

ADDITIONS TO THE ORCHID FLORA OF BHUTAN III: *PAPHIOPEDILUM* × *PRADHANII*

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ABSTRACT. *Paphiopedilum* × *pradhanii*, a natural hybrid between *P. fairrieianum* (subgenus *Paphiopedilum*, section *Ceratopetalum*) and *P. venustum* (subgenus *Paphiopedilum*, section *Barbata*), is reported for the first time from Bhutan. Detailed geographical distribution, ecology, taxonomic notes, and dichotomous keys to all *Paphiopedilum* species found in Bhutan are provided. Additionally, a brief description of the parent species of this hybrid is provided.

KEYWORDS / PALABRAS CLAVE: Cypridioideae, híbrido natural, natural hybrid, *Paphiopedilum* (grex) Pan-dion, sección *Barbata*, sección *Ceratopetalum*, section *Barbata*, section *Ceratopetalum*

Introduction. Natural hybridization among angiosperms is regarded as an important process in plant evolution (Arnold *et al.* 2012, Cozzolino *et al.* 2006, Radak *et al.* 2019). This phenomenon has been extensively documented in numerous orchid genera, like *Anacamptis* Rich. (Radak *et al.* 2019), *Dactylorhiza* Neck. ex Nevski (Hedrén 1996), *Epidendrum* L. (Arida *et al.* 2021), *Laelia* Lindl. (Salazar *et al.* 2014), *Neotinea* Rchb.f. (Djordjević *et al.* 2012), *Paphiopedilum* Pfitzer (Cribb 1998), *Pleione* D. Don (Zhang *et al.* 2018), *Serapias* L. (Bellusci *et al.* 2010), and *Spiranthes* Rich. (Sun 1996).

Paphiopedilum belongs to the subfamily Cypridioideae, commonly known as slipper orchids, in the family Orchidaceae. This genus is distributed in the subtropical and tropical regions of the Western Ghats, Himalaya, Southeast Asia, southern China, Indo-Myanmar, the Malay Archipelago, New Guinea, and the Solomon Islands (Liao *et al.* 2019, Metusala 2017, Pearce & Cribb 2002). Currently, it comprises 110 accepted species (POWO 2023), of which around 100 species are known to be threatened as per IUCN Red List of Threatened Species (IUCN 2023), with horticultural trade being the most significant threat (Hinsley

et al. 2016). The genus includes highly exploited, cultivated, and horticulturally important plants (Hinsley *et al.* 2016). The species in this genus are characterized by their striking multicoloured flowers with shoe-shaped labellum and a synsepal, a structure formed by connation of two lateral sepals.

In Bhutan, the genus is represented by three species belonging to two sections (Pridgeon *et al.* 1999: section *Ceratopetalum* Hallier ex Pfitzer: *Paphiopedilum fairrieianum* (Lindl.) Stein and sect. *Barbata* Kraenzl.: *Paphiopedilum spicerianum* (Rchb.f.) Pfitzer and *Paphiopedilum venustum* (Wall. ex Sims) Pfitzer (Gurung *et al.* 2019, Pearce & Cribb 2002, Pradhan 1976). These three species are listed in the IUCN Red List as Critically Endangered (CR) and Endangered (E) (Rankou & Molur 2015, Rankou & Kumar 2015a, b). Of the recorded species, *P. fairrieianum* is widely distributed, *P. venustum* is rare, and *P. spicerianum* is probably extinct in Bhutan. According to Gurung *et al.* (2019), Bjoka and Ngangla in Zhemgang District is the only habitat where both *P. fairrieianum* and *P. venustum* coexist in Bhutan.

Recently, biodiversity assessment surveys were conducted in the areas of Bjoka and Ngangla with the

objective of declaring them as Key Biodiversity Areas (KBA). The Bhutanese authors encountered three individuals of an unfamiliar orchid with intermediate floral characteristics between the sympatric species, *P. fairrieanum* and *P. venustum*. After a critical examination of morphological parts and scrutiny of herbarium materials and literature (Dalstrom *et al.* 2017, Gurung 2006, Gurung *et al.* 2019, Pearce & Cribb 2002, Pradhan 1979), the plants were identified as *Paphiopedilum* × *pradhanii* Pradhan, a new record for Bhutan. It was originally described from adjacent India. A detailed description, phenology, and ecology, along with coloured photographs, are provided based on the collected specimens. A figure of comparative account of features of both parents of this hybrid is also provided.

