early glabrescent; plant green, brown on drying, the petals white; cystoliths obvious; stem 2–4 mm diam. *Probract* (broadly) elliptic or obovate, 2–11 by 2–5 mm, entire, with glands. *Tendrils* 2- or 3-branched. *Leaves*: blade shallowly (or deeply) 3–5-lobed, to $\frac{1}{3}$ –($\frac{3}{4}$) deep (leaves of juvenile plants deeply compoundly lobed); membranous or chartaceous, (sub) scabrous above, glabrous beneath; broadly ovate or orbicular in outline, (4–)7–15 by (3–)5–14 cm, the base cordate, the mid-lobe triangular or ellipsoid(-oblong), to 12 cm long, the apex acute(-acuminate), the apex of side-lobes frequently somewhat down-curved, the margin (sub)entire or \pm coarsely dentate, the glands few to several, scattered, 0.5–1 mm diam.; petiole 3–7.5 cm long. *Male raceme* 7–16 cm long, hairy (partly glabrescent); peduncle (2–)5–11 cm long, ca. 0.2 cm thick; rachis with 3–20 flowers; bracts persistent or late-caducous, membranous or chartaceous, (broadly) obovate-elliptic or rhomboid, 15–30(–40) by 14–20 mm, with conspicuous glands, the margin at apical portion irregularly lobed or incised, 2–7 mm deep. *Male flowers* short hairy; pedicel caducous, 3–5 mm long; receptacle tube 30(–50) mm long, at apex 4–7 mm wide; sepals (narrowly) ovate-triangular or oblong, 10–16 mm long, 3–5 mm wide at base, margin entire or \pm lobed at base, or serrate, without or with glands; petals obovate-rhomboid, ca. 15 mm long, the threads ca. 20 mm long, white or yellow; synandrium 6–10 mm long, the filaments ca. 3 mm long, (sub)glabrous. *Female flowers* (not known from Thailand): pedicel 5–10 mm long, ovary ovoid, ca. 10 mm long, glabrous (glabrescent); perianth as in male. *Fruits* bright red, (ellipsoid-)ovoid, 6–7 by ca. 4.5 cm; exocarp leathery, smooth, coarsely wrinkled on drying; pulp green-black; fruiting pedicel 1–2 by 0.3–0.4 cm. *Seeds* dark brown, compressed, obovate-elliptic or oblong, 9–10 by 5–6 by 1.5–2(–3) mm, the margin absent, edge square or rounded, entire.

Distribution.— Widespread; Myanmar (?), Thailand, and Indochina (Vietnam, type), West Malesia, east to the Moluccas. Not in the Philippines, possibly not in India and Bangladesh.

A fairly homogenous species which can be split into two very similar subspecies, largely defined geographically and according to the shape of the male sepals.

KEY TO THE SUBSPECIES

1. Male bracts with finely, densely, deeply serrate-lacinate margin. Male sepals with serrate margin or with side-lobes (female sepals entire). (Thailand, Indochina; rare in Malesia) **subsp. *tricuspidata***
1. Male bracts with shallowly coarsely dentate margin. Male sepals (almost) entire (female sepals entire). (West Malesia and locally in S Thailand) **subsp. *javanica***

subsp. *tricuspidata*

Trichosanthes tricuspidata Lour., Fl. Cochinch. 1: 589. 1790; 2: 723. 1793; Gagnep., Fl. Gén. Indoch. 2: 1042. 1921; Craib, Fl. Siam. Enum. 1: 754, for *Kerr* 6873 only. 1931; Keraudren in Aubrév. & J.-F. Leroy, Fl. Camb., Laos, Viêt-Nam. 15: 81, p.p., pl. 14: 1 & 4–7. 1975; C. Jeffrey, Cucurbitaceae of Eastern Asia: 39. 1980. Figs. 1J–K & 5C.

Leaves of adult plants shallowly or deeply 3-or 5-lobed, up to $\frac{4}{5}$ deep. *Male bracts* deeply and finely incised, up to ca. $\frac{1}{3}$ deep. *Male sepals* with margin serrate or margin with side-lobes.

Thailand.— NORTHERN: Mae Hong Son, Chiang Mai, Lampang; NORTH-EASTERN: Sakon Nakhon, Nong Khai; CENTRAL: Lob Buri; EASTERN: Chaiyaphum; SOUTH-EASTERN: Chanthaburi (Bo Rai, E of Makham).

Distribution.— S China (?), Laos, Cambodia, Vietnam (type), one collection from Peninsular Malaysia.

Ecology.— Secondary roadside thickets, in mixed deciduous forest edges; on limestone and granitic bedrock; at 100–1,200 m altitude.

Vernacular.— Khuea mak khi ka (เขื่อนมากชีกา) (Champasak, Laos), khi ka daeng (ชีกาแดง).

Note.— *Trichosanthes tricuspidata* subsp. *tricuspidata* as here defined appears quite homogeneous, except for the seeds. Mature seeds are known from Thailand from a comparatively large number of collections, and show a rather problematic variation in seed size and shape, comprising compressed forms with a square edge (e.g. *Pooma et al.* 2672), or more less-compressed forms with a rounded edge. Possible taxonomic implications of this variation are as yet unclear.

subsp. **javanica** Duyfjes & Pruesapan, **subsp. nov.** a subspecies typica bracteis masculis vadosae grosse dentatis, sepalis masculis integris differt. Typus: Indonesia, Java, *W. J. de Wilde & Duyfjes* 21777 (holotypus L; isotypus BO, K, L). Fig. 6B.

Trichosanthes tricuspidata auct. non Lour.: Blume, Bijdr. Fl. Ned. Ind.: 935, excl. type. 1826; Cogn. in A. & C. DC., Monogr. Phan. 3: 374. 1881; Rugayah & W. J. de Wilde, Blumea 42(2): 481, fig. 1b, 2b & 2c. 1997; Rugayah, *Trichosanthes* (Cucurbitaceae) in Malesia: 120, pl. 10. 1999.— *T. bracteata* auct. non. (Lam.) Voigt: Backer in Backer & Bakh. f., Fl. Java 1: 304. 1963.— *T. tricuspis* Miq., Fl. Ind. Bat. 1 (1): 679. 1856.

Leaves of adult plants 3-lobed, to $\frac{1}{3}$ – $\frac{1}{2}$. *Male bracts* shallowly and coarsely dentate. *Male sepals* (almost) entire.

Thailand.— SOUTH-WESTERN: Phetchaburi (*Phonsena, De Wilde & Duyfjes* 3982); SOUTH-EASTERN: Chanthaburi (*Larsen et al.* 32315; *Seidenfaden* 2878).

Distribution.— West Malesia (Java, type) to the Moluccas and Lesser Sunda Islands (not in Philippines).

Vernacular.— Khi ka daeng (ชีกาแดง).

Note.— Collections from Kaeng Krachan NP have conspicuously bright yellow petal fringes, not white as in the specimens from the type locality (Java).

15. *Trichosanthes truncata* C. B. Clarke in Hook. f., Fl. Brit. Ind. 2: 608. 1879; Cogn. in A. & C. DC., Monogr. Phan. 3: 364. 1881; Chakrav., Ind. J. Agric. Sc. 16(1): 22. 1946; Monogr. Ind. Cucurbitaceae, 17(1): 39. 1959; S. K. Chen & C. H. Yueh, Acta Phytotax.

Sin. 12(4): 434. 1974; C. Jeffrey, *Cucurbitaceae Eastern Asia*, Kew: 43. 1980; Kew Bull. 34: 797. 1980; S. K. Chen in A. M. Lu & S. K. Chen, *Fl. Reip. Pop. Sin.* 73(1): 238. 1986; S. K. Chen in C. Y. Wu, C. Chen & S. K. Chen, *Fl. Yunnan.* 6: 364. 1995. Type: India, Khasia, Cherra Coal-pit, *Hooker & Thomson* 1188 (lectotype K, select here).— *T. ovata* Cogn. in A. & C. DC., *Monogr. Phan.* 3: 365. 1881; C. H. Yueh & C. Y. Cheng, *Acta Phytotax. Sin.* 12(4): 435. 1974; S. K. Chen in A. M. Lu & S. K. Chen, *Fl. Reip. Pop. Sin.* 73(1): 237. 1986; S. K. Chen in Y. Wu, C. Chen & S. K. Chen, *Fl. Yunnan.* 6: 364, pl. 94: 7–10. 1995. Type: India, Sikkim, *Thomson* 148 (holotype L; isotype LE).

Climber, 4–10 m long; glabrous or very minutely hairy, glabrescent; plant green, not reddish tinged, the petals white; cystoliths not obvious; stem 2–4 mm diam. *Probract* absent. *Tendrils* simple (Annam) or 2- or 3-branched. *Leaves*: blade unlobed or rarely (deeply) 3-lobed; chartaceous, glabrous; ovate(-oblong), 8–16 by 7–14 cm, the base cuneate or rounded or shallowly cordate (sometimes slightly peltate), the apex acute-acuminate, the margin subentire or sparsely sharply dentate, with apical teeth 1–1.5 mm long; nerves prominent beneath; glands absent; petiole 3–6 cm long. *Male raceme* solitary or sometimes panicle-like branching from the older wood, (4–) 10–20 cm long, glabrous or glabrescent, sometimes with a long-pedicelled flower co-axillary, or male inflorescence existing of one solitary flower at the node only; peduncle 3–7 cm long, 1–1.5 mm thick; rachis with 4–24 flowers; bracts sessile or 1(–2) mm stiped, persistent, chartaceous, suborbicular or (narrowly) elliptic, 7–16(–20) by 2–12 mm, at base usually narrow, without or with several glands, the margin entire or sharply 3–5-toothed or shallowly lobed. *Male flowers* minutely hairy; pedicel 2–6 mm long; receptacle tube 20 mm long, at apex ca. 7 mm wide; sepals linear, reflexed, 5–8 mm long, less than 1 mm wide, margin entire; petals finely hairy, long-cuneate, ca. 20 mm long, threads ca. 10 mm long; synandrium not seen, filaments glabrous. *Female flowers* (not known from Thailand): pedicel 3–4 cm long; ovary ellipsoid, ca. 20 by 8 mm, brown hairy; sepals slightly shorter than in male; petals like in male. *Fruits* (not known from Thailand, description from literature) orange, ellipsoid (or oblong), 12–18 by 5–10 cm, glabrous; fruiting pedicel (1?–)4–5 cm long. *Seeds* (pale) brown, oblong-obovate, 18–30 by 12–20 by 4–6 mm, the apex subrounded, the base obtuse to oblique, sometimes slightly emarginate, the margin present, edge entire.

Thailand.— NORTHERN: Chiang Mai (Doi Suthep-Pui NP; Ban Pa Deng, Mae Dang District; Mae Soi Ridge-Awp Luang NP near Ban Bah Gluay; Mong village, Jawm Thong District), Nan (Doi Phukha NP).

Distribution.— China (Yunnan), India (Assam, Sikkim, type), Bangladesh, Vietnam (Annam).

Ecology.— (Degraded) deciduous or evergreen forest, forest with bamboo; rugged limestone terrain or on granite bedrock; at 900–1,450 m altitude.

Notes.— 1. The description in the present treatment is drawn largely from the restricted Thai material available, supplemented with data (especially for fruit and seed) from the literature. The male flowers seen from Thai material are full grown buds and one open flower. According to Clarke (1879) the receptacle tube at anthesis is ‘0.75–1.5 inch long’.

2. Yueh & Cheng (1974), Chen (1986) and Chen (1995) accept both *T. ovata* and *T. truncata* for China, besides *T. smilacifolia* C. Y. Wu. Differences mentioned are in the male bracts (in *T. ovata* chartaceous, without stipe, in *T. truncata* coriaceous with stipe), in the sepals (in *T. ovata* longer than in *T. truncata*) and in the seed size (in *T. ovata* smaller than in *T. truncata*). Tentatively, we do not follow this for Thailand because the above mentioned differences are not distinct there, and also because the types of both names concerned are from India, and both are without fruits and seeds.

3. According to Yueh & Cheng (1974, 1980) and Chen (1995) *T. truncata* and *T. smilacifolia*, from China, have the same habit and male flowers, but different seeds. In *T. smilacifolia* the edge of the seeds is crenate, that of *T. truncata* entire (see also Chen, 1995, pl. 94, 5).

4. Maxwell 93-862, a male plant, contains one (immature) solitary female flower.

Field-notes.— Calyx tube pale light yellow-greenish, lobes green, corolla lobes whitish with light green veins; anthers cream.

16. *Trichosanthes villosa* Blume, Bijdr. Fl. Ned. Ind.: 934. 1826; Cogn. in A. & C. DC., Monogr. Phan. 3: 366. 1881; Gagnep., Fl. Gén. Indoch. 2: 1047, p.p. 1921; Craib, Fl. Siam. Enum. 1: 754, ?p.p. (see notes). 1931; Backer in Backer & Bakh. f., Fl. Java 1: 304. 1963; C. H. Yueh & C. Y. Cheng, Acta Phytotax. Sin. 12(4): 443, pl. 87: 2. 1974; Keraudren in Aubrév. & J.-F. Leroy, Fl. Camb., Laos, Viêt-Nam 15: 77. p.p., pl. 13: 4. 1975; S. K. Chen in A. M. Lu & S. K. Chen, Fl. Reip. Pop. Sin. 73(1): 224. 1986; S. K. Chen in C. Y. Wu, C. Chen & S. K. Chen, Fl. Yunnan. 6: 354. 1995; Rugayah & W. J. de Wilde, Blumea 42(2): 481. 1997; Rugayah, *Trichosanthes* (Cucurbitaceae) in Malesia: 152. 1999. Type: Indonesia, West Java, Blume s.n. (holotype L; isotype P). Figs. 1M, 4 & 5D.

Climber 8–25 m long; brown or grey-white villose, the hairs ca. 1 mm long, to 3 mm long in sterile running shoots; plant green, the petals white; cystoliths not obvious; stem 3–4 mm diam. *Probract* absent. *Tendrils* 4–7(–9)-branched, portion below point of branching 1–3 cm long, late glabrescent. *Leaves*: blade unlobed or shallowly 3–5-lobed or angular; membranous, minutely whitish (rough-)hairy above, villose below; broadly ovate or suborbicular in outline, (8–)10–18 by (4.5–)6–14 cm, the base cordate, the apex acute-acuminate, to 12 mm long mucronate, the margin entire; glands few to many, scattered, ca. 0.5 mm diam.; petiole 5–9 cm long. *Male raceme* 10–20(–30) cm long, hairy; peduncle 5–13 cm long, 2–3 mm thick; rachis with 10–20 flowers; most bracts inserted on the pedicel below the middle, subpersistent, \pm obovate, 20–40(–60) by 20–30(–40) mm, mostly with small glands, the margin subentire or shallowly lobed-dentate. *Male flowers* shaggy hairy; pedicel ca. 30 mm long; receptacle tube 25–30 mm long, at throat 8–12 mm diam., the base \pm swollen, forming a ‘pseudo-ovary’; sepals linear or narrowly triangular, 13–20 mm long, 1–2 mm wide at base, the margin entire; petals finely hairy, wedge-shaped, 15–20 mm long, the threads ca. 10 mm long; synandrium 10–12 mm long, the filaments 2–3 mm long, glabrous, inserted about halfway the tube. *Female flowers* (not seen from Thailand): pedicel 30(–50) mm long; ovary ellipsoid, ca. 10 mm long, hairy; otherwise like in male. *Fruits* green, longitudinally whitish banded, broadly ellipsoid, ca. 14 by 11.5 cm, glabrous (glabrescent); pericarp hard-fleshy, ca. 15 mm thick; exocarp thin, woody-leathery, not wrinkled on drying; pulp white, finely fibrous; fruiting pedicel ca. 5 by 0.6 cm. *Seeds* bright brown, compressed, ovate-oblong, (23–)25–27 by 11–12 by 5–6 mm, the base narrowly rounded, apex truncate, notched, and laterally \pm bulging, the margin 2–3 mm broad, edge rounded, entire.

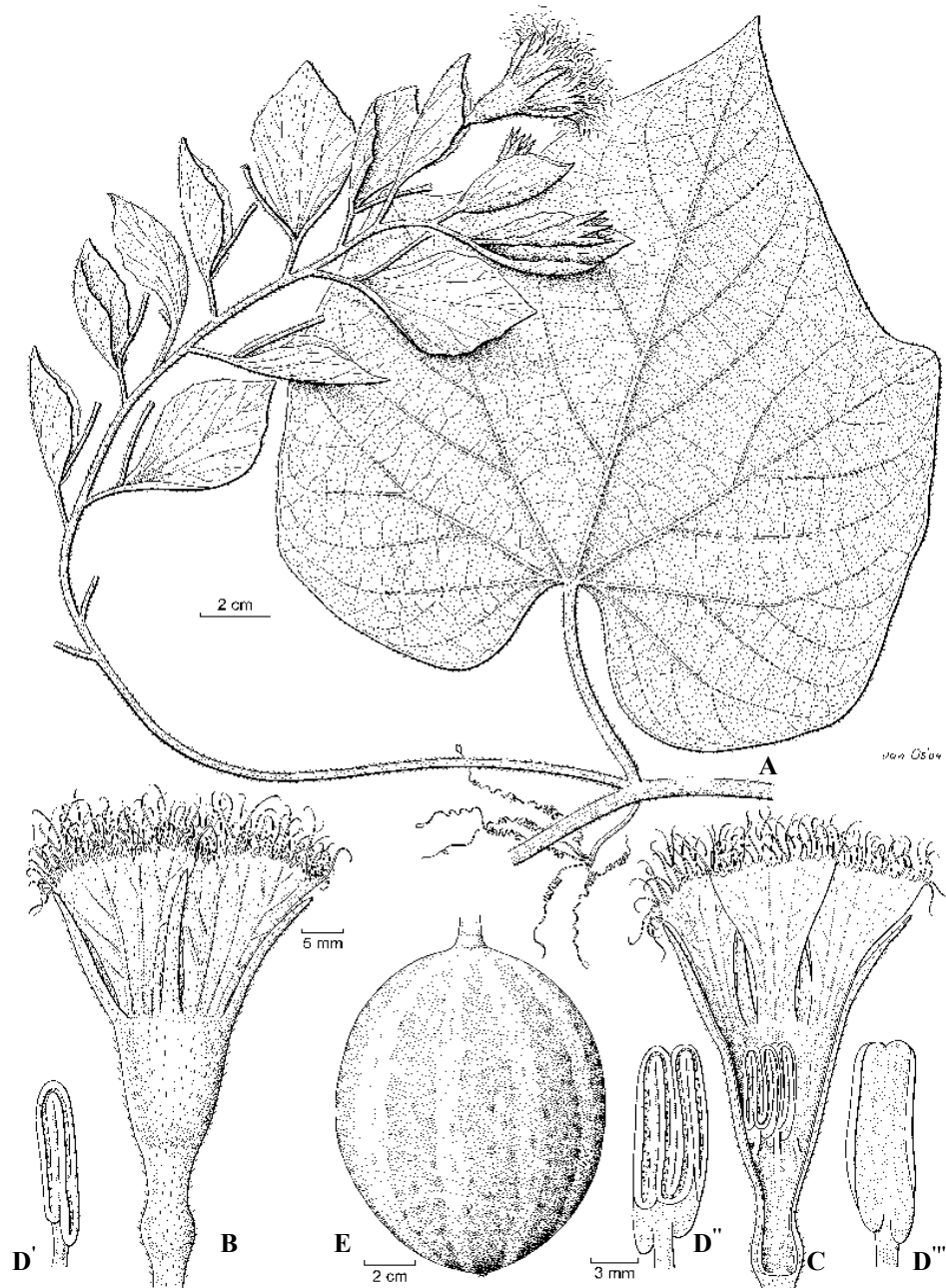


Figure 4. *Trichosanthes villosa* Blume: A. part of twig with male inflorescence; B male flower; C. opened male flower; D'. stamen, 1- thecous; D"—D'''. stamens, 2-theous, showing ab-and adaxial side respectively; E. fruit. A—D: Phonsena et al. 4000; E: Phonsena et al. 3518. Drawn by Jan van Os.

Thailand.— NORTHERN: Chiang Mai (Doi Inthanon NP); NORTH-EASTERN: Nong Khai (Singhanat Ban Phot Temple); SOUTH-WESTERN: Kanchanaburi (Erawan NP), Phetchaburi (Kaeng Krachan NP); SOUTH-EASTERN: Chantaburi (Khao Soi Dao).

Distribution.— Yunnan (no material seen), Indo-china (no material seen), Java (type), Borneo (Sabah), Philippines, Lesser Sunda Islands east to Flores. Not known from Peninsular Malesia and Sumatra.

Ecology.— In mixed evergreen (deciduous) forest, and bamboo forest, near streams; at 150–550 m altitude.

Vernacular.— Taeng soi dao (แตงสอยดาว).

Notes.— 1. Female flowers are not known from Thailand, while fruits are known only from one collection.

2. The records of *T. villosa* by Craib (1931): 754, pertain largely to specimens of *Thladiantha cordifolia* Blume, a species with the leaves similarly densely villose below. Only the collection Kerr s.n., 22 Oct. 1922, Mae Taeng, Chiang Mai (BM), may belong to *T. villosa*.

3. Whether the Thai and Chinese collections of *T. villosa* are similar to those from Malesia needs further study; possibly in Thailand the seeds are bigger, and the sepals of the male flowers narrower.

17. *Trichosanthes wawrae* Cogn. in A. & C. DC., Monogr. Phan. 3: 384. 1881 ('wawraei'); Ridl., Fl. Malay Penin. 1: 845. 1922; Craib, Fl. Siam. Enum. 1: 754. 1931; Rugayah & W. J. de Wilde, Blumea 42: 481. 1997; Rugayah, *Trichosanthes* (Cucurbitaceae) in Malesia: 108. 1999. Type: Singapore, *Wawra* 241 (holotype W).— *T. trifolia* auct. non (L.) Blume: Blume, Bijdr. Fl. Ned. Ind.: 936. 1826 ("trifoliata"); Backer in Backer & Bakh. f., Fl. Java 1: 303. 1963. Fig. 1L.

Climber, 3–8 m long; glabrous or partly short hairy; plant green, the petals white; cystoliths obvious or not; stem ca. 2 mm thick. *Probract* obovate ca. 4 by 2 mm, with glands (always?). *Tendrils* 2-branched. *Leaves*: blade: 3-foliolate, in juvenile plants partly simple, lobed or unlobed; membranous, ± glabrous; suborbicular in outline, the middle leaflet obovate-lanceolate, 4.5–9 by 2–4 cm, base long-cuneate, apex acute-acuminate, the lateral leaflets unequal-sided (sometimes deeply 2-lobed), ovate-oblong, of about the same size as the middle one, the margin entire or minutely sparsely dentate; glands absent to several, scattered, ca. 0.5 mm diam.; petiolules ca. 0.5 cm long; petiole 2–3.5(–5) cm long. *Male raceme* 9–20 cm long, thinly hairy; peduncle 2–6 cm long, 2(–3) mm thick; rachis with 10(–20) flowers; bracts (sub)persistent, membranous, obovate or oblong, 7–13 by 2–7 mm, with glands, the margin (entire or) shallowly or deeply dentate-laciniate. *Male flowers*: pedicel ca. 3 mm long; receptacle tube 20(–40) mm long, narrow in lower half, at apex (3–)5 mm wide; sepals narrowly triangular, 5–7 mm long, ca. 2 mm wide at base, entire; expanded petals not seen; synandrium ca. 11 mm long, the filaments ca. 1 mm long, glabrous. *Female flowers* (not seen in Thai material): pedicel 5–15 mm long, ovary ovoid, ca. 10 by 5 mm, glabrous; perianth as in male. *Fruits* (orange-)red with yellowish lengthwise streaks, ovoid, ca. 7 by 5 cm; pericarp ca. 5 mm thick when dry, with age leaving the exocarp leathery; pulp greenish-blackish; fruiting pedicel 0.5–2 by ca. 0.3 cm. *Seeds* dark brown, compressed, ovate or elliptic (–oblong), 15–17 by 10–11 by 2 mm, the base subtruncate, the apex obtuse or subacute, the margin broad but obscure, the edge entire.

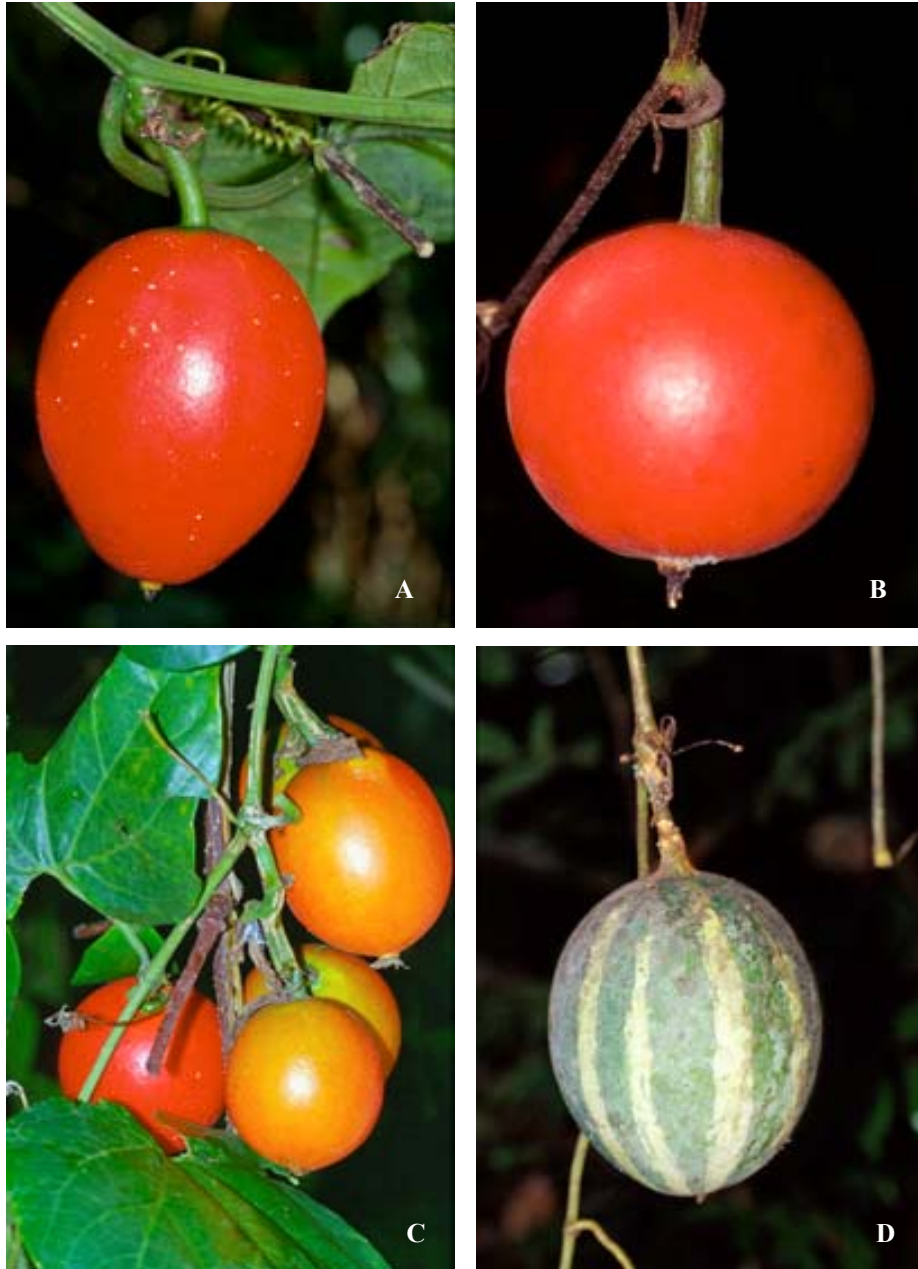


Figure 5. *Trichosanthes pubera* Blume subsp. *rubriflos* (Cayla) Duyfjes & Pruesapan: A. ovoid fruit (Doi Inthanon NP); B. globose fruit (Doi Suthep-Pui); C. *Trichosanthes tricuspidata* Lour. subsp. *tricuspidata* (Central Thailand, roadside); D. *Trichosanthes villosa* Blume, mature fruit (Chanthaburi, Khao Soi Dao WS). Photographed by W.J.J.O. de Wilde.

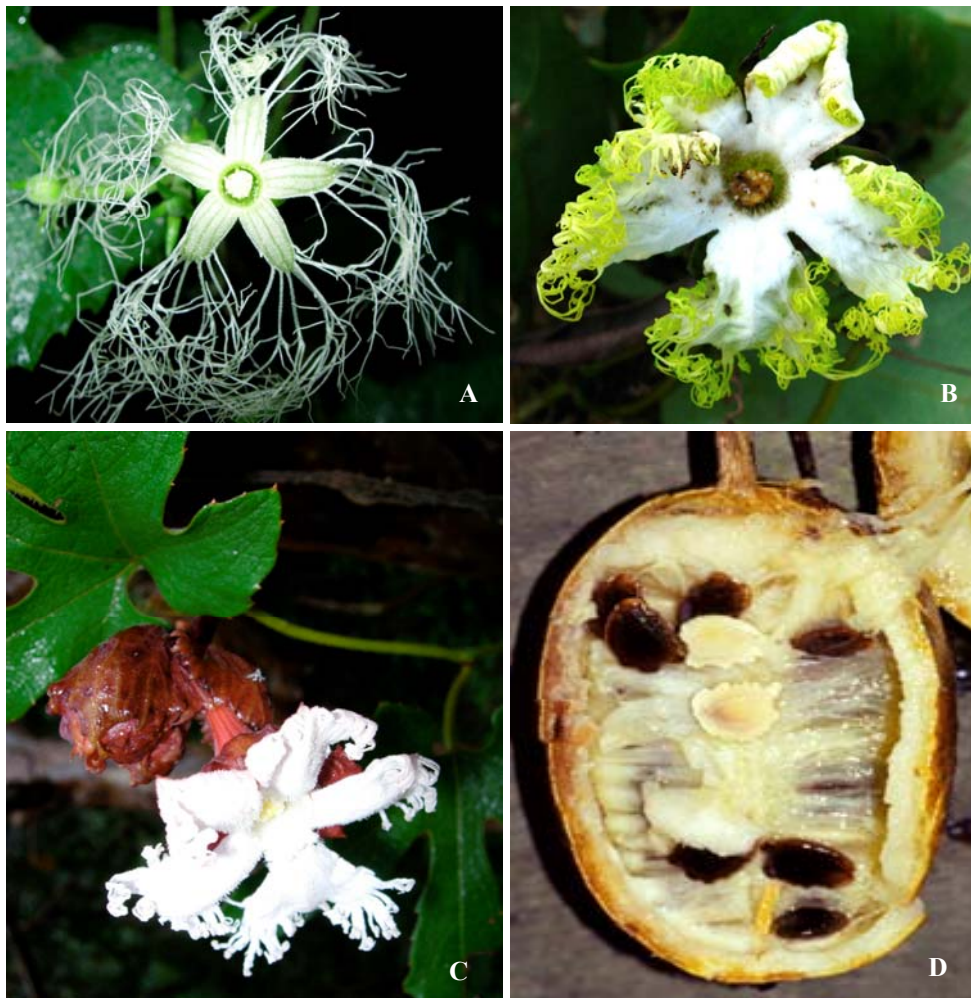


Figure 6. A. *Trichosanthes ovigera* Blume, male flower (Doi Inthanon NP); B. *Trichosanthes tricuspidata* Lour. subsp. *javanica* Duyfjes & Pruesapan, male flower (Kaeng Krachan NP); C. *Trichosanthes pubera* Blume subsp. *rubriflos* (Cayla) Duyfjes & Pruesapan var. *rubriflos*, male flower, a specimen with completely white flowers (Doi Inthanon NP); D. *Trichosanthes kerrii* Craib, showing crenate seed margin (Doi Phukha NP). Photographed by W.J.J.O de Wilde.

