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Taxonomic notes on the *Piper pedicellatum* C. DC. (Piperaceae)

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Abstract

Based on the evidence from morphology, literature survey and specimen examination, *Piper curtipedunculum* (Piperaceae) is recognized as independent species which is used to be a synonym of *Piper pedicellatum*. *Piper boehmeriifolium* var. *glabriceule*, *Piper terminaliflorum* and *Piper yunnanense* are considered as new synonyms of *P. pedicellatum* to which they are similar by a series of morphological characters. And the morphological differences, similarities and geographical ranges of these plant are clarified.

Keywords

Piper, morphology, new synonym, reinstated, taxonomic revision

Introduction

Piper Linnaeus (1753: 28) is the nominate genus of the family Piperaceae and one of the most diverse lineages among basal angiosperms (Tebbs 1993, Soltis et al. 1999), comprising approximately 2,000 species, mainly distributed in the tropics (Gentry 1982, Kubitzki et al. 1993, Marquis 2004, Quijano-Abril et al. 2014). Asian taxa of *Piper* have been studied in numerous publications and currently estimated with more than 600 species (Wallich 1824–1849, Blume 1826, Hooker 1886, De Candolle 1910, 1912, 1923, Ridley 1924, Backer and Bakhuizen van den Brink 1963, Long 1984, Huber 1987, Gardner 2006, Suwanphakdee et al. 2006, 2008, 2011, 2012, 2014). Till now, more than 60 species have been recorded in China, half of which are endemic (Gilbert and Xia 1999, Cheng et al. 1999, Gajurel et al. 2001, Hao et al. 2012, Hao et al. 2015, Hao et al. 2017, Hao et al. 2020).

It is hard to identify the specimens of *Piper* accurately due to polytypic blades, lack of perianth, only tiny bracts, stamens and pistils in the flowers. Moreover, depending on the herbarium specimens and the insufficient observation to the population variation pattern, there are still some taxonomic problems in Chinese *Piper* species, such as misapplication of names, unclear species delimitation and improper taxonomic treatment of some species.

The aim of this paper is to clarify *P. pedicellatum*, *P. curtipedunculum*, *P. boehmeriifolium* var. *glabricaule*, *P. terminaliflorum* and *P. yunnanense* based on our extensive examination of literature studies and detailed observations on the field populations. The related articles of *International Code of Nomenclature*(ICN) (Turland et al. 2018) were followed for nomenclature changes.

Material and methods

Original publications and descriptions of *P. pedicellatum*, *P. curtipedunculum*, *P. boehmeriifolium* var. *glabricaule*, *P. terminaliflorum* and *P. yunnanense* were obtained from the literature survey of the library, Tropicos (<http://www.tropicos.org/>), Biodiversity Heritage Library (<https://www.biodiversitylibrary.org/>), JES (<https://www.jse.ac.cn/>), Jstor (<https://www.jstor.org/>), CVH (<https://www.cvh.ac.cn/index.php>) and other data. Label information was also recorded.

We examined specimens that kept in all the major Chinese herbaria, holotype especially, including IBSC, KUN, NAS and PE, and in some non-Chinese herbaria as well, including A, B, E, G, K, MO, P and US. The size and shape of leaves and inflorescences were studied first. Then the details of flowers and fruits were examined. Through the study of a large number of specimens, the morphological character variation pattern, phenology, habitat and other information of those plants were preliminarily understood, which laid a foundation for field work.

The basic distribution data and photographs of the those plants were collected during our fieldwork from 2012 to 2021 in Yunnan province of China. The habitat was photographed and some of major morphological characters were measured, such as plant life form, size and shape of the leaves and inflorescences, details of flowers and fruits, form of the floral bracts and others.

Results

Piper curtipedunculum C. DC. in Notizbl. Bot. Gart. Berlin-Dahlem: 481. 1917.
Figure 1, 2 ; Table 1

Type. CHINA. Yunnan Province, Mengzi, Elevation:1829 m, *A. Henry 10438* (holotype: B [B100294777!]; isotypes: A [A00005900!], E [E00318488!]; G [G00314149!]; K [K000794373!]; MO [MO-150824!]; US [US 00105456!]).

