

Taxonomic notes on the genus *Piper* (Piperaceae)

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Sixteen lectotypifications of Asian *Piper* species are provided. *Piper argyrites*, *P. baccatum*, *P. leptostachyum*, *P. majusculum*, *P. peepuloides*, *P. quinqueangulatum* and *P. sulcatum* are accepted as species and many new synonyms are proposed. Useful diagnostic characters are described and geographical distribution data of each species are provided.

Piperaceae is a diverse and widespread family including well-known species such as *Piper betle* (used in as a stimulant in Asian countries such as India, Myanmar, Thailand, Laos and Vietnam), *P. nigrum* (used as black and white pepper spice), *P. ornatum* (used as an ornamental plant), *P. retrofractum* (used as a medicinal plant in Asia) and *P. sarmentosum* (used as a local vegetable and medicinal plant in Asia). Piperaceae is one of the largest angiosperm families, with 1050 species divided into three genera in Asia (Tebbs 1993, Simpson 2006, Mabberley 2008, Suwanphakdee 2012). In 1869, Casimir de Candolle produced a monograph of the whole family for the ‘Prodromus systematis naturalis regni vegetabilis’. He recognized slightly more than 1000 species divided into two genera, *Piper* and *Peperomia*. He relegated all other previously proposed genera to synonymy or to sectional status, thus illustrating conservatism with respect to generic concepts in the family that he continued to favour throughout his life. From the publication of the ‘Prodromus’ until his death in 1918, a period covering approximately half a century, scarcely a line was published on this group except for *Peperomia* (Henschen 1873, Dahlstedt 1900). At the time of his death he had, in manuscript form, a key including all of the species known to him. The ‘Piperacearum Clavis Analytica’ was published posthumously in 1923 and included approximately 3000 species and varieties (De Candolle 1923). There has been some progress in Piperaceae taxonomy in the last one and a half centuries but there are still many outstanding problems and a high amount of synonymy. The primary reason for this situation is the large number of described species (Hodgkinson and Parnell 2007). Many species have been described without any reference to their putative position within the genus. Several factors have contributed to this artificially inflated species number. First, the flowers are small and the vegetative and floral morphology are uniform. Second, species descriptions have often been based on characters of

doubtful taxonomic value, or on fragmentary material often lacking flowers or fruits essential for identification. Third, new species have been described based on their occurrence in distinct political distributional units. The aim of this paper is to clarify seven accepted names from the Asian–Malesian Piperaceae literature.

Material and methods

Herbarium specimens of *Piper* were consulted at AAU, BK, BKF, BM, BO, C, CMU, DMSC, G, G-DC, K, K-W, KEP, KGU, L, PSU, QBG, SING and TCD (Thiers 2015). Specimens were examined under light microscope and compared with type specimens. Label information was also recorded.

Data available from the Dryad Digital Repository: <<http://dx.doi.org/10.5061/dryad.qp50f>> (Suwanphakdee et al. 2016).

Typifications and synonymy

Piper argyrites Ridl. ex C.DC. (1912, p. 25)

Type: Malaysia, Selangor, Gua Batu Cave, Ridley 8176 (lectotype: SING!, designated by Suwanphakdee and Chantaranonthai 2011, p. 239, isolectotypes: K! [K000794914], G-DC! [G00219986]). Fig. 1A, 3, 10A–G.

Taxonomic synonyms: *Piper nigrantherum* C.DC. (1912, p. 20). **Type:** Singapore, Ridley s.n. cultivated in “Singapore Botanic Garden” (holotype: G-DC! [G00320818]); Singapore, Ridley s.n., 27 Dec 1920, cultivated in Singapore Botanic Garden (epitype designated here: K! [K000794917]; isoeotypes: K! [K000794918], K! [K000794919], BM!), syn. nov.

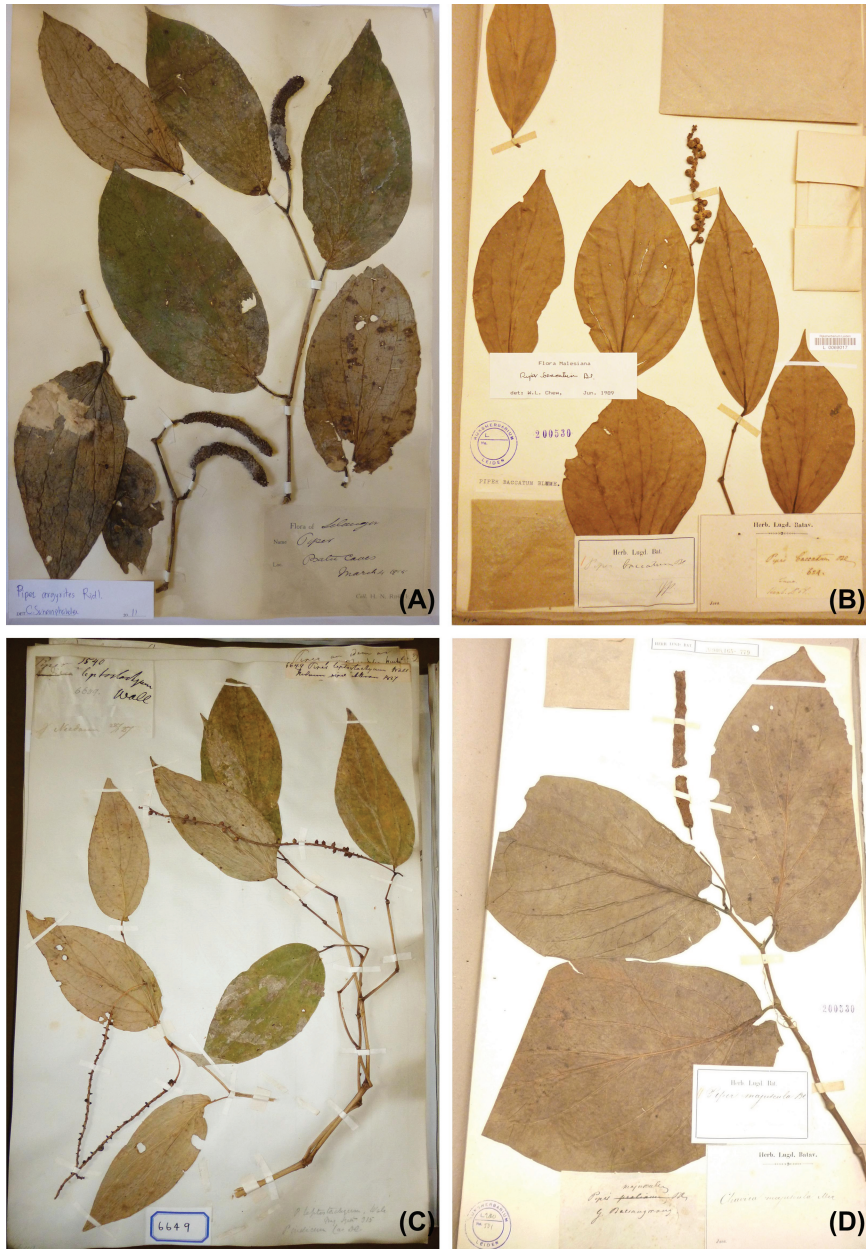


Figure 1. Type specimens of *Piper* species; (A) *P. argyrites* Ridl. ex. C.DC, Ridley 8176 (K), (B) *P. baccatum* Blume, Blume 624 (L), (C) *P. leptostachyum* Wall. ex Miq., Wallich 6649 (K-W), (D) *P. majusculum* Blume, Blume s.n. (L).

– *Piper maculaphyllum* A. Chaveer. & R. Sudmoon (in Chaveerach et al. 2008, p. 120). – **Type:** Thailand, Phuket, Khao Pra Thaeo Wildlife Sanctuary, Chaveerach 126 (holotype: BK?, isotype: BKF?).

Distribution

Thailand, Malaysia, Singapore and Indonesia.

