

Curcuma siamensis (Zingiberaceae, Zingibereae), a new species of *Curcuma* subgen. *Ecomatae* from Southeastern Thailand

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Abstract. Saensouk P, Boonma T, Saensouk S. 2021. *Curcuma siamensis* (Zingiberaceae, Zingibereae), a new species of *Curcuma* subgen. *Ecomatae* from Southeastern Thailand. *Biodiversitas* 22: 5239-5246. *Curcuma siamensis* Saensouk & Boonma sp. nov. (Zingiberaceae: Zingibereae) belonging to the genus *Curcuma* subgenus *Ecomatae*, as herein described and illustrated discovered in Chachoengsao Province, Southeastern Thailand during our exploration of Zingiberaceae family in Thailand and in preparation for the revision of the genus *Curcuma* for the Flora of Thailand project. It is similar to *Curcuma rangsimae* Boonma & Saensouk in having terminal inflorescences between the leaf-sheaths, emerging at the basal of the pseudo-stem, lacking coma bract, yellow flowers, presence of epigynous glands, and anther spurs make this plant most similar to, which are also distributed in this nearby area too. But differ in having leaves narrowly elliptic, narrower and shorter in size 18–36 × 6–8.5 cm, upper midrib reddish; thyrses shorter and smaller (5–6.5 cm long, 4–5 cm in diam.); peduncle glabrous; bracts per inflorescence 10–15 in number, fused almost only at base; corolla lobes white, longer and narrower 17–18.3 × 6–7.8 mm; staminodes uniquely obovate-rhombic; labellum ovate-trullate; filament 4.4–4.5 mm long; anther longer c. 8 mm long, spurs pointing outward in front view, with anther crest apex retuse (vs. *C. rangsimae* having leaves narrowly elliptic to oblanceolate, 40–70 × 12–20 cm, upper midrib green; thyrses 12–20 cm long, 7.8–9.5 cm in diam.; peduncle pilose; 25–48 in number, connate 1/4 to 1/3 at base; corolla lobes light pale yellow, 15–17 × 9–12 mm; staminodes asymmetrical trullate-ovate; labellum ovate; filament 6–7 mm long; anther 6.3–6.9 mm long, spurs pointing downward in front view, with anther crest apex rounded). Based on the results of the morphological comparison and examination of all allied species in the same genus were found to be inconsistent with any species, especially in the subgenus *Ecomatae*. A comprehensive description, illustration, photographs, ecology, etymology, distribution and a revised key to 21 species of *Curcuma* subgenus *Ecomatae* in Thailand are provided.

Keywords: *Curcuma rangsimae*, *C. cotuana*, Chachoengsao, Flora of Thailand, taxonomy, Zingiberales

INTRODUCTION

Curcuma L. is one of the beautiful flowering plants belonging to the family Zingiberaceae with *Curcuma longa* L. as the type species and is widely distributed from India to Southeast Asia and southern China, to Papua New Guinea, and Northern Australia (Larsen and Larsen 2006; Leong-Škorničková and Newman 2015; Sirirugsa et al. 2007). The first taxonomic study of this genus in Thailand was conducted by Professor Puangpen Sirirugsa, who reported thirty species of *Curcuma*, but seven species of which were not yet identified up to species level (Sirirugsa 1966). In 2007, Sirirugsa et al. suggested classifying species of *Curcuma* in Thailand into five groups based on the presence or absence of epigynous glands, the shape of the anther and some characters including coma bracts shape. Later studies of Závěská et al. (2012) and Leong-Škorničková et al. (2015) proposed and supported the classification of *Curcuma* into three subgenera namely *Hitcheniopsis* (Baker) K. Schum., *Curcuma* L., and *Ecomatae* Škorničk. & Šída f. and also included some genera and species to be classified under the *Curcuma*. Since then, many new species of *Curcuma* with all three

subgenera have been continuously discovered in Thailand up until now. A recent publication by Maknoi et al. (2021) reported two new species of *Curcuma* subgenus *Ecomatae* from Thailand. These two new species make the total number of subgenus *Ecomatae* to 20 species for Thailand, and a total number 32 species across its geographical range.

In this study, we found an undescribed species of *Curcuma* belonging to subgenus *Ecomatae* in Chachoengsao Province, Southeastern Thailand, during our exploration for the diversity of family Zingiberaceae in Thailand in preparation for the revision of the genus for the Flora of Thailand project. This plant is similar to *Curcuma rangsimae* Boonma & Saensouk which can be found in the nearby area. After a careful morphological examination and comparison of all allied species within subgenus *Ecomatae*, results revealed that the species does not match any other known *Curcuma* species and is divergent. We, therefore, describe it here as *Curcuma siamensis*, a species new to science. A comprehensive description, illustration, color photographs, ecology, etymology, and distribution are provided below as well as a revised key to the 21 species of *Curcuma* subgenus *Ecomatae* in Thailand to facilitate easy identification.

