THAI FOREST BULL., BOT. 47(1): 91–107. 2019.
DOI https://doi.org/10.20531/tfb.2019.47.1.13

A revision of *Meiogyne* (Annonaceae) in Thailand, with descriptions of four new species

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ABSTRACT

We review the species diversity of the Asian genus *Meiogyne* (Annonaceae) in Thailand. Four new species, *M. anomalocarpa*, *M. chiangraiensis*, *M. gardneri*, and *M. maxiflora*, are described. *Meiogyne anomalocarpa* has the widest distribution of any *Meiogyne* species in Thailand, but the other three species are narrowly distributed. *Meiogyne anomalocarpa* and *M. maxiflora* have the axillary inflorescences typical of the genus, but in *M. chiangraiensis* and *M. gardneri* the inflorescences are flagelliform and arise from the lower trunk, a morphology previously unreported from members of this genus. The presence of *M. chiangraiensis* in northern Thailand extends the range of the genus significantly northward. *Meiogyne caudata* is reported as new to the flora of Thailand. Several *Meiogyne* specimens from southernmost Thailand previously identified as *M. virgata* in the past by various workers were found to be more similar to *M. kanthanensis*, recently described from Perak, Peninsular Malaysia. A key is provided for the eight species currently recognized as occurring in the country.

KEYWORDS: Annonaceae, Southeast Asia, tree diversity, taxonomy.

Accepted for publication: 27 May 2019. Published online: 12 June 2019

INTRODUCTION

Meiogyne Miq. (Annonaceae) is a genus of Southeast Asian shrubs and trees with distinctive warty or corrugated patches at the base of the adaxial surface of the inner petals. The plants have small to medium-sized, nearly sessile, axillary flowers and oblong, multi-seeded indehiscent monocarps. Nine species were recognized in the first revision of the genus (van Heusden, 1994), which emphasized as diagnostic features of *Meiogyne* the differentiated petal bases and the elongate, obliquely oriented connective apex of the anthers of the innermost stamens. These two features united Annonaceae species that previously had been classified in six separate genera: *Ancana* F.Muell., *Chieniodendron* Tsiang & P.T.Li, *Guamia* Merr., *Meiogyne*, *Oncodostigma* Diels, and *Polyaulax* Backer. In a subsequent paper, van Heusden (1996) expanded the genus to 13 species by the addition of four species from New Caledonia.

After van Heusden's revisions, a series of molecular analyses established the phylogenetic placement of the genus within the family, clarified relationships among *Meiogyne* species, and supported expansion of the genus to comprise 24 species (Mols *et al.*, 2004; Thomas *et al.*, 2012; Xue *et al.*, 2014). The analyses by Thomas *et al.* and Xue *et al.* also showed that the two species of the Australian genus *Fitzalania* F.Muell. were nested within *Meiogyne*. Conservation of the name *Meiogyne* (1865) against *Fitzalania* (1863) was therefore proposed (Chaowasku *et al.*, 2011) and adopted (Applequist, 2012). The size of the genus has continued to increase as the result of both re-examination of previously described

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Annonaceae species (Turner & Utteridge, 2015; Xue *et al.*, 2017) and field and herbarium discoveries (Tan *et al.*, 2014; Turner & Utteridge, 2015).

For Thailand, van Heusden (1994) reported only two species, *Meiogyne virgata* (Blume) Miq. and *M. monosperma* (Hook.f. & Thomson) Heusden, the former from southeastern and peninsular Thailand, and the latter from peninsular Thailand only. Collecting in subsequent years has revealed both a wider geographic distribution and a greater range of morphological diversity within the country, and diversity in the genus needs to be re-assessed. For example, Gardner *et al.* (2015) described, as '*Meiogyne* sp. B,' a remarkable species of Annonaceae with flagelliform inflorescences arising from the base of the trunk and extending for a distance of up to three meters along the ground. About the same time as this discovery, several collections of a second cauliflorous species from Chiang Rai and Nan Provinces in northern Thailand were brought to the attention of P. Chalermglin and T. Chaowasku. The latter plants showed dense erect pubescence covering the monocarps similar to that present in a *Meiogyne* collection that had been made in 1993 by James Maxwell from Kanchanaburi Province in western Thailand.

Here we provide a review of *Meiogyne* material from Thailand and neighbouring countries, presenting diagnoses and full descriptions for four newly described species, abbreviated descriptions for known species, and a key to all species known to occur in Thailand.

MEIOGYNE

Miq., Ann. Mus. Bot. Lugduno-Batavi 2: 12. 1865, **nom. conserv.**— Type: *Meiogyne virgata* (Blume) Miq.

Trees or occasionally shrubs, evergreen, with spiral branching from the main trunk axis. *Indument* of simple hairs. *Leaves* chartaceous, rarely subcoriaceous, sometimes with scalariform tertiary venation. *Inflorescences* axillary or from axils of fallen leaves, or cauliflorous in complex inflorescences, 1–3-flowered, short-pedicellate, the pedicels bearing 2–5 small persistent bracts proximal to the midpoint; buds conical to ovoid, but petals usually separating early in the bud stage. *Sepals* much shorter than petals, overlapping or not at the base, free or connate at base. *Petals* valvate, often with the inner petals remaining loosely pressed together at anthesis, ovate or elliptic to linear, the inner whorl of petals slightly shorter and narrower than the outer, with a conspicuous glabrous patch of warty or corrugated tissue toward the base on the adaxial surface. *Stamens* many, anther connective apex transversely flattened, sometimes slightly sunken, inner whorl of stamens with an obliquely elongated connective. *Carpels* 1–17, stigmas disk-like, club-shaped, or globose. *Torus* flat or slightly convex. *Fruit* consisting of oblong, ellipsoid, ovoid, pear-shaped, or cylindrical, slightly to strongly torulose, indehiscent monocarps, these sessile or stipitate and pubescent in most species, the pericarp usually thick and woody or leathery when dried. *Seeds* attached laterally in one or two rows, 2–12 per monocarp, semicircular or circular in lateral view, flattened, smooth or slightly pitted, perichalazal ring (extension of the raphe around the circumference of the seed) slightly sunken or raised into a ridge, endosperm ruminations plate-like or spiniform, aril absent.

An Asian genus now represented by ca 30 species, eight of them occurring in Thailand. The most widespread species in Thailand is *M. anomalocarpa*, newly described in this paper, which extends from southeastern Thailand to Peninsular Malaysia. Three of the four species newly described in this paper, *M. chiangraiensis*, *M. gardneri*, and *M. maxiflora*, may be regarded as Thai endemics, although all occur near country borders and are thus likely to be discovered elsewhere. The presence of *M. chiangraiensis* in extreme northern Thailand extends the distribution of the genus into an area of the country where it was not previously known.

KEY TO THE SPECIES OF *MEIOGYNE* OCCURRING IN THAILAND

1. Inflorescences and infructescences emerging directly from the trunk at or above its base on rachides 7.8 cm long or longer
  2. Leaves glabrous or with a few hairs; petals lanceolate-oblong, 6–7 mm wide at midpoint **4. M. gardneri**
  2. Leaves densely pubescent with erect brown hairs below; petals linear, ca 1 mm wide at midpoint **3. M. chiangraiensis**
1. Inflorescences and infructescences axillary or from axils of fallen leaves, rarely from trunk axis, but then rachides less than 7.8 cm long
  3. Mature flowers yellowish orange to dark red in vivo; mature monocarps narrowly cylindrical, 0.8–0.9 cm wide
    4. Leaf acumen narrow, 5–11 mm long, monocarps 4 or fewer per fruit **2. M. caudata**
    4. Leaf acumen broad, 6–9 mm long, monocarps up to 15 per fruit **7. M. monosperma**

3. Mature flowers pale brown, pale yellow, or cream-colored in vivo; monocarps ovoid, ellipsoid, or oblong, 1.9–3.2 cm wide
5. Petals 26–35 mm long; monocarp indument of erect hairs; leaves distinctly pubescent with erect hairs abaxially **6. M. maxiflora**
5. Petals 6–22 mm long; monocarp indument of appressed or matted hairs, not erect; leaves glabrous or at most sparsely pubescent with lax hairs abaxially
6. Outer petals ovate, 12–15 mm wide, silky abaxially; tertiary venation weakly scalariform; monocarps always sessile **5. M. kanthanensis**
6. Outer petals lanceolate to linear-lanceolate, 2.5–6.5 mm wide, pubescent but not silky abaxially; tertiary venation weakly scalariform to distinctly scalariform, if distinctly scalariform then monocarps sessile rather than stipitate
7. Tertiary venation of leaf weakly scalariform, indistinct; outer petals lanceolate, 4.5–6.5 mm wide at base, 4–5 mm wide at midpoint; monocarps up to 14 per fruit, the stipes 14–18 mm long **1. M. anomalocarpa**
7. Tertiary venation of leaf distinctly scalariform; outer petals linear-lanceolate, 2.5–3.5 mm wide at base, 2–3 mm wide at midpoint; monocarps up to 4 per fruit, sessile or rarely with stipes up to 3 mm long **8. M. virgata**

1. Meiogyne anomalocarpa D.M.Johnson & Chalermglin, **sp. nov.**

= *Meiogyne* "*hainanense*" sensu Chalermglin (2001, p. 202), non Bân.

= *Meiogyne* sp. of Thomas *et al.* (2012), as to Fig. 2E, H, & I, but not molecular voucher.

= *Meiogyne* sp. A of Gardner *et al.* (2015).

Species resembling *M. hainanensis* in the numerous (up 14) stipitate monocarps and absence of strongly scalariform tertiary venation, but differing in the ovoid rather than rounded flower buds, the sepals free or connate only at base rather than distinctly connate, and the monocarps not torulose rather than torulose. It differs from *M. virgata* in its indistinct and weakly scalariform rather than distinctly scalariform tertiary venation, the ovate to lanceolate rather than linear-lanceolate petals, and monocarps up to 14 per fruit and distinctly stipitate versus up to four per fruit and sessile. Type: Thailand, Phetchaburi, Amphoe Kaeng Krachan, Kaeng Krachan NP, on road to Thor Thip waterfall, 12°49′N, 99°31′E, 400 m, 9 Aug. 2002 (fl.), *Middleton et al. 876* (holotype: **BKF** [143708!]; isotypes: **CMUB!**, **K**-2 sheets, not seen, **OWU!**). Figs. 1A–H, 2A–B.

