

## Two new taxa of *Curcuma* subgen. *Ecomata* (Zingiberaceae: Zingibereae), from coastal Central Vietnam

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Manuscript received: 25 February 2022. Revision accepted: 24 April 2022.

**Abstract.** Nguyen DD, Le TA, Hoang QH, Le QT, Nguyen E. 2022. Two new taxa of *Curcuma* subgen. *Ecomata* (Zingiberaceae: Zingibereae), from coastal Central Vietnam. *Biodiversitas* 23: 2512-2519. *Curcuma sixsensesensis* and *Curcuma vinhlinhensis*, two new species belonging to subgenus *Ecomata* from Coastal Central Vietnam, are described and illustrated in the present articles. The *C. sixsensesensis* easily gets confused with *C. newmanii* Škorničk. in compact rhizome; short lateral inflorescence composing of a few bracts; white corolla lobes and lateral staminodes; white labellum with a yellow mid-rid band but readily distinguished in rhomboid lateral staminodes (vs. obovate) with apex acuminate (vs. rounded); labellum 3-lobed (vs. emarginated), a mid-rid band being yellow at apex half, white at the base (vs. yellow throughout); anther crest presented (vs. reduced); oblong (lightly arching) (vs. L-shaped) anther in side view with slender and inward-pointing (vs. stout and outward-facing) spurs. The second one is similar to *C. pambrosima* Škorničk. & N. S. Lý in general habit and shape of the spike but differs in reduced ligule ca. 1 (vs. 4-5) mm long; lateral staminodes orange throughout (vs. yellow at apex, white at base), elliptic with round apex (vs. unequally ovate-rhomboid with acute apex); anther spurs elongate into the acute apex, outward-facing (vs. curved inward), ca. 2-3 (vs. ca. 1.5) mm long, anther crest reduced, up to 0.5 mm, 2-lobed (vs. prominent anther crest, ca. 1.5 mm apex round). Data for each described species comprises standard citation of type specimens, description, proposed species epithet etymology, data on ecology and distribution, and short taxonomic notes and morphological comparison of these new species with its allies species, a revised key to species of *Curcuma* subgen. *Ecomata* in Vietnam is included.

**Keywords:** *Curcuma sixsensesensis*, *C. vinhlinhensis*, Khanh Hoa, Quang Tri, Zingiberaceae

### INTRODUCTION

*Curcuma* L. is one of the largest genus of the family Zingiberaceae occurs dominantly in monsoon tropical and subtropical Asia, and extends to the south with few species in Malesian islands and the North Australian continent. The traditional taxonomy, supposed by Schumann (1904), divides the genus into two subgen. *Hitcheniopsis* (Baker) K. Schum. and *Curcuma* L. (Leong-Škorničková et al. 2020). Recently, the application of molecular analysis to taxonomy resulted in taxonomic changes in the genus, including establishing the third new section, namely *Ecomata* Škorničk. & Šída f. (Leong-Škorničková et al. 2015b), which differs from the first subgenus by the presence of epigynous glands, anther spurs and inflorescence lacking a conspicuous coma of sterile bracts; from the second one by smaller habit, inflorescence lacking a conspicuous coma of sterile bracts. Additionally, a number of species of the relative genus were transferred within the genus *Curcuma*. Members of *Stahlianthus* Kuntze and *Laosanthus* K.Larsen & Jenjitt. were nested in *Hitcheniopsis*. Whereas genus *Smithatris* W. J. Kress & K. Larsen included within subgen. *Ecomata*.

Before the 2000s, comprehensive investigations in Indochinese resulted in 32 taxa (P. Saensouk et al. 2021).

Thailand became the biodiversity center of this section with 10 new species described, namely *C. glans* K.Larsen & Mood, *C. bicolor* Mood & K.Larsen (Mood & Larsen 2001), *C. woodii* N.H.Xia & Juan Chen (Chen et al. 2015), *C. supraneana* (W.J.Kress & K.Larsen) Škorničk., *C. putii* Maknoi & Jenjitt. (Maknoi et al. 2019), *C. cinnabarina* Škorničk. & Soonthornk., *C. eburnea* Škorničk., Suksathan & Soonthornk. (Leong-Škorničková et al. 2020), *C. chantaranothaii* Boonma & Saensouk, *C. rangsimae* Boonma & Saensouk (S. Saensouk et al. 2021a), *C. aruna* Maknoi & Saensouk, *C. pitukii* Maknoi, Saensouk, Rakarcha & Thammam (Maknoi et al. 2021), *C. siamensis* Saensouk & Boonma (P. Saensouk et al. 2021b). At the same time in Vietnam, the zinger expeditions conducted by Jana Leong-Škorničková and Vietnamese botanists resulted in eight new species described, namely *C. rhomba* Mood & K.Larsen (Mood & Larsen 2001), *C. vitellina* Škorničk. & H.Đ.Trần (Leong-Škorničková et al. 2010), *C. pambrosima* Škorničk. & N.S.Lý (Leong-Škorničková & Lý 2010), *C. newmanii* Škorničk., *C. xanthella* Škorničk. (Leong-Škorničková & Trần 2013), *C. arida* Škorničk. & N.S.Lý, *C. sahuynhensis* Škorničk. & N.S.Lý (Leong-Škorničková et al. 2015a) and *C. cotuana* Luu, Škorničk. & H.Đ.Trần (Luu et al. 2017), and become the second hot pot of biodiversity of subgen. *Ecomata*. This achievement is a

