Phytotaxa 697 (1): 129–137
https://www.mapress.com/pt/

Article

ISSN 1179-3155 (print edition)
PHYTOTAXA
ISSN 1179-3163 (online edition)

https://doi.org/10.11646/phytotaxa.697.1.9

Piper hongheense (Piperaceae), a new species from Yunnan, China

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Abstract

Piper hongheense (Piperaceae), a new species from Yunnan Province of China, is here described and illustrated. Morphologically it is similar to *Piper boehmeriifolium* and *Piper boehmeriifolium* var. *glabricaule*, from which it can be easily distinguished by the combination of characters: height 0.7–1 m, leaves oblong-lanceolate to lanceolate, 10–16 cm × 2.5–4 cm, infructescences ±0.6 cm in diam., berries and bracts white when mature. The description of the new species includes photographs, a detailed description, notes on etymology, distribution and habitat, as well as a comparison with morphologically similar species.

Key words: Asia, Honghe Prefecture, morphology, taxonomy, tropical flora

Introduction

Piper Linnaeus (1753: 28) is the nominal genus of the family Piperaceae, comprising over 2,600 species, mainly distributed in the tropics (Mabberley 2008, Jaramillo *et al*. 2023), and it is also one of the oldest and most diverse lineages among basal angiosperms (Tebbs 1993, Soltis *et al.* 1999, Jaramillo *et al*. 2008). The greatest diversity of *Piper* species occurs in the American tropics (1804 spp.), followed by the Southeast Asian tropics (~600 spp.), and the South Pacific (78 spp.) (Ulloa Ulloa *et al*. 2017, Sen *et al*. 2022). The Neotropical species are shrubs/treelets with bisexual flowers, while the South Pacific ones are dioecious shrubs/treelets, and the Asian species are dioecious root climbers. Phylogenetic analyses confirm that the genus is monophyletic and it is divided into Neotropical, Asian, and South Pacific clades (Jaramillo & Manos 2001, Jaramillo & Callejas 2004, Wanke *et al*. 2007, Jaramillo *et al*. 2008, Smith *et al*. 2008). *Piper* species are rather uniform morphologically, with simple, alternate leaves, jointed stems with enlarged nodes, and perianthless flowers arranged in condensed terminal spikes (Tebbs 1993). Despite its high species richness, previous studies showed that most *Piper* species were found in restricted geographical ranges (Marquis 2004, Hao *et al.* 2012).

In tropical Asia, *Piper* is distributed throughout southeast Asia, extending from the north to southern China and Korea, westward to the Indian Subcontinent, and then eastward to New Guinea and Australia. The vast majority of species are climbing vines, and very few are herbs or small shrubs. Climbers exhibit strong leaf dimorphism between the monopodial, orthotropic shoots and the sympodial, plagiotropic branches (Jaramillo *et al.* 2008). In climbing species,

Accepted by Marie-Stéphanie Samain: 19 Mar. 2025; published: 10 Apr. 2025

leaves on monopodial shoots are cordate or ovate, and often equilateral at base, whereas leaves on fertile, sympodial branches are ovate, lanceolate or elliptic, and often oblique at base. The inflorescences are lax, erect or pendulous, being solitary and densely arranged with the flowers. The flowers of most species are unisexual and dioecious. Fruits are free or sunken into the rachis and are frequently green, yellow, or red in color. Many economically important species originated here, such as *P. nigrum* Linnaeus (1753: 28) and *P. betle* Linnaeus (1753: 28) (Colvard *et al*. 2006, Scott *et al.* 2008).

China spans the tropical, subtropical and temperate zones, and is an important distribution area of *Piper* species (Hao *et al*. 2012). More than 60 *Piper* species are represented, half of which are endemic, and eight species have been listed in the *China Species Red List* since 2004 (Gilbert & Xia 1999, Cheng *et al.* 1999, Wang & Xie 2004, Hao *et al.* 2012, 2015, 2017, 2020, Su *et al*. 2022, 2024). During floristic investigations of *Piper* in South China, we collected an interesting new species from Honghe Prefecture in Yunnan Province of China, which is morphologically similar to *Piper boehmeriifolium* (Miquel 1843: 265) Wallich ex C. de Candolle (1869: 348) and *Piper boehmeriifolium* var. *glabricaule* (C. de Candolle 1917: 477) M.G. Gilbert & N.H. Xia (1999: 191). Based on a thorough examination of the morphological characteristics of this plant and its potential relatives, we assert that it is an undescribed species. It is proposed here as *Piper hongheense*.