Notes

Suwanphakdee and Chantaranothai (2011) reduced *Piper maculaphyllum* to a synonym of *P. argyrites*. The two species names, *P. argyrites* and *P. nigrantherum*, were published simultaneously. De Candolle (1912, p. 20) described *Piper*

nigrantherum based on material he got from Ridley, which were living specimens taken from Gua Batu Cave, Selangor, Malaysia and cultivated in Singapore Botanic Garden. We found that the type specimen has only a line drawing of leaves and select Ridley s.n. 27 Dec 1920 in K and BM as epitypes because the specimens were collected by Ridley at the same type locality. However, the collections have only inflorescences and leaves. De Candolle (1912) published *P. argyrites* and its description was written by Ridley. The type specimens of this name have infructescences which are useful for species identification. Moreover, new evidence from herbarium specimens and publications indicate that the type specimen of *P. nigrantherum* was collected from

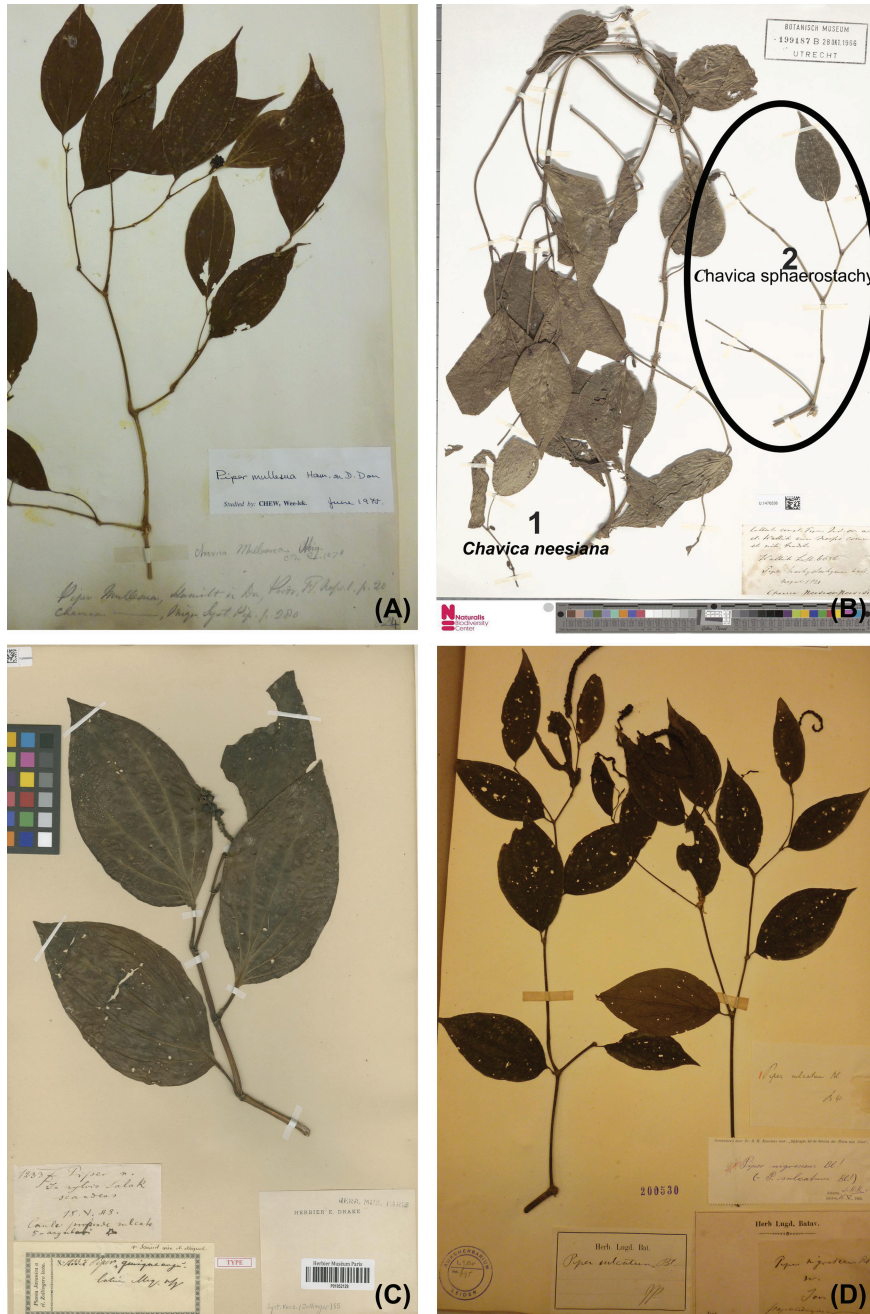


Figure 2. Type specimens of *Piper* species (A) *P. peepuloides* Roxb., Wallich 6650A (U), (B-1) *Chavica neesiana* Miq., (B-2) *Chavica sphaerostachya* Miq., Wallich 6656 (U), (C) *P. quinqueangulatum* Miq. Zollinger 1233 (P), (D) *P. sulcatum* Blume, Blume s.n. (L).

living specimens of *P. argyrites*. We, therefore, reduced *P. nigrantherum* to a synonym of *P. argyrites*. The leaves of this taxon are pink, white and purple when young and turn to pale green at maturity. The fruits are conrescent with velutinous hairs and they have a trigonoid-like persistent style.

***Piper baccatum* Blume (1826, p. 172). Fig. 1B, 4, 10H–L**

Based on the same type: *Muldera baccata* (Blume) Miq. (1843, p. 341).

Type: Indonesia, Java, Blume 624 (lectotype: L! [L1535860], designated here, isolectotypes: U! [U1478540], G-DC! [G00203234], K! [K000794885]).

Taxonomic synonyms: *Piper recurvum* Blume (1826, p. 176). – *Muldera recurva* (Blume) Miq. (1843–1844, p. 343). **Type:** Indonesia, Java, Blume s.n. (lectotype: L! [L1547132], designated here) syn. nov.

– *Muldera firma* Miq. (1863, p. 140), basionym of *Piper firmum* (Miq.) C.DC. (1869, p. 242). **Type:** Indonesia, Sumatra, Korthals s.n.1863 (lectotype: L! [L1545934],