novelty, compared to the first taxonomic treatment of Gagnepain (1907) in "Flore Generale de l'Indo-Chine" which listed only two species, namely *C. cochinchinensis* Gagnep. and *C. pierreana* Gagnep. (1907:405), which was repeated in a later edition without any new data (Ho Pham Hoang 2003). Additionally, three new species from Laos, namely *C. corniculata* Škorničk., *C. flammea* Škorničk (Leong-Škorníčková et al. 2014), *C. peramoena* Souvann. & Maknoi (Souvannakhoummane & Maknoi 2015), and two species from Myanmar, namely *C. kayahensis* Nob. Tanaka & M.M. (Tanaka & Aung 2019) and *C. stolonifera* Nob. Tanaka, K. Armstr. & M.M. Aungare (Tanaka et al. 2020) is described. The checklist of this subgenus as long as genus *Curcuma* in Vietnam is nearly completed. These taxa described in the present article are two of the last interesting specimens collected or captured by nature enthusiasts in all parts of Vietnam.

## MATERIALS AND METHODS

Fresh flowers were dissected as soon as living plant specimens were collected. Photos of Tuan Anh Le and Six Senses Ninh Van Bay team were photographed using camera Olympus Tough TG6 and camera Canon PowerShot G7 X Mark III, respectively. The measurement used for the description was based on the plant specimens collected from the type locality. Several plant samples were initially preserved in 70% ethanol, then dried and stored at VNMN herbarium. A few flowers were still kept in ethanol for research. The data used for the description is from fieldwork mainly based on measurements of the living plants specimens, combined with dried material and alcohol-treated flowers mentioned above. The morphological characteristics of each specimen were compared to the others of similar species based on protologue and concern documents of all *Curcuma* subgen. *Ecomata* species from Vietnam and neighboring countries, especially Thailand, as long as the high-resolution images of the same dry specimens from herbarium websites (<https://plants.jstor.org/>; <https://science.mnhn.fr/>)

The general plant terminology used to describe this species follows Beentje (2016) and the previous work of Leong-Škorníčková et al. (2020).

## RESULTS AND DISCUSSION

### Taxonomic treatment

*Curcuma sixsensesensis* D.D. Nguyen & T.A. Le, sp. nov. (Figure 1)

**Diagnosis:** New species is similar to *C. newmanii* Škorničk. in a compact rhizome, short lateral inflorescence composed of a few bracts, white corolla lobes and lateral staminodes, white labellum with the yellow mid-rib band but readily distinguished in lateral staminodes being rhomboid (vs. obovate) with apex acuminate (vs. rounded); labellum 3-lobed (vs. emarginated), the mid-rib band being yellow at apex half, white at the base (vs. yellow throughout); anther crest presented (vs. reduced);

oblong (lightly arching) (vs. L-shaped) anther in side view with slender and inward-pointing (vs. stout and outward-facing) spurs.

**Etymology:** The specific epithet *sixsensesensis* is derived from Six Senses Ninh Van Bay resort, the name of an ecology resort where the new species occur around and thanks to the resort management board for supporting our floristic investigation as long as conserving the wild environment around.

**Type:** VIETNAM, Khanh Hoa Province, Ninh Hoa District, Ninh Van Commune, 12°21'38.3"N 109°16'42.0"E, 150–200 m a.s.l., 10 September 2021, – *Le Tuan Anh, Hoang Quoc Huy, Le Quoc Thuong, Emmy Nguyen* № LTA-1220 (holotype VNMN!).

