

Curcuma lampangensis and *C. sabhasrii*, two new species of the family Zingiberaceae from northern Thailand

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Abstract. Rakarcha S, Saensouk S, Maknoi C, Wongnak M, Thammamong W, Saensouk P. 2022. *Curcuma lampangensis* and *C. sabhasrii*, two new species of the family Zingiberaceae from northern Thailand. *Biodiversitas* 23: 4448-4459. *Curcuma lampangensis* Saensouk, Maknoi & Rakarcha and *C. sabhasrii* Saensouk, Maknoi, Wongnak & Rakarcha, two new species of ginger family (Zingiberaceae) from northern Thailand, are described, illustrated and photographed. Additionally, the authors provide their detailed morphological descriptions, as well as illustrations, color photographs, distributions, ecology, etymology, phenology, vernacular, conservation status and its closely related species. The two new species are assignable to the *Curcuma* subgenus *Ecomatae*. *Curcuma lampangensis* and *C. sabhasrii* are endemic to Lampang and Phitsanulok provinces of northern Thailand, respectively. The morphological characteristics of *C. lampangensis* are compared to *C. rhomba* J. Mood & K. Larsen while *C. sabhasrii* is compared to *C. peramoena* Souvann. & Maknoi. *Curcuma lampangensis* is recognized by its glabrous on nearly all parts of the plant, creeping rhizome and the inflorescence usually arises from a new rhizome branch next to the existing pseudostem, flowers that are white to pale pink and white to pale yellow labellum with 2 dark yellow bands at the center and reddish tinge at the base. *Curcuma sabhasrii* is recognized by having 8-15 greenish to reddish-purple bracts, reddish-purple corolla lobes, white with reddish-purple mottling to reddish-purple staminodes and labellum which is reddish-purple with an embossed yellow path along the midrib from base to apex and reddish-purple mottling on yellow mid-band of lower half. A key to 24 species of *Curcuma* subgenus *Ecomatae* in Thailand is presented.

Keywords: *Curcuma peramoena*, *Curcuma rhomba*, Krachiao, Lampang, Phitsanulok, taxonomy

INTRODUCTION

The genus *Curcuma* L. is a rhizomatous herbaceous plant in the family Zingiberaceae and is widely distributed in the tropics of Asia from India to south China, southeast Asia, Papua New Guinea and northern Australia (Sirirugsa et al. 2007; Saensouk and Saensouk 2021; Saensouk et al. 2021a, b). Despite the fact that the precise number of *Curcuma* species is still unclear, it is undoubtedly greater than the 120 species estimated by Leong-Škorničková et al. (2007). The genus *Curcuma* has three subgenera, according to Závěská et al. (2012) and Leong-Škorničková et al. (2015): *Curcuma* subgenus *Curcuma* L. is characterized by the presence of epigynous gland, inflorescence with coma bracts, a closed flower form and the presence of two forward-facing spurs; *Curcuma* subgenus *Ecomatae* Škorničk. & Šída f. characterized by lacking coma bracts, present of the epigynous gland and anther spurs, fertile bracts connate only at the base and leaves with well-developed ligules; and *Curcuma* subgenus *Hitcheniopsis* (Baker) K. Schum characterized by lack of epigynous glands and the lack of anther spurs. Thailand is one of the regions with the highest species diversity for the *Curcuma* genus. Thirty-fourth species of the genus *Curcuma* were reported by Larsen (1996). Later, 38 species of *Curcuma* were reported in

Thailand (Maknoi 2006; Sirirugsa et al. 2007). Recently, many new species and new records of *Curcuma* were described from Thailand, as shown in Table 1. Currently, 72 species of *Curcuma* are reported in Thailand, with all three subgenera: 22 species belong to subgenus *Ecomatae*, 26 species belong to *Curcuma* and 24 species belong to *Hitcheniopsis* (Saensouk et al. 2022; Soonthornkalump et al. 2022).

In northern Thailand, two unidentified *Curcuma* specimens were collected and photographed. The first was discovered in the deciduous forests of the limestone hills in Lampang province, and the other was discovered in the deciduous forest in Phitsanulok province. Later, after examining the relevant taxonomic literature, comparing its morphological characteristics to all allied species and studying the type specimens, the authors discovered that it did not match with any existing taxa and obviously represents an undescribed species. Therefore, it's were identified as species new to science, and are described here as *Curcuma lampangensis* and *C. sabhasrii*. As a result, Thailand now recognizes 74 species belonging to the genus *Curcuma*. We provide a thorough explanation of its morphology, as well as illustrations, color photographs, distribution, ecology, etymology, phenology, vernacular, information about its conservation status and a study of its closest species.

Table 1. A list of new species and new records of *Curcuma* taxa were described from Thailand (2011-2022)

Taxa	References
<i>Curcuma bella</i> Maknoi, K. Larsen & Sirirugsa	Maknoi et al. (2011)
<i>C. woodii</i> N. H. Xia & J. Chen	Chen et al. (2015)
<i>C. prasina</i> Škorničk.	Leong-Škorničková et al. (2017)
<i>C. saraburiensis</i> Boonma & Saensouk	Boonma and Saensouk (2019)
<i>C. putii</i> Maknoi & Jenjitt.	Maknoi et al. (2019)
<i>C. cinnabarina</i> Škorničk. & Soonthornk.	Leong-Škorničková et al. (2020)
<i>C. eburnean</i> Škorničk., Suksathan & Soonthornk.	Leong-Škorničková et al. (2020)
<i>C. fimbriata</i> Škorničk. & Soonthornk.	Leong-Škorničková et al. (2021)
<i>C. micrantha</i> Škorničk. & Soonthornk.	Leong-Škorničková et al. (2021)
<i>C. spathulata</i> Škorničk. & Soonthornk.	Leong-Škorničková et al. (2021)
<i>C. globulifera</i> Škorničk. & Soonthornk.	Leong-Škorničková et al. (2021)
<i>C. papilionacea</i> Soonthornk., Ongsakul & Škorničk.	Soonthornkalump et al. (2020)
<i>C. lithophila</i> Škorničk. & Soonthornk.	Soonthornkalump et al. (2021)
<i>C. rufostriata</i> Škorničk. & Soonthornk.	Soonthornkalump et al. (2021)
<i>C. chantaranothaii</i> Boonma & Saensouk	Saensouk et al. (2021a)
<i>C. charanii</i> Boonma & Saensouk	Saensouk et al. (2021a)
<i>C. rangsimae</i> Boonma & Saensouk	Saensouk et al. (2021a)
<i>C. phrayawan</i> Boonma & Saensouk	Saensouk et al. (2021a)
<i>C. puangpeniae</i> Boonma & Saensouk	Saensouk et al. (2021a)
<i>C. purpurata</i> Boonma & Saensouk	Saensouk et al. (2021a)
<i>C. peramoena</i> Souvann. & Maknoi	Saensouk et al. (2021a)
<i>C. wanenlueanga</i> Saensouk, Thomudtha & Boonma	Saensouk et al. (2021b)
<i>C. rangjued</i> Saensouk & Boonma	Saensouk et al. (2021c)
<i>C. cordata</i> Wall.	Saensouk et al. (2021c)
<i>C. aruna</i> Maknoi & Saensouk	Maknoi et al. (2021)
<i>C. pitukii</i> Maknoi, Saensouk, Rakarcha & Thammar.	Maknoi et al. (2021)
<i>C. siamensis</i> Saensouk & Boonma	Saensouk et al. (2021d)
<i>C. achrea</i> Saensouk & Boonma	Saensouk et al. (2022)
<i>C. stahlianthoides</i> Škorničk. & Soonthornk.	Soonthornkalump et al. (2022)

MATERIALS AND METHODS

Herbarium specimens and field collections served as the foundation for this study's description and illustration. In 2021, two unidentified *Curcuma* collections were collected from Lampang and Phitsanulok provinces, Thailand. The first was discovered in the deciduous forest of the limestone hills in Lampang province, and the other was discovered in the deciduous forest in Phitsanulok province. The morphological descriptions of all recognized species, particularly the distribution of those species in Thailand and its neighboring countries, all published *Curcuma* literature, particularly that pertaining to the subgenus *Ecomatae*, and any available digital photos were examined. The morphological characteristics of *C. lampangensis* are compared to type specimen from the digital image of herbarium specimen available online from AAU (*M. Collins* VH8077) and all existing published literature of *C. rhomba* J. Mood & K. Larsen (Souvannakhommane and Maknoi 2014; Tanaka and Aung 2019; Chen et al. 2015) and *C. sabhasrii* is compared to type specimen from QBG (P. Srisanga, M. Norsangsri, W. La-ongsri, S. Suk-ieam, K. Phouthavong & K. Souvannakhommane L2-294) and all existing published literature of *C. peramoena* Souvann. & Maknoi (Souvannakhommane and Maknoi 2014). The morphological description is described under a stereomicroscope. Measurements were recorded from fresh materials, herbarium specimens and spirit specimens. A

preliminary conservation assessment was prepared according to IUCN Standards and Petitions Committee (2019).