Trees up to 20 m tall, dbh up to 25 cm; bark dark brown, grayish brown or reddish brown, smooth to slightly rough. *Twigs* puberulent, soon glabrate. *Leaves* chartaceous, slightly shiny on both surfaces, elliptic, oblong-elliptic, ovoid, or oblanceolate, larger blades 7.5–20.3 by 2.5–6.3 cm, base cuneate to rounded, apex acuminate to caudate, the acumen 9–26 mm long, glabrous or with a few hairs on the secondary veins abaxially; midrib flat or slightly impressed adaxially, raised abaxially, secondary veins 7–11 per side, arcuate, brochidodromous, plane adaxially, raised abaxially, tertiary venation weakly scalariform, indistinct; petiole 2.5–3 mm long. *Inflorescences* from axils of fallen leaves, rarely cauliflorous [*Niyomdham 2856*, **BKF**], 1(–2)-flowered; pedicels 5–7 mm long, 1–1.2 mm thick, pubescent, with 2–4 bracts on proximal half of pedicel; buds ovoid, slightly 3-angled in cross-section, apex acute. *Sepals* connate or slightly overlapping at base, triangular, 3–4 by 3.5–4 mm, apex acute, reflexed, margins often revolute, sericeous abaxially. *Petals* pale tan-colored to orange-brown, flushed with pink on corrugated base of inner petals in vivo, ovate to lanceolate, apex acute to obtuse; outer petals spreading at anthesis, 7–17 by 4.5–6.5 mm, finely pubescent on both surfaces; inner petals erect to slightly spreading at anthesis, 6–11 by 4.5–5.3 mm, with a corrugated patch present on lower ½ of adaxial surface, sparsely pubescent to tomentose adaxially except on corrugated patch, which is glabrous, finely pubescent abaxially. *Stamens* wedge-shaped to club-shaped, ca 0.7 mm long, anther connective apex pale yellow to pink at anthesis in vivo, flat. *Carpels* 5–14, stigmas obconical, ca 0.8 mm long. *Torus* ca 3.5 mm in diam. *Fruit* of up to 14 monocarps borne on a pedicel ca 8 by 5 mm, torus depressed-globose, 12–17 mm in diam., pubescent. *Monocarps* oblong, ovoid, or pear-shaped, not torulose or rarely weakly torulose, 2.4–4.4 by 1.9–2.5 cm, warty, velvety black to orange-brown tomentose, apex obtuse, sometimes apiculate, contracted into a stipe 9–18 by 4–6 mm, sometimes with a distal abscission ring along which the seed-containing portion breaks irregularly, pericarp ca 2 mm thick. *Seeds* up to 10 per monocarp, in two rows, 13–15 by 10–13 mm, flattened-ellipsoid, tan to brown, perichalazal ring slightly sunken.

Thailand.— SOUTH-WESTERN: Prachuap Khiri Khan [Hua Hin, 350 m, 11 May 2002 (fr.), *Chalermglin 450511* (**BKF**); Amphoe Hua Hin, Kaeng Krachan NP, Pa La U, beside river near foot bridge, 12°32′N,

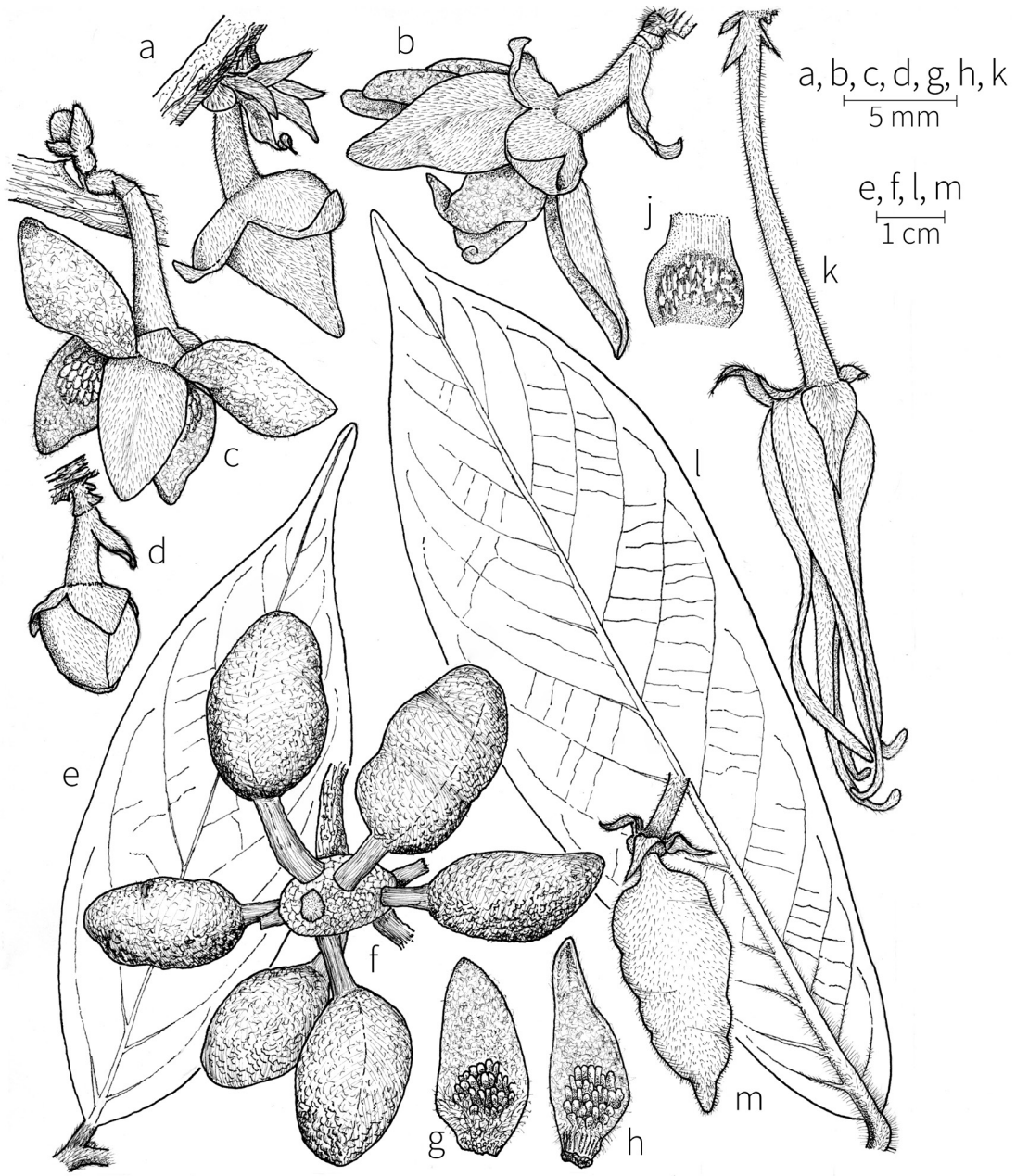

Figure 1. *Meiogyne anomalocarpa* and *M. chiangraiensis*. A–H, *Meiogyne anomalocarpa*. A. Flower bud, side view. B, C. Open flowers, side view. D. Flower bud, side view. E. Leaf, adaxial view. F. Fruit, side view. G, H. Inner petals, adaxial view. J–M, *Meiogyne chiangraiensis*. J. Base of inner petal, adaxial view. K. Flower, side view. L. Leaf, abaxial view to show pubescence. M. Fruit, side view. A, B, and H based on *Johnson et al. 2037* (**OWU**), C, D, and G based on *Johnson et al. 2024* (**OWU**), E based on *Middleton et al. 876* (**OWU**), F based on *Maxwell 75-510* (**BK**), J based on photograph by P. Suksathan, K based on *Norsaengsri & Tathana 7482* (**BKF**), L and M based on *Norsaengsri & Tathana 7897* (**BKF**). Illustration by D.M. Johnson.

