



Zingiber magang and *Z. tamii* (Zingiberaceae), two new species from central Vietnam

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ABSTRACT: *Zingiber magang* and *Z. tamii*, two new species of *Zingiber* sect. *Cryptanthium* (Zingiberaceae) from central Vietnam are described and illustrated. Information on their distribution, ecology, phenology, uses and vernacular names are provided. A preliminary IUCN conservation assessment of each of these species is proposed. A key to species of *Zingiber* sect. *Cryptanthium* in Vietnam is also given.

KEY WORDS: Annamite range, endemic species, monocots, taxonomy, *Zingiber* sect. *Cryptanthium*.

INTRODUCTION

Zingiber Mill. (Zingiberaceae: Zingibereae) is one of the largest genera in the family with about 188 species (ZRC 2021), distributed throughout tropical and subtropical Asia (Wu and Larsen, 2000; Leong-Škorničková and Newman, 2015). The members of this genus are easily recognised by the horn-shaped anther crest embracing the upper part of the style and the existence of a swollen part of the petiole, known as a pulvinus (Bai *et al.*, 2015). Traditionally, four sections are recognized, based on the position of the inflorescence, i.e., the nominal *Z. sect. Zingiber* (spike on an erect and, usually, long peduncle), *Zingiber* sect. *Cryptanthium* Horan. (radical inflorescences composed of a spike appearing at ground level, usually with a short procumbent peduncle), *Z. sect. Dymczewiczia* Benth. (terminal inflorescences), and *Z. sect. Pleuranthisis* (spikes breaking through the leaf sheaths laterally). The general outline of *Zingiber* in Vietnam has been given in the recent publications (Leong-Škorničková *et al.*, 2015b; Lý, 2016; Le *et al.*, 2019a,b) and is therefore not repeated here. Currently, more than 37 *Zingiber* species representing all four sections, are known from Vietnam with many species described or newly reported for the flora of Vietnam only recently (Leong-Škorničková *et al.*, 2015b; Lý, 2016; Lý *et al.*, 2016; Nguyen, 2017; Le *et al.*, 2019a,b).

During our floristic surveys in central Vietnam many interesting species and genera were discovered and described from mountainous areas in Quảng Ngãi Province (e.g. Lý, 2017c,d; Lý and Tillich, 2016; Lý *et*

al., 2017; Lý *et al.*, 2021), including four ginger species, namely *Alpinia newmanii* N.S.Lý (Lý, 2017a), *Amomum cristatissimum* N.S.Lý & Škorničk. (Lý and Leong-Škorničková, 2018; recently transferred to *Meistera* by Šída *et al.*, 2019), *Boesenbergia quangngaiensis* N.S.Lý (Lý, 2017b), *Curcuma sahuynhensis* N.S.Lý & Škorničk. (Leong-Škorničková *et al.*, 2015a), and *Zingiber skornickovae* N.S.Lý (Lý, 2016). In the present paper, we describe and illustrate another two *Zingiber* species from this area, namely *Z. magang* and *Z. tamii*. As both new species exhibit inflorescences appearing at the ground level, with peduncles being partly or fully embedded in the ground, we place them in the section *Cryptanthium*.

MATERIALS AND METHODS

Herbarium specimens of the morphologically related species from the sect. *Cryptanthium* were examined from the following herbaria: E, P, K, SING, and VNM, as well as digitized specimen images available from the Chinese Virtual Herbarium (<http://www.cvh.org.cn/>), Jstor Global Plant (<https://plants.jstor.org/>), Muséum National d'Histoire Naturelle (<https://science.mnhn.fr/>). Relevant references (e.g. Gagnepain, 1908; Phạm, 2000; Wu and Larsen, 2000; Triboun *et al.*, 2014; Leong-Škorničková *et al.*, 2015b; Le *et al.*, 2019a,b) were also scrutinised. The description and all measurements were made from mature individuals of living flowering plants in the field, supplemented with herbarium specimens and flower material preserved in alcohol. The general terminology used follows Beentje (2012) and the standard work of Bai *et al.* (2015). Conservation status was assessed using the



IUCN Red List Categories and Criteria version 3.1 (IUCN 2019). The extent of occurrence (EOO) and the area of occupancy (AOO) were estimated using the web Geospatial Conservation Assessment Tool or GeoCAT (<http://geocat.kew.org/editor>) with an auto-value cell width of 2 km (Bachman *et al.*, 2011).