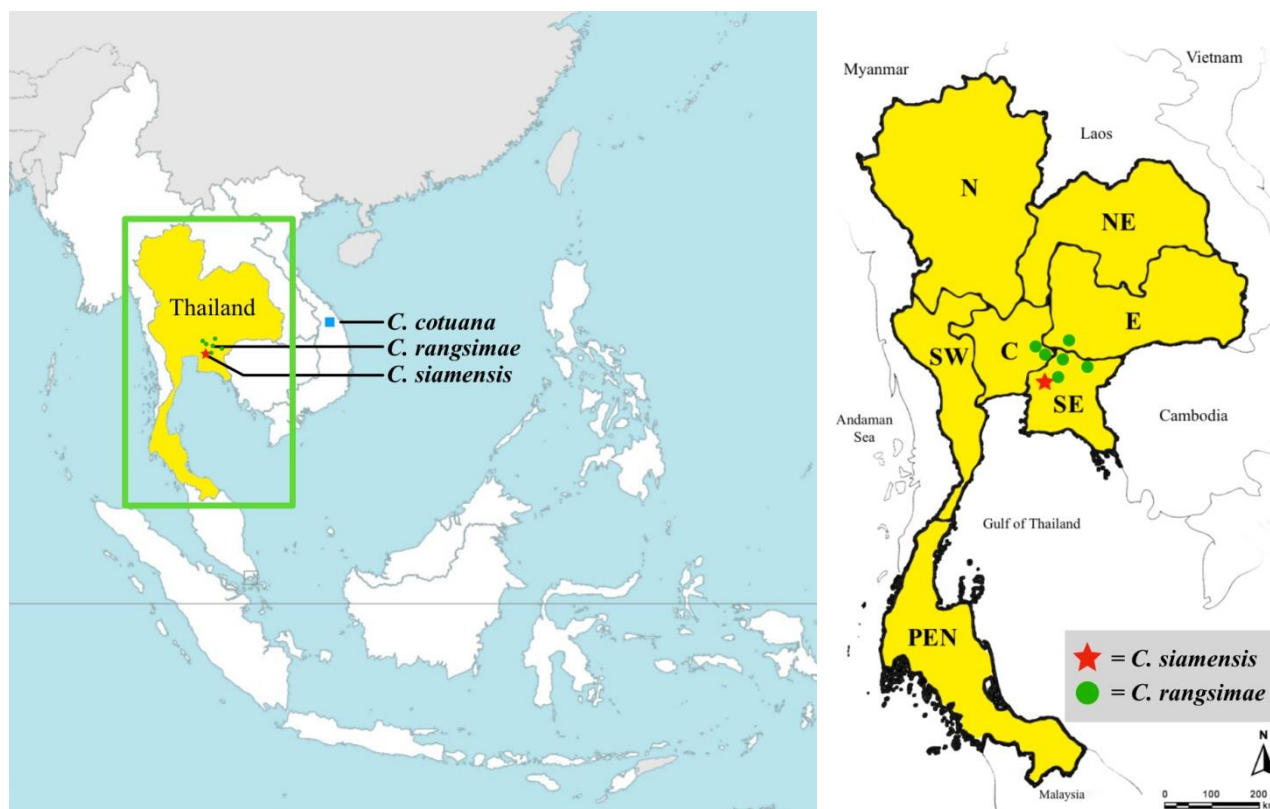


Figure 1. Distribution map of *Curcuma siamensis* Saensouk & Boonma sp. nov. and its allies. Abbreviations in the map are the floristic region after the "Flora of Thailand" project which N: Northern; NE: Northeastern; SW:Southwestern; C: Central; E: East; SE: Southeastern; and PEN: Peninsular. (Southeast Asia map from <https://aseanup.com/wp-content/uploads/2015/04/ASEAN-map-white-blank.jpg>)

MATERIALS AND METHODS

Plant materials were collected from Chachoengsao Province, Southeastern Thailand (Figure 1) from August 2018 to 2020. Measurements were recorded from living and spirit collection, and were deposited at KKU and additional specimens were deposited at Brio Botanical Research Garden. Type specimens of species that are similar in morphological were compared and verified. The morphological descriptions in all species of accepted species, especially species distribution in Thailand and neighboring countries, available digital images and information online e.g. photographs of Herbarium specimen with details from Kew's Herbarium or powo.science.kew.org (Kew Science 2021), Queen Sirikit Botanic Garden Herbarium (QBG), including existing published literature of *Curcuma* were also compared in this study.

RESULTS AND DISCUSSION

Curcuma siamensis Saensouk & Boonma (Zingiberaceae: Zingibereae) was described here as a new species of *Curcuma* which has been found distributed only in the forest in Chachoengsao Province, Southeastern Thailand (Figures 3–4). It was named from "Siam" the

former name of Thailand refers to the geographical origin of this new species which was first reported from Thailand. Detailed descriptions along with illustrations, photographs, distribution (Figure 1), ecology, and uses have been provided, the morphological comparison with its allies species in Table 1, followed by a revised key to species of *Curcuma* subgen. *Ecomatae* in Thailand.