RESULTS AND DISCUSSION

During the fieldwork aimed to study the species diversity of the threatened plant in the northern Thailand. Two new species of *Curcuma* were described from Lampang and Phitsanulok provinces, i.e. *Curcuma lampangensis* sp. nov. and *C. sabhasrii* sp. nov., respectively. Two new species are assignable to the *Curcuma* subgenus *Ecomatae*. We include a comprehensive explanation of its morphology, illustrations, color photographs, information on its distribution, ecology, etymology, phenology, vernacular, information on its conservation status, and a study of its closest relatives (Figures 1-6 and Tables 1-3). A key to 24 species of *Curcuma* subgenus *Ecomatae* in Thailand is presented.

Taxonomic treatment

Curcuma lampangensis Saensouk, Maknoi & Rakarcha, sp. nov.

Curcuma lampangensis is the most similar to *C. rhomba* having a similar shape of the lamina with glabrous on both surfaces of the lamina, a short peduncle, the shape and size of the spike, an inflorescence without coma bracts,

the presence of an epigynous gland, and overall flowers. However, it differs in that it has an elliptic rhizome that is small, long branched, and creeping (vs ovoid in *C. rhomba*), a spike composed of whitish to pale green or with a pale pink tinge bract (vs red bracts in *C. rhomba*), white to pale pink corolla lobes (vs red corolla lobes in *C. rhomba*), white or white at the basal part with an increasing pale yellow tinge towards the apical part with red-brown spots at the base of the staminode (vs light pale orange with dark red dots at the base of the staminode in *C. rhomba*), and a longer anther spur, measuring 4–6 mm (vs ca. 1 mm in *C. rhomba*). The other morphological differences between *C. lampangensis* and *C. rhomba* are provided in Table 2. *Type*: THAILAND, Lampang Province, Mae Mo District, Ban Dong Subdistrict, Ban Tha Si, Doi Pha Kan, 23 August 2021, W. Thammarong, S. Rakarcha, S. Yokyo & M. Tabut 2991 (holotype QBG!; isotypes BKF!, KCU!). Figures 1–3, Table 2–subgen. *Ecomatae*

Perennial herb. *Primary rhizome* elliptic, 2.5–3.5 × 1.6–2 cm, outside brownish, inside pale yellow, with small and long branched, creeping, 4–7 mm in diam. *Root* fibrous and bearing ovate to elliptic tubers, 2–4 × 1–2 cm, inside translucent white. *Leafy shoots* 45–75 cm tall. *Bladeless sheaths* 2, 4–18 cm long, green, glabrous on both surfaces, apex acute. *Leaves* 4–6; *leaf sheaths* 12–18 cm long, green, glabrous; *ligule* bilobed, ca. 3 mm long, each lobe apex obtuse, sparsely hairy or glabrous; *petiole* canaliculate, 10–20 cm long, green, glabrous; *lamina* elliptic, 28–42 × 12–16 cm, apex acuminate, base attenuate, adaxially green, abaxially pale green, glabrous on both surfaces. *Inflorescence* lateral or rarely terminal, arising at the same time as leaves; *peduncle* 3–5.5 cm long, 3–5 mm diam., greenish-white, glabrous, with 4–8 sheathing bracts, sheathing bracts green with white at the base, apex acute, glabrous; *spike* 3.5–7 cm long, 2.5–4.5 cm diam.; *cincinnus* 3–6 flowers. *Coma bract* absent. *Fertile bracts* 12–24 in number, broadly ovate, 2.5–4.2 × 1.4–3.2 cm, connate 3–4 mm at the base, apex acute, margin entire, whitish to pale green or with a various pale pink ting, glabrous, *Bracteoles* small, narrowly triangular, ca. 4 × 1.5 mm, sometimes fully reduced (absent). *Flowers* 5.2–6.5 cm long, exerted from bracts. *Calyx* tubular, 14–18 mm long, apex 3-lobed with a unilateral incision 6–9 mm long from apex, pale purple, glabrous, 2 lobes apices mucronate, mucro ca. 2 mm long, another one lobe apex acute. *Corolla tube* 2.8–3.6 cm long, narrowly cylindrical at the base, funnel-shaped at apex, outside white to pale pink, puberulent, inside white, puberulent; *dorsal corolla lobe* triangular-lanceolate, 18–20 × 7–10 mm, apex mucronate, mucro ca. 2 mm, white to pale pink, glabrous; *lateral corolla lobe* triangular-lanceolate, 16–19 × 6–8 mm, apex broadly acute, white to pale pink, glabrous. *Lateral staminodes* rhomboid, 20–24 × 12–19 mm, white or white at basal part with increasing pale yellow tinge towards the apical part, with red-brown spots at the base, adaxially puberulent, abaxially sparsely puberulent to glabrous. *Labellum* irregularly obovate-rhomboid, 20–25 × 14–18 mm, apex emarginate, sinus 4–6 mm depth, white to pale yellow, with an embossed yellow-

orange path along the center from base to apex (divided into two patches like a Y-shaped at the base), with a reddish tinge at the base, minutely puberulent along both side of mid-band. *Stamen* 12–15 mm long, white; *filament* flat, 6–7.2 × 3.6–4 mm, puberulent; *anther* 7.5–8.2 mm long, white, connective tissue puberulent; *anther spurs* 4–6 mm long, conical; *anther crest* 1–1.6 mm long, apex slightly emarginate. *Ovary* oblong, 3–3.2 × 2.2–2.5 mm, trilocular, white, glabrous or rarely sparsely puberulent; epigynous gland 2, cylindrical, 6–8 mm long, white or pale yellow; *style* white, glabrous; *stigma* conical, 0.8–1.2 mm wide, ostiole ciliate, white. *Fruit* obovate, ca. 12 × 10 mm, white to pure yellow, glabrous; *seed* elliptic to oblong, 3–4.2 × 2–2.5 mm, light brown with white aril.

Distribution: Endemic to northern Thailand, only known from the type locality in Mae Mo District, Lampang province.

Ecology: It grows in a mixed deciduous forest along the foothills of limestone hills on sandy soil in the shade, altitude 410 m above sea level.

Phenology: Flowering and fruiting in August.

Vernacular: Krachiao lampang (Krachiao in Thai means *Curcuma* and lampang means Lampang province).

Etymology: The specific epithet “*lampangensis*” refers to Lampang province, where the type was collected.

Preliminary conservation status: *Curcuma lampangensis* is endemic to northern Thailand and currently known only from three collections in one locality. The species was discovered in an area at risk of human disturbance because the residents surrounding region is used for agricultural purposes and the subpopulation occurs in a protected area of Tham Pha Thai National Park. The Extent of Occurrence (EOO) is estimated at less than 5 km² and the Area of Occupancy (AOO) is estimated at 4 km². The total number of individuals is less than 500. Therefore, the conservation status is provisionally evaluated as Critically Endangered [*EN: B1ab(ii), B2ab(ii)*], according to IUCN Standards and Petitions Committee (2019). However, this species might occur in other nearby areas of Tham Pha Thai National Park. Therefore, further fieldwork is also important in determining the direction of the conservation status.

