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Raphiocarpus sinovietnamicus (Gesneriaceae), a new species from southern China and central Vietnam

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Raphiocarpus sinovietnamicus, a new species of Gesneriaceae from China and Vietnam, is described and illustrated here. It is morphologically close to *R. axillaris* and *R. tamdaoensis*, but can be distinguished from the later two by its broadly tubular corolla tube and red to purple-red, purplish-yellow corolla outside. Detailed morphological description together with color illustration, information on phenology, distribution, ecology and preliminarily conservation status of the new taxon was also presented.

Keywords: Didymocarpoideae, Flora of China, Flora of Vietnam, Ha Tinh, Hainan Island, Kon Tum, Sino-Vietnamese

Introduction

The genus *Raphiocarpus* Chun (1946) (Gesneriaceae, Didymocarpoideae, Trichosporeae, Didymocarpinae) was originally described more than 70 years ago. As presently understood, this genus includes all species from China and Vietnam formerly placed in Didissandra C.B.Clarke & C.D.C. and comprises ca 15 species (Vu 2018, Weber et al. 2020, Middleton et al. 2021, IPNI 2022, POWO 2022). Of which, there are currently nine species of *Raphiocarpus* recorded from northern and central Vietnam, while seven species recorded from southern and southwestern China (Wang et al. 1998, Zhang et al. 2010, Phuong et al. 2012, Chen et al. 2015, Nguyen and Wen 2018, Vu 2018, Wei 2018, Middleton et al. 2021, Wen et al. 2022). Nearly all species of *Raphiocarpus* are geobiotic, they are mainly grow on the ground under the moist evergreen forests, and rare in limestone areas.

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While studying diversity of Gesneriaceae from China and Vietnam, we collected specimens of an unidentified Gesneriaceae species from Baoyou Town, Ledong Li Autonomous County and Maogan Town, Baoting Li and Miao Autonomous County, Hainan Province, southern China, Vu Quang National Park, Ha Tinh Province, central Vietnam and Kon Plong protected forest area, Kon Tum Province, Central Highland Vietnam. Based on the morphological characters such as four stamens, 2-lobed stigma, narrowly clavate capsules and unappendaged seeds, these specimens were placed in the genus *Raphiocarpus* (Chun 1946, Chen et al. 2015, Middleton et al. 2021). The new species morphologically close to *R. axillaris* D.J.Middleton and *R. tamdaoensis* Phuong, Xuyen & Y.G.Wei, but can be distinguished from the later two by its broadly tubular corolla tube and red to purple-red, purplish-yellow corolla outside. After detailed morphological comparison, we confirmed that it represents a new species of *Raphiocarpus*, namely *R. sinovietnamicus*, which is here described and illustrated. The description, illustration, information on ecology, phenology and provisional conservation assessment of the new species are also provided.

Taxonomic treatment

Raphiocarpus sinovietnamicus Z.B.Xin, L.X.Yuan & T.V.Do, sp. nov. (Fig. 1–3)

Type: China. Hainan Province, Baoting Li and Miao Autonomous County, Maogan Town, grows on humid rock surfaces along the stream or slope soil under a tropical evergreen seasonal rain forest, 18°33′N, 109°29′E, ca 526 m a.s.l., 8 Nov 2021, L.X.Yuan & Z.Y.Zhang 20211118001 (holotype: IBK!; isotypes: CSH!; IBSC!).

