

New species and a revision of the genus *Peperomia* (Piperaceae) in Thailand

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ABSTRACT

We update the descriptions of seventeen native species of *Peperomia* in Thailand, including a new species, *P. ranongensis*, and a detailed morphological description for the uncommon species *P. kotana* based on Thai specimens. We provide a generic description, a key to all the species and provide lectotypifications for *P. bavina*, *P. heyneana*, *P. laticaulis*, *P. nakaharae* and *P. reflexa* var. *parvifolia*. Five species, *P. heptaphylla*, *P. masuthoniana*, *P. multisurcula*, *P. ranongensis* and *P. sirindhorniana*, are endemic to Thailand. *Peperomia pellucida* is a common pantropical species. Eight species, namely *P. cavaleriei*, *P. dindygulensis*, *P. heyneana*, *P. laevifolia*, *P. masuthoniana*, *P. moulmeyniana*, *P. multisurcula* and *P. sirindhorniana* have a high potential for development as ornamental plants.

KEYWORDS: Flora of Thailand, lectotypification, Piperales, taxonomy, tropical plants.

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INTRODUCTION

The genus *Peperomia* Ruiz & Pav. (Piperaceae) has considerable economic value with its species used as ornamental plants for a long time (Yuncker, 1958; Tebbs, 1993). They are grown for their exquisite ornamental foliage, succulent characteristics and attractive inflorescences and some species are known to have medicinal properties (Perry, 1980).

Many *Peperomia* species grow in cloud forest at higher elevations in tropical areas (Tebbs, 1993) and some are pantropical. They are commonly found as epiphytes, lithophytes or terrestrial plants, and are often small annual or perennial herbs. The number of inflorescences can vary from one to seven. The flowers are minute and bisexual, and a perianth is completely lacking. The flowers are subtended by an orbicular bract. The stamens are two basifixed and sit on short or very short filaments. The anther contains two thecae with transverse dehiscence. The rounded-“D”-shaped theca is a distinctive character. The fruit is a nutlet

with or without sticky papillae. A pseudopedicel is present in some species (Suwanphakdee, 2012) and some of them also have a pedicel (Frenkze *et al.*, 2015). The fruits release sticky secretions or exhibit hook-shaped appendages indicative of epizoochorous dispersal (Frenkze *et al.*, 2016). *Peperomia* is a species-rich genus with more than 1,600 species enumerated (Frodin, 2004), and with 1,411 accepted species names in the world (The International Plant Names Index and World Checklist of Vascular Plants, 2022).

Taxonomic work on *Peperomia* in Asia includes India, Bangladesh, Nepal, Sri Lanka, Bhutan and Myanmar by Wallich (1828–1849), Hooker (1887), Long (1984) and Huber (1987); China by Yongqian *et al.* (1999); Indochina and the Philippines by Candolle (1910, 1912 & 1923); the Malay Peninsula by Ridley (1924) and Henderson (1959); Indonesia by Blume (1826), and Java by Backer & Bakhuizen van den Brink (1963). The genus of *Peperomia* in Thailand was revised in a

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PhD thesis by Suwanphakdee (2012). Initially only two names, *Peperomia dindygulensis* Miq. and *P. wightiana* Miq. (= *P. dindygulensis*), were reported (Wilson, 1972). Later, three species, *P. blanda* (Jack.) Kunth. (= *P. dindygulensis*), *P. pellucida* (L.) Kunth and *P. tetraphylla* (G.Forst.) Hook. & Arn. were enumerated (Yongqian *et al.*, 1999). In total, 13 taxa including 12 native ones, *P. bavina* C.DC., *P. cavaleriei* C.DC., *P. cochinchinensis* C.DC., *P. dindygulensis*, *P. heyneana* Miq., *P. kotana* C.DC., *P. laevifolia* (Blume) Miq., *P. moulmeyniana* C.DC., *P. nakaharuae* Hayata, *P. pellucida*, *P. portulacoides* (Lam.) A.Dietr., *P. tetraphylla*, and two exotic ones, *P. argyreia* (Hook.f.) É.Morren and *P. caperata* Yunck., were reported including descriptions, illustrations and distributional data but without a key to species (Suwanphakdee *et al.*, 2014; Pooma & Suddee, 2014). Most recently, four new species, *P. heptaphylla* Suwanph. & Hodk., *P. masuthoniana* Suwanph. & Chantar., *P. multisurcula* Suwanph. & Hodk. and *P. sirindhorniana* Suwanph. & Chantar. have been described (Suwanphakdee *et al.*, 2017).

This paper provides an updated revision of Thai *Peperomia* for the Flora of Thailand project including a generic description, a key to all species, description of a new species, description of uncommon species and enumeration of all species known in Thailand.

MATERIALS AND METHODS

This study was based on field and herbarium collections. Herbarium codes follow Thiers (2021, continuously updated). Field surveys were undertaken throughout Thailand between 2009 and 2020 with the voucher specimens deposited in BK, BKF, KGU and QBG. Additional materials were seen by first author from the following herbaria: AAU, BK, BKF, BM, BO, C, CMUB, G, G-DC, K, K-W, KGU, KEP, L, PSU, QBG, SING, TCD, U and WAG. Digital images were also examined from The Global Plants Database (<https://plants.jstor.org>). All vegetative and reproductive parts were studied in a dry state under a stereo-microscope. The appropriate literature for species identification were consulted: Hooker (1887), Long (1984), Huber (1987), Ridley (1924), Backer & Bakhuizen van den Brink (1963) and Yongqian *et al.* (1999).

TAXONOMIC TREATMENT

PEPEROMIA

Ruiz & Pav., Fl. Peruv. Prodr.: 8. 1794. Type species: *Peperomia pellucida* (L.) Kunth; Miq., Syst. Piperac. 1: 63. 1843; Hook.f., Fl. Brit. India 5: 96. 1887; C.DC. in A.DC., Prodr. 16: 392. 1869; in Lecomte, Fl. Indo-Chine 1: 63. 1910; J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 75: 288. 1914; Candollea 1: 189. 1923; Merr., Enum. Philip. Pl. 2: 18. 1923; Ridl., Fl. Malay Penins. 3: 26. 1924; Trelease & Yuncker, Piperac. of Northern South America: 443. 1950; Henderson, Malay. Wild Flow. Dicot. 6(3): 435. 1959; Backer & Bakh.f., Fl. Java 1: 173. 1963; Long in Grierson & Long, Fl. Bhutan 1(2): 344. 1984; Huber in Dassan., Fl. Ceylon 6: 291. 1987; Tebbs in Kubitzki, Fam. & Gen. Vas. Pl. 2: 519. 1993; Yongqian *et al.* in Wu & Raven, Fl. China 4: 20. 1999.

Annual or perennial herbs, epiphytic, epilithic or terrestrial; stems sometimes forming clumps, 2–6 main stems with 2-numerous branchlets, rooting from nodes toward base of stem or without roots, erect, stolons present or absent, glabrous, puberulous, pilose, scabrous, hispid, hirsute, velutinous, sericeous or glabrescent. *Stem* fleshy when fresh, wrinkled when dry, rounded, winged or angular; exstipulate. *Leaves* simple, opposite, opposite decussate, whorled with 3–7 leaves, spiral or alternate; lamina fleshy when fresh, chartaceous, subcoriaceous or coriaceous when dry, orbicular, ovate, elliptic, obovate, rhomboid, cordate, deltoid or lanceolate, symmetric or asymmetric, base cuneate, cordate or oblique, apex acute, acuminate, rounded, emarginate or cleft, margin undulate, upper surface green, glabrous, puberulous, pilose, scabrous, hispid, hirsute, velutinous, sericeous or glabrescent, lower surface pale green or yellowish, glabrous or puberulous; venation pinnate or palmate, 1–3(–5)-nerved, main lateral veins all basal; petioles glabrous or pubescent. *Inflorescence* spicate, solitary or branching (or a pseudo-panicle), single or fascicled with 2–7 inflorescences/shoot, in the axils of the upper leaves, positioned along stem or terminal shoot, erect; rachis thick or slightly thickened, glabrous or hairy. *Flower* minute, sessile, often in depression on rachis; without sepals and petals; 1 floral bract, orbicular, nearly peltate or sometimes elliptic, glabrous. *Stamens* 2, filament short or very short, 2-thecae, rounded-“D”-shaped. *Ovary* 1-loculed; ovule 1, style short or very short, stigma 1 or 3-lobed,

rarely 2-cleft, globose, apex obtuse or acute, beaked, filiform-like or brush-like. *Fruit* a nutlet with or without pseudocupula, with or without pedicel or pseudopedicel, ellipsoid, globose or subglobose, with or without sticky papillae; persistent floral

bract, stigma and or style, often partly enclosed on rachis, sometimes distinctly curved or oblique.

Seventeen native species are currently known in Thailand.

