



## *Curcuma sirirugsae*, a New Species of the family Zingiberaceae from Northern Thailand

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## ABSTRACT

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The aim of this study was to describe a new species of the genus *Curcuma* L. (Zingiberaceae) from northern Thailand. It has been named *Curcuma sirirugsae* Saensouk & Rakarcha and its description, illustrations, and photographs have been provided. The new species belongs to the subgenus *Curcuma* and is identified by its two downward-facing spurs, presence of coma bracts, closed flower form and epigynous glands. *Curcuma sirirugsae* is endemic to the Sukhothai Province in northern Thailand. The morphology of *C. sirirugsae* and *C. angustifolia* Roxb. are quite similar, but there are distinct differences in the following characteristics: the leaves are broadly elliptic, the fertile bracts are ovate to lanceolate and densely arranged with an acute apex, they are also pubescent. Additionally, the coma bracts are larger, pubescent, and have an acute apex. The lateral staminodes are irregularly oblong to irregularly elliptic, and the anther spur is longer. Details on the description regarding morphological characteristics, including distribution, ecology, phenology, vernacular, etymology and preliminary conservation assessment are provided. It also includes an updated key to the 25 species of the *Curcuma* subgenus *Curcuma* recognized in Thailand, as well as an investigation of its closest species.

**Keywords:** *Curcuma angustifolia*, *Curcuma sirirugsae*, limestone hills, Sukhothai

## Introduction

The family Zingiberaceae includes the genus *Curcuma* L. as one of the largest genera, with an estimated number of species over 120 and perhaps reaching over 150 in the future, according to Leong-Škorničková *et al.* in 2015 and Leong-Škorničková *et al.* in 2022.<sup>1,2</sup> The genus has a wide distribution in the tropical regions of Asia, ranging from India to southern China, southeast Asia, Papua New Guinea, and northern Australia.<sup>3,4,5,6,7</sup> Thailand has exceptional species richness for the genus *Curcuma*, having around 70 species distributed within three subgenera.<sup>8</sup> A total of more than 30 species of *Curcuma* have been identified in Thailand throughout the period spanning from 2011 to 2023.<sup>5-27</sup>

During a botanical survey in Sukhothai province, northern Thailand in 2023, a collection of unidentified *Curcuma* spp. was discovered. These plants had a distinctive rhizome without branches, leafy shoots measuring 65–80 cm in height, broadly elliptic leaves, and inflorescences that typically grew near the ground. The plants also had short peduncles, which were embedded in the ground, and their flowers featured yellow staminodes and labellum. The specimens were collected and photographed. It grows in deciduous forests located at the foothills of limestone hills.

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Subsequently, the authors conducted a carefully analysis and comparison of the morphological characteristics of the unknown *Curcuma* with all related species in the genus *Curcuma*. They determined that the unknown *Curcuma* did not exhibit any resemblance to any known species. Consequently, it is determined that the unidentified *Curcuma* is a new species and was identified as *Curcuma sirirugsae* Saensouk & Rakarcha in this description. A description of the morphological characteristics is provided together with information on their distribution, ecological data, flowering and fruiting periods, vernacular, etymology, and conservation status. It also includes a study of the closest species and an updated key to the 25 species of the *Curcuma* subgenus *Curcuma* that have been recognized to be present in Thailand.

## Materials and Methods

In 2023, while conducting research in Sukhothai province, located in the northern part of Thailand, the first author collected unidentified *Curcuma* specimens. This species was found in the deciduous forest located in the limestone hills of Si Samrong district. The plant specimens were meticulously preserved in a solution of 70% ethyl alcohol, while voucher specimens were officially deposited at QBG. The current research involved a thorough examination of the available published literature on *Curcuma*, with specific emphasis on the subgenus *Curcuma*. The research involved the analysis of type materials and protologues of all documented species within this subgenus. Furthermore, the study primarily focused on the geographic distribution of these species in Thailand, along with Myanmar, China, Laos, and Vietnam. Additionally, the research procedure also involved considering any available digital resources related to this topic matter. The morphological characteristics have been evaluated and documented employing fresh materials, spirit specimens, and herbarium specimens, uses a stereomicroscope. The preliminary evaluation for conservation

status was conducted in adherence to the guidelines established by the IUCN Standards and Petitions Committee in 2022.<sup>28</sup> Data collection was conducted through fieldwork to collect data pertaining to vernacular, ecology, and distribution. A comparison is performed between the morphological characteristics of *C. sirirugsae* and the type specimen in Roxburgh *Asiat. Res. (Calcutta)* 11: Tab. 3 in 1810<sup>29</sup> and all existing published literature of *C. angustifolia* Roxb.<sup>29, 30, 31, 33</sup>