Specimens examined: THAILAND, Lampang Province, Mae Mo District, Ban Dong Subdistrict, Ban Tha Si, Doi Pha Kan, 23 August 2021, W. Thammarong, S. Rakarcha, S. Yokyo & M. Tabut 2991 (BKF, KCU, QBG); *ibid.*, 2 September 2021, S. Rakarcha, C. Doungdang & M. Tabut 1344 (QBG).

Note: *Curcuma lampangensis* is recognized by its 45–75 cm tall, elliptic rhizome with small and long branched and creeping, inflorescence lateral or rarely terminal and arising at the same time as leaves, spike composed whitish to pale green or with various pale pink ting bract, white to pale pink corolla lobes, white or white at basal part with increasing pale yellow tinge towards the apical part with red-brown spots at the base of staminode and white to pale yellow labellum with 2 dark yellow bands at the center and reddish tinge at the base.

Table 2. Morphological comparison between *Curcuma lampangensis* Saensouk, Maknoi & Rakarcha and *C. rhomba* J. Mood & K. Larsen (Souvannakhoummane and Maknoi 2014; Tanaka and Aung 2019; Chen et al. 2015 from *M. Collins* VH8077 (AAU))

Characters	<i>C. lampangensis</i>	<i>C. rhomba</i>
Rhizome	Elliptic with small and long branched and creeping	Ovoid
Plant size	45–75 cm tall	Up to 1 m tall
Leaf-size	Elliptic, 28–42 × 12–16 cm	Broadly elliptic, 29–46 × 9–18.3 cm
Leaf	Green, glabrous on both surfaces, base attenuate	Green, glabrous on both surfaces, base truncate to cordate
Inflorescence	Lateral or rarely terminal	Terminal
Fertile bracts	Broadly ovate, 2.5–4.2 cm long, whitish to pale green or with a various pale pink ting	Ovate, ca. 4.5 cm long, red
Corolla lobes	White to pale pink	Outside dark red, inside yellow
Staminode	Rhomboid, 20–24 × 12–19 mm, white or white at basal part with increasing pale yellow tinge towards the apical part, with red-brown spots at the base	Rhomboid, light pale orange with dark red dotted at the base
Labellum	Irregularly obovate-rhomboid, 20–25 × 14–18 mm, white to pale yellow, with an embossed yellow-orange path along the center from base to apex (divided into two patches like a Y-shape at the base), with reddish tinge at the base	17 × 9 mm, lower half orange, upper half yellow
Anther spur	4–6 mm long	ca. 1 mm long

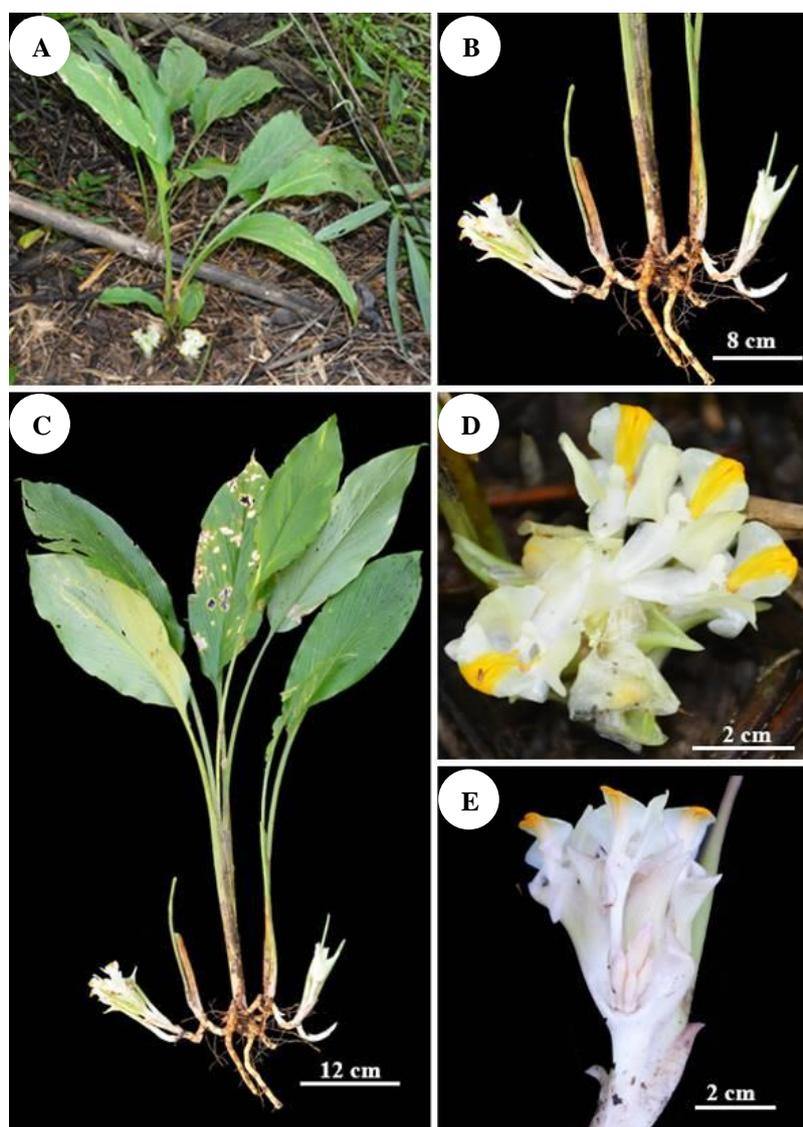


Figure 1. *Curcuma lampangensis* Saensouk, Maknoi & Rakarcha: A. habitat; B. rhizome and inflorescence; C. habit; D. top view of inflorescence with flowers; E. side view of inflorescence with flowers. Photographed by S. Rakarcha