Materials and methods

Morphological studies of the new species were conducted based on the type specimens deposited in the herbarium IBSC and the living plants distributed in the Daweishan National Nature Reserve in Honghe Prefecture. Photographs of the plants in the wild were taken with Canon D50 digital camera. All morphological characters were studied with a Leica M50 stereomicroscope and Dino-Lite digital microscope. A detailed examination of the morphological characters of this plant and its potential relatives was conducted. Specimens were examined from the following herbaria: A, B, E, G, IBK, IBSC, HITBC, K, KUN, MO, PE, US, and VNM (Thiers 2022).

Taxonomy

Piper hongheense W.J. Zhao, C.Y. Hao & N.H. Xia, *sp. nov.* (Figs. 1–2)

Type:—CHINA. Yunnan: Pingbian County, Daweishan National Natural Reserve, tropical montane moist forests, elevation 1424 m, 23°00'07"N, 103°41'53"E, 19 May 2023, *C.Y. Hao et al*. *Hao0159* (holotype IBSC 0918555!, isotypes IBSC 0918556, IBSC 0918557!).

Erect subshrub, 0.7–1 m high, aromatic, dioecious. Stem greenish, terete, 3–4 mm in diameter, young branchlet sparsely puberulent, glabrescent, finely striate when dry, swollen at node. Leaf dimorphism present, prophyll 1–2 cm long. Sympodial leaf membranous to chartaceous, finely glandular, oblong-lanceolate to lanceolate, 10–16 cm × 2.5–4 cm, base subequilaterally truncate to oblique, one side rounded, the other tapered and acute; apex acutely acuminate to long acuminate, adaxially green and glabrous, abaxially pale greenish and sparsely puberulent on veins; petioles glabrous, 5–7 mm long; venation plinerved, veins 5–9, reticulate, uppermost distal pair of secondary veins alternate, arising 1–3 cm above base, reaching leaf apex, others basal. Monopodial leaf exhibits morphological similarities to sympodial leaf, with the primary distinction being that the base of monopodial leaf is predominantly symmetrical. Inflorescence a pedunculate spike, leaf-opposed, solitary, pendulous, cylindrical, white. Male inflorescence delicate, 10–15 cm × 2–3 mm; peduncle slender, 3–3.5 cm long, glabrous; axis glabrous; bracts imbricate, white, subcircular, 1.5–2 mm wide, base often concave, apex slightly protruding, peltate, stalk 0.8–1 mm long; stamens 2; filaments marginally longer than anthers, anthers ovoid to globose, 2-locular. Female inflorescences shorter than male ones, 4–8 cm × 3–5 mm; peduncle and bracts as in male spikes; rachis sparsely pubescent; ovary ovoid, distinct; stigmas 3 or 4. Infructescence pendulous, 5–10 × 0.5–0.8 cm, glabrous, cylindrical, white. Fruit single–seeded berry, ±1.5 mm in diam., ovoid to globose, connate on rachis, glabrous, distinct; floral bracts persistent, white; seed pale brown, ovoid, ±1 mm in diam., smooth.

Phenology:—Flowering from March to June; fruiting from July to November.

Etymology:—The epithet refers to its distribution, Honghe Prefecture in Yunnan, China.