KEY TO THE SPECIES

1. Rachis of inflorescence hairy; leaves uniformly 4-verticillate 17. *P. tetraphylla*
1. Rachis of inflorescence glabrous; leaves not uniformly 4-verticillate
 2. Leaves opposite, opposite-decussate, verticillate or verticillate on terminal parts; inflorescence on terminal parts
 3. Leaves 5–7-verticillate 5. *P. heptaphylla*
 3. Leaves otherwise
 4. Stem equaling or slightly longer than the inflorescence
 5. Fruit with a pseudopedicel; stem 3–5 cm high; shoot and branch with single or fascicled inflorescences; a solitary or branching spike 2–5 cm long 2. *P. cavaleriei*
 5. Fruit without a pseudopedicel; stem 8–15 cm high; shoot and branch with a single inflorescence; a solitary spike 8–12 cm long 6. *P. heyneana*
 6. Fruit ovoid; inflorescence slender; leaves subcoriaceous 3. *P. cochinensis*
 6. Fruit ellipsoid-oblong; inflorescence stout; leaves coriaceous 3. *P. cochinensis*
 4. Stem much longer than the inflorescence
 7. Both shoots and branches with an inflorescence forming a solitary spike 12. *P. nakaharae*
 8. Stem and peduncle glabrous; fruit with pseudopedicel; plant epiphytic 9. *P. masuthoniana*
 8. Stem and peduncle hairy, fruit without pseudopedicel; plant terrestrial, epilithic or epiphytic 9. *P. masuthoniana*
 9. Leaves with one midrib only; plant with red spots or bands 9. *P. masuthoniana*
 9. Leaves 1–3(–5)-palmiserved; plant without spots or bands 9. *P. masuthoniana*
 10. Inflorescence 5–8 cm long; internodes 4–6 cm long; plant epilithic and epiphytic 11. *P. multisurcula*
 10. Inflorescence 2–5 cm long; internodes 2–3 cm long; plant terrestrial and epilithic
 11. Leaves fleshy, chartaceous when dry, puberulous or shortly hispid on both surfaces; petiole puberulous or scabrous; peduncle puberulous or shortly hispid 1. *P. bavina*
 11. Leaves thick, coriaceous when dry, glabrous on both surfaces, rarely puberulous on lower surface; petiole puberulous; peduncle glabrous or puberulous 14. *P. portulacoides*
 7. Some shoots and branches with more than one inflorescence, forming a solitary or branching spike
 12. Leaves opposite-decussate or 4-verticillate on terminal shoot, caducous chartaceous when dry; stem velutinous, rarely scabrous or puberulous; fruit globose with a pseudopedicel, papillae with sticky glandular trichome; plant epilithic 4. *P. dindygulensis*
 12. Leaves 3-verticillate, rarely caducous, sometimes like opposite-decussate or 4-verticillate on terminal shoot, coriaceous or subcoriaceous when dry; stem puberulous, glabrescent or glabrous; fruit ovoid without a pseudopedicel, papillae without trichome; plant epiphytic 15. *P. ranongensis*
 2. Leaves alternate or spiral; inflorescence along stem and terminal parts
 13. Leaves spiral 10. *P. mouleimiana*
 13. Leaves alternate
 14. Stem winged; leaves elliptic, elliptic-oblong, ovate or rhomboid 8. *P. laevifolia*
 14. Stem unwinged; leaves ovate, broadly ovate or cordate
 15. Plant epiphytic, hispid; inflorescence on terminal shoot only; fruit with a pseudopedicel 7. *P. kotana*
 15. Plant terrestrial or lithophytic, glabrous or glabrescent; inflorescence along stem and terminal shoot; fruit without a pseudopedicel
 16. Plant glabrous; leaves chartaceous; inflorescences 2–6 cm long; fruits ±globose, striate with sparse papillae; common 13. *P. pellucida*
 16. Plant glabrescent; leaves subcoriaceous; inflorescences 5–15 cm long; fruits ovoid with dense papillae, apex beaked; rare 16. *P. sirindhorniana*

1. *Peperomia bavina* C.DC., Ann. Cons. Jard. Bot. Gen.: 287. 1898; Suwanphakdee *et al.*, Thai For. Bull. (Bot.) 42: 62. 2014. Type: Vietnam, Tonkin, *Balansa 3641* (lectotype **P** [P00444528!], designated here; isolectotypes **K** [K000820266!], **P** [P00444529!]).

Thailand.—NORTHERN: Lamphun [Doi Khun Tan NP, 5 Sept. 1967, *Tagawa et al. T-9256* (AAU,

BKF, L)]; Lampang [Pralu Pha, 10 July 1965, *Santisuk & Phengklai 8881* (BKF); Tham Sakoen NP, 12 May 2011, *Wathana 3870* (QBG)].

Distribution.—Thailand and Vietnam (type).

Ecology.—Open areas on mountain summits in pine and oak forests. Flowering and fruiting: May–September.

Vernacular name.—Bia khon (เปี้ยขอน) (Proposed here).

Notes.—Candolle (1898) published *Peperomia bavina* based on *Balansa 3641* (**P**) as a type. We found collections of *Balansa 3641* in **P** (2 sheets) and **K** (1 sheet). We, therefore, chose the specimen at **P** (P00444528) as the lectotype because this collection is the original material, and designate **P** (P00444529) and **K** (K000820266) as isolectotypes. Living specimens of *P. bavina* are very fleshy and juicy but become very thin when dry. Useful characters for the species include the red or pale red stems, the puberulous or shortly hispid vegetative organs compared to the glabrous reproductive organs, and the inflorescences that are shorter than the stem. This species is similar to *P. portulacoides* but differs in the dried leaves that are chartaceous in *P. bavina* but coriaceous in *P. portulacoides*. The hairs are puberulous or shortly hispid on both leaf surfaces in *P. bavina* but glabrous on both surfaces, or rarely puberulous on lower surface in *P. portulacoides*. The peduncle is puberulous or shortly hispid compared to glabrous or puberulous in *P. portulacoides*.

2. *Peperomia cavaleriei* C.DC. in Lecomte, Notul. Syst. (Paris) 3: 41. 1914; Yongqian *et al.* in Wu & Raven, Fl. China 4: 21. 1999; Suwanphakdee *et al.*, Thai For. Bull. (Bot.) 42: 62. 2014. Type: China, Kouy-Tcheou, *Cavalerie 2649* (holotype **P** [P00444530!]; isotypes **G-DC** [G00317974! (fragm.)], **K** [K000820254!]).

Thailand.—NORTHERN: Tak [Doi Muser, 9 Dec. 1960, *Umpai 1* (**BK**); 22 Aug. 1961, *Chermsirivattana 41* (**BK**); Umphang, [Thung Yai Naresuan WS, 14 Feb. 2011, *Suwanphakdee 358-1* (**BK, BKF, K KU**)].

Distribution.—China (type) and Thailand.

Ecology.—Epiphytic on tree trunks in freshwater swamp and hill evergreen forests. Flowering and fruiting: August–February.

Vernacular name.—Bia phru (เปี้ยพรุ) (General).

Notes.—This species has high potential as an ornamental plant because of its very small size and interesting pigmentation. *Peperomia cavaleriei* is the smallest of Thai *Peperomia* species and is distinguished by being hirsute on all its parts. The leaf of living specimens is fleshy and thick with red spots or

bands on the lower surface. The inflorescence is much longer than the stem. In some specimens, the inflorescences are varied from solitary to branching spikes (or pseudo-panicle). Suwanphakdee *et al.* (2014) described the fruit morphology of *P. cavaleriei* based on dry specimens and found that the fruit lacked a pseudopedicel, however, the first author subsequently collected living specimens and found that the fruits do have pseudopedicels.

3. *Peperomia cochinchensis* C.DC., Repert. Spec. Nov. Regni Veg. 13: 297. 1914; Suwanphakdee *et al.*, Thai For. Bull. (Bot.) 42: 62. 2014. Type: Vietnam, Cochin, Parambicolam, *Meebold 12543* (holotype **BRA**; isotype **G-DC** [G00328385! (fragm.)]).

Thailand.—NORTHERN: Mae Hong Son [Pang Mapha, Kiew Lom, 18 Oct. 2009, *Suwanphakdee 278* (**BK, BKF, K KU**)]; Lampang [Ngao, Pak Bok, 14 Oct. 2010, *Suwanphakdee 341* (**BK, BKF**)].

Distribution.—China, Taiwan, Thailand and Vietnam (type).

Ecology.—Epiphytic on tree trunks in pine, oak or evergreen forests. Flowering and fruiting: June–November.

Vernacular name.—Bia mucang nua (เปี้ยเมืองเหนือ) (General).

Notes.—This species has characteristically thick, fleshy and rigid leaves when fresh and coriaceous leaves when dry. The inflorescences are longer than the peduncle but shorter than the stem.