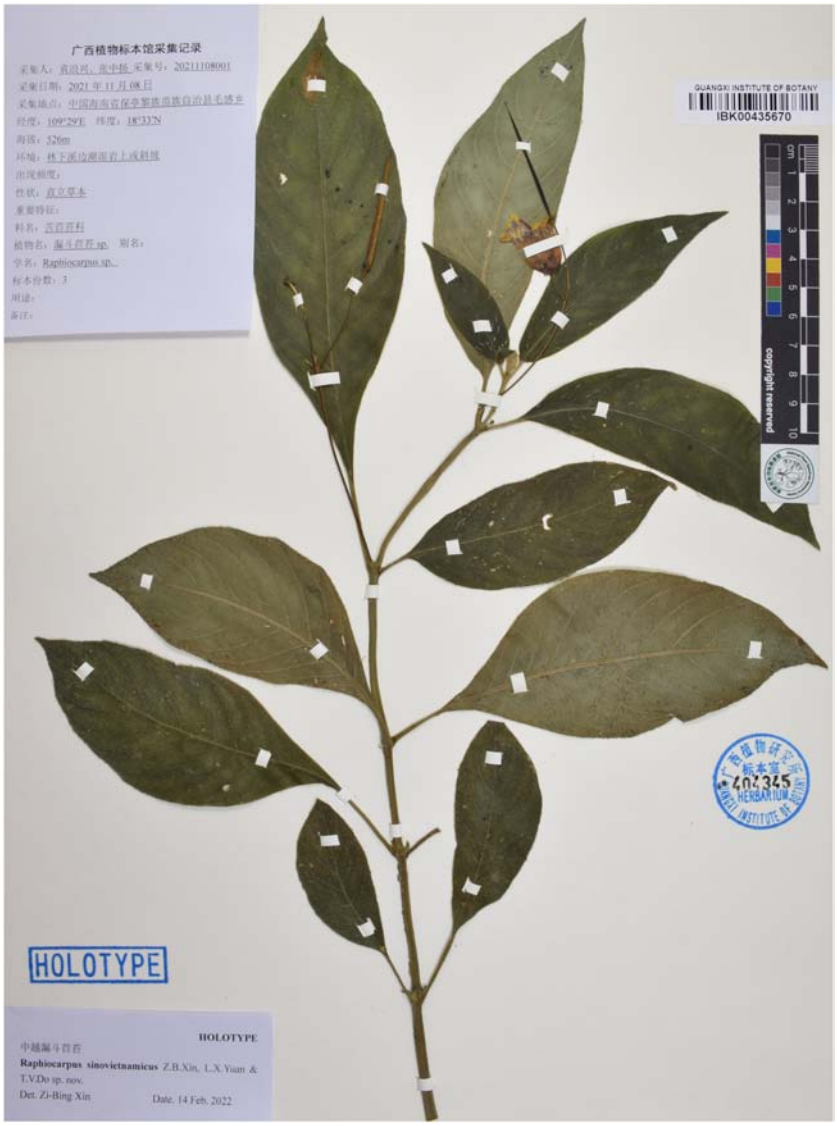

Figure 1. Holotype of *Raphiocarpus sinovietnamicus* sp. nov.