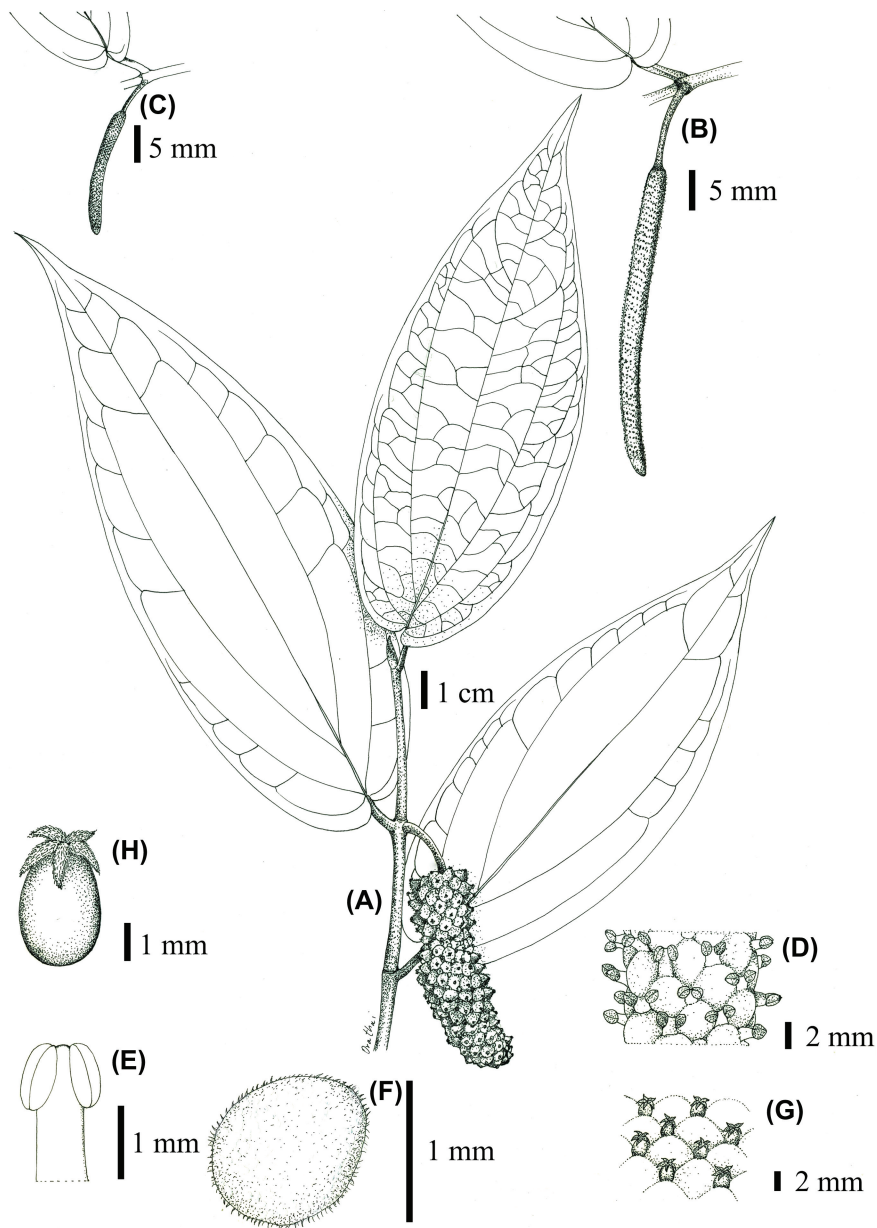


Figure 3. *Piper argyrites* Ridl. ex C.DC. (A) branch with infructescence, (B) male inflorescence, (C) female inflorescence, (D) a portion of male inflorescence, (E) stamen, (F) floral bract (top view), (G) a portion of female inflorescence, (H) ovary (C. Suwanphakdee 246♂ and C. Suwanphakdee 247♀ (BK, BKF, KKU and QBG)). Drawn by O. Kerdkaew.

designated here; isoelectotypes: L! [L1545936], K! [K000575308], G-DC! [G00314043]).

– *Piper ceylanicum* C.DC. (1869 p. 242). **Type:** Sri Lanka, Thwaites 2175 (lectotype: G! [G00203250], designated here; isoelectotypes: K! [K000794403], P [P02030045] photo!, P [P02030046] photo!) syn. nov.

– *Piper pachyphyllum* Hook. f. (1886, p. 80). **Type:** Malaysia, Griffith 4427 (holotype: K! [K000575309]) syn. nov.

– *Piper flavimarginatum* C.DC. (1912, p. 26). **Type:** Singapore, Bukit-Timah, Ridley 3772 (holotype: SING!) syn. nov.

– *Piper protrusum* Chaveer. & Tanee (2011, p. 473). **Type:** Thailand, Phangnga, Sriphangnga National Park, Chaveerach 615 (holotype: BK?) syn. nov.

Distribution

India, Sri Lanka, Thailand, Malaysia, Singapore, Indonesia and the Philippines.

Notes

Blume (1826) published *Piper baccatum* and *P. recurvum* based on his own specimens but did not mention the types. Miquel (1843) transferred *P. baccatum* and *P. recurvum* to

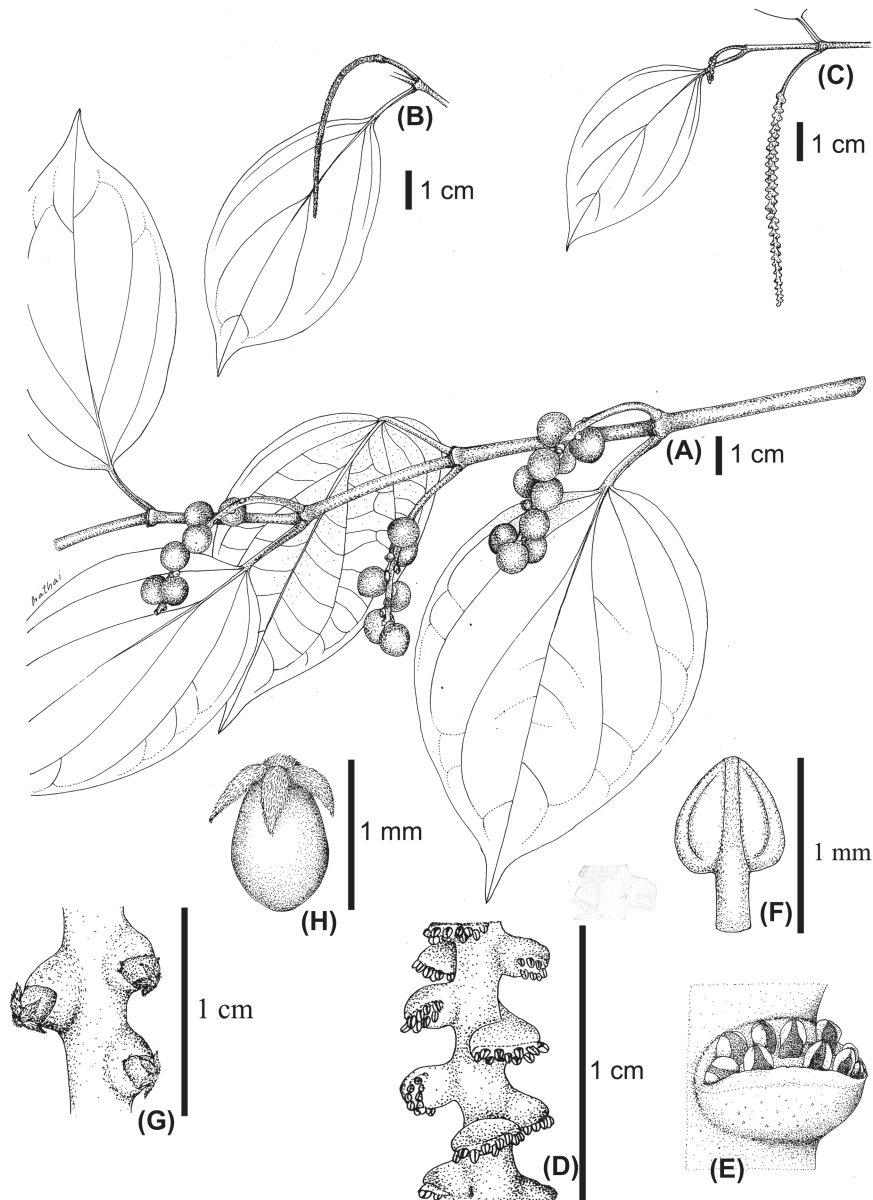


Figure 4. *Piper baccatum* Blume (A) branch with infructescence, (B) male inflorescence, (C) female inflorescence, (D) a portion of male inflorescence, (E) male flower, (F) stamen, (G) a portion of female inflorescence, (H) ovary (C. Suwanphakdee 211♀ (BK, BKF, QBG), C. Suwanphakdee 285♂ (BKF)). Drawn by O. Kerdkaew.

Muldera baccatum and *M. recurvum*, respectively. We examined both and found them to be conspecific. We selected Blume's collections as the type specimens of both names. Sudmoon et al. (2011) published a new species, *P. protrusum* based on DNA barcode techniques using *rpoB*, *rpoC1* and the *psbA-trnH* inter-genic spacer region of plastid DNA and indicated that the type of this species is deposited in BK. However, we were unable to find this specimen and, from discussion with staff in BK, understand that it is not

deposited in this herbarium. Using comparisons of the line drawing and description of *P. protrusum*, we found that it matches the morphology of *P. baccatum*. We synonymized *P. recurvum*, *M. firma*, *P. ceylanicum*, *P. pachyphyllum* and *P. flavimarginatum* with *P. baccatum*. The diagnostic characters of *P. baccatum* are its conchiform or bilabiate floral bracts, very fleshy leaves that are shiny green when fresh and coriaceous when dry, and its sessile fruits sometimes with a pseudo-stalk that are formed from the floral bract.