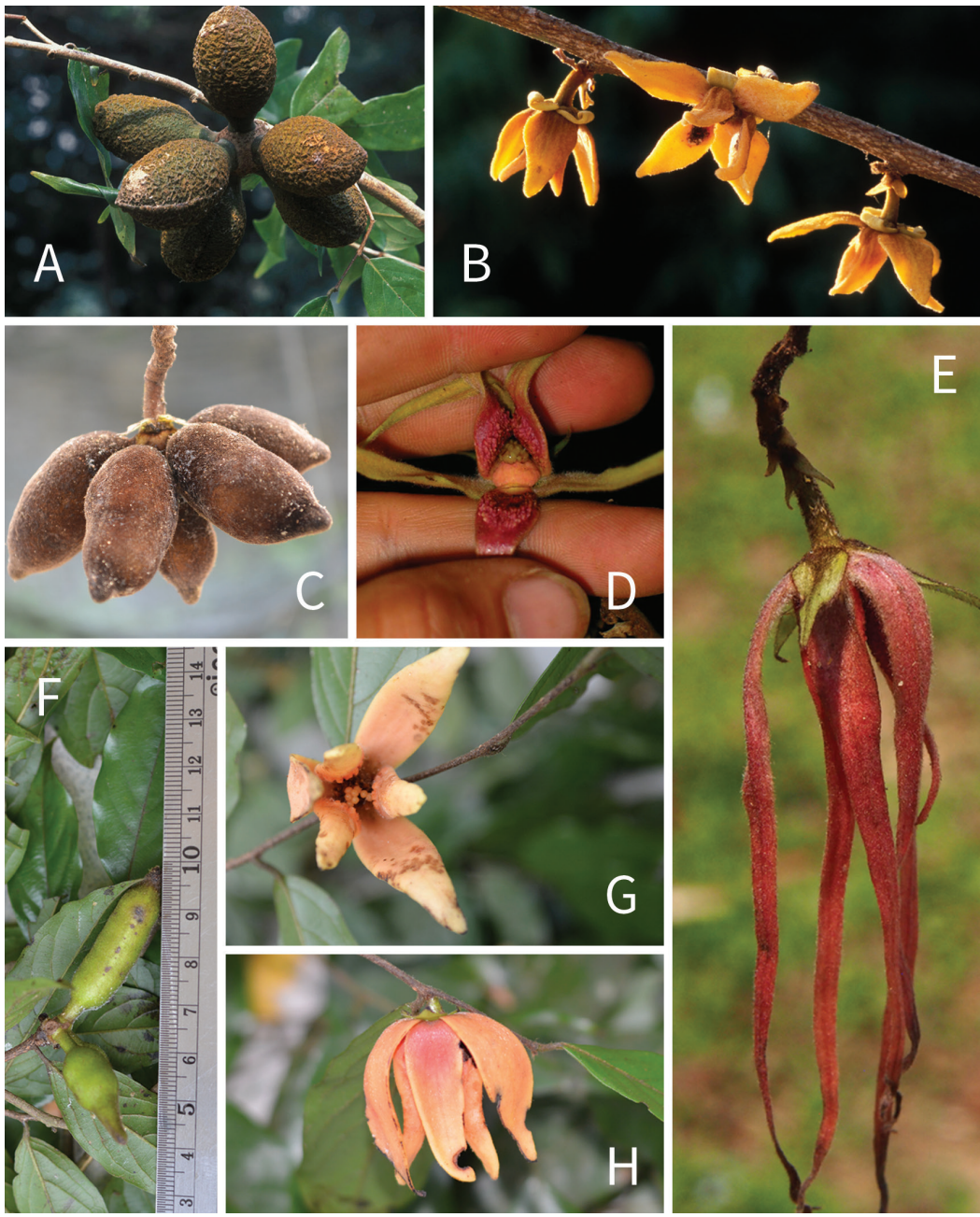

Figure 2. *Meiogyne anomalocarpa*, *M. chiangraiensis*, and *M. caudata*. A–B, *M. anomalocarpa*, from Krabi Province. A. Fruit. B. Flowers, side view. C–E, *M. chiangraiensis*. C. Fruit, from Chiang Rai Province. D. Flower, from Nan Province, showing stigmas at anthesis and inner petal corrugations. E. Flower, side view, from Chiang Rai Province. F–H, *M. caudata*, from Prachuap Khiri Khan Province. F. Fruit, side view. G. Flower, apical view. H. Flower, side view. A–B by S. Gardner, C and E–H by P. Chalermglin, D by P. Suksathan.

99°28′E, 250 m, 14 Aug. 2002 (fr.), *Middleton et al. 1049* (**BKF** [143721, 143722], **CMU**, **OWU**); 3 Feb. 2003 (fr.), *Johnson et al. 2032* (**BKF**, **OWU**)]; CENTRAL: Saraburi [Phu Kae, 21 Jan. 2003 (fl.), *Johnson & Chalermglin 2026* (**BKF**, **OWU**)]; SOUTH-EASTERN: Chachoengsao [S of Tha Takiap, 19 Jan. 2003 (fl., young fr.), *Johnson et al. 2024* (**BKF**, **OWU**), *2025* (**BKF**, **OWU**); Lum Changwat, Khao Ang Rue Nai WS, Tha Takiap District, 13°15′N, 101°43′E, 3 Feb. 2000 (bud), *Koonkhunthod 116* (**BKF** [144861, 144862, 144768)]; Chanthaburi [Tamun, Chantabun, ca 200 m, 18 Dec. 1924 (fl.), *Kerr 9706* (**BK**); [Khao?] Soi Dao WS, *Keßler PK 3210* (**SING**); Headquarter, Khao Soi Dao WS, Khao Soi Dao District, 13°01′60″N, 102°10′0″E, 200 m, 22 Jan. 2000 (fl., fr.), *Koonkhunthod 94* (**BKF** [144845, 144846]); Headquarter, Khao Soi Dao WS, Khao Soi Dao District, 13°01′60″N, 102°10′0″E, 200 m, 13 Feb. 2002 (fl., fr.), *Koonkhunthod 159* (**BKF** [144982, 144983]); North Soi Dao Mountain, Bong Nam Ron District, 150 m, 7 May 1975 (fl.), *Maxwell 75-510* (**BK**)]; Chonburi [Bo Thong, Khao Yai Forest Ranger Unit, 20 June 1997 (fl.), *Decharach s.n.* (**BKF** [101115])]; PENINSULAR: Krabi [Lan Ta NP, *Niyomdham 2856* (**BKF** [098769, 098770]); Khao Phanom District, Khao Phanom Bencha NP, close to start of trail to summit from east side, 8°18′N, 98°58′E, 200 m, 20 Apr. 2007 (fl.), *Sidisunthorn ST2904* (**BKF** [169445, 169440], **L**)]; Nakhon Si Thammarat [Khao Luang-Wang Mai Pai, 25 Feb. 1962 (fl.), *Smitinand 1813* (**BKF** [003007])]; Satun [Tarutao NP, La Ngu District, trail between Talo Wao and Talo Udang, approx. 2 km N of Talo Udang, 6°33′N, 99°40′E, 10 m, 16 Feb. 2005 (fl.), *Gardner et al. ST1541* (**BKF** [169441, 169442], **L**), from same tree collected on 16 Feb. 2005, 30 Mar. 2006 (fl., fr.), *Gardner & Sidisunthorn ST1541a* (**BKF** [16436])]; Songkhla [Sadao District, Padang Besar Subdistrict, Khao Rup Chang temple, 17 Mar. 2003 (fl., fr.), *Johnson et al. 2048* (**BKF**, **OWU**)]; Trang [Khao Chong 16-hectare plot, 7°33′N, 99°48′E, ca 125 m, Feb. 2001 (fl.), *Sinbumroong & Davies AS150* (**BKF** [154439, 155199]), *AS 174* (**BKF** [154514])]; Yala [Banang Sata District, entrance to Bang Lang NP, 15 Mar. 2003 (fl.), *Johnson et al. 2037* (**BKF**, **OWU**); Than To District, Bang Lang NP, Headquarters, 150 m, *Pooma et al. 4335* (**BKF** [167281]); Bannang Sata, 12 Dec. 1966 (fl.), *Sangkhachand 1424* (**BKF** [003005]); Tan To Waterfall, Bannang Sata, 100 m, 9 Dec. 1972 (fr.), *Santisuk & B.N. 360* (**BKF** [004248])].

Malaysia.— Kelantan [Besor, 20 June 1991 (young fr.), *Remy KL 4049* (**KEP**)]; Negeri Sembilan [Hutan Simpan Pasoh, 22 Feb. 2008 (fl., fr.), *Teo & Din KL 5550* (**KEP**)]; Pahang [Sungai Mai Estate, 1 Apr. 1959 (fr.), *Kadim & Mahmood KM.108* (**SING**)]; Selangor [Kanching, Bukit Anak Takun, 1 Oct. 1971 (fr.), *Chin & Baddaruddin 1692* (**KEP**); Bukit Anak Takun, 31 July 1968 (fl., young fr.), *Whitmore FRI 12157* (**KEP**)].

Distribution.— Southeastern, central, southwestern, and peninsular Thailand, extending south to Negeri Sebilan State in Peninsular Malaysia (Fig. 3).

Ecology.— Dry to moist evergreen forest at elevations from 10 to 680 meters. Flowering: December–August; fruiting: December–April, August, and October.

Etymology.— Named for several fruit characters unusual for the genus: the large number of monocarps, the dark-colored tomentum, and the irregular thickening and abscission of the monocarp stipe.

Vernacular.— Nom kho (นมโค)(*Middleton et al. 1049*), sai den (ไสเดน)(*Chalermglin 450511*, *Koonkhunthod 94*, *116*, *159*), sang mu yu sang (สังหมูหยูสัง) (*Smitinand 1813*).

Notes.— *Meiogyne anomalocarpa* occurs widely across eastern and southern Thailand and south into Peninsular Malaysia. The species has been confused with both *M. hainanensis* and *M. virgata*. It does not overlap in distribution with *M. hainanensis*, which is endemic to Hainan, and differs from that species in having flower buds longer than wide and often distinctly acute, sepals that are free or connate only at the base, corrugations of the inner petals covering only the basal half (Fig. 1G, H) rather than nearly the entire petal, and monocarps that are not constricted between the seeds. In addition, the monocarps of *M. anomalocarpa* often develop an abscission zone at the apex of the stipe, often visible even in immature fruits, along which the seed-containing portion tends to break free at maturity. *Meiogyne anomalocarpa* monocarps are covered with a dense orange-brown to black corrugated to velvety tomentum (Fig. 2A). *Meiogyne anomalocarpa* overlaps in distribution with *M. virgata* in Peninsular Thailand and Peninsular Malaysia, even occurring in some of the same sites, such as Khao Chong in Trang Province, but the two species may be readily distinguished on the basis of both floral and fruit

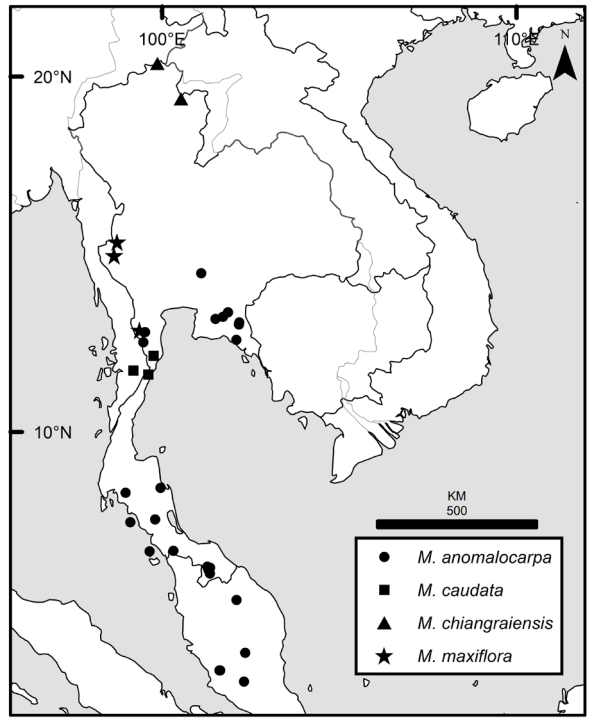

Figure 3. Global distributions of *Meiogyne anomalocarpa*, *M. caudata*, *M. chiangraiensis*, and *M. maxiflora* in Thailand and adjoining countries.

characters. The petals of *M. anomalocarpa* are light brown to orange-brown and ovate to lanceolate, while those of *M. virgata* are yellow, cream-colored, or greenish yellow, and linear-lanceolate. In addition, the corrugated inner petal patch is pink or tan in *M. anomalocarpa* and pink-red, purple, or brown in *M. virgata*. The monocarps of *M. anomalocarpa* may be as many as 14 per fruit, and have pronounced stipes, while those of *M. virgata* never exceed four per fruit, and are sessile or nearly so. In addition, *M. anomalocarpa* is a tree reaching up to 20 meters, with only indistinct tertiary venation of its leaves, while *M. virgata* is a shrub or small tree, rarely reaching 10 meters, and its leaves have strongly scalariform tertiary venation.