## Results and Discussion

A new species, *Curcuma sirirugsae*, was described in northern Thailand according to this study. *Curcuma sirirugsae* is only found in deciduous forests that are adjacent to bamboo forest, located at the base of limestone hills. The newly discovered species is classified under the subgenus *Curcuma* L. It can be identified by its epigynous glands, closed flower form, presence of coma bracts, and two spurs pointing downward. The subgenus *Curcuma*, as classified by Leong-Škorničková et al. in 2015, comprises a total of 69 species.<sup>1</sup> Furthermore, a number of new species within the subgenus *Curcuma* were described, including *C. globulifera* Škornič. & Soonthornk.<sup>15</sup>, *C. ruiensis* N.H. Xia & Juan Chen<sup>32</sup>, *C. phrayawan* Boonma & Saensouk<sup>5</sup>, *C. wanenlueanga* Saensouk, Thomudtha & Boonma<sup>6</sup>, *C. rangjued* Saensouk & Boonma<sup>18</sup>, and *C. suraponii* Boonma<sup>27</sup>. Thailand presently recognizes the presence of 25 species belonging to the *Curcuma* subgenus *Curcuma*<sup>6,18,27,33</sup>. A unique morphological characteristic that differentiates this species apart from all others is described in depth in the notes.

There are 25 species of the *Curcuma* subgenus *Curcuma* (Zingiberaceae) in Thailand. The following was the key applied from as Boonma in 2023<sup>27</sup> and Leong-Škorničková and Saensouk in 2023<sup>33</sup>:

- |  |                          |
|--|--------------------------|
| 1a. Rhizome unbranched   | 2                        |
| 1b. Rhizome branched   | 3                        |
| 2a. Leaf blades narrowly elliptic; fertile bracts ovate to obovate, glabrous or hairy, with rounded or obtuse apex | <i>C. angustifolia</i>   |
| 2b. Leaf blades broadly elliptic; fertile bracts ovate to lanceolate, pubescent with acute apex                    | <i>C. sirirugsae</i>     |
| 3a. Inflorescences lateral   | 4                        |
| 3b. Inflorescence central  | 12                       |
| 4a. Leaf blades pubescent on the abaxial surface   | 5                        |
| 4b. Leaf blades glabrous on the abaxial surface  | 7                        |
| 5a. Coma bracts absent   | <i>C. globulifera</i>    |
| 5b. Coma bracts present  | 6                        |
| 6a. Leaf blades plain green  | <i>C. aromatica</i>      |
| 6b. Leaf blades with red or reddish-purple patch along midrib  | <i>C. zedoaroides</i>    |
| 7a. Leaf sheaths and petioles purplish red   | <i>C. rubescens</i>      |
| 7b. Leaf sheaths and petioles green  | 8                        |
| 8a. Leaf blades green  | 9                        |
| 8b. Leaf blades with red or reddish-purple patch   | 10                       |
| 9a. Fertile bracts white with pale pink apices; rhizome pale brown to white  | <i>C. comosa</i>         |
| 9b. Fertile bracts greenish white with green patch in center; rhizome white to pale yellow                         | <i>C. mangga</i>         |
| 10a. Rhizome internally bluish green   | <i>C. aeruginosa</i>     |
| 10b. Rhizome internally yellow or orange or cream to beige   | 11                       |
| 11a. Rhizome internally cream to beige   | <i>C. picta</i>          |
| 11b. Rhizome internally dark yellow-orange to deep bright yellow   | <i>C. zanthorrhiza</i>   |
| 12a. Anther spurless   | 13                       |
| 12b. Anther prominently spurred  | 14                       |
| 13a. Fertile bracts green; flowers yellow orange   | <i>C. aurantiaca</i>     |
| 13b. Fertile bracts orange; flowers cream-white to very pale yellow with deep yellow median band of labellum       | <i>C. roscoeana</i>      |
| 14a. Inflorescence central but breaking through leaf sheaths near the ground                                       | 15                       |
| 14b. Inflorescence central appears in between the innermost leaf sheaths at the top of the pseudostems.            | 16                       |
| 15a. Fertile bracts bright red nearly to the base with yellowish or pale green at base; coma bracts absent         | <i>C. rubrobracteata</i> |
| 15b. Fertile bracts ruby pink only at the apices with pale green at base; coma bracts present                      | <i>C. suraponii</i>      |
| 16a. Bracts glabrous   | 17                       |
| 16b. Bracts pubescent  | 18                       |
| 17a. Coma bracts white with violet apices  | <i>C. antinaia</i>       |
| 17b. Coma bracts pinkish white or pinkish pale green   | <i>C. sattayasaiorum</i> |
| 18a. Coma bracts nearly white or pale green at base, green apices  | <i>C. viridiflora</i>    |
| 18b. Coma bracts with pink or pink to violet apices  | 19                       |
| 19a. Leaf blades above with reddish-purple midrib, sometime extending to lamina                                    | 20                       |