TAXONOMIC TREATMENT

Zingiber magang N.S.Lý & Škorničk. *sp. nov.*

Figs. 1 & 2

Zingiber magang is rather distinct from its congeners by combination of leafy shoots composed of only 3–5 prominently petiolate leaves with weakly plicate and somewhat shiny leathery laminae, and inflorescences with basal part of basal bracts convex and slightly inflated giving it somewhat bullate appearance.

Type: VIETNAM. Quảng Ngãi Province: Ba To District, Ba Nam Commune, Tây Ba To protection forest, subzone 451, Cao stream, 14°37'49.08"N, 108°37'10.20"E, 962 m, 7 August 2019, Lý Ngọc Sâm, Trương Bá Vương, Cao Ngọc Giang, Lý-1327 (holotype VNM; isotypes: P, SING).

Description: Rhizomatous herbs 15–40 cm tall forming small loose clumps each with 2–7 leafy shoots. **Rhizome** loosely branched, 0.8–1.1 cm in diam., externally light brown, internally yellowish, slightly aromatic, covered with triangular, light brown, glabrous scales 2–3 cm long, soon decaying; root tubers formed at the end of roots, subglobose to ellipsoid, 1.4–2 × 0.5–1.2 cm, pale brown externally, cream-white internally. **Leafy shoots** 2–6 cm apart, swollen at base ca. 2 cm in diam., each shoot comprising of 3–5 leaves at maturity, positioned at apical part of the pseudostem; **bladeless sheaths** 3–4, 2.5–18 cm long, inconspicuously longitudinally striate, light green, outer ones with reddish tinge at base, glabrous; **leaf sheaths** inconspicuously longitudinally striate, light green, glabrous; **ligule** bilobed, 2–5 mm long, light green, glabrous or sparsely puberulous, apex acute, margins rusty brown; **petiole** 3–7.7(–10.5) cm long, light green, pulvinus inconspicuous, positioned at the base of petiole, green, slightly pubescent to glabrescent; **lamina** broadly elliptic, (12.5–)19.5–26.5(–31.4) × (6.5–)8.5–13(–16) cm, leathery, weakly plicate, adaxially dark green, shiny, glabrous, abaxially light green, semi-matt, glabrous, apex attenuate to acuminate, base obtuse with narrow wing-like leaf margins gradually extending along the petiole/pulvinus. **Inflorescences** 1–2 per clump, arising near the base of the pseudostem, 15–26 cm long, with 1–2 flowers open at a time; **peduncle** partly or fully embedded in ground, 5–11 cm long, 0.4–0.5 cm in diam., covered by 5–10 sheathing bracts, broadly triangular-ovate at base, ovate distally, white with red tinge, externally sparsely pubescent; **spike** narrowly ovoid to oblong, 7–14 × 1.8–2.5 cm, consisting of up to 15 strongly imbricate fertile bracts, each