Taxonomic treatment

Curcuma siamensis Saensouk & Boonma, sp. nov. – Figures 3–4, Table 1–Subgen. *Ecomatae*

The new species is similar to *C. rangsimae* Boonma & Saensouk. but differ in having leaves narrowly elliptic, narrower and shorter in size 18–36 × 6–8.5 cm, upper midrib reddish; thyse shorter and smaller (5–6.5 cm long, 4–5 cm in diam.); peduncle glabrous; bracts per inflorescence 10–15 in number, fused almost only at base; corolla lobes white, longer and narrower 17–18.3 × 6–7.8 mm; staminodes uniquely obovate-rhombic; labellum ovate-trullate; filament 4.4–4.5 mm long; anther longer c. 8 mm long, spurs pointing outward in front view, with anther crest apex retuse (vs. *C. rangsimae* having leaves narrowly elliptic to oblanceolate, 40–70 × 12–20 cm, upper midrib green; thyse 12–20 cm long, 7.8–9.5 cm in diam.; peduncle pilose; 25–48 in number, connate 1/4 to 1/3 at base; corolla lobes light pale yellow, 15–17 × 9–12 mm; staminodes asymmetrical trullate-ovate; labellum ovate;

filament 6–7 mm long; anther 6.3–6.9 mm long, spurs pointing downward in from view, with anther crest apex rounded).

Type: Thailand, Chachoengsao Province, Phanom Sarakham District, 172 m, Boonma 39, 10.08.2018 (holo KKU!; iso BK!)

Perennial herb, *Primary rhizome* ovoid with small and long branched downward, brownish externally, pale yellow internally, $2\text{--}3 \times 1.8\text{--}2.5$ cm, *Root* fibrous with tuberous roots. *Leafy shoot* 45–60 cm tall. *Sheathing bracts* 1–2, 5–14 cm long, green with a brownish-red tinge or brownish-red, apex mucronate. *Leaf-sheaths* 4–8(–9), green or green with brownish-red tinge, distichous, 8–15 cm long, glabrous; *ligule* bilobed, 3–4 mm long, apex rounded; *petiole* green, canaliculate, 8–10 cm, glabrous. *Lamina* narrowly elliptic, slightly recurved, $18\text{--}36 \times 6\text{--}8.5$ cm (the first leaf usually shortest and narrowest), apex acuminate, base attenuate, margin slightly undulate, hyaline, translucent white, adaxially green with reddish patch along the midrib, abaxially paler green, glabrous on both surfaces. *Inflorescence* terminal between the leaf sheaths, emerge at the base of the pseudostems; *thyrses* 5–6.5 cm long, 4–5 cm in diam. in the broadest part; *peduncle* pale green to white, c. 6 mm in diameter, glabrous. Coma bract absent. *Fertile bracts* 10–15 in number, $3.5\text{--}5.4 \times 1\text{--}2.8$ cm, apex mucronate, whitish to pale green or with a various reddish tinge, fused only at base, puberulent especially at the distal part (may not be visible to the naked eye), lowest bracts are the longest and broadest, upper bract shorter and smaller. *Flower* various shades of pale yellow, open form, 5.3–5.5 cm. *Bracteoles* subulate, $8\text{--}14 \times 1.6\text{--}2$ mm, translucent white, ciliate. *Calyx* tubular 18.3–18.5 mm long, apex 3-lobed (two lobes apex mucronate, mucro c. 1.5 mm long, another one lobe apex obtuse), with unilaterally incision up to 8 mm long, white, glabrous except the margin of the three lobes have a few hairs. *Floral tube* tubular and enlarged to conical at distal part, 3.28–3.3 cm long, pale yellow to white at base, glabrous except at distal part puberulent; *dorsal corolla lobe* 1, narrowly triangular, $17.6\text{--}18.3 \times 7.6\text{--}7.8$ mm, apex mucronate (mucro c. 3 mm long), slightly cucullate, white, glabrous; *lateral corolla lobes* 2, narrowly triangular, $17.0\text{--}17.5 \times 6.3\text{--}6.5$ mm, apex acute slightly mucronate, slightly cucullate, white, glabrous. *Lateral staminodes* 2, uniquely obovate-rhombic, $16.2\text{--}16.8 \times 9.5\text{--}10$ mm, apex obtuse, yellow at base gradually fade to whitish-yellow at the margin and distal part (or various shades of pale yellow), puberulent. *Labellum* ovate-trullate, 17.8–18.2 mm long, 14.5–15 mm at the widest part, and 0.7–0.72 cm at the base, apex emarginate to bilobed with an incision c. 5 mm, various shades of pale yellow with yellow to a deep yellow median band from the tip to the base (divided into two patches like a Y-shape at the base), two rows of short white hairs along both sides of the midrib (the length of each row 8.5–9.5 mm long). *Stamen* 1; *filament* flat 4.4–4.5 mm long and 4.5 mm wide, pubescent. *Anther* c. 8×2 mm, puberulent, spurred; *spurs* 3–4 mm long; *crest* very short, slightly longer than the anther lobes, apex retuse. *Stigma* conical, c. 0.8×0.8 mm, glabrous, ostiole ciliate. *Epigynous glands* 2, 4.2 mm long, apex acute, yellow.

