horticulturae

MDPI

Article

A Horticultural Gem Unveiled: *Curcuma peninsularis* sp. nov. (Zingiberaceae), a New Species from Peninsular Thailand, Previously Misidentified as *Curcuma aurantiaca* Zijp

Piyaporn Saensouk [1], Surapon Saensouk [2,*], Charun Maknoi [3], Ahmad Dwi Setyawan [4] and Thawatphong Boonma [2,5]

[1] Diversity of Family Zingiberaceae and Vascular Plant for Its Applications Research Unit, Department of Biology, Faculty of Science, Mahasarakham University, Kantarawichai District, Maha Sarakham 44150, Thailand; pcornukaempferia@yahoo.com
[2] Diversity of Family Zingiberaceae and Vascular Plant for Its Applications Research Unit, Walai Rukhavej Botanical Research Institute, Mahasarakham University, Kantarawichai District, Maha Sarakham 44150, Thailand; boonma.thawat@gmail.com
[3] Romklao Botanic Garden, The Botanical Garden Organization, Phitsanulok 65170, Thailand; charun@qsbg.org
[4] Biodiversity Research Group, Universitas Sebelas Maret, Jl. Ir. Sutami 36A, Surakarta 57126, Indonesia; ahmad@staff.uns.ac.id
[5] Brio Botanical Research Garden, 53 M. 5 Phikun-ok, Ban Na District, Nakhon Nayok 26110, Thailand
* Correspondence: surapon.s@msu.ac.th; Tel.: +66-0888-029-3958

Abstract: The genus *Curcuma* L. (Zingiberaceae) is highly diverse and often exhibits similar morphological appearances, leading to frequent misidentifications that impact botanical practices, horticultural activities, and conservation efforts. This study addresses the taxonomic confusion surrounding the plant locally known as "Ploy Thaksin", which was previously misidentified as *Curcuma aurantiaca* Zijp. To resolve this issue, we conducted a detailed morphological analysis and reviewed the protologues descriptions of its ally species, focusing on anther characteristics and other key features. Our findings reveal that "Ploy Thaksin" actually represents two distinct species: one correctly identified as *C. aurantiaca* found in lower Peninsular Thailand (Satun and Trang Provinces), and another species, characterized by calcarate anthers found in upper Peninsular Thailand which resemble *C. sumatrana* Miq., *C. nepalensis* M.Sabu, Kasaju, and S.Subedi, described here as a new species under the name "*C. peninsularis* Saensouk, P.Saensouk, Maknoi, and Boonma" along with the details of a description, illustration, map of distribution, vernacular name, ecology, phenology, utilization, and economic value, including the proposal of a conservation status. This study clarifies previous misidentifications and underscores the importance of precise taxonomic practices for the accurate classification and conservation of *Curcuma* species. The results provide valuable insights for future research and horticultural applications, enhancing the understanding of *Curcuma* biodiversity.

Keywords: *Curcuma*; diversity; horticulture; new species; taxonomy; Thailand; Zingiberaceae

check for updates

Citation: Saensouk, P.; Saensouk, S.; Maknoi, C.; Setyawan, A.D.; Boonma, T. A Horticultural Gem Unveiled: *Curcuma peninsularis* sp. nov. (Zingiberaceae), a New Species from Peninsular Thailand, Previously Misidentified as *Curcuma aurantiaca* Zijp. *Horticulturae* **2024**, *10*, 950. https://doi.org/10.3390/horticulturae10090950

Received: 2 August 2024
Revised: 30 August 2024
Accepted: 5 September 2024
Published: 6 September 2024

Copyright: © 2024 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/).

1. Introduction

The genus *Curcuma* L., part of the Zingiberaceae family, includes over 160 species of flowering plants distributed throughout tropical and subtropical Asia [1]. It is divided into three subgenera. The subgenus *Hitcheniopsis* (Baker) K. Schum. is distinct due to the absence of epigynous glands, whereas the other two subgenera have these glands. The subgenus *Ecomata* Škorničk. and Šída f. typically lacks coma bracts and generally produces open-form flowers. In contrast, the subgenus *Curcuma* L. usually has well-developed coma bracts and predominantly produces closed-form or bell-shaped flowers [2]. Known for their diverse uses [3–5] ranging from horticultural and medicinal applications to ritualistic and ornamental purposes, they are especially diverse in Thailand, which hosts

over 80 species [1,6,7]. This high species richness underscores Thailand's critical role in the conservation and study of *Curcuma* diversity.

During ongoing studies of the genus *Curcuma* in Thailand, it has been observed that the plants within this genus are highly diverse, yet often exhibit similar appearances, making them easily confused if not scrutinized. This is especially true within the subgenus *Curcuma*. For example, a recent report from Thailand revealed that *C. borealis* Saensouk, P.Saensouk, Maknoi, and Boonma, recently described as a new species [8], had been misidentified as *C. ecomata* Craib [9]. Similarly, *C. suraponii* Boonma [10] was previously thought to be the same species as *C. rubrobracteata* Škorničk., M.Sabu, and Prasanthk [11]; even *C. phrayawan* Boonma and Saensouk [12] had been misidentified as *C. ferruginea* Roxb [13]. However, upon detailed examination, it was found that these are distinct species, differing in several morphological characteristics.

In this study, we found another plant that has been misidentified. This plant is well-known for its habitat on the edge of forests, in rubber and palm plantations in upper Peninsular Thailand. It is widely recognized under the horticultural name "Rainbow *Curcuma*" and is known locally as "Ploy Thaksin". This name was also published in the Thai ornamental book on *Curcuma* plants in 1996 [14], along with two photographs of the inflorescence, which show an anther with spurs. In that book, it was misidentified as "*C. aurantiaca* van Zijp". Since then, it has made significantly contributions to the development of new hybrids, leading to popular cultivars that have gained international acclaim.