subtending a single flower; **bracts** narrowly ovate, 3.5–4.5 × 1–1.9 cm (gradually narrower towards apical part of the inflorescence), basal bracts greenish at base rest with rich red to purple tinge, apices in upper bracts greenish, externally densely pubescent, internally glabrous, margins straight (not undulated), pubescent, apex narrowly acute; **bracteoles** narrowly ovate, 2.6–3.2 × 1.5–2.0 mm, greenish, sometimes with purple tinge at apex, externally sparsely pubescent, internally glabrous, apex acute. **Flowers** exerted from bracts, 6.2–7.5 cm long; **calyx** tubular, clasping the floral tube at base, 10–10.5 mm long, white, externally puberulous, with unilateral incision 4.5–5.5 mm long, apex with three blunt teeth (ca. 2 × 2 mm); **floral tube** 33–37 mm long, narrowly cylindrical, slightly widening distally (to ca. 3.5 mm in diam.), white, externally glabrous, internally with few hair near the throat; **dorsal corolla lobe** triangular-ovate, 2.2–2.4 × 7.5–8 mm, cream-white with semi-translucent veins, glabrous, apex narrowly acute with a short mucro ca. 1.5 mm long; **lateral corolla lobes** narrowly triangular-ovate, 2.1–2.2 × 4–5 mm, cream white with semi-translucent veins, glabrous, apex narrowly acute; **labellum** obovate, 2.3–2.5 mm long, 1.5–1.6 mm at widest point near the middle of labellum (1.8.5–2.1 mm broad inclusive of lateral staminodes), cream-white at basal 1/3, distally dark purple to purple-violet in the centre, gradually changing to pale purple or almost white slightly deflexed margins, glabrous, apex bifid, with incision of 5–6 mm long; **lateral staminodes** obovate, 1.5–1.5.7 × 3–4.5 mm, cream-white to very pale yellow with semi-translucent veins, connate to labellum 1/2–1/3, glabrous, apex rounded to obtuse; **stamen** 1.9–1.9.5 mm long (unmanipulated); **filament** ca. 1 mm long, 2–2.5 mm wide, cream-white, glabrous; **anther** 1.1.5–1.2 mm long (crest not straightened), 3.5–4 mm broad, connective tissue cream-white to pale yellow, glabrous, anther thecae 1.0.5–1.1 mm long, dehiscing along the entire length, pollen cream white, elliptic; **anther crest** 9.5–1.1 mm (straightened), cream with pink to red-purple tinge towards apex, glabrous. **Epigynous glands** two, subulate, 5–5.5 mm long, ca. 0.5 mm in diam. at base, cream sometimes with slight purple tinge. **Ovary** cylindrical, 4–5.2 × 3–3.5 mm, pale greenish to cream white with purple tinge, pubescent, trilocular with axile placentation; **style** white, glabrous; **stigma** slightly thicker than style, white, ostiole ciliate. **Fruit (immature)** ovoid, bluntly trigonous septifragal capsule, 2.2–2.6 × 8–1.1 mm, cream-white with longitudinal reddish lines along the valves, glabrous, apex with persistent calyx. **Seeds (immature)** 4–6 per locule, oblong, 8–9.5 × 3.5–4 mm long, white; aril sac-like, irregularly edged/laciniate at apex, white, nearly fully covering the seeds.

Distribution: The species only occurs in two provinces in central Vietnam, Quảng Ngãi and Kon Tum.

Habitat and phenology: Stream sides and moist and shady areas of primary and secondary tropical broadleaved



Fig. 1. *Zingiber magang* N.S.Lý & Škorničk. **A.** Habit. **B.** Basal part of the plant with an inflorescence. **C.** Inflorescence with a flower (side view). Photos Ngọc-Sâm Lý from the type Lý-1327.

