

New records of *Peperomia* (Piperaceae) in Thailand

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ABSTRACT. Eight species of *Peperomia*, namely *P. bavina*, *P. cavaleriei*, *P. cochinchensis*, *P. heyneana*, *P. laevifolia*, *P. moulmeiniana*, *P. nakaharai* and *P. portulacoides*, are newly recorded for Thailand. Descriptions, illustrations and geographic distribution data are provided.

KEY WORDS: *Peperomia*, new records, Thailand.

INTRODUCTION

Peperomia Ruiz & Pavón is the second largest genus of Piperaceae after *Piper* with an estimated 2,000 species. A total of 1,432 species plus 176 varieties and forms are currently accepted (Mathieu, 2001–2014). The taxonomic study of *Peperomia* in Thailand has been slow up until now due to the lack of collections and fieldwork. However some attempts to recognize and classify *Peperomia* species in Thailand have been made (Wilson, 1972; Yongqian et al., 1999). The Forest Herbarium (2001) also made a list of *Peperomia* with four taxa viz., *P. blanda*, *P. kotana*, *P. pellucida* and an exotic variety, *P. sandersii* var. *argyreia*, which is a synonym of *P. argyreia*. This species is exclusively South American and only occurs in cultivation in Thailand. *Peperomia blanda* is probably the most misapplied name in the genus because the morphological characters of all collections and distribution data matched with *P. dindygulensis*; genuine *P. blanda* is restricted to Northern Venezuela.

A revision of the genus has recently been undertaken by the first author as part of the Flora of Thailand project. Eight new species records have been made for Thailand, each of which are described and illustrated here. A key to all *Peperomia* species will be provided in the Flora of Thailand

account; it is not possible to do so here because some new species have yet to be described.

MATERIALS AND METHODS

This study is based on field collections and herbarium specimens. Voucher specimens are deposited in BK, BKF, KGU and QBG (Thiers, 2012). Additional material has been examined and consulted from the following herbaria: AAU, BK, BKF, BM, BO, C, G, G-DC, K, KGU, L, KEP, PSU, QBG, SING and TCD. Identification of taxa is based on the appropriate literature, viz. Backer & Bakhuizen (1963), de Candolle (1910), Hooker (1887), Huber (1987), Long (1984), Ridley (1924) and Yongqian et al. (1999) and consultation of type specimens.

All vegetative and reproductive parts were measured in a dry state under a stereo microscope. The morphological terminology is generally in accordance with the vocabulary of Stearn (1992) while terms relating to inflorescences and floral features follow Beentje (2010). However, we use spike for the inflorescence rather than spadix because the structure of the *Peperomia* inflorescence better fits the botanical definition of a spike. There is no spadix, which is an integral component of the araceous inflorescence.

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DESCRIPTIONS

1. *Peperomia bavina* C.DC., Ann. Cons. Jard. Bot. Gen.: 287. 1898. Types: Vietnam, Tonkin, *Balansa 3641* (holotype **P**; isotypes **K!**, **P**).

Perennial herbs, 10–30 cm high, erect, terrestrial or lithophytic; stems forming clumps, 2–4 main stems with 2–4 branchlets; stolons present, fleshy, without rooting at basal nodes, internodes 2.5–3 cm long, puberulous or scabrous. *Leaves* opposite and whorled on terminal branchlets, 3–4-verticillate; lamina chartaceous when dry, obovate, elliptic or elliptic-obovate, puberulous, shortly hispid and glabrescent on both surfaces, more indument on lower than upper surface, 1.5–3 by 1–1.5 cm, asymmetric, base cuneate or oblique, sometimes almost rounded, apex rounded to subacute or shallowly emarginate and ciliate, margin entire or undulate; venation 1–3(–5)-palmatinerved, rarely pinnate, 2-paired; petioles 0.5–2 cm long, puberulous or scabrous. *Inflorescence* a solitary spike and a single inflorescence per shoot, terminal or in the axils of the upper leaves, 2–5 cm by 1–1.5 mm, erect, cylindrical, green or pale yellow; rachis glabrous, with sparse or dense flowers; peduncles 0.5–2 cm long, puberulous or shortly hispid. *Flower* with orbicular floral bract, 0.5–0.7 mm diam., covering the basal part of ovary. *Stamens*: filaments 0.2–0.3 mm long; anthers 0.5–0.6 mm long, slightly exserted at anthesis. *Ovary* ±globose; stigma glabrous. *Fruit* without pseudopedicel, sparse and immersed in a rachial pit, obliquely ellipsoid to broadly ellipsoid, 0.5–1.2 mm diam., golden-brown and obscurely papillate.