**Description.** *Rhizomatous terrestrial herb* to 0.3–0.4 m tall. *Rhizome* ovoid to narrowly ovoid, 2–3 × 0.5–1.5 cm, with short thin branches pointing downwards, outside light brown, cream white to pale yellow inside (on cross-section); *rhizome scales* triangular, brown, glabrous; *root tubers* fusiform, 2.0–3.5 × 1.5–3 cm, light brown, white with translucent white center inside, distant to 8 cm from the rhizome. *Leafy shoot* 1–3 per plant with 2–5 leaves developing at the same time or shortly after flowering; *pseudostem* 15–25 cm long, pale green composed of leaf sheaths and sheathing bracts; *sheathing bracts* 3–5, glabrous, pinkish, becoming papery and decaying with age; *leaf sheaths* green, glabrous; *ligule* 2–3 mm long, bi-lobed, hyaline, greenish, glabrous, margin ciliate; *petiole* 5–20 cm, petioles of basal leaves much shorter than apical, canaliculate, green, glabrous; *lamina* 20–22 × 5–8 cm, elliptic to lanceolate, obtuse to rounded and slightly oblique at base, attenuate to acuminate apex, lightly plicate, puberulent, adaxially bright green, glabrous, abaxially light green, glabrous; *median vein* green, glabrous on both sides, adaxially slightly canaliculate. *Inflorescence* lateral, with peduncle hidden underground; *peduncle* 10–20 cm, white; *spike* 4–5 cm long, 4–5 cm in diameter at the middle, with no obvious coma, composed of 7–12 bracts; *bracts* 3.0–5.5 × 1.5–4.0 cm, broadly ovate to rhombic (broader at the base, narrowed to the apex), pure white to greenish-white, margin and apex tinged pink or not, glabrous on both sides, connate in lower 1/4–1/3 portion, cute, reflexed; *bracteoles* subulate, 2–5 × 0.5–1.0 mm, narrowly triangular, translucent, glabrous, often completely reduced. *Flowers* 4.5–5.5 cm long, exerted from bracts; *calyx* 20–23 mm long, 3-toothed, with unilateral incision ca. 5–7 mm long, semi-translucent, white, glabrous; *floral tube* ca. 2.7–3.0 cm long, narrowly cylindrical at the base above the ovary, funnel-shaped at apex, externally white, puberulent at funnel-shaped part, internally white, glabrous at the base, hairy towards the throat; *dorsal corolla lobes* 20–23 × 5–7 mm, narrowly triangular ovate, concave, with sides slightly incurved, apex mucronate, mucro ca. 1–2 mm, externally white with pink ting at apex, internally white; *lateral corolla lobes* 18–20 × 5–6 mm, narrowly triangular, apex acute, semi-translucent; *labellum* 21–23 × 14–16 mm, trilobed, narrowly obovate to rhomboid, the apex of mid lobe emarginated to bi-teethed with an incision 5–12 mm long, pure white, mid-rib band yellow at apex half, white at base; *lateral staminodes* ca. 21–23 × 15–18 mm, rhomboid, pure

white, glabrous both two sides, apex acute. *Stamen* 15–16 mm long; *filament* flat, 6–7 mm long, 3–4 mm in diameter at the base, 1.5–2 mm in diameter at the apex (the point of attachment to the connective), pure white, puberulent with glandular hairs; *anther* 11 mm long (including anther crest and spurs), oblong (lightly arching) in side view with prominent round bulge fixed below the thecae and inward-pointing, ca. 1.5 mm longspurs; *connective* pure white throughout, densely puberulent with glandular hairs; *anther crest* 1–1.2 mm long, stout, apex rounded; *thecae* 7–8 × 0.5–1.3 mm, narrowly obovate, dehiscing along their entire length; *pollen* white. *Epigynous glands* two, 5–6 mm long, 0.6 mm in diameter, white, with blunt apices. *Style* white, glabrous, basally placed in a dorsal groove of the floral tube; *stigma* capitate, ca. 1.1 cm in diameter, pale yellow, with ostiole ciliate, facing forward; *ovary* ca. 3–5 × 2–4 mm, 3-locular, white, glabrous. *Fruits* globular to broadly ellipsoid, 11–12 × 9–11 mm, cream white, nearly glabrous. Seeds obovate, 4–5 mm, light brown, shiny, with white lacinate aril.

**Habitat, ecology and phenology.** Under the canopy of coastal semi-deciduous forests at elevations 150–200 m. The flowering period coincides with the beginning of the rainy season in Coastal Central Vietnam from August to October.

**Distribution and IUCN preliminary assessment.** *C. sixsensesensis* is found only in the type locality in the peninsula of Khanh Hoa Province, Vietnam. Recently, through flora investigation in Coastal Central, botanists discovered many *Curcuma* subgen. *Ecomata* distributing limited. The distance from the type location of the new one to the nearest type location of *C. pambrosima* (from the north) or *C. arida* (from the south) is only about 100 km. The EOO of type location is currently slightly less than 100 km<sup>2</sup>. In addition, the reproductive parts of *C. sixsensesensis* are sold as vegetables in local markets. It is supposed to be harvested from the adjacent mountain. The real EOO based on suitable habitat of both areas is maybe more than 100 km<sup>2</sup> but certainly less than 5000 km<sup>2</sup>. This new species is locally common but limited in the non-protected forest being under pressure of deforestation for extension of urban areas as long as resorts, hence we highly suggest to assessed as Endangered (EN B1ab(iii)), following (IUCN, 2019)

#### Taxonomic notes

*Curcuma sixsensesensis* is similar to *C. singularis* Gagnep., *C. newmanii* Škorničk., and *C. tongii* Y. H. Tan & L. X. Zhang. in general view of vegetative parts as long as short lateral inflorescence and flower color. The new species differs from older ones in its rhomboid lateral staminodes with acute apex, labellum 3-lobed with an interrupted yellow mid-rid band and the shape of the anther. The comparison of the new one with these three allies is given in Table 1. Details showing the difference between each species with the host plant are given in bold.