Ovary obovoid, $3.6\text{--}4.0 \times 2.3\text{--}2.5$ mm, pale yellow to white, glabrous, ovule with axile placentation. *Fruit and seeds* not seen.

Common name: “Khamin Siam”–The word “Khamin” comes from the Thai name of *Curcuma* genus, while “Siam” is the former name of Thailand refer to this species was first discovered and reported from Thailand. And two other names are known and called among the sacred plant collectors in namely “*Suwan Phanom*” (“Suwan” = gold, “Phanom” = Phanom Sarakham District, the first locality which found this species), and the name “*Maha Udom Lueang Nuan*” (“Maha Udom” = Very plentiful, “Lueang Nuan” = pale yellow refer to the color of flowers of this species).

Phenology: Flowering in late July to September; inflorescence terminal, appearing between the innermost leaves sheaths, emerge almost at the base of pseudostems, flowers fully open in the early morning and last a single day. Leafy shoot emerging in April and dormancy begins in November.

Distribution: Recently found only in the type locality in Chachoengsao Province, Southeastern Thailand (Figure 1).

Ecology: It grows in sandy loam soil, well-drained, in the mixed-deciduous forest, at elevation 140–250 m above sea level.

Etymology: The specific epithet “*siamensis*” is named from the former name of Thailand, refers to the geographical origin of this new species.

Uses: Auspicious ornamental plant.

Provisional IUCN conservation assessment. This species is only known in Chachoengsao province which is non-protected area. Our survey found this species in total was less than 500 individuals, but there is the presence of suitable locations which limited access to surveys nearby e.g. Khao Ang Ru Nai Wildlife Sanctuary and other nearby National Park. Therefore, we consider ranking this species as Data Deficient (DD) category, following the IUCN criteria (2019), Although this species has a high risk of removal from its habitats as it was sold in many online groups which mostly are taken directly from the wild. We hope to find this species more and more in the future surveys in nearby unexplored areas to further change its conservation status to a suitable one.

Discussion

Curcuma siamensis Saensouk & Boonma is belongs to the subgenus *Ecomatae* Škorničk. & Šída f. (Záveská et al. 2012) since the presence of epigynous glands and anther spurs, lacking conspicuous coma bracts, fertile bracts fused only at the base, and flower open-form. Although the species in the subgenus *Curcuma* also present epigynous glands but usually with well-developed coma bracts and flowers is usually closed-form. While the species in subgenus *Hitcheniopsis* lack epigynous glands. Thus this new species fall into *Curcuma* subgenus *Ecomatae*.

The appearance of the yellow tone flowers of this new species makes it look like many plants belonging to the same subgenus. A striking contrast to the first species in the same subgenus *Ecomatae* is *Curcuma supraneeana* (W.J. Kress & Larsen) Škorničk., which has the same tone

of flower's color but produces an elongated peduncle that makes the inflorescences outstanding above the pseudostems while *C. siamensis* has a short peduncle and emerged only at the basal of the pseudostems. Considering the appearance of the anther spurs 3–4 mm long makes *C. siamensis* different from *C. arida* Škorničk. & N.S. Lý, *C. chantaranothaii* Boonma & Saensouk, *C. cochinchinensis* Gagnep., *C. eburnea* Škorničk., Suksathan & Soonthornk., *C. pambrosima* Škorničk. & N.S. Lý, *C. pierreana* Gagnep., *C. pitukii* Maknoi, Saensouk, Rakarcha & Thammar, and *C. vitellina* Škorničk. & H.Đ. Trần. which all seven species mentioned have anther spurs filamentous and very short or not over 2 mm long. Especially *C. pambrosima* and *C. pierreana* have staminodes with purple whereas the staminodes of *C. siamensis* without purple.

In addition, when compared to species that have spurs longer than 2 mm long. They were found to be able to divide them in considering by the position of inflorescences for easy comparison. Firstly, compared to the species which produced lateral inflorescence directly from the rhizome and also have a similar color of flowers but differ in having purple staminodes or with purple at the base of staminodes namely *C. ecomata* Craib, *C. corniculata* Škorničk., and *C. glans* Larsen & Mood. (VS. *C. siamensis* have pale yellow staminodes without purple). While other species produced lateral inflorescences directly from the rhizome, namely *C. aruna* Maknoi & Saensouk, *C. candida* (Wall.) Techapr. & Škorničk., *C. flaviflora* S.Q. Tong, *C. newmanii* Škorničk., *C. sahuynhensis* Škorničk. & N.S. Lý, *C. singularis* Gagnep., *C. tongii* Y.H. Tan & L.X. Zhang., and *C. xanthella* Škorničk. are included in the comparison but differ in many parts as well. However, albeit it can be separated by the position of the inflorescence, some species in the *Curcuma* genus are not stable about the position of producing inflorescences character which is likely to form inflorescences in both positions; for example, in *Curcuma angustifolia* Roxb., thus we need to compare all parts of them in morphological characteristics for accuracy and completeness of the study results, which finally *C. siamensis* produced only terminal inflorescence and not

matched with any species of *Curcuma* that produced lateral inflorescence.