To address the confusion and resolve the misidentification issues, we conducted a thorough study that investigated the literature, as well as species' morphological comparisons and distributions. We examined the original description of *C. aurantiaca*, first published in 1915 [15], along with its synonym *C. ecalcarata* Sivar. and Balach., and *C. wilcockii* M.A. Rahman and Yusuf [16–18], including a description from a new publication [19]. All these taxa [15–19] can be accurately identified by their anthers without spurs. Our findings revealed that the name "Ploy Thaksin" has been applied to two distinct species within the subgenus *Curcuma*. One species, characterized by spurless anthers, can be accurately identified as *C. aurantiaca*. The second species, with calcarate anthers resembling *C. sumatrana* Miq., *C. nepalensis* M.Sabu, Kasaju, and S.Subedi [20,21], is described here as a species new to science due to its unique morphological characteristics.

This study clarifies the misidentification of *Curcuma* species from upper Peninsular Thailand, which were previously thought to be *C. aurantiaca*. It addresses a longstanding taxonomic issue impacting horticultural and botanical practices and provides a foundational reference for future studies. This work underscores the importance of precise taxonomic research in resolving species misidentifications and advancing our understanding of *Curcuma* biodiversity.

2. Materials and Methods

Plant Materials: Fieldwork was conducted in Ranong Province, Peninsular Thailand (Figure 1), during the flowering seasons of 2019, and 2023 to 2024. Specimens were collected from a variety of habitats, including forest edges, and rubber and palm plantations. The collected specimens were preserved in 70% ethanol alcohol, which were then deposited at the Faculty of Forestry Herbarium (FOF!), and Mahasarakham University Herbarium (MSU!).

Morphological Analysis: Detailed morphological examinations were conducted on 30 living specimens of *C. peninsularis*, compared with type specimens and the descriptions of allies' species, *C. aurantiaca*, *C. nepalensis*, and *C. sumatrana* from the relevant literature [15–17,19–21]. Measurements were taken of key morphological traits, e.g., rhizomes, leaves, bracts, flowers, and reproductive structures, with particular attention to the anthers and the presence or absence of spurs. Small characteristics were measured under a stereoscopic microscope (ZEISS–Stemi 2000-C, Oberkochen, Germany) with the same methods as Saensouk et al. [8].

Graphic Design and Illustrations: All graphics designed in this study were created using the Pixelmator Pro Program (Version 3.6.5 (Archipelago), 2023, Pixelmator Team,

Vilnius, Lithuania) on a MacBook Pro (13-inch, M1, 2020, Apple Inc., Cupertino, CA, USA). Line drawings were executed on an iPad Air 5 (iPadOS 17.5.1 (21F90), 2024, Apple Inc., Cupertino, CA, USA).