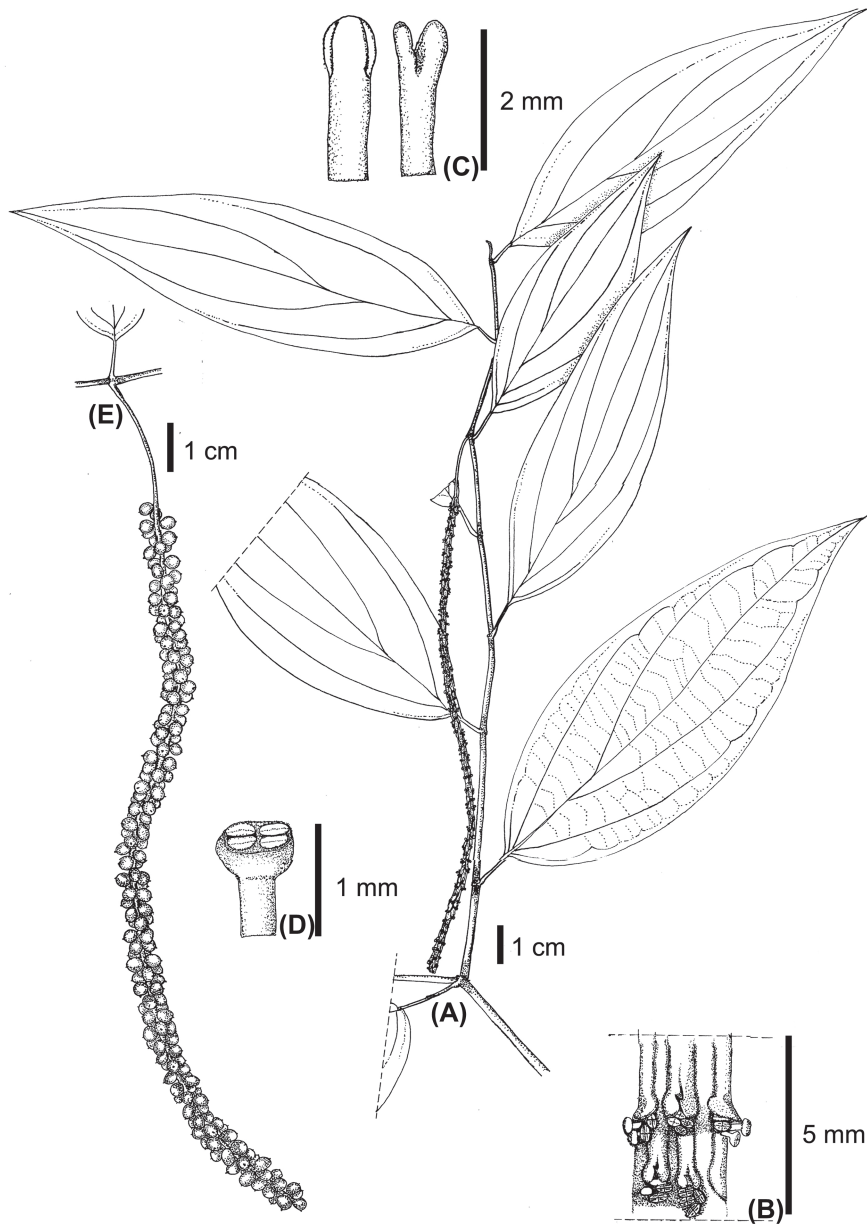


Figure 5. *Piper leptostachyum* Wall. ex Miq. (A) branch with female inflorescence, (B) a portion of male inflorescence, (C) floral bracts (front and back views), (D) stamen, (E) infructescence (C. Suwanphakdee 464♀ (BK, BKF, K KU, QBG), C. Suwanphakdee 465♂ (BKF, K KU and QBG)). Drawn by L. Loe-Khachon.

***Piper leptostachyum* Wall. ex Miq. (1843, p. 315).
Fig. 1C, 5, 11A–G**

Type: Myanmar, Nidaun/Ataran river, Wallich 6649 (holotype: K-W! [K001124408]).

Taxonomic synonyms: *Piper indicum* C.DC. (1869, p. 362). **Type:** Myanmar, Nidaun/Ataran river, Wallich 6649 (holotype: G-DC! [G00206817]) syn. nov.

– *Piper nigrum* var. *macrostachyum* C.DC. (1869, p. 363). **Type:** India, Khasia, Hooker and Thomson s.n. (holotype: G-DC! [G00206465]).

– *Piper rhytidocarpum* Hook. f. (1886, p. 92). **Type:** Bangladesh, Chittagong, Hooker and Thomson s.n. (lectotype: K! [K000794414], designated by Gilbert and Xia 1999, p. 194; isolectotypes: K! [K000794408], BM!) syn. nov.

– *Piper chandocanum* C.DC. (1898, p. 274), ‘*chaudocanum*’. **Type:** Vietnam, Monte Chandoe, Harmand 536 (holotype: G-DC! [G00329209]) syn. nov.

Distribution

India, Bangladesh, China, Thailand, Lao PDR, Vietnam and Cambodia.

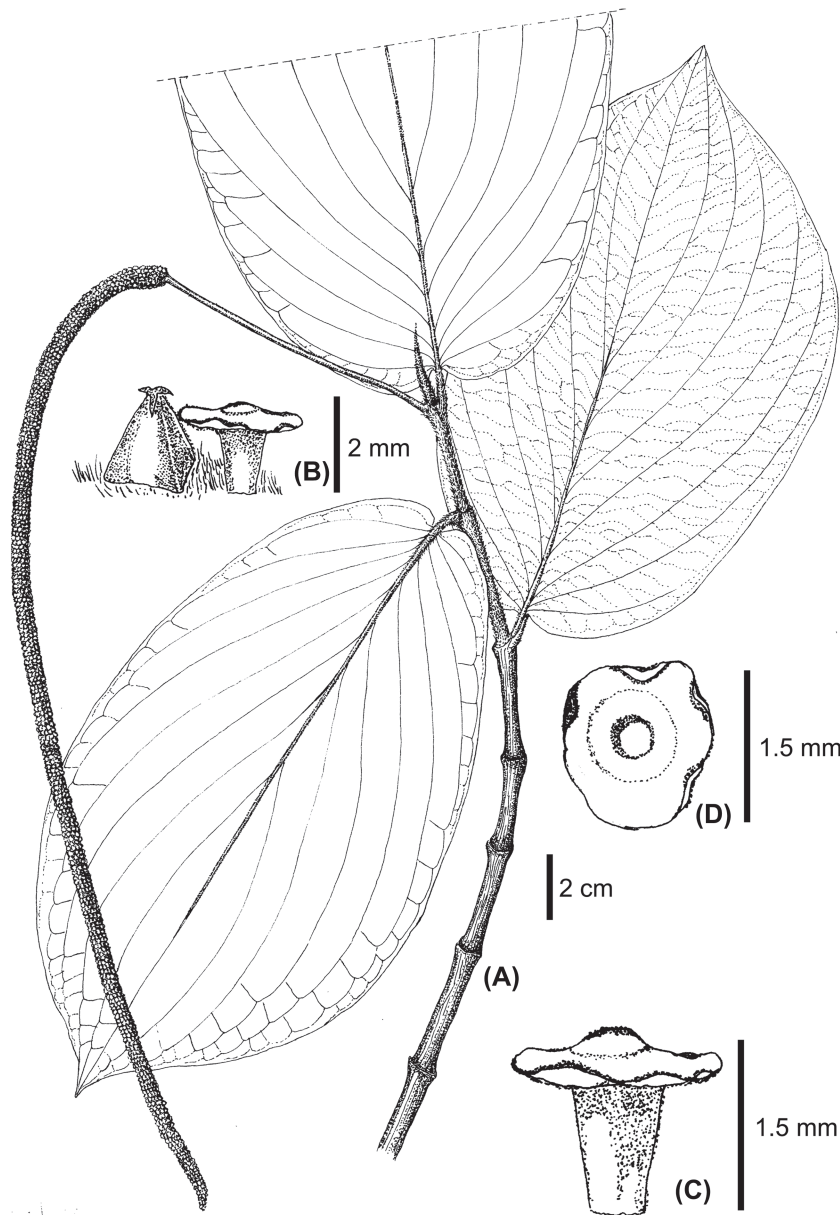


Figure 6. *Piper majusculum* Blume (A) branch with an infructescence, (B) female flower, (C)–(D) floral bract (side and top views) (C. Suwanphakdee 54♀ (BK, BKF, KCU). Drawn by P. Inthachub.