Subsequently, compared to the remainder of the species which produced terminal inflorescence in the same subgenus *Ecomatae*, which consists of *Curcuma bicolor* Mood & K. Larsen, *C. cinnabarina* Škorničk. & Soonthornk., *C. cotuana* Luu, Škorničk. & H.Đ. Trần, *C. flammea* Škorničk., *C. kayahensis* Nob. Tanaka & M. M. Aung, *C. peramoena* Souvann. & Maknoi, *C. putii* Maknoi & Jenjitt., *C. rangsimae* Boonma & Saensouk, *C. rhomba* Mood & Larsen, *C. stenochila* Gagnep., *C. stolonifera* N. Tanaka, K. Armstrong & M. M. Aung, and *C. woodii* N. H. Xia & J. Chen. From the twelve species mentioned, four species, namely *C. rhomba*, *C. woodii*, *C. peramoena*, and *C. putii* have staminodes with dark red or dark purple spots at the base, two species namely *C. bicolor* and *C. flammea* have staminodes with lower half red to dark red. Based on these traits make all six of these species different from *C. siamensis* which has staminodes in yellow tone without red or purple at the base.

Considering the remaining species about the basal of leaves appearance, there are three species with leaves base rounded to cordate and with reddish corolla lobes namely *C. cinnabarina*, *C. stenochila*, and *C. kayahensis*, whereas *C. siamensis* has leaves base attenuate. And the last comparison to these three species namely *C. cotuana*, *C. rangsimae*, and *C. stolonifera* to *C. siamensis* which all of them have leaves glabrous on both sides except in *C. rangsimae* has a few hairy at the tip of leaves. *Curcuma stolonifera* has a reddish patch along its midrib as in *C. siamensis*, but it has closed-form flowers, and an inflorescence terminal but does not emerge at basal of pseudostems make it differ from *C. siamensis*. Comparison of the morphological characteristic of *C. siamensis* with *C. rangsimae* from a neighbor area and *C. cotuana* from Vietnam in Table 1, anther comparison of *C. siamensis* and its allies species in side view and front view under the same scale in Figure 2, and a revised key to 21 species of *Curcuma* subgenus *Ecomatae* in Thailand for facilitating identification is also prepared.

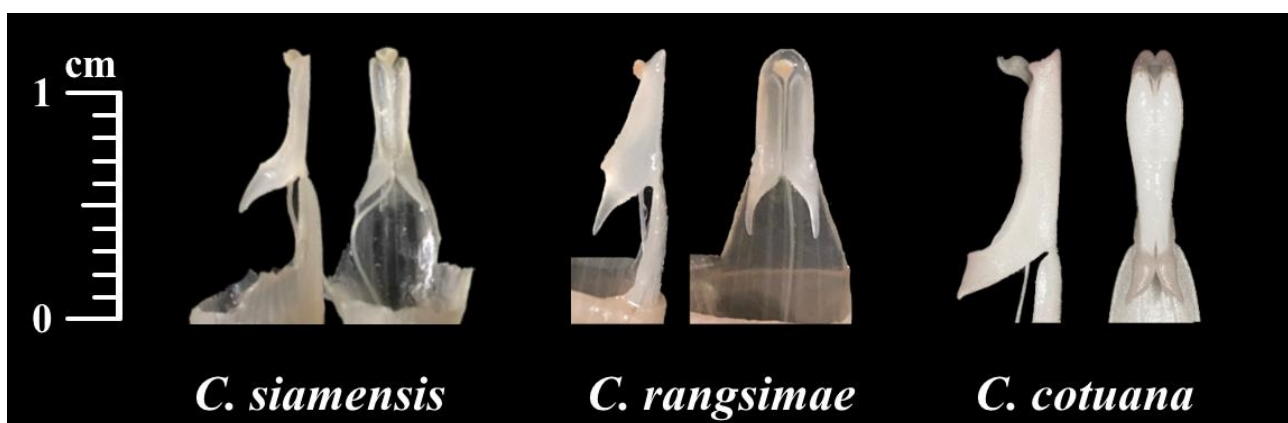


Figure 2. Anther comparison of *Curcuma siamensis* Saensouk & Boonma sp. nov. and its allies species in side view and front view under the same scale. Photographs by Thawatphong Boonma