Note. De Candolle (1917) described *Piper curtipedunculum* (Piperaceae) based on *A. Henry 10438* (A, B, E; Fig. 1 A-C) , from Mengzi, southeastern Yunnan province, China. *Piper pedicellatum* C. DC.(1866) was also described by De Candolle based on specimens from Bangladesh, with *A. Henry 9482A* (B; Fig. 1 D-F) being the holotype. Y.C. Tseng (1979) published a new distribution of *P. pedicellatum* in China, in *Acta Phytotaxonomica Sinica*, who stated that the species was similar to *P.*

curtipedunculum, but differs from it by leaves 7-9 veins, 3 of which emanate from the base; Pedicels often as long as petioles; bracts large, 1-1.2 mm in diameter (leaves 7-9 veins, 5-7 of which emanate from the base; Pedicels length, often twice as long as petioles; bracts 0.5-1 mm in diameter). M.G. Gilbert and N.H. Xia(1999) considered that the difference was small between the two species and *P. curtipedunculum* was considered as a synonym of *P. pedicellatum* in *Flora of China*.

In the protologue, we found that both of them were described as liana and no significant characteristic difference by De Candolle. However, *P. curtipedunculum* can easily be distinguished from *P. pedicellatum* by several morphological characters. We examined the holotype and origin specimens of both names and found that *P. pedicellatum* were subshrubs and *P. curtipedunculum* were woody lianas. Morphology of leaves, inflorescences and fruits were obviously different. Field observation and examination on the different populations of both species showed that *P. pedicellatum* and *P. curtipedunculum* were differ significantly in their leaf blade shape (ovate or narrowly ovate to broad elliptic vs. trophophyll leaf blade lanceolate, gonophyll leaf blade broad lanceolate to ovate), leaf blade texture (papery, rough vs. leathery, glossy), infructescence size (length 4-10 cm, 7-11 mm in diameter vs. length 5-10 cm, 3-4 mm in diameter), mature berries (obovate, 4-angled, 2-3 mm in diameter, red vs. globose, 0.8-1.2 mm in diameter, green), and stigmas (3 or 4 vs. 3)(Figure 1, Table 1).



FIGURE 1. **A-C** Type of *P. curtipedunculum* C. DC., Mengzi Yunnan Province, **A** holotype, B100294777; **B-C** isotype, A00005900, E00318488, respectively. **D-F** Type of *P. pedicellatum* C. DC., Bangladesh, **D** lectotype, K000794428; **E** isolectotype, P01656299; **F** Syntype, K000794427.

Table 1. Comparative features of *P. curtipedunculum* and *P. pedicellatum*

	<i>P. curtipedunculum</i>	<i>P. pedicellatum</i>
Plant life form	Woody liana	Subshrub
Bracts diameter	0.5-1 mm	1-1.2 mm
Male inflorescence	15-30cm	15-25 cm
Stamens number	2	2
Female inflorescence	7-18 cm	4-9 cm
Stigmas number	3	3 or 4
Infructescence length	8-20cm	5-10cm
Infructescence diameter	3-5mm	6-10
Fruit size	0.8-1.2mm	2-3mm
Fruit shape	globose	obovate, 4-angled
Mature fruit color	green	red