Thailand.— SOUTH-EASTERN: Chonburi; PENINSULAR: Pattani, Satun.

Distribution.— West Malesia: Peninsular Malaysia, Singapore (type), Sumatra, Java, Borneo (Sarawak).

Ecology.— Open areas, forest edges, in evergreen forest, at 200–900 m altitude. Flowering April & June; fruiting March.

Vernacular.— Khi ka din (ขี้กาเดิน).

18. *Trichosanthes* species aff. *laceribractea* Hayata

Three collections from Indochina (*Pételot* 1084, Tonkin; *Poilane* 11304, Annam; *Poilane* 16778, Laos), treated in Flora of Laos, Cambodia & Vietnam (Keraudren, 1975) under the widely conceived *T. tricuspidata* Lour., actually represent a separate species. The collection *Pételot* 1084 was mentioned by Jeffrey (1980) as representing the SE Chinese species *T. laceribractea*. However, comparison of the original description (Hayata, 1911) with the treatments in Flora of China (S. K. Chen, 1986) and Flora of Yunnan (S. K. Chen, 1995) reveals some substantial differences, viz. plants obviously not red-tinged, bracts long and slender, male sepals narrower with long and slender side-lobes, leaves glabrous below, glands copious, 2–3 mm diam., all characters not mentioned for *T. laceribractea*. The provenance of the three above mentioned collections makes the discovery of this possibly yet undescribed species in Thailand probable.

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We thank the curators of the herbaria AAU, BK, BKF, E, L, K, P and SING for providing loans. We are grateful to the staff of the Royal Botanic Gardens Kew and the Paris Herbarium for providing facilities during the time we worked there. The Director and staff of the Forest Herbarium (Bangkok) generously facilitated instrumental fieldwork. Dr Chumpol Khunwasi (Chulalongkorn University) gave us the chance to work on *Trichosanthes* in Thailand. The Latin diagnoses of the new taxa were provided by J.F. Veldkamp, and Jan van Os prepared the fine drawings. The second author thanks ARCBC (Asean Regional Center for Biodiversity Conservation, Manila, a joint co-operation project between ASEAN and the European Union) for financial support, while staying at Leiden.

REFERENCES

- Chakrabarty, H. L. 1959. Monograph on Indian Cucurbitaceae. Record of the Botanical Survey of India 17(1): 28–56.
- Chen, S. K. 1986. *Trichosanthes*. In: Lu, A. M. & Chen, S. K. (eds), Flora Reipublicae Popularis Sinicae 73, 1: 218–257. Science Press. Beijing.
- . 1995. *Trichosanthes*. In: Wu, C. Y., Chen, C. & Chen, S. K. (eds), Flora Yunnanica. 6: 351–376. Science Press. Beijing.
- Clarke, C.B. 1879. Cucurbitaceae. In: Hooker J. D., Flora of British India 2: 604–635. Reeve & Co. London.

- Craib, W. G. 1931. *Florae Siamensis Enumeratio*: a list of the plants known from Siam, with records of their occurrence 1: 751–755. Siam Society, Bangkok.
- De Wilde, W. J. J. O. & Duyfjes, B. E. E. 2004. The genus *Trichosanthes* (Cucurbitaceae) in Sabah. *Sandakania* 14: 5–32.
- Haines, H. H. 1922. The botany of Bihar and Orissa; an account of all the known indigenous plants of the province and of the most important or most commonly cultivated exotic ones 3: 385–399. Adler & Son & West Newman Ltd., London.
- Hayata, B. 1911. Materials for a flora of Formosa. *Journal of the College of Science, Imperial University Tokyo* 44: 117.
- Huang, L., Yue, C., Yang, B., Cheng, C., Li, N., Ruan, C., Qu, L. & Gu, H. 1998. Systematic studies on *Trichosanthes* L. (Cucurbitaceae). In: Chiu, S.-T. & Peng, C.-I. (eds), *Proceedings of the Cross-strait symposium on floristic diversity and conservation*. National Museum of Natural Science, Taichung.
- Jeffrey, C. 1980. The Cucurbitaceae of eastern Asia. A report on studies made during, and in connexion with, a visit to China, Hong Kong and Japan in 1980. Royal Botanic Gardens, Kew, U.K. 60 pp.
- Keraudren-Aymonin, M. 1975. Cucurbitacées. In: Aubréville, A. & Leroy, J.-F., *Flore du Cambodge, du Laos et du Viêt-Nam* 15: 76–92. Paris.
- Pruesapan, K. & Van der Ham, R. A. J. M. In press. Pollen morphology of *Trichosanthes* (Cucurbitaceae). *Grana* (in press).
- Rugayah & De Wilde, W. J. J. O. 1997. *Trichosanthes* L. (Cucurbitaceae) in Java. *Blumea* 42: 417–482.
- _____. 1999. Conspectus of *Trichosanthes* (Cucurbitaceae) in Malesia. *Reinwardtia* 11(4): 227–280.
- Rugayah. 1999. *Trichosanthes* (Cucurbitaceae) in Malesia. Dissertation. Institute Pertanian Bogor: 1–2–39.
- Smitinand, T. 1980. Thai Plant Names: botanical names-vernacular names. Royal Forest Department, Bangkok.
- _____. 2001. Thai Plant Names: botanical names-vernacular names. Revised edition. Royal Forest Department, Bangkok.
- Yueh, C. H. & Cheng, C. Y. 1974. A preliminary study on the Chinese medicinal species of genus *Trichosanthes* L. *Acta Phytotaxonomica Sinica* 12(4): 415–445.
- _____. 1980. The Chinese medicinal species of the genus *Trichosanthus* L. *Acta Phytotaxonomica Sinica* 18(3): 333–352.

IDENTIFICATION LIST

- 1a = *T. cucumerina* var. *cucumerina*
 1b = *T. cucumerina* var. *anguina*
 2 = *T. dolichosperma*
 3 = *T. dunniana*
 4 = *T. erosa*

- 5 = *T. inthanonensis*
- 6 = *T. kerrii*
- 7 = *T. kostermansii*
- 8 = *T. ovigera*
- 9 = *T. pallida*
- 10 = *T. phonsenae*
- 11 = *T. pubera* subsp. *rubriflos*
- 11a = *T. pubera* subsp. *rubriflos* var. *rubriflos*
- 11b = *T. pubera* subsp. *rubriflos* var. *fissisepala*
- 12 = *T. quinquangulata*
- 13 = *T. siamensis*
- 14 = *T. tricuspidata*
- 14a = *T. tricuspidata* subsp. *tricuspidata*
- 14b = *T. tricuspidata* subsp. *javanica*
- 15 = *T. truncata*
- 16 = *T. villosa*
- 17 = *T. wawrae*

Balick et al. 3409: 11.— *Boonnak* 655: 11.

Chayamarit et al. 1539: 11; 1622: 3; 1966: 11.— *Chiramongkolgarn* UC 384: 11b.— *Collins* 901: 11; 1494: 12; 1648: 12; 1649: 8.— *Congdon* 261: 12.

De Wilde et al. 22128: 11a; 22130: 11a; 22131: 12; 22138: 8; 22140: 8; 22141: 11b; 22142: 11; 22143: 5; 22146: 11a; 22150: 14a; 22164: 11; 22167: 14a; 22267: 16; 22295: 11a; 22296: 11a.

Garrett 442: 8; 818: 11b; 1486: 1a.— *Geesink et al.* 6183: 9.

Henderson SF 25225: 14.

Iwatsuki et al. T-10364: 11; T-10372: 11b; T-10865: 11b; T-11079: 8; T-13269: 11.

Kasin 361: 11b.— *Kerr* 1-08-1924: 1a; 10880: 12; 1266: 14; 12715: 12; 14585: 17; 14965: 17; 17327: 12; 17631: 1a; 2454: 6; 27-8-1921: 14; 372: 1a; 4414: 11; 4414A: 11a; 5660: 14; 653: 14a; 6873: 14; 714: 1a; 8203: 12; 8203A: 12; 9711: 12.— *Kocyan* AK189: 15.— *Konta et al.* 4020: 11; 4022: 8.— *Koonkhunthod et al.* 326: 12; 334: 16.— *Kostermans* 1078: 11b; 743: 7.

Lace 6228: 11b.— *Ladell* 228: 12.— *Lakshnakara* 244: 1a; 767: 12; 926: 11.— *Larsen et al.* 2277: 11b; 2956: 15; 32315: 14b; 46198: 11a; 46381: 11a.

Marcan 1504: 12; 1808: 1a; 420: 11a; 998: 1a.— *Maxwell* 13-7-1969: 1b; 71-641: 11; 71-770: 12; 71-778: 1a; 72-387: 11; 72-603: 12; 72-719: 11; 73-601: 12; 74-926: 8; 75-1077: 11a; 75-693: 12; 75-719: 11a; 76-381: 17; 86-389: 12; 87-1145: 8; 87-1224: 14a; 87-1318: 11; 87-1523: 8; 88-1036: 8; 88-1091: 11; 88-799: 11a; 88-803: 11b; 89-1184: 3; 89-1369: 8; 89-1462: 8; 89-553: 11b; 90-1105: 8; 90-669: 15; 90-852: 11b; 90-853: 11; 91-628: 11b; 91-698: 11b; 91-911: 1a; 91-927: 11b; 93-1084: 8; 93-1222: 8; 93-438: 11b; 93-862: 15; 93-906: cf. 11b; 93-946: 15; 94-546: 13; 94-854: 11b; 94-934: 12; 96-1240: 8; 96-854: 14a; 97-645: 11b; 97-868: 11; 98-1140: 8; 98-910: 14a; 02-345: 8; 03-197: 11b.— *Middleton* 165: 8; 196: 11a.— *Middleton et al.* 1068: 11b; 2168: 11.— *Mitsuta et al.* T-50463: 11.— *Murata* T-17222: 1a; *Murata et al.* T-16568: 14a; T-16718: 11b; T-17171: 14; T-51642: 11; T-51644: 8.

Niyomdham 4485: 4.— *Niyomdham et al.* 1531: 12.— *Nooteboom et al.* 783: 11.— *Nui Noe* 265: 14.

Paisooksantivatana y1619-86:14.— *Palee* 269: 12; 385: 14a; 458: 11a.— *Phengkklai et al.* 1164: 12; 6225: 11b; 7016: 5.— *Phonsena et al.* 3907: 11a; 3914: 11; 3916: 11; 3921: 11; 3926: 11; 3951: 11a; 3970: 11a; 3518: 16; 3521: 8; 3905: 16; 3913: 8; 3915: 11b; 3917: 15; 3925: 11b; 3927: 8; 3930: 5; 3933: 5; 3938: 11b; 3944: 15; 3952: 5; 3958: 5; 3959: 6; 3967: 15; 3969: 6; 3977: 14a; 3980: 10; 3981: 9; 3982: 14b; 4000: 16; 4001: 10; 4002: 10; 4007: 14a; 4414: 14b; 4415: 14b; 4417: 14b; 4419: 10; 4449: 16.— *Pooma et al.* 500: 14; 1656: 14; 2671: 11a; 1656: 14; 2574: 14a; 2585: 14a; 2672: 14a; 2690: 16; 2900: 14a; 2943: 14a; 2963: 14a; 3103: 11b; 3106: 11b; 500: 14.— *Pradit* 226: 14; 346: 11; 527: 11.— *Prayad* 367: 11; 423: 12; 450: 11.— *Pruesapan* KP66: 7; KP67: 5.— *Put* 124: 11a; 2540: 1a.

Sai Jai 45: 15.— *Santisuk* 1420: 11.— *Seidenfaden* 2879: 14b.— *Shimizu* T-11764: 12; T-11779: 2.— *Shimizu et al.* T-10799: 8; T-19165: 11.— *Smitinand* 3520: 14.— *Smitinand et al.* 1334: 11a.— *Sørensen et al.* 7627: 11b.— *Suradej* 49: 11.— *Sutheesorn* 2443: 11; 2732: 12; 3425: 12.

Tagawa et al. T-10629: 11a; T-11245: 11a.— *Takahashi* T-62576: 14a.— *Tamura* T-60124: 11.

Van Beusekom et al. 1250: 11b; 19051: 11a; 3464: 11b.— *Vidal et al.* 6307: 11b.

Wongprasert 009-25: 11; 012-21: 12; 27-05-1998: 6; 997-35: 11.

A new species of *Litsea* (Lauraceae) from Thailand

CHATCHAI NGERNSAENG SARUAY*

ABSTRACT. *Litsea phuwuaensis* C. Ngernsaengsaruy, a new species from north-eastern Thailand is described and illustrated.

Litsea Lam. includes approximately 400 species (Kostermans, 1957) and is widely distributed in tropical and subtropical Asia from India through Malesia and northwards to Japan, and in the Pacific Islands, Australia, New Zealand and the Americas (Kochummen, 1989). The Lauraceae are an important component of wet tropical forests and are well represented in the Flora Malesiana region (Van der Werff, 2001). In Peninsular Malaysia 54 species of *Litsea* have been recorded in a wide variety of habitats (Kochummen, 1989). In Thailand, Kostermans (1974) described six new species of this genus. The Forest Herbarium, Royal Forest Department (2001) reported botanical names and vernacular names of 22 species of Thai *Litsea* in “Thai Plant Names, Tem Smitinand, Revised Edition”. A taxonomic revision of the genus *Litsea* for the Flora of Thailand has been done by the author.

Fruiting specimens of a *Litsea* sp. were collected by Thawatchai Wongprasert et al. in 1998 and Rachun Pooma, W.J.J.O. de Wilde, B.E.E. Duyfjes, Voradol Chamchumroon & Kanlaya Phattarahirankanok in 2001. During a field trip in May 2003 with Naiyana Tetsana, Nantawan Suphuntee and Narong Koonkunthod, we first found this species in Phu Wua Wildlife Sanctuary, Nong Khai Province and in Phu Langka National Park, Nakhon Phanom Province. This species is only known from these two protected areas, but it is not rare there, and is especially abundant at Thum Fun in Phu Wua Wildlife Sanctuary. Eventually in June 2003, the author visited Phu Wua Wildlife Sanctuary again and collected good flowering material. Therefore, the following new species is described as part of a preparation of a taxonomic revision of the genus *Litsea* for the Flora of Thailand.

***Litsea phuwuaensis* C. Ngernsaengsaruy, sp. nov.**

Frutex 0.5–2.5 m altus, ramulis villosa. Folia spiralis, obovato-oblonga, oblongo-lanceolata, oblonga, elliptico-oblonga vel obovato-lanceolata, 7–18(–25) cm longa, 2–5.5(–7) cm lata, supra villosa, subtus villosa, nervis 7–14, supra impressis subtus elevatis. Inflorescentia axillaris vel caulina. Fructus ovoideus, 0.8–1 x 0.7–0.9 cm, glaber.

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Typus: Thailand, Nong Khai, Buengkhla, Phu Wua Wildlife Sanctuary, way to Tham Fun near check point, mixed deciduous forest, 200 m altitude, 21 June 2003, male inflorescences, *C. Ngernsaengsaruy* 376 (holotypus BKF; isotypi BK, QBG, PSU, Department of Botany, Kasetsart University Herbarium). Figs. 1–2.

Shrub 0.5–2.5 m tall; young parts very densely pale brown villose; branchlets densely villose. *Leaves* spiral; blade obovate-oblong, oblong-lanceolate, oblong, elliptic-oblong or obovate-lanceolate, 7–18(–25) by 2–5.5(–7) cm, apex caudate or acuminate, base obtuse or cuneate, margin ciliate, chartaceous, green or dark green above, villose on both surfaces, glaucous beneath; petiole 0.3–1 cm long, densely villose; midrib sunken above, raised beneath, secondary veins 7–14 pairs, sunken above, raised beneath, curving and looping near margin, tertiary veins scalariform-reticulate, indistinct above, prominent beneath. *Inflorescences* umbellate, umbels in clusters, in axils of leaves or along branchlets, rarely cauliflorous (along main stem), 0.5–0.7 cm in diam.; peduncles 0.3–0.5 cm, villose; bracts 4, decussate, suborbicular or broadly ovate, concave, 3.5–5 by 3–4 mm, thinly coriaceous, with veins, villose outside. *Male flowers* 5 in each umbel; tepals 4–6, linear-oblong, subequal, 2–2.5 by 0.5–1 mm, membranaceous, sparsely hairs outside; pedicels 1–2 mm long, villose; stamens 6–8 (–9), usually arranged in 2 whorls, outer whorls usually longer than inner whorls; anthers oblong, sometimes ovoid, 0.5–1 mm long, 4-celled, all introrse; filaments slender, 1.5–2.5 mm long, villose, the outer whorl without glands, the inner whorl with 2 glands at base. *Female flowers* 5 in each umbel; tepals 5–6, linear-oblong, subequal, 2–2.5 by 0.5–1 mm, membranous, sparsely hairs outside; perianth tube funnelliform; pedicels 1–2 mm long, villose; ovary ovoid, 1–2 mm long, glabrous; style 1–2 mm long; stigma peltate; staminodes 6–7, linear, 1.5–2 mm long, villose. *Fruits* ovoid, 0.8–1 by 0.7–0.9 cm, apex apiculate, green with white dots, glabrous, glossy, seated on enlarged perianth tube; enlarged perianth tube shallowly cup, 0.5–0.6 cm in diam.; fruiting pedicels thickened, 0.8–1.2 cm long, sparsely villose; infructescence stalks 4–5 mm long, villose.

Thailand.— NORTH-EASTERN: Nong Khai [Phu Wua Wildlife Sanctuary, 27 Aug. 2001, *Pooma, De Wilde, Duyfjes, Chamchumroon & Phattarahirankanok* 2794 (BKF); Tham Fun, Phu Wua Wildlife Sanctuary, 21 May 2003, *Ngernsaengsaruy, Tetsana, Suphuntee & Koonkunthod* 319 (BKF, BK, Department of Botany, Kasetsart University Herbarium); Phu Wua Wildlife Sanctuary, 24 May 2003, *Ngernsaengsaruy, Tetsana, Suphuntee & Koonkunthod* 328 (BKF, BK); Tham Fun, Phu Wua Wildlife Sanctuary, 21 June 2003, *Ngernsaengsaruy* 377, 378, 379, 380, 381 (BKF, BK, Department of Botany, Kasetsart University Herbarium)]; Nakhon Phanom [Tat Kham Fall, Phu Langka National Park, 30 Oct. 1998, *Wongprasert et al.* s.n. (BKF); Ban Phaeng, Phu Langka National Park, 24 May 2003, *Ngernsaengsaruy, Tetsana, Suphuntee & Koonkunthod* 331 (BKF, BK, Department of Botany, Kasetsart University Herbarium), 335 (BKF, BK)].

Distribution.— Known only from NE Thailand.

Ecology.— In mixed deciduous forest, occasionally by streams, ca. 150–200 m.

Phenology.— Flowering May–June; fruiting June–August.

Vernacular.— Thang bai khon phu wua (ถังใบขนภูว) (The name is given by the author).

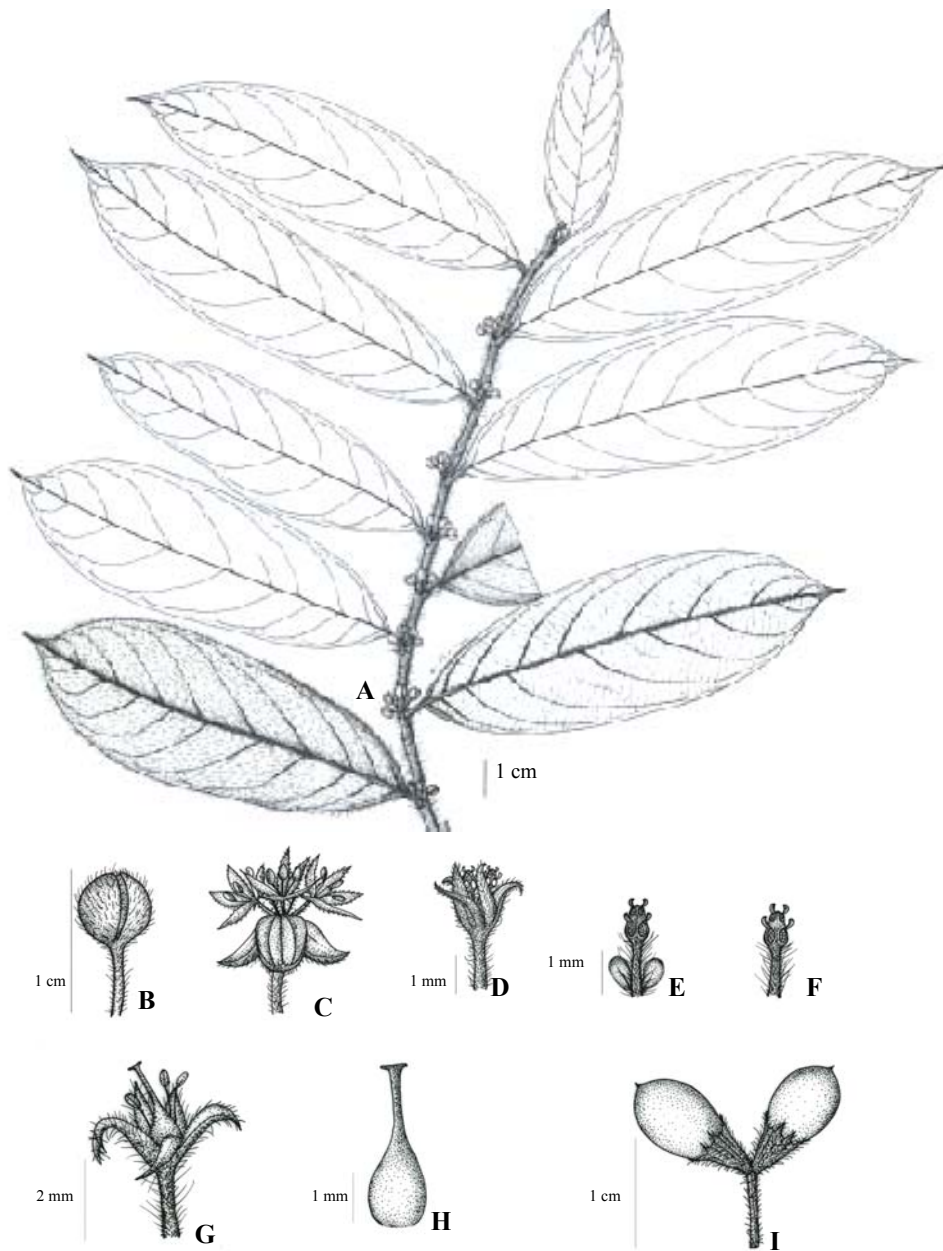


Figure 1. *Litsea phuwaensis* C. Ngernsaengsaruy: A. flowering branch; B. young umbel is enclosed in decussate bracts; C. male inflorescence; D. male flower; E. stamen with 2 glands; F. stamen without gland; G. female flower with staminodes; H. pistil; I. infructescence. Drawn by N. Tetsana.



Figure 2. *Litsea phuwuaensis* C. Ngernsaengsaruy: A. habit; B. young branch; C. young umbels are enclosed in decussate bracts; D. young umbels along main stem; E. male inflorescences; F. female inflorescence; G. young infructescences; H. fruiting branch; I. infructescence. Photographed by C. Ngernsaengsaruy.

Notes.— *Litsea phuwuaensis* is distinguished by the villose indumentum on most plant parts, the caudate or acuminate leaf apex and the ciliate leaf margin. Young parts are especially very densely pale brown villose.

Young umbels are enclosed in decussate bracts which can easily be mistaken for flower buds. *Litsea* is very similar to *Lindera* in their vegetative parts and even specimens with female flowers or in fruit are difficult to place to genus. *Litsea* differs from *Lindera* in its 4-celled anthers (*Lindera* has 2-celled anthers).

The specific epithet is named after Phu Wua Wildlife Sanctuary where we found and collected the type specimens.

ACKNOWLEDGEMENTS

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REFERENCES

- Kochummen, K. M. 1989. Lauraceae, pp. 98–178. In F.S.P. Ng (ed), Tree Flora of Malaya. vol. 4. Art Printing Works Sdn Bhd, Kuala Lumpur.
- Kostermans, A. J. G. H. 1957. Lauraceae. Reinwardtia 4: 193–256.
- _____. 1974. New species and combinations of Lauraceae from Thailand. Natural History Bulletin of Siam Society 25: 29–44.
- The Forest Herbarium, Royal Forest Department. 2001. Thai Plant Names, Tem Smitinand, Revised Edition. Prachachon Co. Ltd, Bangkok.
- Van der Werff, H. 2001. An annotated key to the genera of Lauraceae in the flora Malesiana region. Blumea 46 (1): 125–140.

Three new species and a new variety of Fagaceae from Thailand

CHAMLONG PHENGKLAI*

ABSTRACT. Three new species of Fagaceae, *Castanopsis pseudo-hystrix*, *Castanopsis thaiensis* and *Lithocarpus loratefolius*, together with a new variety *Quercus mespilifolia* var. *pubescens*, are described and illustrated.

During work on a revision of the family Fagaceae for the Flora of Thailand, three undescribed species of the genera *Castanopsis* and *Lithocarpus* and one variety of the genus *Quercus* were discovered and are herewith described.

***Castanopsis pseudo-hystrix* Phengklai sp. nov.** haec. species *Castanopsidis hystricis* (Hook. f. et. Thom.) A. DC. similissima, sed foliis ovatis vel raro obovatis, coraceis, margine revoluta et in parte tertia apicali serrata, glandibus unam nucem habentibus, cupulis spinas ramosas et in 4–5 lineis irreguaribus distributas praebentibus differt. Typus: Thailand, Chiang Mai, *Smitinand* 90–198 (holotypus BKF!). Fig. 1.

Tree, 5–20 m high, 70–100 cm girth. *Twigs* dark brown tomentose then glabrescent, with sparsely rounded lenticels. *Terminal buds* ovoid, 5–6 by 2–3 mm, with many bracts, hairy on outer part and glabrous on inner part. Bark brown to dark brown, longitudinally furrowed; inner bark reddish brown with pale longitudinal stripes. *Leaves* ovate or obovate, 6–10 by 3–7 cm, coriaceous, sparsely pubescent then glabrous, glossy on upper surface, slightly serrate on the upper half to entire and revolute margin; apex acute, obtuse to shortly acuminate and usually minute emarginate; base obtuse to slightly cuneate; midrib and lateral nerves raised sharply on lower surface; lateral nerves in 5–7 pairs, arched but not anastomosing; scalariform veins inconspicuous; petioles 4–5 mm long, pubescent then glabrescent, blackish when dry. *Male and female inflorescences* terminal or axillary. *Male inflorescence* much branched, spikelets 4–7 cm long, pubescent; calyx 6-lobed, free, ± 1 by 0.5 mm, obovate or spatulate, outer part pubescent; rudimentary ovary ca. 1 by 1 mm, hairy; stamens 11–12, 2–2.5 mm long; anthers dorsifixed, all glabrous. *Female inflorescence* erect, simple or few branches, 8–17 cm long, pubescent; perianth 6-lobed, similar to male flower; staminodes 11–12; ovary inferior, 3 locular, each locule with 2 anatropous ovules; styles 3, hairy on lower half, stigmas pointed with divergent apex. *Acorns* ovoid 1–2.5 cm in diam. (including cupule spines), sessile; on erect infructescences, 8–17 cm long. *Cupule* almost enclosed the nut, except the top most near by the umbonate, pubescent then glabrescent; skin covered with branched and recurved spines, set in 4–5 irregularly lines, spine pubescent then glabrescent. *Nut* 1 in each cupule, ovoid to ellipsoid, 1.3–1.5 by 1–1.2 cm, \pm glossy brown.