Notes

De Candolle (1869) published *P. indicum* based on Wallich 6649, making it a homotypical synonym of *P. leptostachyum*. Gilbert and Xia (1999) placed *P. madidum* and *P. nigrum* var. *macrostachyum* under *P. rhytidocarpum*. We found that *P. rhytidocarpum* and *P. chaudocanum* are conspecific with *P. leptostachyum*. This species is distinguished by its inflorescences that are produced from terminal branches and its floral bract that is oblong when flowering and spatulate when fruiting. It is similar to *P. nigrum* but differs in its elliptic-oblong leaf, transversely dehiscent stamens, and

infructescence and fruit that are longer and larger than *P. nigrum*. The ripening fruits are dark purple to black.

***Piper majusculum* Blume (1826, p. 210). Fig. 1D, 6, 11H–I**

Based on the same type: *Chavica majuscula* (Blume) Miq. (1843, p. 271).

Type: Indonesia, Java, Blume s.n. (lectotype: L! [L1546892], designated here, isotype: G-DC! [G00206465]).

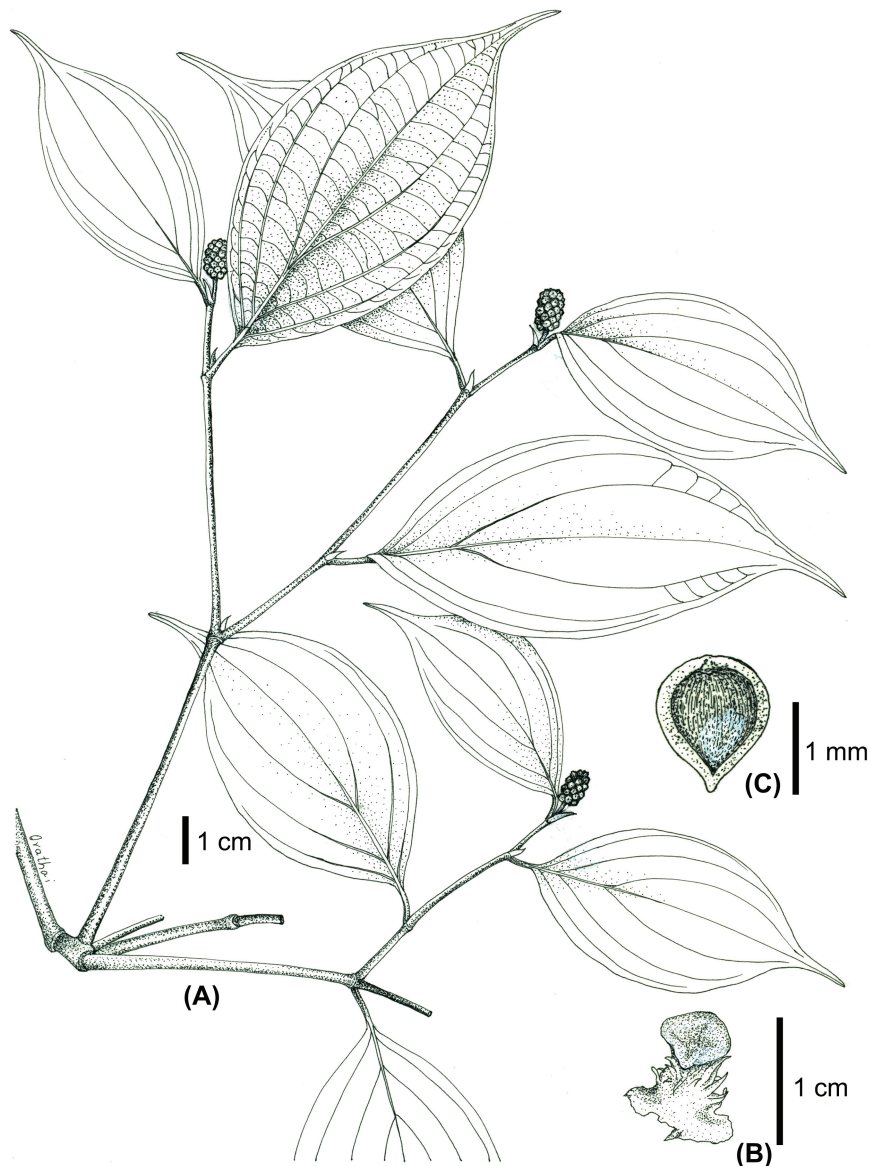


Figure 7. *Piper peepuloides* Roxb. (A) branch with infructescence, (B) floral bract, (C) fruit (P. Srisanga 2249♀ (QBG)). Drawn by O. Kerdkaew.

Taxonomic synonyms: *Piper rotundistigmum* C.DC. (1910a, p. 425). **Type:** Philippines, Mindanao, Lake Lanao, Camp Keithley, Clemens s.n. (holotype: G-DC! [G00322943]) syn. nov.

– *Piper febrifugum* C.DC. (1912, p. 10). **Type:** Malaysia, Sunjei Ujong, Atrar Sang Trap, Alvin 1867 (lectotype: SING!, designated here; islectotypes: BM!, K! [K000794923]) syn. nov.

– *Piper kraense* Ridl. (1920, p. 112), ‘*kraensis*’. **Type:** Thailand, Ranong, Kra Isthmus, Kloss 7045 (lectotype: K! [K000794895], designated here; islectotype: SING!) syn. nov.

– *Piper subgrande* Ridl. (1925, p. 329). **Type:** Malaysia, Batu caves, Ridley 14013 (holotype: K! [K000794913]) syn. nov.

– *Chavica amboinensis* Miq. (1863, p. 134), basionym of *Piper amboinense* (Miq.) C.DC. (1869, p. 347). **Type:** Indonesia, Sylvis, Amboina, Forsten s.n. (lectotype: U! [U1476512], designated here; islectotypes: U! [U1476511], L! [L15360006], L! [L1536005]).

Distribution

India, Myanmar, Thailand, Malaysia, Indonesia, New Guinea and the Philippines.

Notes

Blume (1826) published *Piper majusculum* based on his own collection, but without indicating a type. Later, Miquel (1843) made a new combination and transferred *P. majusculum* to *Chavica*. We found the description and all the notes of de Candolle (1912) according to which Alvin