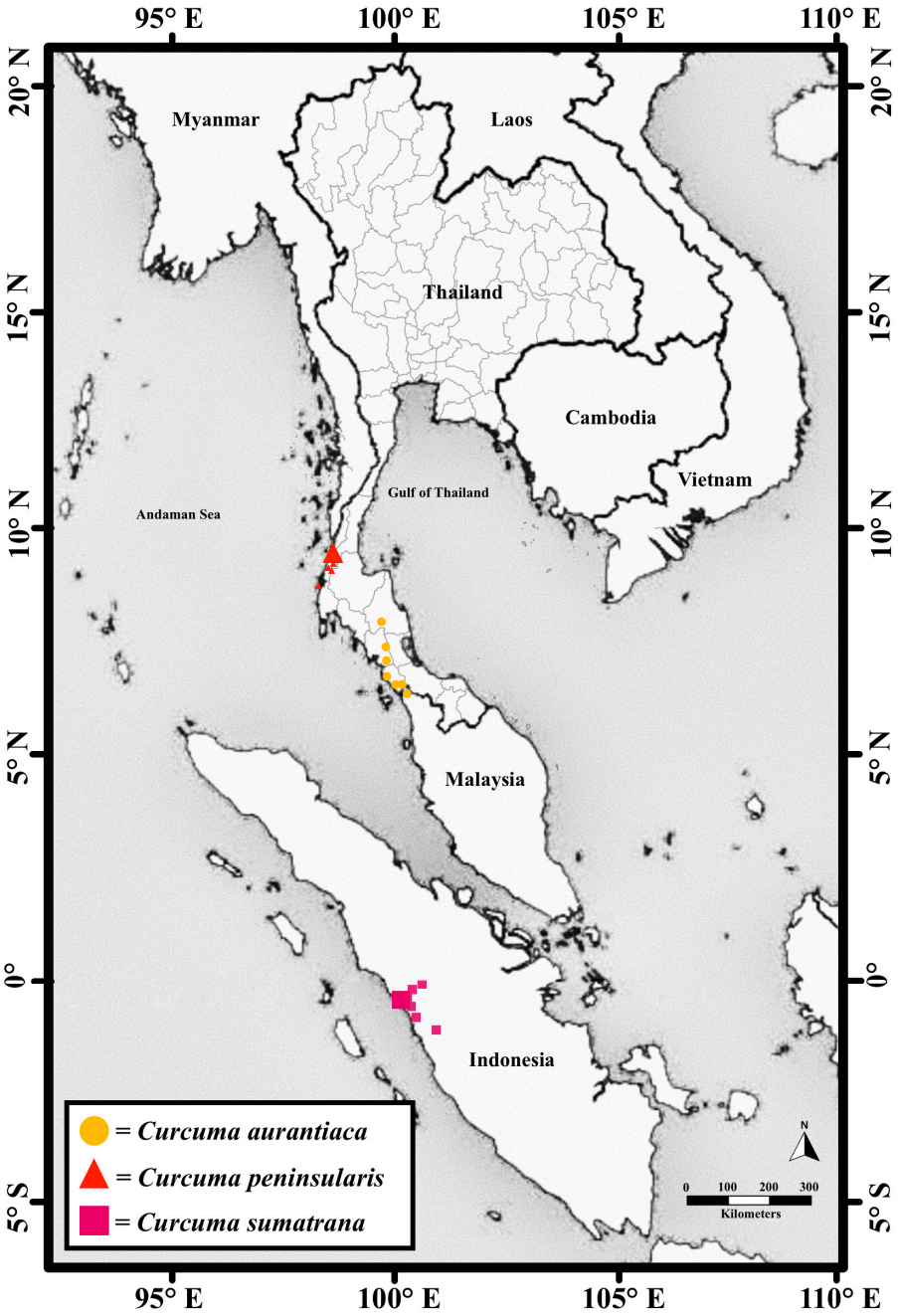

Figure 1. Distribution map of *Curcuma peninsularis* Saensouk, P.Saensouk, Maknoi, and Boonma sp. nov. (red triangle) and its ally species, *C. sumatrana* Miq. (pink square), *C. aurantiaca* Zijp (yellow circle). Designed in Pixelmator Pro Program by Thawatphong Boonma.

Methods for Assessing Economic Values (Gross Annual Revenue)

Revenue from Individual Plants: To calculate the gross annual revenue from individual *Curcuma peninsularis* plants, the following formula was applied:

$$\text{Gross Annual Revenue (GARp)} = \text{Np} \times \text{Nm} \times \text{Pp} \quad (1)$$

where Np = number of plants sold per month; Nm = number of months in the sales period per year; Pp = price per plant. This formula was applied separately for the lower and higher price points to determine the range of potential gross annual revenue.

Revenue from Clumps: To calculate the gross annual revenue using the formula:

$$\text{Gross Annual Revenue (GARc)} = \text{Nc} \times \text{Pc} \quad (2)$$

where Nc = number of clumps sold per year, and Pc = price per clump. This formula was also applied separately for the lower and higher price points to determine the range of potential gross annual revenue.

Total Gross Revenue: Combine the revenues from individual plants and clumps to determine the total gross revenue using the formula:

$$\text{Total Gross Annual Revenue} = (\text{GARp}) + (\text{GARc}) \quad (3)$$

This formula was also applied separately for the lower and higher price points to determine the range of potential gross annual revenue.

The additional specimens examined are listed as follows:

Curcuma aurantiaca Zijp: India, Kerala, Palghat, Kanjirappuzha, 10°47′ N, 76°39′ E, year 1982, *Sivarajan V.V. and Balachandran I. 1497* (Holotype of *C. ecalcarata* Sivar. and Balach.)(E!); India, Kerala, year 1903, *Wight R. 1066?* (E00097577)(E!); India, Kerala, *Wight R.* (E00097576)(E!); India, Kerala, Malabar, 9°58′ N, 76°14′ E, June 1836, *Wight R. 1068* (E00097578)(E!); India, Kerala, Malabar, 9°58′ N, 76°14′ E, June 1836, *Wight R. 1069* (E00097579)(E!). Indonesia, Jawa, Jawa Barat, 6°46′ S, 108°8′ E, *Tomo 619* (BO!, K!, L!); Indonesia, Jawa, Jawa Barat, Buitenzorg, Botanic Garden, 6°35′ S, 106°47′ E, 862b (K!, L!); Indonesia, Jawa, Jawa Barat, Buitenzorg, Botanic Garden, 6°35′ S, 106°47′ E, *Alston A.H.G. 12624* (BO!); Indonesia, Jawa, Jawa Barat, Cianjur, Kiara Payung, 6°49′ S, 107°8′ E, Altitude 550 m, *Backer C.A. 23584* (BO!, L!); Indonesia, Jawa, Jawa Barat, Tomo, 6°80′ S, 108°8′ E, Altitude 138 m, *Marlina Ardiyani 36MA* (E!); Indonesia, Jawa, Jawa Timur, Ngawi, Kampung Tambak Selo, 7°34′ S, 111°34′ E, Altitude 115 m, *Marlina Ardiyani 67MA* (E!); Indonesia, Jawa, Jawa Barat, Tomo, 6°80′ S, 108°8′ E, Altitude 138 m, *Marlina Ardiyani 35MA* (BO!, E!); Indonesia, Jawa, Jawa Timur, 6°51′ S, 115°26′ E, Altitude 50 m, *Backer C.A. 27587* (BO!); Indonesia, Jawa, Jawa Timur, Mount Puger Besuki, 8°22′ S, 113°28′ E, Altitude 100 m, *Buwalda P. 7298* (K!, L!); Indonesia, Jawa, Jawa Timur, Ngawi, Kampung Tambak Selo, 7°34′ S, 111°34′ E, Altitude 115 m, *Marlina Ardiyani 68MA* (BO!, E!); Indonesia, Jawa, Jawa Timur, Ngawi, Kampung Tambak Selo, 7°34′ S, 111°34′ E, Altitude 115 m, *Marlina Ardiyani 69MA* (BO!); Indonesia, Jawa, Jawa Timur, Saradan, Madiun, 7°33′ S, 111°44′ E, Altitude 80 m, 2 April 1920, *Wisse C.A. 156* (BO!); Indonesia, Jawa, Jawa Timur, Malang, Kuntji Kerbo, 7°57′ 59″ S, 112°37′ 54″ E, year 1911, *Zijp C.v.* (Lectotype of *C. aurantiaca* Zijp) (BO!); Indonesia, Jawa, Jawa Tengah, Bodja, 7°6′ S, 110°16′ E, Altitude 150 m, *Beumée J.G.B. 3831* (BO!); Indonesia, Jawa, Jawa Tengah, Djepara, 6°35′ S, 110°39′ E, *Heyne K. 633* (BO!); Indonesia, Jawa, Ngorogoenoeng by Tjileboeng, *Kalshoven L.G.E. 1620* (BO!); Indonesia, Jawa, Jawa Tengah, 7°12′ S, 111°23′ E, Randublatung, *Koorders S.H. 42257ß* (BO!); Indonesia, Jawa, Jawa Tengah, Tjabak, 7°2′ S, 111°31′ E, *Koorders S.H. 42524ß* (BO!); Indonesia, Sulawesi, Sulawesi Selatan, Altitude 1350 m, *Ardiyani M., Poulsen A.D. and Firdaus 158* (E!). Malaysia, Peninsular Malaysia, Perlis, 6°30′11″ N, 100°14′46″ E, *Henderson M.R. 22869* (K!). Thailand, Peninsular, Nakhon Si Thammarat, Tung Song, 8°9′ N, 99°41′ E, *Rabil Bunnag 165* (K!); Satun Province, 23 August 1996, *BGO staff 132* (QBG!); Satun Province, Khuan Don District, 24 June 2002, *Maknoi 265* (AAU!, BKF!, PSU!, QBG!); Satun Province, Khuan Don District, 14 September 2003, *Maknoi 514* (AAU!, BKF!, PSU!, QBG!); Satun Province, La Ngu District, 14 September 2003, *Maknoi 515* (AAU!, BKF!, PSU!, QBG!); Satun Province, Thale Ban NP, 3 October 1991, *K.Larsen, S.S.Larsen, C.Niyomdham, W.Ueachirakan, and P.Sirirugsa 42118* (AAU!, BKF!); Satun Province, on the way to Thale Ban NP, 3 August 1977, *Sorensen and Smitinand 1201* (BKF!); Satun Province, Mueang Satun District, Chalung, 13 August 1987, *Vacharee 802* (BK!). Trang Province, Khao Chong, 12 September 2002, *Maknoi and Pong-*