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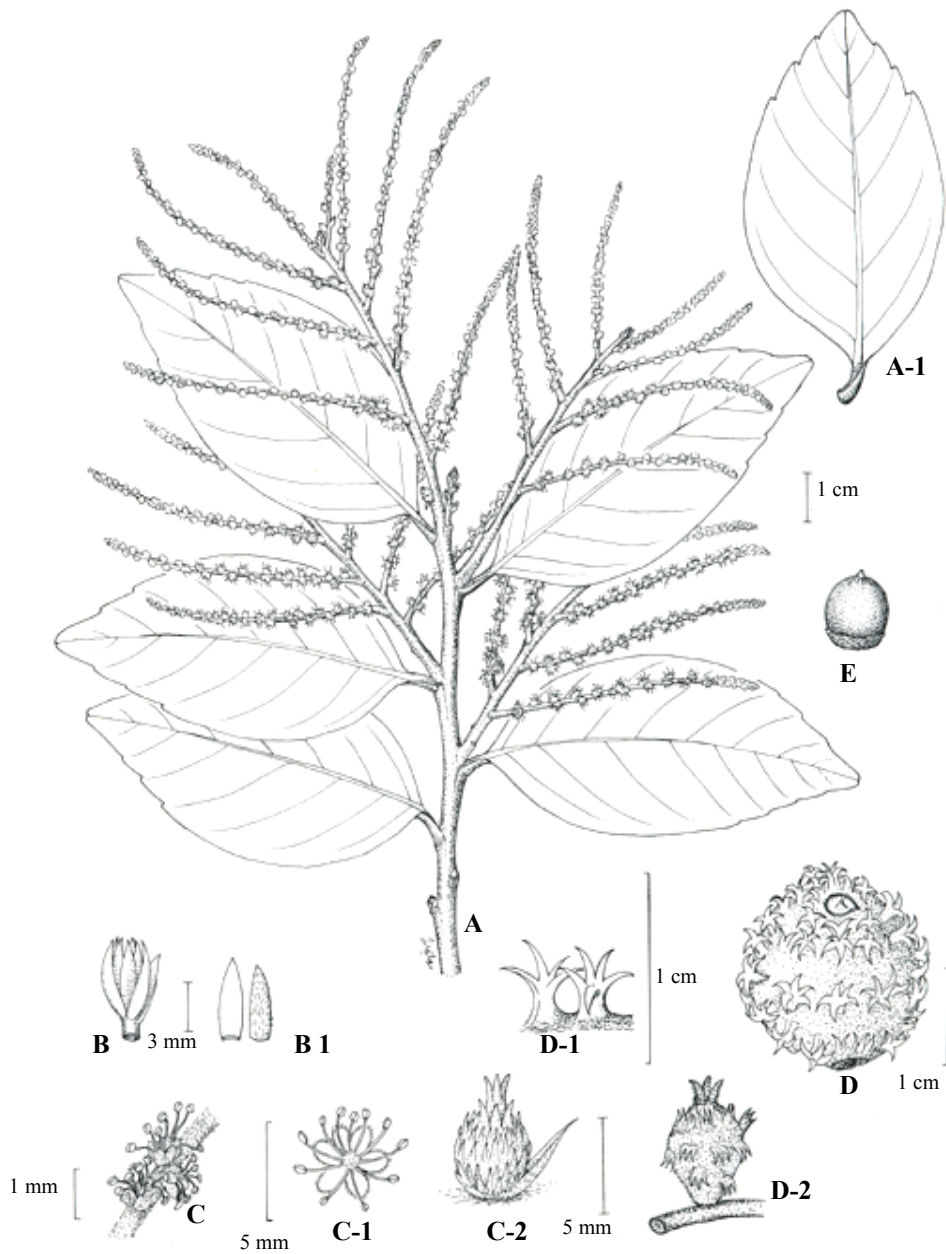


Figure 1. *Castanopsis pseudo-hystrix* Phengklai: A. twig and inflorescences, A-1 leaf; B. terminal bud, B-1 sheath; C. male flowers, C-1 male flower (enlarged), C-2 female flower (enlarged); D. acorn (mature), D-1 spines, D-2 young acorn; E. nut (A.-C. from T. Smitinand 90-198; D.-E. from W. Eiadthong BKF 97215). Drawn by O. Kirdkaew.

Thailand.— Chiang Mai [*Smitinand* 90–198 (holotype BKF)].

Distribution.— Endemic to Thailand.

Ecology.— In lower montane forest; ca. 1,200 m altitude.

***Castanopsis thaiensis* Phengklai sp. nov.** haec, species *Castanopsidis wallichii* King ex Hook.f. similissima sed foliis subtus permanente molliter pubescentibus, magine in parte tertia apicali folii serrata, petiolo tantum usque ad 1 cm longo, bracteis inflorescentiae magis, glandibus ad maturitatem in partes tres vel quinque dehiscentibus, nucibus semper urniformibus et a latere et vertice visis triangularibus, stylis in apice nucis maturae vulgo praesentibus differt. Typus: Thailand, Nan, *K. Larsen* 44319 (holotypus AAU!; isotypus BKF!). Fig. 2.

Tree. *Twigs* densely grey simple hairs and indumentum, then glabrescent, with sparsely round and convex top lenticels. *Lateral buds* flattened, 0.4–0.5 by 0.2 mm., scales hooked, terminal buds ovoid, 9–10 by 3–4 mm, scales imbricate, adpressed silvery hairs along the middle line and around apex on outer part, glabrous on inner side. *Leaves* oblong or oblong-elliptic, 10–12 by 3–4 cm, subcoriaceous to coriaceous, glabrous except along midrib near base on upper surface, densely shortly pubescent, especially along nerves on lower surface; margin serrate on $\frac{1}{3}$ toward the apex; apex cuspidate, caudate or bluntly acute; base cuneate to obtuse, \pm symmetric; midrib and lateral nerves prominent beneath, \pm depressed on upper surface; lateral nerves in 12–15 pairs, rigid, aligned at 30°–35° to midrib and curved near margin; scalariform veins distinct on lower and subdepressed on upper surface; petioles 0.5–1 cm long, grooved at adaxial, densely darkish grey hairy. *Male inflorescence* not seen. *Female inflorescence* terminal or axillary, rachis 8–15 cm long, spike 3–5 cm long, densely to pubescent grey hairy, bracts ca. 10 by 3 mm, silvery hairy on outer part, glabrous on inner side, not early caducous. *Flowers* solitary or 2–3-flowered in a group; perianth 6-lobed, 1.5–1 mm in diam. (young), divided $\frac{1}{2}$ – $\frac{2}{3}$ to the base; sepals ovate, sparsely hairy on outer part and ciliate; staminodes 12, very short, glabrous; ovary inferior, 3-locular, each locule with 2 anatropous ovules; styles 3, hairy on lower half, stigmas with pointed and divergent apex. *Acorns* sessile, ovoid, subdepressed, 1.5 by 2–2.5 cm (including branched spines), on erect, 8–15 cm long infructescences. *Cupule* entirely enclosed the nut, except the top most near by the umbonate, shortly grey hairy on outer part, long silky fulvous on inner part, dehiscent in 3–5 parts when dry; skin covered with branches and recurved spines, spine base tubular, 2.5–3 mm high, then divided into 3–5 curved and sharp branches (rarely 1–2), pubescent along tube, branches glabrous. *Nuts* 1–3 in each cupule, urceolate, when 3 the middle one longitudinally triangular, the other two flattened on one side and remaining 3-angled in both lateral and vertical outlines, glossy brown except at the narrow top, with persistent style and stigmas.

Thailand.— NORTHERN: Nan [*Larsen* 44319 (holotype AAU; isotype BKF)].

Distribution.— Endemic to Thailand.

Ecology.— In evergreen forest; 1,000 m altitude.

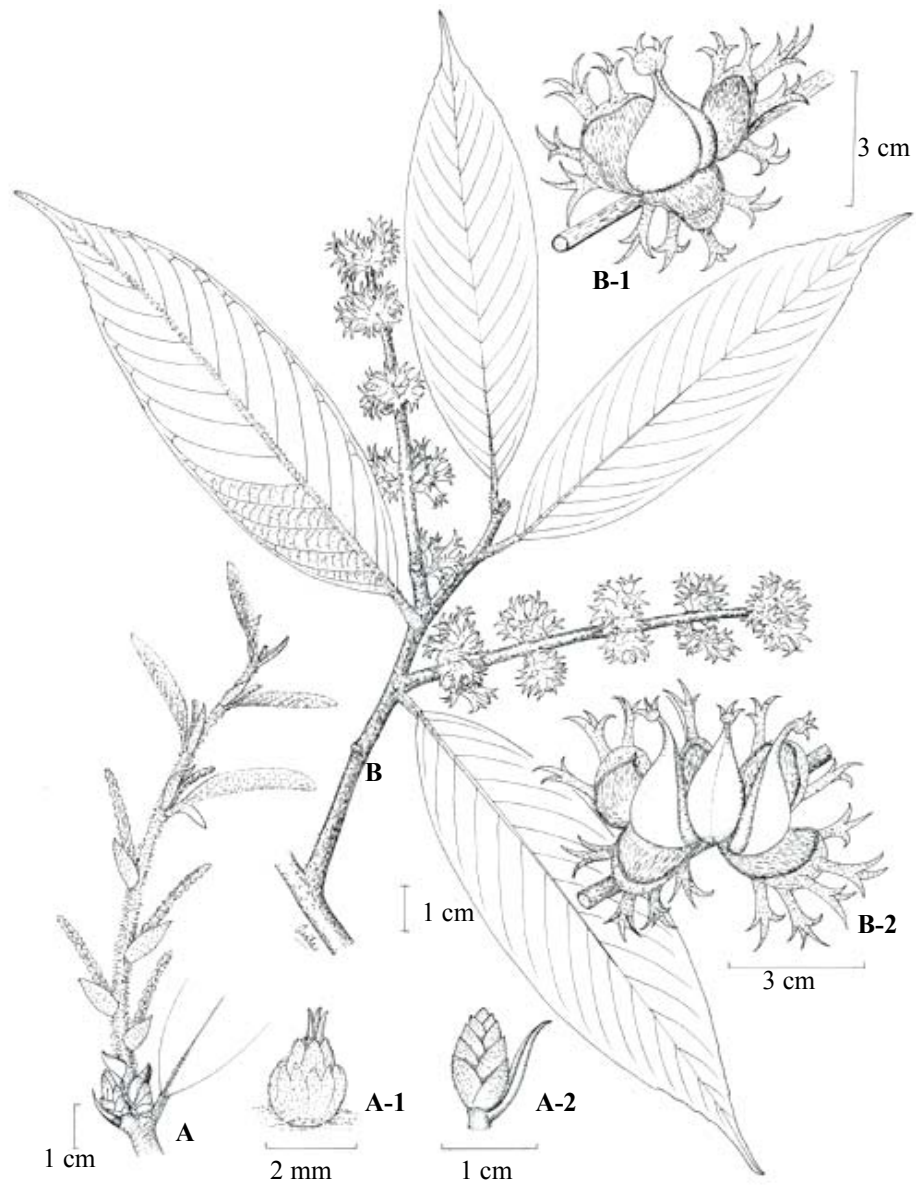


Figure 2. *Castanopsis thaiensis* Phengklai: A. female inflorescences, A-1 female flower, A-2 bud; B. twig and infructescences, B-1 & B-2 acorns (K. Larsen *et al.* 44319). Drawn by O. Kirdkaew.

Lithocarpus loratefolius Phengklai **sp. nov.** haec species *Lithocarpi lucidi* (Roxb.) Rehder similissima, sed foliis chartaceis ensiformibus, ranunculis juvenilibus tri-vel tetra-angularibus, petiolo brevissimo (2–3 mm); glandibus collum manifestum in medio parte nucis supra cupulam visibili habentibus. Typus: Thailand, Ranong, *Th. Wongprasert* 92-6-68 (holotypus BKF!). Fig. 3.

Tree, 10–15 m high, 60–90 cm girth. *Twigs* with 3–4 sharp longitudinal ridges, then terete, glabrous; bark thick, rough, with brown to brownish grey scales and sparsely lenticels. *Leaves* ensiform, linear to linear lanceolate, 14–20 by 2–2.5 cm, chartaceous, sparsely simple hairy and indumentum on both sides, glabrescent; apex acuminate to caudate; base slightly cuneate, not oblique; midrib prominent on both surfaces; lateral nerves in 14–20 pairs, faint on both sides; reticulate veins inconspicuous; petioles 2–3 mm long, glabrous, dark brown when dry. *Male and female* inflorescences not seen. *Acorns* conical and subdepressed, 2–2.5 by 2.5–3 cm (including cupule), sessile on fruit stalk up to 2 mm long, on erect, up to 10 cm infructescences, with sparsely grey indumentum. *Cupule* saucer-shaped, 0.5–1 by 2.5–3.5 cm, woody, and 2–4 mm thick, enclosing only the base or up to $\frac{1}{5}$ of the nut; skin covered with thick lamellae, set in 5–7 ring-like lamellae, fused and covered with grey indumentum, then glabrescent on both sides. *Nut* 1 in each cupule, subdepressed, broadly conical, 1.5–2 by 2.5–3 cm, dull brown to shiny, one strongly horizontal annular pressed on the middle of nut, scar at the base convex, 1.5–2 cm in diam.

Thailand.—PENINSULAR: Ranong [*Wongprasert* 92-6-68 (holotype BKF)].

Distribution.—Endemic to Thailand.

Ecology.—In rain forest; up to 120 m altitude.

Quercus mespilifolia Wall. ex DC., Prodr. 16. II. 101. 1864. **var. pubescens** Barnett ex Smitinand & Phengklai **var. nov.** qui a typo differt folia angustiora et subtus molliter et durabiliter pubescentia praebens. Typus: Thailand, Kamphaeng Phet, *Kerr* 6107 (holotypus K!). Fig. 4.

Tree, 15–20 m high, 80–90 cm girth. *Twigs* greyish-brown, then glabrescent; bark \pm 1 cm thick; sapwood yellowish with distinct radial rays; hardwood dark brown, durable. *Leaves* oblong, lanceolate-oblong, rarely elliptic, 5–17 by 2–5 cm, coriaceous, dull green and glabrescent except along nerves on the upper surface and softly greyish hairy on lower surface; apex acuminate or acute; base obtuse, slightly cuneate and unequally sided; midrib and lateral nerves prominent on lower surface; lateral nerves in 15–18 pairs, parallel and straight towards the end of serrate margin; scalariform veins conspicuous on lower surface; petioles 1–2.5 cm long, sparsely hairy with dark brown hairs. *Female inflorescences* axillary, hairy on all parts; perianth 6-lobed; staminodes 12, glabrous; ovary inferior, 3-locular, each locule with 2 anatropous ovules; styles 3(–4), conical, 1–1.5 mm long, greyish hairy on lower half, stigmas flattened, glabrous and blackish. *Acorns* obconical or cup-shaped, 1 by 1–1.5 cm (including cupule), sessile, on erect, 1–4 cm, greyish-brown hairy infructescences. *Cupule* entirely enclosing the nut, except the top most nearby the umbonate; skin covered with 6–8, thick, ring-like lamellae, fused at base, apex free, hairy on both sides. *Nut* 1 in each cupule, top flattened, green and brown when dry; scar at the bottom, flattened or slightly convex, ca. 0.5 cm in diam.

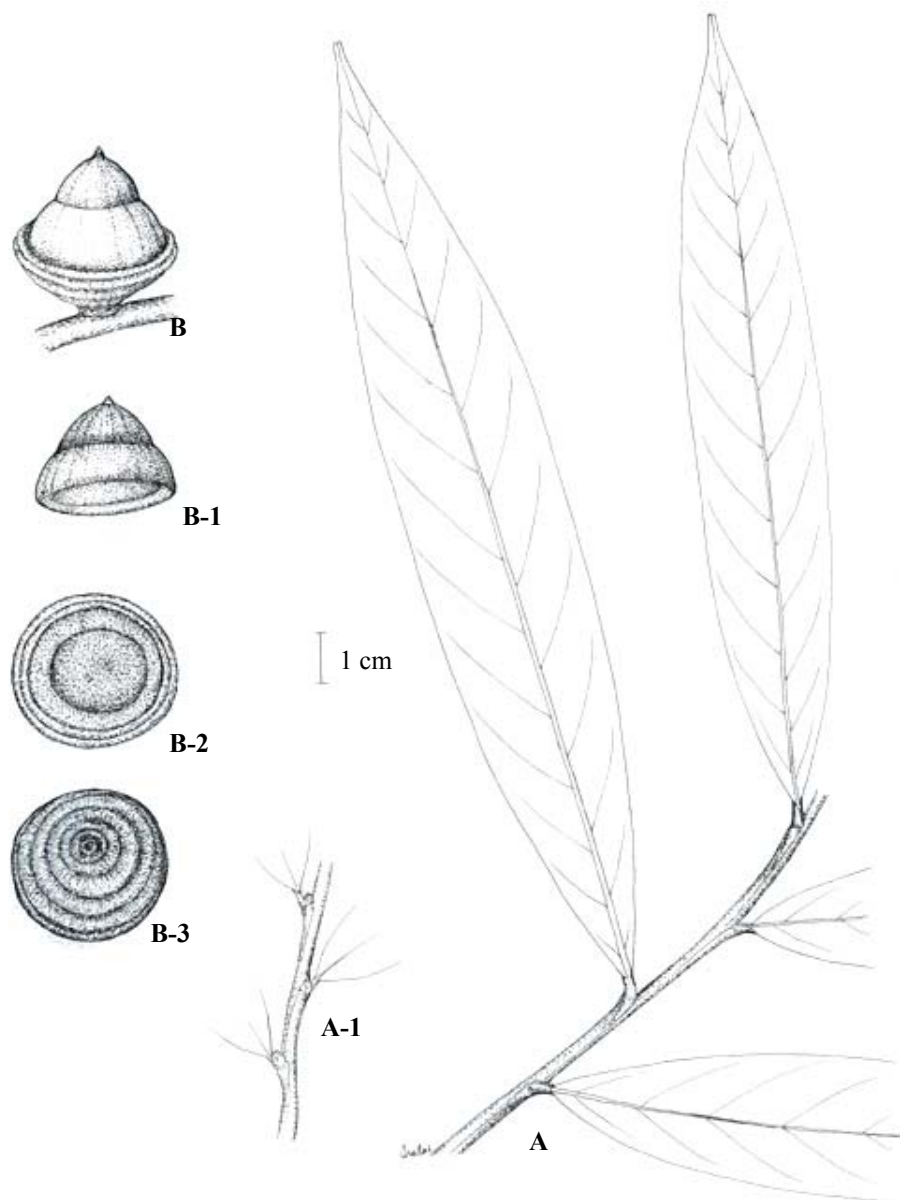


Figure 3. *Lithocarpus loratefolius* Phengklai: A. twig and leaves, A-1 young twig; B. acorn, B-1 nut, B-2 inner part of cupule, B-3 outer part of cupule. All from *Th. Wongprasert* 92-6-68. Drawn by O. Kirdkaew.

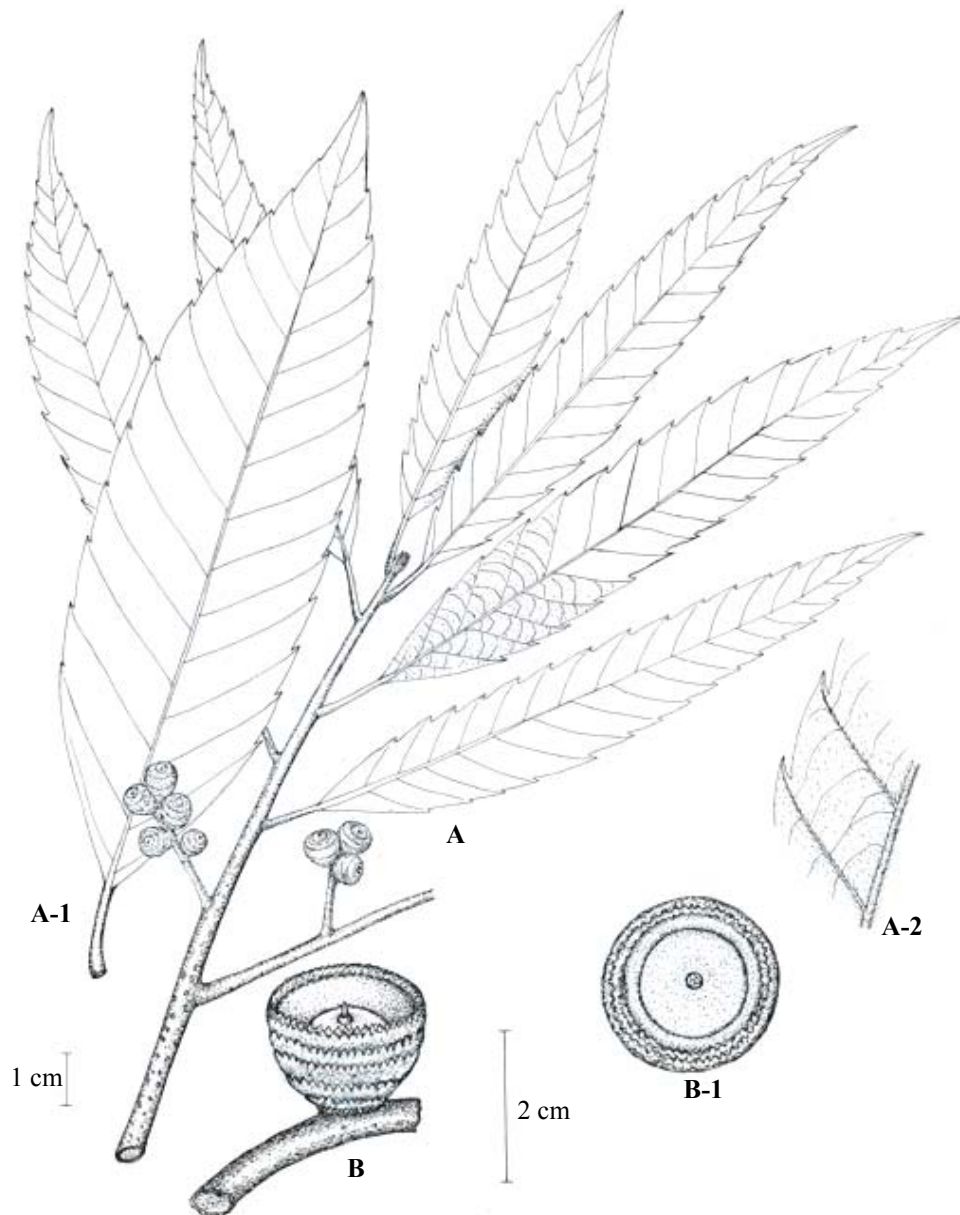


Figure 4. *Quercus mespilifolia* Wall. ex DC. var. *pubescens* Barnett ex Smitinand & Phengklae: A. twig & infructescences, A-1 & A-2 leaf & part of leaf; B. acorn, side view, B-1 top view (enlarge). All from A.F.G. Kerr 6107. Drawn by O. Kirdkaew.

Thailand.— NORTHERN: Kamphaeng Phet [*Kerr* 6107 (holotype K)].

Distribution.— Endemic to Thailand.

Ecology.— In deciduous forest.

ACKNOWLEDGEMENTS

The author is deeply indebted to Dr P. Wagner, Botanical Museum and Library of the University of Copenhagen, who kindly wrote the Latin diagnoses. I would also like to thank all collectors for the specimens concerned, and for the excellent drawings by Mrs Oratai Kirdkaew. Finally I am very grateful to the Biodiversity Research and Training Program (BRT) for a grant to pursue this research.

***Plagiopteron suaveolens* (Plagiopteraceae): an emended description**

PHONGSAK PHONSENA*

ABSTRACT. An amplified description of the monotypic *Plagiopteron suaveolens*, including additional details of the flowers, fruit and seed, is presented. Observations have been made on the mode of climbing, the size of the liana and vegetative reproduction. Elastic threads which conspicuously show up in torn fresh leaves are an excellent field character.

INTRODUCTION

The taxonomic position of the monotypic *Plagiopteron* has been disputed since its publication as a genus (Griffith, 1843). It was raised to family rank by Airy Shaw (1965), and in various later studies (Airy Shaw, 1973, 1979; Baas et al., 1979; Chen, 1980; Lu et al., 1989; Tang et al., 1990, Daniel, 1991) it remained as a separate family. Most recently, through DNA sequencing (Chase et al., 2002), it was placed in Celastraceae (Celastrales). Although the number of herbarium specimens and its known distributional area have been considerably augmented in recent years, some essential characteristics, such as the morphology of mature seed, remain insufficiently known. Watson & Dallwitz (1992 onwards) provide a useful, and easily accessible, summary of the family's characteristics. The following study was designed to aid the forthcoming treatment of the family Plagiopteraceae for the Flora of Thailand.

As head of the R.F.D. Centennial Botanic Garden in south-eastern Thailand, I have been able to locate and observe various wild specimens of *Plagiopteron* in the natural forest around the garden. I studied, and present below, observations on plant growth form, flowers, and seed morphology. In addition, a complete description of the solitary species is presented. For discussion and interpretation of the unique combination of characters, leading to supposed affinity with a large number of families, see Baas et al. (1979), Tang (1994, 1995), and Chase et al. (2002). Anatomical evidence led Baas (in Baas et al., 1979) to suggest that *Plagiopteron* had affinities with the Celastraceae. However, my findings confirm that *Plagiopteron suaveolens* represents a separate family close to Celastraceae.

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TAXONOMIC DESCRIPTION

PLAGIOPTERON

Griff., Calcutta J. Nat. Hist. 4: 244, t. 13. 1843; Benth. & Hook. f., Gen. Pl. 1: 238. 1862; Warb. in Engl. & Prantl, Nat. Pflanzenfam. III. 6a: 55. 1893; Airy Shaw, Kew Bull. 18: 266. 1965; Hutch., Gen. Pl. 2: 479. 1967; Airy Shaw in Willis, Dict. Fl. ed. 8: 910. 1973.

One species in E India, Myanmar, S China and Thailand.

Plagiopteron suaveolens Griff., Calcutta J. Nat. Hist. 4: 244, t. 13. 1843; Kurz, Forest Fl. Burma 1: 172. 1877; Brandis, Indian Trees: 93. 1906; Kanjilal, P. C. Kanjilal & A. Das, Fl. Assam 1: 169. 1934; Baas, R. Geesink, W.A. van Heel & J. Muller, Grana 18: 69. 1979; Y. X. Lu, G. B. Huang & C. F. Liang, Guihaia 9, 2: 171. 1989; Y. Tang, C. Y. Wu & H. Li, Acta Bot. Yunnan. 12, 2: 126, fig. 1. 1990.— *P. fragrans* Griff., nom. alt., op. cit.: 246; Mast. in Hook. f., Fl. Brit. Ind. 1: 399. 1874; Warb. in Engl. & Prantl, Nat. Pflanzenfam. III. 6a: 55. 1894; Airy Shaw, Kew Bull. 33: 428. 1979. Type of *P. suaveolens* and *P. fragrans*: Griff., l.c., Plate XIII (lectotype selected by Daniel, 1991).— *P. chinensis* X. X. Chen, Acta Bot. Yunnan. 2: 331, fig. 1. 1980. Type: X. X. Chen 2-0423 (Herb. Guangxi Inst. Mat. Med., not seen).

Liana to 30 m tall, to 11 cm diam. *Bark* grey-brown, shallowly and irregularly longitudinally fissured. *Twigs* terete, climbing by means of (opposite) axillary twigs 15–30 cm long, which hook for 180°–360° around supports; younger parts densely brown stellate hairy, hairs of mixed sizes; all fresh parts releasing elastic threads when torn. *Leaves* simple, opposite; stipules absent or minute (see note), caducous; petiole 0.7–1.2 cm long; blade (ob) ovate, orbicular or elliptic 8–15(–20) by 4–6(–9) cm, base shallowly cordate, rounded, or subcuneate, apex acute-acuminate, margin entire, adaxial surface (except nerves) glabrescent; nerves pinnate, in 4–6 pairs, the lowest, basal ones, weaker, adaxially flat. *Inflorescences* axillary to upper leaves, panicle-thyriform, 4–11 cm long including the 2–6 cm long peduncle, bracteate, flowers in many-flowered subglobose clusters, densely hairy. *Flowers* bisexual, regular, white, fragrant; pedicel (2–)3 mm long. *Calyx* lobes 3(–4), free, apert, oblong, ca. 1 mm long. *Corolla* sympetalous in bud urceolate, ± inflated, somewhat fleshy, ca. 3 by 2 mm, densely brown hairy outside, more sparsely so inside, at apex with 3 (or 4) free valvate triangular lobes, ca. 0.5 mm long, the tube at anthesis tearing apart into 3 (or 4) oblong, recurved, secondarily formed free petals 3.5–4 mm long, remaining connate at base for only ca. 0.2 mm. *Disc* absent. *Stamens* 40(–50), free, in ±2 rows; filaments slender, terete, white, at apex slightly clavate, 2.5–4 mm long, anthers basifixed, broadly clavate, somewhat flattened, (0.3–)0.4 mm long, 4-locular, opening with one transverse apical slit. *Ovary* superior, broadly ovate-globose, faintly 3-grooved, ca. 0.8 mm long, densely brown hairy (hairs stellate, but arms long and patent), style subulate, glabrous, 1.5–2 mm long, stigma minute, ca. 0.1 mm diam., faintly 3-lobed, papillate; locules 3, each with 2 basal, collateral, anatropous ovules, filling the locule. *Fruit* one or few developing per infructescence, 3-winged, with reflexed perianth and persistent stamens, woody, indehiscent, green then brown, 1 seed produced in one of the locules, the other 2 locules remaining empty; fruiting pedicel 5–10 mm long, fruit except wings ± turbinate, 6–11 by 5–10 mm, apex flattish with minute remnant of style, hairy; fruit including wings

4–8 cm wide; wings spreading, each one growing from below the apex of the fruit, corresponding with the locules, coriaceous, elliptic-oblong, 2–3.5(–5) cm long, somewhat narrowed at base, apex rounded, 7–8 parallel-nerved, more sparsely hairy. *Seed* elliptic-oblong, subterete, at apex curved into the hollow extension of the locule towards the wing-base, 10–12 by 4(–6) mm, brownish black, very finely irregularly striate; albumen copious, white. *Embryo* large, pale yellow; cotyledons straight, elongated, swollen; plumule less than 0.1 mm long, radicle cylindrical, ca. 1 mm long.

Thailand.— NORTHERN: Lampang [Amphoe Mae Tha, Ban Sam Kha, *Phonsena & Banchong* 4262 (BKF)]; NORTH-EASTERN: Kalasin [King Amphoe Don Chan, Dong Mae Phet, *Phonsena* 3381 (BKF, RFD, Centennial Botanic Garden)]; EASTERN: Nakhon Ratchasima [specimen not located]; SOUTH-EASTERN: Sa Kaeo [Khao Ang Rue Nai Wildlife Sanctuary, RFD, Centennial Botanic Garden, *Phonsena* 3235, 3369 & 3462 (BKF, RFD, Centennial Botanic Garden); *De Wilde et al.* 22291 (L); Pang Sida National Park, *Phonsena* 3379 (BKF, RFD, Centennial Botanic Garden)]; Chachoengsao [Khao Ang Rue Nai Wildlife Sanctuary, Ban Phu Thai, *Thaithong* s.n. (BCU)]; Rayong [specimen not located], Trat [specimen not located]; Chanthaburi [Khao Soi Dao Wildlife Sanctuary, *van Beusekom et al.* 2112 (BKF, L); *Maxwell* 74-673 (AAU, BKF, L); *Phonsena* 433, 3241 & 3460 (BKF, RFD, Centennial Botanic Garden); *Phonsena et al.* 3523 (BKF, L, RFD., Centennial Botanic Garden); Pong Nam Ron-Pilin, *Larsen* 32174 (AAU, BKF); west of Soi Dao, *Larsen et al.* 32203 (AAU, BKF, L)].