Due to the without of mature leaves, the unbranched rhizomes, and the lateral inflorescence morphology, there have been occasional misidentifications of *Curcuma sirirugsae* as *C. angustifolia* in herbarium specimens. *Curcuma sirirugsae* can be readily differentiated from *C. angustifolia* in dried specimens by examining the bracts and leaf structure, as seen in Table 1 and Figures 1–4. The current key to the 25 species of the *Curcuma* subgenus *Curcuma* that have been recognized to be present in Thailand.

## Taxonomic treatment

*Curcuma sirirugsae* Saensouk & Rakarcha, sp. nov.

The morphological characteristics of *Curcuma sirirugsae* that are similar to *C. angustifolia* include its prominent rhizome without branches, a spike composed of green bracts, flowers with yellow staminodes and labellum that have an embossed dark yellow median band. However, it differs in its broadly elliptic leaves (vs narrowly elliptic in *C. angustifolia*), fertile bracts ovate to lanceolate, pubescent with acute apex (vs fertile bracts ovate to obovate, glabrous or hairy, with rounded or obtuse apex in *C. angustifolia*), larger coma bracts (4.5–5.5 × 1.6–2.2 cm) with acute apex and densely pubescent (vs smaller coma bracts (3.0–4.0 × 0.7–1.0 cm) with acute or obtuse apex and hairy in *C. angustifolia*), lateral staminodes irregularly oblong to irregularly elliptic (vs obovate in *C. angustifolia*), labellum obovate (vs obscurely trilobed in *C. angustifolia*), longer anther spur (2.6–3 mm) (vs 1–2 mm in *C. angustifolia*). Table 1 shows other morphological differences between *C. sirirugsae* and *C. angustifolia*.

- 19b. Leaf blades above without red or reddish-purple midrib  
 20a. Bladeless, leaf sheaths, petiole and peduncle red or brownish red  
 20b. Bladeless, leaf sheaths, petiole and peduncle green  
 21a. Rhizome bright yellow orange to orange  
 21b. Rhizome internally white, pale yellowish-white, light yellow to yellow  
 22a. Coma white to pale green with violet apices  
 22b. Coma bracts white to pale pink at base, pink to dark pink apices  
 23a. Fertile bracts green to whitish, with pink apices  
 23b. Fertile bracts white to vary pale green  
 24a. Rhizome internally white, with scent and taste of unripe mango  
 24b. Rhizome internally yellowish-white, with non-aromatic

- 21  
*C. phrayawan*  
*C. wanenlueanga*  
*C. longa*  
 22  
*C. cordata*  
 23  
*C. petiolata*  
 24  
*C. amada*  
*C. rangjued*

**Type:** THAILAND, Sukhothai Province, Si Samrong District, Na Khun Krai Subdistrict, 120 m elevation, 22 June 2023, S. Rakarcha, W. Thammarong, C. Doungdang, W. Prabang & M. Tabut 1405 (holotype QBG!; isotypes BKF!, KKU!).