Sinclair (1953) identified *Kerr 9706* as *Meiogyne maclurei* Merr., an illegitimate name for *M. hainanensis* (Merr.) Bân (Bân, 1973). Van Heusden (1994) determined *Maxwell 75-510* to be *Meiogyne virgata*. Both collections are *M. anomalocarpa*.

2. Meiogyne caudata (C.E.C.Fisch.) I.M.Turner, Kew Bull. 66(4): 587–588. 2011.— *Desmos caudatus* C.E.C.Fisch., Bull. Misc. Inform. 1926: 448–449. 1926.— Type: Myanmar, South Tenasserim, Ngawun chaung forest, 300 ft., Jan. 1926 (fl.), *C.E. Parkinson 1633* (holotype: **K** [K000190046!]). Fig. 2F–H.

Trees up to 10 m tall, dbh up to 4 cm; bark brown. *Twigs* with a mixture of long appressed hairs and short erect hairs, eventually glabrate. *Leaves* chartaceous, narrowly to broadly elliptic, blades 5.9–11 by 1.6–4 cm, base cuneate, apex bluntly acuminate, the acumen 5–13 mm long, glabrous except for short erect hairs on the midrib adaxially, sparsely appressed-hirsute, especially along the midrib and secondary veins, abaxially; secondary veins 6–9 per side, arcuate, brochidodromous, tertiary venation vein scalariform, indistinct; petiole 2–6 mm long. *Inflorescences* axillary, 1-flowered; pedicels 2–4 mm long, with 1–2 small bracts near the base; buds ovoid, petals separating early. *Sepals* free, broadly ovate, 2.5–5 mm long, apex obtuse to acute, appressed-pubescent abaxially. *Outer petals* linear-lanceolate to lanceolate, 15–20 by 4–6 mm, appressed-hirsute, hairs longer and denser at the base, apex subacute. *Inner petals* lanceolate, ca 18 by 5 mm,

with a corrugated patch on the proximal ⅓ of the adaxial surface, apex obtuse. *Stamens* many, wedge-shaped, 1.5–2.5 mm long, anther connective apex peltate. *Carpels* 5–9, stigmas globose, "minutely pustular, sparsely hirsute with short brown hairs" (Fischer, 1926); ovules 6 in a single row. *Fruit* of up to 4 monocarps borne on a pedicel ca 4 mm long, torus depressed-globose, not much expanded. *Monocarps* cylindrical, slightly torulose, 10–27 by 7–9 mm, apex often with a beak 4–8 mm long, densely appressed-hirsute, base contracted into a short stipe 3–5 mm long, pericarp thin. *Seeds* up to 5 per monocarp, in a single row, sub-globose, diameter ca 7 mm, perichalazal ring raised.

Thailand.— SOUTH-WESTERN: Prachuap Khiri Khan [Huay Yang NP, near Khao Lan Ranger Station, 24 Nov. 2017 (fl., fr.), *Chalermglin 601122* (**HKU**, additional duplicates to be distributed); Kui Buri District, Kui Buri NP, 23 Jan. 2004 (fl.), *Middleton et al. 2437* (**A**, **BKF**)].

Distribution.— Southern Myanmar and south-western Thailand (Fig. 3).

Ecology.— Dry evergreen forest at 700–1,000 m. Flowering: January and November; fruiting: November.

Notes.— This is the first record of this species from Thailand, representing eastward and northward extensions of 50–60 km of the known distribution of this species from its type locality in southern Myanmar. The type specimen has flowers with outer petals 20–40 mm long, but otherwise the description agrees with the Thai material. The flowers turn dull reddish orange at anthesis (Fig. 2G, H), and the fruits become pale yellow at maturity. A *Meiogyne* specimen with immature fruits, recently collected in northwestern Thailand, Mae Hong Son, Ban Huai Phung, Tham Pla-Namtok Pha Suea NP, Mueang 47Q 0394807, 2169325, 1033 m, 21 Nov. 2013 (young fr.), *Lakoet 0642* (**QBG** [73482]), is similar, but may represent a distinct species once more complete material is known.

3. Meiogyne chiangraiensis Chalermglin & M.-F. Liu, **sp. nov.**

Species resembling *M. gardneri* in its flowers borne on rachides emerging from the trunk, but differing in the dense indument of erect brown hairs of the twigs and abaxial leaf surfaces, the caudate sepals 8–12 mm long, and linear petals reaching at least 21 mm in length. It addition to these characters it is further to be distinguished from other *Meiogyne* species by the monocarps, which are oblong and torulose, with a pronounced apical beak 3–7 mm long, and are densely covered by erect brown to black hairs. Type: Thailand, Chiang Rai, Ban Phamee, Huay Nam Dun, Mae Sai, N 589453 E 2254872, 502 m, 13 Jan. 2011 (fl.), *Norsaengsri & Tathana 7482* (holotype **BKF** [202223!]; isotype: **QBG!**). Figs. 1J–M, 2C–E.

Shrubs or trees up to 6 m tall; dbh up to 3.5 cm; bark pale gray-green to gray-brown, smooth. *Twigs* densely pubescent with persistent erect brown hairs. *Leaves* chartaceous, concolorous or slightly discolorous, olive-green adaxially, light green to orange-brown abaxially, elliptic to oblong, 14.2–27.5 by 4.2–11.2 cm, base rounded, apex acuminate, the acumen 8–17 mm long, glabrous adaxially, densely pubescent with erect hairs abaxially; midrib slightly impressed adaxially, raised abaxially, secondary veins 11–16 per side, more or less parallel but curving and weakly brochidodromous near the margin, raised abaxially, tertiary venation scalariform, distinct; petiole 4–7 mm long. *Inflorescences* borne on rachides 7.8–15 cm long emerging from the trunk, often near the base, branched, only a single flower maturing at a time at the end of each branch; pedicels 15–30 mm long, 1.2–1.3 mm thick, pubescent with erect hairs, with 2–5 bracts attached along the proximal half of the axis, persistent, lanceolate, up to 4.5 mm long, apex acute to attenuate; buds long-conical, apex obtuse. *Sepals* free or connate at base, lanceolate, 8–12 by 3.5–4 mm, apex caudate, pubescent with erect hairs abaxially. *Petals* pale green, becoming red in vivo, linear-lanceolate, apex long-attenuate; outer petals slightly spreading at anthesis, at least 15–21 by 3.5–4.5 mm, ca 1 mm wide at midpoint, pubescent with curly hairs on both surfaces; inner petals erect at anthesis, with small gaps between the bases, ca 17 by 4.5 mm, with a corrugated patch on proximal half of adaxial surface, densely pubescent with curly hairs on both surfaces, except corrugated patch, which is glabrous. *Stamens* many, narrowly wedge-shaped, 1.5–2.5 mm long, anther connective apex flat, sometimes oblique, slightly sunken in the middle, papillate. *Carpels* 5–6, stigmas connivent, globose, sparsely pubescent. *Fruit* of up to 6 monocarps attached to a pedicel ca 30 by 5 mm; torus irregularly globose, ca 6 mm in diam., pubescent.

Monocarps sessile or short-stipitate, irregularly oblong, weakly to strongly torulose, 3.4–3.9 by 1.3–1.7 cm, densely pubescent with erect brown hairs, apex rostrate, the beak 3–7 mm long, base rounded, sessile or contracted into a stipe 1–3 by 3 mm, pericarp thin. *Seeds* up to 6 in a single row, 9–14 by 7–10 mm, ellipsoid, flattened-ellipsoid, or reniform, dull yellow-white, perichalazal ring raised.

Thailand.— NORTHERN: Chiang Rai [Khun Nam Nang Non Village, Mae Sai, Feb. 2015 (fl.), *Chalermglin 580222* (**HKU**, plus duplicates to be distributed), Ban Png Pha Village, Mae Sai, Apr. 2017 (fl.), *600406* (**HKU**, plus duplicates to be distributed), July 2017 (fr.), *600702* (**HKU**, plus duplicates to be distributed); Khun Nam Nang Non Forest Park, Mae Sai, N 0588524 E 2251277, 601 m, 25 May 2011 (fr.), *Norsaengsri & Tathana 7897* (**BKF** [202239], **QBG**), Chiang Rai District, Mae Fah Luang, Doi Tung, 1.5 km north-west of Akha Pa Kluay village, 910 m, 24 May 2017 (young fr.), *van de Bult 1512* (**CMUB**), 890 m, 1 July 2017 (fr.), *van de Bult 1524* (**CMUB**)]; Nan [Tham Sakoen NP, Song Khwae, 19°23′N, 100°32′E, 800 m, 12 May 2006 (fr.), *Srisanga et al. 2850* (**QBG** [31175]); Tham Sakern NP, Song Khwae, 700 m, 2 Mar. 2006 (fl.), *Suksathan 3823* (**QBG** [27170])].

Distribution.— Nan and Chiang Rai Provinces of northern Thailand (Fig. 3).

Ecology.— Evergreen hardwood forest, sometimes with bamboo, on limestone or granite at elevations of 500–900 m. Flowering: January–April; fruiting: May and July.

Etymology.— Name denotes the type locality, as well as a tribute to the people of Chiang Rai Province.

Notes.— The inflorescences of this species arise directly from the trunk at various points all the way to the trunk base. Dimensions of ethanol-preserved flowers is sufficiently greater than the measurements from the **BKF** sheet of *Norsaengsri & Tathana 7482*, suggesting that the flower on the herbarium specimen is immature. Ethanol-preserved flowers have sepals 10–25 by 8–9 mm, narrowed into an acumen 8–17 mm long, outer petals 92–106 by 8–9 mm, and inner petals 70–92 by 8–9 mm. The dull red color of the flowers at anthesis is unusual for the genus. The flowers emit a mild fragrance in early evening. In indument and monocarp shape this species resembles *Meiogyne monogyna* (Merr.) Bân (basionym: *Desmos monogynus* Merr.), described from northern Vietnam from a single specimen (Merrill, 1942, Bân 1974) and placed by van Heusden (1994) as a taxonomic synonym of *M. virgata*. The fruit on the type collection of *M. monogyna* at **A**, however, is borne in a leaf axil rather than on the trunk.