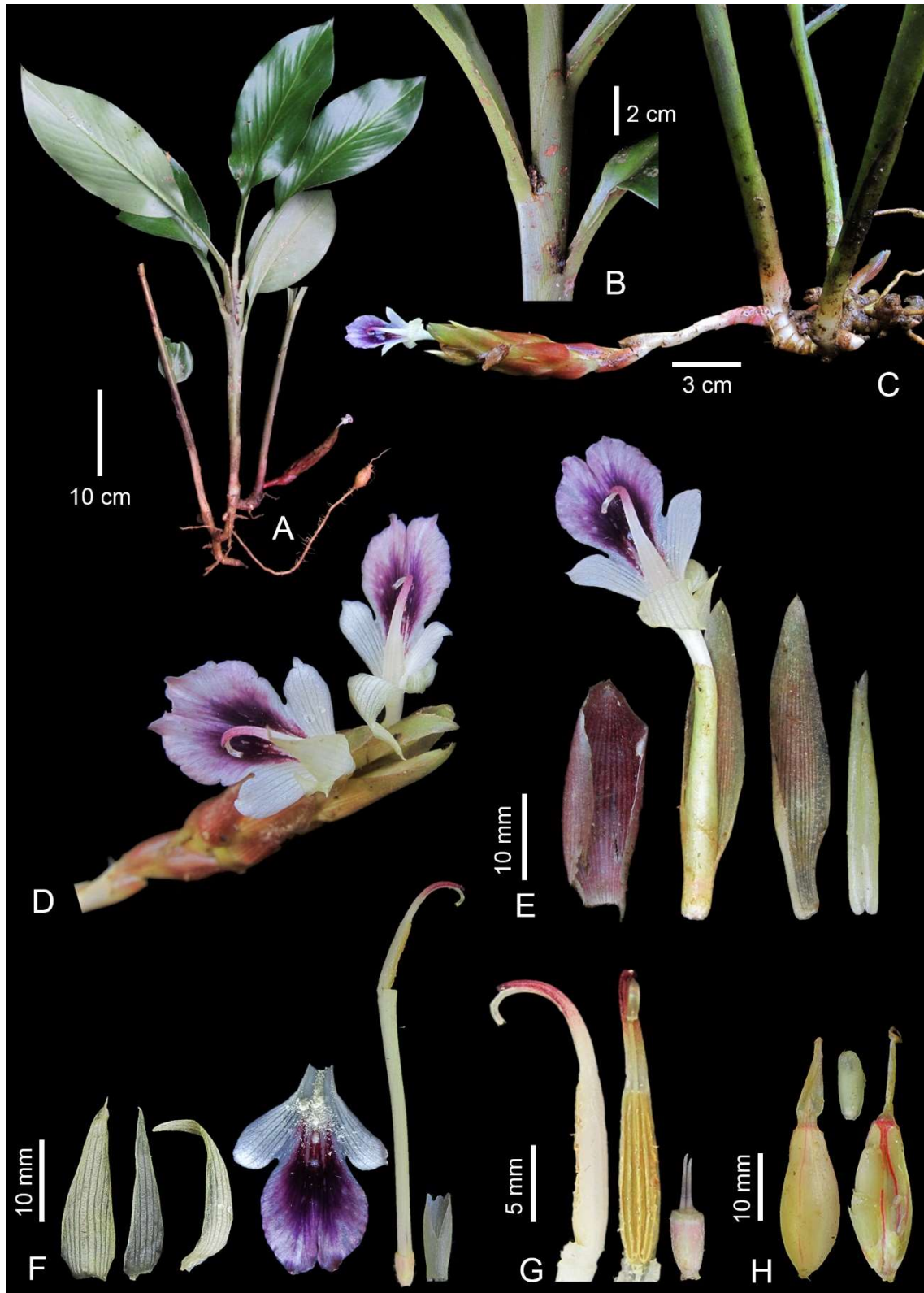


Fig. 2. *Zingiber magang* N.S.Lý & Škorničk. **A.** Habit. **B.** Detail of pseudostem. **C.** Basal part of the plant with an inflorescence. **D.** Inflorescence with flowers (top view). **E.** Fertile bract (basal part of the inflorescence), flower enclosed in fertile bract (middle part of the inflorescence), bract, bracteole. **F.** corolla lobes, labellum, ovary with floral tube and stamen (calyx removed), calyx. **G.** Stamen from side and front view, ovary with epigynous glands. **H.** Young fruit from outside and when open with young seed in between. Photos Ngọc-Sâm Lý from the type *Lý-1327*.



forests between 850–1,230 m elevation. Flowering was observed from June to August, fruiting was observed in August and September, but presumably extends till October.

Vernacular names and uses: This species is locally known as magang (Kinh minority), Pagieng or Pagang (Co, Ca Dong and Hre minorities). Rhizomes of this species are harvested, crushed and applied for healing wounds and bone fractures.

Etymology: The specific epithet “magang” is derived from the common name applied to this species by local people from Kinh tribe in Quảng Ngãi province.

Preliminary IUCN assessment: At present, three relatively-large populations consisting of about 2000 mature individuals/mature clumps have been observed. Of these about 1800 mature clumps occur in Quảng Ngãi province and about 200 mature clumps Kon Tum province. The extent of occurrence (EOO) and the area of occupancy (AOO) were calculated to be 361.7 km² and 12 km², respectively. Although the known habitat of the new species is within forests protected by the provincial authorities of Quảng Ngãi and Kon Tum, these populations are still vulnerable because of the continuing decline in area, extent and quality of habitat due to various human activities, such as harvesting of non-timber forest products (medicinal plants, rattans, etc.), forest fires, and especially clearing of forest land for *Acacia* plantations. Based on the IUCN Red List Criteria (IUCN 2019), we therefore provisionally assess this species as Endangered (EN B2ab(iii), C).