4. *Peperomia [dindigulensis] dindigulensis* Miq., Syst. Piperac.: 122. 1843; Hook.f., Fl. Brit. India 5: 98. 1886; Ridl., Fl. Malay Penins. 3: 26. 1924; Henderson, Malay. Wild Flow. Dicot. 6(3): 435. 1959; Suwanphakdee *et al.*, Kew Bull. 72(1): 9. 2017. Type: India, Dindygul, *Wight in Wallich 6663B* (lectotype **K** [K000820258!], designated by Gilbert & Nian He [1999]; isolectotypes **BM** [BM000949834!], **E** [E00313742! & E00313744!], **G** [G00438520!], **G-DC** [G00207737!], **K** [K000820259!], **GZU** [GZU000256109 (photo!)]).

—*Peperomia thwaitesii* C.DC. in A.DC., Prodr. 16(1): 448. 1869. Type: Sri Lanka (Ceylon), *Thwaites 2956* (lectotype **G-DC** [G00207840!], designated here; isolectotypes **G** [G00438551!], **GOET** [GOET009425 (photo!)], **P** [P00444539 (photo!)]).

— *Peperomia formosana* C.DC., Ann. Cons. Jard. Bot. Genève. 21: 223. 1920. Type: Taiwan, Warburg 9338 (holotype **B** [B100004567!]).

— *Peperomia laticaulis* C.DC., Ann. Cons. Jard. Bot. Genève. 21: 223. 1920. Type: Taiwan, Faurie 481 (lectotype **B** [B100004568!], designated here; isolectotypes **BM** [BM000950706!], **G-DC** [G00329958!], **P** [P00444532!]).

Thailand.— NORTHERN: Chiang Mai [Doi Chiangdao WS, 25 July 2008, *Sonsupab s.n.* (**BK**); Mae Rim, 30 Aug. 2013, *Suwanphakdee 443* (**QBG**); Lampang [Ngao, Pratu Pha, 10 July 1965, *Smitinand & Phengkhai 8881* (**BKF**); Pak Bok, Tham Phathai NP, 14 Dec. 2010, *Suwanphakdee 339* (**BK, BKF, K KU**); *Suwanphakdee 340* (**BK, BKF, K KU**); NORTH-EASTERN: Phetchabun [Nam Nao NP, 30 July 2011, *Suwanphakdee 371* (**BK, BKF, K KU**); Loei [Phu Ruea NP, 29 June 1967, Umpai 370 (**BK**); Phu Suan Sai NP, 30 July 1997, *Nanakorn 9461* (**QBG**); Tad Luang Waterfall, 18 May 2010, *Suwanphakdee 351* (**BK, BKF, K KU**); EASTERN: Nakhon Ratchasima [Lat Bua Khao, 9 Nov. 1931, *Put 4378* (**BK**); Pak Thong Chai, 11 Nov. 1963, *Prachit 544* (**BK**); Sakaerat, 29 Oct. 1971, *van Beusekom et al. 3331* (**BKF, K, L**); SOUTH-WESTERN: Phetchaburi [Kaeng Krachan NP, 13 Sept. 2006, *Phonsena et al. 5220* (**BKF**); Ratchaburi [Khao Nam Tok, 10 Aug. 1966, *Larsen et al. 1375* (**BKF, L**); Prachuap Khiri Khan [Huai Yang Waterfall NP, 4 Oct. 1930, *Put 3200* (**BK, K**); Khao Chong Wan, 18 Aug. 1967, *Shimizu et al. 7625* (**BKF, L**); SOUTH-EASTERN: Chanthaburi [Khao Soidao WS, 12 Dec. 1924, *Kerr 9640* (**BK, BM**), 13 Nov. 1969, *van Beusekom & Smitinand 2195* (**BKF**); Khao Sabap, 6 July 1927, *Put 906* (**BK, BM, L**); Pong Nam Rawn, 6 July 1974, *Maxwell 74-680* (**BK, L**); PENINSULAR: Chumphon [Siep Yuan, 7 Sept. 1927, *Put 979* (**BK, BM**); Surat Thani [Khao Nang Daeng, 24 Oct. 1963, *Smitinand & Sleumer 1254* (**BKF, K, L**)].

Distribution.— India (type), Sri Lanka, Myanmar, China, Thailand, Laos, Vietnam, Cambodia and Malaysia.

Ecology.— Growing on mountain summits, rock-falls, in shallow depressions, exposed rocky slopes and in open areas on rock platforms in hill evergreen and dipterocarp forests. Flowering and fruiting: June–December.

Vernacular name.— Mo rakot prai (มรดกไพร) (General), Phak pong daeng (ผักปองแดง) (Chanthaburi).

Notes.— Candolle (1869) reported that *Thwaites 2956* was a type in the protologue. We found four collections of *Thwaites 2956* in **G**, **G-DC**, **GOET** and **P**. We selected **G-DC** [G00207840] as the lectotype because this collection is the original material.

Peperomia laticaulis was named by Candolle (1920) based on syntypes as *Faurie 481* and *Faurie 626*. We found *Faurie 481* in **B**, **BM**, **G-DC** and **P** and also *Faurie 626* in **G**. We selected *Faurie 481* in **B** [B100004568] as the lectotype and **BM** [BM000950706], **G-DC** [G00329958] and **P** [P00444532] as isolectotypes because this collection is the original material and the specimens have fruits which are an important distinguishing character for identification.

The leaves of *Peperomia dindygulensis* are characteristically opposite decussate or 4-verticillate on the terminal shoot. The stems, leaves, petioles and peduncles are velutinous, or rarely scabrous or pilose. The fruits are globose with a pseudopedicel and have caducous sticky glandular trichomes on papillae. The sticky glandular trichomes are readily caducous and usually cannot be observed on dry material even though they are easily observed on living specimens. The inflorescences vary from solitary to branching spikes (pseudo-panicle), and can sometimes be fascicled (Fig. 1A).

5. *Peperomia heptaphylla* Suwanph. & Hodk., *Suwanphakdee et al.*, Kew Bull. 72(1): 2. 2017. Type: Thailand, Prachuap Khiri Khan, Huai Yang Waterfall NP, 12 Apr. 2010, *Suwanphakdee 300* (holotype **BKF!**; isotypes **BK!**, **QBG!**).

Thailand.— SOUTH-WESTERN: Prachuap Khiri Khan [Huai Yang Waterfall NP, 12 Apr. 2010, *Suwanphakdee 300* (type **BK, BKF, QBG**).

Distribution.— Endemic to Thailand.

Ecology.— Epilithic and epiphytic plants occurring in shaded areas on mountain summits at 1,250 m alt. Flowering and fruiting: April–May.

Vernacular name.— Bia pra chuap (เบี้ยประจวบ) (Proposed here).

Notes.— The distinguishing characters of *Peperomia heptaphylla* include the verticillate leaf



Figure 1. A. *Peperomia dindygulensis* Miq.; B. *P. kotana* C.DC.; C. *P. masuthoniana* Suwanph. & Chantar.; D. *P. moulmeiniana* C.DC.; E. inflorescences of *P. moulmeiniana* C.DC.; F. *P. pellucida* (L.) Kunth; G. *P. portulacoides* (Lam.) Dietr.; H. *P. tetraphylla* (G.Forst) Arn. (photos by C. Suwanphakdee).

arrangement with 5–7 leaves/nodes, and the inflorescence numbers that are equal to leaves/node. It can be further distinguished by its hirsute or slightly densely hispid or velutinous indument. This species is the largest of the Thai epiphytic *Peperomia*.

6. *Peperomia heyneana* Miq., Syst. Piperac. 1: 123. 1843; Hook.f., Fl. Brit. India 5: 99. 1886; C.DC. in A.DC., Prodr. 16(1): 453. 1869; Long in Grierson and Long, Fl. of Bhutan 1(2): 344. 1984; Huber in Dassan., Fl. Ceylon 6: 297. 1987; Gilbert & Nianhe, Novon 9(2): 191. 1999; Yongqian *et al.* in Wu & Raven, Fl. China 4: 22. 1999. Suwanphakdee *et al.*, Thai For. Bull. (Bot.) 42: 63. 2014. Type: Nepal, Chandraghry [Chandagiri], July 1821, *Wallich s.n.* [Numer. List 6663C] (lectotype U [U0005530!], designated here; isolectotypes **K-W** [K001124443!] & **G-DC** [G00207737!]).