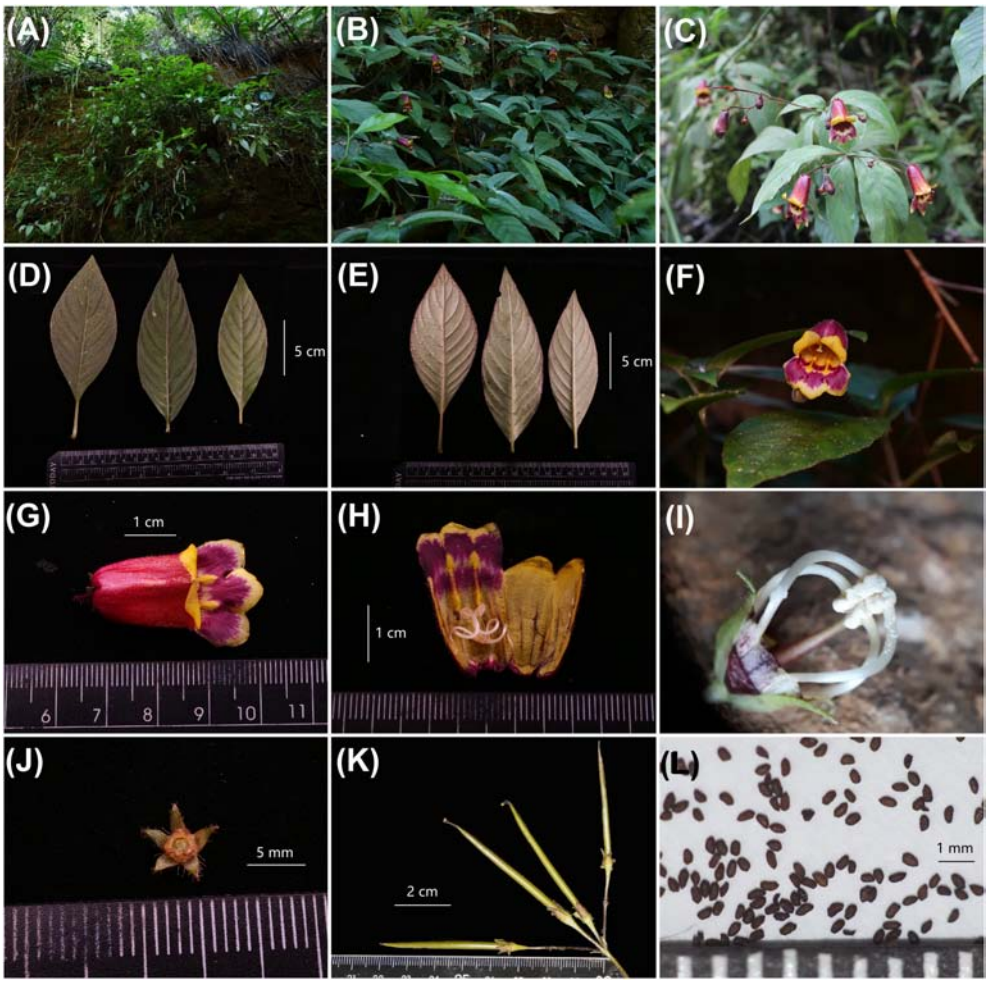

Figure 2. *Raphiocarpus sinovietnamicus* sp. nov. (A) habitat in type locality, (B and C) plants with flowers, (C) habit, (D) adaxial surface of leaf blades, (E) abaxial surface of leaf blades, (F) front view of the corolla, (G) top view of the corolla, (H) opened corolla with stamens and staminode, (I) four stamens connected in two pairs, (J) calyx and disc, (K) young capsule, (L) seeds. A–B, D–H and J photographed by Lang-Xing Yuan; C, I and K–L photographed by Truong Van Do.

Etymology

'*Sino-*' comes from Latin, 'Sinae', means 'China' and 'Chinese'. Thus, the specific '*sinovietnamicus*' was derived from its known populations both from China and Vietnam.

Description

Perennial herb to subshrubs. Stems erect, to ca 80 cm tall, near decumbent at the base, densely appressed hirsute when young, becoming slightly glabrescent with age. Leaves opposite, densely appressed hirsute; petioles 1.0–3.5 cm long; blades symmetrical, unequal in each pair, elliptic, 8–15 × 4–7 cm, base cuneate, apex acuminate, margin entire; lateral veins 9–11 pairs, on both side of midrib, depressed adaxially, protuberant abaxially. Inflorescences axillary or subterminal, dichasium, 1–4-flowered; all axes with sparse erect gland-tipped hairs; peduncle 5–8 cm long, indumentum same as axis; bracts 2, opposite, narrowly ovate to lanceolate, 3–5 mm long, with erect gland-tipped hairs; pedicels 8–14 mm long. Calyx 5-parted to the base, lobes broadly lanceolate, 4.0–6.5 × 1.5–2.0 mm, with erect glandular hairs outside, glabrous inside. Corolla red to brownish-red outside, sometime purplish-yellow, yellow inside except three lobes of abaxial lip, broadly tubular, 2.8–3.2 cm long, sparsely covered with erect gland-tipped puberulent hairs outside, glabrous inside; tube 1.8–2.2 cm long, 1.2–1.5 cm in diameter; limb 2-lipped; adaxial lip 2-lobed to the base, lobes 4–5 × 8–9 mm; abaxial lip 3-lobed to near the middle, lobes 8.0–10.5 × 6–8 mm. Stamens 4, adnate to ca 4 mm above the base of the corolla tube, in two pairs, each pair coherent at their apices, glabrous, anther thecae confluent; filaments 18–20 mm long, adnate to corolla tube ca 6 mm long, free 12–14 mm long, ca 1 mm in diameter, glabrous, anthers ca 2 × 2 mm; staminode 1, ca 1 mm long, adnate to ca 2 mm above the base of the corolla tube. Disc wax-yellow, annular, slightly 5-lobed, 1.5–2.0 mm high. Pistil linear, 1.5–2.0 mm long, sparsely pubescent; ovary 1.0–1.4 cm long; style 4–5 mm long; stigma ca 1 mm long, two lobes the left and right. Capsule green when young, 4.5–5.5 cm long, ca 3 mm in diameter, straight, linear, when