pipatsattaya 321 (AAU!, BKF!, PSU!, QBG!); Trang Province, Palian District, 14 September 2003, *Maknoi 516* (AAU!, BKF!, PSU!, QBG!).

Curcuma nepalensis M.Sabu, Kasaju, and S.Subedi: Nepal, Karnali Province, Surkhet District, Dailekh Road, 28°38.167′ N, 81°37.739′ E, Altitude 1353 m a.s.l., 12 August 2021, *S.K. Kasaju and S. Subedi 72* (Holotype KATH!; isotype TUCH!).

Curcuma peninsularis Saensouk, P.Saensouk, Maknoi, and Boonma: Thailand, Peninsular floristic region, Phangnga Province, Foothill of Khao Pra Mi, 8 July 1972, *K.Larsen, S.S.Larsen, I.Nielsen, and T.Santisuk 30750* (AAU!, K!, P!); Ranong Province, Klong Naka Wildlife Sanctuary, 7 November 1999, *Maknoi 73* (QBG!); Ranong Province, Kapoe District, 15 June 2002, *Maknoi 253* (AAU!, BKF!, PSU!, QBG!); Thailand, Peninsular floristic region: Ranong Province, Kapoe District, Altitude 110 m.a.s.l., 2 July 2019, *Boonma 1971* (MSU!); Ranong Province, Kapoe District, Altitude 102 m a.s.l., 8 July 2023, *Boonma 2378* (MSU!); Ranong Province, Kapoe District, Altitude 98 m a.s.l., 2 July 2024, *Surapon and Boonma 24732* (FOF!). Surat Thani Province, Khlong Saeng Wildlife Sanctuary, 25 November 1986, *Niyomdham 1246* (AAU!, BKF!, K!).

Curcuma sumatrana Miq.: Indonesia, Sumatra, Pariaman, *Diepenhorst [1327 H.B.]* (lectotype, Acc. No. BO 0083511); Indonesia, West Sumatra, Kabupaten Agam, Kecamatan Tanjung Raya, Kanagarian Koto Malintang, Maninjau, Labuah Baru, Altitude 1210 ft, 8 July 2009, *M. Ardiyani*, *Ari Anggara and Pitra Akhriadi 189* (ANDA!, BO!, E!); Indonesia, Western Maninjau, Muko-muko, small hill behind Field Research Station of Andalas University, 500 m, 11 September 1984, *M. Hotta and T. Kohyama 356* (ANDA!); Indonesia, Maninjau, about 60 km west from Bukittinggi, Muko-muko, Gunung Datar, 12 May 1984, *Asmiati 73* (BO!); Indonesia, Bukittinggi, Siniok, 21 October 1989, *Laivia Syarana 027* (ANDA!); Indonesia, Kabupaten Pariaman, Sipisang Kayu Tanam, about 55 km north from Padang city, Altitude 150–450 m, 25 May 1995, *Nofrida 64* (ANDA!); Indonesia, ibidem, 26 May 1995, Andan 72 (ANDA!); Indonesia, ibidem, 25 May 1995, *Irma Suryani 34* (ANDA!); Indonesia, ibidem, 26 May 1995, *Irma Suryani 50* (ANDA); Indonesia, ibidem, 25 May 1995, *Efdar Roza 19* (ANDA); ibidem, 29 November 1992, *Isman Afandi 21* (ANDA!); Kabupaten Tanah Datar, Kecamatan X Koto, Cagar Alam Lembah Anai, Altitude 400–800 m, 1 June 2008, flowering, *Ari Anggara and Rikinovtian Burlis 59* (ANDA!); Indonesia, Asam Pulau about 9 km from Lubuk Alung, 1 November 1991, *Mesli 084* (ANDA!); Indonesia, along river of Asam Pulau about 9 km from Lubuk Alung, 3 November 1991, *Childa 12* (ANDA!); Indonesia, Kabupaten Padang Pariaman, Lubuk Alung, Asam Pulau, 60–250 m, 22–24 March 2002, *Ade, Rizki, Indah, Icha, Lenmar and Yessi AP-08-027* (ANDA!); Indonesia, Padang, Ulu Gadut, along Sungai Gadut Gadang, 350–450 m, 2 August 1984, *M. Hotta, H. Okada and T. Kohyama 281* (ANDA!); Indonesia, Sumatra, sine loc. [presumably Padang Highlands], *Curtis 115* (K!); culta Hort. Veitch. (from Curtis), August 1882, s.n. (K!); culta Hort. Veitch. (from Curtis), 3 September 1884, s.n. (K!).