The identity of *Curcuma cochinchinensis* Gagnep. described over one century ago and based on dried herbarium material is not clear. Based on the protologue of Gagnepain (1907) and the high-resolution image of original

materials

(<https://plants.jstor.org/stable/10.5555/al.ap.specimen.p002.92622>), *C. sixsensesensis* is similar to the later in short lateral inflorescent and white tone flower. We eliminated our new species as *C. cochinchinensis* because of some differences. The new one is readily distinguished from *C. cochinchinensis* in the compact rhizome (vs. well elongate), prominent (vs. reduced) filament being as long (vs. three times as short) as anther; anther slightly broader at the apex (vs. broader at base).

*Curcuma vinhlinhensis* D.D. Nguyen & T.A. Le sp. nov. (Figure 2)

**Diagnosis.** similar to *C. pambrosima* Škorničk. & N.S. Lý in general habit and shape of the spike but differs in lateral staminodes being orange throughout (vs. yellow at apex, white at base), elliptic with round apex (vs. unequally ovate-rhomboid with acute apex), anther spurs conical, elongated into the acute apex, outward-facing (vs. cylindrical, curved inward), ca. 2–3 (vs. ca. 1.5) mm long, reduced anther crest up to 0.5 mm, 2-lobed (vs. prominent anther crest ca. 1.5 mm, apex round)

**Etymology:** The specific epithet *vinhlinhensis* is derived from Vinh Linh District, the hometown of the third author, where this species was first collected.

**Type:** VIETNAM, Quang Tri Province, Vinh Linh District, Vinh Hien Commune, 17°02'20.6"N 107°04'04.0"E, 150–200 m a.s.l., 10 September 2016, – Le Tuan Anh № NTA-1221 (holotype VNMN!).

**Description.** *Rhizomatous terrestrial herb* to 0.5–0.7 m tall. *Rhizome* ovoid to narrowly ovoid, 2.5–5.3 × 0.7–1.1 cm, with short thin branches pointing downwards, outside light brown, white to pale yellow inside (on cross-section); *rhizome scales* triangular, brown, glabrous; *root tubers* elliptic, 2.6–3.8 × 1.7–2.2 cm, light brown outside, white with translucent white center inside, distant to 8 cm from the rhizome. *Leafy shoot* 3–7 per plant with 2–5 leaves developing at the same time or shortly after flowering; *pseudostem* ca. 15 cm long, pale green composed of leaf sheaths and sheathing bracts; *sheathing bracts* 2–4, glabrous, becoming papery and decaying with age, pale green, tinged pink at apex; *leaf sheaths* green, glabrous; *ligule* ca. 1 mm long, bi-lobed, hyaline, greenish, glabrous, with sparsely hairy margin; *petiole* 5–13 cm, petioles of basal leaves much shorter than apical, canaliculate, green, glabrous; *leaf lamina* 25–40 × 6–8 cm, lanceolate to elliptic, obtuse and slightly unequal at the base, attenuate at apex, plicate, adaxially mid-green and glabrous, abaxially light green, puberulent in median vein, glabrous on both sides. *Inflorescence* lateral, with peduncle hidden underground; *peduncle* 5–10 cm, white; *spike* 10–20 cm long, 5–7 cm in diameter at the middle, with no obvious coma, composed of 15–25 bracts; *bracts* 3.5–3.7 × 1.5–3.0 cm, broadly ovate to rhombic (broader at the base, narrowed to the apex), pure white to greenish-white, margin and apex tinged pinkish red, glabrous on both sides, connate in lower 1/4–1/3 portion, cute, reflexed; *bracteoles* subulate, 2–5 × 0.5–1.0 mm, narrowly triangular, translucent, glabrous, often completely reduced. *Flowers* ca. 4.7 cm long, exerted from bracts; *calyx* ca. 15 mm long, 3-toothed, with unilateral incision ca. 3–5 mm long, semi-

translucent, white tinged pink, glabrous; *floral tube* 2.1–2.3 cm long, narrowly cylindrical at base for 1.5–1.8 mm in diameter above the ovary, funnel-shaped at apex for 5–6 mm, externally white, puberulent at funnel-shaped part, internally white tinged densely red at middle, lightly at apex, glabrous at base, hairy towards the throat; *dorsal corolla lobe* 16–17 × 5–6 mm, triangular, concave, with sides slightly incurved, apex mucronate, mucro ca. 1 mm, externally white with pink tinge at apex, internally white; *lateral corolla lobes* 15–17 × 5–6 mm, triangular, apex broadly acute to obtuse, semi-translucent; *labellum* 18–19 × 14–15 mm, bi-lobed, obovate, apex emarginated with an incision ca. 3 mm long, yellow at apex-half turning white at base, mid-rid band warm yellow with two lateral thin red lines running throughout half base; *lateral staminodes* ca. 18–21 × 11–13 mm, elliptic, pure yellow, glabrous both two sides, apex round. *Stamen* 11–12 mm long; *filament* 3–4 mm long, 4–4.5 mm in diameter at the base, 2 mm in diameter at the apex (the point of attachment to the connective), white tinged yellow, puberulent with glandular hairs; *anther* 8–9 mm long, with two blunt yellow knobs fixed below the thecae, weakly L-shaped with spurs