Perennial herb. **Primary rhizome** elliptic to ovate, 5–9 × 2.5–3.8 cm, outside pale yellow, inside brownish. **Root** fibrous with tuberous roots, tubers ovate to elliptic, 2–3.5 × 1.2–2 cm. **Leafy shoots** 65–80 cm tall with 4–6 leaves; **bladeless sheath** 2–3, 3–20 cm long, green, apex acute, pubescent, decayed at anthesis; **leaf sheaths** 14–30 cm long, green, pubescent; **ligule** decurved, ca 2 mm long, sparsely hairy; **petiole** canaliculate, 3–14 cm long, green, glabrous; **blades** broadly elliptic, 30–45 × 12.5–16.5 cm, base cuneate, apex acuminate, adaxially green, usually with red patches on along side of midvein, glabrous, abaxially pale green, densely pubescent. **Inflorescence** terminal; **peduncle** ca 6 cm long, greenish, pubescent, peduncle basally embedded in ground with 4–6 sheathing bracts, sheathing bracts green, apex acute, pubescent; **spike** 6–14 cm long, 5.5–7 cm diam.; **cincinni** 5–6 flowers at base, 1–3 flowers at top. **Fertile bracts** 18–30, ovate to lanceolate, 3.5–4.8 × 2–2.5 cm, connate 5–8 mm at the base, apex acute, margin incurved at the center, pale green to green, densely pubescent. **Coma bracts** ca 10, lanceolate, 4.5–5.5 × 1.6–2.2 cm, connate 5–8 mm at the base, apex acute, white or with pink or red tinge towards apex, densely pubescent. **Bracteoles** elliptic, ca 18 × ca 10 mm, apex acute, semitranslucent white, pubescent. **Flowers** ca 3.5 cm long. **Calyx** 12–13 mm long, apex tridentate, with unilateral incision 6–7 mm, apex acute, semitranslucent white, pubescent. **Corolla tube** 1.6–1.8 cm long, outside glabrous at base, puberulent distally, inside glabrous at base, densely pubescent at funnel-shaped; **dorsal corolla lobe** triangular-ovate, 13–14 × 9–10 mm, hooded with mucronate apex, mucro ca 1.5 mm, white to pale yellow, sometimes with pink to red tinge toward apex, puberulent; **lateral corolla lobe** triangular-ovate with obtuse apex, 10–13 × 7–8 mm, white to pale yellow, sometimes with increasing pink to red tinge at apex, puberulent. **Lateral staminodes** irregularly oblong to irregularly elliptic, 14–16 × 6–7 mm, white at base with increasing yellow tinge distally or yellow, sparsely puberulent to glabrous. **Labellum** obovate with emarginated apex, 16–18 × 12–14 mm, sinus 2–3 mm depth, white at base with pale yellow tinge distally or yellow, with an embossed dark yellow path, minutely puberulent along either side of median band. **Stamen** 14–18 mm long; **filament** 1–1.5 × 3.5–4 mm, puberulent; **anther** 3.2–3.4 mm long, puberulent; **anther spurs** 2.6–3 mm long, conical, point downward; anther crest absent. **Ovary** oblong, 2.5–2.8 × 1.8–2.2 mm, trilobular, white, pubescent; epigynous glands 2, cylindrical, 2.4–2.8 mm long; **stigma** conical, 0.8–1.2 mm wide. **Fruit** elliptic to obovate, ca 12 × ca 8 mm, glabrous; **seed** elliptic to oblong, 2.8–4.2 × 1.8–2.2 mm, light brown, aril lacinate, white.

**Distribution:** It is confined to northern Thailand, and the type locality of *C. sirirugsae* is known to have just one population in Sukhothai province.

**Ecology:** The newly discovered species grows in deciduous forests that are closely connected to bamboo growth. These forests are located at the base of limestone hills, where the soil is composed of sandy clay and stones, at an elevation approximately of 120 meters above sea level.

**Phenology:** The process of blooming and producing fruit occurs over the months of June to July.

**Vernacular:** Krachiao sirirugsa refers to the *Curcuma* spp. plant in Thailand, while Sirirugsa is the surname of Prof. Puangpen Sirirugsa.