3. Results

The identification of *Curcuma peninsularis* as a new species highlights its distinct morphological traits, setting it apart from similar species such as *C. sumatrana* and *C. nepalensis*. Specifically, *C. peninsularis* exhibits unique anther characteristics, floral structure, and rhizome coloration. Additionally, *C. peninsularis* can be distinguished from *C. aurantiaca*, which produces anthers lacking spurs, whereas *C. peninsularis* produces anther spurs. Furthermore, *C. peninsularis* is classified within the subgenus *Curcuma* due to its possession of epigynous glands, well-developed coma bracts, and predominantly closed or bell-shaped flowers, which are characteristic of this subgenus. The description and details of the new species *Curcuma peninsularis* are provided below.

Curcuma peninsularis Saensouk, P.Saensouk, Maknoi, and Boonma sp. nov.

Diagnosis: The new species is similar to *C. sumatrana* Miq but differentiated by its pale yellow rhizome (vs. *C. sumatrana* with a light purple and cream rhizome); 16–22 mm-long ligule (vs. c. 3 mm-long); 25–45 cm-long peduncle (vs. 4–18 cm-long); 25–42 × 10–12 cm

thyrse (vs. 14–25 × 5.5–7 cm); 70–98 bracts per inflorescence (vs. 15–29); broadly obovate fertile bracts, dark red or dark reddish brown, with a pale green base (vs. ovate-elliptic, bright red, gradually becoming a yellowish cream base); 3.6–4.2 cm-long fused bracts (vs. 3.0–3.3 cm-long); 1.8–3 cm bracteole (vs. c. 1.3 cm-long); 5.3–5.8 cm-long flowers (vs. c. 6.5 cm-long); pubescent floral tube (vs. glabrous); pale yellowish, pubescent corolla lobe (vs. white, glabrous); pubescent lateral staminodes (vs. glabrous); pubescent filament (vs. glabrous); 1.5–2 mm-long anther spurs (vs. 3 mm-long). (Table 1, Figures 1–4).

Table 1. Comparison of morphological characters between *Curcuma peninsularis* and its allied species.

Characters	*Curcuma sumatrana*	*Curcuma peninsularis* (Present Study)
Rhizome	Light purple	Pale yellow
Rhizome branches	Produces lateral rhizomes oriented in parallel with the main rhizome	Produces short branches rhizomes not parallel with the main rhizome but pointing downward
Tuberous root	Not seen	3–5 × 1–2 cm
Ligules	c. 3 mm long	16–22 mm long
Number of leaves	2	4–7
Lamina shape	Elliptic	Narrowly ovate to elliptic
Lamina apex	Caudate	Acuminate
Lamina base	Acute	Broadly cuneate to rounded
Lamina size	57–64 × 24–30 cm	38–70 × 20–35 cm
Lamina abaxial surface	Glabrous, Pale green with a maroon tinge towards the margin	Pubescent, Pale green, or with a reddish tinge at the distal part near the margin
Midrib of leaves	Green throughout	Green or tinged reddish brown from the base, gradually fading to reach almost 2/3 of the lamina's length
Peduncle	4–18 cm long	25–45 cm long
Thyrse	14–25 × 5.5–7 cm	25–42 × 10–12 cm
Bracts per inflorescence	15–29	70–98
Fertile bracts shape	Ovate-elliptic, Apex rounded	Broadly obovate, Apex rounded to narrowly obtuse
Fused of bracts	3.0–3.3 cm long	3.6–4.2 cm long
Bracts size	6–6.5 × 5–6.5 cm	5–6.5 × 3–5 cm
Bracts color	Bright red, gradually becoming yellowish cream at base	Dark red or dark reddish brown, with pale green base
Coma bracts	4–5 bracts per inflorescence	4–7 bracts per inflorescence
Bracteole size	c. 1.3 cm long	1.8–3 cm long
Bracteole color	White	White with pinkish tinge at the distal part
Flowers	c. 6.5 cm long	5.3–5.8 cm long
Floral tube	Glabrous	Pubescent
Corolla lobes	Translucent white, Glabrous	Pale yellowish, Pubescent
Dorsal corolla lobe	c. 1.8 × 0.9 cm	1.4–1.6 × 1.0–1.3 cm
Lateral corolla lobes	c. 1.7 × 0.7 cm	1.3–1.5 × 1.0–1.2 cm
Lateral staminodes	c. 11 × 5 mm, Glabrous	1.2–1.3 × 0.8–1.0 cm, Pubescent

Table 1. *Cont.*

Characters	*Curcuma sumatrana*	*Curcuma peninsularis* (Present Study)
Filament	Glabrous	Pubescent
Anther	c. 8 × 3 mm	7.0–7.5 × 3.2–3.5 mm
Anther thecae	c. 6 mm long	c. 5 mm long
Anther spurs	c. 3 mm long	1.5–2 mm long
Epigynous glands	2–3 mm long	c. 4 mm long