Thailand.—NORTHERN: Mae Hong Son [Doi Mae Sakut, 23 Sept. 1995, *Nanakorn et al.* 4675 (**QBG**); Pai, 3 Sept. 2006, *Maxwell 06-610* (**QBG**); Chiang Mai [Mueang, 29 Oct. 1994, *Nanakorn 2542* (**QBG**); Pangko, Khunwang, 12 Mar. 1965, *Smitinand 8748* (**BKF**); Doi Pha Hom Pok, 23 Nov. 1998, *Suksathan 1463* (**QBG**); Mae Chaem, 19 Dec. 1998, *Phengkklai & Konta 4851* (**BKF**); 9 Dec. 1984, *Koyama et al. T-39919* (**BKF**); 15 Jan. 2015, *Suwanphakdee 509* (**BK, BKF, K KU, QBG**); Mae Rim, Mon Long, 15 Oct. 2009, *Suwanphakdee 342* (**BK, BKF, K KU**), 15 June 2012, *Suwanphakdee 376* (**BK, BKF**); 30 Aug. 2013, *Suwanphakdee 442* (**BKF, K KU**); Doi Inthanon NP, 26 July 1988, *Koyama, T-61139* (**BKF**); 13 Jan. 1998, *Khantchai 268* (**BKF**); 12 Mar. 1965, *Santisuk et al. 8748* (**BKF**); Doi Chiang Dao WS, 18 Feb. 1922, *Kerr 6343* (**BK**); 18 July 1958, *Khantchai 942* (**BKF**); 13 Sept. 1967, *Tagawa et al. T-9897* (**BKF**); 6 Dec. 1965, *Hennipman 3239* (**BKF**); Chiang Rai [Doi Tung, 21 June 2002, *Chamchamroon et al. 1552* (**BKF**); Doi Laung NP, 10 Dec. 2002, *Chamchumroon et al. V.C. 1795* (**BKF**); Nan (Doi Phu Wae, 12 Nov. 2000, *Srisanga 1884* (**BKF**); Tak [Doi Muser, 22 Aug. 1961, *Chermsirivatana 41* (**BK**); NORTH-EASTERN: Loei [Phu Kra Dueng NP, 3 Aug. 1948, *Bunpheng 138* (**BK, BKF, K**); 7 July 1959, *Floto 7384* (**BKF, C, NY**); 27 Nov. 1965, *Tagawa et al. T-362* (**BKF**); 3 Sept. 1967, *Shimizu et al. T-8829* (**BKF**); 10 Nov. 1970, *Suvathabhandhu 247* (**BK**); 12 Sept. 1988, *Takahashi, T-63518* (**BKF**); 15 Sept.

1990, *Chantaranothai et al. 90/246* (**K, K KU**); 8 Nov. 2010, *Suwanphakdee 346* (**BKF, K KU, QBG**); Phu Luang WS, 4 Dec. 1965, *Tagawa et al. T-1237* (**BKF**); Phu Suan Sai NP, 25 Aug. 2006, *Maknoi 1048* (**QBG**).

Distribution.—India, China, Sri Lanka, Nepal (type), Bhutan, Myanmar and Thailand.

Ecology.—Epiphytic on pine and oak in open areas or mountain summits in hill or lowland evergreen forests. Flowering and fruiting: April–December.

Vernacular name.—Bia kliang (เบียเกลี้ยง) (General), Bia phu khao (เบียภูเข่า) (Proposed here).

Notes.—Miquel (1843) mentioned that *Wallich s.n.* Numer. List 6663C is the type in the protologue. We found three collections in **K-W** [K001124443], **G-DC** [G00207737] and **U** [U0005530] and selected the collection in **U** as the lectotype because he worked there and this collection is best preserved. This species is epiphytic and lithophytic and very common in northern and north-eastern Thailand. The plant size and leaves are highly variable.

7. *Peperomia kotana* C.DC., Rec. Bot. Surv. India 6: 2. 1912; Ridl., Fl. Malay Penins. 3: 27. 1924. Type: Malaysia, Pahang, Kota Slanggi, *Ridley s.n.* (not located). Fig. 2B.

Annual herbs, 10–20 cm high, erect, epiphytic; stem sometimes forming clumps, 1–3 main stems with 1–3 branchlets or without branchlets; stolons present, with rooting at basal nodes; nodes 1.5–2 cm long, densely or sparsely hispid. *Leaves* alternate; lamina subcoriaceous-coriaceous when dry, lower leaves rounded, upper leaves elliptic or elliptic-ovate or elliptic-oblong, hispid on both surfaces, symmetric or asymmetric, 2–3 by 1–1.5 cm; base acute, obtuse, cuneate, rounded; apex acute or rounded, obtuse, retuse or emarginate; venation palmate, 1(–3)-nerved; petioles ca 0.5 cm long, hispid. *Inflorescence* solitary or rarely 2–3 inflorescence(s)/shoot, terminal, 4–5 cm long, erect, cylindrical, green; rachis glabrous, with sparse flowers; peduncles 1–1.5 cm long, densely hispid. *Flower* with orbicular floral bract, ca 0.5 mm diam. *Stamens* filaments 0.1–0.2 mm long; anthers 0.3–0.4 mm long; slightly exerted at anthesis. *Ovary* globose; stigma glabrous. *Fruit* with pseudopedicel, globose or subglobose, 0.4–0.5 mm, apex acute, papillae.

Thailand.— SOUTH-WESTERN: Phetchaburi [Kaeng Krachan NP, 7 May 2005, *Middleton et al.* 3263 (**BKF**)]; PENINSULAR: Nakhon Si Thammarat [Khao Luang NP, 24 July 1954, *Smitinand* 692 (**BKF**); 15 May 1968, *van Beusekom & Phengkklai* 775 (**BKF, K, L**); 20 Apr. 2009, *Suwanphakdee* 311/1 (**BK, BKF**); 7 Apr. 2013, *Suwanphakdee* 428 (**BKF**); 18 Feb. 2018, *Suwanphakdee* 566 (**BK, BKF, KKU, QBG**)]; Phatthalung [Khao Poo Khao Ya NP, 23 Sept. 1986, *Maxwell* 86-693 (**BKF, L**)]; Trang [Khao Chong, 3 Aug. 1929, *Rabil* 335 (**BM, BK, K**); 13 June 1974, *Geesink et al.* 7186 (**BKF, K, L**); 15 Aug. 1975, *Maxwell* 75-884 (**BK**)]; Satun [Thung Wa, 19 Sept. 2010, *Middleton et al.* 5475 (**BKF**)]; Songkhla [Khao Nam Kang, 20 Oct. 1991, *Larsen et al.* 42427 (**BKF**)]; Yala [Betong, 20 July 2004, *Pooma et al.* 4468A (**BKF**)].

Distribution.— Thailand and Malaysia (type).

Vernacular name.— Nakkharat (นาคคราช) (Nakhon Si Thammarat).

Ecology.— Epiphytic on trunks in evergreen forest near streams or waterfalls. Flowering and fruiting: May–October.

Notes.— This species is distributed from southern Thailand to Malaysia. All parts are uniformly hispid, except the inflorescence axis. Sometimes, the internodes are very short and seem like opposite or opposite-decussate. The inflorescence is only on the terminal shoot and the species is distinguished by its fruit with a pseudopedicel (Fig. 1B).

8. *Peperomia laevifolia* (Blume) Miq., Syst. Piperac. 1: 107. 1843; C.DC. in A.DC., Prodr. 16: 419. 1869; Backer & Bakh.f., Fl. Java 1: 174. 1963. *Suwanphakdee et al.*, Thai For. Bull. (Bot.) 42: 64. 2014.— *Piper laevifolium* Blume, Verh. Batav. Gen. 9: 229. 1823. Type: Indonesia, Java, *Blume s.n.* (lectotype **U** [U1482316!], designated by *Suwanphakdee et al.* [2014]; isolectotypes **G-DC** [G00207479!], **K** [K000820278!]).

Thailand.— PENINSULAR: Ranong [Khao Sung, 17 Apr. 1918, *Kerr* 15256 (**BK, BM, K**); Khao Pho Ta Luang Kaeo, 22 June 1974, *Geesink et al.* 7429 (**BKF, K, L**)]; Surat Thani [Khao Hawng, 10 Aug. 1927, *Kerr* 13256 (**BK, BM, K**)]; Trang [Khao Chong, 15 Aug. 1975, *Maxwell* 75-884 (**BK, L**)]; Nakhon Si Thammarat [Khao Luang NP, 16 May 1968, *van Beusekom & Phengkklai* 810 (**BKF, L**);

21 July 1999, *Wattana et al.* 508 (**QBG**); 18 Apr. 2010, *Suwanphakdee* 304 (**BK, BKF, KKU**); 7 Apr. 2013, *Suwanphakdee* 423 (**BKF, QBG**); 18 Feb. 2018, *Suwanphakdee* 565 (**BKF**)]; Phatthalung [Khao Oktalu, 21 Apr. 1928, *Kerr* 15362 (**BK, BM, K**); Khao Soi Dao, 29 Apr. 1930, *Kerr* 19212 (**BK, BM, K, L**)]; Satun [Khao Ko Range, 12 Mar. 1928, *Kerr* 14530 (**BK, BM, C, K, L, P**)].