Additional specimens examined (Paratypes):

VIETNAM. Quảng Ngãi Province: Ba Tơ District, Ba Nam Commune, Tây Ba Tơ protection forest, subzone 451, Nước Léch stream, 14°38'1.43"N, 108°37'22.37"E, 886 m elev., 20 August 2019, *Lý Ngọc Sâm, Trương Bá Vương, Đỗ Đăng Giáp, Lý-1317* (VNM); Sơn Tây District, Sơn Lập Commune, Tà Ngàm Village, Mount Azin 23 May 2020, 14°52'53.88"N, 108°24'57.52"E, 975 m elev., *Lý Ngọc Sâm, Cao Ngọc Giang, Nguyễn Văn Thành, Lý-1503* (VNM). Kon Tum Province: Kong Plong District, Hiếu Commune, 14°35'36.81"N, 108°24'55.25"E, 1221 m elev., 2 June 2017, *Lý Ngọc Sâm, Lý-905* (VNM).

Taxonomic notes: As mentioned in the diagnosis, *Z. magang* is not particularly similar to any of the currently known species. The leafy shoot composed of only a few leaves may be seen as somewhat similar with *Z. monophyllum* Gagnep. (Gagnepain, 1903) and *Z. ellipticum* (S.Q.Tong & Y.M.Xia) Q.G.Wu & T.L.Wu (Wu *et al.*, 1996), however both of these species have much larger leafy shoots composed of 1–3 leaves, and more importantly the inflorescence protrudes from the pseudostem.

Zingiber tamii N.S.Lý & Škorničk. *sp. nov.*

Figs. 3 & 4

Similar to *Z. vuquangense* N.S.Lý *et al.* by overall similarity in leafy shoots consisting of prominently petiolate, broadly elliptic and prominently plicate laminae, but differs by overall smaller size 0.5–0.7 m, shorter ligules 3–5 mm long, smaller abaxially glabrous laminae 15.8–21.5 × 7.5–9.5 cm, narrowly ovate bracts, shorter

calyx 10–12 mm long, pale yellow and externally sparsely puberulous corolla lobes, pale yellow lateral staminodes and ovate to elliptic ovate very dark purple labellum with small yellow blotches and yellow margin (compared to larger size 1.2–1.8 m, ligules 12–30 mm long, larger laminae abaxially densely pubescent along midrib 26–50.8 × 9–14.7 cm, oblong to club-shaped bracts, longer calyx 17–18 mm long, bright yellow and glabrous corolla lobes, lateral staminodes yellow with pink purple apex and obovate pink-purple labellum with pale yellow spots in *Z. vuquangense*).

Type: VIETNAM. Quảng Ngãi Province: Ba Tơ District, Ba Nam Commune, Tây Ba Tơ protection forest, subzone 451, Nước Léch stream, 14°37'25.28"N 108°37'08.29"E, 927 m, 22 August 2019, *Lý Ngọc Sâm Lý, Cao Ngọc Giang, Trương Bá Vương, Lý-1323* (holotype VNM; isotype: SING).