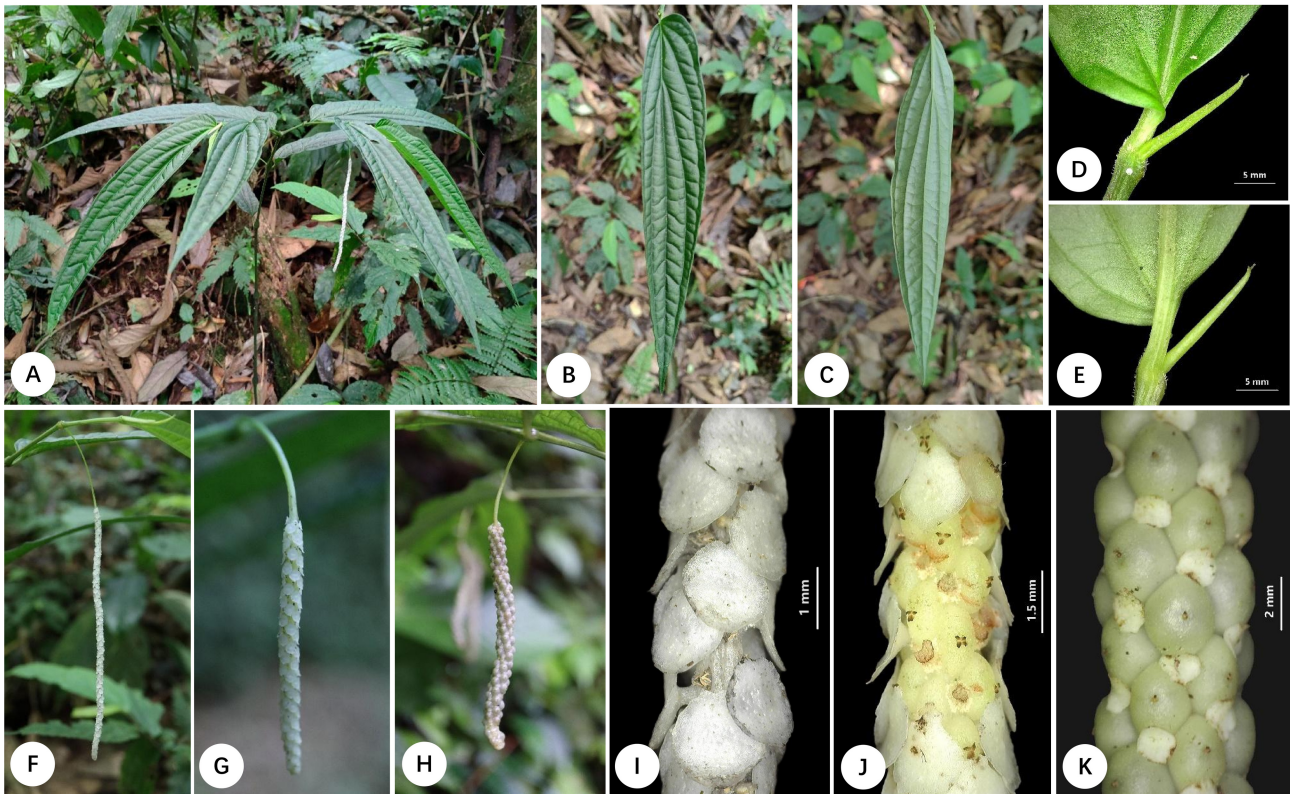

FIGURE 1. *Piper hongheense* W.J. Zhao, C.Y. Hao & N.H. Xia, sp. nov. **A** habit; **B** adaxial surface of leaf; **C** abaxial surface of leaf; **D** adaxial surface of leaf base and petiole; **E** abaxial surface of leaf base and petiole; **F** male spike; **G** female spike; **H** mature infructescence; **I** close-up of portion of the male spike; **J** close-up of portion of the female spike (some bracts were removed); **K** close-up of portion of the mature infructescence. Photographs by R. Fan & C.Y. Hao based on the holotype.

Distribution and habitat:—*Piper hongheense* is currently known only from its type locality in Pingbian county, Honghe Prefecture in Yunnan (Fig. 3), in wet tropical montane forest, at elevations of 1000–1600 m. Nevertheless, considering that this new species thrives in the shadow of wet tropical montane forests in Jinping, a region adjacent to Tinh Ha Giang and Tihn Lao Cai in Vietnam, it is highly likely that the species is also present in Vietnam.

Taxonomic affinities:—The new species is morphologically similar to *P. boehmeriifolium* and *P. boehmeriifolium* var. *glabricaule*. Following a detailed comparison with specimens and the academic literature (De Candolle 1869, Gilbert & Xia 1999), we have determined that *P. hongheense* can be unequivocally distinguished by several key characteristics, as outlined in the diagnosis above and summarized in Table 1 and Fig. 4.