Thailand.—NORTHERN: Lamphun [Doi Khun Tan National Park, 5 Sept. 1967, *M. Tagawa et al.* T-9256 (**AAU!**, **BKF!**, **L!**)].

Distribution.—Vietnam.

Ecology.—Open areas on mountain summits in pine and oak forest; flowering and fruiting April–June.

Notes.—*Peperomia bavina* is very fleshy when fresh and very thin when dry. The vegetative parts are puberulous or shortly hispid.

2. *Peperomia cavaleriei* C.DC. in Lecomte, Notul. Syst. (Paris) 3: 41. 1914; Yongqian et al. in Wu & Raven, Fl. China 4: 21. 1999. Types: China,

Kouy-Tcheou, *Cavalerie 2649* (holotype **P**; isotypes **G-DC** [fragm.], **K!**).

Perennial herbs, 3–5 cm high, erect, epiphytic, densely hirsute; stems forming clumps, 1–3 main stems with 2–3 branchlets; stolons present with rooting at nodes; internodes 1–1.5 cm long, densely hirsute. *Leaves* opposite and whorled on terminal branchlets, 3–4-verticillate; lamina chartaceous when dry, elliptic, obovate, rounded or rarely elliptic-oblong, symmetric, 0.5–1.3 by 0.6–1 cm, base rounded or cuneate, apex rounded, margin undulate and hirsute, densely hirsute on both surfaces, more indument on young leaves than mature ones; venation 1–3-palmatinerved, hirsute; petioles 3–5 mm long or short or absent, densely hirsute. *Inflorescence* a solitary spike and 2–3 inflorescences per shoot or sometimes a compound spike, terminal or in the axils of the upper leaves, 2–5 by 0.1–0.2 cm, erect, cylindrical, pale green or yellowish; rachis glabrous, with sparse flowers; peduncles 0.5–1.5 cm long, puberulous. *Flower* with orbicular floral bract, ca 0.5 mm diam., covering the basal part of ovary. *Stamens*: filaments 0.1–0.2 mm long; anthers 0.2–0.3 mm long, slightly exserted at anthesis. *Ovary* ellipsoid, stigma glabrous. *Fruits* without pseudopedicel, dense and immersed in a rachial pit, ellipsoid, 0.7–0.8 by 0.4–0.5 mm, brown and sticky papillate.

Thailand.—NORTHERN: Tak [Umphang, Thung Yai Naresuan Wildlife Sanctuary, 14 Feb. 2011, *C. Suwanphakdee 358-1* (**BK!**, **BKF!**, **KKU!**)].

Distribution.—China.

Vernacular.—Bia phru (เปี้ยพรุ).

Ecology.—Epiphytic on tree trunks in fresh water swamp forest; flowering January–February.

Notes.—*Peperomia cavaleriei* is distinct from all other Thai *Peperomia* by being the smallest in size, hirsute vegetative parts and inflorescences that are longer than stems.

3. *Peperomia cochinchensis* C.DC., Repert. Spec. Nov. Regni Veg. 13: 297. 1914. Types: Vietnam, Cochinchina, Parambicolam, *Meebold 12543* (holotype **BRA**; isotype **G-DC** [fragm.]).

Perennial herbs, 8–10 cm high, epiphytic; stems forming clumps, 2–3 main stems with 2–4 branchlets, puberulous or scabrous; stolons absent.