Distribution.— India, Thailand, Malaysia, Indonesia and Philippines.

Ecology.— Epiphytic on the basal region of tree trunks or lithophytic on rocks along streams or waterfalls in evergreen forest. Flowering and fruiting: March–August.

Vernacular name.— Bia khao luang (เบี้ยขาวหลวง) (General).

Notes.— The leaves of *Peperomia laevifolia* are distinctively alternate and distichous. The stem, petioles and peduncles are 4-winged. The inflorescences originate in the leaf axils along the stem.

9. *Peperomia masuthoniana* Suwanph. & Chantar., *Suwanphakdee et al.*, Kew Bull. 72(1): 2. 2017. Type: Thailand, Chiang Mai, Doi Chiangdao, *Suwanphakdee* 458 (holotype **BKF!**; isotypes **BK!, KKU!, QBG!**).

Thailand.— NORTHERN: Chiang Mai [Doi Chiangdao WS, 15 Oct. 1926, *Put* 340 (**BK**); 15 July 1958, *Smitinand* 4696 (**BKF**); *Larsen et al.* 2922 (**BKF**); 16 Dec. 1983, *Fukuoka & Ito* T-35230 (**BKF**); 23 Oct. 2013, *Suwanphakdee* 458 (type **BK, BKF, KKU, QBG**), 10 Dec. 2008, *Suwanphakdee* 251 (**BK, BKF, KKU, QBG**); 13 June 2012, *Suwanphakdee* 375 (**BK, BKF, QBG**)].

Distribution.— Endemic to Thailand.

Ecology.— Epiphytic on pine and oak trees or epilithic in open areas or mountain summits at 1,200–1,500 m alt. Flowering and fruiting: October–December.

Vernacular name.— Bia chiangdao (เบี้ยเชียงตาว) (Proposed here).

Notes.— The stem is shorter than the inflorescence and densely puberulent (Fig. 1C). The leaves are thicker than those of *P. heyneana*. The inflorescences are longer than the stems. The fruit is ellipsoid and the apex is beaked.

10. *Peperomia moulmeiniana* C.DC., J. Bot. 4: 140. 1866 & in A.DC., Prodr. 16: 415. 1869; Hook.f., Fl. Brit. India 5: 97. 1886; Suwanphakdee *et al.*, Thai For. Bull. (Bot.) 42: 64. 2014. Type: Myanmar, Mawlamyine [Moulmein], *Parish 118* (holotype **K** [K000820256!]).

Thailand.— NORTHERN: Tak [Umphang, Thung Yai Naresuan WS, 14 Jan. 2011, *Suwanphakdee 359* (**BK, BKF, KKU**), *Suwanphakdee 360* (**BK, BKF, KKU**); 25 Mar. 2013, *Suwanphakdee 414* (**BK, KKU**); Nakhon Sawan [Khao Pacho, 5 June 1927, *Kerr 6072* (**BK, BM, K**)]; SOUTH-WESTERN: Kanchanaburi [Sangkhlha Buri, Thung Yai Naresuan WS, 19 Apr. 2006, *van de Bult 887* (**CMUB**); Takian Thong Waterfall, 20 Oct. 2007, *Suwanphakdee 200* (**BK, BKF, KKU**); 11 Dec. 2007, *Suwanphakdee 204* (**BK, BKF, KKU**); 13 Feb. 2013, *Suwanphakdee 400* (**BKF**); 1 Apr. 2013, *Suwanphakdee 420* (**BKF, KKU**); *Suwanphakdee 421* (**KKU**)].

Distribution.— Myanmar (type) and Thailand.

Ecology.— Epiphytic on trunks in freshwater swamp forest, along streams or in waterfall areas in evergreen forest. Flowering and fruiting: December–June.

Vernacular name.— Bia nam tok (เปี้ยน้ำตก) (General).

Notes.— This species has two forms, large and small. The large form has a long stem and large leaves. The small form has a short stem and small leaves. It has a distinctive spiral arrangement of its thick and fleshy leaves. The inflorescences are variable from solitary to branching spikes, or are compound spikes; they are sometimes fascicled (Fig. 1D & E). The stigma is thread-like. Suwanphakdee *et al.* (2014) examined dry specimens and mistakenly reported that the fruit lacked a pseudopedicel. Later, the first author collected living specimens from the field and found that the fruits do have a pseudopedicel.

11. *Peperomia multisurcula* Suwanph. & Hodk., *Suwanphakdee et al.*, Kew Bull. 72(1): 5. 2017. Type: Thailand, Nan, Doi Phu Ka NP, *Suwanphakdee 323* (holotype **BKF!**; isotypes **BK!**, **KKU!**, **QBG!**).

Thailand.— NORTHERN: Nan [Doi Phu Ka NP, 1 July 1999, *Srisanga et al. 785* (**QBG**); 2 Sept. 2000, *Srisanga 1583* (**QBG**); 16 Nov. 2001, *Srisanga 2295* (**QBG**); 4 Oct. 2009, *Suwanphakdee 323* (type **BK,**

BKF, KKU); Phu Wae, Doi Phu Ka NP, 24 Sept. 2000, *Srisanga 1690* (**QBG**); 13 Nov. 2000, *Srisanga 1825* (**QBG**); Sa Pan Waterfall, Khun Nan NP, 5 Oct. 2009, *Suwanphakdee 327* (**BK, BKF, KKU**)].

Distribution.— Endemic to Thailand.

Ecology.— On granite bedrock along streams or on tree trunks near waterfalls in hill evergreen forests. Flowering and fruiting: July–November.

Vernacular name.— Bia Sa Pan (เปี้ยสะปัน) (Proposed here).

Notes.— Based on general characters, *Peperomia multisurcula* is similar to *P. heyneana* but is smaller and its leaf arrangement is 3–4-verticillate (rarely opposite). The inflorescences are thicker than *P. heyneana* and the inflorescences are longer than the stem. It is found in damp habitats along streams or near waterfalls.

12. *Peperomia nakaharae* Hayata, J. Coll. Sci. Imp. Univ. Tokyo 25: 188. 1908; Yongqian *et al.* in Wu & Raven, Fl. China 4: 22. 1999; Suwanphakdee *et al.*, Thai For. Bull. (Bot.) 42: 65. 2014. Type: Taiwan, Morrison Mountain, *Nakahara s.n.*, Nov. 1906 (lectotype **TI** [TI 00011314!], designated here; isolectotypes **TI** [TI 00011315! & TI 00011316!]).

Thailand.— NORTHERN: Chiang Mai [Doi Inthanon NP, 14 Apr. 1960, *Smitinand 6659* (**BKF**); 28 July 1988, *Phengklai et al. 7168* (**BKF**); 9 Dec. 1984, *Koyama et al. T-39919* (**BKF**); 9 Dec. 1984, *Phengklai 49873* (**BKF**); Doi Chang Khian, 16 June 2012, *Suwanphakdee 380* (**BK, BKF, KKU**)].

Distribution.— Thailand and Taiwan (type).

Ecology.— Epiphytic in shaded areas of pine, oak and hill evergreen forests. Flowering and fruiting: April–December.

Vernacular name.— Bia doi suthep (เปี้ยดอยสุเทพ) (Proposed here).

Notes.— Hayata (1908) published *Peperomia nakaharae* based on syntypes *Nakahara s.n.*, Nov. 1906 (TI 00011314, TI 00011315, TI 00011316) and *Kawakami & Mori 1997* (TI00011317) which are deposited in Tokyo University Herbarium (**TI**) and also in Taiwan Forestry Research Institute (TAIF). We chose *Nakahara s.n.* (TI 00011314) to be the lectotype based on its good condition. Therefore, the others (TI 00011315 and TI 00011316) are

isolecotypes. This species is uncommon in Thailand, as it was found only in Doi Suthep National Park, Chiang Mai Province. It is similar to *P. heyneana* but differs in its indument, as the whole plant is glabrous, or rarely puberulous. The leaves are elliptic-oblong. The inflorescences are shorter than those of *P. heyneana*.

13. *Peperomia pellucida* (L.) Kunth, Nov. Gen. Sp. 1: 64. 1815; C.DC. in Lecomte, Fl. Indo-Chine 1: 66. 1910; Ridl., Fl. Malay Penins. 3: 27. 1924; Henderson, Malay. Wild Flow. Dicot. 6(3): 436. 1959; Backer & Bakh.f., Fl. Java 1: 174. 1963; Long in Grierson & Long, Fl. Bhutan 1(2): 345. 1984; Huber in Dassan., Fl. Ceylon 6: 299. 1987; Yongqian *et al.* in Wu & Raven, Fl. China 4: 22. 1999.— *Piper pellucidum* L., Sp. Pl. 1: 30. 1753. Type: Linnaeus, Hort. Cliff. 6, tab 4.1739 (lectotype designated by Stearn [1957]).