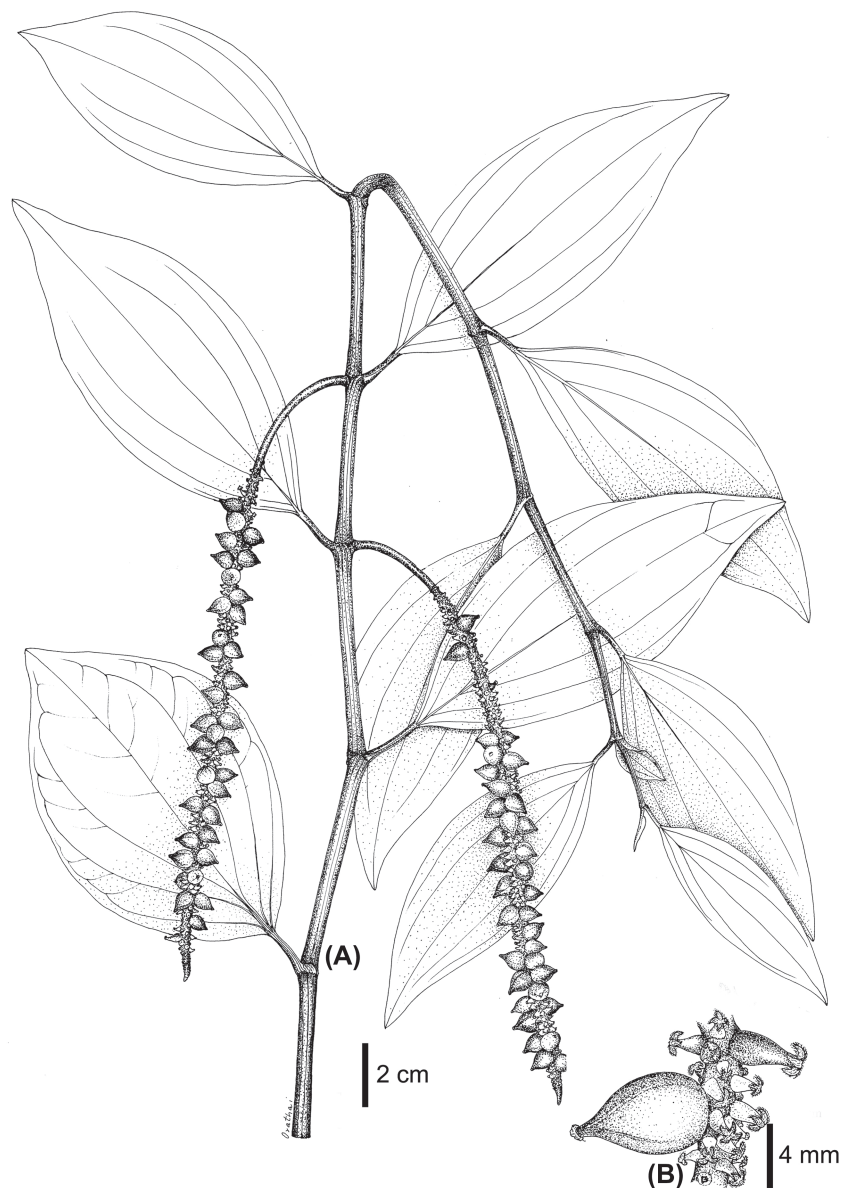


Figure 8. *Piper quinqueangulatum* Miq. (A) branch with infructescence, (B) fruits and female flowers (C. Niyomdham 5332♀ (BKF, K)). Drawn by O. Kerdkaew.

1867 (SING) is the type of *P. febrifugum*, not Ridley 1867 as mentioned in De Candolle (1912). We found that *P. amboinense*, *P. rotundistignum*, *P. febrifugum*, *P. kraense* and *P. subgrande* are conspecific. *Piper majusculum* has the largest leaves and longest inflorescences of southeast Asian Piperaceae. Its leaves are glabrous to velutinous, and its fruitlets are very small and conrescent.

***Piper peepuloides* Roxb. (1814, p. 4, 1820, p. 159).
Fig. 2A, 7**

Based on the same type: *Chavica peepuloides* (Roxb.) Miq. (1843, p. 237).

Type: Bangladesh, Sylhet, Wallich 6650A (lectotype: U! [U1476553], designated here; isolectotypes: K! [K000794359], K-W! [K000794360]).

Taxonomic synonyms: *Piper mullesua* Buch.-Ham. ex D. Don (1825, p. 20), basionym of *Chavica mullesua* (Buch.-Ham. ex D. Don) Miq. (1843, p. 280). **Type:** Nepal, Naranhetty, Hamilton, 17 Jan 1803 (holotype: BM!).

– *Piper guigual* Buch.-Ham. ex D. Don (1825, p. 20), basionym of *Chavica guigual* (Buch.-Ham. ex D. Don) Miq. (1843, p. 280). **Type:** Nepal, Naranhetty, Hamilton, 6 Feb 1803 (holotype: BM!).

– *Chavica neesiana* Miq. (1843, p. 249). **Type:** Nepal, Wallich 6656 (holotype: U! [U1476536], left-hand side of herbarium sheet). Fig. 2B–1.

– *Chavica sphaerostachya* Miq. (1843, p. 278). **Type:** Nepal, Wallich 6656 (lectotype: U! [U1476536], right-hand side of herbarium sheet, designated here, Fig. 2 (B-2); isolectotype: K! [K000794464]).

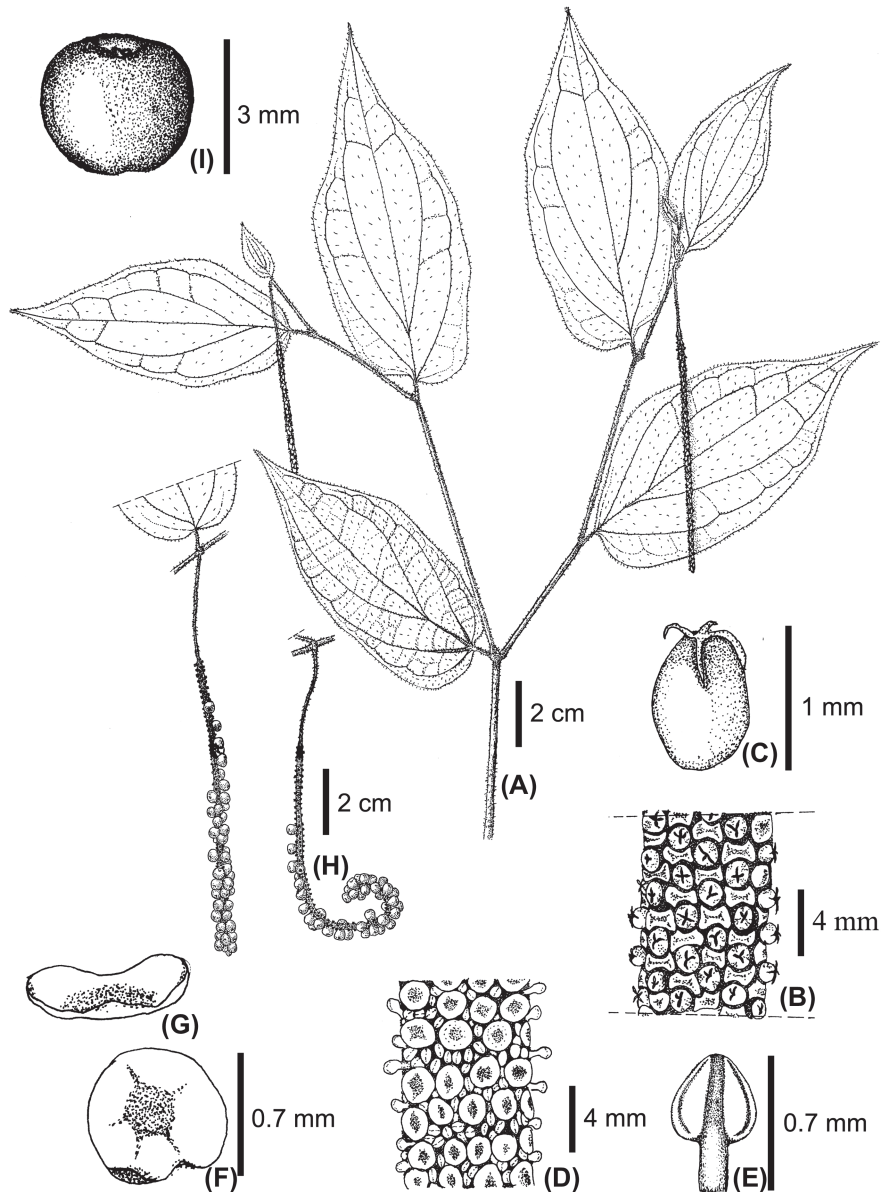


Figure 9. *Piper sulcatum* Blume (A) branch with inflorescence, (B) a portion of female inflorescence, (C) ovary, (D) a portion of male inflorescence, (E) stamen, (F)–(G) floral bract (top and side views), (H) infructescences (C. Suwanphakdee 53♀ (BK, BKF, KKU) and C. Suwanphakdee 280♂ (BKE, QBG)). Drawn by L. Loe-Khachon.

– *Piper brachystachyum* Hook. f. (1886, p. 87). **Type:** Nepal, Wallich 6656 (lectotype: K-W! [K001124432], designated here; isolectotypes: K-W! [K001124429], BM!, G-DC! [G00207123]).