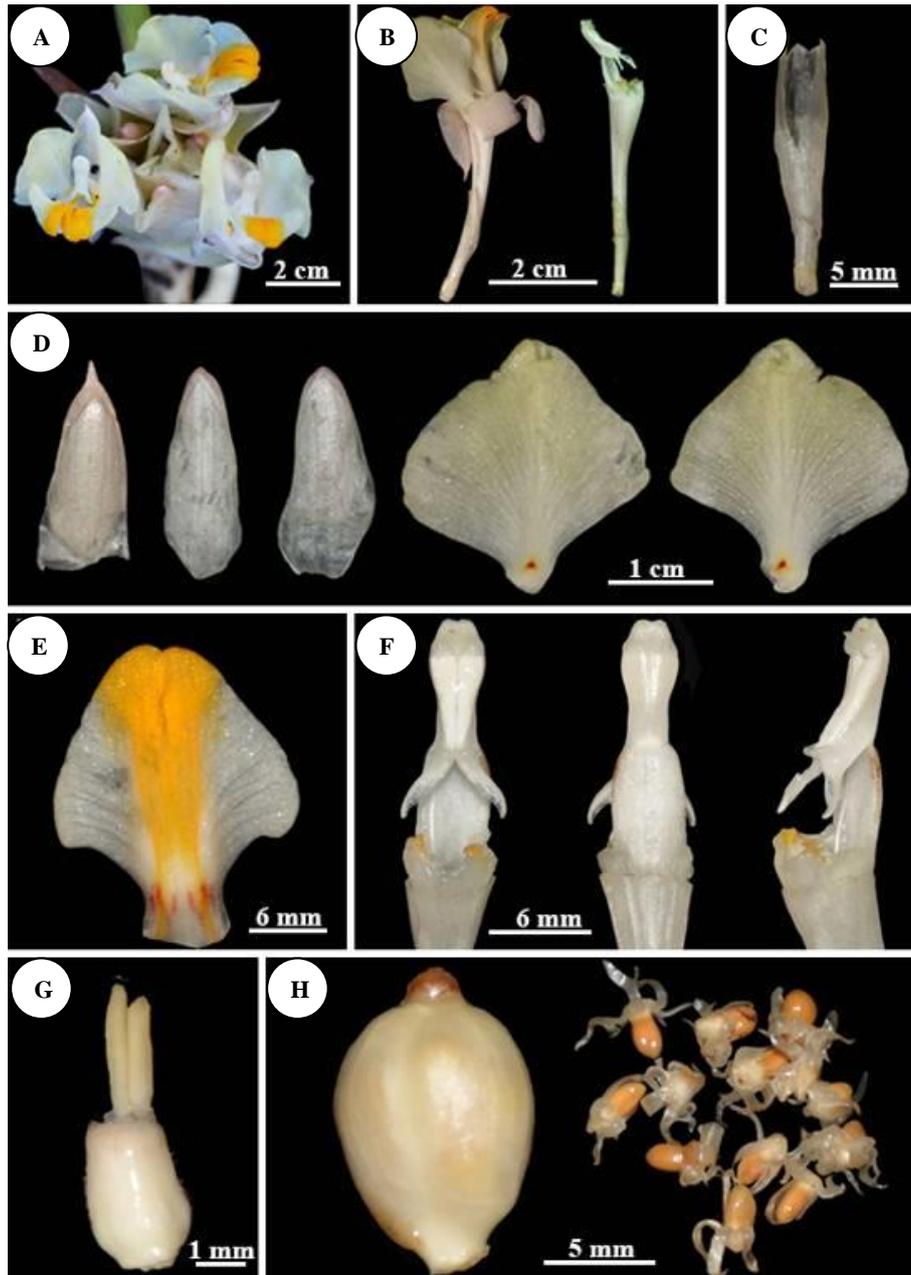


Figure 2. *Curcuma lampangensis* Saensouk, Maknoi & Rakarcha: A. top view of inflorescence with flowers; B. side view of flowers and corolla tube with stamen; C. calyx; D. flower dissection: dorsal corolla lobe, lateral corolla lobes and staminodes; E. labellum; F. stamen: front view, back view and side view; G. ovary with epigynous glands; H. fruit and seeds. Photographed by S. Rakarcha

Curcuma sabhasrii Saensouk, Maknoi, Wongnak & Rakarcha, **sp. nov.**

Curcuma sabhasrii is the most similar to *C. peramoena* Souvann. & Maknoi in having terminal inflorescences, short peduncles, inflorescences without coma bracts, and conical anther spurs. They differ noticeably in that *C. sabhasrii* has flowers that are longer, measuring 5.2–6 cm (vs 2–4 cm long in *C. peramoena*), longer calyx, measuring 16–20 mm (vs up to 15 mm long in *C. peramoena*), staminode larger in size, measuring 18–22 × 13–16 mm (vs 12–15 × 8–10 mm in *C. peramoena*), white with reddish-purple mottling to reddish-purple and a dark reddish-purple patch at the base of staminodes (vs white with dark purple spots at the base of staminodes in *C. peramoena*), labellum

ovate-oblong (vs diamond shaped in *C. peramoena*), labellum larger in size, measuring 22–24 × 14–18 mm (vs 15–18 × 12–14 mm in *C. peramoena*), reddish-purple with an embossed yellow path along the center from base to apex and reddish-purple mottling on yellow mid-band of the lower half of labellum (vs white with a yellow patch in center and red spots at the base in *C. peramoena*) and longer anther spur, measuring 3.2–4 mm (vs ca. 2.5 mm long in *C. peramoena*). The other morphological differences between *C. sabhasrii* and *C. peramoena* are provided in Table 3. *Type:* THAILAND, Phitsanulok Province, Chat Trakan District, 15 May 2021, P. Phaosrichai & M. Wongnak 2641 (holotype QBG!; isotypes BKF!, KGU!). Figures 4–6, Table 3—subgen. *Ecomatae*

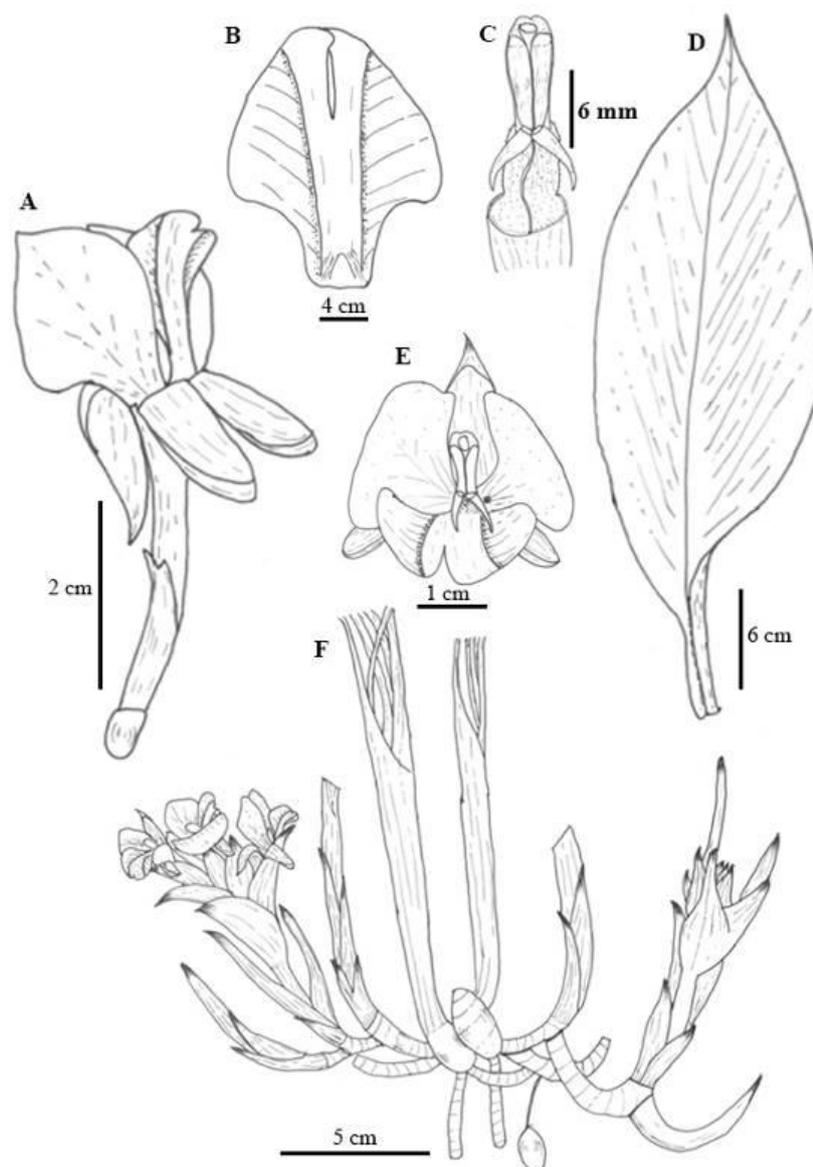


Figure 3. *Curcuma lampangensis* Saensouk, Maknoi & Rakarcha: A. side view of flowers; B. labellum; C. front view of a stamen; D. leaf; E. front view of flowers; F. rhizome and inflorescence. Drawn by S. Rakarcha

Perennial herb. *Rhizome* elliptic to obovate, 1.8–3.5 × 1.4–2.2 cm, outside light brown, inside pale yellow. *Root* fibrous and bearing ovate, 2.5–4 × 1–1.8 cm, inside translucent white. *Leafy shoots* 30–55 cm tall. *Bladeless sheaths* 2–4, 5–18 cm long, reddish, adaxially glabrescent, abaxially puberulent, margin entire. *Leaves* 2–3; *leaf sheaths* 10–20 cm long, reddish, adaxially glabrous, abaxially densely puberulent, margin entire; *ligule* concave, 2–3 mm long, densely puberulent; *petiole* canaliculate, 8–18 cm long, green to reddish, adaxially glabrous, abaxially densely puberulent; *lamina* elliptic to oblanceolate, 27–40 × 10–15 cm, apex acute, base cuneate, margin hyaline, semitranslucent white, ca. 0.5 mm wide, adaxially green, glabrous, abaxially pale green, densely puberulent. *Inflorescence* terminal; *peduncle* 4–7 cm long, greenish-white, densely puberulent; *spike* 6–8 cm long, 3–5 cm