elongate into the acute apex, yellow, stout and outward-facing, ca 2 mm long; *connective* pure white turning yellow at apex and base near spurs, densely puberulent with glandular hairs; *anther crest* ca. 0.5 mm long, yellow, stout, apex rounded or bi-lobed; *thecae* 6–8 × 0.5–1 mm, narrowly obovate, dehiscing along their entire length; *pollen* white. *Epigynous glands* two, 4–5 mm long, 0.6 mm in diameter, white, with blunt apices. *Style* white, glabrous, basally placed in a dorsal groove of the floral tube; *stigma* ca. 1.5 mm in diameter, pale yellow, with ostiole ciliate, facing forward; *ovary* ca. 2–3 × 2–2.5 cm, 3-locular, white, puberulent with glandular hairs. *Fruits* not seen.

**Habitat, ecology and phenology.** Cultivated on Bazan soil by local people as a source of starch for traditional food in the elevation of about 0–100 m. The flowering period coincides with the beginning of the rainy season in Coastal Central Vietnam from August to October.

**Distribution and IUCN preliminary assessment.** *C. vinhlinhensis* is found only from the type locality in cultivation declining because of low yield. We need to conduct more field trips to find out the wild population. Hence we highly suggest assessed as Data Deficient (DD)

**Table 1.** Comparison of the morphologically vegetative and reproductive characteristics of *C. sixsensesensis* with four allies. Details showing the difference between each species with the host plant are given in bold

Character	<i>C. sixsensesensis</i>	<i>C. singularis</i>	<i>C. newmanii</i>	<i>C. tongii</i>
Ligule	2–3 mm, bi-lobed	1–1.5 mm long, bi-lobed	Up to 3 mm long, bi-lobed	4–5 mm long, bi-lobed
Lamina size (cm)	20–22 × 5–8	10–17 × 2.5–4	Up to 32 × 8 cm	20–26 × 8.5–10 cm
Lamina shape	Narrowly lanceolate to elliptic, slightly plicate	Narrowly ovate, prominent plicate	Narrowly lanceolate, slightly plicate	Elliptic
Inflorescent	Lateral, composing from 7–12 bracts	Lateral, composing from 7–9 bracts	Lateral, composing from 7–9 bracts	Lateral, composing from 7–12 (–15) bracts
Calyx	Tubular, 20–23 mm long	Tubular, 10–17 mm	Tubular, up to 23 mm long	16–18 mm long
Lateral staminodes	21–23 × 15–18 mm, Rhomboid, apex acute	<b>25–28 × 12–15 mm, Irregularly narrow obovate, apex rounded</b>	<b>26–30 × 16–18 mm, Irregularly obovate, apex rounded</b>	<b>22–23 × 12–13 mm, Irregularly obovate, apex rounded</b>
Labellum shape and color	Rhomboid, apex tri-lobed of middle lobe emarginated, deeply split to 1/2-the length	<b>Obovate, apex emarginate, incised 1–1.5 mm long</b>	<b>Obovate, apex emarginate, split up to 5 mm</b>	<b>Obovate, apex bi-lobed with incision 8–9 mm long</b>
Labellum color	White, median band yellow at apex half, white at base	White, <b>median band yellow, more or less white at apex</b>	White with a <b>bright yellow midrid band running through the centre</b>	White with a <b>bright yellow median band running through the centre</b>
Labellum size (mm)	21–23 × 14–16	22–25 × 18–21	26 × 20	20–22 × 12–13
Filament	6–7 mm long	<b>4–5 mm long, 3–4 mm wide at base, 1.5–2 mm wide toward upper</b>	<b>2–3 mm long, c. 4 mm wide at base, 2–2.5 mm wide at apex</b>	8–10 × 4–6 mm
Anther	10–11 mm long, narrowly oblong	9 mm, <b>L-shaped</b>	10 mm long, <b>L-shaped</b>	<b>6–6.5 mm long, L-shaped</b>
Anther spurs	1–1.5 mm, cylindrical, apex downward-pointing with two blunt knobs below thecae	<b>3–4 mm long, stout, apex outward-facing</b>	<b>1 mm long, stout, apex facing-pointing with two blunt knobs at apex</b>	<b>4–5 mm long, stout, apex outward-facing</b>
Anther crest	1.5 mm long, thick, rounded	<b>Absent</b>	<b>Absent</b>	1.2–1.5 mm long, thick, <b>bi-lobed</b>