Leaves opposite and whorled on terminal branchlets, 3–4-verticillate; lamina coriaceous when dry, elliptic, elliptic-oblong, rarely ovate or obovate, red spots on lower surface, glabrous, puberulent, puberulous or rarely scabrous on both surfaces, symmetric or asymmetric, 1–1.5 by 0.6–1 cm, base cuneate, apex acute, subacute or retuse, ciliate, margin undulate; venation 1(–3)-palmatinerved; petioles 0.3–0.5 mm long, puberulous. *Inflorescence* a solitary spike and 1–3 inflorescence/s per shoot, terminal or in the axils of the upper leaves, 2–5 by 0.2–0.3 cm, erect, cylindrical, green; rachis glabrous, with sparse flowers; peduncles 0.3–0.5 mm long, glabrous, puberulent or puberulous. *Flower* with orbicular floral bract, ca 0.5 mm diam., covering the basal part of ovary. *Stamens*: filaments 0.1–0.2 mm long; anthers 0.2–0.3 mm long, slightly exerted at anthesis. *Ovary* ovoid; stigma glabrous. *Fruit* without pseudopedicel, sparse and immersed in a rachial pit, ellipsoid, ca 0.8 by 0.5 mm, bright brown and papillate.

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

Distribution.—China, Taiwan.

Vernacular.—Bia muang nua (เบี้ยเมืองเหินือ).

Ecology.—Epiphytic on tree trunks in pine, oak or evergreen forest; flowering June–November.

Notes.—All parts of *Peperomia cochinesis* are glabrous, puberulent or rarely scabrous and its inflorescences are thick and longer than the peduncles. The lower leaf surfaces have red spots. This species is distributed mainly in high altitude areas in northern Thailand.

4. *Peperomia heyneana* Miq., Syst. Piperac. 1: 123. 1843; Hook.f., Fl. Brit. Ind. 5: 82. 1886; C.DC. in A.DC., Prodr. 16(1): 453. 1869; Long in Grierson and Long, Fl. of Bhutan 1(2): 345. 1984; Gilbert & Nianhe, Novon 9(2): 191. 1999; Yongqian et al. in Wu & Raven, Fl. China 4: 22. 1999. Types: Nepal, Kandrang Garhi, near Kathmandu (Chandaghiri), *Wallich* 6663C (holotype **K-W!**; isotypes **G-DC!**, **GZU**, **H-T**, **U**).

Perennial herbs, 8–15 cm high, erect, epiphytic; stems forming clumps, 2–3 main stems

with 2–4 branchlets; stolons present, without rooting at nodes; internodes 1.5–2.5 cm long, wrinkled when dry, glabrous, puberulous or densely scabrous. *Leaves* opposite and whorled on terminal branchlets, 3–4-verticillate; lamina subcoriaceous when dry, elliptic, elliptic-oblong, rarely obovate, lower surface puberulous or scabrous, upper surface glabrous or puberulous, glabrescent, more indument on lower surface than upper one, asymmetric, 1.5–3.5 by 0.5–1.5 cm, base cuneate or rarely suborbicular, apex rounded, subacute or shallowly emarginate and ciliate, margin entire or undulate; venation 1–3-palmatinerved; petioles 3–10 mm long, puberulous or scabrous. *Inflorescence* a solitary spike and a single inflorescence per shoot, terminal or in the axils of the upper leaves, 8–12 by 0.1–0.2 cm, erect, cylindrical, green; rachis glabrous, with sparse flowers; peduncles 0.5–1.5 cm long, glabrous. *Flower* with orbicular floral bract, ca 0.5 mm diam., covering the basal part of the ovary. *Stamens*: filaments very short; anthers 0.1–0.2 mm long, not exerted at anthesis. *Ovary* ovoid, oblique; stigma glabrous. *Fruit* without pseudopedicel, dense and immersed in a rachial pit, ellipsoid to ovoid-oblong, apex curved, 0.4–0.8 mm, bright brown and papillate.