diam.; *cincinnus* 3–4 flowers. *Coma bract* absent. *Fertile bracts* 8–15 in number, broadly ovate, 3–5 × 2.2–3 cm, connate 8–15 mm at the base, apex acute, margin entire, greenish to reddish-purple, adaxially glabrescent, abaxially sparsely puberulent. *Bracteoles* are small, narrowly linear to lanceolate, 1.5–8 × 1.5–3 mm, sometimes fully reduced (absent). *Flowers* 5.2–6 cm long, exerted from bracts. *Calyx* tubular, 16–20 mm long, apex 3-lobed with a unilateral incision 7–8 mm long from the apex, translucent white, sparsely puberulent or glabrous. *Corolla tube* 2.5–3 cm long, narrowly cylindrical at the base, funnel-shaped at apex, outside white at the basal part with increasing purple tinge towards the apical part, densely puberulent, inside white, glabrous at basal part, with densely puberulent at funnel-shaped; *dorsal corolla lobe*, narrowly ovate, 18–22 × 6–8 mm, hooded, apex mucronate, mucro 1–2 mm, pale

reddish-purple at basal part with increasing reddish-purple tinge towards the apical part, glabrous with sparsely puberulent mucro; *lateral corolla lobe* narrowly ovate, 16–19 × 5–7 mm, apex obtuse-hooded, pale reddish-purple at basal part with increasing reddish-purple tinge towards the apical part, glabrous. *Lateral staminodes* ovate-rhomboid to elliptic-rhomboid, 18–22 × 13–16 mm, white with reddish-purple mottling to reddish-purple, with a dark reddish-purple patch at the base, sparsely puberulent to glabrous. *Labellum* ovate-oblong, 22–24 × 14–18 mm, sinus 3–6 mm depth, reddish-purple with an embossed yellow path along the center from base to apex (divided into two patches at the base like a Y-shaped) and reddish-purple mottling on yellow mid-band of the lower half, minutely puberulent on either side of mid-band. *Stamen* 12–14 mm long; *filament* flat, 5–6 × 4–5 mm, ca. 3 mm broad at apex, white with reddish-purple mottling, densely puberulent; *anther* 6–8 mm long, white, connective tissue densely puberulent; *anther spurs* small, 3.2–4 mm long, conical, pointing outwards; *anther crest* ca. 2 mm long, white to pale reddish-purple, apex emarginate, densely puberulent. *Ovary* spherical, 2.8–3.2 × 2.5–3 mm, trilobular, white, densely puberulent; epigynous gland 2, cylindrical, 4–5 mm long, pale yellow; *style* white, glabrous; *stigma* capitate, 1.5–2 mm wide, ostiole glabrous, white. *Fruit and seed* not seen.

Distribution: Endemic to Thailand.

Ecology: It grows in deciduous forests, altitude of 180 m above sea level.

Phenology: Flowering from May to July.

Vernacular: Krachiao sabhasri (กระเจียวสรรพศรี) (Krachiao = Thai name for called *Curcuma* spp., sabhasri = the last name of Prof. Dr. Sanga Sabhasri) or Krachiao

thapthim (กระเจียวทับทิม) (thapthim = Thai name for called rubies, the color of the flowers resembles that of rubies.) or Dinso ruesi (ดินสอดำสี)

Etymology: The specific epithet “*sabhasrii*” is named in honor of Prof. Dr. Sanga Sabhasri, who was the first to establish the Botanical Garden Organization (BGO), Thailand, in 1992 with the goals of research, conservation, exhibition, and learning source of public.

Use: Auspicious ornamental plant.

Preliminary conservation status: *Curcuma sabhasrii* is only known from three locations in Phitsanulok province. The total number of mature individuals is less than 1,000. The Area of Occupancy (AOO) is about 12 km². The species occurs in an area at risk of human disturbance. Therefore, the conservation status is provisionally evaluated as Endangered, EN B2ab(iii), according to IUCN Standards and Petitions Committee (2019).

Specimens examined: THAILAND, Phitsanulok Province, Chat Trakan District, 15 May 2021, *P. Phaosrichai* & *M. Wongnak* 2641 (BKF, KKU, QBG); *ibid.*, May 2020, QBG20210733 (QBG-living specimen); Wat Bot District, 15 July 2021, *S. Rakarcha*, *K. Sompong* & *S. Sittisuk* 1331 (QBG); Chat Trakan District, 5 July 2021, *KI 1432* (QBG).

Notes: *Curcuma sabhasrii* is recognized by its 30–55 cm tall, spike 6–8 cm long, 8–15 greenish to reddish-purple bracts, reddish-purple flowers, white with reddish-purple mottling to reddish-purple staminodes, and labellum which is reddish-purple with an embossed yellow path along the midrib from base to apex and reddish-purple mottling on yellow mid-band of lower half. The flowers of *C. sabhasrii* begin to open around 9 a.m. and are fully open at approximately 10.30 a.m.

Table 3. Morphological comparison between *Curcuma peramoena* Souvann. & Maknoi (Souvannakhoummane and Maknoi 2014 from *P. Srisanga*, *M. Norsaengsri*, *W. La-onsri*, *S. Suk-ieam*, *K. Phouthavong* & *K. Souvannakhoummane* L2-294 (QBG)) and *C. sabhasrii* Saensouk, Maknoi, Wongnak & Rakarcha

Characters	<i>C. peramoena</i>	<i>C. sabhasrii</i>
Ligule	bilobed, 2–5 mm long, 2–4 mm wide	concave, 2–3 mm long
Lamina	narrowly elliptic to elliptic-ovate, 15–19 × 5–8 cm	elliptic to oblanceolate, 27–40 × 10–15 cm
Number of fertile bracts	5–15	8–15
Flowers	2–4 cm long	5.2–6 cm long
Calyx	up to 15 mm long	16–20 mm long
Corolla lobe	triangular ovate-lanceolate, 10–17 × 3–7 mm, outside white-pink on lower half gradually turning red upwards, inside pale pink to white	narrowly ovate 16–22 × 5–8 mm, pale reddish-purple at basal part with increasing reddish-purple tinge towards the apical part
Lateral staminodes	ovate-rhomboid, 12–15 × 8–10 mm, white with dark purple spots at base	ovate-rhomboid to elliptic-rhomboid, 18–22 × 13–16 mm, white with reddish-purple mottling to reddish-purple, with dark reddish-purple patch at the base
Labellum	diamond shaped, 15–18 × 12–14 mm, white with yellow patch in center and red spots at base	ovate-oblong, 22–24 × 14–18 mm, reddish-purple with embossed yellow path along the center from base to apex and reddish-purple mottling on yellow mid-band of lower half
Anther spurs	ca. 2.5 mm long	3.2–4 mm long
Epigynous gland	1–2 mm long	4–5 mm long