Additional specimens examined:—CHINA. Yunnan: Pingbian County of Jinping Prefecture, Shibanxiang, 3 October 1954, *G.–M. Feng 04736* (PE!); Pingbian County of Jinping Prefecture, Xinnongxiang, 13 July 1953, *P.-Y. Mao 02455* (KUN!); Pingbian County of Jinping Prefecture, Pujijing, 29 March 1958, *G.-M. Feng 21778* (KUN!).

Discussion

Asian taxa of the genus *Piper* have been studied in numerous publications (Wallich 1824-1849, Blume 1826, Hooker 1887, De Candolle 1910, 1912, 1923, Ridley 1924, Backer & Bakhuizen van den Brink 1963, Long 1984, Huber 1987, Gardner 2006, Suwanphakdee *et al*. 2006, 2008, 2011, 2012, 2014, 2020, Asmarayani 2018). A recent study of phylogenetic relationships revealed that Asian Pipers predominantly distributed to the west of Wallace's line (WWL) formed a moderately/strongly supported clade, and 12 subclades were identified within the WWL clade (Asmarayani 2018). In light of the morphological traits and geographical dissemination, *P. hongheense* ought to be assigned to the subclade W1. Pipers in this subclade include both climbers and shrubs, both dioecious and polygamous. The bracts are round, peltate, subsessile to sessile, and the fruits are generally free but crowded, thus giving the appearance of being confluent.