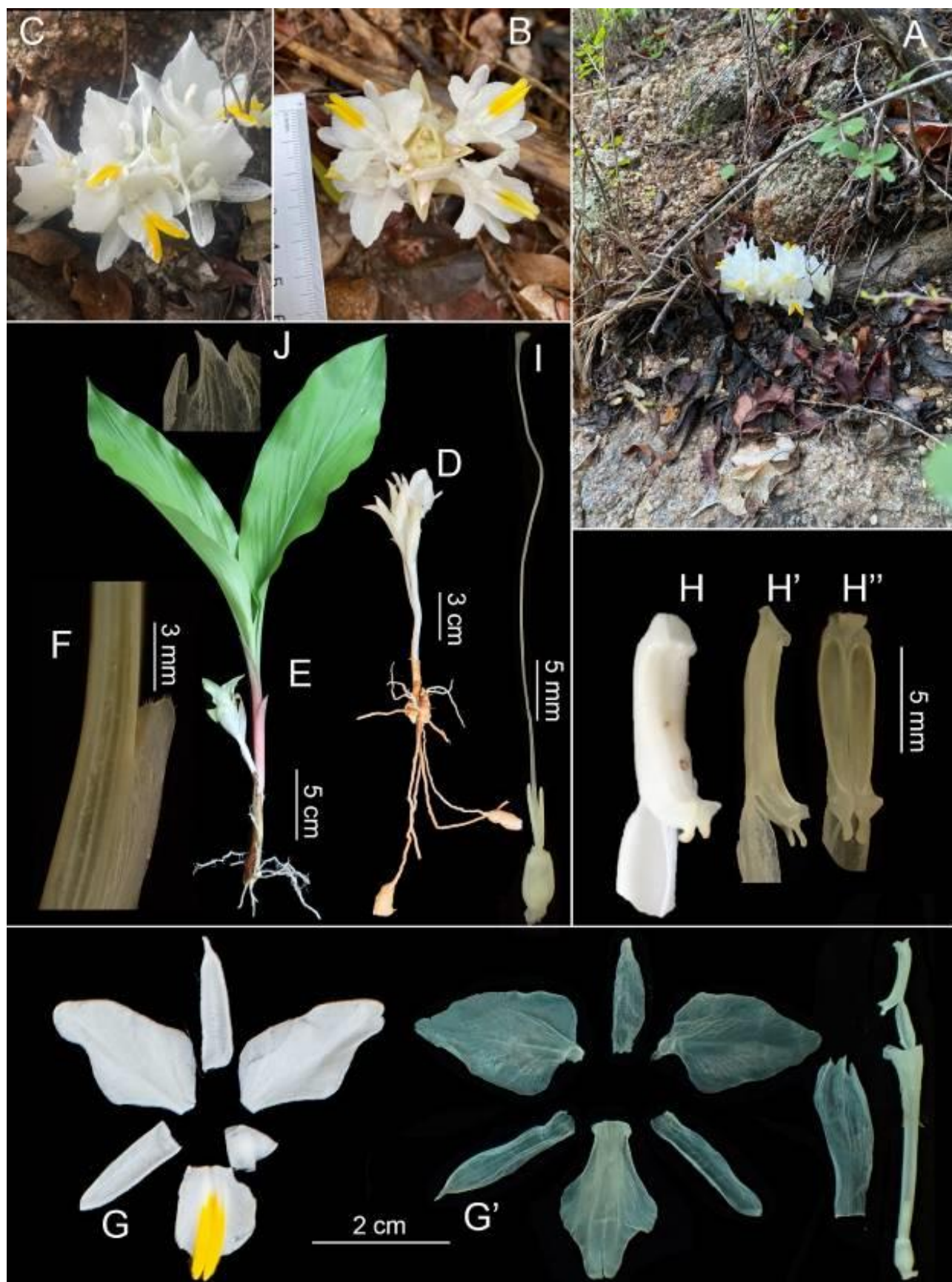
**Taxonomic notes**

*Curcuma vinhlinhensis* is similar to *C. pambrosima* Škorničk. & N.S.Lý, *C. cotuana* Luu, Škorničk. & H.Đ.Trần, *C. sahuynhensis* Škorničk. & N.S.Lý in a general view of habit, the shape of inflorescence, warm

yellow to orange flowers, and *L-shaped anther*. The comparison of the new taxa with these three allies is given in Table 2. Details showing the difference between each species with the host plant are given in bold.