Materials and methods. Fresh plants were photographed in the wild, one flower was collected for dissection, and dissected parts were photographed using a digital camera. Plates were prepared based on which a description of the plant was prepared, following the terminology of Beentje (2016).

TAXONOMIC TREATMENT

Paphiopedilum × *pradhanii* Pradhan, Indian Orchids 2: 675 (1979). (Fig. 1, 2, 3B, 4).

TYPE: Icones t.5, dt. 11-14 October 1974 in Herb. U.C. Pradhan. (reproduced here in Figure 4).

Paphiopedilum × *pradhanii* Pradhan, Orchid Digest 40 (3): 92 (1976), *nom. illeg.* (without Latin description or type).

Terrestrial *herb* with reduced stem. *Roots* cylindrical, thick, brownish, root hairs white. *Leaves* 3 to 5, distichous; *petiole* inconspicuous, conduplicate, *blade* oblong-elliptic, 15–25 × 3.5–7 cm, apex obtuse to shortly acute, margin entire, glabrous, membranous, greyish green, adaxial surface mottled with darker green, abaxial surface whitish to light greyish red, spreading, coriaceous, longitudinal venation dark green, obscure to distinct. *Inflorescence* one-flowered, erect to arcuate, up to 42 cm tall; *peduncle* cylindrical, up to 34 cm long, brown to purplish brown, pubescent, indumentum white; *floral bracts* 2, outer bract ovate, 3.3 × 1.7 cm, yellowish-green, abaxial surface pubescent, adaxial surface glabrous, apex narrowly acute,

margin ciliate, dorsal veins prominent, keeled, the inner bract oblong, *ca.* 8 × 3 mm, outer surface hirsute, inner surface glabrous, apex acute. *Flower* large, 8 × 6 cm; *pedicel and ovary* cylindrical, 8.0 × 0.8 cm, pubescent, 6-grooved, purplish green, hairs white. *Dorsal sepal* broadly ovate, 4.5 × 4.3 cm, pinkish-white, veins prominent, adaxial surface pubescent, green, abaxial surface glabrous, green, with deep brownish-purple spots, margin ciliate, undulate, and recurve, apex acute. *Synsepal* ovate, 3.5 × 1.9 cm, adaxial surface pubescent, abaxial surface glabrous, white, veins yellowish-green, 11-numbered, margin ciliate, apex acute. *Petals* oblong-elliptic, 5.5 × 1.6 cm, adaxial surface sparsely hirsute at the base, abaxial surface glabrous, yellowish green at basal half to two-thirds then turning brownish pink towards the apex, with green venation, spotted with dark brownish purple, apex obtuse, margin ciliate, undulate. *Labellum* slipper-shaped, oblong, outer surface yellow with brown towards the margin, spotted in brownish-purple, greenish venation, inner surface yellow to yellowish-white, hirsute, deeply saccate; side lobes 5 × 6 mm; mid-lobe 4.8 cm × 2.5 cm, apex obtuse to truncate. *Column* cylindrical, 5 mm long; *filament apices* horn-like with rounded structure at base; *staminode* lunate, 1.0 × 1.5 cm, yellowish green to pale green, with short triangular acute tooth at middle; *stigma* sub-orbicular, 9 × 11 mm, yellowish-white, glabrous; *anthers* subglobular, *ca.* 2 mm diameter. *Ovary* narrowly fusiform, 8 cm long, 8 mm in diameter, brownish green, shortly white pubescent, slightly bent at apex.

PHENOLOGY: Flowering and fruiting from November to January.

HABITAT: *Paphiopedilum* × *pradhanii* is a terrestrial herb growing on the slopes in the subtropical forest at around 920 m in elevation. Associated vegetation in the habitat comprises *Bauhinia purpurea* L., *Litsea glutinosa* (Lour.) C.B.Rob., *Pandanus furcatus* Roxb., *Rhus chinensis* Mill., and *Thysanolaena latifolia* (Roxb. ex Hornem.) Honda. The orchid was growing in close association of *Capillipedium assimile* (Steud.) A.Camus and *Neyraudia* Hook.f. sp.