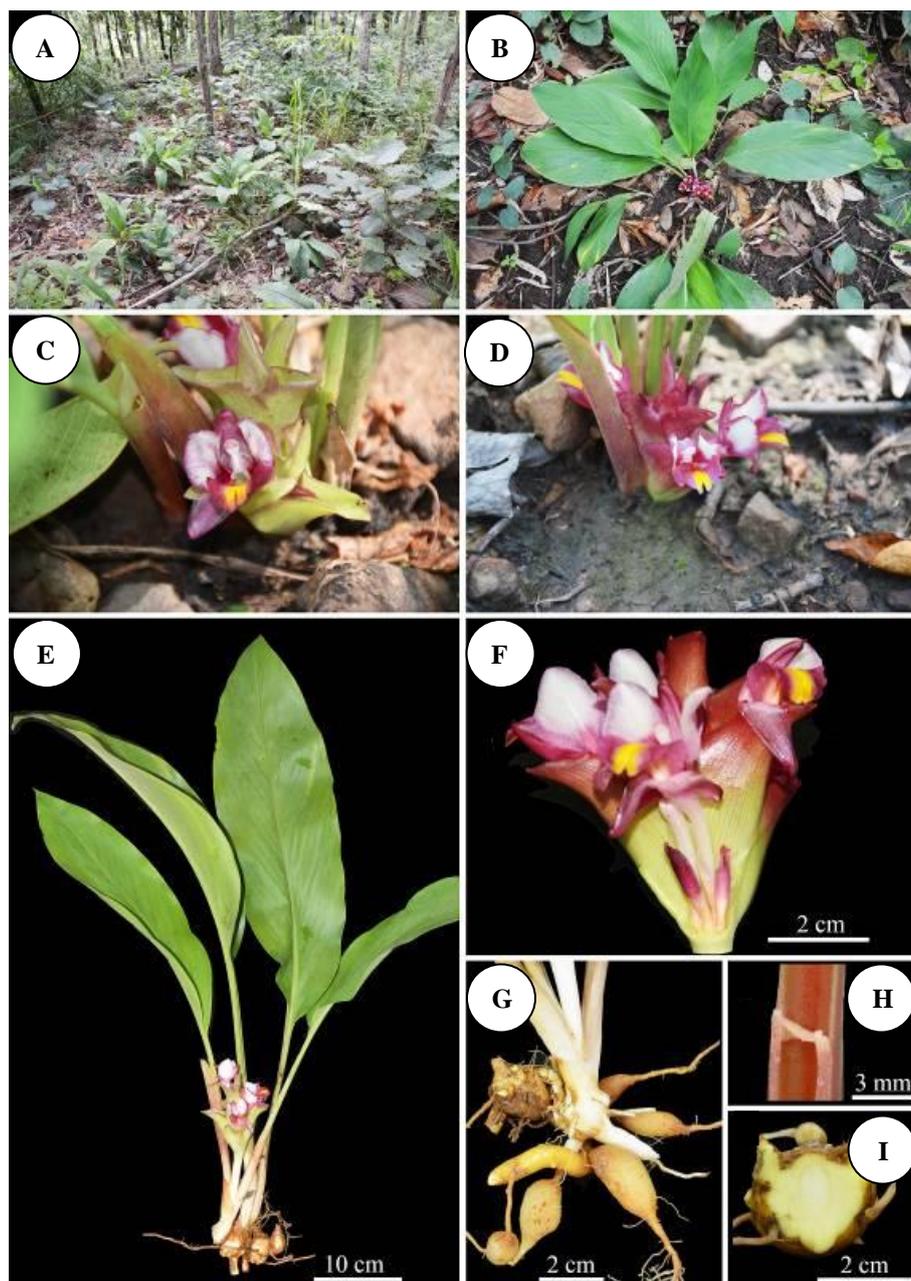


Figure 4. *Curcuma sabhasrii* Saensouk, Maknoi, Wongnak & Rakarcha: A.–B. habitat; C.–D. inflorescences; E. habit; F. cincinnus with 4 flowers; G. rhizome and root tubers; H. ligule; I. colour of rhizome. Photographed by S. Rakarcha

Currently, 74 species in three subgenera of the genus *Curcuma* have been identified in Thailand, including those from this study. Thus, the diverse hotspot of genus *Curcuma* is Thailand. The study showed two new species of the genus *Curcuma* in Thailand. Two new species belong to subgenus *Ecomatae* characterized by their epigynous glands, presence of anther spur and absence of a conspicuous coma of sterile bracts. The species of *Curcuma* subgenus *Ecomatae*, Leong-Škorničková et al. (2015) included 18 species in this subgenus. In addition, several new species in subgenus *Ecomatae* were described, i.e. *C. newmanii* Škorničk., *C. xanthella* Škorničk. (Leong-Škorničková and Tràn, 2013); *C. woodii* N. H. Xia & J. Chen (Chen et al. 2015); *C. putii* Maknoi & Jenjitt. (Maknoi et al. 2019); *C. tongii* Y. H. Tan & L. X. Zhang

(Zhang et al. 2019); *C. kayahensis* Nob. Tanaka & M. M. Aung (Tanaka and Aung 2019); *C. cinnabarina* Škorničk. & Soonthornk., *C. eburnea* Škorničk., Suksathan & Soonthornk. (Leong-Škorničková et al. 2020); *C. stolonifera* Nob. Tanaka, K. Armstrong & M. M. Aung (Tanaka et al. 2020); *C. chantaranothaii* Boonma & Saensouk, *C. rangsimae* Boonma & Saensouk (Saensouk et al. 2021a); *C. aruna* Maknoi & Saensouk, *C. pitukii* Maknoi, Saensouk, Rakarcha & Thammar. (Maknoi et al. 2021d); *C. siamensis* Saensouk & Boonma (Saensouk et al. 2021d); *C. achrea* Saensouk & Boonma (Saensouk et al. 2022). Including the species from this study, there are currently 34 species recognized for the *Curcuma* subgenus *Ecomatae*. According to this study, a total of 24 species of subgenus *Ecomatae* were reported in Thailand.

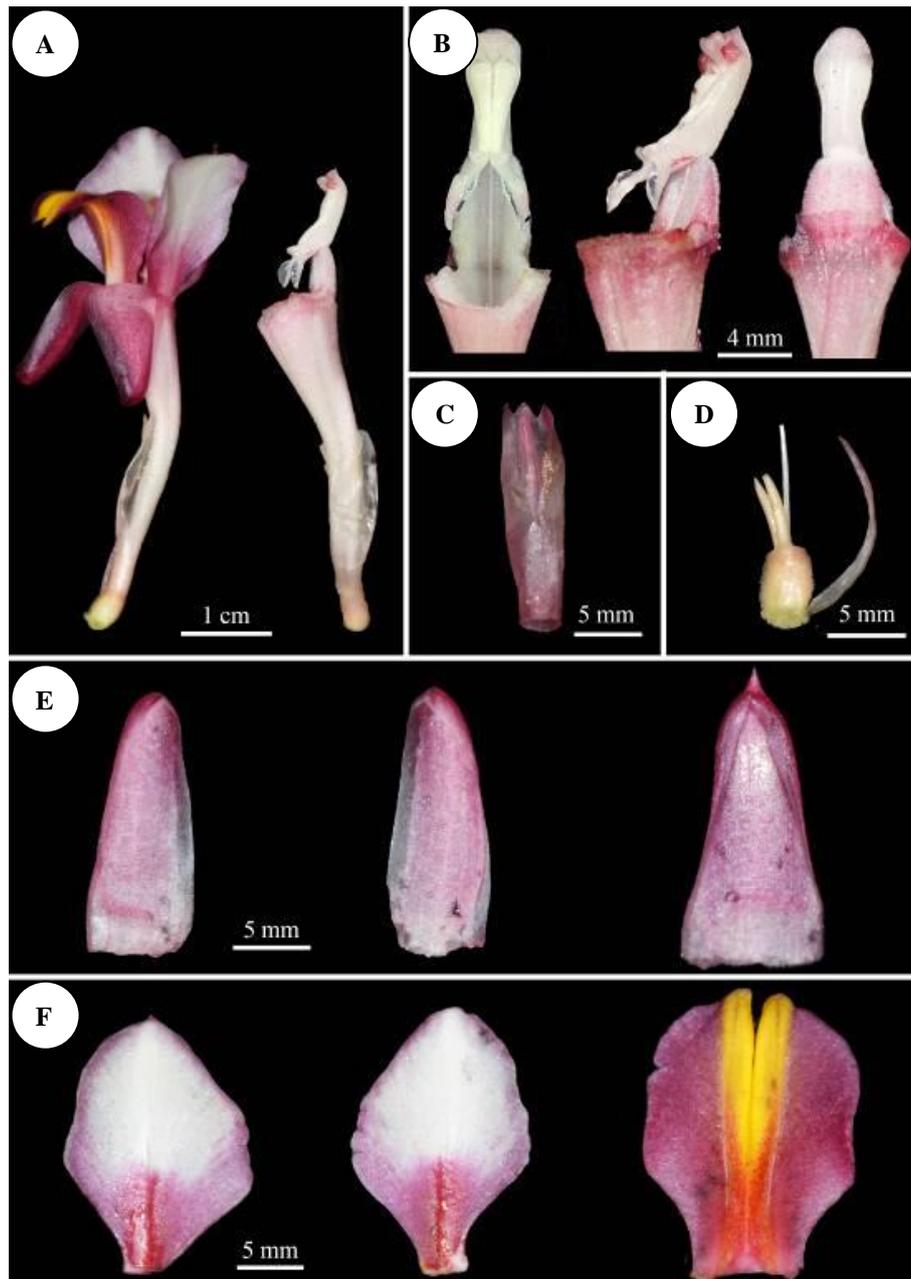


Figure 5. *Curcuma sabhasrii* Saensouk, Maknoi, Wongnak & Rakarcha: A. flower in side view and flower without corolla lobes, lateral staminode and labellum; B. front, side and back view of anther; C. calyx; D. ovary with epigynous gland and bracteoles; E. lateral corolla lobes and dorsal corolla lobe; F. lateral staminodes and labellum. Photographed by S. Rakarcha

Curcuma lampangensis is easily distinguished by its creeping rhizomes and the inflorescence usually arises from new rhizomes branches next to the existing pseudostem (Figure 1C). The notes give a description of a specific morphological characteristic that distinguishes this species apart from everyone else. *Curcuma sabhasrii* is

easily distinguished by its 30–55 cm tall, spike 6–8 cm long, reddish-purple flowers with an embossed yellow path along the center from base to apex on labellum. A key to 24 species of *Curcuma* subgenus *Ecomatae* in Thailand is presented for facilitating their identification in the field.