— *Peperomia exigua* (Blume) Miq., Syst. Pip. 1: 77. 1843; Hook.f., Fl. Brit. India 5: 97. 1886. — *Piper exiguum* Blume, Verh. Batav. Gen. 11: 232. 1826. Type: Indonesia, Java, *Blume s.n.* (holotype L[L0040968!]).

Thailand.— Selected specimens examined. NORTHERN: Mae Hong Son [Doi Pha Daeng, 20 Oct. 1979, Shimizu *et al.* T-20008 (BKF)]; Chiang Mai [Doi Suthep NP, 16 July 1988, Takahashi T-62951 (BKF)]; Doi Inthanon NP, 30 July 1988, Fukuoka T-62377 (BKF)]; Lamphun [Doi Khun Tan NP, 4 Sept. 1967, Tagawa *et al.* T-9146 (BKF)]; Lampang [Doi Khun Tan NP, 5 Sept. 1967, Tagawa *et al.* 9254 (BKF)]; Wang Nua, 25 Aug. 1996, Maxwell 96-1136 (BKF)]; Tak [Mae Sod, 21 Aug. 1994, Maxwell 94-914 (BKF)]; Phitsanulok: [Thung Salaeng Luang NP, 30 Sept. 1967, Tagawa *et al.* T-11226 (BKF)]; NORTH-EASTERN: Sakon Nakhon [Phu Phan NP, 12 Nov. 1984, Murata *et al.* T-51347 (BKF)]; Nakhon Phanom [Mueang, 4 Nov. 1982, Vacharee 420 (BK)]; EASTERN: Buri Ram [Mueang, 28 Nov. 1976, Phengklai 3512 (BKF)]; Ubon Ratcha Thani [Kaeng Tana NP, 22 Aug. 2001, Pooma *et al.* 2355 (BKF)]; SOUTH-WESTERN: Kanchanaburi [Sangkhlaburi, Wang Ka, 14 June 1946, Hoed 950 (BK)]; Phetchaburi [Kaeng Krachan NP, 3 Aug. 1995, Larsen *et al.* 45335 (BKF)]; SOUTH-EASTERN: Chanthaburi [Khlung, 25 Sept. 1984, Fukuoka T-36264 (BKF)], Khao Soi Dao WS, 11 Nov. 1969, van Beusekom & Smitinand 2102 (BKF)]; CENTRAL: Saraburi [Pra Putthabat, 30 July 1982, Shimizu *et al.* T-28329 (BKF)]; Nakhon Nayok

[Khao Yai NP, 6 Aug. 1970, Phengklai 3726 (BKF, PSU)]; PENINSULAR: Ranong [Bunyabarn Waterfall, 8 Sept. 1984, Fukuoka *et al.* T-35991 (BKF)]; Surat Thani [Kuan Thuli, 7 Sept. 1931, Put 4129 (BK)]; Phangnga [Thap Pud, 24 Aug. 1987, Shimizu *et al.* T-7942 (BKF)], Takua Thung, 15 Dec. 1979, Shimizu *et al.* T-27358 (BKF)]; Nakhon Si Thammarat [Khao Luang NP, 5 Mar. 1983, Koyama *et al.* T-34057 (BKF)]; Phatthalung [Ban Pak Klong, 20 Dec. 1979, Shimizu *et al.* T-27757 (BKF)]; Songkhla [Hat Yai, 20 Sept. 1985, Maxwell 85-904 (BKF, PSU)].

Distribution.— Pantropical.

Ecology.— Widespread in cultivation and found growing wild in many types of forest. Flowering and fruiting: all year round.

Uses.— Used as a medicinal plant and locally as a vegetable.

Vernacular name.— Phak kra sang (ผักกระสัง) (Central).

Notes.— The well-known cosmopolitan species *Peperomia pellucida* is very common. All parts are juicy when fresh and very thin when dry; it has angled fresh stems. The inflorescence varies from solitary to branching spikes and its fruits have sticky papillae (Fig. 1F).

14. *Peperomia portulacoides* (Lam.) A. Dietr., Sp. Pl. 6(1): 172. 1839; C.DC. in A.DC., Prodr. 16: 443. 1869; Hook.f., Fl. Brit. India 5: 98. 1886; Ridl., Fl. Malay Penins. 3: 26. 1924; Suwanphakdee *et al.*, Thai For. Bull. (Bot.) 42: 65. 2014.— *Piper portulacoides* Lam. Tabl. Encycl. 1: 82. 1791. Type: Mauritius, *Commerson s.n.* (holotype P [P00540636!]).

Thailand.— NORTHERN: Chiang Rai [Doi Tung, 23 Oct. 2013, Suwanphakdee 462 (BKF, QBG)]; Chiang Mai [Doi Inthanon NP, 18 July 1922, Kerr 6343 (BM, C, K)]; 21 Sept. 1927, Garrett 441 (BM); 21 Sept. 1927, Garrett 461 (BM, L, P); 26 July 1988, Koyama *et al.* T-61139 (BKF, GH, L); Chiang Dao WS, 23 Oct. 2013, Suwanphakdee 459 (BKF)]; Phayao [Tham Sakoen NP, 12 May 2011, Wattana 3870 (QBG)]; Phitsanulok, Ban Rom Klao, 16 May 2010, Suwanphakdee 349 (BK, BKF, K KU, QBG), 18 June 2012, Suwanphakdee 381 (BK, BKF, K KU, QBG)]; NORTH-EASTERN: Loei [Phu Suan Sai NP, 20 Oct. 2016, Suwanphakdee 546 (BKF)].

Distribution.— Mauritius (type), Seychelles, India, Sri Lanka and Thailand.

Ecology.— Shaded areas in limestone forest or hill evergreen forest. Flowering and fruiting: July–October.

Vernacular name.— Bia yai (เบี้ยไทร) (Proposed here).

Notes.— The stems and leaves of *Peperomia portulacoides* are the largest of the native Thai *Peperomia*. The leaves are very thick and large (1.5–3 by 1–2 cm). The inflorescences are terminal spikes and are shorter than the stem (Fig. 1G).

15. *Peperomia ranongensis* Suwanph., Hodk. & Chantar., **sp. nov.**

Peperomia ranongensis is similar to *P. dindygulensis* but can be distinguished by the epiphytic vs epilithic habit. The stems are green or slightly reddish vs. red or reddish. The stem is puberulous, glabrescent or glabrous, densely hispid on its terminal parts vs. velutinous, rarely scabrous or puberulous. Rooting at the basal node is present in *P. ranongensis* vs absent in *P. dindygulensis*. The phyllotaxy is 3-verticillate or rarely opposite-decussate vs opposite decussate and 4-verticillate on terminal stems. The leaf texture is coriaceous or subcoriaceous when dry, puberulous or scabrous and scabrous on midrib vs chartaceous when dry, velutinous, scabrous or pilose and pilose on midrib. The intramarginal vein is present vs absent. The fruits are ovoid without a pseudopedicel vs globose with pseudopedicel. Sticky glandular trichomes are absent on papillae of *P. ranongensis* vs present in *P. dindygulensis*. Type: Thailand, Ranong, Kaper, Khao Por Ta Chong Dong WS, *Suwanphakdee 582* (holotype **BKF!**; isotypes **BK!**, **KKU!**, **QBG!**). Figs. 2 & 3.

Perennial herbs 10–15 cm high, erect, epiphytic; stems forming a clump, 3–5 main stems with 4–6 branchlets; stolons present, rooting at basal nodes; internodes 1.5–2 cm long, fleshy, reddish, puberulous, glabrescent or glabrous, densely hispid on terminal branches. *Leaves* 3-verticillate, rarely opposite decussate; petiole 3–5 mm long, puberulous or scabrous; lamina coriaceous or subcoriaceous when dry, elliptic or ovate-elliptic, puberulous on both surfaces, denser on lower surface, 2.5–3 × 1–1.5 cm, symmetrical or asymmetrical, base cuneate, apex acute, margin with intramarginal vein and entire,

(1)–3 palminerved, scabrous on midrib. *Inflorescence* with 1–5 spikes per shoot, terminal or in the axils of the upper leaves, 5–7 × 0.1–0.2 cm, erect, green or greenish-yellow, cylindrical; rachis glabrous with sparse flowers; peduncle 0.5–1 cm long, slightly puberulous to scabrous. *Flower* with orbicular floral bract, ca 1 mm diam., covering the basal part of ovary. *Stamens* filament 0.1–0.2 mm long; anthers 0.2–0.3 mm long, slightly exerted at anthesis, transversely dehiscent. *Ovary* ovoid; style short; stigma glabrous. *Fruit* without pseudopedicel, immersed within rachial pit, ovoid, 0.5–1.5 mm, with papillae.