Distribution.— India (Silhet), Myanmar (Tenasserim), China (Guangxi).

Ecology.— In open evergreen forest, secondary forest (evergreen forest type), open deciduous forest, or sometimes at the edge of cultivation; soil over granite, or sandy soil; 80–430 m altitude. Flowering September–November; fruiting: October–January.

Vernacular.— Khruea sam pik (เครือสามปีก) (Chanthaburi); Thao duk ngu (เถาตุกงู) (Nakhon Ratchasima).

Uses.— The stem, boiled with herbs, is used to treat osteoporosis.

FIELD OBSERVATIONS

Growth form

The plant appears to reiterate from near its base by sapling-like shoots several metres long. These later seek support against the stems of slender trees or other lianas, clambering by means of short, leafy axillary shoots from one or both the opposite leaf axils of the main stem, twisting the full 360° around the supporting stem (Fig. 3B). Apparently, not all the leaf axils behave like this, though "clambering arms" can be found on several nodes successively. The curving of the lateral shootlets is possibly thigmotactic, being induced by the stimulus of touching a suitable support. Injured roots in places where the forest soil has been cleared and removed by bulldozing, frequently appeared to produce sprouts quite far away (to ca. 10 m) from the parent liana. Seed germination and development of the seedling in the wild has not, yet, been seen.

Elastic threads

When breaking or tearing fresh leaves or twigs (and other parts of the plant) numeric elastic threads, up to 4 cm long, appear (Fig. 3F), a phenomenon well known in Celastraceae. Griffith (1843) and later authors suggested that these are produced from "spiral vessels", [Airy Shaw (1973) calls them "latex canals"]. Baas (in Baas et al., 1979) indicated that the elastic material represents "gutta-percha", that is coagulated protoplasmatic material, present in the thin-walled fibres, and frequent in tissue sheathing or near the vascular system.

Cellular bodies

The "curious cellular bodies" found along the margins of the young leaves (Griffith, l.c.) were not seen in this study.

Stipules

Stipules were reported as absent by e.g. Griffith (l.c.), Airy Shaw (1965, 1973), but as present, minute, and caducous by later authors, e.g. Kanjilal et al. (1934), Geesink (in Baas et al., 1979). Despite extensive observations I was unable to find stipules.

Flowers

Geesink (in Baas et al., l.c.) suggested that the apert calyx lobes, 3(–5), might represent stipules, forming an epicalyx. The corolla, composed of recurved, valvate lobes should then be called the calyx of an apetalous flower. I found the calyx almost always to consist of only three apert segments, and also the corolla to be composed of three parts, alternating with the calyx segments. As the ovary is 3-locular the flowers are, clearly, 3-merous. Authors such as Kurz (1877), Masters (1874), Warburg (1894) or Kanjilal et al. (1934) describe the calyx and corolla as 5-partite, but I could find no evidence to support this contention. My observations coincide with those of Chen (1980) who also found 3-partite flowers in China. Further examination of material from India and Myanmar is clearly required to confirm the occurrence of 3-partite flowers.

The corolla, which is rather fleshy in structure, appears sympetalous in bud, and only tears into three, nearly free recurved lobes on anthesis. Using microscopic study of stained anatomical cross-sections taken through various levels of the tube, I verified that the lobes are largely truly connate for ca. $\frac{4}{5}$ of their length, and are not adnate (microtome sections tear apart easily because the elastic threads are also present in the corolla tube). Interestingly, though sympetaly was noted by Griffith (l.c.) in Plate XIII, it was not mentioned by him in the description. In the literature the flowers are often described as greenish, but living flowers are pure white (Fig. 3D).

It should be noted that flowers and fruit from Thailand are considerably stouter than those seen in collections made in the botanical garden at Bogor (plants originating from cuttings taken from plants from Sylhet that were grown in Calcutta).

Winged fruit

Only one or a few of the 50–100 bisexual flowers of each paniculate inflorescence develop into a fruit (Fig. 3E). The flowers are pure white and fragrant, with the many white stamens exerted, suggesting insect pollination. However, there are no hard data on this species' pollination biology. The fruit is conspicuously 2-, 3- or 4-winged, and superficially resembles the fruit of some Tiliaceae, Malpighiaceae and Celastraceae: however, the first two families do not appear to be closely related to *Plagiopeteron*. The wing-like follicles of *Loeseneriella* (Celastraceae-Hippocratioideae) are of completely different origin to the wings in *Plagiopeteron*. In *Hiptage* (Malpighiaceae) the wings develop from appendages already visible on the ovary. In *Plagiopeteron* the ovary (Fig. 1C, J, K) is devoid of any trace of the later developing wings; they develop from areas below the apex of the ovary. Although the fruit was described as indehiscent by Kurz (1877), later authors supposed the fruit to split into three 1-winged parts. In fact, field observations show that the fruit detaches in an entire state and remains so, even when it has fallen on the ground. The fruits always contain only one seed which develops in one of the three locules. It appears that the fruits never open. However, germination of the seed has not yet been observed.

Seed

The seed is \pm oblong with a curious hook at its apex (Fig. 2, D–F). The large, elongated cotyledons are thick and carnose, not flat as in the Celastraceae. The albumen is copious, white, in section contrasting with the thin, black seedcoat. The embryo is large, straight, and pale yellowish.

SYSTEMATIC POSITION OF *PLAGIOPTERON*

As stated above, recent molecular research places *Plagiopeteron* in the Celastraceae (Celastrales) (Chase et al., 2002). Previous authors variously discussed its position (see above), until Baas et al. (1979) concluded, on widely-based reasoning, that it could best be accommodated as a monotypic family in the Malvales. In the same paper, however, on anatomical grounds Baas (l.c.) repeatedly pointed to strong affinities with Celastraceae (Celastrales): a relationship which was emphatically denied by pollen evidence. Tang (1995) corroborated *Plagiopeteron*'s affinity with the Celastraceae on the basis of leaf and stem anatomy: a finding congruent with embryological evidence (van Heel, in Baas et al., l.c.; Tang, 1994), where the presence of an endothelium in the embryo sac is particularly significant. This latter character is said to be characteristic of many sympetalous families, and it is relevant to recall that the corolla in *Plagiopeteron* now appears to be truly sympetalous in the bud stage (a sympetalous corolla is also found in Scytopetalaceae of the Malvales). The thickened cotyledons of *Plagiopeteron* are also rather unlike those in the Celastraceae. One of the most conspicuous similarities with some of the Celastraceae is the occurrence of "elastic threads" easily seen when living parts of the plant are torn apart (see above). Mature old wood has not yet been investigated anatomically.

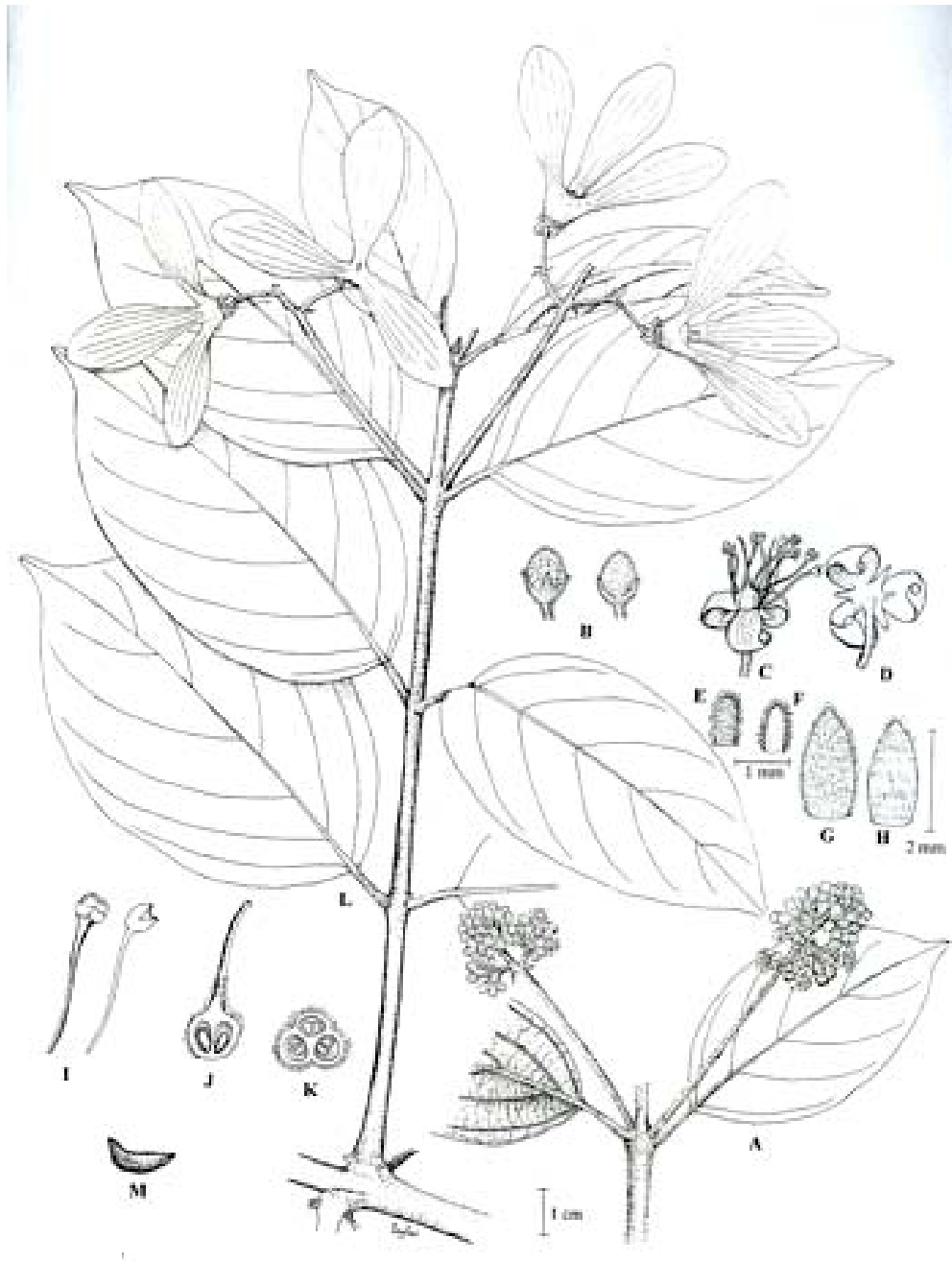


Figure 1. *Plagiopteron suaveolens* Griff.: A. inflorescence ; B. flower buds, showing variable position of the segment of the outer sepals whorl; C. open flower; D. ditto from below; E. sepal outside; F. sepal inside; G. petal outside; H. petal inside; I. stamens; J. pistil; K. ovary, cross section, showing two ovules per locule; L. fruiting branch; M. seed. All from P. Phonsena 3241. Drawn by O. Kerdkaew.

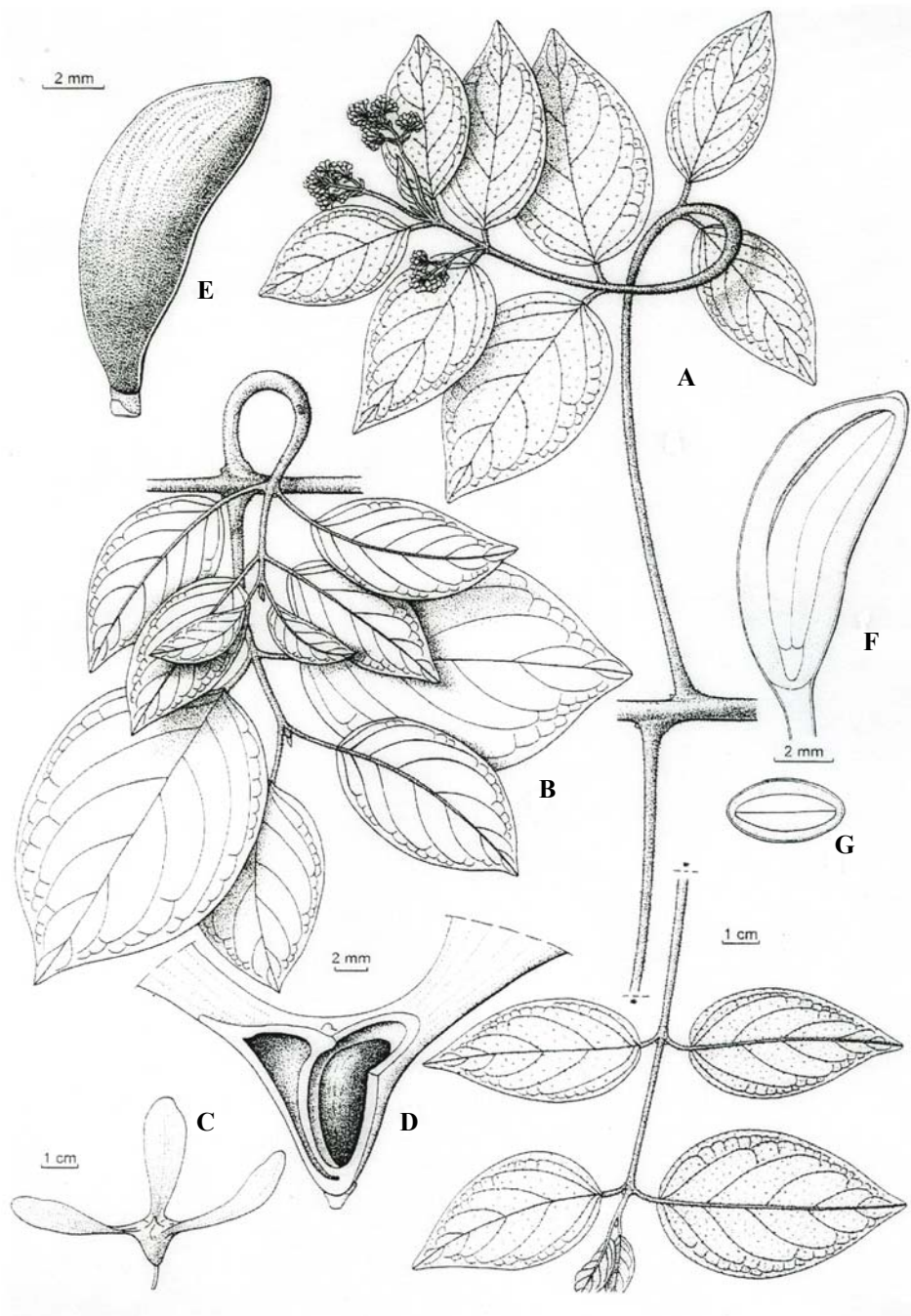


Figure 2. *Plagiopteron suaveolens* Griff.: A. & B. portions of twisting branches: C. fruit: D. ditto, longitudinal section (wings partly removed). showing one seed; E. seed; F. ditto, longitudinal section; G. ditto, cross section. All from *De Wilde et al.* 2229. Drawn by Anita Walsmit Sachs-Jansen.



Figure 3. *Plagiopteron suaveolens* Griff. A. stem; B. portions of twisting branches; C. inflorescences; D. flowers; E. infructescence; F. elastic threads from leaves and twig. Photographed by Phonsena.

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REFERENCES

- Airy Shaw, H. K. 1965. Diagnoses of new families, new names, etc., for the seventh edition of Willis's 'Dictionary'. Kew Bulletin 18: 266–267.
- _____. 1973. *Plagiopteron*. In: Willis, J. C. (ed.). A dictionary of the flowering plants and ferns, ed. 8, p. 910. University Press, Cambridge.
- _____. 1979. The genus *Plagiopteron* (Plagiopteraceae) recorded for Thailand. Kew Bulletin 33: 428.
- Baas, P., Geesink, R., van Heel, W. A. & Muller, J. 1979. The affinities of *Plagiopteron suaveolens* Griff. (Plagiopteraceae). Grana 18: 69–89.
- Bentham, G. & Hooker, J. D. 1862. Genera Plantarum. Volume 1. Lovell, Reeve & Co., London.
- Chase, M. W., Zmarzty, S., Lledó, M. D., Wurdack, K. J., Swensen, S. M. & Fay, M. F. 2002. When in doubt, put it in Flacourtiaceae: a molecular phylogenetic analysis based on plastid *rbcL* DNA sequences. Kew Bulletin 57: 141–181.
- Chen, X. X. 1980. Plagiopteraceae—a new record from China and new species. Acta Botanica Yunnanica 2: 331–333.
- Daniel, P. 1991. The alternative names of the type of *Plagiopteron* (Plagiopteraceae). Taxon 40: 619–620.
- Griffith, W. 1843. On some remarkable plants in the H. C. Botanic Gardens, Calcutta. Calcutta Journal of Natural History 4: 244–246.
- Hutchinson J. 1967. The genera of flowering plants. Volume 2. Clarendon Press, Oxford.
- Kanjilal, U. N., P. C. Kanjilal & A. Das. 1934. *Plagiopteron* Griff. Flora of Assam 1: 169–170.
- Kurz, S. 1877. *Plagiopteron*, Griff. Forest Flora of British Burma 1: 172.
- Lu, Y. X., G. B. Huang & C. F. Liang. 1989. Study on the endemic plants from Guangxi. Guihaia 9: 119–186.
- Masters, M. T. 1874. *Plagiopteron* In: Hooker, J. D. (ed.). Flora of British India 1: 399. Reeve & Co., London.
- Tang, Y, Wu, C. Y. & Li, H. 1990. The revision of the genus *Plagiopteron*. Acta Botanica Yunnanica 12: 126–128.
- Tang, Y, Wu, C. Y & Li, H. 1994. Embryology of *Plagiopteron suaveolens* Griffith (Plagiopteraceae) and its systematic implications. Botanical Journal of the Linnean Society 116: 145–157.
- _____. 1995. Leaf and stem anatomy of *Plagiopteron suaveolens* and its systematic significance. Acta Bototonica Yunnanica 17: 439–444.
- Warburg, O. 1893. *Plagiopteron*. In: Engler, A. & Prantl, K. (eds.). Die natürlichen Pflanzenfamilien III.6a: 55.
- Watson L. & Dallwitz M. J. 1992 onwards. The Families of Flowering Plants: Descriptions, Illustrations, Identification, and Information Retrieval. Version: 14th December 2000. <http://biodiversity.uno.edu/delta/>.

**Systematic notes on *Ophiorrhiza trichocarpon* Blume (Rubiaceae)
and some related species**

IVAN A. SCHANZER*

ABSTRACT. Three closely related species of *Ophiorrhiza* L. (Rubiaceae), viz. *O. trichocarpon*, *O. pedunculata*, and *O. villosa* are considered as to their nomenclature, differential characters, distributions, and presence of heterostyly. *O. pedunculata* is suggested as a new name to substitute *O. hispidula* var. *longipedunculata* after raising its rank to species level. A new variety *O. trichocarpon* var. *glabra* is described from Khao Takrup in E Thailand.

Ophiorrhiza trichocarpon Blume was described by Blume from Java in 1825. Over the 19th and 20th centuries quite a number of collections of were this species accumulated from different parts of Java, as well as from neighbouring islands of Bali and Bawean. However, it has never been reported from any other of the Sunda Islands.

G. Don (1834) described plants that were collected in Southern Burma and were very similar to *O. trichocarpon* as *O. hispidula* Wall. ex G. Don. J. D. Hooker (1880) seems to be the first who synonymised this with the Blume's species. Pitard (1923) followed this point of view in his treatment of *Ophiorrhiza* in the "Flore Générale de l'Indo-Chine". Deb and Mondal (1997 publ. 2001) also accepted this approach in the revision of the genus for the Indian subcontinent, but not the authors in Thailand and Malay Peninsula (King and Gamble, 1903; Ridley, 1923; Craib, 1932). On the contrary, Craib (1932) underlined the status of *O. hispidula* as a separate species by putting *O. trichocarpa* Hook. f. non Blume to its synonymy. He also described a peculiar variety *O. hispidula* var. *longipedunculata* with long peduncled inflorescences from W Thailand.

Revision of many herbarium collections for the upcoming treatment of the genus *Ophiorrhiza* for the Flora of Thailand lead me to the conclusion, that plants of *O. trichocarpon* from Java, and *O. hispidula* from the mainland belong to the same species. This species varies in overall dimensions and hairiness over its range but no clear pattern can be seen. The only exception is a single population from Khao Takrup in E Thailand, at the eastern limit of *O. trichocarpon* distribution, plants of which are completely glabrous except for only loosely hairy peduncles and rudimentary hairs on the ovary surface. Since the distribution of this is exceptionally limited it is recognised below as a variety; *O. trichocarpon* var. *glabra*. The other variety, *O. hispidula* var. *longipedunculata*, possesses a number of substantially stable characters that can discriminate it from typical *O. trichocarpon*, and is confined to mountainous areas of N, NW, and W Thailand within the general range of the latter. I suggest recognising it as a new separate species. In the course of field investigations of the author in Thailand in 1999

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and 2002 both of the species were repeatedly collected from many localities close to each other, but they seemed never to occur in mixture, and were always clearly separable from each other (Figs. 2, 3).

In 1824 Wallich described *O. villosa* from Chittagong (now in Bangladesh), another species very similar to *O. trichocarpum*. The first indication of its occurrence in Thailand was made by Craib (1932), who cited in his work a single specimen from N Thailand (Doi Chiang Dao, *Kerr* 5618), however, doubtfully determined since it was in young bud. The revision of collections from N and W Thailand loaned from L and AAU revealed a number of specimens that can be identified as *O. villosa*. However, Thai specimens differ from the type in having shorter, caducous stipules, denser pubescent leaves, and white rather than rusty villous pubescence on the peduncles. A compact long peduncled inflorescence is regarded as a characteristic feature of *O. villosa* (Wallich, 1820; Hooker, 1882; Deb & Mondal, 1997 publ. 2001). Our plants have shorter peduncles and inflorescence branches very short during anthesis, but usually somewhat elongating afterwards. *O. villosa* deserves more study to finally confirm whether Thai populations are actually conspecific with the Indian ones.

Differential characters of the three species are summarised in Table 1.

A few words must be added on the heterostyly within these species. Heterostyly in *Ophiorrhiza* is a special issue for discussion. Usually *Ophiorrhiza* is not considered among heterostylous genera of Rubiaceae (Verdcourt, 1958; Darwin, 1976). However, in more recent revisions of *Ophiorrhiza* at least some taxa are considered heterostylous (Lo, 1990; Deb & Mondal, 1997 publ. 2001). As far as I could find out in this study, in the above species plants with both homostylous and heterostylous flowers occur over their ranges (Fig. 1).

O. trichocarpum is usually homostylous, with the stigma positioned at the anthers level in the middle part of the corolla tube. Corollas are small, up to 5 mm long. However, a specimen with a stigma positioned at the tube throat clearly above the anthers was collected from Krabi in Peninsular Thailand (*Supapol* 177). In the revision by Deb and Mondal (1997 publ. 2001) a long styled flower is also depicted in the figure showing this species. I have not seen any plant of *O. trichocarpum* with short styled flowers. However, it seems probable they can rarely occur, since the reciprocal form does exist.

A similar patterns can be seen in *O. pedunculata*. Most of the examined specimens appeared to be homostylous (corolla 5–7 mm long). Only a few plants appeared to belong to heterostylous morphs. The difference between them includes not only the reciprocal position of anthers and stigma, but also the overall corolla dimensions. The longistylous plant (*Suvarnakoses* 1895) from SW Thailand has corollas to 6.6 mm long, comparable to those of homostylous plants, while the brevistylous one (*Larsen et al.* 46836), from Doi Pui in NW Thailand, has exceptionally large corollas to 9–11 mm long, which is untypical for the bulk of homostylous flowers. Similar differences in corolla size in different flower types were also reported in some other rubiaceous genera, viz. *Rudgea*, *Palicourea*, *Luculia*, *Guettarda*, *Manettia*, *Hedyotis*, *Gaertnera*, and *Bouvardia* (Faivre & McDade, 2001). So, both *O. trichocarpum* and *O. pedunculata* are usually homostylous, with rarely occurring heterostylous plants.

Table 1. Differential characters of *O. trichocarpon*, *O. pedunculata*, and *O. villosa*

<i>O. trichocarpon</i>	<i>O. pedunculata</i>	<i>O. villosa</i>
Inflorescence bracts minute, appressed to branches, < 2 mm long	Inflorescence bracts linear to narrow lanceolate, up to 5 mm long	Inflorescence bracts minute, appressed to branches, < 1 mm long
Upper leaf surface: loosely scattered with short 0.1–0.3 mm appressed hairs or glabrous (var. <i>glabra</i>)	Upper leaf surface: leaves, especially young, densely to loosely scattered with 0.2–0.5 mm appressed hairs	Upper leaf surface: leaves, especially young, densely to loosely scattered with 0.2–0.6 mm appressed hairs
Lower leaf surface: loosely short hairy along nerves or glabrous (var. <i>glabra</i>)	Lower leaf surface: scatteredly to rather densely hairy throughout surface, especially on young leaves	Lower leaf surface: scatteredly to rather densely hairy throughout surface, especially on young leaves
Flower buds rounded or slightly angular in the upper part and at the top	Flower buds rounded or slightly angular in the upper part and at the top	Flower buds with small conical appendages at the top
Peduncle in fruit up to 3 cm long	Peduncle in fruit up to 10 cm long	Peduncle in fruit up to 4–5 cm long
Pedicels short, to 1.5 mm	Pedicels short, to 1.5 mm	Pedicels up to 4 mm long

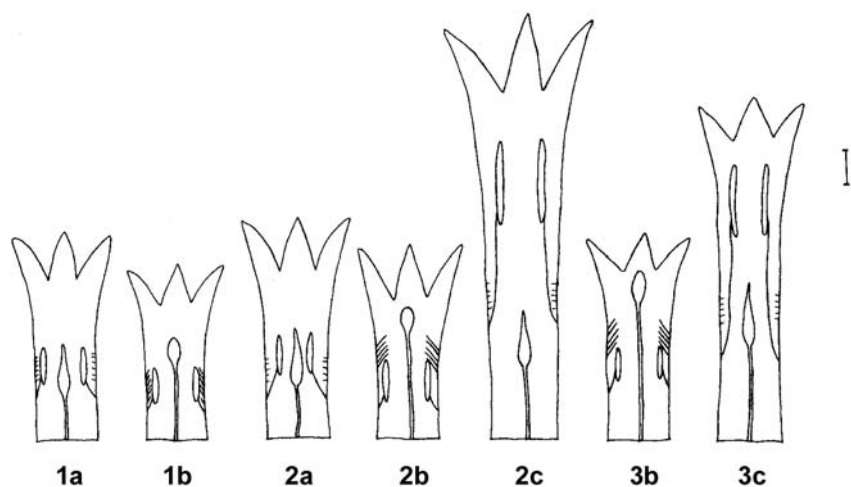


Figure 1. Diagrams of corollas of *O. trichocarpon*, *O. pedunculata*, and *O. villosa*, showing relative position of anthers and stigmas in different types of flowers. Scale bar = 1 mm.: 1. *O. trichocarpon*: a. homostylous flower; b. longistylous flower; 2. *O. pedunculata*: a. homostylous flower; b. longistylous flower; c. brevistylous flower; 3. *O. villosa*: b. longistylous flower; c. brevistylous flower.

The opposite situation is characteristic of *O. villosa*. All the specimens examined were either long or short styled. The short styled flowers are almost twice as long (8–9 mm) the long styled (5–6 mm), similar to the pattern observed in *O. pedunculata*. Yet homostylous flowers can probably occur in *O. villosa*, too, since such a flower is shown in the figure in Deb & Mondal (1997 publ. 2001) for an Indian plant. The isotype specimen at K is, however, brevistylous.

Different types of flowers share several common features in all these and many other species that I have examined. Short-styled flowers in all cases possess a loose ring of relatively short (to 0.1–0.3 mm) hairs, more or less normal to the inner wall of the corolla tube. The stigma here is long (usually more than 1 mm), lanceolate, and positioned below the hair ring, while the anthers are positioned above the hair ring, nearly reaching the throat of the corolla. Homostylous flowers are similar to these, but their corollas and filaments are much shorter, so that both stigma and anthers are positioned at the same level inside the loose hair ring, approximately in the middle of the corolla tube. On the contrary, long-styled flowers always possess a dense ring of relatively long (to 0.4–0.6 mm), more or less upwards appressed hairs inside the corolla tube. The anthers here are positioned below the hair ring; and the stigma is shorter than in short-styled flowers, with elliptic or roundish lobes, positioned above the hair ring, usually just below the throat of the corolla. As far as it is possible to judge from herbarium specimens, protandry is the common case.

Examination of mature but still unopened flower buds in *O. trichocarpum* and *O. pedunculata* often reveals that anthers open in bud and the stigmas are all covered with pollen. It seems probable that these species are selfers and that loss of heterostyly is connected with their evolutionary transition to selfing.

Distributions of these three species are shown in Figs. 4–6. As one can see, areas of *O. pedunculata* and *O. villosa* are within the range of *O. trichocarpum*. *O. pedunculata* is restricted to E slopes of the range system stretching from N Thailand southward to the Isthmus of Kra. *O. villosa* has a wider distribution from Bangladesh in the W to the NW and W Thailand in the E. Deb & Mondal (1997 publ. 2001) also report it from Andaman Islands, however I have not seen any specimen from there. *O. trichocarpum* has a much wider range compared to the two former species, and demonstrates the most unusual disjunction between the Malay Peninsula and Java. Such a disjunction can hardly be the result of just mis-sampling. Examination of rather rich collections of *Ophiorrhiza* from S Malay Peninsula and Sumatra at L and K, as well as at several Thai herbaria and SING, revealed no specimens that could be assigned to *O. trichocarpum*.

The nomenclature and examined specimens of these three species are given below.