4. Meiogyne gardneri D.M.Johnson, **sp. nov.**

= *Meiogyne* sp. 2 of Xue *et al.* (2014)

= *Meiogyne* sp. B of Gardner *et al.* (2015)

Species resembling *M. chiangraiensis* in its long inflorescence axes arising from the trunk, but differing in the leaves lacking hairs and with indistinct weakly scalariform tertiary venation, the sepals only 3.5–4 mm long as opposed to 8–12 mm long, and the petals lanceolate rather than linear-lanceolate. Type: Thailand, Ranong ["Surat Thani"], Tha Chang District, Khlong Yan WS, Wang Nam Yen Substation, 9°31′N, 98°45′E 100 m, 4 Dec. 2005 (fl.), *Gardner, Sidisunthorn & Khumchompoo ST2014* (holotype: **BKF** [169448! (lvs), 169449! (fl.)]; isotypes: **K**-2 sheets, not seen, **L** [0819582! (with inflorescence), 0819581!]). Figs. 4, 5C–D.

Trees up to 10 tall, dbh 17 cm; trunk with stilt roots and aerial roots at the base to a height of 1 m; bark medium grey brown, smooth. *Twigs* glabrate, inconspicuously lenticellate. *Leaves* chartaceous, not shiny on either surface, elliptic to oblong-elliptic, larger blades 18–22.8 by 6–8.9 cm, base rounded to broadly cuneate, apex acuminate to caudate, the acumen 13–15 mm long, glabrous adaxially, soon glabrate or with a few hairs abaxially; midrib slightly sunken adaxially, raised abaxially, secondary veins 12–14 per side, more or less parallel but curving and weakly brochidodromous near the margin, plane to slightly raised on both surfaces, tertiary venation weakly scalariform, indistinct; petiole 6–8 mm long. *Inflorescences* emerging from the lower part of the trunk and plunging downward into the soil, the flowers arising from the inflorescence axis up to 3 m from the trunk, forming a branched rachis with only a single flower maturing at a time at each shoot tip, pedicels 8.5–18 mm long, 0.8–1 mm thick, initially appressed-pubescent but soon glabrate, with 2–4 bracts scattered along the axis, persistent, ovate, 2–4.5 by ca 2 mm, apex sometimes apiculate; buds ovoid, apex acute, petals separating well before

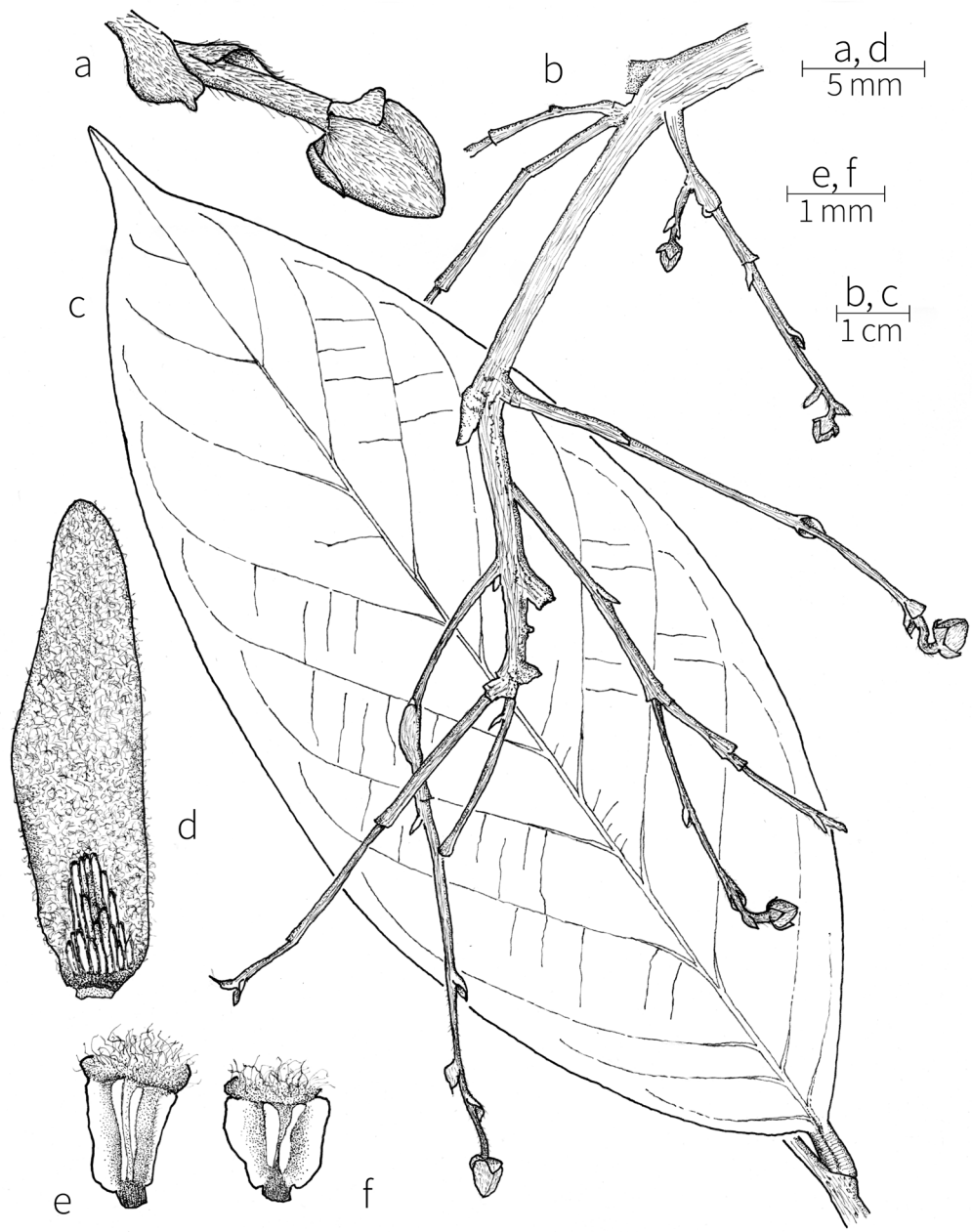

Figure 4. *Meiogyne gardneri*. A. Flower bud, side view. B. Portion of inflorescence. C. Leaf, adaxial view. D. Inner petal, adaxial view. E and F. Stamens, adaxial view. Based on *Gardner ST 2014* (**L** [0819582]). Illustration by D.M. Johnson.

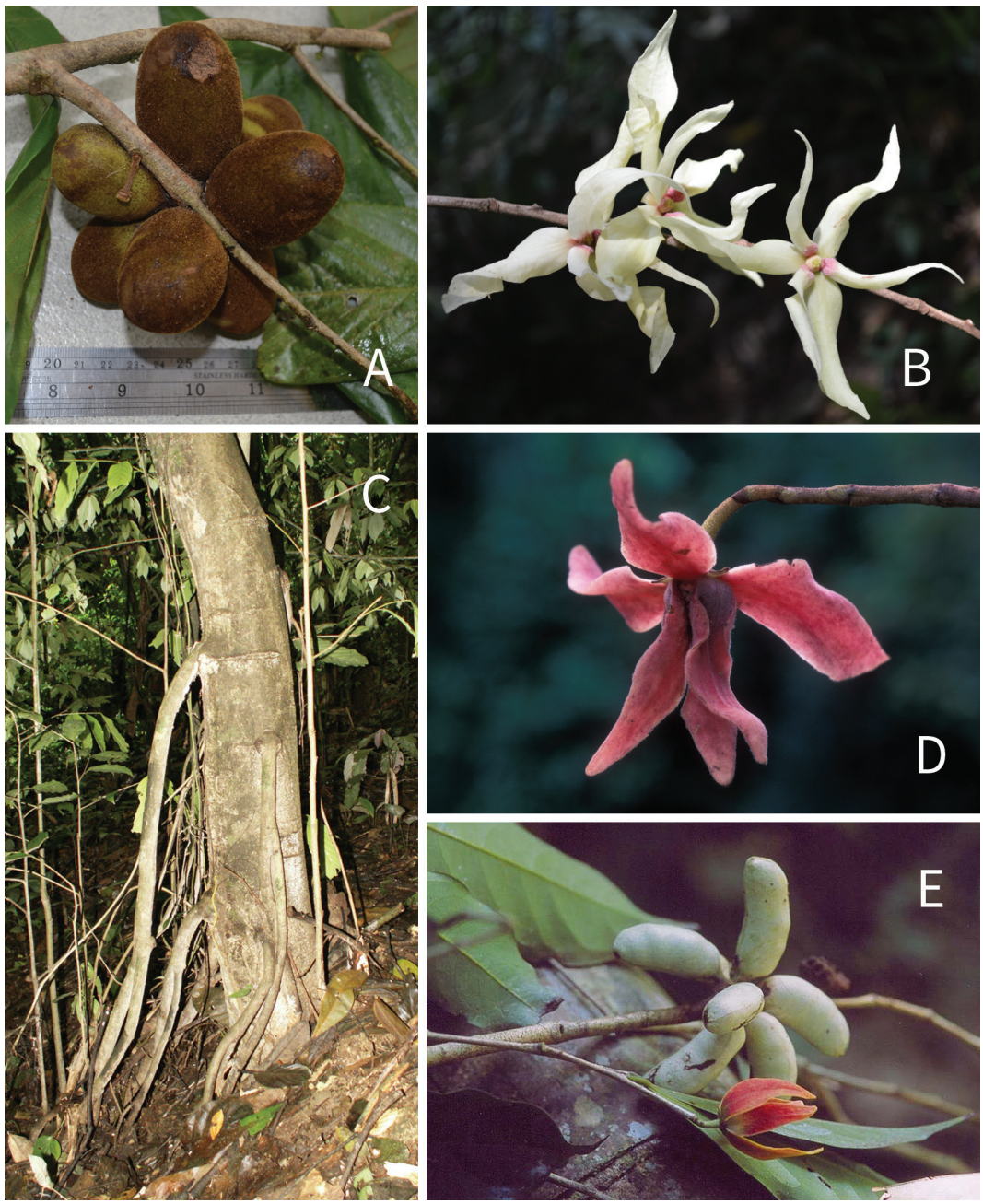

Figure 5. *Meiogyne maxiflora*, *M. gardneri*, and *M. monosperma*. A–B, *M. maxiflora*, from Kanchanaburi Province. A. Fruit. B. Flowers, apical view. C–D, *M. gardneri*, tree from which type specimen collected, Ranong Province. C. Base of trunk, showing stilt roots and inflorescences emerging from trunk and descending to the ground. D. Flower, side view. E. *M. monosperma*, fruit and flower in side view. A, B, and E by P. Chalermglin, C and D by S. Gardner.

maturity. *Sepals* free, ovate, 3.5–4 by ca 3 mm, apex acute to slightly acuminate, flat, loosely pubescent with appressed hairs up to 1 mm long abaxially. *Petals* cream, turning pink to red with age in vivo, lanceolate; outer petals spreading at anthesis, 12–20 by 4.5–7 mm, 6–7 mm wide at midpoint, apex acute to attenuate-acute, pubescent with curly hairs adaxially, sparsely pubescent with loosely appressed hairs up to 1 mm long abaxially; inner petals erect at anthesis, 8.5–15 by 5–6 mm, apex acute to obtuse, with a corrugated patch on proximal ⅓ of adaxial surface, pubescent with curly hairs on both surfaces except on corrugated patch, which is glabrous. *Stamens* wedge-shaped, 1.4–1.7 mm long, anther connective apex flat, pubescent with long hairs. *Carpels* ca 2, ovaries oblong, ca 2 mm long, stigmas ovoid to globose, ca 1 mm long, setose. *Torus* 2–3.5 mm in diam. *Fruits* and seeds unknown.