Thailand.—NORTHERN: Mae Hong Son [Doi Mae Sakut, 23 Sept. 1995, *W. Nanakorn et al.* 4675 (**QBG!**); Pai, 3 Sept. 2006, *J.F. Maxwell* 06-610 (**QBG!**)]; Chiang Mai [Muang, 29 Oct. 1994, *W. Nanakorn* 2542 (**QBG!**), Pangko, Khunwang, 12 March 1965, *T. Smitinand* 8748 (**BKF!**); Doi Pha Hom Pok, 23 Nov. 1998, *P. Suksathan* 1463 (**QBG!**); Mae Chaem, 19 Dec. 1998, *C. Phengkklai & F. Konta* 4851 (**BKF!**), 9 Dec. 1984, *H. Koyama, S. Mitsuta & T. Yahara* T-39919 (**BKF!**); Mae Rim, Mon Long, 15 Oct. 2009, *C. Suwanphakdee* 342 (**BK!**, **BKF!**, **KKU!**); Chiang Rai [Doi Tung, 21 June 2002, *V. Chamchamroon et al.* 1552 (**BKF!**); Tak [Doi Musor, 9 Dec. 1960, *Umpai* 1 (**BK!**), 22 Aug. 1961, *C. Chermisrivatana* 41 (**BK!**)]; NORTH-EASTERN: Loei [Phu Kradueng National Park, 3 Aug. 1948, *D. Bunpheng* 138 (**BK!**, **BKF!**, **K!**), 10 Nov. 1970, 15 Sept. 1990, *P. Chantaranothai, et al.* 90/246 (**K!**, **KKU!**), *K. Suvathabhandhu* 247 (**BK!**), 7 July 1959, *F. Floto* 7384 (**BKF!**, **C!**, **NY!**); Phu Luang Wildlife Sanctuary, 4 Dec. 1965, *M. Tagawa et al.* T-1237 (**BKF!**), Phu Suansai National Park, 25 Aug. 2006, *C. Maknoi* 1048 (**QBG!**)].

Distribution.—India, Sri Lanka, Nepal, Bhutan, Myanmar, China.

Vernacular.—Bia phu khao (เปี้ยภูเข).

Ecology.—Epiphytic on pine and oak in open areas or mountain summits in hill evergreen or evergreen forest; flowering April–October.

Notes.—*Peperomia heyneana* is similar to *P. cochinchensis* but differs by its trichomes, leaf texture and inflorescence length. It also lacks red spots on lower leaf surfaces which are easily observed on fresh specimens of the latter species. *Peperomia heyneana* is common in moderate to high altitudes in northern Thailand. Its leaf size, shape and trichomes show a broad range of variation.

5. *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. Types: Indonesia, Java, Blume s.n., (lectotype **L!**, chosen here; isolectotypes **G-DC!**, **K!**).—*Piper laevifolium* Blume, Verh. Batav. Gen. 9: 200. 1823. Additional Syntypes: Indonesia, Java, Zollinger 1789 (**G-DC**), Zollinger 1960 (**G-DC!**).

Perennial herbs, 20–30 cm high, erect, lithophytic or epiphytic; a single main stem with 2–5 branchlets; stolons present, rooting from basal nodes; internodes 1–2 cm long and forming wings, fleshy, sparse reddish bands, glabrous rarely puberulous. *Leaves* alternate and distichous; lamina chartaceous when dry, elliptic, elliptic-oblong, ovate or rhomboid, with a perimarginal vein, glabrous on both surfaces, asymmetric, 2–3.5 by 1–1.5 cm, base cuneate, apex acute, acuminate, ciliate at the tip, margin undulate; venation 3 (–5)-palmatinerved; petioles 5–8 mm long, sulcate, winged, with reddish spots or bands, glabrous or puberulous. *Inflorescence* solitary spike or 1–3 inflorescence/s per axil along stem, or terminal, 3–5 cm by 0.5–1 mm, erect, cylindrical, pale green; rachis glabrous, with sparse flowers; peduncles 0.8–1 cm long, glabrous. *Flower* with orbicular floral bract, ca 0.5 mm diam., covering the basal part of ovary. *Stamens*: filaments very short; anthers 0.2–0.3 mm long, exserted at anthesis. *Ovary* obovate, oblique, forming a short pseudopedicel; stigma glabrous. *Fruit* with pseudopedicel, sparse and immersed in a rachial pit, ±rounded or oblique, ca 0.5 mm diam., bright brown and papillate.