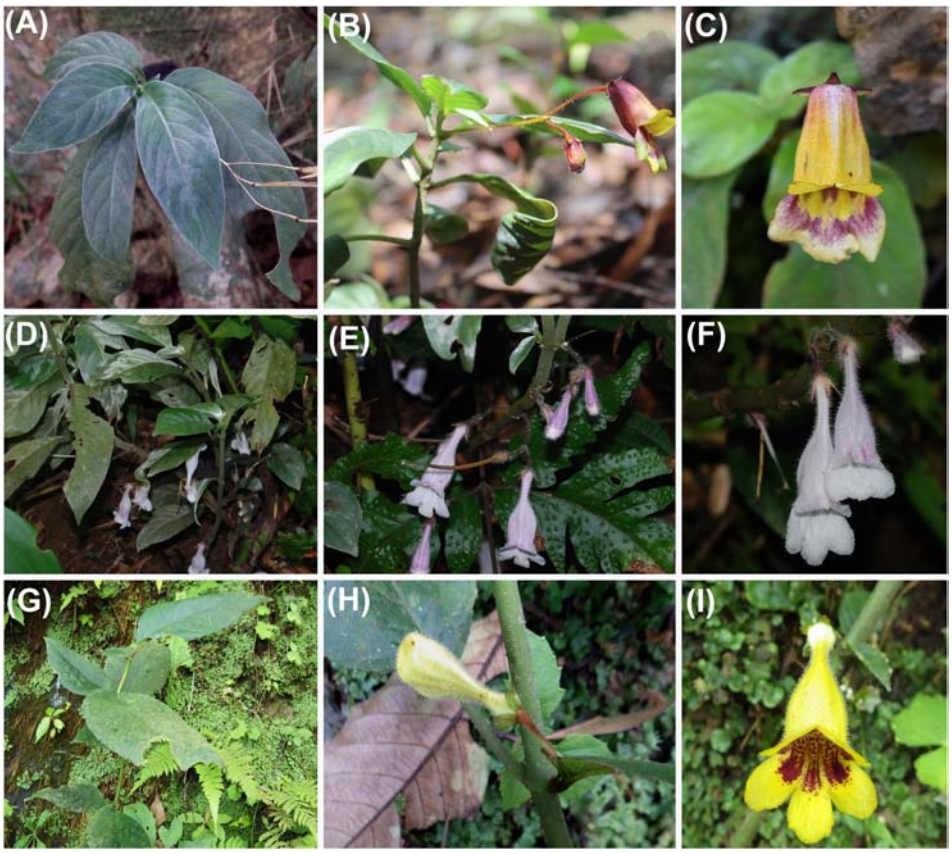

Figure 3. Morphological comparison of *Raphiocarpus sinovietnamicus* sp. nov. (A–C) with *R. axillaris* (D–F) and *R. tamdaoensis* (G–H). A, D, G habit; B, E, H inflorescence; C, F, I shape and color of corolla. A–B and D–I photographed by Truong Van Do; C photographed by Quang Diep Dinh.

mature dehiscing loculicidally to base; valves 2, straight, not twisted. Seeds ellipsoidal, ca 0.5 mm long, ca 0.3 mm in diameter, unappendaged.

Phenology

Flowering was observed from October to December. Fruiting may occur from November to January.

Distribution and habitat

The new species is currently known from four populations from Baoyou Town, Ledong Li Autonomous County, and Maogan Town, Baoting Li and Miao Autonomous County, Hainan Province, southern China, Vu Quang National Park, Ha Tinh Province, central Vietnam and Kon Plong protected forest area, Kon Tum Province, Central Highland Vietnam. The new species grows on humid rock surfaces or slope soil under the tropical evergreen seasonal rain forest, at 400–1200 m a.s.l.