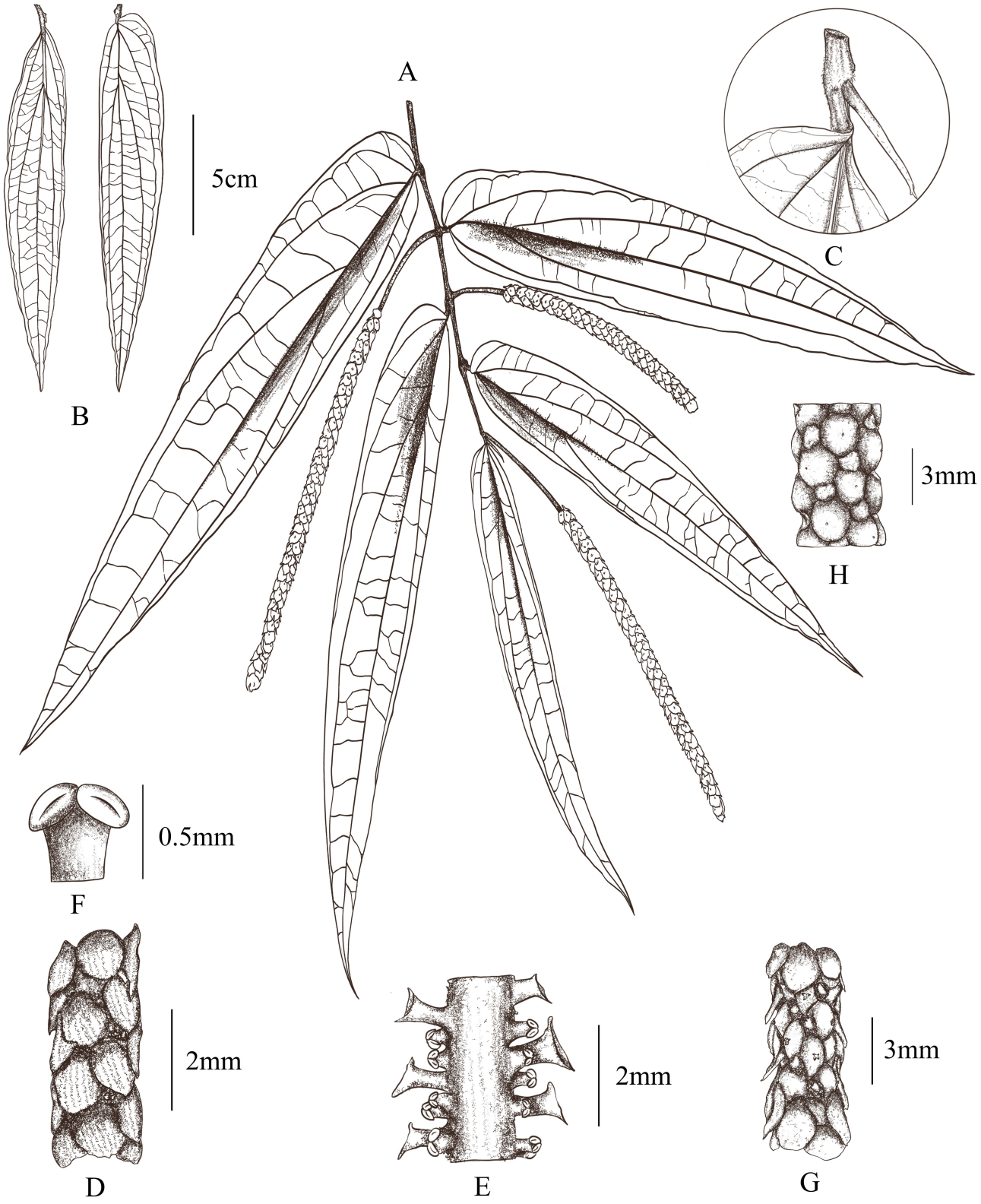

FIGURE 2. Line drawing of *Piper hongheense* W.J. Zhao, C.Y. Hao & N.H. Xia. **A** branch with female infructescence; **B** adaxial surface of monopodial leaf on the left, and abaxial surface of sympodial leaf on the right; **C** detail of the leaf base and the prophyll; **D** magnified view of male inflorescence; **E** magnified view of the longitudinal section of male inflorescence; **F** stamen; **G** magnified view of female inflorescence; **H** magnified view of infructescence. Illustration by F. Su based on the holotype.

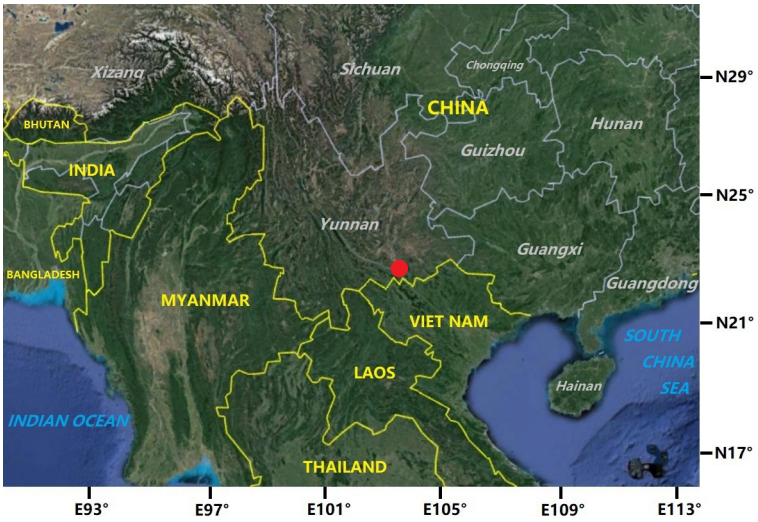

FIGURE 3. Distribution of *Piper hongheense* in Yunnan, China. Map by C.Y. Hao.

FIGURE 4. Morphological characteristics of *Piper boehmeriifolium* and *Piper boehmeriifolium* var. *glabricaule.* **A** Habit of *P. boehmeriifolium*; **B** Immature infructescence of *P. boehmeriifolium*; **C** Mature infructescence of *P. boehmeriifolium*; **D** Habit of *P. boehmeriifolium* var. *glabricaule*; **E** Immature infructescence of *P. boehmeriifolium* var. *glabricaule*; **F** Mature infructescence of *P. boehmeriifolium* var. *glabricaule*. Photographs by R. Fan & C.Y. Hao.