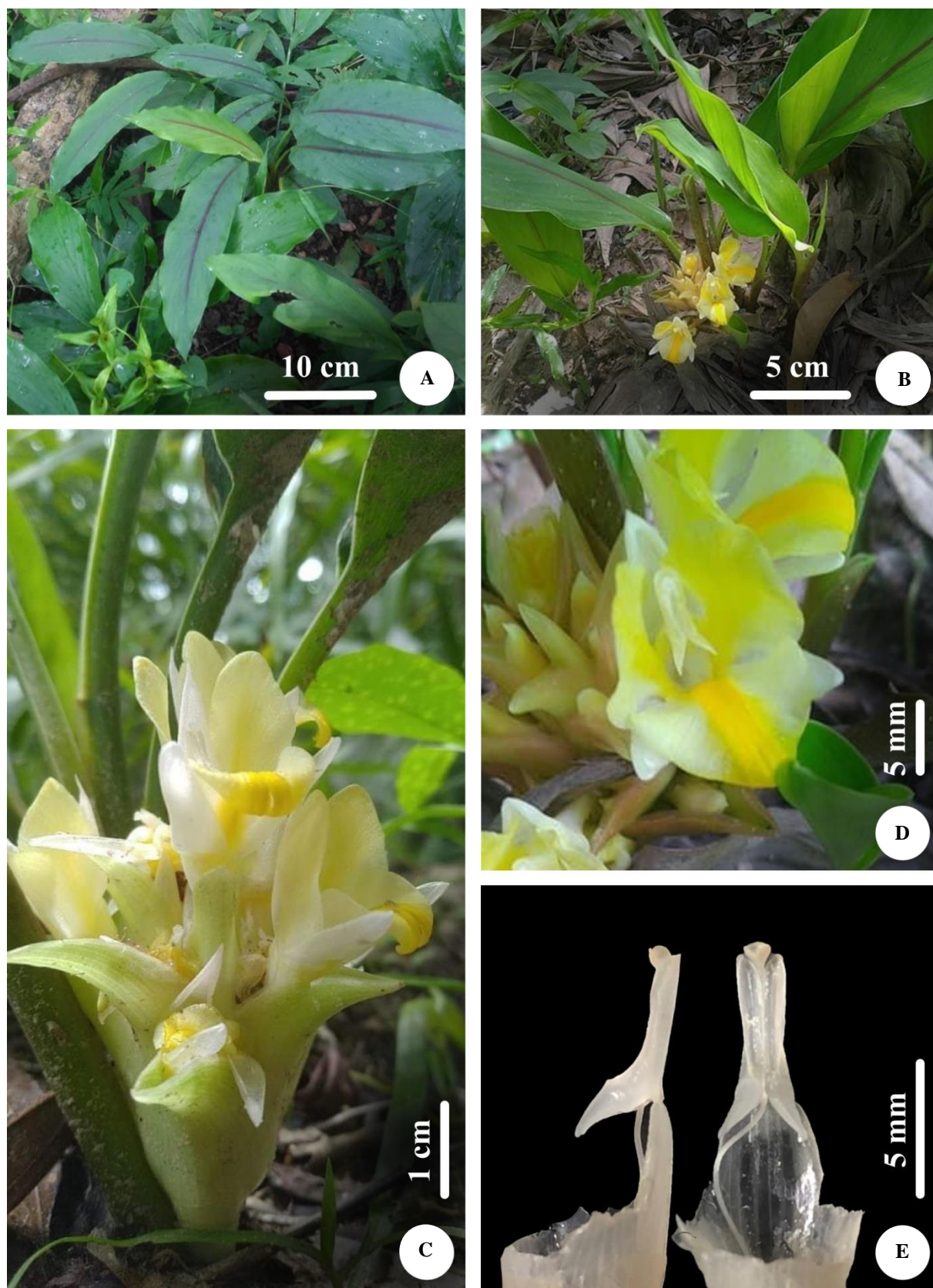


Figure 3. *Curcuma siamensis* Saensouk & Boonma sp. nov. (A) Natural habitat in oblique-top view, *C. siamensis* (red midrib) grows near *C. harmandii* Gagnep., (B) plants with inflorescence and flowers in oblique-top view, (C) inflorescence with flowers in side view, (D) flower-front view, (E) anther-side and front view. Photographs A–D by N. Wannaphirun; E by Thawatphong Boonma