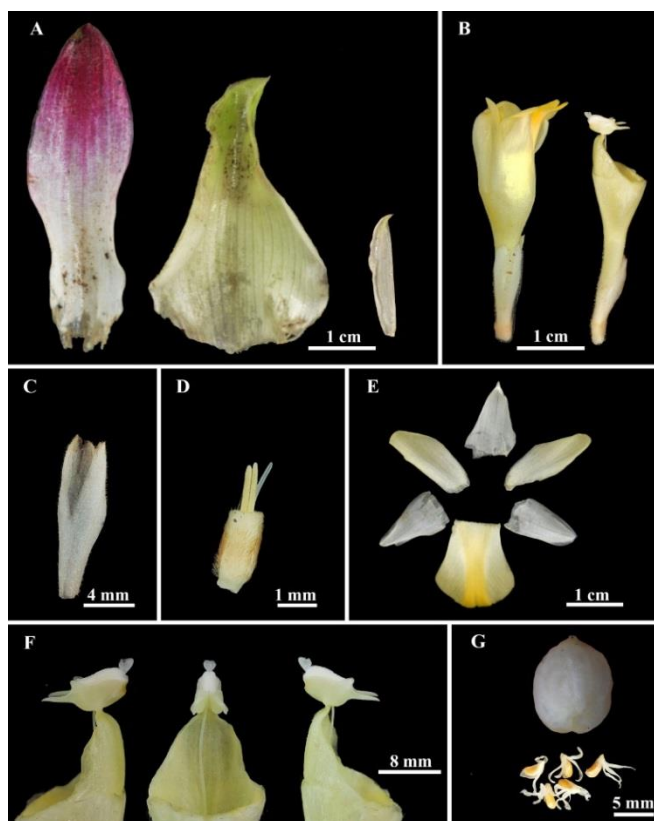
**Etymology:** As the first Thai botanist to study the family Zingiberaceae in Thailand, Prof. Puangpen Sirirugsa (Prince of Songkla University: PSU) is honored with the specific epithet "sirirugsae".

**Preliminary conservation status:** The type locality of *C. sirirugsae* is only known to have one population, and it is endemic to northern Thailand with less than 500 individuals. Both the Area of Occupancy (AOO) and the Extent of Occurrence (EOO) are expected to be less than 6 and 10 km<sup>2</sup>, respectively. The species was discovered close to pasture and agricultural areas. On the positive side, sub-population occurs in a protected area of Tham Lom-Tham Wang Forest Park and young inflorescence is not consumed as vegetable, probably because of hairy inflorescence. Consequently, according to the IUCN Standards and Petitions Committee in 2022<sup>27</sup>, the conservation status of *C. sirirugsae* is provisionally classified as Critically Endangered based on currently available data [CR: B1ab(ii), B2ab(ii)].

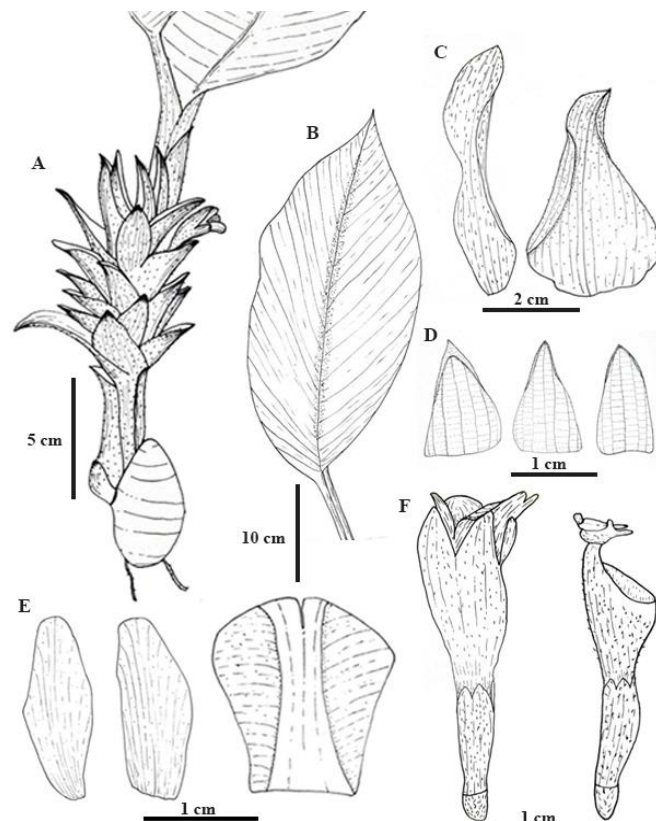


**Figure 1:** *Curcuma sirirugsae* Saensouk & Rakarcha: A. rhizome and inflorescence with red coma bracts; B. inflorescence with white coma bract; C. rhizome; D. front view of flower; E. side view of inflorescence; F. leafy shoots. Photographed by S. Rakarcha.