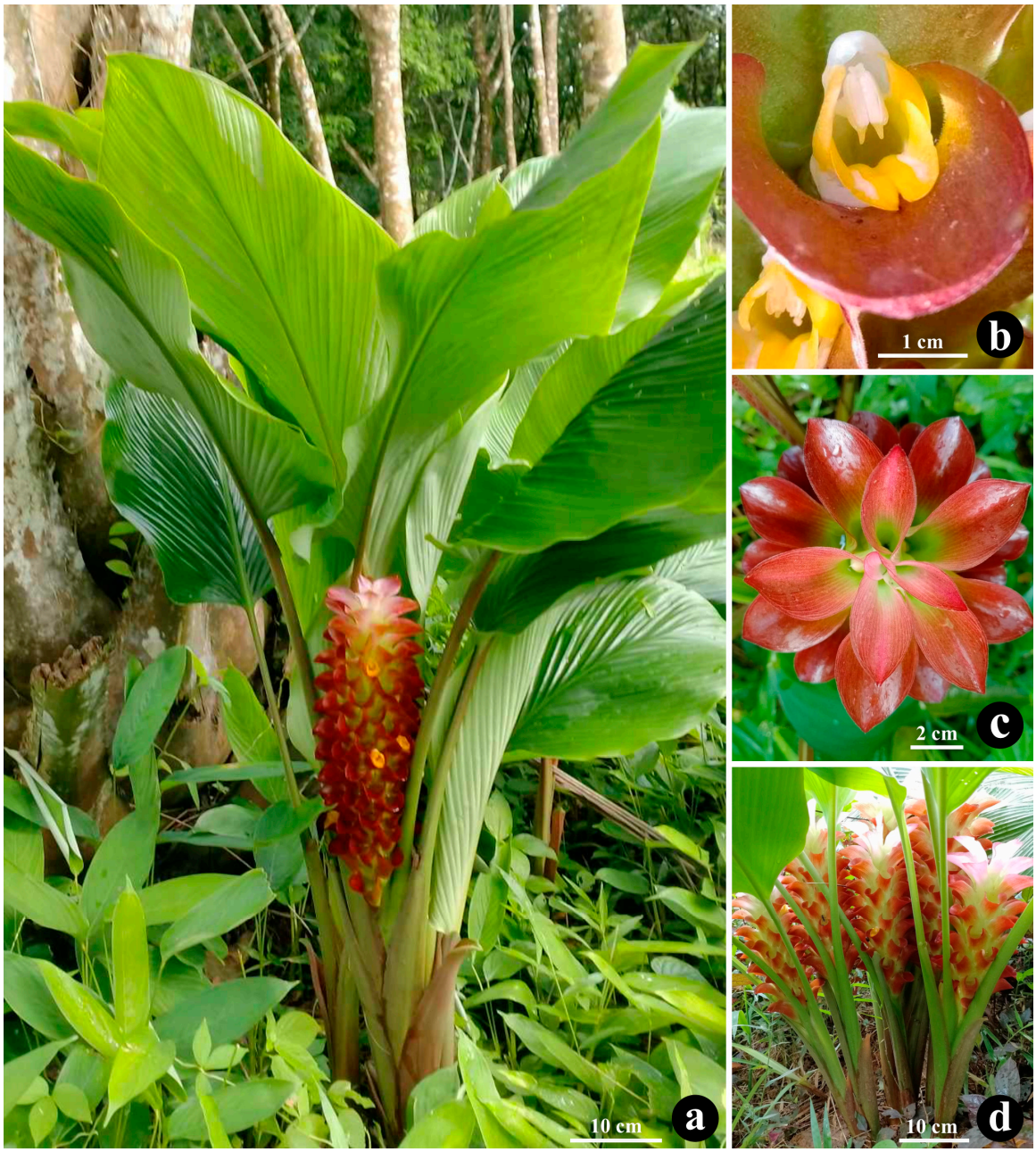

Figure 2. *Curcuma peninsularis* Saensouk, P.Saensouk, Maknoi, and Boonma sp. nov. (**a**) habit; (**b**) front view of flower; (**c**) top view of inflorescence; (**d**) clump-forming growth habit. Photographs by Ornicha Chinkam and Thawatphong Boonma.



Figure 3. *Curcuma peninsularis* Saensouk, P.Saensouk, Maknoi, and Boonma sp. nov.: (**a**) leaf apex on abaxial side with slightly reddish tinge; (**b**) reddish along the midrib both adaxial and abaxial side of leaves; (**c**) ligules; (**d**) rhizome and tuberous root with dissected part; (**e**) plants in a rubber plantation connected to a natural forest, Ranong Province, Peninsular Thailand. Photographs (**a**–**d**) by Thawatphong Boonma, (**e**) by Ornicha Chinkam.

Type: Thailand, Peninsular, Ranong Province, Kapoe District, Altitude 98 m.a.s.l., Surapon and Boonma 24731, 2 July 2024 (holotype FOF!).