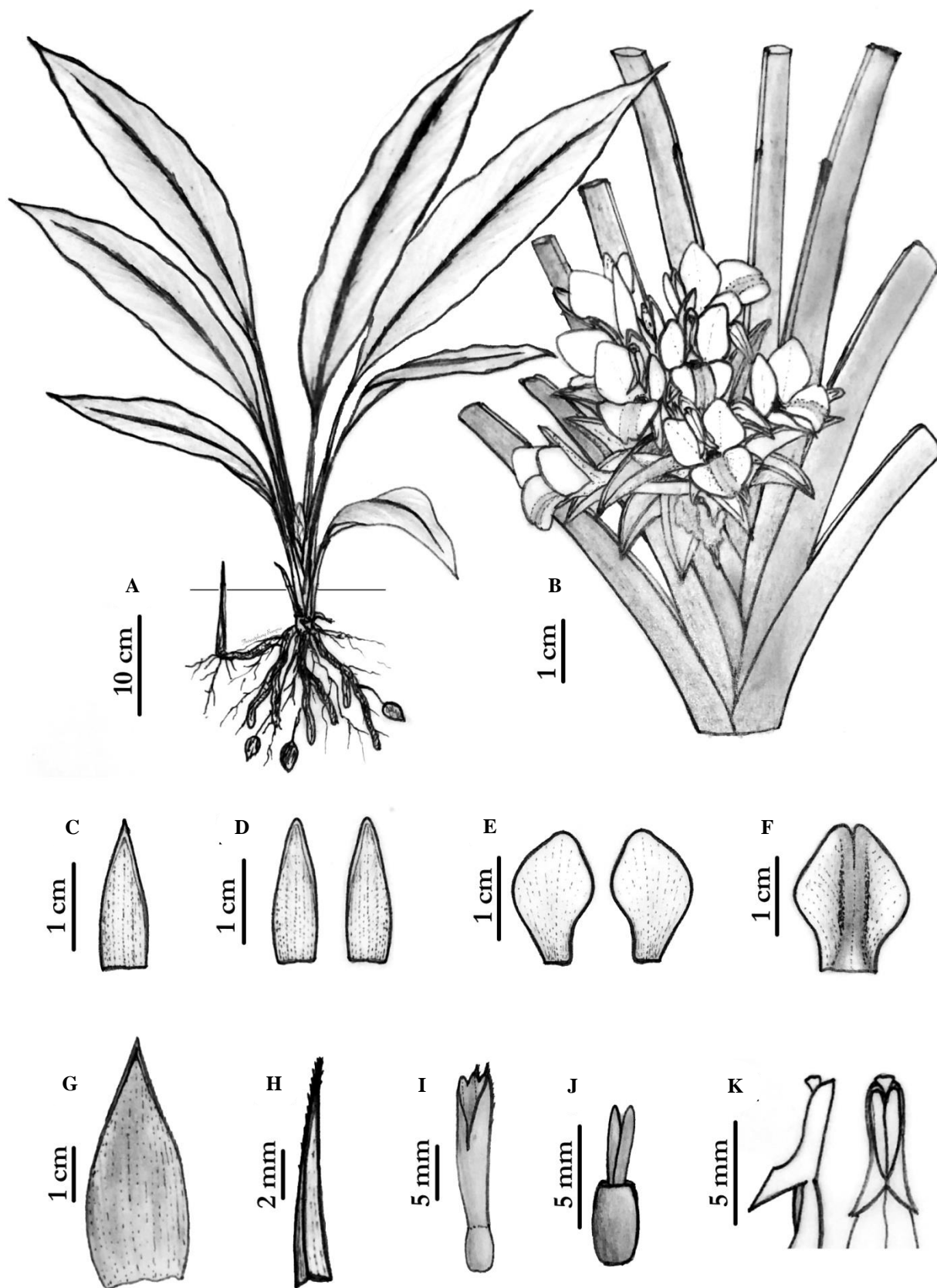


Figure 4. *Curcuma siamensis* Saensouk & Boonma sp. nov. (A) habit, (B) side view of terminal inflorescence in the leaf-sheaths, (C) dorsal corolla lobe, (D) lateral corolla lobes, (E) staminodes, (F) labellum, (G) bract, (H) bracteole, (I) calyx with ovary, (J) epigynous glands with ovary, (K) side and front view of anther. Drawn by Thawatphong Boonma