**Figure 2:** *Curcuma sirirugsae* Saensouk & Rakarcha: A. coma bract, fertile bracts, and bracteole; B. side view of flowers, and flower without corolla lobes, staminodes and labellum; C. calyx; D. ovary with epigynous glands; E. flower dissection: corolla lobes, staminodes and labellum; F. stamen: side view and semi-front view; G. fruit and seeds. Photographed by S. Rakarcha.



**Figure 3:** *Curcuma sirirugsae* Saensouk & Rakarcha: A. rhizome and inflorescence; B. leaf; C. coma bract and fertile bracts; D. corolla lobes; E. staminodes and labellum; F. side view of flowers, and flower without corolla lobes. Drawn by S. Rakarcha.

**Table 1:** Morphological comparison between *Curcuma sirirugsae* and *C. angustifolia* (Roxburgh 1810; Baker 1894; Maknoi 2006; Figure 4)

Characters	<i>C. sirirugsae</i>	<i>C. angustifolia</i>
Leaf	broadly elliptic, 30–45 × 12–16.5 cm, adaxially glabrous, abaxially densely pubescent	narrow elliptic, 25–60 × 3–6.5 cm, glabrous or pubescent on both surfaces
Peduncle	ca 6 cm long	5–20 cm long
Fertile bracts	ovate to lanceolate, 3.5–4.8 × 2–2.5 cm, connate 5–8 mm at the base, apex acute, margin incurved at the center, densely pubescent	ovate to obovate, 2.5–4.0 × 1.5–2.5 cm, apex obtuse to rounded, glabrous or hairy
Coma bracts	lanceolate, 4.5–5.5 × 1.6–2.2 cm, apex acute, margin incurved at the center, white or white at basal part with increasing pink or red tinge towards the apical part, densely pubescent	elliptic, 3.0–4.0 × 0.7–1.0 cm long, apex acute or obtuse, red, hairy
Staminode	irregularly oblong to irregularly elliptic, 14–16 × 6–7 mm	obovate, 10–12 × 4–7 mm
Labellum	obovate, 16–18 × 12–14 mm	obscurely trilobed, 10–13 × 12–13 mm
Anther	3.2–3.4 × ca 1.8 mm, puberulent	3–4 × ca 2 mm, glabrous
Anther spur	2.6–3 mm long	1–2 mm long

*Specimens examined:* THAILAND, Sukhothai Province, Si Samrong District, Na Khun Krai Subdistrict, 120 m elevation, 22 June 2023, S. Rakarcha, W. Thammarong, C. Doungdang, W. Prabang & M. Tabut 1405 (BKF, KKU, QBG). It can be identified by its epigynous glands, closed flower form, inflorescence with coma bracts, and two spurs pointing downward.

*Note:* *Curcuma sirirugsae*. belongs to subgenus *Curcuma* characterized by the present of epigynous glands, closed flower form, inflorescence with coma bracts, and two spurs pointing downward. *Curcuma*

*sirirugsae* is recognized by its hairy appearance on almost every portion of the plant, prominent rhizome without branches, leafy shoots 65–80 cm tall, broadly elliptic leaves, inflorescences usually occur near the ground, short peduncle (peduncle basally embedded in ground), densely imbricated and ovate to lanceolate fertile bract with densely pubescent, lanceolate and white or white with pink or red at apex coma bracts with densely pubescent and flowers with yellow staminodes and labellum that have an embossed dark yellow median band.

## Conclusion

The description, illustration, and photography of *C. sirirugsae*, a recently discovered species of *Curcuma* L. (Zingiberaceae) found in Sukhothai province, northern Thailand, are provided. Furthermore, we delineate its distinctions from *C. angustifolia*, the species showing the most similar morphology. According to the present data, the conservation status of *C. sirirugsae* is tentatively assessed as Critically Endangered. The new species is primarily distinguished by hairy on almost every parts of the plant, prominent rhizome without branches, broadly elliptic leaves, densely imbricated and ovate to lanceolate fertile bract with densely pubescent, with acute apex, and flowers with yellow staminodes and labellum that have an embossed dark yellow median band.

## Conflict of Interest

The authors declare no conflict of interest.

## Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

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**Figure 4:** *Curcuma angustifolia* Roxb.: A. leafy shoots; B. inflorescence; C. front view of flower. Photographed by S. Rakarcha.

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