Ophiorrhiza trichocarpum Blume, Bijdr.: 977. 1825. Type: "circa Linga Jaltie (Cheribon) et etiam in umbrosis Insulae Nusae Kambangae" (holotype L!).—*Ophiorrhiza trichocarpa* auct. non Blume, Hook. f., 1882, Fl. Brit. India, 3: 78; Pitard, 1923, Fl. Indo-Chine, 3 (2): 157–158; Deb & Mondal, 1997 (publ. 2001), Bull. Bot. Surv. India, 39 (1–4): 131–133.—*Ophiorrhiza trichocarpos* auct. non Blume, Bakh. f. in Backer & Bakh. f., 1882, Fl. Java, 2: 291.—*Ophiorrhiza hispidula* Wall. ex G. Don, 1834, Gen. Hist., 3: 523; King & Gamble, 1904, J. As. Soc. Bengal., 72 (4): 173–174; Ridl., 1923, Fl. Malay Pen., 2: 40; Craib, 1932, Fl. Siam. Enum., 2 (1): 64–65. Type: "Wall. cat. no. 6234. ... Native of the East Indies, at Tavoi" (holotype K!).

The correct spelling of *O. trichocarpon* has been subject to a long discordance in the literature. In most cases it is misspelled as '*trichocarpa*'. Bakhuizen van den Brink (1965) indicated this spelling as erroneous, but gave another equally erroneous variant '*trichocarpos*' himself. Deb & Mondal (1997 publ. 2001), on the other hand, gave '*trichocarpa*' as the correct spelling, putting '*trichocarpon*' under "sphalmate". I suppose there is no reason to reject the original Blume's epithet, since it seems to be in full concordance with article 23.1. of the ICBN which reads: "The name of a species is a binary combination consisting of the name of the genus followed by a single specific epithet in the form of an adjective, a noun in the genitive, or a word in apposition..." '*Trichocarpon*' as a Greek noun standing in the nominative can certainly be regarded as such "a word in apposition", so I cannot see any reason for changing it to a latinised adjective.

Distribution.— India, Bangladesh, Myanmar, Thailand, Malaysia, Indonesia (Fig. 4).

Habitat.— 5–960 m altitude; along trails, on sandy loam or loamy soil, boulders and rocks, along streams and waterfalls in primary or secondary, disturbed, evergreen, deciduous, or bamboo forests; fl. March–November; fr. June–February.

Specimens examined (homostylous plants):

India.— Andaman Is: Little Andaman. Near forest nursery, Hut Bay, 08.05.75, *Bhargava* 2417 (L); Middle Andaman. Vic. of Camp no. 15, 03.11.77, *Bhargava, Noteboom et al.* 6319 (L); Middle Andamans. Billy ground, 22.07.74, *Bhargava* 1909 (L); North Andamans. Keralapuram, 21.11.76, *Nair* 4858 (L); S Andamans (Baratang I.). Near Nilambur, 22.07.75, *Bhargava* 2479 (L).

Myanmar.— Eastern Tenasserim, 29.03.32, *Kerr* 21599 (K); Katha district, Suigon, 20.11.08, *Lace* 5213 (K); *Tavoy W. G.* 6234 (holotype: K); Tenasserim and Andamans; distr. at the Royal Gardens, Kew. 1862–3, *Herb. Helfer* 2857 (L).

Indonesia.— Bali: Monkey forest near Ubud 22 km N of Den Pasar, 05.04.75, *Mejer, Noerta* 8081 (L); Bawean: Bawean, 17.06.24, *Dorgelo* 57 (L); Tunche Sangkapoera & Telogo, 17.06.24, *Dorgelo* 48 (L); Java: Linga Jattei, Nusa Kumbanga, Blume, holotype (L); Buitenzorg [= Bogor] 16.02.89, *Herb. Boerlage* (L); E Java, res. Besuki, Mt. Raung, S slope above village Gunungsari, 17.05.57, *Jacobs* 4806 (L); anonymous (L); *Korthals* 619 (L); *Herb. Rwdt* (L); Nusabambagan Is., SW part between Soloh Babakan to Karanganjer, 22.11.38, *Kostermans, v. Woerden* 130 (L); Puroeroen, Terrei W von Lawang, 06.02.30, *Backer* 37682 (L); Prov. Batavia, in agro Buitenzorgensi, apud Kossa Batu, 07.02.94, *Schiffner* 2687 (L); 2628 (L); Udjung Kulon Reserve, Tjibunar, 11.11.60, *Kostermans* 108 (L); distr. Banten, Bantardjaja rubber estate. 18 km S of Rangkasbetung, 29.04.37, *Buwalda* 2712 (L).

Thailand.— NORTHERN: Chiang Mai [Botanic Garden, Mae Rim, 31.05.94, *BGO staff* 719 (689) (QBG)]; Chiang Rai [Doi Luang National Park, a trail from headquarters to Phu Kaeng Waterfall, 08.12.02, *Schanzer* 02-097 (MHA)]; Phayao [Doi Luang National Park, Cham Pa Thong Waterfall, 09.12.02, *Schanzer* 02-108, (MHA)]; distr. Muang, Doi Luang National Park, east side, Chaha Na Tong Falls, 26.05.97, *Petrair* 24 (BKF)]; Lampang [Mae Ngow, 26.08.20, *Khoon Winit* 748 (BKF, K)]; Tak [20 km E of Mae Sot, 30.05.73, *Geesink, Phanichapol, Santisuk* 5580

(L, BKF, AAU); Kamphaeng Phet [Khlong Naum Lai substation, Klong Lan National Park, 03.08.00, *Chamchumroon* vc1019 (BKF)]; NORTH-EASTERN: Loei [along trail from Samhaek (RS-5) to Langpae (RS-7), 29.08.88, *Fukuoka* T-63701 (BKF)]; Phu Kradueng, 30.10.84, *Murata, Phengklai et al.* T-42064 (BKF, L); interior of Nam Thop, on eastern slope of Phu Luang, 07.12.65, *Tagawa, Iwatsuki, Fukuoka* T-1916 (BKF)]; EASTERN: Chaiyaphum [Phu Khiao, Thung Kra Mang trail, 04.08.72, *K. & S. Larsen, Nielsen & Santisuk* 31377 (AAU)]; Nakhon Ratchasima [Muak Lek, Saraburi, 30.08.24, *Kerr* 9077 (K)]; SOUTH-WESTERN: Kanchanaburi [Hin Dat, Kanchanaburi, 29.06.26, *Put* 41 (K); distr. Sangklaburi; Thung Yai Naresuan Wildlife Reserve, 15.06.93, *Maxwell* 93-613 (BKF); Kwae Noi Basin Expedition, Brangkasi, 22.06.46, *den Hoed & Kostermans* 899 (L, K); Kwae Noi Basin Expedition; near Neeckey (n. Wanglea), 24.04.46, *Kasin* 155 (L, K); Pompi village near Khwae Noi river, E of Sangkhla, 25.03.68, *C. van Beusekom, Phengklai* 95 (BKF, L, AAU)]; CENTRAL: Saraburi [Sam Lan, 19.05.74, *Maxwell* 74-519 (AAU)]; SOUTH-EASTERN: Chon Buri [Khao Khiao, Sriracha distr., 22.06.75, *Maxwell* 75-600 (BKF, L)]; Chanthaburi Doi Soi Dao Nue, 13.05.74, *Geesink, Hattink, Phengklai* 6740 (BKF, L, AAU); Pong Namron, 16.10.55, *B. Sangkhachand* 22639 (BKF); Nam Tok Taka Mao, N of Chanthaburi, 25.08.72, *K. & S. Larsen, Nielsen & Santisuk* 32015 (BKF, AAU)]; PENINSULAR: Chumphon [Siepyuan, 07.09.27, *Put* 997 (K)]; Surat Thani [Ban Na, Surat Yuang 19 (K)]; Krabi [distr. Plaipraya, Ban Klong Puan, 30.11.86, *Maxwell* 86-1006 (L); Khao Phanom Bencia, foothill of S range, 11.07.92, *K. Larsen et al.* 43289 (AAU)]; Trang [Lamphura, 10 km N of Trang, 15.11.90, *K. Larsen et al.* 41412, (AAU)]; Yala [Biserat in Jalou (Yala) Bukit Goah, 08.06.94, *Gwynne-Vanghan* 536 (K)].

Specimens examined (longistylous plants):

Thailand.— PENINSULAR: Krabi [distr. Plaipraya, Ban Khlong Puan, Mo 7, 30.11.86, *Supapol* 177 (BKF, L)].

Ophiorrhiza trichocarpa Blume var. *glabra* var. nov.

Herba perennis, *Ophiorrhizae trichocarpis* habitu characteribusque valde similis, sed foliis glabris, caulibus glabris, pedunculis sparse pubescentibus, ovariis glabris vel minute sparse papillois, corollis extus glabris, floribus homostylis. Typus: Thailand, Sa Kaeo, SE foot of Khao Takrup, Centennial Bot. Gard., 11.08.99, *Schanzer* 78 (holotypus MHA!).

Plants collected from Khao Takrup seem to be conspecific with *O. trichocarpa* in all characters except pubescence, being nearly glabrous in all parts. Stems, leaves and corollas are completely glabrous, peduncles are usually loosely scattered with short (0.3–0.1 mm long) hairs, which are even shorter (0.1–0.05 mm) on inflorescence branches, and reduced to few papillae on ovaries. This variety seems to be restricted in its distribution to Khao Takrup. Normally pubescent plants do not occur there either.

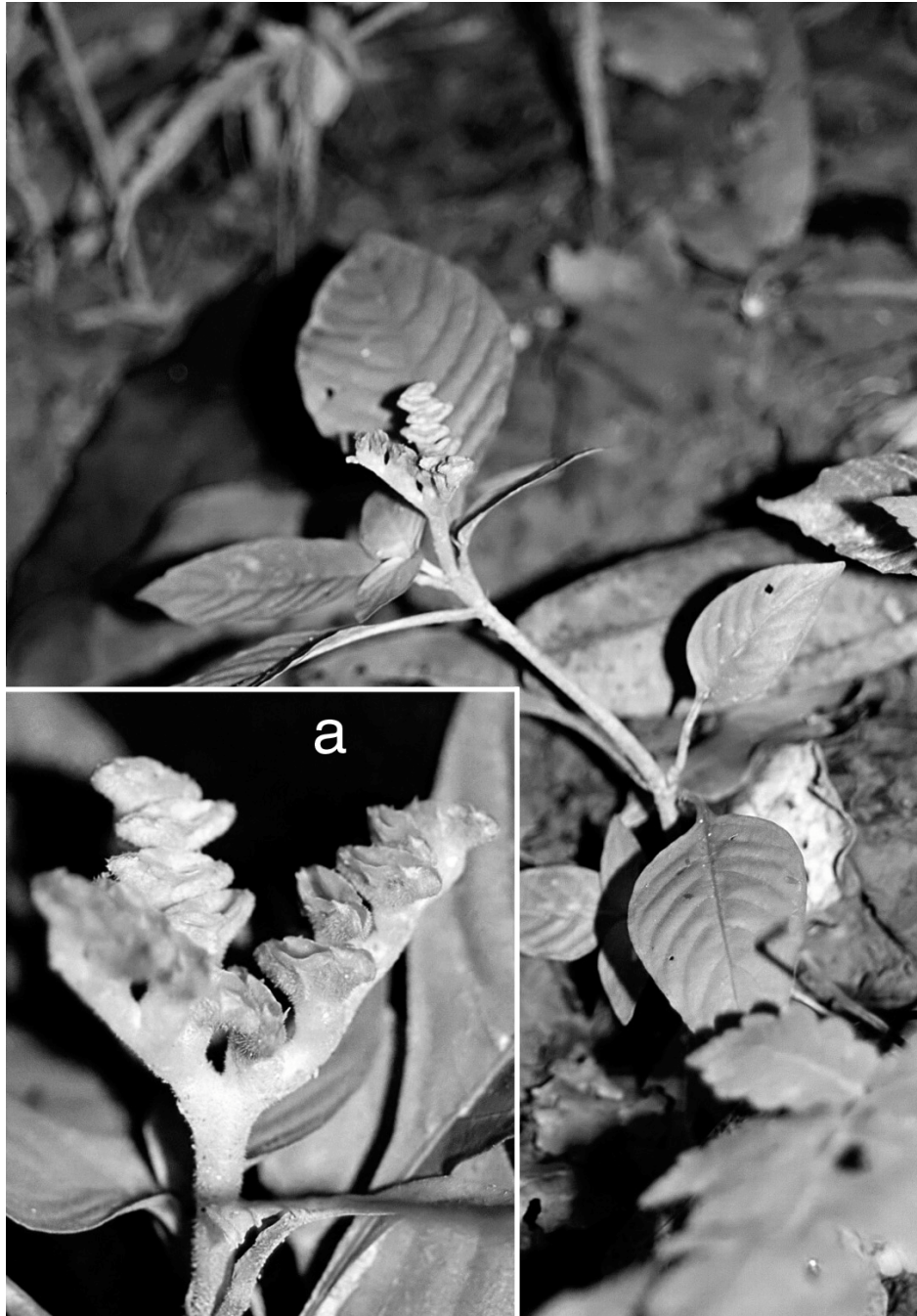


Figure 2. *Ophiorrhiza trichocarpa*. Thailand, Doi Luang Nat. Park, 8.12.2002.: a. inflorescence enlarged: bracts are hardly visible. Photographed by I. Schanzer.



Figure 3. *Ophiorrhiza pedunculata*. Thailand, Doi Luang Nat. Park, 8.12.2002: Arrow points to an elongated bract. Photographed by I. Schanzer.

Specimens examined:

Thailand.— SOUTH-EASTERN: Sa Kaeo [S of Khao Takrup, Centennial Bot. Gard., 10.08.99, *Schanzer* 52 (MHA); SE foot of Khao Takrup, Centennial Bot. Gard., 11.08.99, *Schanzer* 60, 78 (holotype), 68, 82, 88 (MHA)].

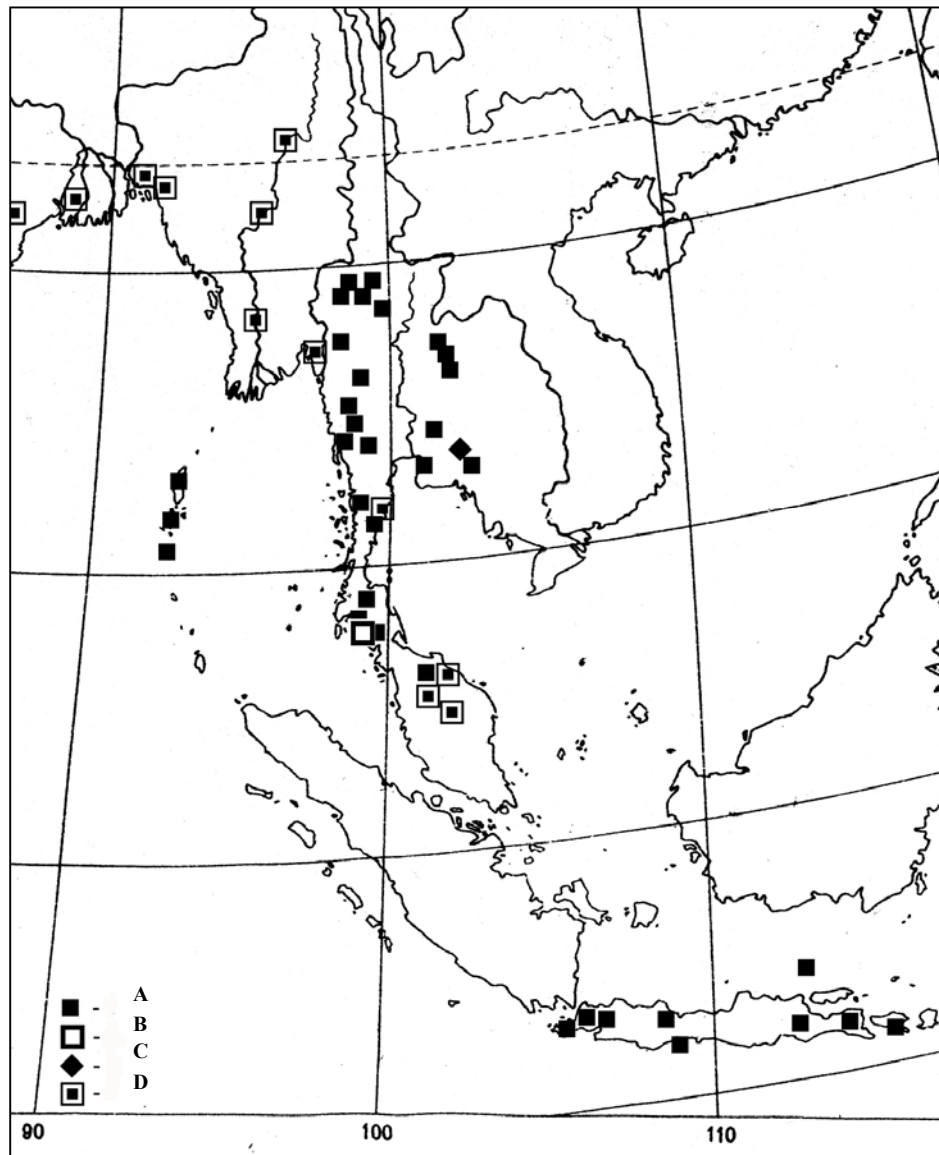


Figure 4. Distribution of *Ophiorrhiza trichocarpa*: A. homostylous plants; B. longistylous plants; C. *O. trichocarpa* var. *glabra*; D. localities cited in literature.

***Ophiorrhiza pedunculata* nom. et stat. nov.**— *O. hispidula* var. *longipedunculata* Craib, 1932, Fl. Siam. Enum., 2 (1): 65, non *O. longipedunculata* Merr., 1937, Mitt. Inst. Allg. Bot. Hamburg, 7 (4): 277. Type: Payap. Me Ping Rapids, Hat Yuak, ca. 200 m, damp rocks by stream, Kerr 4656 (holotype BK!; isotypes K!, BM!).

Distribution.— Myanmar, Thailand (Fig. 5).

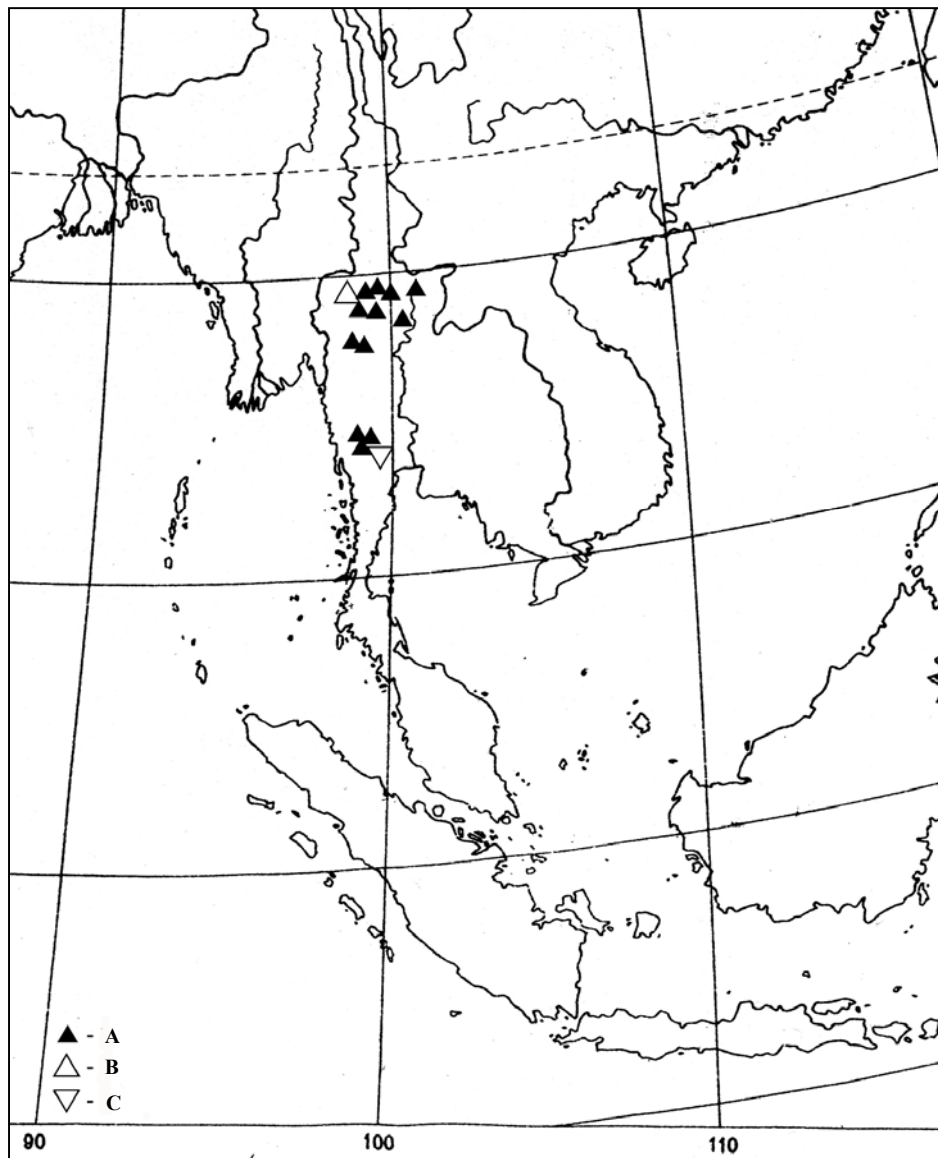


Figure 5. Distribution of *Ophiorrhiza pedunculata*: A. homostylous plants; B. brevistylous plants; C. longistylous plants.

Habitat:— 100–1,125 m altitude; on humus, open soil, wet rocks, along streams and waterfalls in primary or disturbed evergreen, mixed, or disturbed bamboo dominated forests; fl. April–September; fr. June–December.

Specimens examined (homostylous plants):

Thailand.— NORTHERN: Mae Hong Son [Doi Mae Sakut, Muang, 23.09.95, *BGO staff* 4671 (QBG), 4680 (QBG)]; Chiang Mai [Botanic Garden Mae Rim, 23.06.94, *BGO staff* 974 (QBG); Doi Suthep, N of the temple, 07.08.99, *Schanzer* 10 (MHA), foot of Doi Chiang Dao, 11.09.67, *Tagawa, Shimizu & al.* T-9773 (BKF, AAU, L), middle elevation of Doi Suthep, 20.09.67, *Shimizu, Hutoh* T-10564 (BKF); Doi Suthep, 05.07.14, *Kerr* 3279 (K); Hat Yuak, Mae Ping Rapids, 26.11.20, *Kerr* 4656 holotypes & isotypes (K, BM, BK); Mae Rim-Samoeng Rd, Mae Rim, 20.11.95, *BGO staff* 5264, (QBG); Mok Fa waterfall (just W of Pang Hang) (part of Doi Suthep-Pui National Park), 13.09.99, *Puff* 990913–1/2 (QBG); Khao Chiang Dao, 07.12.61, *Bunchuai* 50, (BKF); Doi Suthep-Pui National Park, Doi Suthep, 02.12.02, *Schanzer* 02-008 (MHA); Doi Chiang Dao, 28.11.62, *Bunchuai* 1233 (BKF); Teen Tok 10 km N of Doi Chiang Dao, 02.08.68, *K. Larsen, Santisuk, Warncke* 3045 (BKF, L, AAU); Botanic Garden, Mae Rim, 12.09.95, *BGO staff* 4195 (QBG); distr. Muang; Doi Suthep, east side, Rue-Si Cave, 15.06.88, *Maxwell* 88-762 (BKF, L); Huai Mae Sanoi, Botanic Garden, Mae Rim, 29.08.94, *BGO staff* 1468 (QBG); Pong Dueat, 04.09.99, *Suksathan* 1754-1 (QBG); Mok Fa Waterfall 40 km NE of Chiang Mai, 24.11.93, *K. Larsen et al.* 44784 (AAU); 44764 (AAU)]; Chiang Rai [Doi Luang National Park, a trail from headquarters to Phu Kaeng Waterfall, 08.12.02, *Schanzer* 02-097 (MHA)]; Lamphun [enroute from Ban Khun Tan to Doi Khun Tan, 04.09.67, *Tagawa et al.* T-9118 (L); Lampang [distr. Wahng Hua, Jae Sawn National Park, 26.10.95, *Maxwell* 95-1020 (BKF)]; Nan [Amphoe Thung Chang, Ban Huai Sataeng, 20.11.93, *K. Larsen et al.* 44667 (AAU)]; Phrae [Huai Rong (= Doi Sawan) Waterfall, NE of Phrae, 09.09.95, *K. Larsen et al.* 46225 (AAU)]; SOUTH-WESTERN: Kanchanaburi [Sai Yok, 02.08.28, *Marcan* 2407 (K); Thong Pha Phum, 03.07.73, *Maxwell* 73-73 (AAU); Kwae Noi River Basin Exp. 1946; near Linthin near Kin Saiyok, 19.07.46, *Kostermans* 1231 (L); Erawan, 01.07.74, *K. & S.S. Larsen* 33965 (BKF, L, AAU, K; SW); between Huai Ban Khao and Kriti, 04.07.73, *Geesink, Phengklai* 6085 (BKF, L, AAU); Erawan National Park, 18.11.71, *van Beusekom, Phengklai et al.* 3826a (BKF, K); Erawan National Park, 20.11.71, *van Beusekom, Phengklai et al.* 3885 (BKF, L, K); Tham Than Lot National Park, Bo Phloi, 07.11.79, *Shimizu et al.* T-21989 (BKF, L); Thung Kang Yang Hills, 07.07.63, *K. Larsen* 10570 (BKF, AAU)].

Specimens examined (longistylous plants):

Thailand.— SOUTH-WESTERN: Kanchanaburi [Muang, 04.07.63, *P. Suvarnakoses* 1895 (BKF, L, K)].

Specimens examined (brevistylous plants):

Thailand.— NORTHERN: Mae Hong Son [Doi Pui, SE of Mae Hong Son, 23.09.95, *K. Larsen et al.* 46836 (AAU)].

Ophiorrhiza villosa Roxb., 1824, Fl. Ind., ed. Carey, 2: 546; Craib, 1932, Fl. Siam. Enum., 2 (1): 71–72; Deb & Mondal, 1997 (pub. 2002), Bull. Bot. Surv. India, 39 (1–4): 133–135. Type: "A native of shaded, moist places amongst the hills of Chittagong", *Wall. Cat.* 6230A (holotype CAL; isotype K!).

Distribution.— India, Bangladesh, Myanmar, Thailand (Fig. 6).

Habitat.— 400–1,800 m altitude; under humid conditions on clayey slopes, by streams and cascades, in crevices of shady limestone in evergreen forests; fl. July–November; fr. July–November.

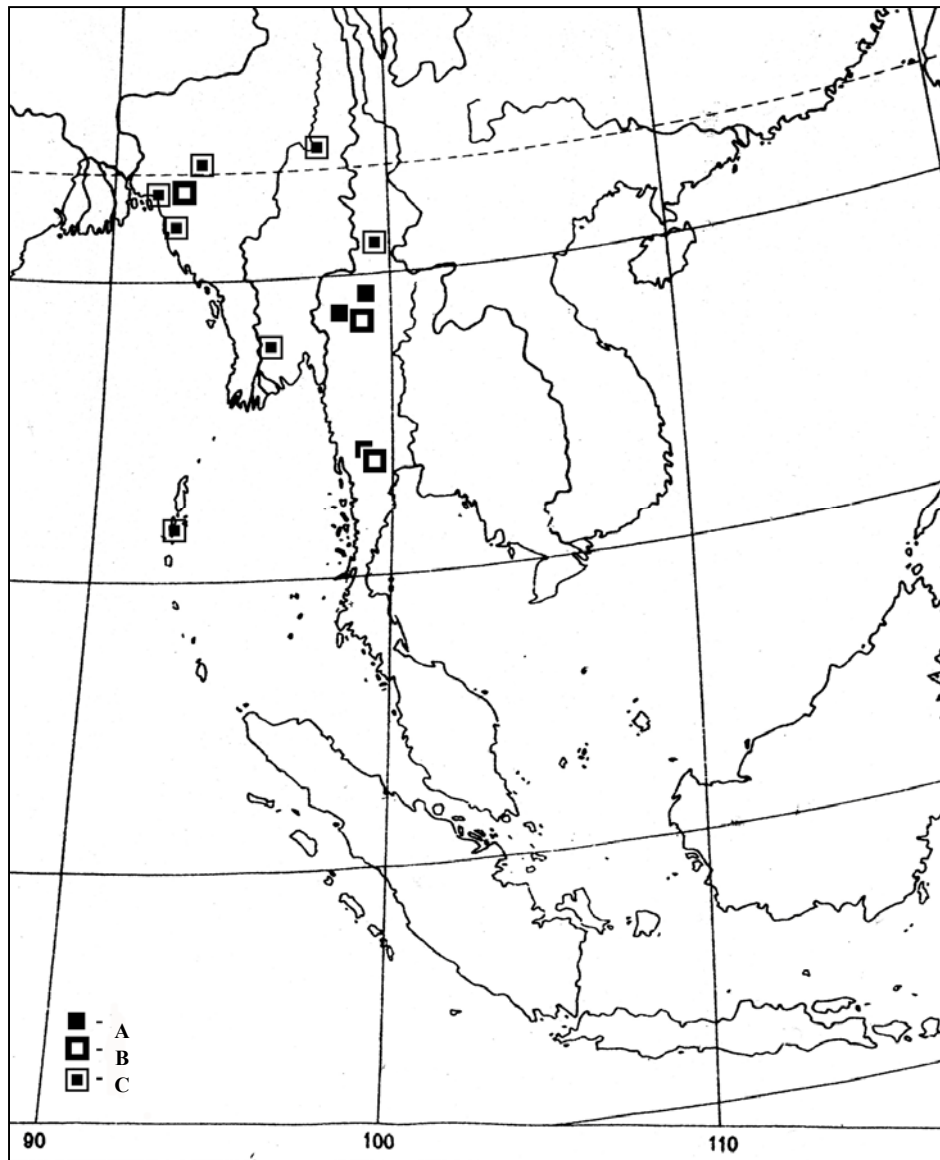


Figure 6. Distribution of *Ophiorrhiza villosa*: A. longistylous plants; B. brevistylous plants; C. localities cited in literature.

Specimens examined (brevistylous plants):

Bangladesh.— Chittagong, 1825 H. B. 6230A (isotype: K!).