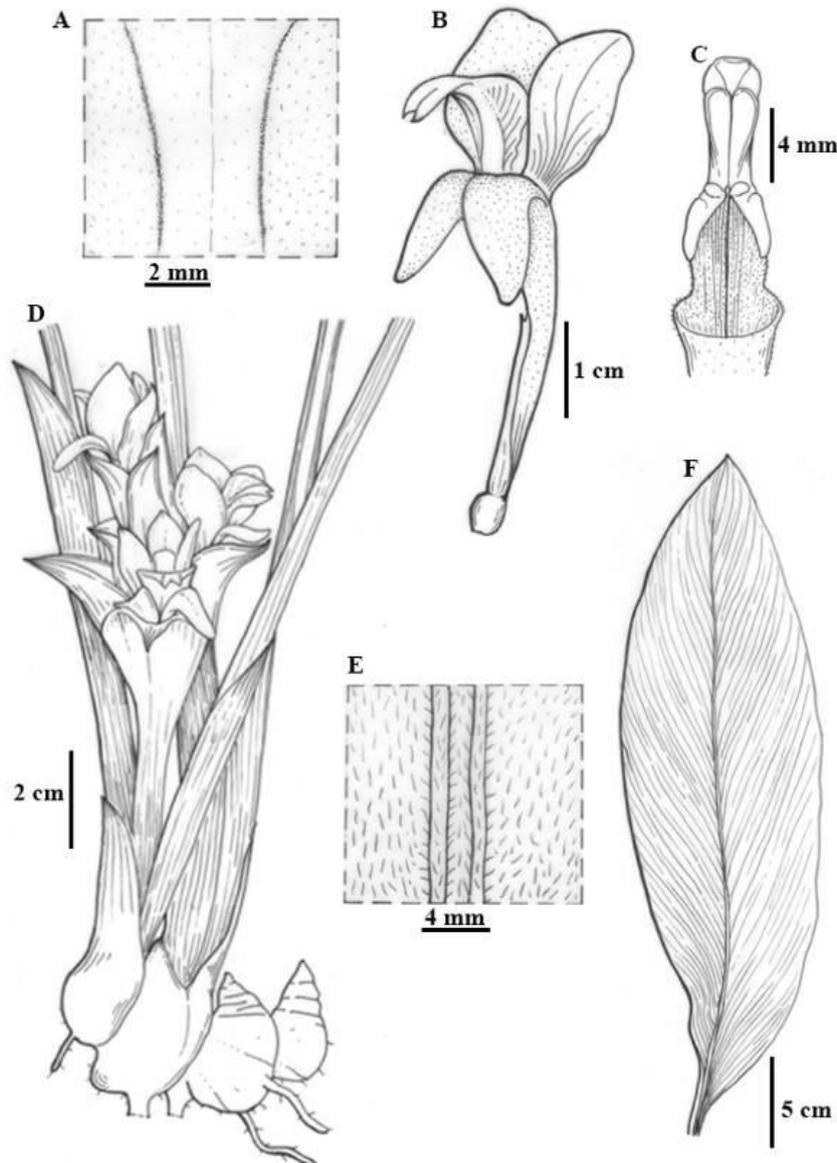


Figure 6. *Curcuma sabhasrii* Saensouk, Maknoi, Wongnak & Rakarcha: A. adaxial surface of labellum; B. flower in side view; C. front view of anther; D. habit; E. abaxial surface of leaf; F. leaf. Drawn by W. Thammarong

Key to 24 species of *Curcuma* subgenus *Ecomatae* in Thailand

- 1a. Corolla tube longer than bracts, narrow; flowers yellow; petiole very distinct from leaf blade *C. supraneaana*
- 1b. Corolla tube shorter than bracts, wide; flowers of various colors, leaf blade tapering into the petiole 2
 - 2a. Anther spurs filamentose 3
 - 3a. Staminodes white with dark purple tips *C. pierreana*
 - 3b. Staminodes white or white with a yellowish patch in center and apex 4
 - 4a. Leaves adaxially puberulous on both surfaces *C. chantaranothaii*
 - 4b. Leaves adaxially glabrous 5
 - 5a. Rhizomes creeping; leaf base attenuate *C. cochinchinensis*
 - 5b. Rhizomes ovoid; leaf base cuneate to rounded, or sub-cordate 6
 - 6a. Calyx white, glabrous; filament 2 mm long; anther 8–9 mm long ... *C. eburnea*
 - 6b. Calyx pale purple, puberulent; filament 5–8 mm long; anther 2.5–4 mm long *C. pitukii*
 - 2b. Anther spurs conical or cylindrical 7
 - 7a. Inflorescence terminal 8
 - 8a. Leaves adaxially glabrous 9
 - 9a. Staminodes without red spots at the base ... 10
 - 10a. Midrib adaxially green *C. rangsimae*
 - 10b. Midrib adaxially red *C. siamensis*
 - 9b. Staminodes with dark red or dark purple spots or at the base 11
 - 11a. Leaf abaxially glabrous; labellum yellow with inside half orange *C. rhomba*
 - 11b. Leaf abaxially pubescent; labellum not as above 12
 - 12a. Staminode elliptic, white with orange tip *C. woodii*

- 12b. Staminode ovate-rhomboid white or white with reddish-purple mottling to reddish-purple, without orange tip ... 13
- 13a. Staminode white with dark purple spots at base; labellum diamond-shaped, white with a yellow patch in center and red spots at base *C. peramoena*
- 13b. Staminode white with reddish-purple mottling to reddish-purple, with a dark reddish-purple patch at the base; labellum ovate-oblong, reddish-purple with an embossed yellow path along the center from base to apex and reddish-purple mottling on yellow mid-band of lower half *C. sabhasrii*
- 8b. Leaves adaxially hairy along the veins or pubescent 14
- 14a. Corolla lobes whitish-green to pale green; leaf base cuneate to attenuate *C. putii*
- 14b. Corolla lobes pink, red or purple; leaf base oblique, rounded or cordate 15
- 15a. Staminodes dark red in the lower half, upper half orange-yellow *C. bicolor*
- 15b. Staminodes pale yellow to yellow 16
- 16a. Thyse <10 cm long; flowers open form; corolla lobes red ... *C. stenochila*
- 16a. Thyse >10 cm long; flowers close form; corolla lobes white to yellow ... *C. cinnabarina*
- 7b. Inflorescence lateral 17
- 17a. Rhizome with small and long branched and creeping; inflorescence arising at the same time as leaves *C. lampangensis*
- 17b. Rhizome not branched and creeping; inflorescence arising before leaves 18
- 18a. Staminodes purple *C. ecomata*
- 18b. Staminodes white or yellow 19
- 19a. Labellum yellow 20
- 20a. Anther almost straight in sideview; staminodes with reddish V-shaped or triangular patch at the base *C. achrea*
- 20b. Anther L-shaped in sideview; staminodes without red patch as above 21
- 21a. Leaves elliptic to oblanceolate and pubescent on both surfaces, leaf base cuneate, staminodes ovate to elliptic *C. flaviflora*
- 21b. Leaves ovate and glabrous on both surfaces, leaf base rounded, staminodes obovate *C. aruna*
- 19b. Labellum white with a yellow median band 22
- 22a. Leaves upper green with red patch along the midrib *C. candida*
- 22b. Leaves upper green without red patch along the midrib 23
- 23a. Staminodes white on the lower half and golden yellow on the upper half, the central part with purple patch *C. glans*
- 23b. Staminodes white ... *C. singularis*