Distribution.— Known from a single locality in Ranong Province, peninsular Thailand (Fig. 6).

Ecology.— Growing in semi-open understory of disturbed evergreen-bamboo forest close to a permanent stream at 100 m elevation. Flowering: December; fruiting phenology unknown.

Etymology.— Named in honor of Simon Gardner, who collected the type specimen and reported the morphological details of this remarkable plant (Gardner *et al.*, 2015).

Notes.— Simon Gardner (personal communication) reports that at least some of what appear to be aerial roots emerging from the base of the trunk are actually inflorescence axes, and suggests that these axes appear to live for multiple years and become longer and more woody in the process. The shoots are embedded in leaf litter just under the soil surface and anchored by small root-like projections along their length, with the flowers appearing singly, apparently without connection to a tree, at the ends of the branches in different directions from the trunk.

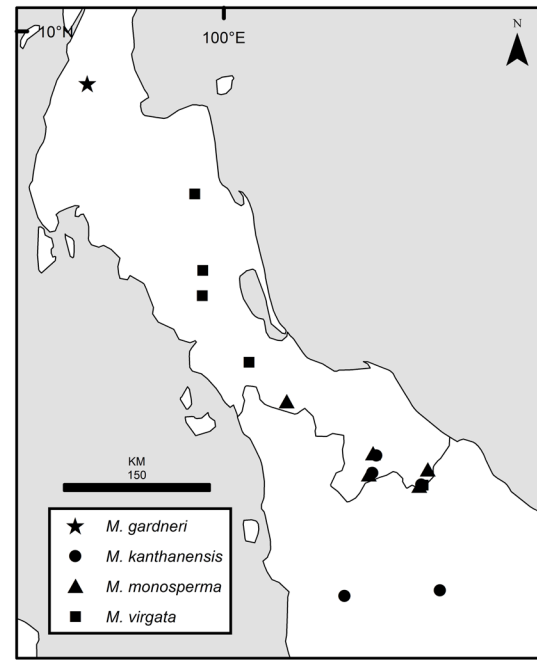

Figure 6. Distributions of *Meiogyne gardneri*, *M. kanthanensis*, *M. monosperma*, and *M. virgata*. Global distributions are shown for *M. gardneri* and *M. kanthanensis*, but only distributions in Thailand for *M. monosperma* and *M. virgata*. Overlapping symbols indicate the occurrence of *M. kanthanensis* and *M. monosperma* in nearly the same localities in Yala Province, and of these two species plus *M. virgata* at one locality in southernmost Narathiwat Province.

5. Meiogyne kanthanensis Ummul-Nazrah & J.P.C.Tan, Phytotaxa 177(3): 149–151. 2014.— Type: Malaysia. Perak: Kinta, Chemor, Gunung Kanthan, 04°45′44.04″N, 101°07′13.96″E, 104 m, 26 Apr. 2014, *Tan et al. FRI 81800* (**KEP!**).

Small trees 5–8 m tall; dbh up to 12 cm. *Twigs* sparsely pubescent, soon glabrate. *Leaves* chartaceous, elliptic to oblong-elliptic, larger blades 13.5–24 by 4.8–9.8 cm, base rounded to broadly cuneate, apex narrowly acuminate, acumen 6–10 mm long, glabrous adaxially, with a few hairs on the midrib and secondary veins abaxially, secondary veins 8–11 per side, tertiary venation weakly scalariform; petiole 5–8 mm long. *Inflorescences* axillary or from axils of fallen leaves, rarely cauliflorous, 1-flowered; pedicels 5–9 mm long, bearing 2 small bracts on proximal half of pedicel; buds not seen. *Sepals* connate basally, broadly ovate, 2.5–4 mm long, apex obtuse, recurved, pubescent abaxially. *Outer petals* obovate, elliptic, or broadly lanceolate, 19–22 by 12–15 mm, 9–12 mm wide at midpoint, apex obtuse, densely tomentose adaxially, sericeous abaxially, inner petals broadly lanceolate, 17–18 by 7–9 mm, with a corrugated patch on proximal ¼ of adaxial surface, apex obtuse, densely tomentose adaxially, sericeous abaxially. *Stamens* ca 80, obconical to broadly clavate, 1–1.5 mm long, anther connective apex peltate, papillate. *Carpels* ca 3–4, ovaries ca 2.5 mm long, stigma

obovoid, ca 1.3 mm long, densely pubescent. *Fruit* a single monocarp borne on a pedicel 8–10 by ca 5 mm. *Monocarp* oblong, not torulose, 2.7–5.5 by 2.3–3.2 cm, wrinkled or smooth, pubescent with fine brown hairs, apex rounded, base sessile, rounded to truncate. *Seeds* ca 12 in two rows, ca 12–17 mm long.

Thailand.— PENINSULAR: Narathiwat [Bala-Hala, Waeng, 15 Feb. 1999 (fl., fr.), *Puudjaa 531* (**BKF**); Waeng, 19 Nov. 1971 (fr.), *C.S.S. 243* (**BKF** [119332])]; Yala [Than To District, Bang Lang NP, near Halasa Waterfall, 06°04′N, 101°25′E, 12 Feb. 2004 (fl., fr.), *Middleton et al. 2997* (**A**, **BKF** [168698, 168699], **L**); Betong, Hala-Bala, 5 Aug. 1996 (fl.), *Puudjaa 230* (**BKF** [112385])].

Malaysia.— Kelantan [Gua Panjang at Gua Ninik, 23 Oct. 1927 (fl., fr.), *Henderson SFN 19609* (**SING**)].

Distribution.— Extreme southern peninsular Thailand, and Peninsular Malaysia (Fig. 6).

Ecology.—Evergreen forest, sometimes on limestone, at low elevation. Flowering: February, August, and October; fruiting: February, October, and November.

Notes.— The specimens cited above compare reasonably well with this recently described species from Malaysia, which was described by its authors (Tan *et al.*, 2014) as exceptional for the large and broad, densely silky petals. None of the Thai specimens has petals as large as those of the type material of *Meiogyne kanthanensis*, but the shape and indument of the petals matches very well, much better than with *M. virgata*. There is some similarity of the specimens to *M. subsessilis* (Jovet-Ast) J.Sinclair, based on specimens from Vietnam, but closer inspection of the type material of that name showed that its petals were less hairy, narrower and more acute. It is unclear whether any of the fruits on the Thai specimens examined were fully mature.

6. Meiogyne maxiflora D.M.Johnson & Chalermglin, **sp. nov.**

= *Monocarpia marginalis* sensu Chalermglin (2001, p. 240), non J.Sinclair.

= *Meiogyne* spec. Thailand in Mols *et al.* (2004).

= *Meiogyne* sp. of Thomas *et al.* (2012), as to molecular voucher, not of Fig. 2.

= *Meiogyne* sp. 1 in Xue *et al.* (2014).

Species resembling *Meiogyne virgata* in the strongly scalariform tertiary venation and short pedicels, and small number of sessile monocarps, but differing in the abaxial leaf surface which is uniformly pubescent rather than glabrous or with scattered sparse hairs, the leaf blades oblong with 16–19 secondary veins per side rather than elliptic to ovate with 5–15 secondary veins per side, and monocarps that are erect brown-pubescent rather than appressed gray-pubescent. Type: Thailand, Kanchanaburi Province, Sangklaburi District, Toong Yai Naresuan Wildlife Preserve, Lai Wo Subdistrict, Ban Saneh Pawng (Karen Village) area, 450 m, 11 Oct. 1993 (fl.), *Maxwell 93-1208* (holotype: **CMUB!**; isotypes: **A!**, **BKF** [178802!, 186802!], **CAS** [552868!]). Figs. 5A, B, 7.