– *Piper vasculosum* Wall. nom. nud. Material: India, Nilgiri, Wallich 6660 (K-W! [K001124438]).

Distribution

India, Sri Lanka, Nepal, China and Thailand.

Notes

Roxburgh (1814) published *P. peepuloides* as a nomen nudum, but published a validating description in Roxburgh

(1820), but he did not mention a type. Later, Miquel (1843) transferred the name to the genus *Chavica*. Miquel (1843) described *Chavica neesiana* and indicated that the major part (left-hand side of herbarium sheet) of Wallich 6656 at U (barcode U1476536) is the holotype. However, he also indicated that the minor part (female specimen) on the right hand side of the same herbarium sheet, and Schmidt s.n. (U, barcode U1477628), are the types of *C. sphaerostachya*. We therefore designated the minor part (female specimen), on the right-hand specimen of Wallich 6656 at U (barcode U1476536) as the lectotype of *C. sphaerostachya*, in preference to Schmidt s.n. (U1477628), because the specimen has an infructescence that is informative for species identification that the other specimen lacks. Hooker (1886)

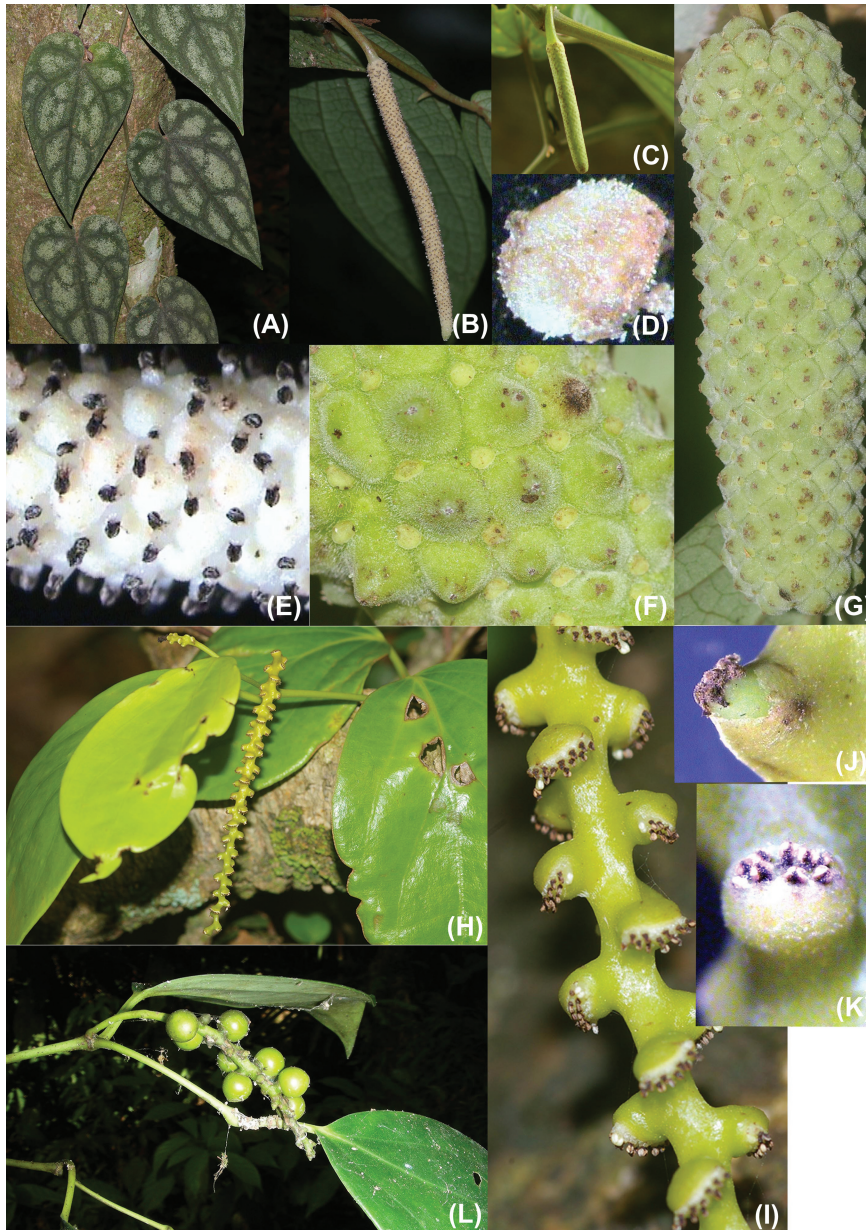


Figure 10. *Piper argyrites* Ridl. ex C.DC. (A) young leaves, (B) male inflorescence, (C) female inflorescence, (D) floral bract, (E) a portion of male inflorescence, (F) a portion of infructescence, (G) infructescence, *P. baccatum* Blume (H) male inflorescence, (I) a portion of male inflorescence, (J) female flower, (K) male flower, (L) infructescence. Photo by C. Suwanphakdee.

described the second sheet as the type of *P. brachystachyum* and placed *C. neesiana* and *C. sphaerostachya* as synonyms of *P. brachystachya*. We found duplicates of Wallich 6656 in several herbaria (BM, K, K-W, G, G-DC and U). After consulting all type specimens, we found that they are conspecific and placed *C. mullesua*, *C. neesiana*, *C. peepuloides*, *C. sphaerostachya*, *P. mullesua*, *P. guigual*, *P. brachystachyum* as synonyms under *P. peepuloides*. The infructescence of *P. peepuloides* is distinct by being globose or subglobose. The fruits are dense and concrescent in some collections. The young leaves smell sweet when bruised.

***Piper quinqueangulatum* Miq. (1854, p. 85)**

Type: Indonesia, Java, Zollinger 1233 (holotype: P [P01952129] photo!). Fig. 2C, 8, 12A–E.

Taxonomic synonyms: *Piper korthalsii* Miq. (1863, p. 139). **Type:** Indonesia, Sumatra, Korthals s.n. (lectotype: L! [L1547158], designated here, isolectotype: K! [K000820065]).

– *Piper cristatum* C.DC. (1910b, p. 770). **Type:** Philippines, Mindanao, Elmer 10703 (lectotype: G-DC! [G00329641],