Thailand.— NORTHERN: Chiang Mai [Doi Pa Kao, 25.08.31, *Garrett* 704 (L, AAU); SOUTH-WESTERN: Kanchanaburi [Southwestern: Kanchanaburi, Erawan waterfall, 05.07.63, *Suvarnakoses* 36932 (L)].

Specimens examined (longistylous plants):

Thailand.— NORTHERN: Mae Hong Son [Khun Yuam, 05.09.74, *K. & S. Larsen* 34163 (L, AAU), 34163b (L, AAU)]; Chiang Mai [higher elevation of Doi Chiang Dao, 13.09.67, *Tagawa, Shimizu et al.* T-9923 (L, AAU); middle elevation of Doi Chiang Dao, 15.09.67, *Shimizu, Hutoh* T-10159 (L); SOUTH-WESTERN: Kanchanaburi [Erawan National Park, 18.11.71, *van Beusekom, Phengkklai et al.* 3826a (L)].

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I wish to thank the curators of the following Herbaria, L, AAU, K, BM, SING, BK, BKF, QBG, for lending materials and opportunity to study their collections; Drs C. Puff (Botanical Institute, Vienna, Austria), K. Chayamarit (the Forest Herbarium, Bangkok, Thailand), and Mr V. Chamchumroon (the Forest Herbarium, Bangkok, Thailand) for help in conducting field research; the Percy Sladen Memorial Fund for financial support of the field work in 1999; Drs M. Roos (Rijksherbarium, The Netherlands), A. Davis (Royal Botanic Gardens, Kew, UK), and C. Puff for help in obtaining the necessary literature; I also wish to express special thanks to Dr C. Puff for critical reading and correcting of the manuscript.

REFERENCES

- Backer, C. A. & R. C. Bakhuizen van den Brink, Jr. 1965. *Flora of Java* 2. N.V.P. Noordhoff, Groningen.
- Craib, W. G. 1932. *Florae Siamensis Enumeratio*, 2 (1). Siam Society, Bangkok.
- Darwin, S.P. 1976. The Pacific species of *Ophiorrhiza* L. (Rubiaceae). *Lyonia*, 1(2): 47–102.
- Deb, D. B., Mondal, D.C. 1997, publ. 2001. Taxonomic revision of the genus *Ophiorrhiza* L. (Rubiaceae) in Indian subcontinent. *Bulletin of the Botanical Survey of India* 39 (1–4): 1–148.
- Don, G. 1834. *A General History of the Dichlamydeous Plants* 3. London.
- Faivre, A. E. & L. A. McDade. 2001. Population-level variation in the expression of heterostyly in three species of Rubiaceae: does reciprocal placement of anthers and stamens characterize heterostyly? *American Journal of Botany* 88(5): 841–853.
- Hooker, J. D. 1880. Rubiaceae. In: Hooker, J. D. (ed.), *The Flora of British India*, 3 (7): 1–192. Reeve & Co., London.
- King, G. & J. S. Gamble. 1903. Materials for a Flora of the Malayan Peninsula. *Journal of the Asiatic Society of Bengal* 72 (2, 4): 111–229.

- Lo, H.-S. 1990. Taxonomic revision of the Chinese species of *Ophiorrhiza* (Rubiaceae). Bulletin of Botanical Research North-Eastern Forestry Institute 10(2): 1–82.
- Pitard, J. 1922. Rubiaceae. In: Lecomte, M.H. (ed.), Flore Générale de l'Indo-Chine, 3, 2. Masson, Paris.
- Ridley, H. N. 1923. The Flora of the Malay Peninsula 2. Reeve & Co., London.
- Roxburgh, W. 1824. Flora Indica, ed. W. Carey 2. Mission Press, Serampore.
- Verdcourt, B. 1958. Remarks on the classification of the Rubiaceae. Bulletin du Jardin Botanique de l'État 28: 209–281.

***Jasminum rufohirtum* Gagnep. (Oleaceae), a new record for Thailand**

PRACHAYA SRISANGA*, CHUSIE TRISONTHI & PETER S. GREEN*****

ABSTRACT. *Jasminum rufohirtum* Gagnep., previously known from China (Yunnan), Laos and Vietnam, is reported from northern Thailand. The species is described and illustrated.

In the account of Oleaceae for the Flora of Thailand, thirty-one indigenous species in the genus *Jasminum* L. are recorded (Green, 2000). During an expedition by the first author to Doi Phukha National Park, Nan province in March 2000, specimens belonging to this genus were collected and identified as *J. rufohirtum* Gagnep., a new record for Thailand.

***Jasminum rufohirtum* Gagnep.**, Bull. Soc. Bot. Fr. 80: 77. 1933 & in Fl. Indo-Chine 3: 1057. 1933; M. C. Chang et al. in C. Y. Wu & P. H. Raven, Fl. China 15: 317. 1996; in Fl. China Illustr. 15: 274, fig. 274, 1. 2000. Types: Vietnam, *Colani* in herb. *Petelot* 5032 (syntype P!) & Laos, *d' Orleans* s.n. (syntype P!).—*J. yunnanense* Jien ex P. Y. Bai, Acta Bot. Yunnan. 5(1): 66, fig. 2. 1983; B. M. Miao in Fl. Reipubl. Pop. Sin. 61: 211, fig. 55, 1. 1992. Type: China, Yunnan, *Yunnan exped.* 359 (holotype KUN). Fig. 1.

Woody climber; branchlets terete, rusty-villous. *Leaves* simple, chartaceous, lanceolate, elliptic to ovate, (7–) 10–15 by (2.5–) 5–8 cm; apex acute, shortly acuminate or caudate, base rounded or cordate; margins entire, rusty-villous on both surfaces, especially below and on the veins, midrib impressed above, raised and prominent below, primary veins 6–8 on each side of the midrib, prominent on lower surface; petioles 3–6 mm long, rusty-villous. *Inflorescence* in terminal cymes, congested, 5- or more-flowered, rusty-villous; bracts filiform, 3–6 mm long, rusty-villous. *Flowers* fragrant; pedicels 0.5–2 mm long, rusty-villous; bracteoles 2, filiform, ca. 5 mm long, rusty-villous. *Calyx* rusty-villous; tube 1–2 mm long; lobes 5–8, filiform, 3–8 mm long. *Corolla* white, glabrous; tube 2.5–3 cm long; lobes 5–8, lanceolate, ca. 10 by 3 mm, apex acute, margin ciliate. *Stamens* 2; filaments c. 0.5 mm long, glabrous; anthers 4–4.5 mm long, glabrous, dehiscing by longitudinal slits, connective appendage acute. *Ovary* barrel-shaped, glabrous, 0.5–1 mm long; style ca. 4 mm long, glabrous; stigma ca. 2.5 mm long, glabrous; ovules 2. *Fruit* ellipsoid, 10 by 6 mm.

Thailand.—NORTHERN: Nan [Doi Phukha National Park, 19° 13' N 101° 06' E, *Srisanga* 1345 (BKF, K, P, QBG)].

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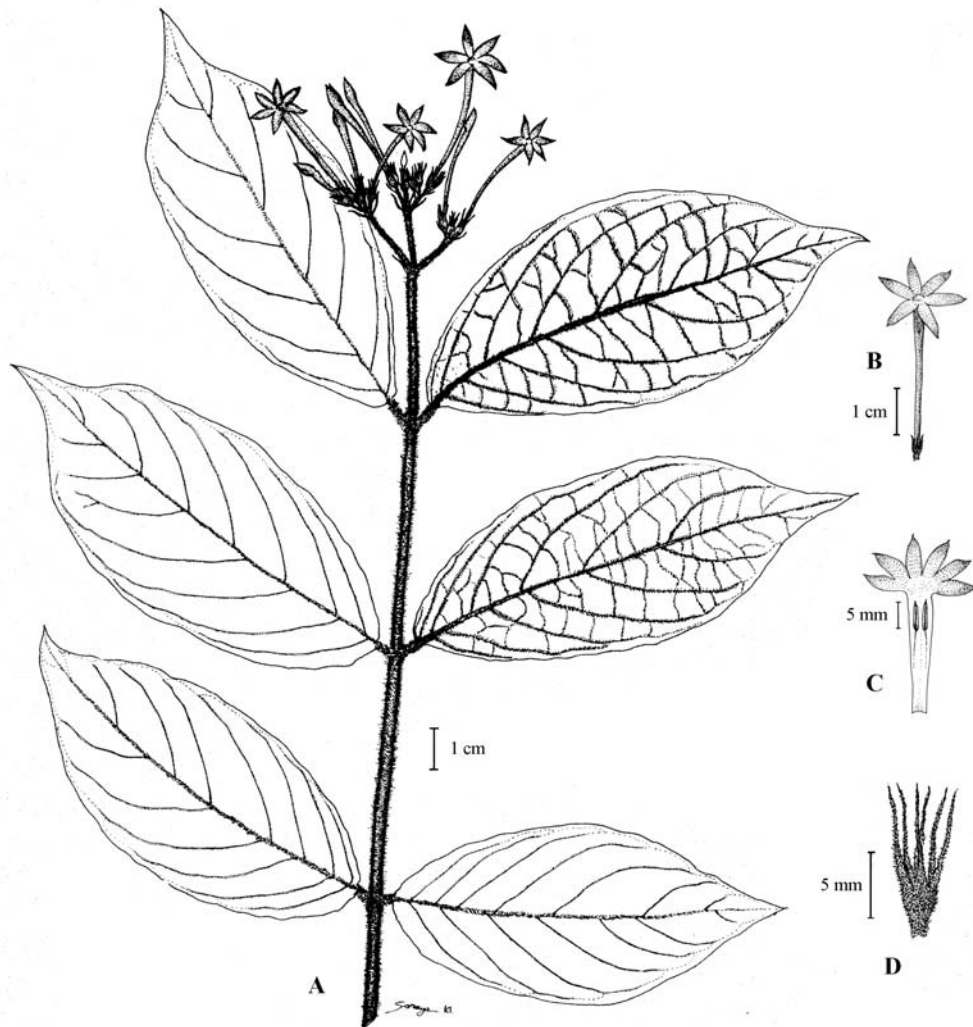


Figure 1. *Jasminum rufohirtum* Gagnep.: A. flowering branch; B. flower; C. opening corolla; D. calyx. All from Srisanga 1345. Drawn by S. Klankoom.

Distribution.— China, Laos and Vietnam.

Ecology.— Lower montane forest, 1,300–1,500 m altitude. Flowering: March–May. Fruiting: May–June.

Note.— *Jasminum rufohirtum* is characterised by its congested, 5- or more-flowered inflorescence and the rusty-villous surface of the branchlets, leaves, inflorescence and calyx. It is similar to *J. annamense* Wernham subsp. *annamense* and *J. maingayi* C. B. Clarke but differs from the former in the shorter calyx lobes, 3–8 mm (vs. 10–17 mm long) and rusty-villous (vs. velutinous) branchlets, leaves, inflorescence and calyx and from the latter in chartaceous (vs. coriaceous) leaves and rusty-villous (vs. glabrous, puberulent or pubescent) branchlets, leaves, inflorescence and calyx.

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Much appreciation is due to the curators and staff of BKF, CMU, K, KUN, P and QBG for their kind permission to study specimens and staff of Doi Phukha National Park for assistance in the field. The first author would like to thank Dr Somran Suddee for valuable advice, Mr Wachana Bunchai (QBG) for literature and photos of holotype of *J. yunnanense* from KUN, Ms Soraya Klankoom for the drawings and Mr Pasakorn Kaewket for technical assistance. This work was supported by a grant from the Thailand Research Fund.

REFERENCE

- Green, P. S. 2000. Oleaceae. In: Santisuk, T. & Larsen, K. (eds). Flora of Thailand 7: 271–340.

New combinations in Thai Convolvulaceae

GEORGE STAPLES*

ABSTRACT. Two new combinations are made in Thai Convolvulaceae, *Argyreia siamensis* and *Tridynamia bialata*.

Two new combinations are necessary so that the names will be available for a checklist of Thai Convolvulaceae to be published elsewhere in the *Thai Forest Bulletin (Botany)*. Additional new combinations in *Argyreia* are published separately.

Argyreia siamensis (Craib) Staples, **comb. nov.**— *Ipomoea siamensis* Craib, Kew Bull. Misc. Inform. 1911: 424. 1911. Type: Thailand, Chiang Mai, Doi Suthep, *A. F. G. Kerr* 1401 (isotypes BM, K!).

It is curious that the fruits of this species had never been collected until recently, although there is ample flowering material of it to be found in several herbaria. In 1999 Patrick Blanc, CNRS, Paris, and in 2002 Atchara Teerawatananon, Chiang Mai University, Thailand independently collected fruits that show this species belongs in *Argyreia*. The latter collection was not vouchered.

Thailand.— NORTHERN: Chiang Mai, Lamphun, Sukhothai [Wat Chedi Ngam, *P. Blanc* 99-301 (P, photo seen); same loc., *P. Blanc* 01-20 (P)]; Kamphaeng Phet; Nakhon Sawan. SOUTH-WESTERN: Kanchanaburi.

Tridynamia bialata (Kerr) Staples, **comb. nov.**— *Porana bialata* Kerr, Bull. Misc. Inform. 1941: 19. 1941. Type: Thailand, Prachuap Khiri Khan, Huai Sang, *Put* 3166 (isotypes A!, ABD!, BK!, BM!, E!, K!, L!).

This species, known from a mere six Thai collections (and only a dozen collections in total), is one of the rarer Convolvulaceae in Southeast Asia. The most recent Thai collection was made in 1975 and the current status of the species is unknown.

Thailand.— SOUTH-WESTERN: Ratchaburi [mts W of Huai Yang, *Larsen, Smitinand & Warnecke* 1529 (AAU)]; Prachuap Khiri Khan [Kan Kradai, *Put* 2326 (A, ABD, BK, BM, K, L)]; Phetchaburi [Me Prachan, *K. Winit* 406 (K, sketches BM)]; SOUTH-EASTERN: Chonburi [Bahn Beung (Banbeung) distr., Ta Jahm, *Maxwell* 75-1081 (AAU, BK, L)]; Siricha (Sri Racha) distr., Khao Khiao (Khao Khiao), *Maxwell* 75-953 (AAU, BK, L)].

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**A rare endemic Thai yam rediscovered: *Dioscorea inopinata* Prain & Burkill
(Dioscoreaceae) and its affinities**

CHIRDSAK THAPYAI*, PAUL WILKIN & KONGKANDA CHAYAMARIT*****

ABSTRACT. *Dioscorea inopinata* Prain & Burkill was collected at Khao Sam Roi Yot National Park in 2002 for the first time in over 70 years. The specimens included female plants. This species was formerly known only from males. This allowed a full description and illustration of the species to be produced. The new morphological data are used to re-assess the plant's relationships and origins. It appears to be a member of *Dioscorea* sect. *Enantiophyllum* Uline with atypical wholly alternate leaves and obtuse to acuminate, more or less lanceolate tepals. It is endemic to Khao Sam Roi Yot and thus a candidate for autecological and conservation studies.

INTRODUCTION

When work to prepare a treatment of Dioscoreaceae for the Flora of Thailand began in 1996, *Dioscorea inopinata* Prain & Burkill was known from just three specimens, all from Prachuap Khiri Khan Province, and all male plants. It was first collected by Kerr in July 1924 (*Kerr* 10978), whose specimen was the basis for its description by Prain & Burkill (1927). In their account of Asian *Dioscorea* (Prain & Burkill, 1938) they were able to cite two further specimens, a collection made by Kerr in July 1931 (*Kerr* 20512) and one made by Lakshnakara which has not been located in any of the herbaria used in this study (see Materials and Methods). It was therefore imperative to look for this species to discover if it was still extant 70 years after it was last collected, and to complete its description by finding female flowers and fruits. It was collected by two groups of researchers in 2002. David Middleton and Somran Suddee found male plants at Khao Sam Roi Yot in August, and the authors found female plants in the same area in early December. This allowed a complete description and illustrations to be provided below.

In addition to having a very restricted distribution, *D. inopinata* was singled out by Prain & Burkill (1936) as a species with an unusual combination of morphological characters. Its stem twines to the right (dextrorse in the sense of Burkill, 1960). In the old world tropics, all such species have been placed in *Dioscorea* sect. *Enantiophyllum* Uline. It is also wholly glabrous, as are most species of that section. The leaves of *D. inopinata* are alternate, however, while in the species of *D.* sect. *Enantiophyllum* they are usually opposite. Its tepals are elliptic-oblong, with acute or acuminate apices in the outer whorl,

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unlike the typical ovate to orbicular tepals with rounded or obtuse apices of the right-twining section. These characters, in particular the tepal shape, led Prain & Burkill (1936) to suggest that *D. inopinata* was related to the left-twining *D. bulbifera* L. and thus a member of *D. sect. Opsophyton* Uline. It is the only right-twining species not in *D. sect. Enantiophyllum* in the classifications of Prain & Burkill (1936, 1938) and Burkill (1960). They also hypothesised that the combination of characters found in the species was evidence of a hybrid origin, with the parents being a species of *D. sect. Enantiophyllum* and *D. bulbifera*. The new character data available allow this hypothesis and the relationships of this enigmatic species to be re-evaluated.

MATERIALS AND METHODS

The study of Dioscoreaceae for the Flora of Thailand treatment used 1220 specimens from Thailand at the following herbaria or on loan: AAU, B, BK, BKF, BM, CMU, E, K, L, P, Biology Department, Naresuan University, Phitsanulok (abbreviated as PNU in this paper), QSBG, and TCD. Abbreviations follow Holmgren & Holmgren (1990). Comparative morphology was used to delimit species in all cases.

DESCRIPTION

Dioscorea inopinata Prain & Burkill, Kew Bull. 245. 1927; Prain & Burk. in Ann. Roy. Bot. Gard. (Calcutta) 14(1): 134.1936. Type: Thailand, Prachuap Khiri Khan (Prachuap), Sam Roi Yot (Sam Roi Yawt), on rocky limestone hill, ♂ fl. 13 July 1926, Kerr 10978 (holotype K!; isotypes BK!, BM!). Fig. 1.

Slender climber to 4 m. Underground parts unknown. Indumentum absent. *Stem* 1.25–3 mm in diam. towards base, twining to the right, annual, unarmed, terete with shallow longitudinal ridges, usually wine-red in colour, sometimes green with scattered red-brownish blotches. *Leaves* simple, alternate, blades (2.2–)3–7 by (0.8–)1–3.5 cm, ovate to narrowly ovate, base cordate, sinus 0.1–4 mm deep, apices 1.5–6 mm long, acute to acuminate, margins entire; 5–7-nerved, only main vein and first vein pair reaching apex; chartaceous, green to dark green and glossy above, paler below; forerunner tips 1.5–3 mm long, brown to dark brown; petioles 5–10 mm long, shallowly angled, channelled above, colour as stem, lateral nodal flanges/spines absent. *Cataphylls* (Fig. 1B) 2–3.5 by 3–3.6 mm, ovate, apex obtuse, chartaceous, pale brown to brown. *Bulbils* absent. *Inflorescences* spicate, axes slender, angled, colour as stem; all bracts chartaceous, tepals inserted on a small discoid torus, erect, free, fleshy in texture with inner whorl tepal slightly thicker than outer, green-yellow. *Male inflorescences* (Fig. 1A, 1C) simple or compound (*Middleton et al.* 1181 only), compound inflorescences 2–3.5 cm long, 1(–2) per axil, primary bracts (Fig. 1D, at inflorescence bases) 1.3–1.5 by 0.5–0.6 mm, elliptic-oblong, apices 0.2–0.4 mm long, acuminate; simple/partial inflorescences 1–2 per axil, peduncles 0.8–1.2 mm long, axes 0.7–2.6 cm long. *Flowers* ± patent to axes; floral bracts (Fig. 1F) 0.6–0.8 by 0.6–0.9 mm, ovate, apices 0.1–0.2 mm long, acuminate; bracteoles (Fig. 1G) 0.5–0.9 by 0.3–0.6 mm, ovate, apices 0.1–0.15 mm long, acuminate; outer tepals (Fig. 1H) 1.5–1.9 by 0.6–1.1 mm, ovate-lanceolate to narrowly so, apex acute; inner tepals (Fig. 1I) 1.4–1.8 by 0.4–0.5 mm, narrowly elliptic to elliptic-oblong or lanceolate, apex acute to obtuse; stamens 6 (Fig. 1E),

inserted on torus, filaments 0.3–0.6 mm long, anthers 0.2–0.4 by 0.2–0.3 mm; pistillodes (Fig. 1E) 0.15–0.2 by 0.2–0.25 mm, erect, 3-lobed. *Female inflorescences* not seen. *Old female flowers* (Thapyai & Wilkin 513) with floral bracts (Fig. 1L) 1.4–1.5 by 1.1 mm, broadly ovate, apices 0.1–0.2 mm long, acuminate; bracteoles (Fig. 1M) 1–1.2 by 0.6–0.7 mm, ovate-lanceolate, apices 0.1–0.3 mm long, acuminate; outer tepals (Fig. 1N) 1.5–2 by 0.8–1.1 mm, ovate, apices to 0.14 mm long, acute to acuminate; inner tepals (Fig. 1O) 1.4–1.8 by 0.4–0.7 mm, elliptic to narrowly so, apex obtuse; ovaries (Fig. 1J) 3–5.3 by 0.9–2.3 mm, elliptic in outline, with 3 longitudinal ridges, green to dark green, glossy; staminodes 6 (Fig. 1K), 0.15–0.45 mm long, staminiform, inserted on torus; styles (Fig. 1K) 0.3–0.8 by 0.5–0.7 mm, fused for most of their length, erect; stigmas (Fig. 1K) 0.3–0.6 mm long, recurved. *Infructescences* (Fig. 1P) 6–8 cm long; capsules (Fig. 1Q) 1.8–2.1 by 2.5–3 mm, broadly obovate in outline, base truncate, apices retuse, 0.7–1.4 mm deep sinus, capsular stipes 3–4 by 2–3.5 mm, obconic; immature capsules pale green to dark green and glossy, darker along axis and margins, sometimes with purple streaking or blotching; mature capsules deflexed at angle of 25°–45° to axis. *Seeds* (Fig. 1R) 3.5–5.3 by 4.5–6 mm, ovoid-lenticular; wings 14–15.5 by 13–14 mm, extending all around seed margin, broadly ovate to rounded with a straight margin along capsule axis.

Thailand.— SOUTH-WESTERN: Prachuap Khiri Khan [Khao Sam Roi Yot National Park, ♂ fl. 13 July 1924, *Kerr* 10978 (holotype K!; isotypes BK!, BM!); idem, ♂ fl. 8 Aug. 1966, *Larsen et al.* 1257 (AAU); Khao Sam Roi Yot National Park, Pak Tawan, ♂ fl. 29 July 1931, *Kerr* 20512 (BK, BM, K); Khao Sam Roi Yot National Park, trail from Tham Sai to Tham Phraya Nakhon, 12° 11' N, 100° 01' E, ♂ fl. 18 Aug. 2002, *Middleton et al.* 1181 (BKF, GH, K); idem, 12° 10' 53.9" N, 100° 00' 9.8" E, ♀ fr. 2 Dec. 2002, *Thapyai & Wilkin* 509 (BK, BKF, PNU); Khao Sam Roi Yot National Park, Khao Khan Bandai, Ban Na Thung, 12° 16' 7.3" N, 99° 56' 22.4" E, ♂ fl. (old) 3 Dec. 2002, *Thapyai & Wilkin* 514 (BK, BKF, PNU); idem, ♀ fr. 3 Dec. 2002, *Thapyai* 513 (BK, BKF, PNU, QSBG)].

Distribution.— Restricted to Khao Sam Roi Yot National Park, Prachuap Khiri Khan Province.

Ecology.— In open vegetation on and around rocky limestone hills and outcrops, from near sea level to about 150 m. Flowering July to August, fruiting October to December. The flowering period is early in the year; most Thai yams from north of the Isthmus of Kra have their peak flowering period in September and October. This is probably a response to water availability at Khao Sam Roi Yot declining rapidly once the rains stop, necessitating early fruit development.

Vernacular.— Man nok (มันนกก) (Prachuap Khiri Khan) (Man Tam Rak according to Prain & Burkill (1936), in error).

Conservation.— An endemic of very restricted range. During the 2002 fieldwork one apparently small population (less than five plants seen) was found on the trail from Tham Sai to Tham Phraya Nakhon and a second larger one of about 20 plants at Khao Khan Bandai, Ban Na Thung. Of course, *D. inopinata* may occur on many of the other "300 hills" of Khao Sam Roi Yot National Park. The protection afforded by the park should assure its future. IUCN red list category VU D1 (IUCN 2001).

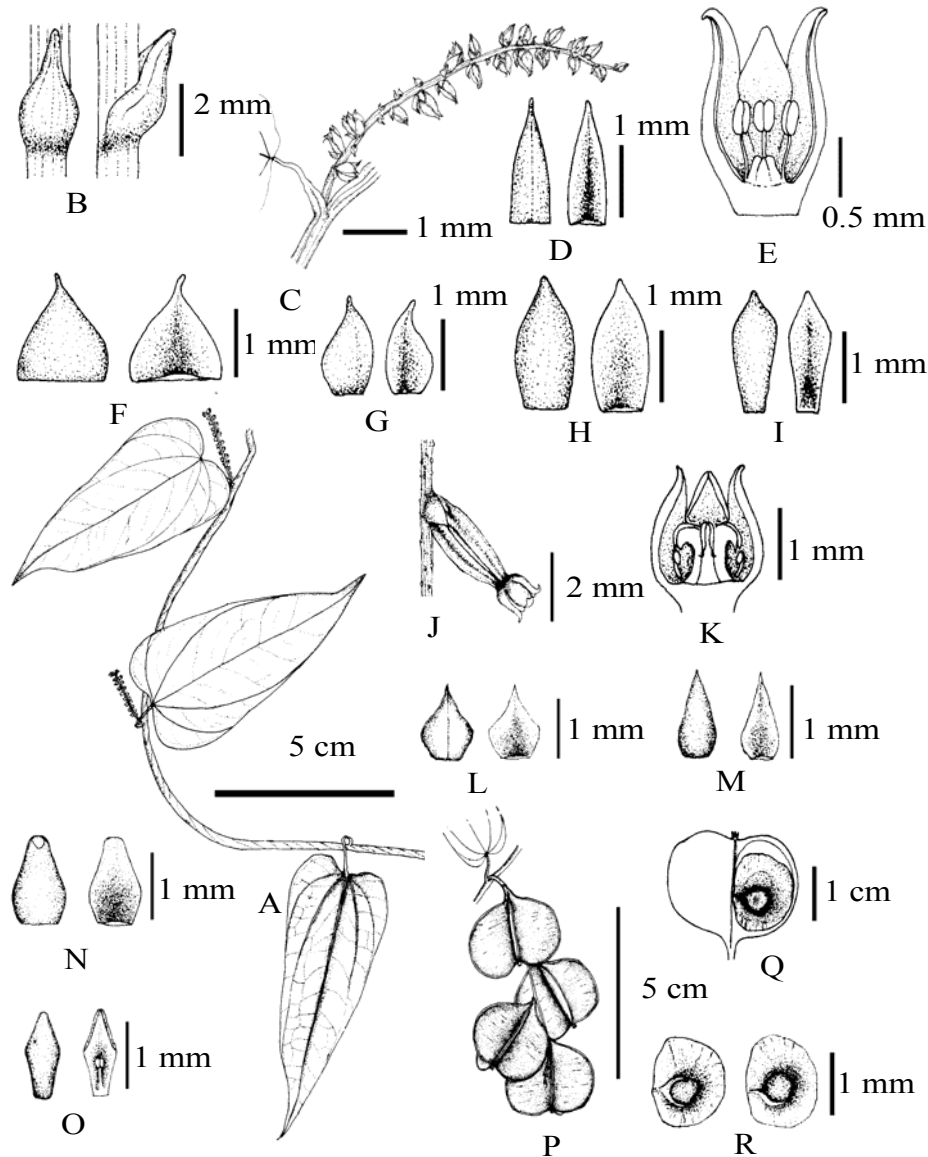


Figure 1. *Dioscorea inopinata* Prain & Burkill: A. plant habit and male inflorescences; B. cataphyll; C. a simple, spicate male inflorescence; D. male primary bract dorsal and ventral surfaces; E–I. male flower; E. longitudinal section showing stamens and pistillode; F. floral bract dorsal and ventral surfaces; G. bracteole dorsal and ventral surfaces; H. outer tepal dorsal and ventral surfaces; I. inner tepal dorsal and ventral surfaces; J–O. female flower; J. side view with ovary; K. longitudinal section (excluding ovary) showing staminodes, style and stigmas; L. floral bract dorsal and ventral surfaces; M. bracteole dorsal and ventral surfaces; N. outer tepal dorsal and ventral surfaces; O. inner tepal dorsal and ventral surfaces; P. infructescence; Q. mature capsule, longitudinal section showing seed position; R. seeds. A, C from Kerr 10987; B from Kerr 20512; D–I from Middleton *et al.* 1181; J–R from Thapayai & Wilkin 513. Drawn by C. Thapayai.



Figure 2. *Dioscorea inopinata* Prain & Burkill: A–B. habit, showing right-twining stem, short petioles and alternate leaf arrangement. C–F. capsules, showing the short, few-fruited infructescences. G–H. the holotype specimen at K. (Kerr 10978), showing the spicate male inflorescence and elliptic-oblong tepals. Photographed by C. Thapayai.

Notes.— The distinguishing characters of *D. inopinata* are leaves with very short petioles and alternate leaf arrangement on right-twining stems. The male inflorescence axis does not exceed 2.6 cm long, and its flowers are held more or less patent to the axis. The tepals of both sexes are elliptic-oblong and the female infructescences are not more than 8 cm long, bearing five capsules at most. The tubers of *D. inopinata* remain unknown; like those of all limestone species, they are difficult to obtain.