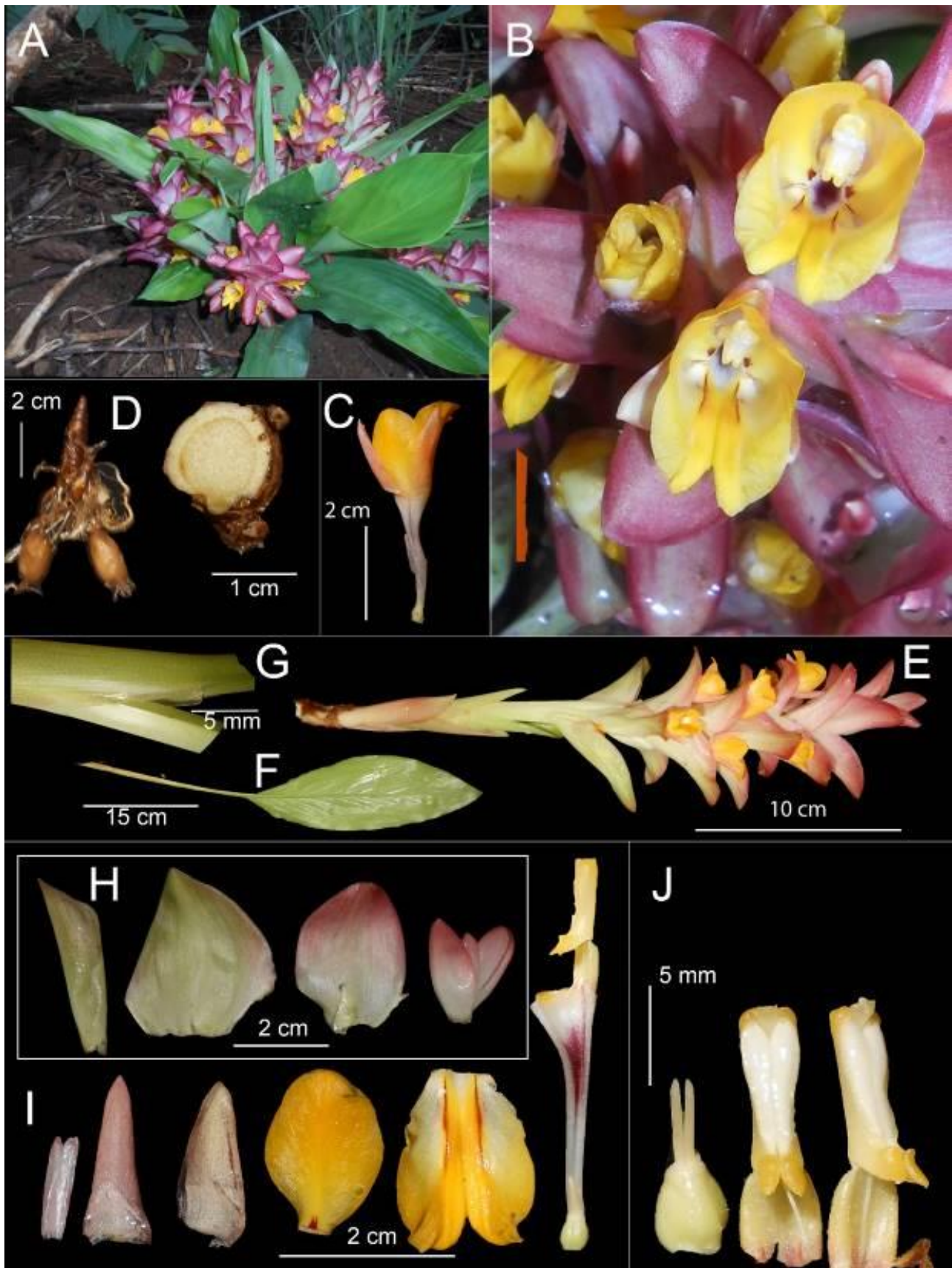
**Table 2.** Comparison of the morphologically vegetative and reproductive characteristics of *C. vinhlinhensis* with four allies. Details showing the difference between each species with the host plant are given in bold

Character		<i>C. vinhlinhensis</i>	<i>C. pambrosima</i>	<i>C. cotuana</i>	<i>C. sahuynhensis</i>
Inflorescent	Position	Lateral	Lateral	Terminal	Lateral, sometime terminal
	spike	10–20 cm long	10–25 cm long	5–9 cm long	6–15 cm
Calyx		10–15 mm	Up to 15 mm	20–22 mm	14–19 mm
Floral tube		2.1–2.3 cm, internally white in basal half turning deep purple in apical half	2.0–2.2 cm, internally white in basal half turning deep purple in apical half	Ca. 3.5 mm, internally white throughout	1.8–2.8 cm, internally white, turning pale yellow towards apical part
Lateral staminodes		17–18 × 11–13 mm, - Elliptic, apex round  - Warm yellow to Orange throughout with red spot at base	12–15 × 8–10 mm, - Unequally ovate-rhomboid with acute apex - Yellow at apex half, white at base with red spot	19–21 × 9.5–10.5 mm, - Unequally ovate to rhomboid - Warm yellow to Orange throughout	15–22 × 10–14 mm, - Unequally ovate to obovate to rhomboid, - Warm yellow to Orange throughout
Labellum	shape	Obovate, apex emarginated with incision up to 3 mm long,	Orbicular-rhombic, apex split 3–8 mm	Rhomboid, apex emarginate, incision up to 6 mm	Obovate, apex emarginated, incision up to 7 mm long,
	color	Dark yellow to orange, midrid band yellow with two lateral dark red lines at the base	Yellow at apex turning white at base midrid band yellow with two lateral dark red lines at the base	Dark yellow to orange midrid band without any dark red lines at the base	Dark yellow to orange with a bright median band without any dark red lines at the base
Filament	size (mm)	18–19 × 14–15	13–16 × 12–14	21–23 × 15–16	15–23 × 12–18
	3–4 mm long	4–5 mm long	7 mm long	6–7 mm long	
Anther	8–9 mm long with two small blunt knobs below the thecae	8–9 mm long prominent round bulge positioned below the thecae	12.5 mm long with two blunt knobs below the thecae	8–9 mm long, without knobs below the thecae	
Anther spurs	2–3 mm long, conical, outward-facing	Ca. 1 mm, cylindrical, inward-curving	3.5–4 mm long, outward-facing	3.5–5 mm long, outward-facing	
Anther crest	Reduced, up to 0.5 mm long, apex emarginate	Ca. 1.5 mm, apex round	1.0–1.2 mm, bi-lobed	Less than 1 mm long, apex emarginate	