In terms of morphological characteristics, the new species is similar to *P. boehmeriifolium* and *P. boehmeriifolium* var. *glabricaule*, which belong to the subclade W1. *Piper hongheense* is currently known only from Honghe Prefecture in the southern Yunnan province. *Piper boehmeriifolium* is found in Guangdong, Guangxi, Hainan, Guizhou, and Yunnan provinces of China, as well as in northern Vietnam, while *P. boehmeriifolium* var. *glabricaule* is distributed in southern Yunnan, China. After examination of material of *P. boehmeriifolium* and *P. boehmeriifolium* var. *glabricaule*, we ascertained that the new species exhibits variations in several characteristics, particularly: height 0.7–1 m high; leaves dimorphic, oblong-lanceolate to lanceolate, 10–16 cm × 2.5–4 cm; infructescences ±0.6 cm in diam.; berries and bracts white when mature. The subclade includes another shrubby species, *P. sarmentosum* Roxburgh (1820: 163). The new species exhibits distinct morphological differences compared to *P. sarmentosum* and can be easily distinguished from the latter in several aspects: the leaf blade oblong-lanceolate to lanceolate (vs. ovate to suborbicular), inflorescence pendulous (vs. upright), infructescence white, berry free (vs. infructescence green, berry partly connate to rachis).

Considering its extremely small population size and living environment, *P. hongheense* should be classified as Critically Endangered according to the World Conservation Union Red List Categories and Criteria (IUCN Standards and Petitions Committee 2024). We recommend that this new species be included in the updated version of the List of Wild Plants and Plants with Minimal Populations under National Key Protection in China.

Yunnan Province in Southwest China is one of the biodiversity hotspots in the world (Li *et al*. 2020). With only 4.1 percent of the country's total land area, Yunnan has all ecosystem types, except ocean (Li 1995). It is one of the 17 key biodiversity areas in China, the core and convergence area of global biodiversity hotspots, and the natural gene pool of China and even the world (Li 1995). According to the literature so far known, this province owns high species diversity of the *Piper* genus including a total of 40 species, among which 20 species are endemic (Hao *et al.* 2012, 2020 Yang *et al*. 2016, Su *et al*. 2022, 2024). Due to the complex topography and large elevation differences, it is suggested to strengthen the investigation of *Piper* plant resources in Yunnan, especially in southern Yunnan.

TABLE 1. Morphological comparison of key characteristics among *Piper hongheense*, *P. boehmeriifol*ium and *P. boehmeriifolium* var. *glabricaule*.

	P. hongheense	***P. boehmeriifolium***	***P. boehmeriifolium* var. *glabricaule***
Habit	subshrub, 0.7–1 m high, glabrous, young branchlet sparsely puberulent	subshrub, 1-3 (-5) m high, glabrous to ± uniformly hairy	subshrub, more than 1.5 m high, glabrous except for rachis and bases of bracts
Leaves	membranous to chartaceous; oblong-lanceolate to lanceolate, 10–16 × 2.5–4 cm; adaxially glabrous, abaxially sparsely puberulent on veins	membranous to chartaceous; elliptic, narrowly elliptic, oblong, or ± ovate, (8–)11–24 × 4–9.5 cm; adaxially glabrous except sometimes for sparsely pubescent veins, abaxially glabrous or occasionally puberulent	thickly chartaceous; elliptic, narrowly elliptic, or oblong, 15-21 × 6-9.5 cm; glabrous
Venation	veins 5–9, uppermost distal pair of secondaries arising 1–3 cm above base, others basal	veins 6-10, uppermost distal pair of secondaries arising 1/3-1/2 way along midvein, next pair often also above base, others basal	veins 9 or 10, uppermost distal pair of secondaries arising 1/2 way along midvein, next pair arising 1-2 cm above base, others basal
Inflorescences	March–June	December–July	December–March
Infructescences	±0.6 cm in diam., white when mature	±1 cm in diam., red when mature	±1 cm in diam., red when mature

Acknowledgements

This study was financially supported by the Collection, Preservation, Identification and Evaluation of Tropical Crop Germplasm Resources in Remote Tropical Area (NONYNCBKFSXM2023-2025) and National Natural Science

Foundation of China (Project No. 31201263). We are grateful to the curators of A, B, E, G, IBK, IBSC, HITBC, K, KUN, MO, PE, US, and VNM for permission to access their collections. We thank Zhong-Cai Li, Xian-Rui Peng, Jun-Tao Gong, Lu Chen and Cheng-Xing Gao for their support during the fieldwork. We are also grateful to two anonymous reviewers for their careful review of the manuscript.

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