Description: Rhizomatous herbs up to 45–70 cm tall, forming small loose clumps each with 2–4 loose leafy shoots. **Rhizome** branched, 0.5–1 cm in diam., externally reddish when young, turning pale brown with age, internally cream-white, slightly aromatic, covered with pale reddish triangular scales, 2–3 cm long, glabrous, soon decaying. **Leafy shoots** 1.5–5 cm apart, slightly arching, with up to 9 leaves, approximately basal 1/3 of pseudostem leafless; **bladeless sheaths** 2–3, 7.5–19.3 cm long, inconspicuously longitudinally striate, pale reddish green, basally richer red to maroon, sparsely pubescent towards margins (white scattered hairs); **leaf sheaths** inconspicuously longitudinally striate, light green sometimes with reddish-green tinge, sparsely pubescent towards margins (white scattered hairs). **Ligule** bilobed, 3–5 mm long, greenish, membranous, pubescent, apex rounded with short ciliae, dry and soon decaying; **petiole** 3–6 cm long, pulvinus purplish, glabrous; **lamina** broadly elliptic to obovate-elliptic, 15.8–21.5 × 7.5–9.5 cm, adaxially mid green, prominently plicate, glabrous, abaxially paler, glabrous, apex acuminate, base obtuse to rounded. **Inflorescences** 1–2 per clump, arising near the base of the pseudostem, 10–13 cm long, with 1–2 flowers opening at a time; **peduncle** fully embedded in ground, 5–7.5 cm long, covered by 8–10 sheathing bracts; sheathing bracts broadly triangular-ovate, densely tinged bright to dark red, externally sparsely pubescent, hairs white; **spike** ovoid, 4.5–6.5 × 2.5–3 cm, consisting of up to 35 strongly imbricate fertile bracts, each subtending a single flower; **bracts** narrowly ovate, 4.5–4.8 × 1.6–1.8 cm (smaller towards apical part of the inflorescence), bright red to purplish-red, sometimes with cream or greenish at base, upper bracts with greenish apices, externally pubescent, internally glabrous, margins sparsely pubescent, slightly incurved, apex narrowly acute; **bracteoles** ovate, 31–34 × 16–17 mm, pale yellow with red to purple tinge apically, externally sparsely pubescent, internally glabrous, apex acute. **Flowers** exerted from bracts, 5.5–6.2 cm long; **calyx** tubular, 10–12 mm long, clasping the floral tube at



Fig. 3. *Zingiber tamii* N.S.Lý & Škorničk. **A.** Plant habit. **B.** Leaves and petioles. **C.** Inflorescence with a flower (side view). **D.** Inflorescence with a flower (semi-top view). Photos Ngoc-Sâm Lý from the type Lý-1323.

base, semi-translucent white, externally puberulous, with unilateral incision ca. 9.5 mm long, apex with three inconspicuous blunt teeth; **floral tube** narrowly cylindrical, slightly widening distally, 30–33 mm long, externally and internally cream-white at base, white apically, externally sparsely pubescent, internally glabrous at base, sparsely pubescent apically near the throat; **dorsal corolla lobe** triangular-ovate, 23–25 × 9–10 mm, pale yellow with semi-translucent veins, glabrous, apex acute, shortly mucronate, mucro ca. 0.5 mm long; **lateral corolla lobes** narrowly triangular-ovate, 21–23 × 6.4–7.5 mm, pale yellow with semi-translucent veins, glabrous, apex narrowly acute; **labellum** elliptic to slightly elliptic-obovate with obtuse apex, 20–24 mm long, 11–12 mm at widest point near the middle of

labellum (28–32 mm broad inclusive of lateral staminodes), cream-white at base, the rest very dark purple with small yellow patches along central line, margin bright yellow, slightly deflexed, undulate to crisped, glabrous; **lateral staminodes** elliptic-obovate with obtuse apex, 17–8 × 8.5–10 mm, pale yellow with semi-translucent veins, connate to labellum by basal 1/2, margin slightly deflexed, slightly undulate, glabrous; **stamen** 16–16.5 mm long (unmanipulated); **filament** ca. 2 × 2 mm, cream, with sparse short glandular hairs; **anther** 12–13 mm long (crest not straightened), 3–3.5 mm broad, connective tissue cream white at base, pale yellow apically, glabrous; **anther thecae** 10–11 mm long, dehiscing along the entire length; **anther crest** 11–12 mm (straightened), bright yellow at base, rest purple-black,