**Figure 1.** *Curcuma sixsensesensis*: A. habitat; B. and C. inflorescences with opening flowers; D. habit with rhizome and young inflorescence; E. habit with a leafy shoot at late anthesis; F. ligule; G: flower dissection from fresh material; G': flower dissection from alcohol-treated material; H-H'': detail of anther; I: ovary with epigynous glands; J: detail of calyx apex. Photographed by Six Senses Ninh Van Bay team (A—E, H, G from type specimen LTA-1220); T.A.Le (G', H', H'', I, J, F from specimen LTA-1220 treated alcohol)





**Figure 2.** *Curcuma vinhlinhensis*: A. habit; B. flower in front view; C. single flower with calyx tube D. Rhizome; E. inflorescence; F. lamia with petiole; G. ligule; H. bracts (from left: bracts at the base to the top of inflorescence); I. flower dissection (from left: calyx, dorsal and lateral corolla lobes, lateral staminode, labellum, a floral tube attached stamen, ovary and epigynous glands). Photographed by T.A. Le

**Key to the species of *Curcuma* subgen. *Ecomata* in Vietnam**

- 1a. Anther spurs filamentous, hook-shaped ..... 2
- 2a. Short inflorescent, rhizome well-elongated ..... 3
- 3a. White staminodes with dark purple tips ..... *C. pierreana*
- 3b. White staminodes without dark purple tips ..... *C. cochichinensis*
- 2b. Longer inflorescent, rhizome compacted ..... 4
- 4a. Cream white bracts, lateral staminodes and labellum being pure warm yellow ..... *C. vitellina*
- 4b. Bracts being white at base tinged pale pink toward apex, lateral staminodes and labellum being white at base tuning pale yellow at apex ..... *C. arida*
- 1b. Anther spurs conical or cylindrical ..... 5
- 5a. Anther spurs longer than 3 cm, L shaped ..... 6
- 6a. White lateral staminodes ..... *C. singularis*
- 6b. Yellow lateral staminodes ..... 7
- 7a. Long inflorescent, epigynous glands 4–5 mm long .... *C. sahuynhensis*
- 7b. Short inflorescent, epigynous glands 11 mm long ..... *C. xanthella*
- 5b. Anther spurs 1–2 mm ..... 8
- 8a. Terminal inflorescent ..... 9
- 9a. Anther spurs outward-facing (weak L-shaped), anther crest bi-lobed ..... *C. cotuana*
- 9b. Anther spurs inward-pointing, anther crest rounded *C. rhomboides*
- 8b. Lateral inflorescent ..... 10
- 10a. Long spike 10–25 cm ..... 11
- 11a. Lateral staminodes and labellum being; anther spurs ca. 1 mm long, cylindrical, inward-curving ..... *C. pambrosima*
- 11b. Lateral staminodes and labellum being warm yellow to orange throughout; anther spurs 2–3 mm long, conical, outward-facing ..... *C. vinhlinhensis*
- 10b. Short spike 5–10 cm ..... 12
- 12a. Anther spurs outward-facing (weak L-shaped), anther crest reduced, short filament 2–3 mm long ..... *C. newmania*
- 12b. Anther spurs inward-pointing, anther crest up to 1.5 mm, longer filament 6–7 mm long .... *C. sixsensesensis*

**ACKNOWLEDGEMENTS**

The authors are also indebted to Mr. Andrew Martin Whiffen, the General Manager of Six Senses Ninh Van Bay Resort, for his discovery and support of the plant research and assistance in the field. The work of the first author belongs to the project — “Investigation of the current status and value of wild orchids (family Orchidaceae) and medicinal resources in Vietnam as a basis for management, use, conservation and sustainable development and results which are presented in this paper” supported in parts by the Institute of Applied Technology managed by Thu Dau Mot University.

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