DISTRIBUTION: Endemic to the Eastern Himalayan: Bhutan (Zhemgang) and India (Sikkim, Assam).



FIGURE 1. Natural habitat of *Paphiopedilum × pradhanii* in Zhemgang District of Bhutan. Photographs by Phub Gyeltshen.

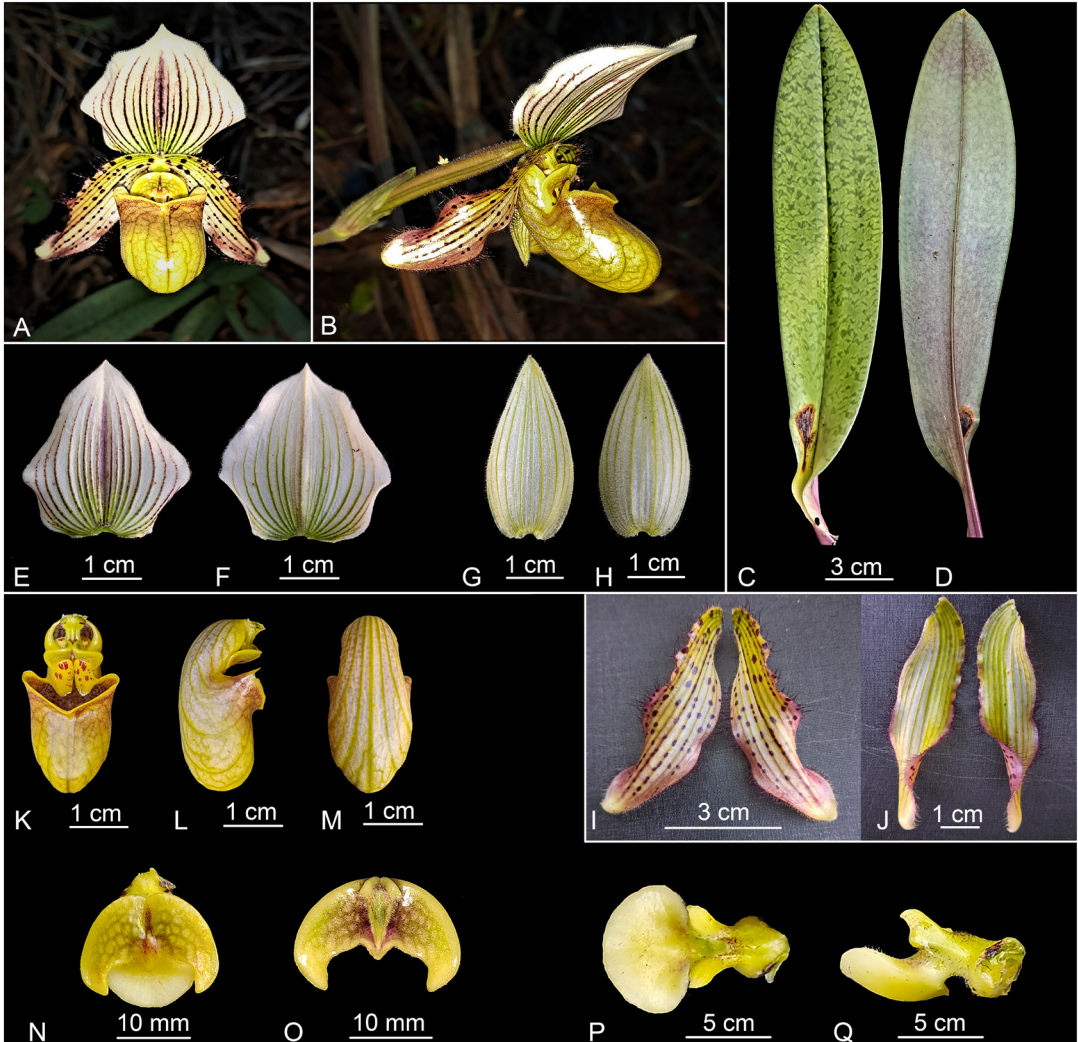


FIGURE 2. *Paphiopedilum* × *pradhanii*. **A.** Flower (front view). **B.** Flower (lateral view). **C–D.** Leaves (adaxial and abaxial surface view). **E–F.** Dorsal sepal (Adaxial and abaxial surface view). **G–H.** Synsepal (Adaxial and abaxial surface view). **I–J.** Petals (Adaxial and abaxial surface view). **K–M.** Labellum (Front, lateral and back view). **N.** Column with gynoeceum, androecium and staminode. **O.** Staminode (abaxial view). **P–Q.** Column and anther (dorsal and lateral view). Photographs by Phub Gyeltshen based on *Phub Gyeltshen 75* (THIM).