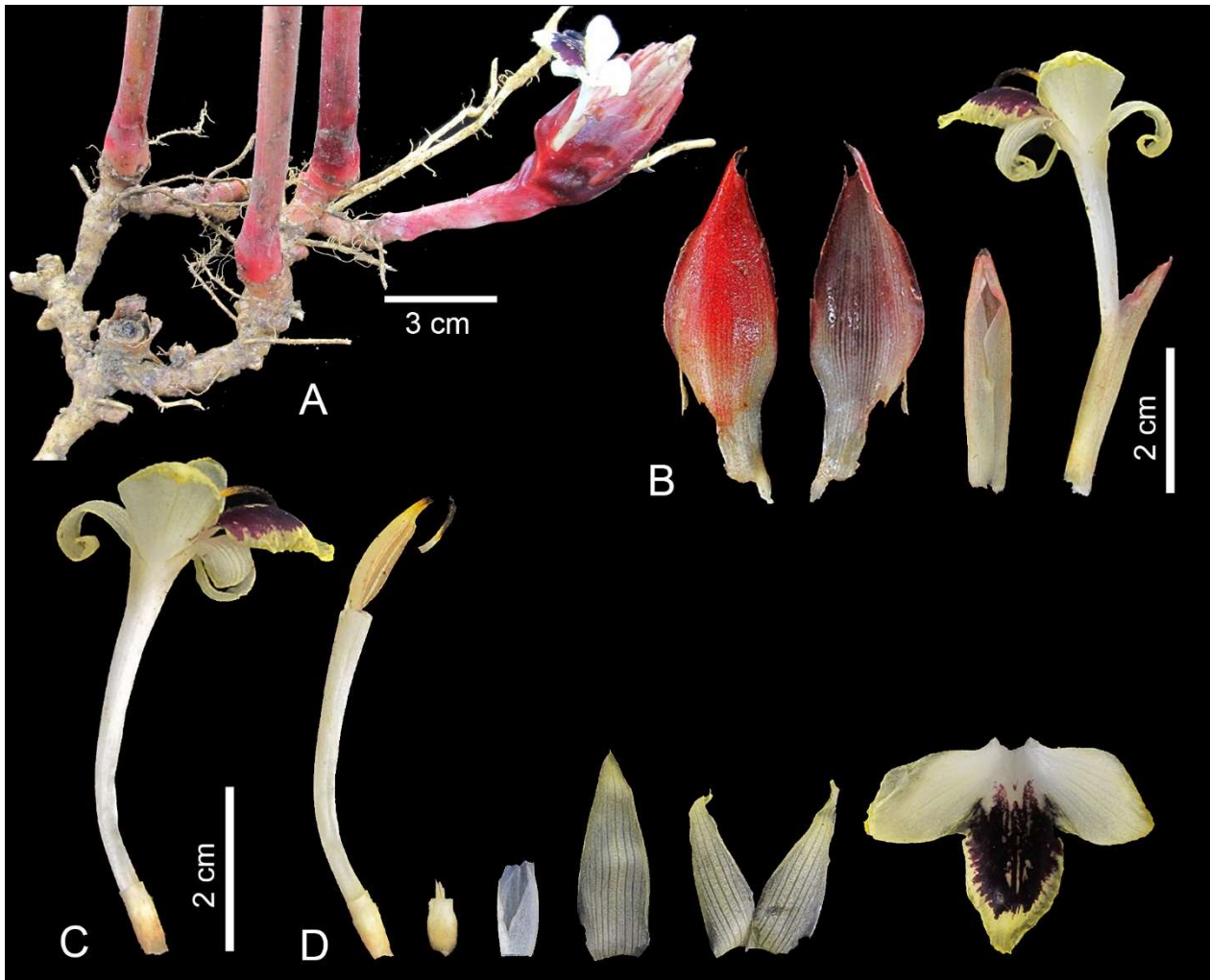


Fig. 4. *Zingiber tamii* N.S. Lý & Škorničk. **A.** Basal portion of flowering plant showing rhizome, inflorescence and leafless sheaths. **B.** Fertile bracts (external and internal view), bracteole, flower in side view with bracteole attached. **C.** Flower in side view with calyx removed. **D.** Flower dissection (from left): floral tube with ovary and stamen attached (calyx removed), ovary with epigynous glands, calyx, dorsal corolla lobe, two lateral corolla lobes, labellum with basally connate lateral staminodes. Photos Ngọc-Sâm Lý from the type Lý-1323.

glabrous. **Epigynous glands** two, subulate, 2–2.5 mm long, ca. 0.5 mm in diam. at base, cream-white. **Ovary** cylindrical, 4.5–6.5 × 3.5–4 mm, cream white, pubescent (rusty coloured hair), trilobular with axile placentation; **style** white, glabrous; **stigma** slightly thicker than style, white, ostiole ciliate. **Fruit** not seen.