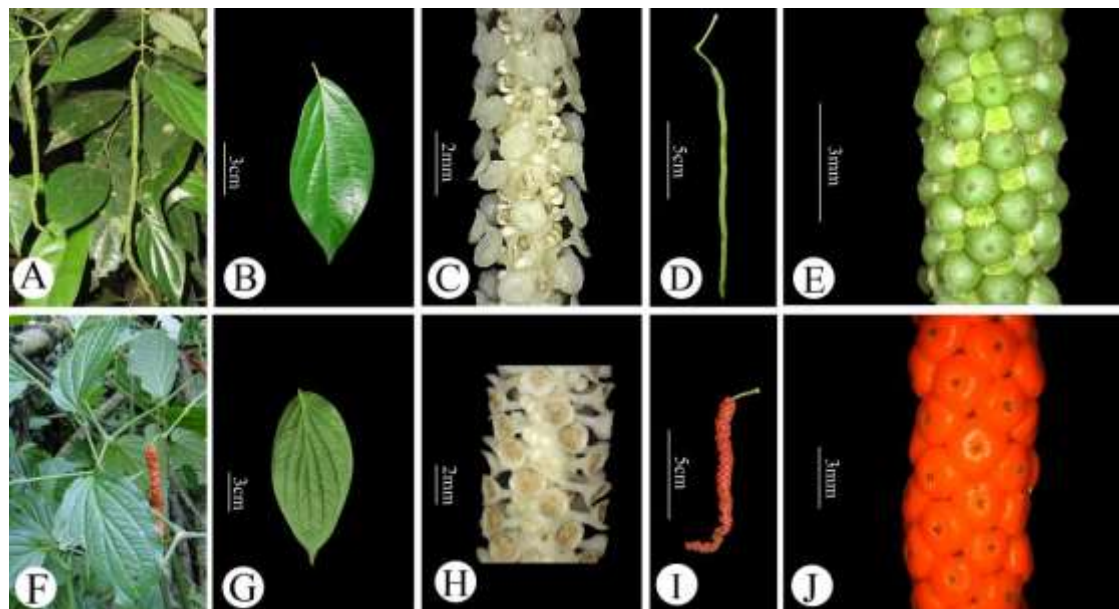


FIGURE 2. A-E *P. curtipedunculum* C. DC. in the wild (Xishuangbanna, Yunnan). A Branch with infructescence; B Adaxial of gonophyll; C Detail of male Spike; D infructescence; E Detail of infructescence. F-J *P. pedicellatum* C. DC. In the wild (Gaoligong mountains, Baoshan, Xishuangbanna, Yunnan). F Branch with infructescence; G Adaxial of gonophyll; H Detail of male Spike; I infructescence; J Detail of infructescence.

Piper pedicellatum C. DC., J. Bot. 4: 164. 1866. Figure 3; Table 2.

Piper glabricaule C. DC., Notizbl. Bot. Gart. Berlin-Dahlem 6: 477. 1917. *Piper boehmeriifolium* var. *glabricaule* (C. DC.) M.G. Gilbert & N.H. Xia, Novon 9(2): 191. 1999. Type: CHINA, Yunnan, Mengzi, elevation: 1524 m, A. Henry 9482A (holotype: B [B100294885!]; isotypes: A [A00005904!]; G [G barcode 00314823!], K [K000575306!]; US [US00106402!]).

Piper terminaliflorum Y.Q. Tseng, Acta Phytotax. Sin. 17(1): 30 – 31, f. 7. 1979. Type: CHINA, Yunnan, Feng-qing, elevation 2200 m, 24 June 1938, T.T.Yü 16454 (holotype: PE [PE00002934!]; isotypes: A [A 00005913!]). **syn.nov.**

Piper yunnanense Y.Q. Tseng, Acta Phytotax. Sin. 17(1): 32. f. 9. 1979. Type: CHINA, Yunnan, Shuangjiang, elevation 1100-2000 m, nearby the stream in the forest ; 22 September 1957, G. S. Xin 1132 (holotype: IBSC [0000687!]; isotypes: NAS [00070272!]; KUN [KUN0435506, KUN0435507!]).

Type. BANGLADESH, Bengalia Orient, *Griffith 4404* (lectotype: K [K000794428!]; isolectotype: P [P01656299!]).

Note. *Piper glabricaule* C. DC. was designated based on only one specimen in branch with male spike (Fig. 3A) by De Candolle (1917) from Mengzi, altitudes 1524 m, Yunnan province in China. M.G. Gilbert and N.H. Xia (1999) reduced *P. glabricaule* to a variety of *Piper boehmeriifolium* mainly because the former is different in leaf morphology and infructescence size. According to the original description, *P. glabricaule* is more similar to *P. pedicellatum* with slight differences in leaf morphology. There should be two extremes of a continuum of material and the leaves are often transitional and not well demarcated in the wild.

The type specimens of *Piper terminaliflorum* Y.Q. Tseng and *Piper yunnanense* Y.Q. Tseng were both collected from Lincang of Yunnan Province in China by Y.Q. Tseng (1979). Y.Q. Tseng stated that the *Piper terminaliflorum* was similar to *P. glabricaule*, but differed by its inflorescences insertion patterns. M.G. Gilbert and N.H. Xia (1999) considered that the difference was small between *P. terminaliflorum* and *P. boehmeriifolium* and placed *P. terminaliflorum* as a synonym of *P. boehmeriifolium* in *Flora of China*. During 2012 to 2021, we carried out continuous field investigation of *Piper* species in Lincang and Mengzi, Yunnan Province. And we also compared the type of specimens and protologue of these four plants. The results showed that the life form, leaves shape and texture, finely glandular, base oblique, veins number, inflorescence structure and length, fruit shape and size vary continuously and have no much distinct morphological difference (Table 2, Fig. 3). In addition, the type localities of the four species are not far away from each other. These available evidence indicate that these species are actually conspecific. *P. pedicellatum* is different from *P. boehmeriifolium* by its leaf blades ovate or narrowly ovate to elliptic, base broadly cuneate or suborbicular, bilateral difference 2-3 mm, apex acute to acuminate, female spikes 6.5-8 mm thick in fruit (leaf blades narrowly elliptic, oblong, oblong-lanceolate, base oblique, bilateral difference 5-10 mm, apex acute to long acuminate, female spikes 3-3.5 mm thick in fruit)(Fig. 1D, Fig. 3E-G).

Table 2. Comparative features from the original description and holotype.