SPECIMEN EXAMINED: BHUTAN. Zhemgang District: Ngangla Gewog, 1000 m, 12 December 2022, *Phub Gyeltshen 75* (THIM).

PARENTAGE: When originally described, *Paphiopedilum* × *pradhanii* was believed to be a natural hybrid of the parentage *P. fairrieianum* × *P. venustum* (Fig. 2) owing to its morphological characters. Subsequently, Parveen *et al.* (2012) supported this claim based on their genetic studies. This hybrid is native to India and Bhutan.

TAXONOMIC NOTES: *Paphiopedilum* × *pradhanii* was originally described as a natural hybrid between *P. fairrieianum* and *P. venustum*, by Udai C. Pradhan in 1976 (Pradhan 1976). However, he neglected to add a Latin diagnosis or description and information on the type, both of which are necessary compulsorily for the valid publication of a new taxon (McNeill *et al.* 2006). He dedicated the hybrid to the Late Rai Sahen Bhim B. Pradhan (11 December 1897 – 8 February 1975), the first person who highlighted the importance of floricult-

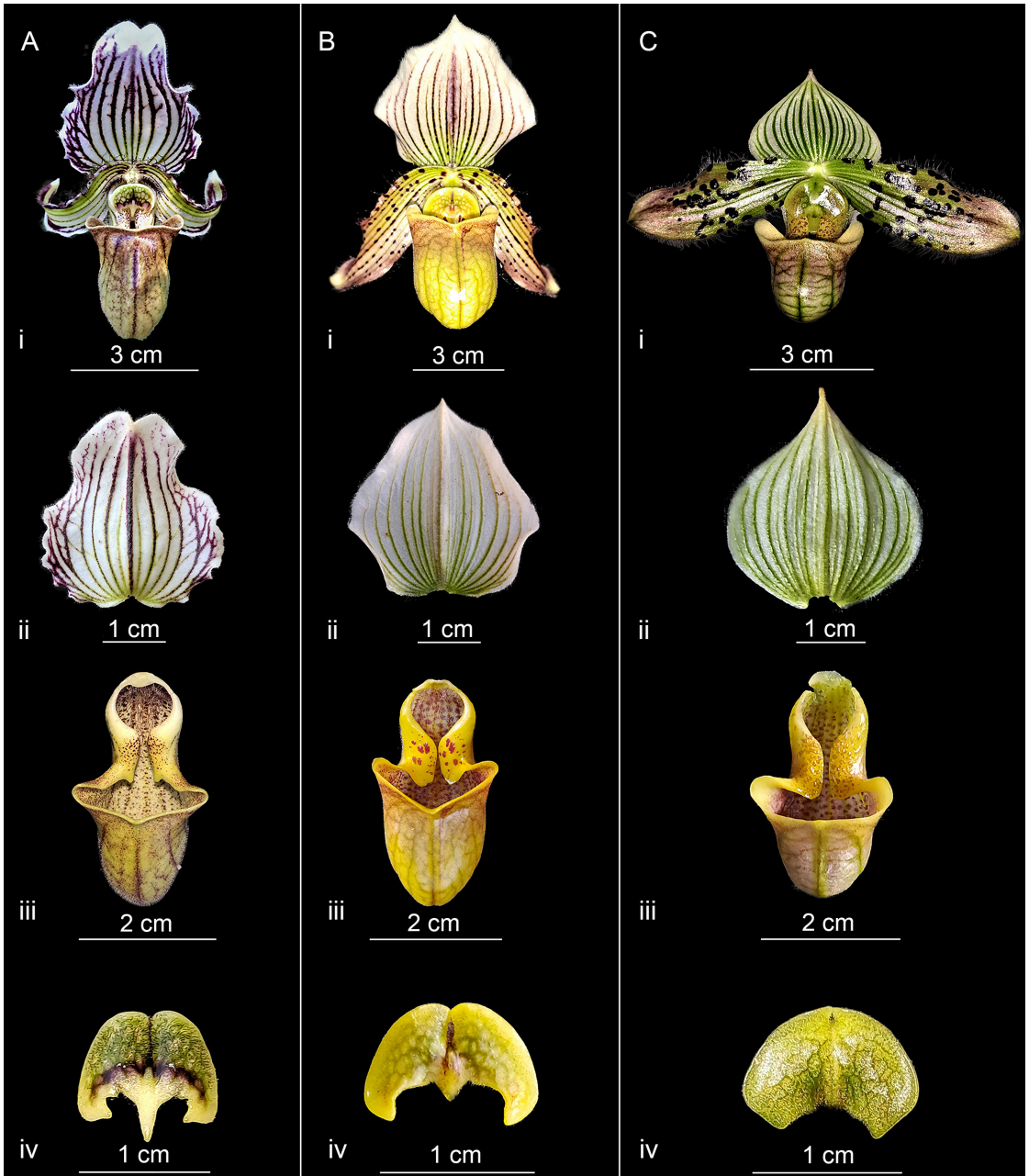


FIGURE 3. Key morphological characters of all three species. **A.** *Paphiopedilum fairrieianum*. **B.** *Paphiopedilum* × *pradhanii*. **C.** *Paphiopedilum venustum*: 1 Flowers. 2 Dorsal sepals. 3 Labellums. 4 Staminodes. Photographs by Phub Gyeltshen.

ture in Sikkim and gave Sikkim the privileged producer and exporter of Orchids. Pradhan (1979) rectified his mistake later when he revised the description of this species and added the information on the type as a painting held in his private herbarium, which is produced in this

manuscript, with his kind permission (Fig. 4). A comparative account of the hybrid and parents are provided in Figure 3. However, earlier, an artificial hybrid with the same parentage was also registered with the Royal Horticultural Society (<https://apps.rhs.org.uk/horticultural->



FIGURE 4. Holotype of *Paphiopedilum x pradhanii*. Original illustration and the photograph of the same by Mr. Udai Chandra Pradhan. Reproduced under his kind permission.