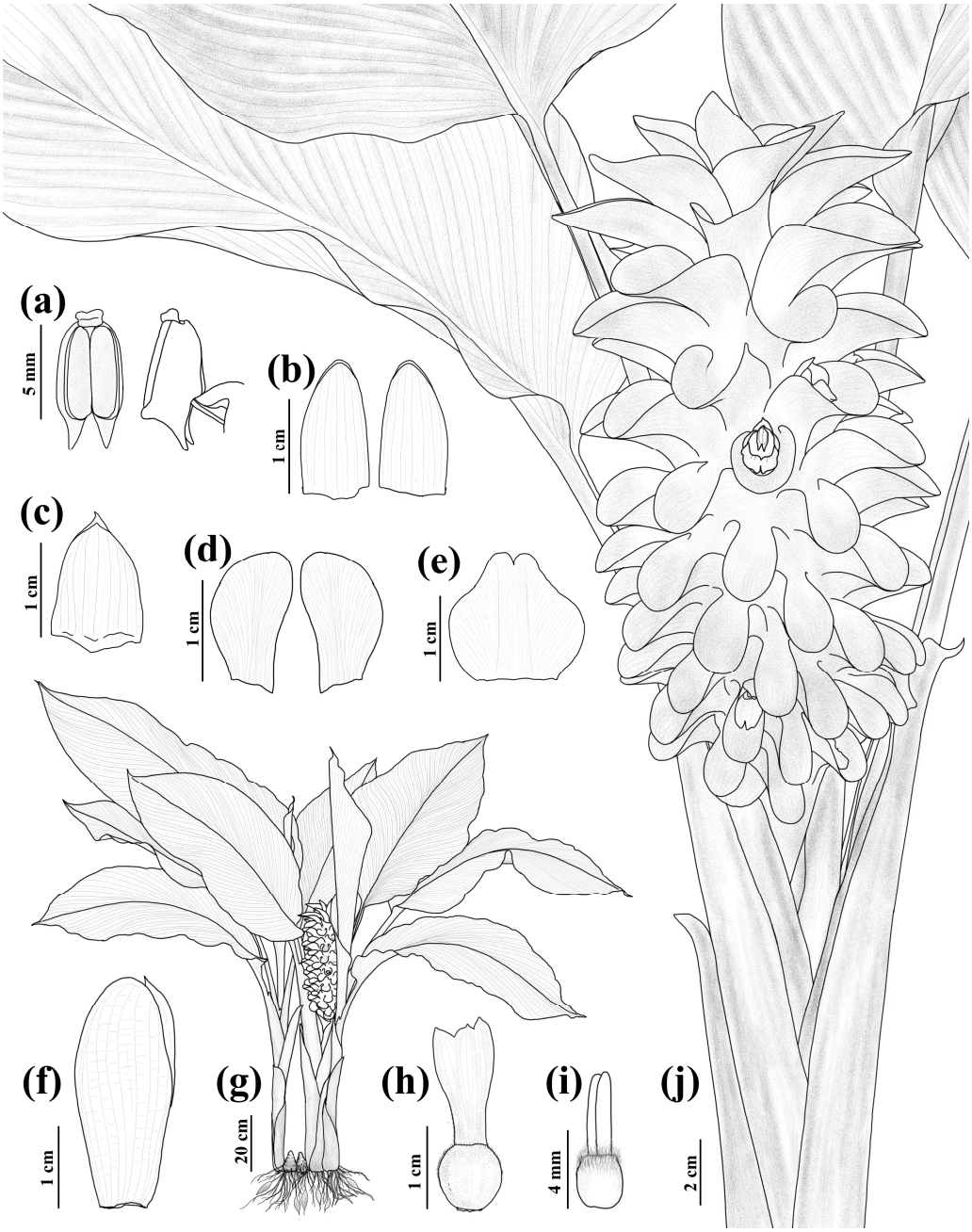

Figure 4. *Curcuma peninsularis* Saensouk, P.Saensouk, Maknoi, and Boonma sp. nov.: (**a**) front and side views of anther; (**b**) lateral corolla lobes; (**c**) dorsal corolla lobe; (**d**) lateral staminodes; (**e**) labellum; (**f**) bracteole; (**g**) habits; (**h**) fruit with calyx; (**i**) ovary with epigynous glands; (**j**) inflorescent with flowers. Drawn by Thawatphong Boonma.

Description: Perennial herb. Leafy shoot—80–130 (150) cm tall. Rhizome—elongated conical shape, 4.5–7 × 2.5–3.5 cm, internally pale yellow, slightly aromatic, sympodial. Branches short and pointing downwards. Roots—fibrous and tuberous. Tuberous roots—ellipsoid to ovoid tuberous roots, whitish internally, 3–6 cm in length and 1–2 cm in width, located at the tip of the root, which has a diameter of 2–4 mm, and usually found more than 5 cm away from the rhizome. Pseudostem—green with dark reddish-brown tinge, 25–47 cm tall, pubescent; bladeless sheath—3–5 in number, 8–54 cm in length, pubescent, reddish brown or dark green with reddish brown tinge, and exhibits a mucronate apex with hairs. Leaf-sheaths—distichous, 49–58 cm in length, green or green with reddish brown tinge, or reddish brown, pubescent. Ligule—bilobed, each lobe rounded