DISCUSSION

Critical evaluation of the morphological character data now available for *D. inopinata* suggests that it is a member of *D. sect. Enantiophyllum* and not related to *D. bulbifera*. This conclusion is based on the information in Table 1. The systematically important characters of the three taxa are given, and an attempt has been made to look for synapomorphies using the phylogenetic trees of Wilkin et al. (submitted) based on plastid gene sequence data. This shows that *D. inopinata* shares just one apparent synapomorphy with *D. bulbifera*, its tepal shape. However, *D. inopinata* does not have the unique tepal coloration of *D. bulbifera*, and the apex shape is different, suggesting that this similarity is non-homologous and probably convergent (as indicated by * and **). *D. inopinata* lacks all of the other autapomorphies of *D. bulbifera*, but shares right-twining with *D. sect. Enantiophyllum*. Its placement in *D. sect. Enantiophyllum* is also supported by Wilkin et al. (submitted). A hybrid origin remains possible, but it seems unlikely given that the main apomorphic characters of *D. bulbifera*; bulbil formation, the typical semicircular, membranous lateral nodal flange (Wilkin, 2001) and an oblong capsule are not encountered at all in *D. inopinata*.

Table 1. A comparison of the morphological characters of *D. inopinata* with *D. sect. Enantiophyllum* and *D. bulbifera*. * = probable synapomorphy/autapomorphy. Polarity decisions are based on the tree topology of Wilkin et al. (submitted).

Character	<i>D. inopinata</i>	<i>D. sect. Enantiophyllum</i>	<i>D. bulbifera</i>
Stem twining direction	RH*	RH*	LH
Leaf arrangement	Alternate	Opposite (usually)*	Alternate
Lateral nodal flange	Absent	Absent	Present*
Bulbil formation	Absent	Rare	Present*
Tepal shape	Elliptic-oblong to lanceolate, apex obtuse to acuminate*	Ovate to orbicular, apex usually obtuse to rounded	Elliptic-oblong, apex obtuse**
Tepal colour	Green-yellow	Pale green to green-yellow	Pale green (immature), cream-yellow (at anthesis), purple to red-brown (post anthesis)*
Capsule shape in outline	Broadly obovate	Orbicular or broadly obovate to transversely elliptic-oblong	Oblong*
Seed wing	All around seed margin	All around seed margin	Basal on seed only*

Dioscorea inopinata shows interesting similarities with other *D.* sect. *Enantiophyllum* species found on limestone in Thailand. All are plants of relatively low stature, with small, narrow leaves and wiry stems to reduce evapotranspiration, due to the low water availability on limestone substrates. The narrowest leaves are encountered in *D. calcicola* Prain & Burkill, where they can be alternate or opposite, and *D. gracilipes* Prain & Burkill, where they are always opposite. Both are from Peninsular Thailand and have the typical ovate to orbicular tepal shape of the section, with obtuse to rounded tepal apices. *D. depauperata* Prain & Burkill is a member of the *D. alata* L. group (with flexuous male inflorescences) of Prain & Burkill (1936), and has alternate leaves at its stem base and shoot apices. Its tepals are also typical of *D.* sect. *Enantiophyllum*; it is found in Kanchanaburi Province, and possibly also in Laos. *D. stemonoides* Prain & Burkill has leaves which are alternate at the stem base and typical *D.* sect. *Enantiophyllum* tepals. It is distributed sparingly in Central, eastern and northern Thailand. Both *D. stemonoides* and *D. depauperata* have similar small, ovate or narrowly ovate leaves with a shallow basal sinus like *D. inopinata*; the former may well be its closest relative. Possessing alternate leaves to some degree allows these species to further reduce water loss and suggests that in *D. inopinata* this adaptation has progressed to a greater degree than in the other species. It is also noteworthy that all five species (with occasional exceptions e.g. Middleton *et al.* 1181) produce few small, simple male inflorescences and few-fruited infructescences. *D. inopinata* is probably the most extreme example of this trait. In limestone substrates, nutrients are limited both by the lack of soil and the lack of water to carry them. Therefore there is little investment in reproduction compared with non-limestone species, especially in relatively expensive female organs. In terms of future work, detailed studies of the autecology, including the reproductive biology, of *D. inopinata* are highly desirable, particularly to help to conserve this rare endemic species.

ACKNOWLEDGEMENTS

CT would like to express his gratitude to the QSBG-DANCED Program for granting the scholarship for conducting research and study at the Faculty of Forestry, Kasetsart University. Thanks are particularly due to Uncle Chamlong for his amazing knowledge of the plants of Khao Sam Roi Yot. We must also thank all the other Royal Forest Department staff at Khao Sam Roi Yot who helped us, David Middleton and Somran Suddee for collecting specimens, Juy for all his hard work and help in the field in December 2002, and Willem de Wilde and Brigitte de Wilde-Duyfjes for being good company. Thanks also to Phillip Cribb for critically reading an earlier version of this manuscript.

REFERENCES

- Burkill, I.H. 1960. The organography and the evolution of the Dioscoreaceae, the family of the yams. *Journal of the Linnaean Society (Botany)* 56: 319–412.
- IUCN. 2001. IUCN Red List Categories: Version 3.1. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland & Cambridge, UK.

- Prain, D. & Burkill, I.H. 1927. The genus *Dioscorea* in Siam. Kew Bulletin 1927: 225–247.
- _____. 1936. An account of the genus *Dioscorea* in the East, Part 1. The species which twine to the left. Annals of the Royal Botanic Garden (Calcutta) 14(1): 1–210.
- _____. 1938. An account of the genus *Dioscorea* in the East, Part 2. The species which twine to the right. Annals of the Royal Botanic Garden (Calcutta) 14(2): 211–528.
- Wilkin, P. 2001. Yams of South-Central Africa. Kew Bulletin 56(2): 361–404.
- Wilkin, P., Schols, P., Chase, M.W., Chayamarit, K., Furness, C.A., Huysmans, S., Rakotonasolo, F., Smets, E. and Thapayai, C. A plastid gene phylogeny of the yam genus, *Dioscorea*: roots, fruits and Madagascar. Systematic Botany (submitted).

***Dioscorea petelotii* Prain & Burkill (Dioscoreaceae): A new record for Thailand
and the discovery of male and female flowers**

CHIRDSAK THAPYAI*, PAUL WILKIN & KONGKANDA CHAYAMARIT*****

ABSTRACT. *Dioscorea petelotii* Prain & Burkill, previously known only from the type specimen collected in Vietnam, has been discovered growing in hill evergreen forest in N and NE Thailand. The type consists only of terminal shoot stems, leaves, and immature capsules. The collection of specimens with underground organs, stem bases and inflorescences of both sexes has allowed a full description and illustrations of this species to be provided. The possible relationships of *D. petelotii* are re-evaluated using the newly available morphological data.

INTRODUCTION

Dioscorea petelotii Prain & Burkill was first described from Vietnam by Prain and Burkill (1933). They named the new species in honour of the French collector Pételot, who collected several duplicate specimens of it in Vietnam in August 1932. Pételot's specimens were taken from a female plant, which possessed only immature capsules, so the morphology of both the male and female flower of *D. petelotii* remained unknown. In September 1996, a sterile specimen from Doi Phu Kha National Park, Pua District, Nan Province in Northern Thailand was collected by the second author (*Wilkin* 908). He collected it again in sterile condition in October 1998 at both Doi Phu Kha and Phu Luang Wildlife Sanctuary, Loei District, in North-eastern Thailand. Preliminary study suggested that the sterile specimens from Doi Phu Kha and Phu Luang might be *D. petelotii* from Vietnam because they shared the distinctive subdeltate shape of the terminal stem leaves and the vertically oriented spiny flange on the swollen nodes of the lower stems. For this reason, the first author went to Doi Phu Kha National Park in November 2001 and located two female plants of *D. petelotii* Prain & Burkill which had mature capsules. Photographs of these plants were sent to the second author who was able to confirm that they matched the type material.

Following this discovery, our main goal was to collect flowers of both sexes and the underground parts of this species in order to provide complete descriptive information. Because it appeared to be restricted to hill evergreen forest, it was assumed that it flowered in March or April like *D. cirrhosa* Lour., which is found in the same habitat. Thus in April 2002, a joint Royal Forest Department/Naresuan University/Royal Botanic Gardens, Kew team visited five mountains in N and NE Thailand and collected

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both male and female flowering specimens from four of them. We were also able to excavate the underground parts of this yam for more detailed morphological investigation.

During the trip, we also looked for previously collected herbarium specimens of *D. petelotii* in Thai herbaria. At BKF and CMU we discovered that J. F. Maxwell had already collected male specimens from Thailand at Doi Suthep-Pui National Park, Chiang Mai in 1992, 1993 and 1997, but he had misidentified them as *Dioscorea esculenta* (Lour.) Burkill. In the checklist of Doi Suthep-Pui (Maxwell & Elliott 2001) they are listed as *D. esculenta* var. *fasciculata* (Roxb.) Prain & Burkill.

Thus it became evident that this species was found in much of the hill evergreen vegetation of the N and NE of Thailand, and represents *D. petelotii*, a new record for the flora which is fully described and illustrated below.

MATERIALS AND METHODS

The Dioscoreaceae treatment for the Flora of Thailand is based on examination of 1220 specimens from Thailand at the following herbaria or on loan: AAU, B, BK, BKF, BM, CMU, E, K, L, P, Biology Department, Naresuan University, Phitsanulok (abbreviated as PNU here), QSBG and TCD. Abbreviations follow Holmgren & Holmgren (1990). Comparative morphology was used to delimit species in all cases.

DESCRIPTION

Dioscorea petelotii Prain & Burkill, Kew Bull. 1933: 240. 1933; Prain & Burkill in Fl. Gén. I.-C.: 717. 1933; Prain & Burkill in Ann. Roy. Bot. Gard. (Calcutta) 14(1): 97. 1936. Type: Vietnam, Province of Lao-Kay, between Cha-Pa and Muong Hoa, ♀ fr. Aug. 1932, *Pételot* 4395 (holotype K!; isotype P!). Figs 1–3.

Large forest climber to at least 30 m. *Tubers* (Fig. 1M, 3J) to 40 cm in diam. and at least 5 kg in mass, shape variable, usually globose to subglobose with several shallow lobes, perennially replaced, shallowly vertically buried but sometimes approaching horizontal when growing in shallow soil on a steep slope; crown of tuber bearing slender rigid roots, very hard and woody, not clearly differentiated from tuber, tuber periderm hard to corky, often dark brown or grey-brown in colour, parenchyma pale yellow to pinkish (Fig. 3K) with a little mucilage. *Indumentum* (Fig. 1B) present on all parts, hairs simple, 0.2–0.6 mm long, brown to red-brown in colour, dense on young shoots and inflorescences, becoming glabrous with age. Stems 7–15 mm in diam. towards base, reducing to 2–5 mm in diam. on upper stem, twining to the left, towards base stems woody and very spiny (Fig. 3J), with 6–8 hard, vertically orientated flanges at each swollen stem node (Fig. 1C), upper stems with few spines (Fig. 3B) or unarmed except paired lateral nodal spines (see Fig. 1D, 3C and description of petiole below), terete with shallow longitudinal ridges, yellowish-green to mid-green. *Leaves* simple, alternate, blades 5–18.5 by 2.3–11.5 cm, broadly sagittate-ovate to broadly ovate towards stem base (Fig. 3A), subdeltate to ovate on the upper stems (Fig. 1A, 3F), base cordate to sagittate, truncate or rounded, basal sinus (where present) to 27 mm deep, apices 8–12 mm long, acuminate, margins entire; 5–7 nerved, only main vein and first

vein pair reaching apex; coriaceous, yellow-green to dark green and glossy above, paler below; petioles (Fig. 3B, 3C), 2.5–10.5 cm long, slender, terete, shallowly channelled above, colour as stem but usually pinkish-brown to violet on pulvinii at base and apex; forerunner tips 5–12 mm long, dark brown; lateral nodal spines (Fig. 1D, 3C) recurved, on either side of each node. Bulbils absent. *Inflorescences* pendent, axes slender, terete, colour as stem; all bracts and tepals chartaceous; tepals inserted on cup-shaped torus, fused at base, ascending, pale green to yellow-green, apices recurved. *Male inflorescences* (Fig. 1E, 3D) simple or compound, compound inflorescences 8.5–20 cm long, 1 per axil, primary bracts (Fig. 1F) 3.3–4.4 by 0.8–1.3 mm, narrowly lanceolate, apices acuminate, 0.6–2.3 mm long; simple/partial inflorescences racemose with cymules of 1–3 flowers, 1–2 (–3) per axil, peduncles 1.2–5.3 cm long, axes 2.3–16(–25) cm long. *Male flowers* 3.5–4.2 mm in diam. at anthesis (Fig. 1G, 3E), pedicels 1.1–2.5 mm long; floral bracts (Fig. 1I) 1.1–2.5 by 0.6–1.2 mm, narrowly ovate to lanceolate, apex acuminate, 0.1–0.3 mm long; bracteoles (Fig. 1J) 0.8–2.0 by 0.5–1 mm, lanceolate, apices to 0.2 mm long, acute to acuminate. *Tepals* in two whorls of three, inserted on a cup-shaped torus (Fig. 1G, 1H); outer tepals (Fig. 1K) 1.2–2.6 by 0.7–1.4 mm, ovate-oblong, apex acute to obtuse; inner tepals (Fig. 1L) 1.8–2.5 by 1.1–1.5 mm, ovate to ovate-oblong, apex acute to obtuse; stamens 6 (Fig. 1G, 1H), inserted on tepal bases, filaments 0.6–1.1 mm long, incurved towards apices so that the anthers are grouped above the centre of the flower; anthers 0.2–0.4 by 0.2–0.3 mm, ovate; pistillodes 3 (Fig. 1H), 0.5–0.6 by 0.9–1.1 mm, fused for their entire length along inner surfaces, broadly ovoid with 3 shallow longitudinal lobes. *Female inflorescences* (Fig. 2N, 3F) spicate, simple, 1 per axil, peduncles 1.7–6.6 cm long, axes 3.5–12.5 cm long. *Flowers* (Fig. 3G) orientated at angle of 30°–90° to axis when receptive; floral bracts (Fig. 2R) 1.1–1.8 by 0.7–1.1 mm, lanceolate, apices 0.3–1.0 mm long, acuminate; bracteoles (Fig. 2S) 1.1–1.6 by 0.4–0.5 mm, narrowly ovate to lanceolate, apices to 0.3 mm long, acute to acuminate. *Outer tepals* (Fig. 2T) 1.8–2.9 by 1–1.4 mm, narrowly elliptic to elliptic-oblong, apex obtuse; inner tepals (Fig. 2U) 1.6–2.6 by 1.1–1.5 mm, oblong, apex obtuse; ovaries (Fig. 2O) 6.5–13 by 1.3–2.2 mm, terete or cylindric in outline, pale green to brownish-green; staminodes 6 (Fig. 2Q), 0.5–0.8 mm long, staminiform; styles 1.3–1.6 by 0.4–0.7 mm, fused for most of their length into an erect column; stigmas 0.5–0.7 by 0.4–0.8 mm long, recurved, bifid. *Infructescences* (Fig. 2V, 3H) 7–20 cm long. *Capsules* (Fig. 2X, 3I) 33–58 by (13–)16–23 mm, oblong to narrowly obovate in outline, base truncate to shallowly retuse, sinus to 1.2 mm deep, apices retuse with 0.05–0.2 mm deep sinus, margin shallowly lobed, persistent tepals (where present) 1–2 mm long, capsular stipes 4.5–6 by 2–2.5 mm, obconic; immature capsules colour as ovary; mature capsules becoming glabrous, reflexed at an angle of 90°–150° to axis. *Seeds* (Fig. 2Y, 3I) 10–13.5 by 5–7.5 mm, lenticular-ovoid; wing oblong, apex truncate to rounded, extending from seed apex, outer margin often lobed, upper seed wings 18–25 by 7.5–10.2 mm, lower seed wings (11–)15–22 by 6.5–11.5 mm.

Thailand.—NORTHERN: Chiang Mai [Doi Suthep-Pui National Park, East side of Doi Pui, near Chang Kian (Maeo) Village, ♂ fl. 8 April 1992, *Maxwell* 92-125 (CMU, E, L); idem, ♂ fl. 20 April 1993, *Maxwell* 93-340 (CMU, BKF); idem, ♂ fl. 1 April 1997, *Maxwell* 97-326 (CMU, BKF); idem, ♂ fl., 23 April 2002, *Thapyai et al.* 404 (BK, BKF, NU, QSBG)]; Nan [Doi Khun Sathan, about 1–2 km before Ban Khun Sathan along the road from Na Noi to Wiang Sa, 18° 16' 39.5" N, 100° 30' 19" E, ♂ fl.

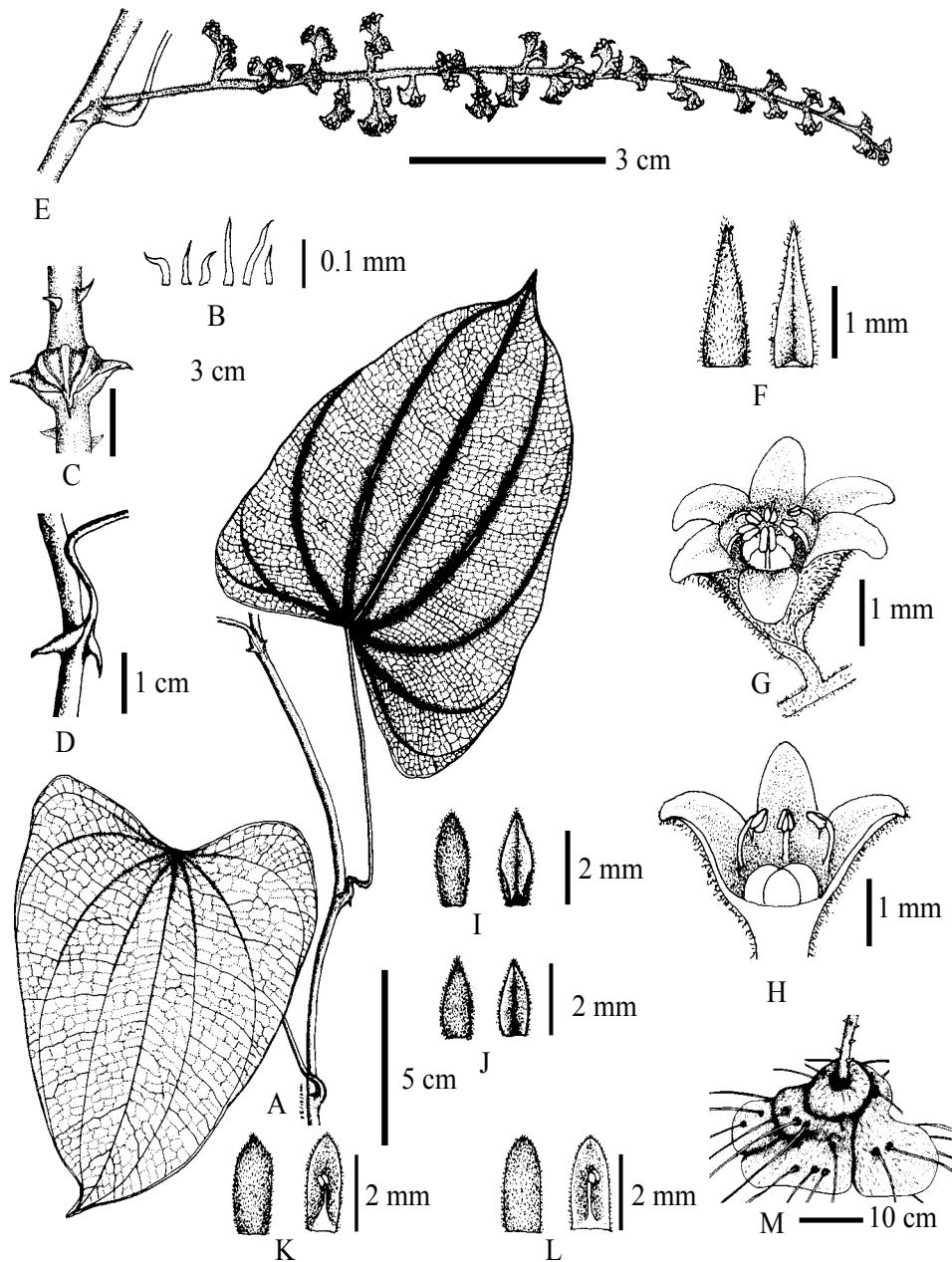


Figure 1. The morphology of *Dioscorea petelotii*: A. upper stem and leaves; B. hairs; C. a node from the stem base, showing the vertically orientated flanges; D. lateral nodal spines from the upper stem; E. simple male inflorescence showing flowers arranged in cymules; F. primary bract; G.–L. male flower; G. side view; H. longitudinal section showing stamens and 3-lobed pistillode; I. floral bract; J. bracteole; K. outer tepal; L. inner tepal. A.–D. from Thapayai 303; E.–L. from Thapayai et al. 388; M. from Thapayai et al. 370. Drawn by C. Thapayai.

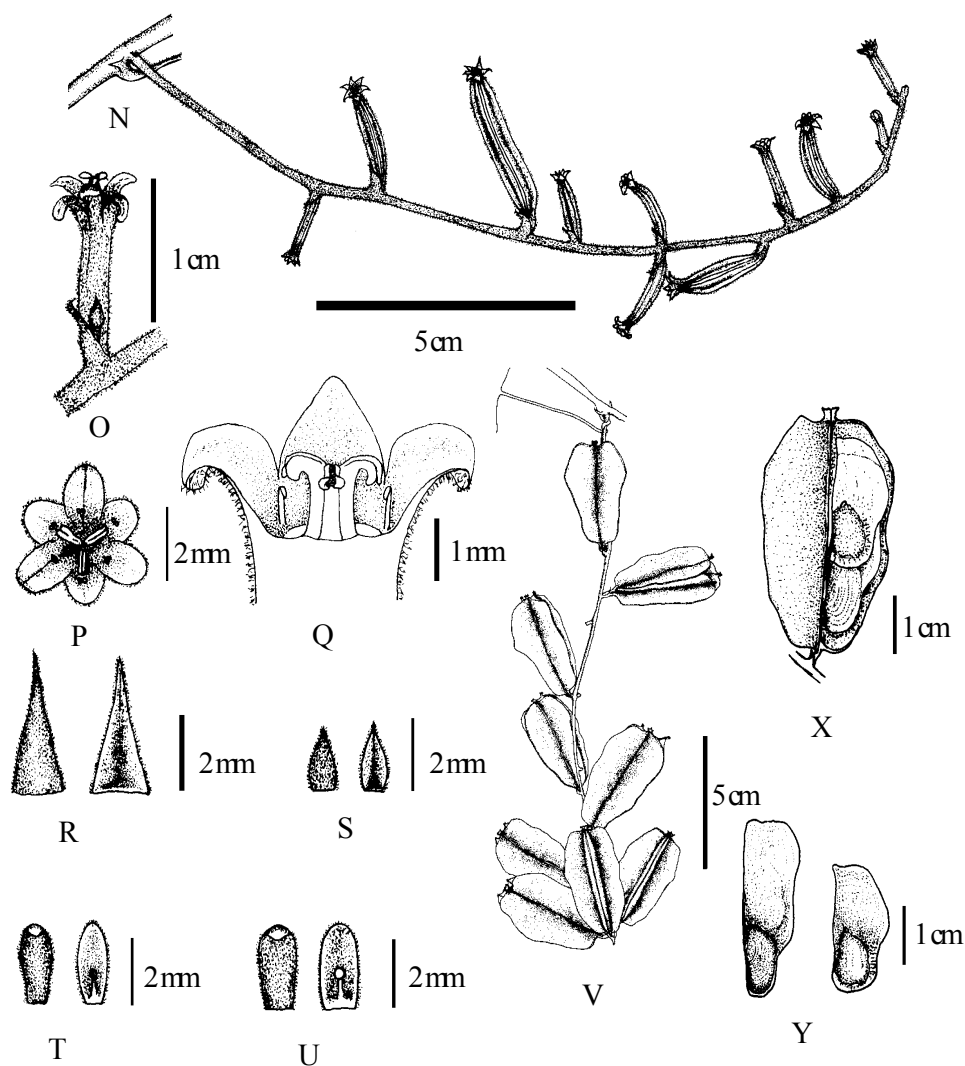


Figure 2. The morphology of *Dioscorea petelotii* Prain & Burkill (continued): N. female inflorescence. O.–U. female flower; O. side view showing terete ovary; P. view from above; Q. longitudinal-section (excluding ovary) showing staminodes, style and stigmas; R. floral bract; S. bracteole; T.&U. outer and inner tepals respectively, showing staminode insertion; V. mature infructescence; X. mature capsule, l-section showing seed position; Y. seeds. N.–U. from *Thapayai et al.* 372; V.–Y. from *Thapayai* 303: drawn by C. Thapayai.

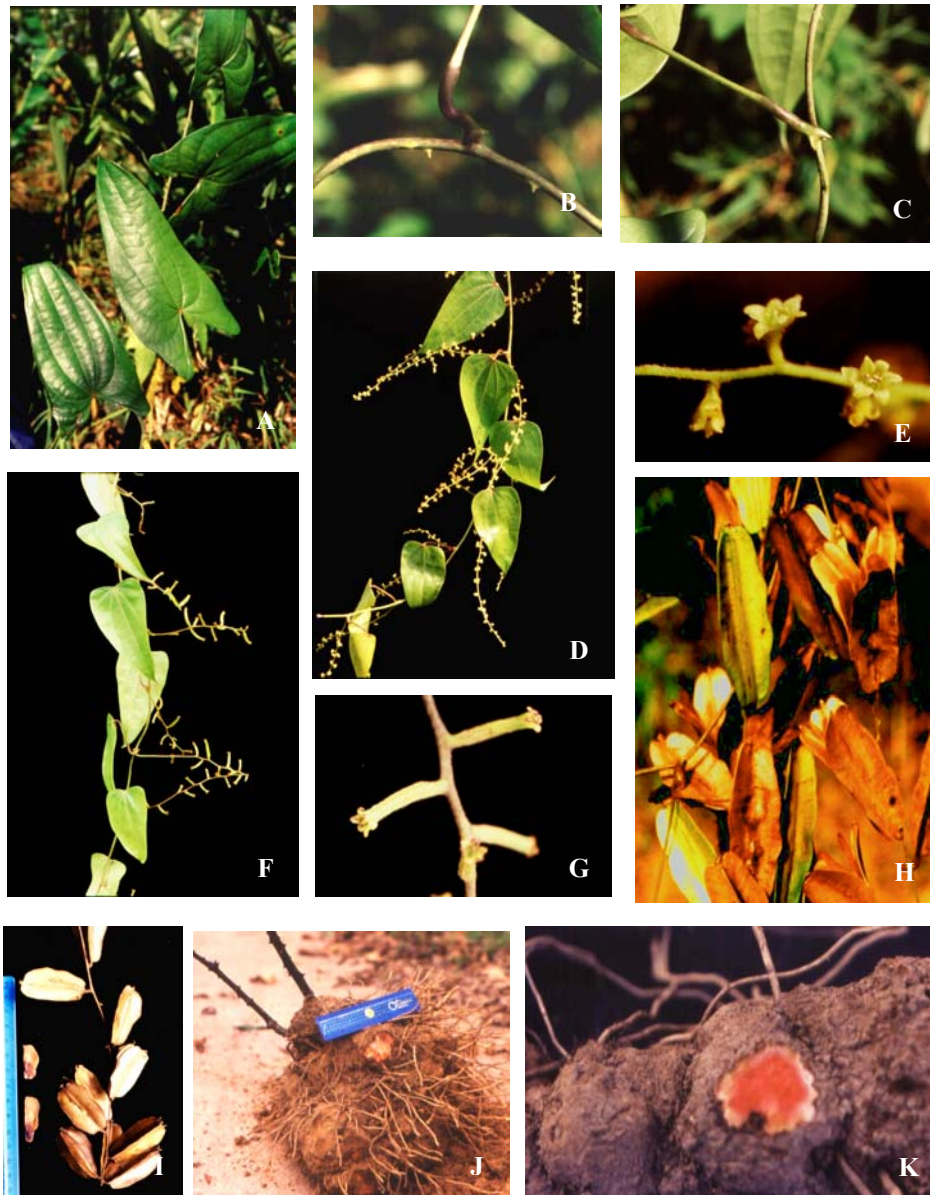


Figure 3. Colour photographs of *Dioscorea petelotii*: A. sterile plant showing the leaves and growth habit; B. stem spines; C. lateral nodal spines; D. male inflorescences and upper stem leaves; E. male flowers; F. female inflorescences and upper stem leaves; G. female flowers; H–I. infructescences with immature (pre-dehiscence) and mature (dehiscing) capsules and seeds; J–K. perennial tuber, showing the periderm and pink parenchyma; Photographed by C. Thapayai.

14 April 2002, *Thapyai et al.* 381 & 382 (BK, BKF, NU, QSBG); Doi Phukha National Park, circular trail from Headquarters Buildings, 19° 22' 1.1" N, 101° 4' 57.2" E, sterile 23 Sept. 1996, *Wilkin* 908 (BKF, K); idem, 19° 12' 05" N, 101° 05' 14" E, sterile 1 Nov. 1998, *Wilkin et al.* 1055 (BKF, K); idem, ♂ fl. 16 April 2002, *Thapyai et al.* 388 (BK, BKF, NU, QSBG), idem, ♀ fl. 16 April 2002, *Thapyai et al.* 390 (BK, BKF, NU, QSBG), idem, ♀ fr. 21 Nov. 2001, *Thapyai* 303 & 306 (BK, BKF, NU, QSBG)]; Uttaradit [Phu Soi Dao National Park, trail to pine rich plateau, about 5 Km from Visitor Centre, sterile 19 Nov. 2001, *Thapyai* 295 (BKF, NU, QSBG)]; NORTH-EASTERN: Loei [Phu Luang Wildlife Sanctuary, about 0.7–1 km along the road from Khok Nok Kraba to Headquarters, 17° 17' 3.3" N, 101° 31' 17.7" E, ♂ fl. 12 April 2002, *Thapyai et al.* 370, 371 & 373 (BK, BKF, NU, QSBG); idem, ♀ fl. 12 April 2002, *Thapyai et al.* 372 (BK, BKF, NU, QSBG); idem, 17° 16' 45" N 101° 31' 05" E, sterile 26 Oct. 1998, *Wilkin et al.* 1023 (BKF, K)].

Distribution.— Vietnam (only known from the type locality in Lao-Kay Province) and on mountains in N and NE Thailand.

Ecology.— Hill evergreen forest, between 1,100–1,500 m in altitude. Flowering from April to May, fruiting from August to November.

Vernacular name.— Man doi (มันดอย), or mountain yam in English.