	<i>P. pedicellatum</i>	<i>P. glabricaule</i>	<i>P. terminaliflorum</i>	<i>P. yunnanense</i>
Plant life form	Subshrub	Subshrub	Subshrub	Subshrub
Leaves shape	ovate or narrowly ovate to elliptic	elliptic, narrowly elliptic, or oblong	Oval or broad oval	ovate, those at apex of stem elliptic
Leaves texture	chartaceous, glandular	chartaceous, glandular	chartaceous, glandular	chartaceous, glandular
Veins number	7-9	9-10	9	9
Bracts	Orbicular, peltate	Orbicular, peltate	Orbicular, peltate	Orbicular, peltate
Male inflorescence	N.A.	15-21 cm	14-16 cm	N.A.
Female inflorescence	4-5 cm	6-8 cm	N.A.	4-8 cm
Infructescence length	4-12 cm	6-12 cm	N.A.	4-8 cm
Fruit size	Berry obovate, 4-angled	Berry obovate, 4-angled.	N.A.	Berry obovate, 4-angled.
Holotype locality	Bengalia Orient	Mengzi, Yunnan	Feng-qing, Yunnan	Shuangjiang, Yunnan
Elevation range	1000-1900 m	500-1900 m	1600-2200 m	1100-2000 m

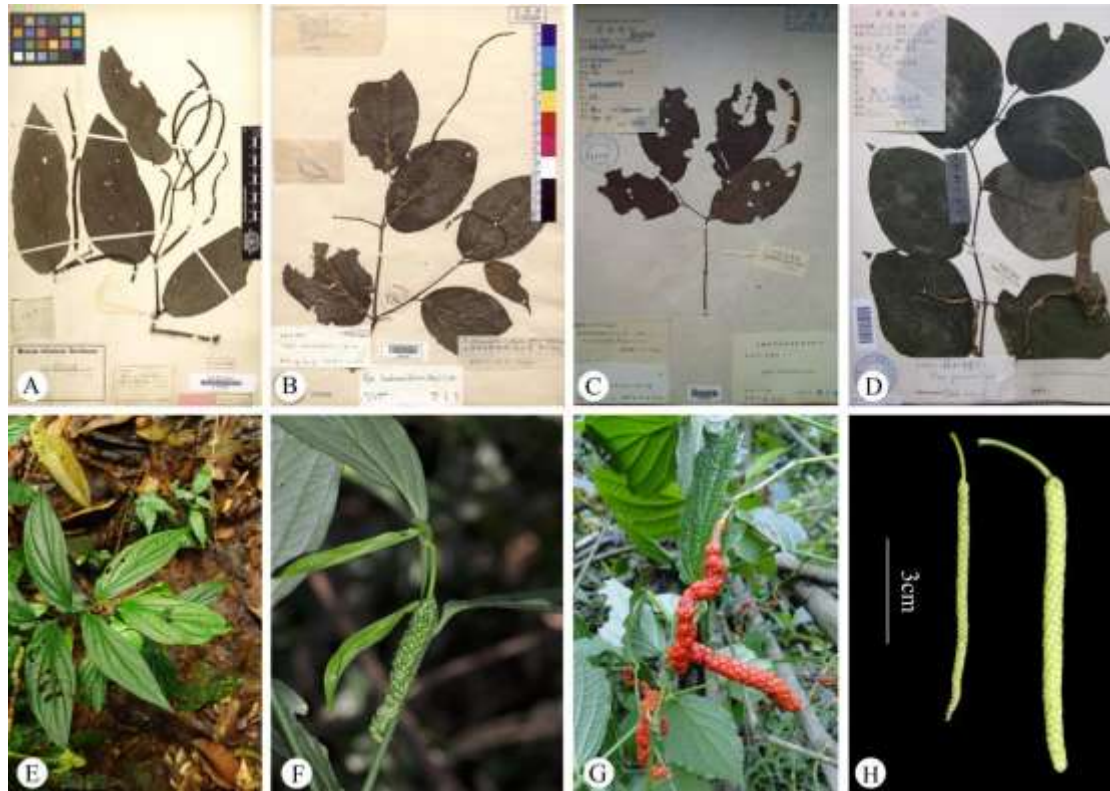


FIGURE 3. A-C Holotype of *P. boehmeriifolium* var. *glabricaule*, *P. terminaliflorum* and *P. yunnanense* respectively; **D** Isotype of *P. yunnanense*; **E-F** Habitat and Branch with infructescence of *P. boehmeriifolium* in the wild (Xishuangbanna, Yunnan); **G** *P. pedicellatum* in the wild (Jingdong wuliang mountain, Puer, Yunnan); **H** Comparison of unripe infructescence between *P. pedicellatum*(Left) and *P. boehmeriifolium*(Right)

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