Table 1. Morphological comparison of *Curcuma siamensis* and its allies species

Characters	<i>Curcuma siamensis</i> Saensouk & Boonma	<i>Curcuma rangsimae</i> Boonma & Saensouk (Saensouk et al. 2021)	<i>Curcuma cotuana</i> Luu, Škorničk. & H.Đ. Tràn (Luu et al. 2017)
Rhizome-size (cm)	2–3 × 1.8–2.5	3.6–4 × 2.5–3.1	1.0–2.7 × 0.4–1.0
Leaf-sheaths	Glabrous	Glabrous	Glabrous at base, sparsely pilose towards the margins and upper part
Leaves-shape	Narrowly elliptic	Narrowly elliptic to oblanceolate	Elliptic to ovate
Leaves-size (cm)	18–36 × 6–8.5	40–70 × 12–20	38.5 × 13.0
Leaves-base	Attenuate	Attenuate–slightly oblique	Rounded to cordate
Leaves-upper midrib	Reddish	Green	Green
Leaves-surfaces	Glabrous on both surfaces	Glabrous on both surfaces except a few shortly hairy at tip	Glabrous on both surfaces
Thyrse	5–6.5 cm long, 4–5 cm in diam.	12–20 cm long, 7.8–9.5 cm in diam.	5–9 cm long, 5.5–6.5 cm in diam.
Peduncle	Glabrous	Pilose	Sparsely pilose
Bracts-number per inflorescence	10–15	25–48	16–24
Bracts-size	3.5–5.4 × 1–2.8 cm	3.4–3.9 × 2.6–3.2 cm	2.5–3.8 × 1.7–2.2 cm
Bracts-apex	Mucronate	Obtuse to acute	Acute
Bracts-surfaces	Puberulent	Pilose	Glabrous
Bracts-connate in basal	Fused almost only at base	1/4–1/3 at base	1/2–2/3 at base
Bracteoles	Ciliate, 8–14 mm long,	Glabrous, 6–10 mm long	Glabrous, sometimes reduced, 2–6 mm long
Calyx	White, 18.3–18.5 mm long, A few hairy at the margin of the three lobes	Translucent white, 12–20 mm long, Glabrous	Semi-translucent red, 20–22 mm long, Glabrous, sometimes sparsely puberulent
Floral tube	Pale yellow to white at base	Pale yellow to white at base	Red tinge towards apex, cream white at base
Dorsal corolla lobe	White, 17.6–18.3 × 7.6–7.8 mm, apex mucronate (mucro c. 3 mm long)	Light pale yellow, 16–17 × 10–12 mm, apex acuminate	Red, 22–24 × 6–7 mm, apex mucronate (mucro c. 1 mm long)
Lateral corolla lobes	White, 17.0–17.5 × 6.3–6.5 mm	Light pale yellow, 15–17 × 9–11 mm	Pale orange–red, 20–22 × 5–6 mm
Staminodes	Uniquely obovate-rhombic, 16.2–16.8 mm long, Pale yellow	Asymmetrical trullate–ovate, 14–16 mm long, Pale yellow	Unequally ovate to rhomboid, 19–21 mm long, Orange
Labellum	ovate-trullate, 17.8–18.2 mm long, Yellow	Ovate, 15–16 mm long, Yellow	Rhomboid, 21–23 mm long, Orange
Filament	4.4–4.5 mm long	6–7 mm long	7 mm long
Anther	c. 8 mm long	6.3–6.9 mm long	12.5 mm long
Anther spurs	3–4 mm long Pointing outward	2.8–3.4 mm long Pointing downward	3.5–4.0 mm long, Pointing outward
Anther thecae	4 mm long	4 mm long	8 mm long
Anther crest-apex	Retuse	Rounded	Bi-lobed
Ovary	3.6–4.0 mm long Pale yellow, Glabrous	3.5–4.0 mm long, Light pale yellow, Glabrous	c. 3 mm long, Cream with a red tinge, Densely pilose

Key to 21 species of *Curcuma* subgen. *Ecomatae* in Thailand

1. Floral tube longer than bracts, narrow; flowers yellow; petiole very distinct from leaf blade *C. supraneeana*
1. Floral tube short, wide, flowers of various colors, leaf-blade tapering into the petiole
 2. Anther spurs filamentous, < 2 mm long
 3. Staminodes with dark purple tips *C. pierreana*
 3. Staminodes without dark purple tips
 4. Leave puberulous on both surfaces *C. chantaranothaii*
 4. Leave adaxially surface glabrous
 5. Rhizome crawling; leaves base attenuate *C. cochinchinensis*
 5. Rhizome ovoid; leaves base cuneate to rounded, or sub-cordate
 6. Calyx white, glabrous; filament short c. 2 mm long; anther 8–9 mm long *C. eburnea*
 6. Calyx pale purple, puberulent; filament 5–8 mm long; anther 2.5–4 mm long *C. pitukii*

2. Anther spurs conical or cylindrical, > 2 mm long
7. Inflorescence terminal
 8. Leaves adaxially surface glabrous
 9. Staminoles without red spots at the base
 10. Midrib adaxially green *C. rangsimae*
 10. Midrib adaxially green with red patch *C. siamensis*
 9. Staminoles with dark red or dark purple spots at the base
 11. Leaves abaxially glabrous; labellum yellow with inside half orange *C. rhomba*
 11. Leaves abaxially pubescent; labellum not as above
 12. Labellum sub-orbicular, white with an orange median band and deep purple lines at the base; staminoles white with orange tip *C. woodii*
 12. Labellum diamond-shaped, white with a yellow median band and red spots at the base; staminoles white without orange tip *C. peramoena*
 8. Leaves adaxially surface with hairy along the veins or pubescent
 13. Corolla lobes whitish-green to pale green; leaves base cuneate to attenuate *C. putii*
 13. Corolla lobes pink, red or purple; leaves base oblique, rounded or cordate
 14. Staminoles lower half dark red, upper half orange-yellow *C. bicolor*
 14. Staminoles pale yellow to yellow
 15. Thyse < 10 cm long; flowers open form; corolla lobes red *C. stenochila*
 15. Thyse > 10 cm long; flowers closed form; corolla lobes white to pale yellow *C. cinnabarina*
7. Inflorescence lateral
 16. Staminoles purple *C. ecomata*
 16. Staminoles white or yellow
 17. Labellum yellow
 18. Staminoles ovate to elliptic; leaves base cuneate *C. flaviflora*
 18. Staminoles obovate; leaves base rounded *C. aruna*
 17. Labellum white with yellow median band
 19. Leaves adaxially with red patch along the midrib *C. candida*
 19. Leaves adaxially with green midrib
 20. Staminoles lower half white, upper half yellow, central with purple patch *C. glans*
 20. Staminoles white *C. singularis*

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