Thailand.— PENINSULAR: Ranong [Khao Por Ta Chong Dong Wildlife Sanctuary, 14 July 2019, *Suwanphakdee 582* (holotype **BKF!**; isotypes **BK!**, **KKU!**, **QBG!**), 10 Oct. 2018. *Suwanphakdee 578* (**BK!**, **BKF!**, **KKU!**, **QBG!**).

Distribution.— Endemic.

Ecology.— This species is epiphytic and grows on tree trunks in open areas on mountain summit at 975 m alt. Flowering and fruiting: June–August.

Conservation status.— This species is uncommon in the wild and restricted in the protected area (Khao Por Ta Chong Dong WS, Ranong Province). The populations are very small and restricted in distribution. We propose that this new species has a provisional rating of Vulnerable (VU) and category of D2 according to IUCN (2012) criteria.

Vernacular name.— Bia po tar (เบี้ยพอดตา) (Proposed here).

Etymology.— The specific epithet refers to the type locality (Ranong Province, southern Thailand) where the specimens were collected.

Notes.— *Peperomia ranongensis* is an uncommon species and is unique in having an intramarginal vein. Based on general morphology, this species is similar to *P. dindygulensis* but differs by its 3-verticillate or rarely opposite-decussate leaves. The plants are epiphytic. The stolons and rooting at basal nodes are unique for epiphytic Thai *Peperomia*. The stems are puberulous, glabrescent or glabrous and densely hispid on the terminal branches. The leaves are scabrous or puberulous. The fruits are ovoid with papillae whereas they are globose with sticky glandular trichomes on papillae in *P. dindygulensis*; differences between *P. ranongensis* and *P. dindygulensis* are shown in Table 1.

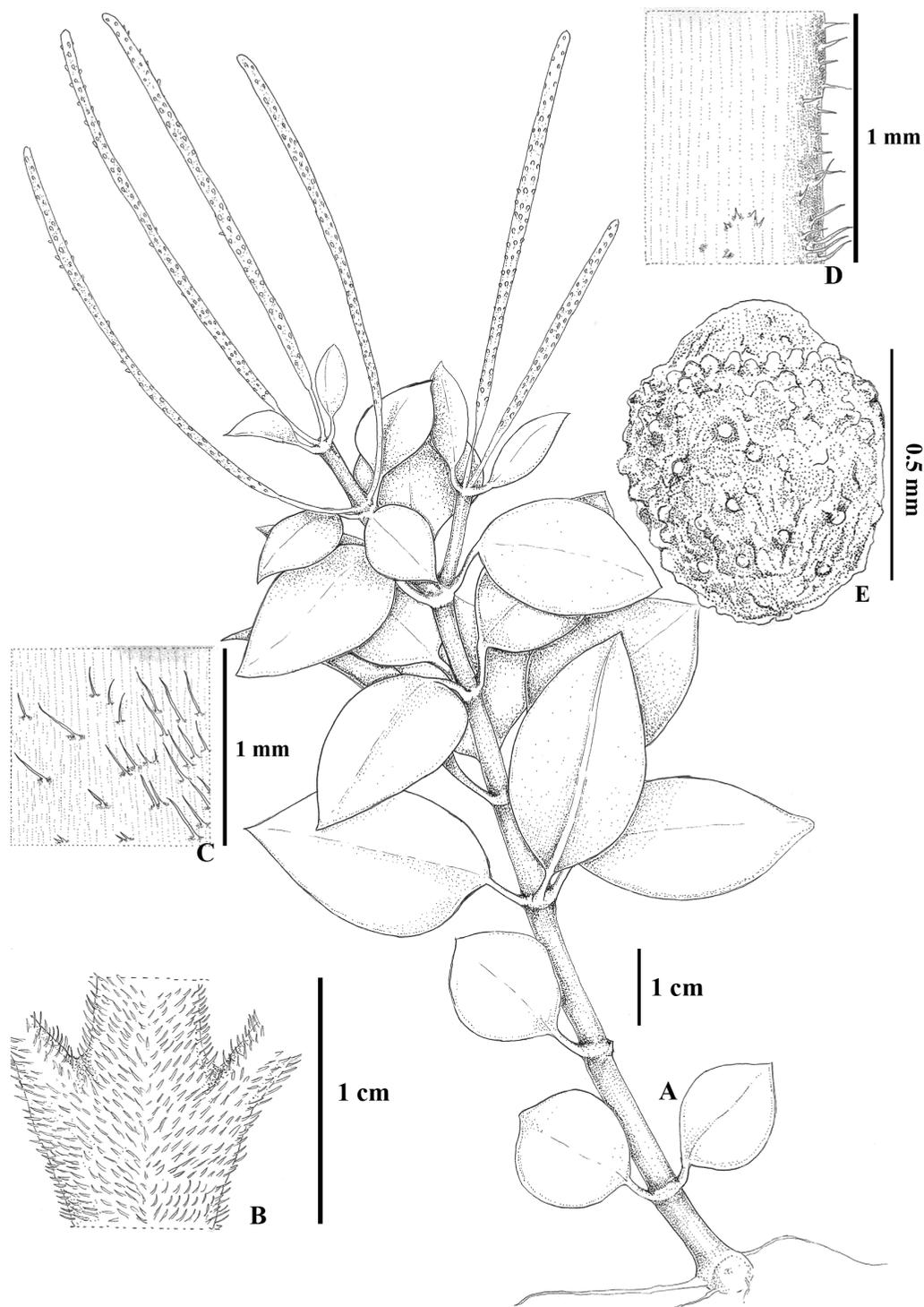


Figure 2. *Peperomia ranongensis* Suwanph., Hodk. & Chantar.: A. whole plant; B. hairs on stem and petiole; C. lower leaf surface; D. upper leaf surface and margin; E. fruit (from type: *Suwanphakdee 582* (BKF, BK, KKU, QBG), drawn by Sangtawan Sriboran).

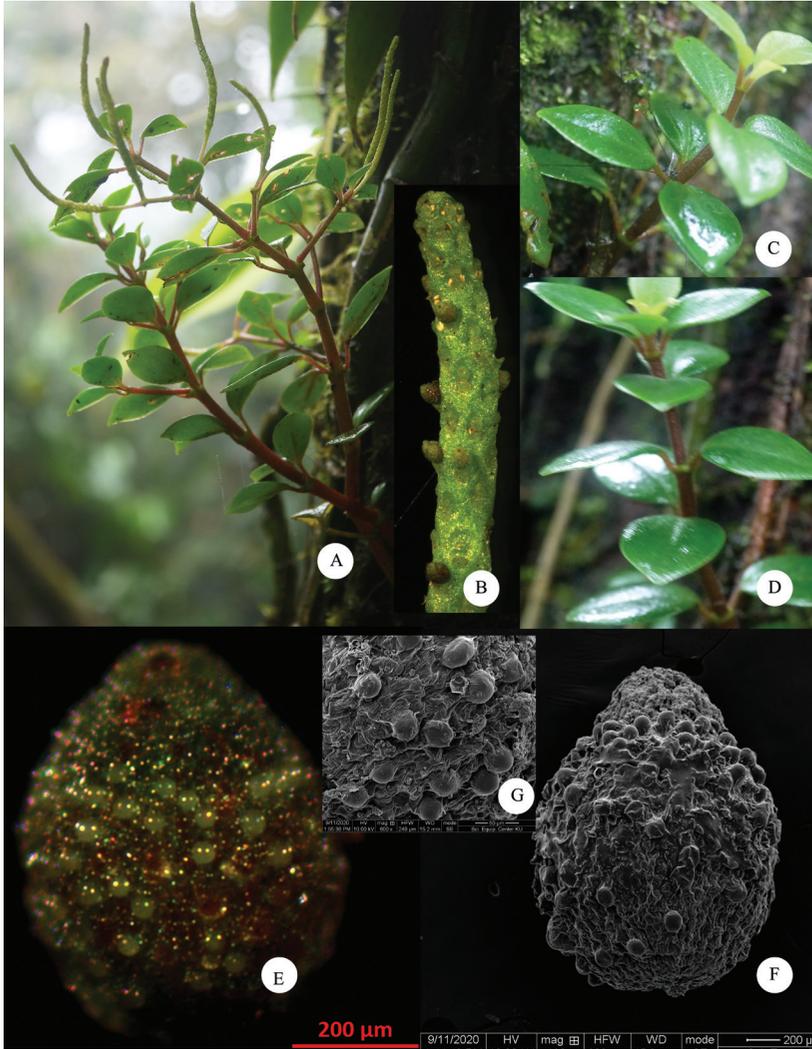


Figure 3. *Peperomia ranongensis* Suwanph., Hodk. & Chantar.: A. plant with inflorescences; B. a portion of infructescence; C. 3-verticillate; D. opposite-decussate; E. fruit image from light microscope; F. fruit image from scanning electron microscope; G. papillae imaged from scanning electron microscope (photos by C. Suwanphakdee).