Trees up to 15 m tall, dbh up 40 cm; bark brownish white, brown-gray, or gray, smooth. *Twigs* densely pubescent with erect short brown hairs, eventually glabrate. *Leaves* chartaceous, not shiny, slightly discolorous, elliptic, elliptic-oblong, or lanceolate-oblong, larger blades 25.6–34.5 by 5.7–9.8 cm, base cuneate to nearly rounded, apex acuminate, the acumen 12–26 mm long, glabrous adaxially, sparsely pubescent with erect acicular hairs abaxially; midrib slightly impressed adaxially, raised abaxially, secondary veins 16–19 per side, joining near the margin, indistinct adaxially, raised abaxially, tertiary venation scalariform, slightly raised adaxially, raised abaxially; petiole 8–10 mm long. *Inflorescences* from axils of fallen leaves, 2–3-flowered, or the tree sometimes cauliflorous; pedicels 4–7 mm long, ca 1 mm thick, pubescent, with 2 bracts on proximal half of pedicel, the bracts 2–4 mm long, ovate, pubescent; buds more or less lanceolate, but petals separating early. *Sepals* free or connate at base, ovate, 4–7 mm long, apex acute, pubescent abaxially. *Petals* cream-coloured to light yellow, the inner ones reddish or purplish on the corrugated inner base in vivo, linear, apex attenuate, acute; outer petals spreading at anthesis, 29–35 by 5–6 mm, pubescent adaxially, sericeous abaxially; inner petals also somewhat spreading at anthesis, 26–27 by 4.5–5 mm, with a corrugated patch on proximal 1/8 of adaxial surface, pubescent adaxially, except for corrugated patch, which is glabrous, sericeous abaxially. *Stamens* wedge-shaped, ca 1 mm long, anther connective apex cream-coloured in vivo, flat. *Carpels* 4–6, stigmas club-shaped, hairy. *Torus* slightly convex, 1.2–1.5 mm in diam. *Fruit* of up to

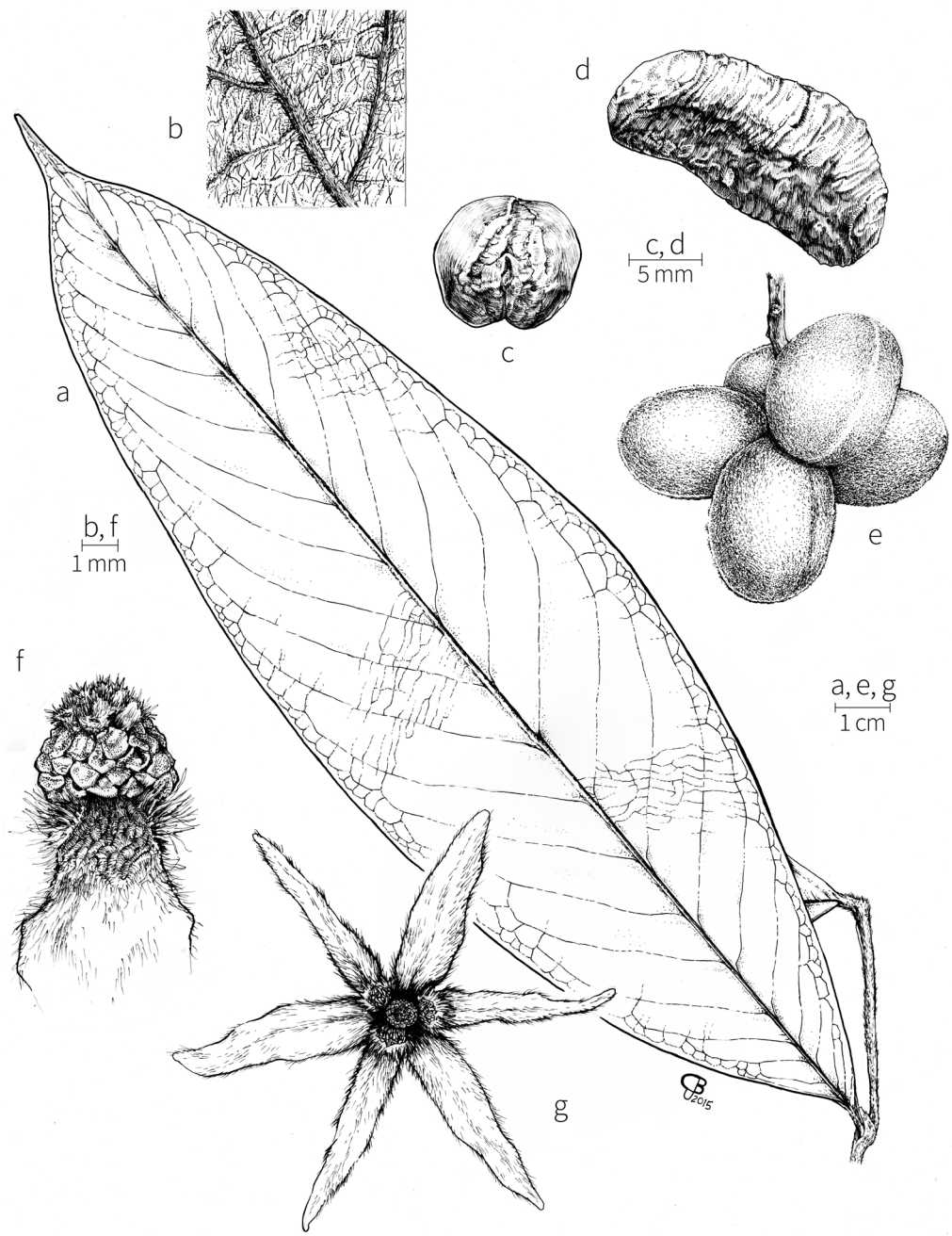

Figure 7. *Meiogyne maxiflora*. A. Leaf, adaxial view. B. Close-up of abaxial surface of leaf, to show indument. C. Seed, view from micropylar end. D. Seed, side view. E. Fruit. F. Close-up of stigmas and surrounding androecium, subtended by an inner petal. G. Flower, apical view. A–D, and F based on *Maxwell 94-486* (**A**), E and G based on photographs in Chalermglin (2001). Illustration by Catherine Beach.

6 monocarps borne on a pedicel 11–15 mm long, ca 3.5 mm thick, torus 4–6 mm in diam., hispid. *Monocarps* sessile, ovoid to oblong, slightly torulose or not torulose, 2–4.9 by 1.8–3.1 cm, rugose, densely covered with short erect brown hairs, apex rounded, base rounded, pericarp ca 2.7 mm thick. *Seeds* up to 11 per monocarp, in two rows, semicircular, slightly flattened, ca 22 mm by 11 mm, reddish brown, perichalazal ring slightly sunken.

Thailand.— SOUTH-WESTERN: Kanchanaburi [without definite locality, *Chalermglin 450120* (**OWU**); Sangkhlaburi District, Sanyataram Monastery, 14.58°N, 98.38°E, 300 m, 16 Feb. 2002 (fl.), *Keßler 3219* (**BKF** [147300, 147301]); Sang klaburi, Khao Laem NP, behind headquarter, 250 m, 16 Dec. 2005 (fr.), *Poopath 419* (**BKF** [189516, 189517]); Sangklaburi District, Thung Yai Naresuan Wildlife Preserve, Lai Wo Subdistrict, Ban Saneh Pawng (Karen Village) area, 450 m, same locality and tree as *Maxwell 93-1208*, 11 Apr. 1994 (fr.), *Maxwell 94-486* (**A**, **CAS** [552867], **CMUB**)]; Phetchaburi [Kaeng Krachan District, Kaeng Krachan NP, trail to summit of Khao Phanoen Thung, 1,100 m, 12.865°N, 99.364°E, 1,100 m, 7 May 2005 (fr.), *Middleton et al. 3265* (**BKF** [168469, 168470])].

Distribution (Fig. 3).— Kanchanaburi and Phetchaburi Provinces of southwestern Thailand.

Ecology.— Dry evergreen or deciduous forest, sometimes over limestone, 250–1,100 m. Flowering: October; fruiting: February, April, May, and December.

Etymology.— Named for the flowers, among the largest in the genus, and in memory of James Maxwell (1945–2015), collector of the type specimen.

Notes.— The relatively large light-colored flowers, large elongate leaves, and erect hairs of the twigs, pedicels, and monocarps separate *M. maxiflora* from other Thai *Meiogyne* species. As noted on the label of *Keßler 3219*, collected in 2002, the branches of the trees at the Sanyataram Monastery site were marked by artichoke-like galls 2.8–4 cm in diam. These galls were again in evidence when the site was re-visited by three of the co-authors in February 2018.

7. Meiogyne monosperma (Hook.f. & Thomson) Heusden, Blumea 38: 502. 1994.— *Cananga monosperma* Hook.f. & Thomson, Fl. Brit. India 1: 57. (1872).— *Oncodostigma monosperma* (Hook.f. & Thomson) J.Sincl., Sarawak Mus. J. 5: 605. 1951.— Type: Malaysia, Malacca, *Maingay 100* (holotype: **K!**; isotypes: **GH!**, **L!**).

— *Unona conchyliata* Ridl., Kew Bull. 1912: 384. 1912.— *U. purpurata* Ridl., Sarawak Mus. J., 1(3): 79 (1913), **nom. illeg.** Type: Malaysia, Borneo, Sarawak, Kuching, s. d. (fl.), *Haviland 1779* (holotype: **K!**; isotypes: **B!**, **L!**, **SING!**). Fig. 5E.

Trees up to 20 m tall, dbh up to 25 cm, bark pale gray, smooth. *Twigs* glabrous. *Leaves* chartaceous to subcoriaceous, elliptic-oblong, larger blades 7.5–17 by 4–5.5(–6.2) cm, base cuneate to broadly cuneate, apex blunt-acuminate, acumen 6–9 mm long, glabrous on both surfaces; secondary veins 11–13 per side, arcuate, brochidodromous, tertiary venation reticulate; petiole 4–6 mm long. *Inflorescences* axillary, 1-flowered; pedicels (2–) 5–10 mm long, with 3 small bracts proximal to the midpoint; buds ovoid, apex obtuse, petals separating early in bud. *Sepals* connate at base, broadly ovate, 2.5–5 mm long, apex rounded, apiculate, sparsely hairy abaxially. *Outer petals* ovate-lanceolate to oblong, 19–23 by 2.5–9 mm, pubescent adaxially, sparsely pubescent abaxially, apex obtuse, inner petals broadly lanceolate, 15–19 by 4.5–5 mm, with a corrugated patch on proximal ½ of adaxial surface, sparsely pubescent on both surfaces except for corrugated patch, which is glabrous, apex acute to obtuse. *Stamens* many, wedge-shaped, 1–2 mm long, anther connective apex flat to sunken in the middle. *Carpels* 3–12, stigmas club-shaped, ca 1.5 mm long, sparsely hairy. *Fruit* of up to 15 monocarps borne on a pedicel 7.5–10 by 2.2–3 mm, sepals often persistent. *Monocarps* cylindrical, slightly torulose, 2.0–2.8 by 0.8–0.9 cm, glabrous, apex obtuse to rounded, base contracted into a thick stipe 1.5–3 mm long. *Seeds* up to 8 per monocarp, in two interdigitated rows, broadly flattened-ellipsoid, ca 9 by 7–8 mm, brown, perichalazal ring sunken into a groove.