Conservation.— Restricted to hill evergreen forest, but appearing abundant where that habitat is encountered. It is therefore vulnerable to habitat loss, as is occurring, for example, at Doi Khun Sathan in Nan Province. IUCN red list category VU B2ab(iii) (IUCN 2001).

Notes. —This species is easily distinguished by means of its swollen lower stem nodes with 6–8 vertically oriented flanges, alternate, coriaceous leaves which are ovate to subdeltate on terminal shoots and 33–58 mm long, male flowers with cup-shaped tori and incurved stamens and oblong fruits with seeds winged at the apex only.

DISCUSSION

Two questions are pertinent to the rediscovery of this yam in Thailand. Firstly, why has it been collected so infrequently when it appears to be relatively common in hill evergreen forest in N and NE Thailand? Secondly, what does the newly available character data tell us about its relationships with other *Dioscorea* species?

We think that there are several answers to the first question. It has remained unknown in part because it lacks a use, unlike many other yams. It flowers at an unusual time of year, at the end of the dry season in April when fewer collectors are active, instead of the rainy season in September/October. Its occurrence at relatively high altitudes, which are perhaps less frequently botanised, may be a third explanation. We suspect that it could be found in similar habitats in the Lao PDR and Vietnam in much greater abundance than the single collection to date from those countries suggests. In fact, it could almost be an "indicator species" of hill evergreen forest based on our observations in N and NE Thailand.

Prain & Burkill (1936) placed *D. petelotii* in *D. sect. Paramecocarpa* Prain & Burkill with *D. flabellifolia* Prain & Burkill and *D. piscatorum* Prain & Burkill, two species from Malaysia and the Philippines. They did so on the basis of the similar fruit morphology of *D. flabellifolia* and *D. petelotii*. Its closest relatives in Thailand appear to be *D. esculenta* Lour. and *D. birmanica* Prain & Burkill, based on similarities in inflorescence and floral morphology (see Table 1). Prain & Burkill, however, placed *D. esculenta* in its own section (*D. sect. Combilium* Prain & Burkill) and placed *D. birmanica* in the rhizomatous *D. sect. Stenophora* Uline. Despite the differences in underground organ morphology and fruit morphology, the authors believe that the similarities in all five taxa in indumentum (they also all tend to be glabrescent except *D. piscatorum*), climbing direction, and male and female inflorescence and floral morphology suggest that all of these taxa may form an infrageneric taxon. This hypothesis is currently under investigation using molecular systematic methods.

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REFERENCES

- Holmgren, P. K. & Holmgren, N. H. 1990. Index Herbariorum. Part 1: the Herbaria of the World. 8th Edition. NYBG Press, New York.
- IUCN. 2001. IUCN Red List Categories: Version 3.1. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland & Cambridge, UK.
- Maxwell, J. F. & Elliott, S. 2001. Vegetation and Vascular Flora of Doi Suthep-Pui National Park, Northern Thailand. Thai Studies in Biodiversity No. 5: 1–205.
- Prain, D. & Burkill, I. H. 1933. Dioscoreae Novae Asiaticae. Kew Bulletin 1933: 240–246.
- _____. 1936. An account of the genus *Dioscorea* in the East, Part 1. Annals of the Royal Botanic Garden (Calcutta) 14(1): 1–210.

Table 1. A comparison of the morphological characters of *D. petelotii*, *D. esculenta* and *D. birmanica* with those of *D. flabellifolia* and *D. piscatorum*

	<i>D. petelotii</i>	<i>D. esculenta</i>	<i>D. birmanica</i>	<i>D. flabellifolia</i>	<i>D. piscatorum</i>
Underground parts	Perennial tuber; not starchy	Perennial to annual tubers from a woody crown; starchy	Thick horizontal branching “rhizome”; not starchy	Unknown	Poorly known (see Prain & Burkill 1936)
Direction of twining	LH	LH	LH	LH	LH
Indumentum	Simple hairs, dense on young shoot apices, leaf lower surfaces and inflorescences	Simple hairs, dense on leaf lower surfaces and inflorescences	Simple hairs, glabrous to pubescent on vegetative parts, inflorescences pubescent	Simple hairs, puberulous to glabrescent	Glabrous
Leaf shape	Broadly sagittate-ovate or cordate or subdeltoid to ovate	Orbicular to broadly ovate	Orbicular to very broadly ovate	Ovate to very broadly so	Ovate
Male (partial) inflorescence	Racemose, 2 or 3-flowered cymules towards base, flowers solitary above	Racemose, flowers solitary, occasionally with cymules of 2-3 flowers	Racemose, 2 or 3-flowered cymules towards base, flowers solitary above	Racemose, flowers solitary, occasionally with 2-flowered cymules	Unknown
Male flower	Cup-shaped torus, reflexed tepals	Cup-shaped torus, reflexed tepals	Cup-shaped torus, reflexed tepals	Cup-shaped torus, reflexed tepals	Unknown
Female inflorescence	Spike	Raceme	Raceme	Raceme	As <i>D. flabellifolia</i> (Prain & Burkill 1936)
Female flower	Cup-shaped torus, reflexed tepals	Cup-shaped torus, reflexed tepals	Cup-shaped torus, reflexed tepals	Cup-shaped torus, reflexed tepals	As <i>D. flabellifolia</i> (Prain & Burkill 1936)
Fruit shape in outline	Oblong	Ovate-oblong, very rarely produced	Ovate-oblong	Oblong to elliptic-oblong	Unknown
Seed	Winged at apex only	Winged all round margin, very rarely produced	Winged all round margin but wing irregular	Winged at apex only	Unknown

A new combination in *Meliosma* (Sabiaceae)

PETER C. VAN WELZEN*

ABSTRACT. *Meliosma pinnata* (Roxb.) Walp. subsp. *barbulata* (Cufod.) Welzen is a new combination for the illegitimate name *M. pinnata* subsp. *arnottiana* (Wight) Beusekom.

When Van Beusekom (1971) did his world revision of the genus *Meliosma* (Sabiaceae) he reduced several names to *Meliosma pinnata* and recognised many infraspecific entities. In one of the subspecies recognised, the oldest epithet was *arnottiana*, a name derived from the species *Meliosma arnottiana* (Wight) Walp. (basonym *Millingtonia arnottiana* Wight). Van Beusekom thus created *Meliosma pinnata* (Roxb.) Walp. subsp. *arnottiana* (Wight) Beusekom and even distinguished several varieties within this subspecies.

Unfortunately the International Code of Botanical Nomenclature (Greuter et al., 2000) states that (art. 11.2) per classification level the oldest, available epithet should be selected: “In no case does a name have priority outside the rank in which it is published”. On the species level the oldest epithet is *arnottiana*. However, one of the synonyms for the entity is *Meliosma rhoifolia* Maxim. subsp. *barbulata* Cufod. Thus, on the subspecific level *barbulata* is the oldest, available epithet and should have been selected.

Van Beusekom became aware of this small error after publication of his thesis, but he never made the new combination. On identification labels he used both names.

Because the new combination was never published and because the revision of the Sabiaceae for the Flora of Thailand is forthcoming, I would here by like to make the new combination:

***Meliosma pinnata* (Roxb.) Walp. subsp. *barbulata* (Cufod.) Beusekom ex Welzen, comb. nov.**

Meliosma rhoifolia Maxim. subsp. *barbulata* Cufod., Oesterr. Bot. Zeit. 88: 254. 1939.— Syntypes: China: *Handel Mazzetti* 12234 (A, W), Hunan; *Mell* 668 (A), Kwangtung; *C. L. Tso* 20653, 21156 (W), Kwangtung; *Y. Tsiang* 1357 (or incorrectly *W.Y. Chun* 1357) (BO, E, P), Kwangtung; *Canton Christian College (To & Tsang)* 12256, 12572, 12673 (E, W), Kangtung; *W.T. Tsang* 27673 (A), Kwangsi; *T.S. Tsoong* (= *Z.S. Chung*) 83303, 83551 (A), no locality.

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This taxon should be understood in the sense of Van Beusekom's *Meliosma pinnata* subsp. *arnottiana* (1971, p. 499).

REFERENCES

- Beusekom, C. F. van. 1971. Revision of *Meliosma* (Sabiaceae), section *Lorenzanea* excepted, living and fossil, Geography and Phylogeny. *Blumea* 29: 355–529.
- Greuter, W. et al. 2000. International Code of Botanical Nomenclature (Saint Louis Code). Koeltz Scientific Books, Königstein.

***Lepisanthes amoena* (Hassk.) Leenh. (Sapindaceae), a new record for Thailand**

PETER C. VAN WELZEN* & PHONGSAK PHONSENA**

ABSTRACT. *Lepisanthes amoena* was recently found in Chanthaburi Province, SE Thailand. It resembles *L. fruticosa*, but the leaves are much longer (up to 42 pairs of leaflets versus up to 14 pairs) and the ovary is 3-locular instead of 2-locular.

Recently, P. Phonsena and C. Kimsiri (7 July 2000) collected a *Lepisanthes* specimen (Sapindaceae) in Chanthaburi (Khao Khitchakut National Park), which did not match with the descriptions in the Flora of Thailand treatment (Welzen, 1999). Identification with Flora Malesiana (Adema et al., 1994) and the Tree Flora of Sabah and Sarawak (Adema et al., 1996) led to the correct identification, a new record for Thailand: *L. amoena* (Hassk.) Leenh. Later, Phonsena also found additional specimens in Khao Soi Dao Wildlife Sanctuary (Chanthaburi).

The species can be added to the key and descriptions in the Flora of Thailand (Welzen, 1999), insert after the first lead in the key to the species (p. 212):

- 1'Leaves imparipinnate with a perfect terminal leaflet; leaves with 7–42 pairs of leaflets. Sepals and petals 5.
Ovary and fruit 3-locular. Inflorescences terminal and axillary **1'. *L. amoena***
1'Leaves paripinnate or imparipinnate with a reduced terminal leaflet; leaves with 1–8(–14) pairs of leaflets.
Sepals and petals 4. Ovary and fruit 2-locular. Inflorescences axillary, rarely terminal **2. *L. fruticosa***

1'. *Lepisanthes amoena* (Hassk.) Leenh., Blumea 17: 71. 1969; Adema et al., Fl. Males. ser. 1, 11: 636, fig. 53. 1994 (see for full synonymy); in Soepadmo et al., Tree Fl. Sabah Sarawak 2: 313, fig. 12a–c. 1996.—*Melicocca amoena* Hassk., Flora 25, 2, Beibl.: 39. 1842. Fig. 1.

Treelet up to 10 m high, shortly hairy when young. *Leaves* imparipinnate with a non-reduced terminal leaflet, 7–42-jugate (up to 90 cm and 16-jugate in Thailand); pseudo-stipules present. *Leaflets* linear to ovate, 5–25 by 1.2–6 cm, thin-chartaceous to pergamentaceous; base oblique or not, obtuse to subcordate; apex obtuse to shortly acuminate; upper surface only densely fulvous on midrib, lower surface sparsely hairy. *Inflorescences* terminal and axillary, up to 75 cm long. *Flowers* scentless. *Sepals* 5, ovate to orbicular, outer two 1.5–3.5 by 1.2–2 mm, inner three 2.5–4 by 2–3.5 mm, red. *Petals* 5, white or red, shortly clawed, blade subdeltoid to suborbicular, up to 1.5 by 1.2 mm, at base with 2 incurved, almost connected lobes. *Stamens* 7–9. *Ovary* 3-locular. *Fruits* purple, slightly 3-lobed, 2–2.5 by 2.2–2.8 cm (fresh ca. 2.5 by 3 cm), (sub)glabrous.

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Thailand.— SOUTH-EASTERN: Chanthaburi (Khao Khitchakut National Park [*Phonsena & Kimsiri* 2541 (BKF)], Khao Soi Dao Wildlife Sanctuary [*Phonsena* 1940 (BKF)]).

Distribution.— Sumatra, Malay Peninsula, Borneo, W. Java, Timor.

Ecology.— In Thailand found in evergreen forest at 20–410 m altitude.

Vernacular.— Chamma liang pa (จ๋ามะเลียงป่า) (Chanthaburi).

Uses.— The fruits are edible.

Notes.— The description is mainly based on Adema et al. (1994).



Figure 1. *Lepisanthes amoena* (Hassk.) Leenh.: A. flowering branch; B. pseudo-stipules; C. flowers; D. fruits. Photographed by P. Phonsena.

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REFERENCES

- Adema, F., Leenhouts, P. W. & Welzen, P. C. van. 1994. Sapindaceae. In: Flora Malesiana, ser. 1, 11: 419–768. Rijksherbarium/Hortus Botanicus, Leiden.
- _____. 1996. Sapindaceae. In: Soepadmo, E., Wong, K. M. & Saw, L. G. (eds), Tree Flora of Sabah and Sarawak 2: 263–374. Forest Research Institute Malaysia, Kepong, etc.
- Welzen, P. C. van. 1999. Sapindaceae. In: Santisuk, T. & Larsen, K. (eds), Flora of Thailand 7: 169–250. Forest Herbarium, Royal Forest Department, Bangkok.

***Mallotus glomerulatus* (Euphorbiaceae sensu stricto), a new species:
description, pollen and phylogenetic position**

PETER C. VAN WELZEN*, RAYMOND W.J.M. VAN DER HAM*& KRISTO K.M. KULJU*

INTRODUCTION

A field trip by several staff members of the Forest Herbarium in Bangkok (BKF) to Phu Langka National Park in Nakhon Phanom Province resulted in the discovery of an unusual undershrub up to 1.5 m high and with the typical ‘explosively’ dehiscent fruits of Euphorbiaceae. The two plants showed a unique combination of characters: opposite leaves, stellate hairs, two apical, axillary ‘fruiting columns’ (no real inflorescences), smooth carpels, and a single ovule per locule (typical for the Euphorbiaceae s.s.: subfamilies Acalyphoideae, Crotonoideae, and Euphorbioideae). A year later, other staff members of BKF collected the staminate flowers, which were present in shortly peduncled glomerules. This inflorescence type is quite common in subfamily Phyllanthoideae (now often referred to at the family level as Phyllanthaceae), but all representatives of this (sub)family have two ovules per locule. Thus, the presence of glomerules makes the set of characters unique and we consider the unidentified plant to be a new species.

The new species resembles the genus *Mallotus* in having extrafloral nectaries in the form of round or oval glands on the upper leaf surface, stellate hairs and short, terminal pistillate inflorescences reduced to a single flower. In Thailand the latter character is present in *M. calocarpus* Airy Shaw. The new species also resembles *M. calocarpus* in the smooth, unarmed fruits, the penninerved (not triplinerved) leaf blade, short staminate inflorescences (though no glomerules in *M. calocarpus*) and a lack of glandular scales.

There are also differences between the new species and *M. calocarpus*. *M. calocarpus* has branches with much longer hairs. The leaf blade has small marginal teeth such that from every loop between two nerves a vein originates, which ends in a very short marginal tooth or a group of hairs in older leaves. The leaf margin is entire in the new species except for a subapical tooth on either side. The staminate inflorescence is longer in *M. calocarpus*, not glomerulate as in the new species, and the fruits are larger, ca. 21 by 15 mm compared to ca. 14 by 10 mm in the new species.

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In order to investigate the relationship of the new species to *Mallotus* a leaf clearing was made to identify the type of laticifers (articulate or inarticulate), its pollen was described and, even though the specimens were dried slowly and perhaps treated with alcohol, DNA samples were taken. The laticifers are numerous and inarticulate; these are characteristic of Euphorbiaceae s.s. The pollen and DNA, discussed below point to *Mallotus*. Therefore, the new species is described here in *Mallotus*. The name refers to the glomerulate staminate inflorescences.

DESCRIPTION

Mallotus glomerulatus Welzen, sp. nov.

Frutices 1–1.5 m alti. Indumentum pilis simplicibus et stellatis. Folia opposita plerumque aequalia elliptica ad 25.5 cm longa venatione pinnata. Inflorescentiae masculini breviter pedunculatae, floribus glomerulatis, sepalis 3, staminibus 26. Inflorescentiae pistillatae floribus singularibus ad paucis, calyce 4-lobato, stigmatibus integris, supra papillis longis ramosis. Fructus laeves.— Typus: Thailand, Nakhon Phanom Prov., Ban Phaeng District, Phu Langka National Park, Tat Pho waterfall, 17° 59'00" N, 104°08'37" E., *Koonkhunthod*, *Supuntee* & *Thetsna* 524 (holotypus L; isotypus BKF). Fig. 1.

Shrub, 1–1.5 m high, according to labels monoecious, but sexes at least on separate branches; young branches shortly hairy, glabrescent. *Indumentum* mainly of white stellate hairs and a few simple ones; glandular scales absent. *Stipules* triangular, 3–4 by 1–2 mm, early caducous, pilose outside. *Leaves* simple, opposite, distichous; petiole 6–15 mm long, completely pulvinate, reniform in transverse section, pilose; blades of each pair usually equal, elliptic, 9.3–25.5 by 2.5–8.2 cm; length/width ratio 3–3.8, symmetric, subcoriaceous, drying greenish, base attenuate, margin entire except for a single subapical tooth at each side, apex acuminate, glabrous, upper surface with round (small ones) to elliptic (larger ones) extra-floral nectaries, light brown when dry, basal ones twice as large as the smaller ones in the loops of the nerves along the margin; venation distinct on both sides, penninerved, 8–12 nerves per leaf side, looped and joined near the margin, veins \pm scalariform, veinlets reticulate. *Inflorescences* ramiflorous to terminal, shortly peduncled, peduncle ca. 7 mm long; with glomerules of flowers, either with many staminate flowers or 1–4 pistillate flowers; bract 1 per flower, triangular, ca. 2 by 1–2 mm, hairy outside. *Flowers* actinomorphic, petals and disc absent. *Staminate flowers* ca. 3.7 mm in diam., white-green; pedicel ca. 4 mm long; sepals 3, free, valvate, ovate, 3.3–3.5 by 1–1.2 mm, pilose outside; stamens 26, glabrous, filaments strap-like, ca. 1 mm long, anthers convex, ca. 1.2 by 0.4 mm, 2-celled, anther cells parallel, opening extrorse-latrorse with lengthwise slits; pistillode short, ca. 0.3 mm long, with a few hairs on top. *Pistillate flowers* ca. 4 mm in diam., (sub)sessile when young, white; calyx 4-lobed, the lobes ca. 3 by 1.7 mm, hairy outside, few simple hairs basally inside; ovary 3(–4)-locular, ca. 2 by 1.8 mm, villous, style ca. 2.3 mm long, hairy, stigmas ca. 4 mm long, not split apically, with long, branching papillae above, hairy beneath. *Fruit* a lobed capsule, on a short (3–4 mm long) pedicel, ca. 14 by 10 mm, dehiscent septically and (partly) loculicidally, with few hairs outside, glabrescent, fruit wall thin, rather woody; column broadly T-shaped, 7.5–8 mm long. *Seeds* obovoid, \pm trigonous in transverse section, 7.7–8 by 6.2–7 by 5.5–6 mm, covered by a thin sarcotesta (when young?).

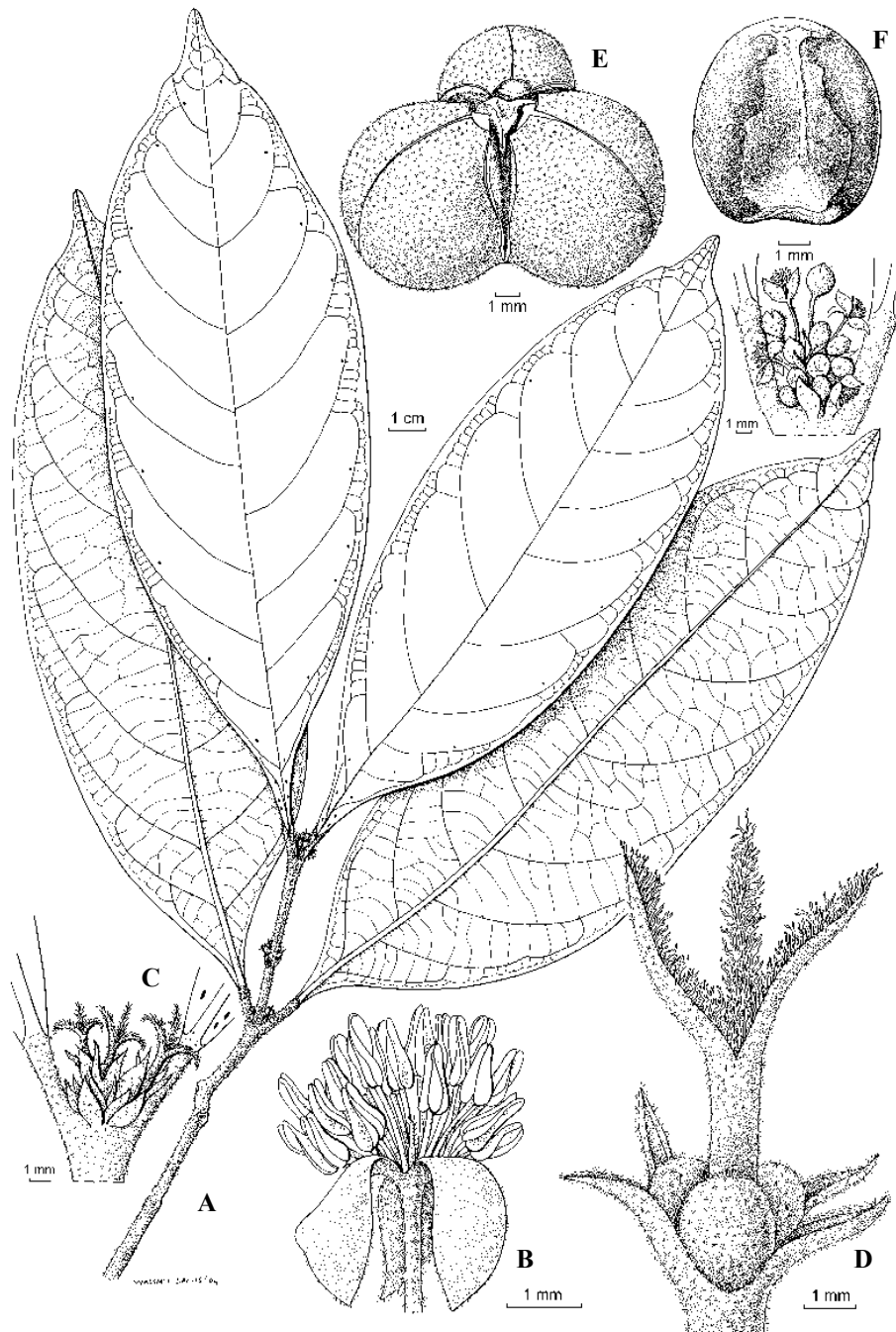


Figure 1. *Mallotus glomerulatus* Welzen: A. habit with staminate inflorescence; B. staminate flower; C. habit with pistillate flowers; D. pistillate flower; E. fruit; F. seed. Drawn by Anita Walsmit Sachs.

Thailand.— NORTH-EASTERN: Nakhon Phanom [Phu Langka National Park, *Koonkhunthod*, *Supuntee*, *Thetsna* 517 (BKF, L) & 524 (holotype L; isotype BKF); Phu Langka National Park, *Pooma et al.* 2636 (BKF, L) & 2662 (BKF, L)].

Distribution.— Endemic to north-eastern Thailand.

Ecology.— Scattered in dry evergreen forest; shaded. Altitude: 150–200 m. Flowering: May; fruiting: August.

Vernacular.— Mak lium (หมากเหลียม).

POLLEN MORPHOLOGY

Material studied: *Koonkhunthod*, *Supuntee*, *Thetsna* 517 (BKF, L), with light microscopy and scanning electron microscopy. Fig. 2A–B.

Pollen grains medium-sized (Polar axis x Equatorial diameter = 28.5 x 28.5 μm), more or less obtusely triangular (3-aperturate grains) or elliptic (2-aperturate grains) in polar view, spheroidal in equatorial view (Polar axis / Equatorial diameter = 1.00).

Apertural system 2- or 3-colporate (ca. 20 / 80%). Colpi narrow, ca. 15 x 2 μm , without margos, without operculum, without costae ectocolpi; colpus membrane covered with irregular, microechinate scabrae up to 0.6 μm in diameter. Endoapertures large, lalongate, 6–8 x 10–15 μm , with indistinct lateral sides and thick, clearly delimited (shield-like) polar sides (costae endocolpi).

Exine ca. 1 μm thick, indistinctly stratified, with thin nexine, thin columellate layer and thick tectum. Ornamentation perforate/microreticulate with minute echinae. Perforations < 0.1–0.3 μm in diam.; microechinae 0.1–0.2 μm in diam.

The pollen of *Mallotus glomerulatus* is indistinguishable from that of a few genera of the subtribe Rottlerinae of the tribe Acalypheae: *Mallotus*, *Neotrewia* and *Trewia* (compare with Nowicke & Takahashi, 2002: 258–269, plates XIII–XVIII).

MOLECULAR ANALYSIS

Material studied: *Koonkhunthod*, *Supuntee*, *Thetsna* 517 (BKF, L).

DNA was extracted from the herbarium specimen using the DNeasy Kit (Qiagen, Leusden, Netherlands). Plastid *trnL* intron and *trnL–F* intergenic spacer regions were amplified using primer pairs c/d and e/f, respectively (Taberlet et al., 1991). Sequence reactions and electrophoresis were conducted with standard methods using BigDye chemistry and an ABI 377 automatic sequencer (Applied Biosystems, Nieuwekerk a/d IJssel, Netherlands).

The obtained sequences were phylogenetically analysed with a dataset consisting of all the genera of subtribe Rottlerinae, including samples from different *Mallotus* sections. The closely related genus *Macaranga* (currently placed in a different subtribe; Webster, 1994) was also included in the study. Details of the methods and results will be available in a separate paper (Kulju et al., in prep.). Although *Mallotus* was not monophyletic, the results of both maximum parsimony (PAUP* 4.0b10; unweighted Fitch

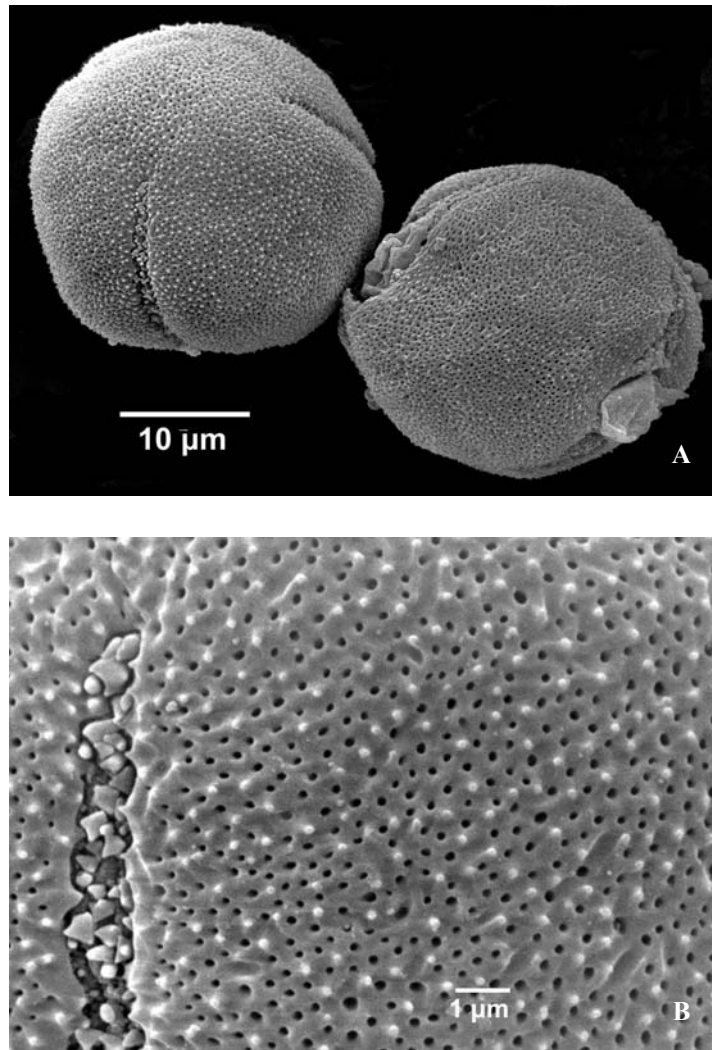


Figure 2. Pollen of *Mallotus glomerulatus* (SEM): A. almost polar view (left) and equatorial view (right) of 3-aperturate pollen grains. Scale bar = 10 µm.; B. detail, showing part of colpus and ornamentation. Scale bar = 1 µm.

parsimony with TBR branch swapping) and Bayesian analyses (MrBayes 3.0b4; GTR+G model) placed *M. glomeratus* indisputably in a highly supported clade containing specimens from most of the *Mallotus* sections, including the type species *M. paniculatus*. Thus, the molecular study clearly supports the inclusion of the new species in the genus *Mallotus*.

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REFERENCES

- Nowicke, J. W. & Takahashi, M. 2002. Pollen morphology, exine structure, and systematics of Acalyphoideae (Euphorbiaceae). Part 4. Tribes Acalypheae pro parte (*Erythrococca*, *Claoxylon*, *Claoxylopsis*, *Mareya*, *Mareyopsis*, *Discoclaoxylon*, *Micrococca*, *Amyrea*, *Lobanilia*, *Mallotus*, *Deuteromallotus*, *Cordemoya*, *Coccoceras*, *Trewia*, *Neotrewia*, *Rockinghamia*, *Octospermum*, *Acalypha*, *Lasiococca*, *Spathiostemon*, *Homonoia*), Plukenetieae (*Haematostemon*, *Astrococcus*, *Angostyles*, *Romanoa*, *Eleutherostigma*, *Plukenetia*, *Vigia*, *Cnesmone*, *Megistostigma*, *Sphaerostylis*, *Tragiella*, *Platygyna*, *Tragia*, *Acidoton*, *Pachystylidium*, *Dalechampia*), Omphaleae (*Omphalea*), and discussion and summary of the complete subfamily. Review of Palaeobotany and Palynology 121: 231–336.
- Taberlet, P., Gielly, L., Pautou, G. & Bouvet, J. 1991. Universal primers for amplification of three non-coding regions of chloroplast DNA. Plant Molecular Biology 17:1105–1109.
- Webster, G. L. 1994. Synopsis of the genera and suprageneric taxa of Euphorbiaceae. Annals of the Missouri Botanical Garden 81: 33–144.