Distribution and habitat: Near streams and in the moist and shady understorey of primary and secondary tropical broadleaved forests between 520–930 m elevation.

Phenology: Flowering was observed in August to September. Fruiting was not observed, but is presumed to occur in October and November.

Eponymy: This species is named in honour of Mr. Trương Quang Tâm, a forestry engineer at Institute of Tropical Biology.

IUCN preliminary assessment: Only two small subpopulations, with a total of about 10 mature individuals were found in an area of less than 5 km² in

Tây Ba Tơ protection forest, Ba Tơ District, Quảng Ngãi Province. Although the type locality is part of protection forest, its habitat is frequently disturbed by logging and clearing of the forest for *Acacia* plantations. To propose an accurate conservation status, further exploration of adjacent areas is needed to understand the extent and population sizes of this species better. Until more information becomes available, we propose to treat this species as data deficient (DD).

Additional specimens examined (Paratypes): VIETNAM. Quảng Ngãi Province: Ba Tơ District, Ba Nam Commune, Tây Ba Tơ protection forest, Trảng Sim, 14°38'1.59"N, 108°37'22.24"E, 523 m elev., 7 August 2017, Lý Ngọc Sâm, Lý-921 (VNM).

Taxonomic notes: As elaborated in the diagnosis, *Zingiber tamii* most resembles *Z. vuquangense* (Le *et al.*, 2019b) recently described from the North-Central Vietnam (Nghệ An province) by its petiolate leaves with strongly corrugate/plicate laminae. The inflorescence and



flower shape of *Z. tamii* also resembles *Z. leongkietii*, recently described from the Central Highlands, Vietnam (Kon Tum Province) (Leong-Škorničková *et al.* 2015), but it can be readily distinguished by the leafy shoot composed of 8–9 leaves, each with prominent 3–6 cm long petiole, and broadly elliptic to obovate-elliptic, prominently plicate laminae compared to leafy shoot composed of up to 20 leaves, each with short petiole up to 1.2 cm, and narrowly ovate and smooth leaf blades.

A key to *Zingiber* sect. *Cryptanthium* in Vietnam

- 1a. Leaves with laminae sessile 2
 1b. Leaves with prominent petioles 5
 2a. Ligule > 22 mm long *Z. mekongense*
 2b. Ligule to 11 mm long 3
 3a. Ligule 8–11 mm long, densely pubescent *Z. recurvatum*
 3b. Ligule to 5 mm long, glabrous 4
 4a. Spike broadly ovoid, 5–6 × 2.5–4 cm, corolla lobes bright red
 *Z. rubens*
 4b. Spike narrowly ovoid to ovoid, 9–13 × 3–4.5 cm, corolla lobes
 cream white to pale yellow *Z. skornickovae*
 5a. Plant 14–50 cm tall, leafy shoots with 3–5 leaves *Z. magang*
 5b. Plant > 50 cm tall, leafy shoots with more than 5 leaves 6
 6a. Labellum plain yellow or very pale purple blotches 7
 6b. Labellum pink purple, dark purple or violet with yellow or white
 spots or blotches 8
 7a. Ligule 20–40 mm long, lamina obovate to elliptic obovate 28–50 ×
 10–15 cm *Z. thorelii*
 7b. Ligule 3–12 mm, lamina ovate to oblong-ovate 20–37 × 4–6
 cm *Z. mioga*
 8a. Ligule 10–20 mm long *Z. vuquangense*
 8b. Ligule to 5 mm long 9
 9a. Petiole to 12 mm long, lamina narrowly ovate *Z. leongkietii*
 9b. Petiole to 20–60 mm long, lamina ovate to broadly elliptic 10
 10a. Plant to 0.7 m tall, petiole 3–6 cm long, lamina 15.8–21.5 × 7.5–
 9.5 cm *Z. tamii*
 10b. Plant >1.5 m tall, petiole 2–2.5 mm long, lamina 44–47 × 11–18
 cm *Z. cornubraceatum*

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