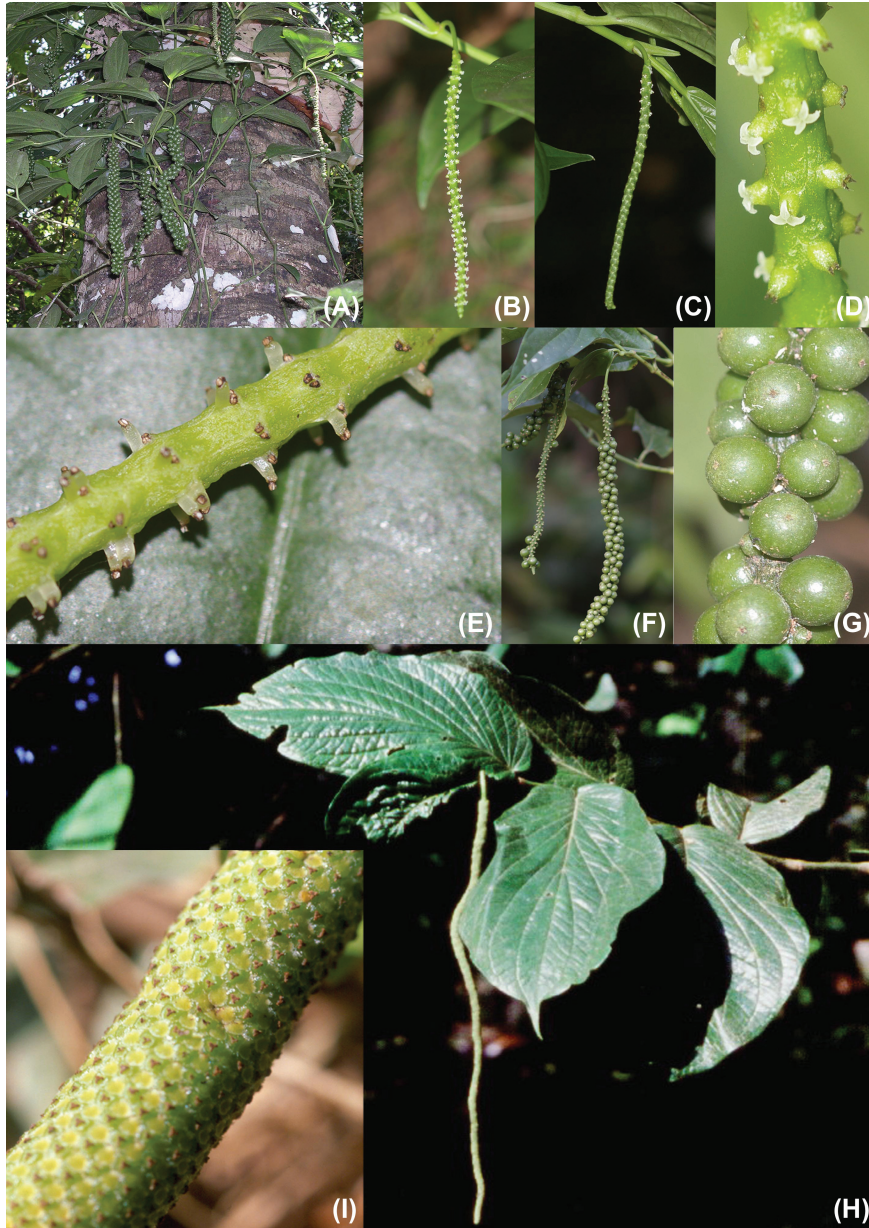


Figure 11. *Piper leptostachyum* Wall. ex Miq. (A) habit, (B) female inflorescence, (C) male inflorescence, (D) a portion of female inflorescence, (E) a portion of male inflorescence, (F) infructescence, (G) fruits, *P. majusculum* Blume (H) branch with inflorescence, (I) a portion of infructescence. Photo by C. Suwanphakdee.

designated here, isoelectotypes: BM!, BISH (photo!), E (photo!), GH (photo!), MO (photo!), NY (photo!), US (photo!) syn. nov.

– *Piper magnibaccum* C.DC. (1912, p. 5). **Type:** Malaysia, Perak, Maxwell Hill, Ridley 5480 (lectotype: SING!, designated by Suwanphakdee et al. 2006, p. 207; isoelectotype: G-DC! [G00320017]) syn. nov.

– *Piper amphibracteatum* C.DC. (1914, p. 128). **Type:** Malaysia, Gibbs s.n. Feb.1910 (holotype: BM!) syn. nov.

– *Piper salticola* Ridl. (1923, p. 88). **Type:** Indonesia, Sumatra, Ridley s.n. Feb 1921 (lectotype: K! [K000820064], designated here; isoelectotypes: K! [K000575307], K! [K000820063]) syn. nov.

Distribution

Thailand, Malaysia, Indonesia and the Philippines.

Notes

This species is easily recognized by its 5–7-winged stem and petioles that are similar to the stem of the genus *Dioscorea*

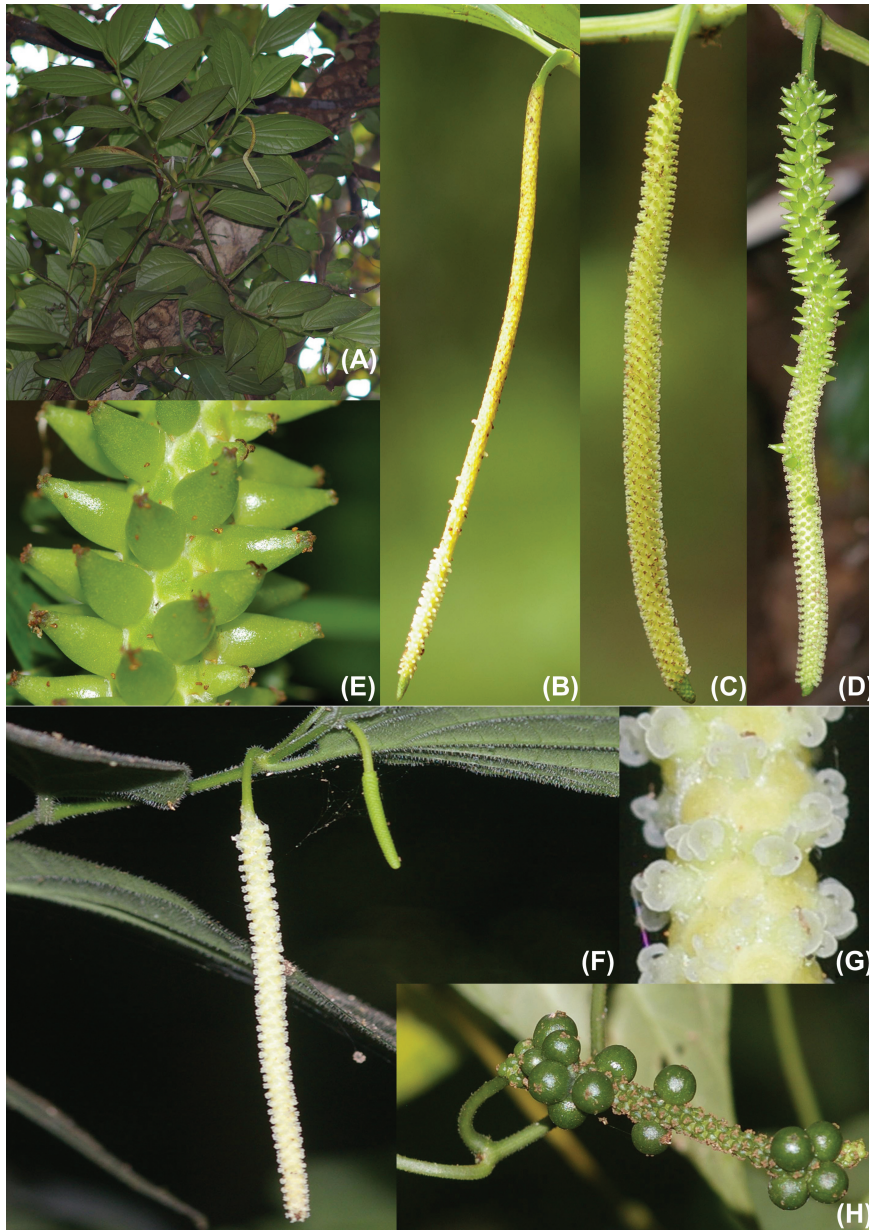


Figure 12. *Piper quinqueangulatum* Miq. (A) habit, (B) male inflorescence, (C) female inflorescence, (D) infructescence, (E) fruits, *P. sulcatum* Blume (F) female inflorescence, (G) a portion of female inflorescence, (H) infructescence. Photo by C. Suwanphakdee.

(Dioscoreaceae). The pointed and curved fruit apex is also useful for species identification. Some infructescences are more than 30 cm long.

***Piper sulcatum* Blume (1826, p. 158)**

Type: Indonesia, Java, Blume s.n. (lectotype: L! [L1542853], designated here; isotype: G-DC! [G00206472]). Fig. 2D, 9, 12F–H.

Taxonomic synonym: *Piper nigrescens* Blume (1826, p. 161).
Type: Indonesia, Java, Blume s.n. (lectotype: L! [L1542854], designated here; isotype: BO!).

Distribution
 Thailand, Malaysia and Indonesia.

Notes
 Blume (1826) described *P. sulcatum* and *P. nigrescens* and provided a line drawing, but did not select a type. Later, by hand writing on the herbarium sheet he indicated that these species were conspecific. We chose the two collections of Blume in L, barcode L1542853 and L1542854 to be the type of *P. sulcatum* and *P. nigrescens*, respectively, and synonymize them. *Piper sulcatum* is distinguished by its chartaceous and glaucous leaves that have pilose or velutinous hairs on both surfaces. The male inflorescences are longer than the female ones and the apex of fruit is retuse when dry.

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