Proposed IUCN conservation status

The new species is currently known from four populations. As well as the collection from the type location Maogan Town, Baoting Li and Miao Autonomous County, in Hainan Province, southern China, three other populations were also recorded in Baoyou Town, Ledong Li Autonomous County, Hainan Province, southern China, Vu Quang National Park, Ha Tinh Province, central Vietnam and Kon Plong protected forest area, Kon Tum Province, Central Highland Vietnam. The first population distributed in an area of less than 4 km^2, the second distributed in an area of less than 8 km^2, the third distributed in an area of less than 2 km^2, the fourth scattered in an area of less than 6 km^2 which is about 700 km away from the third. Estimated from the locations of the four populations, the Extent of Occurrence (EOO) is ca 800 km^2 and the Area of Occupancy (AOO) is ca 20 km^2. Although Vu Quang National Park and Kon Plong protected forest area are legally protected areas, the habitats have been being heavily impacted by human activities, especially cutting and agricultural extension. Given this situation, the species is provisionally assessed as Endangered (EN B1ab(iii)+B2ab(iii)), following the IUCN Red List Categories and Criteria (IUCN 2019).

Taxonomic note

The new species is easily distinguishable from all known *Raphiocarpus* species in its broadly tubular corolla tube and red to purple-red, purplish-yellow corolla outside (versus infundibuliform corolla tube and white, pink to yellow corolla outside in all known *Raphiocarpus* species). Morphologically, the new species can be compared to *R. axillaris*, a species endemic to northern Vietnam (Middleton et al. 2021) by

sharing some characters of vegetative organs such as densely pubescent stems and leaves and symmetrical leaf bases, but it is also easily distinguished from the latter in broadly tubular corolla tube and red to purple-red, purplish-yellow corolla outside (versus infundibuliform corolla tube and whitish to pale-pink corolla outside), and subterminal inflorescences in the upper leaf axils (versus axillary inflorescences in the lower leaf axils and leafless stem below these). Furthermore, its corolla outside is sometime purplish-yellow which is similar to those of *R. tamdaoensis*, another species endemic to northern Vietnam (Phuong et al. 2012), but it also clearly differs from that species in a number of leaf shape, indumentum of stem and leaves and corolla characters (Fig. 3).

Additional specimens examined (paratypes)

Vietnam. Ha Tinh Province: Vu Quang District, Vu Quang National Park, Sao La forest station, 18°15.380′N, 105°26.427′E, ca 520 m a.s.l., 30 Aug 2020, Do Van Truong DVT382 (IBK!; VNMN!); Kon Tum Province: Kon Plong District, Hieu Commune, Vi Chring village, 14°64.620′N, 108°45.094′E, ca 1210 m a.s.l., on humus soil with moss in evergreen forests, 28 Nov 2019, Dinh Quang Diep & Le Tien Hung XH45 (VNMN!); 8 Dec 2021, Do Van Truong DVT328 (PHH!; VNMN!).

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Author contributions

Zi-Bing Xin and Lang-Xing Yuan contributed equally to this publication. **Zi-Bing Xin**: Funding acquisition (equal); Project administration (equal); Methodology (equal); Writing – original draft (lead); Writing – review and editing (lead). **Lang-Xing Yuan**: Funding acquisition (equal); Investigation (lead); Methodology (equal); Resources (equal); Writing – review and editing (lead). **Zhong-Yang Zhang**: Investigation (equal); Resources (equal). **Quang Diep Dinh**: Investigation (equal); Resources (equal). **Gang Lu**: Investigation (equal); Resources (equal). **Stephen Maciejewski**: Methodology (equal); Writing – review and editing (equal). **Truong Van Do**: Funding acquisition (equal); Investigation (lead); Methodology (equal); Project administration (equal); Resources (equal); Writing – original draft (equal); Writing – review and editing (lead).

Data availability statement

This article contains no additional data.

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