Thailand.— PENINSULAR: Narathiwat [Bala-Hala, 50–100 m, 21 June 1998 (fl., fr.), *Niyomdham 5536* (**BKF** [123992, 123993]); Nikom Waeng, Narathiwat, 21 Sept. 1966 (fl., fr.), *Sangkhachand 414* (**BK**); Waeng, 24 Aug. 1966 (fl., young fr.), *B.S. & B.N. 1261* (**BKF** [003439])]; Songkhla [Khao Nam Khang NP, in the vicinity of the Communist Tunnels, 6 km SSW of park HQ, 6°34′N, 100°35′E,

250 m, 25 Jan. 2006 (fl.), *Gardner & Sidisunthorn ST2243* (**BKF** [169451], L)]; Yala [Betong District, near Chulaporn Pataya 10 village, 16 Mar. 2003 (fl., fr.), *Johnson et al. 2045* (**BKF**, **OWU**); Than To District, Ban Chulaphon Phattana 7 area, trail from substation up along ridge, 06°05′N, 101°23′E, 165 m, 11 Feb. 2004 (fl.), *Middleton et al. 2921* (**BKF** [169963, 169964])].

Distribution.— Southern peninsular Thailand (Fig. 6), Peninsular Malaysia, and Borneo.

Ecology.— Lowland evergreen forest, 50–250 m. Flowering (in Thailand): January, February, March, June, August, and September; fruiting (in Thailand): February, March, June, and September.

Vernancular.— Yaay (Yai) pluak (ยายปลวก) (*Sangkhachand 414*).

Notes.— Petals yellow, turning red-orange and then red. Fruit green to whitish green with an orange pulp.

8. Meiogyne virgata (Blume) Miq., Ann. Mus. Bot. Lugduno-Batavi 2: 12. 1865.— *Unona virgata* Blume, Bijdr. 14. 1825. Type: Indonesia, Java, Mt. Salak, Dec., *Blume s.n.* (holotype: **L!**).

Shrubs to small trees up to 12.5(–15 m) tall, dbh up to 11 cm; bark gray to brown-gray, smooth. *Twigs* puberulent, soon glabrate. *Leaves* chartaceous, elliptic, ovate, or sometimes oblong-elliptic, larger blades 9.8–22 by 4.5–9 cm, base broadly cuneate to rounded, apex acuminate, the acumen 7–15 mm long, pubescent along midrib on both surfaces but otherwise glabrate, secondary veins 7–15 per side, tertiary venation scalariform, distinct, petiole 5–9 mm long. *Inflorescences* axillary, 1-flowered; pedicels ca 3 mm long, with 2 small bracts; petals separating early in bud. *Sepals* free to minutely connate, broadly ovate, ca 5 mm long, apex acute to attenuate, hairy on the outside. *Outer petals* linear to linear-lanceolate, 13–17 by 2.5–3.5 mm, apex acute to obtuse, inner petals lanceolate, 9–10 by 3–3.5 mm, with a corrugated patch on proximal ½ of adaxial surface, apex acute to obtuse. *Stamens* many, obconical, ca 1 mm long, anther connective apex flat. *Carpels* 3–5, stigmas globose, ca 0.5 mm long, hairy. *Fruit* of up to 4 monocarps borne on a pedicel 3–5 by 4–5 mm, sepals persistent. *Monocarp* oblong to ellipsoid, not torulose, 2.2–5.4 by 2.2–2.8 cm, gray- or brown-tomentose, rarely with the hairs black, apex rounded, base truncate to rounded, sessile or rarely contracted into a short stipe up to 3 mm long, pericarp ca 3.5 mm thick. *Seeds* 11–15 in two rows, semicircular, 15–20 by 10–11 mm, light brown, perichalazal ring raised as a ridge.

Thailand.— PENINSULAR: Nakhon Si Thammarat [Khao Luang, *Phloenchit 125* (**BKF** [7391])]; Narathiwat [Hala-Bala WS, nature trail of ornamental wild plant in southern project, UTM 47, 813463E, 641456N, 30 Apr. 2004 (fl.), *Poopath 9* (**BKF** [188987]); Hala-Bala, 380 m, 21 Mar. 2008 (fr.), *Petrmitr 781* (**BBH**)]; Phatthalung [See Bahn Fohn District, Riang Tong Falls, Kao Bu NP, 23 Mar. 1986 (fr.), *Maxwell 86-215* (**BKF** [003443])]; Trang [Khao Chong, 83 m, 22 Nov. 1965 (young fr.), *Bunnab 243* (**BKF**); Khao Chong, 7°40′N, 99°45′E, 13 June 1974 (fr.), *Geesink et al. 7185* (**BKF** [003442]); Khao Chong, 30 Dec. 1968 (young fr.), *Phusomsaeng 40* (**BKF**); Khao Chong, 3 Apr. 1969 (fr.), *Phusomsaeng 101* (**BKF**); Khao Chong 16-hectare plot, 7°33′N, 99°48′E, Feb. 2001 (fl.), *Sinbumroong & Davies AS117* (**BKF** [154465])]; Songkhla [Hat Yai, Ton Nga Chang WS, Headquarters, 6.56N, 100.14E, 130 m, 12 May 2004 (fl.), *Gardner & Sidisunthorn ST0496* (**BKF** [169450])].

Distribution.— Southern peninsular Thailand (Fig. 6), Peninsular Malaysia, Singapore, Sumatra, Borneo, Java, and the Philippines.

Ecology.— Moist evergreen forest, sometimes along rivers on granite, 50–600 m. Flowering specimens collected in February, April, and May; fruiting specimens collected in March, June, November, and December.

Vernacular.— Sang yu khao (สังหยูขาว)(*Geesink et al. 7185*).

Notes.— Flowers are cream-colored to pale yellow, with the inner petal base pink-red, purple, or brown. Fruits green, turning brown, purplish, or blackish yellow with white pulp. In Thailand there is variability in flower size and color of *M. virgata*, but it is not yet known whether this indicates different stages of floral maturation or taxonomically significant variation.

ACKNOWLEDGEMENTS

DMJ thanks the Fulbright Foundation, the TEW Presidential Discretionary Fund of Ohio Wesleyan

University, and the Carlsberg Foundation for funding in support of field and herbarium work in Thailand in 2003, 2017, and 2018. The maps in Figures 3 and 6 are the work of Kathleen Vonderembse, and the illustration in Figure 7 the work of Catherine Beach. Sara Stuntz kindly assisted with preparation of the figures. The curators of A, BBH, BK, BKF, CAS, CMUB, K, KEP, L, OWU, P, QBG, SING, and SINU are thanked for making specimens and specimen images available for study. We also thank P. Suksathan for the photograph of *M. chiangraiensis* used in Figure 2, and S. Gardner for providing photographs and field observations of several species as well as comments on an earlier draft of the manuscript. The helpful suggestions of two reviewers are acknowledged with appreciation.

REFERENCES

Applequist, W.L. (2012). Report of the Nomenclature Committee for Vascular Plants: 64. Taxon 61: 1108–1117.

Bân, N.T. (1973). Chto takoe *Fissistigma hainanense* Merr. (Annonaceae)? Botanicheskii Zhurnal 58: 1146–1148.

Bân, N.T. (1974). Critical notes on some species of the genus *Desmos* Lour. (Annonaceae). Botanicheskii Zhurnal 59: 1766–1780.

Chalermglin, P. (2001). Family Annonaceae. Bangkok: Ban Lae Suan [in Thai].

Chaowasku, T., Zijlstra, G. & Chatrou, L.W. (2011). (2029) Proposal to conserve the name *Meiogyne* against *Fitzalania* (Annonaceae). Taxon 60: 1522–1523.

Fischer, C.E.C. (1926). LVI.—Contributions to the flora of Burma. Bulletin of Miscellaneous Information, Royal Gardens, Kew. 1926: 446–468.

Gardner, S., Sidisunthorn, P. & Chayamarit, K. (2015). Forest trees of southern Thailand. Volume 1 (A–Es). The Forest Herbarium, Bangkok, The Royal Botanic Gardens, Kew. xix + 1–749.

Heusden, E.C.H. van (1994). Revision of *Meiogyne* (Annonaceae). Blumea 38: 487–511.

Heusden, E.C.H. van (1996). The genus *Meiogyne* (Annonaceae) in New Caledonia: four new combinations. Bulletin du Muséum d'Histoire Naturelle, Paris, series 4. Section B. Adansonia 18: 75–83.

Merrill, E.D. (1942). Records of Indo-Chinese plants. III. Journal of the Arnold Arboretum 23: 162–164.

Mols, J.B., Gravendeel, B., Chatrou, L.W., Pirie, M.D., Bygrave, P.C., Chase, M.W. & Keßler, P.J.A. (2004). Identifying clades in Asian Annonaceae: monophyletic genera in the polyphyletic Miliuseae. American Journal of Botany 91: 590–600.

Sinclair, J. (1953). Notes on Siamese Annonaceae. Gardens' Bulletin Singapore 14: 40–44.

Tan, J.P.C., Kiew, R., Saw, L.G. & Ummul-Nazrah, A.R. (2014). Three new species from Gunung Kanthan, a limestone tower karst in Perak, Malaysia. Phytotaxa 177: 146–154.

Thomas, D.C., Surveswaran, S., Xue, B., Sankowsky, G., Mols, J.B., Keßler, P.J.A. & Saunders, R.M.K. (2012). Molecular phylogenetics and historical biogeography of the *Meiogyne-Fitzalania* clade (Annonaceae): Generic paraphyly and late Miocene-Pliocene diversification in Australasia and the Pacific. Taxon 61: 559–575.

Turner, I.M. (2011). A catalogue of the Annonaceae of Borneo. Phytotaxa 36: 1–120.

Turner, I.M. & Utteridge, T.M.A. (2015). A new species and a new combination in *Meiogyne* (Annonaceae) of New Guinea. Contributions to the Flora of Mt Jaya, XXI. Kew Bulletin 70: 27.

Xue, B., Liu, M.-F. & Saunders, R.M.K. (2017). The nomenclatural demise of *Oncodostigma* (Annonaceae): the remaining species transferred to *Meiogyne*. Phytotaxa 309: 297–298.

Xue, B., Thomas, D.C., Chaowasku, T., Johnson, D.M. & Saunders, R.M.K. (2014). Molecular phylogenetic support for the taxonomic merger of *Fitzalania* and *Meiogyne* (Annonaceae): new nomenclatural combinations under the conserved name *Meiogyne*. Systematic Botany 39: 396–404.