Thailand.—PENINSULAR: Ranong [Khao Sung, 17 April 1918, A.F.G. Kerr 15256 (**BK!**,

BM!, **K!**); Khao Pho Ta Luang Kaeo, 22 June 1974, R. Geesink et al. 7429 (**BKF!**, **K!**, **L!**); Surat Thani [Khao Hawng, 10 Aug. 1927, A.F.G. Kerr 13256 (**BK!**, **BM!**, **K!**); Trang [Khao Chong, 15 Aug. 1975, J.F. Maxwell 75-884 (**BK!**, **L!**); Nakhon Si Thammarat [Khao Luang National Park, 16 May 1968, C.F. van Beusekom & C. Phengklai 810 (**BKF!**, **L!**), 21 July 1999, S. Watthana et al. 508 (**QBG!**), 18 April 2010, C. Suwanphakdee 304 (**BK!**, **BKF!**, **KKU!**); Phatthalung [Khao Oktalu, 21 April 1928, A.F.G. Kerr 15362 (**BK!**, **BM!**, **K!**); Khao Soi Dao, 29 April 1930, A.F.G. Kerr 19212 (**BK!**, **BM!**, **K!**, **L!**); Satun [Khao Ko Range, 12 March 1928, A.F.G. Kerr 14530 (**BK!**, **BM!**, **C!**, **K!**, **L!**, **P!**)].

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

Vernacular.—Bia khao luang (เปี้ยเขาหลวง).

Ecology.—Epiphytic on basal tree trunks or lithophytic on rocks along streams or waterfalls in evergreen forest; flowering and fruiting in July.

Notes.—*Peperomia laevifolia* is distinguished from other species by having winged internodes and petioles. The plant is usually glabrous, rarely puberulous, and its leaf arrangement is alternate and distichous.

6. *Peperomia moulmeiniana* C.DC., J. Bot. 4: 140. 1866 & in A.DC., Prodr. 16: 415. 1869. Type: Myanmar, Mawlamyine [Moulmein], Parish 118 (holotype **K!**).

Perennial herbs, 10–20 cm high, erect, epiphytic; stems zigzagging and forming clumps, 2–4 main stems with 3–5 branchlets; stolons present, rooting at basal nodes; internodes 1.5–2 cm long, fleshy, glabrous or puberulous. *Leaves* spirally attached; lamina coriaceous or subcoriaceous when dry, elliptic or oblong-elliptic, glabrous, symmetric, 2–4 by 1–2 cm, base cuneate, apex retuse, rounded, obtuse, acute, acuminate or rarely truncate, ciliate, margin undulate, glabrous or puberulous on both surfaces; venation 1–3-palmatinerved, rarely pinnate; petioles 3–5 mm long or subsessile, puberulous or glabrescent. *Inflorescence* a compound spike with 2–4 branchlets, rarely a solitary spike, terminal or in the axils of the upper leaves, 2–4 cm by 1–1.5 mm, erect, cylindrical, pale green; rachis

glabrous, with sparse flowers; peduncles 0.5–1 cm long. *Flower* with orbicular floral bract, 0.5–0.7 mm diam., covering the basal part of the ovary. *Stamens*: filaments ca 0.1 mm long or very short; anthers 0.2–0.3 mm long, slightly exerted at anthesis. *Ovary* ellipsoid; stigma filiform-like and caducous. *Fruit* without pseudopedicel, sparse and immersed in a rachial pit, ±globose, 0.3–0.5 mm diam., bright brown and papillate.

Thailand.— NORTHERN: Tak [Umphang, Thung Yai Naresuan Wildlife Sanctuary, 14 Jan. 2011, *C. Suwanphakdee* 359 (**BK!**, **BKF!**, **KKU!**), same date and locality, *C. Suwanphakdee* 360 (**BK!**, **BKF!**, **KKU!**)]; Nakhon Sawan [Khao Pacho, 5 June 1927, *A.F.G. Kerr* 6072 (**BK!**, **BM!**, **K!**)]; SOUTH-WESTERN: Kanchanaburi [Sangkhla Buri, Thung Yai Naresuan Wildlife Sanctuary, 19 April 2006, *M. van de Bult* 887 (Biology Herbarium, Chiang Mai University!), Takian Thong Waterfall, 20 Oct. 2007, *C. Suwanphakdee* 200 (**BK!**, **BKF!**, **KKU!**), 11 Dec. 2007, *C. Suwanphakdee* 204 (**BK!**, **BKF!**, **KKU!**)].

Distribution.— Myanmar.

Vernacular.— Bia namtok (เบี้ยนัตต).

Ecology.— Epiphytic on trunks in freshwater swamp forest, along streams or in waterfall areas in evergreen forest; flowering and fruiting February.