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REFERENCES

- Boonma T, Saensouk S. 2019. *Curcuma saraburiensis* (Zingiberaceae), a new species from Thailand. *Taiwania* 64 (3): 245-248.
- Chen J, Lindstron AJ, Xia HN. 2015. *Curcuma woodii* (Zingiberaceae), a new species from Thailand. *Phytotaxa* 227 (1): 75-82. DOI: 10.11646/phytotaxa.227.1.8.
- IUCN Standards and Petitions Committee. 2019. Guidelines for using the IUCN red list categories and criteria. Version 14. Prepared by the Standards and Petitions Committee.
- Larsen K. 1996. A preliminary checklist of the family Zingiberaceae in Thailand. *Thai For Bull (Bot)* 24: 35-49.
- Leong-Škorničková J, Sida O, Jarolímová V, Sabu M, Fér T, Trávníček P, Suda J. 2007. Chromosome numbers and genome size variation in Indian species of *Curcuma* (Zingiberaceae). *Ann Bot* 100 (3): 505-526. DOI: 10.1093/aob/mcm144.
- Leong-Škorničková J & Trần HD. 2013. Two new species of *Curcuma* subgen. *Ecomata* (Zingiberaceae) from southern Vietnam. *Gardens' Bull Singap* 65 (2): 169-180.
- Leong-Škorničková J, Šída O, Závěská E, Marhold K. 2015. History of infrageneric classification, typification of supraspecific names and outstanding transfers in *Curcuma* (Zingiberaceae). *Taxon* 64 (2): 362-373. DOI: 10.12705/642.11.
- Leong-Škorničková J, Middleton DJ, Triboun P, Suddee S. 2017. *Curcuma prasina* (Zingiberaceae), a new species from Thailand. *Edinb J Bot* 74 (2): 245-250. DOI: 10.1017/S0960428617000117.
- Leong-Škorničková J, Soonthornkalump S, Suksathan P. 2020. *Curcuma cinnabarina* and *C. eburnea* (Zingiberaceae: Zingiberoideae), two new species from Thailand. *Edinb J Bot* 77 (3): 391-402. DOI: 10.1017/S0960428620000049.
- Leong-Škorničková J, Soonthornkalump S, Thongbai W. 2021. Four new *Curcuma* species (Zingiberaceae) from Thailand. *Blumea* 65 (3): 244-253. DOI: 10.3767/blumea.2021.65.03.09.
- Maknoi C. 2006. Taxonomy and Phylogeny of The Genus *Curcuma* L. (Zingiberaceae) with Particular Reference to Its Occurrence in Thailand. [Dissertation]. Prince of Songkla University, Songkla, Thailand.
- Maknoi C, Ruchisansakun S, Jenjittikul T. 2019. *Curcuma putii* (Zingiberaceae), a new species from Thailand. *Annales Botanici Fennici* 56 (4-6): 351-353. DOI: 10.5735/085.056.0420.
- Maknoi C, Saensouk S, Saensouk P, Rakarcha S, Thammarong W. 2021. Two new species of *Curcuma* L. (Zingiberaceae) from Thailand. *Biodiversitas* 22 (9): 3910-3921. DOI: 10.13057/biodiv/d220937.
- Maknoi C, Sirirugsa P, Larsen K. 2011. *Curcuma bella* (Zingiberaceae), a new species from Thailand. *Thai J Bot* 3 (2): 121-124.
- Saensouk S, Boonma T, Saensouk P. 2021a. Six new species and a new record of *Curcuma* L. (Zingiberaceae) from Thailand. *Biodiversitas* 22 (4): 1658-1685. DOI: 10.13057/biodiv/d220410.
- Saensouk S, Boonma T, Saensouk P. 2021c. A new species and a new record of *Curcuma* subgen. *Curcuma* (Zingiberaceae) from northern Thailand. *Biodiversitas* 22 (9): 3617-3626. DOI: 10.13057/biodiv/d220903.
- Saensouk P, Boonma T, Saensouk S. 2021d. *Curcuma siamensis* (Zingiberaceae, Zingibereae), a new species of *Curcuma* subgen. *Ecomatae* from southeastern Thailand. *Biodiversitas* 22 (12): 5239-5246. DOI: 10.13057/biodiv/d221201.
- Saensouk S, Boonma T, Thomudtha A, Thomudtha P, Saensouk P. 2021b. *Curcuma wananlueanga* (Zingiberaceae), a new species of subgenus *Curcuma* from Thailand. *Biodiversitas* 22 (7): 2988-2994. DOI: 10.13057/biodiv/d220752.

- Saensouk P, Saensouk S. 2021. Diversity, traditional uses, and conservation status of Zingiberaceae in Udorn Thani province, Thailand. *Biodiversitas* 22 (8): 3083-3097. DOI: 10.13057/biodiv/d220752.
- Sirirugsa P, Larsen K, Maknoi C. 2007. The genus *Curcuma* L. (Zingiberaceae) distribution and classification with reference to species diversity in Thailand. *Garden's Bull Singap* 59 (1&2): 203-220.
- Soonthornkalump S, Ongsakul A, Dolaji A, Leong-Škorničková J. 2020. *Curcuma papilionacea* (Zingiberaceae), an unusual new species from southern Thailand. *Phytotaxa* 432 (1): 11-16. DOI: 10.11646/PHYTOTAXA.432.1.2.
- Soonthornkalump S, Puangpairote T, Niwesrat S, Leong-Škorničková J. 2021. *Curcuma lithophila* and *C. rufostriata* (Zingiberaceae), two new species from Thailand, and additional notes on *C. papilionacea*. *Thai For Bull (Bot)* 49 (1): 32-43. DOI: 10.20531/tfb.2021.49.1.03.
- Soonthornkalump S, Kongphapa J, Vianmana S, Kunlapa N, Leong-Škorničková J. 2022. *Curcuma stahlianthoides* (Zingiberaceae), a new species from northeastern Thailand dispersed by ants. *Blumea* 67 (1): 71-75. DOI: 10.20531/tfb.2021.49.1.03.
- Souvannakhoummane K, Maknoi C. 2014. *Curcuma peramoena* Souvann. & Maknoi (Zingiberaceae): a new species from Lao PDR. *Thai J Bot* 6 (2): 125-130.
- Tanaka N, Aung MM. 2019. Taxonomic studies on Zingiberaceae of Myanmar I: a new species of *Curcuma* (subgenus *Ecomatae*) from Myanmar. *Phytotaxa* 387 (3): 241-248. DOI: 10.11646/phytotaxa.387.3.4.
- Tanaka N, Armstrong K, Aung MM, Naiki A. 2020. Taxonomic studies on Zingiberaceae of Myanmar II: *Curcuma stolonifera* (subgenus *Ecomatae*), a new species from the northwestern region. *Brittonia* 72 (3): 268-272. DOI: 10.1007/s12228-020-09619-8.
- Záveská E, Fér T, Šída O, Krak K, Marhold K, Leong-Škorničková J. 2012. Phylogeny of *Curcuma* (Zingiberaceae) based on plastid and nuclear sequences: proposal of the new subgenus *Ecomata*. *Taxon* 61 (4): 747-763. DOI: 10.1002/tax.614004.
- Zhang L-X, Ding H-B, Li H-T, Zhang Z-L, Tan Y-H. 2019. *Curcuma tongii*, a new species of *Curcuma* subgen. *Ecomatae* (Zingiberaceae) from southern Yunnan, China. *Phytotaxa* 395 (3): 241-247. DOI: 10.11646/phytotaxa.395.3.9.