16. *Peperomia sirindhorniana* Suwanph. & Chantar., Suwanphakdee *et al.*, Kew Bull. 72(1): 7. 2017.— Type: Thailand, Loei, Nong Hin, Pha Hin Ngam, *Suwanphakdee 357* (holotype **BKF!**, isotypes **BK!**, **KKU!**, **QBG!**).

Thailand.—NORTH-EASTERN: Loei [Nong Hin, Pha Hin Ngarm, 19 Aug. 2010, *Suwanphakdee 332* (**BK**, **BKF**, **KKU**), 11 Dec. 2010, *Suwanphakdee 357* (**BK**, **BKF**, **KKU**, **QBG**), 3 Nov. 2015, *Suwanphakdee 525* (**BK**, **BKF**, **KKU**, **QBG**)]; Khon Kaen [Pha Nok Khao, 9 Sept. 1963, *Smitinand & Sleumer 1131* (**BKF**, **L**)].

Distribution.— Endemic to Thailand.

Ecology.— Grows only in the shaded areas of limestone mountains at 500–800 m alt. Flowering and fruiting: August–December.

Vernacular name.— Rak ta nil (รักตะนินล) (Proposed here).

Notes.— *Peperomia sirindhorniana* is similar to *P. pellucida* but differs by growing only on limestone. The stem, petioles and peduncle are red or reddish and leaf dark green. The leaves are coriaceous when dry. The fruits are ovoid and beaked.

Table 1. Comparison of characters between *Peperomia ranongensis* and *P. dindygulensis*.

Characteristics	<i>P. ranongensis</i>	<i>P. dindygulensis</i>
Habitat	epiphytic	epilithic
Stem		
height	10–15 cm	20–25 cm
internode	1.5–2 cm long	2–4 cm long
clump	forming a clump, 3–5 main stems with 4–6 branchlets	forming a clump, many main stems with 3–4 branchlets
stolon	present	present
rooting at basal node	present	absent
indumentum	puberulous, glabrescent or glabrous, densely hispid on its terminal regions	velutinous, rarely scabrous or puberulous
Leaves		
phyllotaxy	3-verticillate	opposite decussate or terminally 4-verticillate
petiole	3–5 mm long	0.5–1 cm long
size	2.5–3 × 1–1.5 cm	3–5 × 1.5–3 cm
texture	±coriaceous when dry	chartaceous when dry
venation	palmately (–1)–3 nerved, scabrous on midrib	palmately 3-nerved, pilose on midrib
indumentum	puberulous or scabrous	velutinous, scabrous or pilose
intramarginal vein	present	absent
Inflorescence		
number	single, fascicled, 2–5 spikes/shoot	single or branching, fascicled, 2–4 spikes/shoot
size	5–7 × 0.1–0.2 cm	8–15 × 0.05–0.1 cm
peduncle	0.5–1 cm long, slightly puberulous to scabrous	1–1.5 cm long, puberulous or slightly scabrous
Fruit		
pseudopedicel	absent	present
shape	narrowly ovoid	±globose
size	0.5–1.5 mm	0.8–1 mm
indumentum	only papillae (lacking hairs)	with sticky glandular hairs on each papilla

17. *Peperomia tetraphylla* (G.Forst.) Hook. & Arn., Bot. Beech. Voy. 1: 97. 1832; Backer & Bakh.f., Fl. Java 1: 174. 1963; Long in Grierson & Long, Fl. Bhutan 1(2): 344. 1984; Huber in Dassan., Fl. Ceylon 6: 292. 1987; Yongqian *et al.* in Wu & Raven, Fl. China 4: 21. 1999. (FIG. 1D).— *Piper tetraphyllum* G.Forst., Floru. Ins. Austr.: 5. 1786.— Type: French Polynesia, *Forster s.n.* (holotype **K** [K000820323!]).

— *Peperomia reflexa* (L.f.) A.Dietr., Sp. Pl. 1: 180. 1839.— *Piper reflexum* L.f., Suppl. Pl.: 91. 1781.— Type: *Thunberg 1794* (holotype **LINN** (LINN-HS 73.28, *Piper reflexum* (Herb Smith) (photo!)).

— *Peperomia reflexa* (L.f.) A.Dietr. var. *parvifolia* C.DC. in A.DC., Prodr. 16(1): 452. 1869.— Type: Sri Lanka, *Thwaites 2462* (lectotype **G-DC** [G00207819!], designated here).

Thailand.— Selected specimens examined. NORTHERN: Mae Hong Son [Pang Mapha, Kiew Lom, 16 Jan. 1983, *Koyama et al. T-32560* (BKF)]; Chiang Mai [Doi Suthep NP, 8 Sept. 1967, *Iwatsuki et al. T-9375* (BKF, L); 3 Oct. 1987, *Maxwell 87-1133* (BKF, L); Doi Inthanon NP, 14 Apr. 1960, *Smitinand & Alsterlund 6658* (BKF, K); 10 Nov. 1980, *Put 3415* (BK, BM, K, L); Doi Pah Hom Pok NP, without data, *Phengkklai & Nimanong 974* (BKF)]; Doi Chiangdao WS, 4 Jan. 1966, *Tagawa et al. T-4192* (BKF); 20 Nov 1996, *Triboun 228* (BK); 10 Dec. 2008, *Suwanphakdee 252* (BK, BKF, KKKU); *ibid.*, 23 Oct. 2013, *Suwanphakdee 460* (BKF)]; Chiang Rai [Mae Sai, 30 Oct. 2005, *Maxwell 05-630* (BKF)]; Wieng Pa Paow, 22 Nov. 1997, *Maxwell 97-1410* (BKF); Doi Tung, 17 Feb. 1992, *Pooma 651* (BKF)]; Nan [Doi Phu Kha NP, 9 Apr. 1991, *Pooma 457* (BKF); 7 Nov. 1998, *Srisanga 362* (QBG); 3 Dec. 1999, *Srisanga 1203* (QBG); 16 Nov. 2001, *Srisanga 2293* (QBG); 24 Sept. 2000, *Srisanga 1688* (QBG); Phu Wae, Doi Phu Kha NP, 13 Nov. 2000, *Srisanga 1840* (QBG)]; Tak [Thung Yai Naresuan WS, 24 Mar. 2013, *Suwanphakdee 409* (BKF)]; Sukhothai [Khao Luang, Ramkamhaeng NP, 19 Nov. 2004, *Mattapha 524* (KKU)]; NORTH-EASTERN: Loei [Phu Kradung NP, 10 Feb. 1931, *Kerr 20409* (BK, BM)]; Phu Suan Sai NP, 25 Aug. 2006, *Maknoi 1408* (QBG); Phu Paek, 13 Jan. 1970, *van Beusekom & Phengkklai 3007* (BKF, L)]; EASTERN: Nakhon Ratchasima [Khao Yai NP, 22 Jan. 1972, *Smitinand & Phengkklai 11565* (BKF)]; SOUTH-WESTERN: Prachuap Khiri Khan [Huai Yang Waterfall NP, 17 Feb. 2006, *Middleton et al. 3735* (BKF); 12 Apr. 2010, *Suwanphakdee 302* (BK, BKF)]; 1 Feb. 2016, *Suwanphakdee 536* (KKU, QBG)]; SOUTH-EASTERN: Chanthaburi [Khao Soi Dao WS, 12 Dec. 1924, *Kerr 9625* (BK, BM, K, L); 8 Feb. 1966, *Iwatsuki & Fukuoka T-7127* (BKF); 13 Dec. 1969, *van Beusekom & Smitinand 2195a* (L); 27 Jan. 2008, *Suksathan 4450* (QBG)].

Distribution.— Pantropical.

Ecology.— Epiphytic on trunks or lithophytic at high altitudes in all forest types. Flowering and fruiting: January–February.

Vernacular name.— Kra bong nu (กระบองหนู) (Chanthaburi); phak bia si bai (ผักเบียดสี่ใบ) (Proposed here).

Notes.— Candolle (1869) published *Peperomia reflexa* (L.f.) A.Dietr. var. *parvifolia* based on *Thwaites*

2462 from Sri Lanka and *Hooker & Thomson s.n.* from Khasia, India with syntypes in **G-DC** and **K**. We found two collections were mounted on same herbarium sheet only in **G-DC** which they are *Thwaites 2462* (G00207819) and *Hooker & Thomson s.n.* (G00207820). We designated *Thwaites 2462* (G00207819) as a lectotype because this collection is original material. *Peperomia tetraphylla* can be easily recognized by its whorled (4 leaves per node) thick leaves that are rounded or ovate and uniform in shape; leaves are coriaceous and wrinkled when dry (Fig. 3H). The hairs of this species are variable from glabrous to puberulous, pilose or hispid. The inflorescence is a solitary short spike on a terminal shoot. It can be distinguished from other Thai *Peperomia* by the rachis with hairs. The fruits are ovate-oblong with pseudocupula and without sticky papillae.

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