Notes.— The most distinctive characters of *P. moulmeiniana* are the spiral leaf arrangement and the texture of leaves that are coriaceous when dry. The compound spike has 2–4 branchlets and the thread-like stigma is also a useful character.

7. *Peperomia nakaharai* Hayata, J. Coll. Sci. Imp. Univ. Tokyo 25: 188. 1908; Yongqian et al. in Wu & Raven, Fl. China 4: 22. 1999. Syntypes: Taiwan, Morrison mountain, *G. Nakahara s.n.*, Nov. 1906 (**TI**), *T. Kawakami* 1997 (**TAIF**).

Perennial herbs, 10–20 cm high, erect, epiphytic; stems forming clumps, 1–3 main stems with 2–4 branchlets, stolon absent, without rooting at basal nodes; internodes 2–4 cm long, fleshy, glabrous or slightly puberulous on terminal ones. *Leaves* opposite and 3–4-verticillate on terminal branchlets; lamina chartaceous when dry, elliptic, obovate or oblong-elliptic, glabrous, ±symmetric, 1–3.5 by 0.5–1.5 cm, base cuneate, apex rounded

or truncate, margin undulate, apex glabrous or sparsely ciliate, glabrous on both surfaces; venation 1–3-palmatinerved; petioles 5–8 mm long glabrous, puberulous or glabrescent. *Inflorescence* a solitary spike and a single inflorescence per shoot, terminal or in the axils of the upper leaves, 2–4 cm by 1–1.5 mm, erect, cylindrical, pale green; rachis glabrous, with sparse flowers; peduncles 5–8 mm long. *Flower* with orbicular floral bract, 0.4–0.6 mm diam., covering the basal part of ovary. *Stamens*: filaments ca 0.1 mm long or very short; anthers 0.2–0.3 mm long, slightly exerted at anthesis. *Ovary* ellipsoid; stigma glabrous. *Fruit* pseudopedicellate, ±ellipsoid, 0.4–0.8 mm diam., sparse and immersed in a rachial pit, bright brown and without papillae.

Thailand.— NORTHERN: Chiang Mai [Doi Chang Khian, 16 June 2012, *C. Suwanphakdee* 380 (**BK!**, **BKF!**, **KKU!**)].

Distribution.— Taiwan.

Vernacular.— Bia doi suthep (เบี้ยดอยสุเทพ).

Ecology.— Epiphytic in shaded areas of pine, oak and hill evergreen forests; flowering and fruiting May–June.

Notes.— *Peperomia nakaharai* is similar to *P. heyneana* but is treated as being distinct because it is glabrous in all parts (Yongqian et al., 1999). Thai specimens are slightly puberulous in young plants and are clearly puberulous when observed under high magnification. However, mature plants are glabrous. The fresh leaf is thin compared to thick. Dry leaves are chartaceous compared to sub-coriaceous. All parts are pale green. The plant is epiphytic and mostly in oak, pine and hill evergreen forests at high altitude. However, the living specimens are easy to recognize.

8. *Peperomia portulacoides* (Lam.) A. Dietr., Sp. Pl. 6(1): 172. 1839; C.DC. in A.DC., Prodr. 16: 443. 1869; Ridl., Fl. Malay Penins. 3: 26. 1924.— *Piper portulacoides* Lam. Tabl. Encycl. 1: 82. 1791. Type: Mauritius. *Commerson s.n.* (holotype **P**; isotypes **B**, **MPU**, **P**).

Perennial herbs, 15–25 cm high, erect, litho-phytic or terrestrial; stems forming clumps, 2–3 main stems with 2–4 branchlets, without rooting at nodes; internodes 2–3 cm long, wrinkled when dry,



Figure 1. A. *Peperomia bavina* C.DC.; B. *P. cavaleriei* C.DC. with compound spike inflorescence; C. *P. cavaleriei* C.DC. with single spike inflorescence; D. *P. cochinensis* C.DC.; E. *P. heyneana* Miq.; F. *P. laevifolia* (Blume) Miq.; G. *P. moulmeiniana* C.DC.; H. *P. nakaharai* Hayata; I. *P. portulacoides* (Lam.) A. Dietr. (Photos A-H by C. Suwanphakdee and I by S. Wathana).