database/orchidregister/orchiddetails.asp?ID=35432) under the name *Paphiopedilum* (grex) Pandion by Wyld Court. Photographs of this hybrid available on Google search (<https://www.orchidroots.com/detail/information/?pid=100035432&role=pub>) match well the natural hybrid. Both parents of this natural hybrid are known from Bhutan and India. The grex name does not invalidate the name of the wild-occurring hybrid.

OTHER NOTES: *Paphiopedilum* × *pradhanii* was originally found in a single population in the 1970s in the Baliapara Frontier Tract of Assam (now falls within the West Kameng District of Arunachal Pradesh, India) (Pradhan 1976, 1979). At that time, the total number of mature individuals were less than ten. This subpopulation is assumed to have extirpated completely (Udai Chandra Pradhan pers. comm.). The current report from Bhutan lies around 150 km west of the type locality, and this subpopulation contains three mature individuals of different sizes, one bearing a single flower. However, this hybrid grows under dense vegetation, and being a rough Himalayan landscape, it is likely that more individuals exist in the suitable habitat, waiting to be explored. The three observed plants were not seen to bear fruit; however, the previous blooming season's floral stalk (without any fruit) was present on one of the individuals. Hence, more observations are needed to confirm if the species can set fruit naturally and if they contain viable seeds to elucidate evolution further.

KEY TO *PAPHIOPEDILUM* SPECIES IN BHUTAN

- 1a. Leaves mottled in dark and light green; petals spotted 2
 2a. Petals oblanceolate, 3.8–5.4 × 1.2–1.7 cm; lip side lobes warty *P. venustum*
 2b. Petals oblong-elliptic, 5.5–6.0 × 1.5–2.0 cm; lip side lobes not warty *P. × pradhanii*
- 1b. Leaves not mottled in dark and light green; petals unspotted 3
 3a. Dorsal sepal undulate-ciliate, with several purple or green stripes; petals decurved, margin strongly ciliate *P. fairrieianum*
 3b. Dorsal sepal not undulate-ciliate, with a single central purple stripe; petals falcate, margin faintly ciliate *P. spicerianum*

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