puberulous or scabrous. *Leaves* opposite and 3–4-verticillate on terminal branchlets; lamina coriaceous when dry, elliptic, elliptic-oblong, obovate or nearly rounded, upper surface glabrous, lower surface glabrous or puberulous, symmetric or asymmetric, 1.5–3 by 1–2 cm, base cuneate, apex deeply notched, sometimes subacute or rounded, emarginate and ciliate, margin revolute and undulate; venation 1–3-palmatinerved; petioles 0.3–1.5 mm long, puberulous. *Inflorescence* a solitary spike and a single inflorescence per shoot, 2.5–5 by 0.1–0.2 cm, erect, cylindrical, green; rachis glabrous, with sparse flowers; peduncles 0.5–1 cm long, glabrous or puberulous. *Flower* with orbicular floral bract, ca 0.5 mm diam., covering the basal part of ovary. *Stamens*: filaments very short; anthers 0.1–0.2 mm long, not exerted at anthesis. *Ovary* ovoid, oblique; stigma glabrous. *Fruit* without pseudopedicel, sparse and immersed in a rachial pit, oblique-ellipsoid and convex, 0.4–0.8 mm, apex curved, dark brown and papillate.

Thailand.— NORTHERN: Chiang Mai [Doi Inthanon National Park, 18 July 1922, *A.F.G. Kerr* 6343 (**BM!**, **C!**, **K!**), 21 Sept. 1927, *H.B.G. Garrett* 441 (**BM!**) & 21 Sept. 1927, *H.B.G. Garrett* 461 (**BM!**, **L!**, **P!**), 26 July 1988, *H. Koyama et al.* T-61139 (**BKF!**, **GH**, **L!**)]; Phayao [Tham Sakoen National Park, 12 May 2011, *S. Wattana* 3870 (**QBG!**)].

Distribution.—India, Sri Lanka, Mauritius, Reunion, Seychelles.

Ecology.— Shaded areas in limestone forest or hill evergreen forest; flowering and fruiting July.

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REFERENCES

- Backer, C.A. & Bakhuizen van den Brink, R.C. (1963). Piperaceae. In: *Flora of Java*, 1: 167–175. Noordhoff-Groningen, Netherlands.
- Beentje, H. (2010). *The Kew Plant glossary, an illustrated dictionary of plant terms*. Kew Publishing, Richmond, UK.
- de Candolle, C. (1910). Piperaceae. In: M.H. Lecomte (ed.), *Flore Général de l'Indo-Chine*. 1: 63–92. Masson, Paris.
- Long, D.G. (1984). Piperaceae. In: A.J.C. Grierson & D.G. Long (eds.), *Flora of Bhutan*. 1(2): 342–351. Royal Botanic Garden Edinburgh.
- Mathieu, G. (2001–2014). *The Internet Peperomia Reference*, Botanical Garden, Ghent University. <http://www.peperomia.net> (accessed on 5 July 2014)
- Hooker, J.D. (1887). Piperaceae. In: J.D. Hooker (ed.), *Flora of British India*. 5: 78–96. L. Reeve & Co., London
- Huber, H. (1987). Piperaceae. In: M.D. Dassanayake (ed), *A Revised Handbook to the Flora of Ceylon*. 6: 273–299. Amerind Publishing, New Delhi.
- Ridley, H.N. (1924). Piperaceae. In: *Flora of the Malay Peninsula*. 3: 25–51. Reeve, London.
- Stearn, W.T. (1992). *Botanical Latin* 4th edition (third printing 2010). 546 pages, Timber Press, UK.
- The Forest Herbarium. (2001). *Thai Plant Names*. Tem Smitinand, revised edition. The Forest Herbarium, Royal Forest Department, Bangkok.
- Thiers, B. (2012). *Index Herbariorum: A global directory of public herbaria and associated staff*. New York Botanical Garden's Virtual Herbarium. <http://sweetgum.nybg.org/ih/> accessed on: 5 July 2014.
- Wilson, G.C. (1972). New plant records from Thailand. *Kew Bulletin*. 26: 141–148.
- Yongqian, C., Nianhe, X. & Gilbert, M.G. (1999). Piperaceae In: *Flora of China*. Z.Y. Wu & P.H. Raven (eds.), 4: 110–141. Beijing, Science Press & St. Louis, Missouri Botanical Garden Press.