apex, lobe measures 1.6–2.2 × 1.0–1.3 cm, pubescent, reddish brown with dark green veins, usually curled vertically when mature. Leaves—4–7 in number; petioles—canaliculate, 10–40 cm long, pubescent, green or reddish brown, or green with reddish brown tinge; laminae—narrowly ovate to elliptic, 38–70 × 20–35 cm, apex acuminate, base broadly cuneate to rounded, rarely cordate, with or without reddish tinge at the distal part, margin undulate, with a whitish green semi-translucent hyaline edge and a reddish semi-translucent hyaline at the distal part; adaxial surface—green, prominently embossed veins with sparse hairs along them, usually in two rows along the embossed veins and one row along the veins between the embossed veins, other sparse hairs are present; midrib—green on both sides or tinged reddish brown from the base, gradually fading to reach almost 2/3 of the lamina's length on both side; abaxial surface—pubescent, pale green, or with a reddish tinge at the distal part near the margin. Inflorescence—terminal: peduncle—usually hidden in the innermost leaf sheath, measures 25–45 cm in length, approximately 2 cm in diameter, whitish, pubescent. Thyrse—cylindrical, 25–42 × 10–12 cm. Fertile bracts—70–98 in number, broadly obovate, 5–6.5 × 3–5 cm, the lower bracts have a rounded apex, the upper bracts have a more narrowly obtuse apex than the lower bracts, pubescent on both surfaces, dark red or dark reddish brown, with pale green base, connate about 3.6–4.2 cm long, cincinni with 4–5 flowers. Coma bracts—4–7 in number, obovate shape, 4–6 ×1.8–2.7 cm, apex broadly acute, pubescent on both surfaces, pale pinkish to reddish, usually paler than the fertile bracts, and with pale green base. Bracteoles—obovate, 1.8–3 cm long, and 1–2 cm broad, keeled, hooded, apex with short mucronate, one per flower, semi-translucent white with pinkish tinge at the distal part, pubescent. Flower—5.5–6.0 cm long, pubescent. Calyx—tubular, apex tri-lobes, each lobe acute with mucronate tip, 1.1–1.3 cm long, with an incision up to 3 mm long, pubescent. Floral tube—slender and tubular, 4.0–4.5 cm in length, the distal part is larger in diameter than the basal part, pubescent, yellow distal part and paler yellow towards the base; dorsal corolla lobe—triangular-ovate, 1.4–1.6 × 1.0–1.3 cm, mucronate apex, hooded, pale yellowish and pubescent; lateral corolla lobes—triangular-ovate, 1.3–1.5 × 1.0–1.2 cm, with obtuse apex, hooded, pale yellowish and pubescent. Lateral staminodes—uniquely asymmetrical obovate, 1.2–1.3 × 0.8–1.0 cm, with rounded apices, yellow, and pubescent. Labellum—broadly ovate, 1.5–1.6 × 1.75–1.8 cm, with an emarginate apex to become bilobed at the distal part, featuring a sinus up to 3–3.5 mm long, the lobes are yellow, with a slightly deeper yellow mediant band along the mid-lobe of the labellum, and whitish glandular hairs along the sides of the mediant band, pubescent. Stamen—1; filament—c. 2 mm long, c. 6 mm wide at the base, yellow, pubescent; anther—7.0–7.5 × 3.2–3.5 mm, yellow, calcarate, with nodes at the base of the anther; anther thecae—c. 5 mm in length, with whitish pollen; anther crest—not obvious; anther spurs—slightly flattened conical, 1.5–2 mm long, yellowish. Epigynous glands—two in number, slender, c. 4 mm long, and yellowish, with blunt apex. Ovary—subglobose, 2.5–3 × 2.5 mm, pubescent, axil placentation; style—slender, white; stigma—ciliate, c. 1.5 × 1.5 mm wide, is whitish, and shaped like an inverted cone, bilobed. Fruits—slightly flattened subglobose, 7–9 × 6–9 mm, pubescent. Seeds—subglobose to ovoid, pale brown, with white arils.

Vernacular name: "Ploy Andaman" is derived from Thai, where 'Ploy' means 'gem' or 'jewel' and 'Andaman' refers to the Andaman Sea. This name highlights the beauty and uniqueness of the species, found on the peninsular side of the Andaman Sea and the islands within it. The term emphasizes the splendid inflorescence, which is likened to a jewel of the Andaman Sea. Similarly, the vernacular name "Ploy Thaksin" merges "Ploy" with "Thaksin", which denotes the southern region of Thailand. This name emphasizes the species' occurrence in the southern part of the country. Both names highlight the species' connection to specific geographic locations.

Etymology: The specific epithet "peninsularis" denotes the species' native habitat in the Peninsular floristic region of Thailand, underscoring its geographical distribution.

Distribution: This newly described species is currently known only from Peninsular Thailand, in the Ranong and Phangnga Provinces.

Habitat: *Curcuma peninsularis* is found at the edge of the forest, at the foot of the mountain, and in former forest areas that have been converted into rubber and palm plantations. In a nearby forest, various plants in the ginger family were observed. Notable species in these areas include *Globba pendula* Roxb., *G. ranongensis* Picheans. and Tiyaw., *Kaempferia pulchra* Ridl., *Zingiber longibracteatum* Theilade, and *Z. montanum* (J.Koenig) Link ex A.Dietr.

Phenology: This species enters dormancy from late December to April. After the initial rains, it begins to produce new shoots. Flowering usually occurs between June and September, with flowers blooming early in the morning and lasting for just one day.

Utilization: This species has been used as an ornamental plant. Additionally, some villagers consume the young inflorescences as an herbal remedy for their carminative properties.

Economic values: Our preliminary data from five local shops indicate that *Curcuma peninsularis* holds notable economic value. Individual plants are priced between 20 and 50 baht, not including shipping costs. Each shop sells 30 to 50 plants monthly during a 4- to 5-month sales period annually. Consequently, the gross annual revenue from individual plants ranges from 12,000 to 25,000 THB at the lower price point and from 30,000 to 62,500 THB at the higher price. Clumps are sold at 200 baht each, with 10 to 20 clumps sold per year, adding 2000 to 4000 THB. Therefore, the total gross revenue from both individual plants and clumps ranges from 14,000 to 29,000 THB at the lower price and from 32,000 to 66,500 THB at the higher price. The exchange rate in August 2024 is approximately 1 US Dollar (USD) to 34.01 Thai Baht (THB). Shipping costs are separate and do not affect net revenue.

Despite its economic potential, *Curcuma peninsularis* is sometimes viewed as a weed in rubber or palm plantations, which poses a threat to its persistence. This perception highlights the need for increased awareness of the plant's economic and ecological significance. Our goal is to assist local communities in recognizing the importance of conserving this endemic species by promoting its cultivation, conserving genetic resources, and developing community-based economies. Enhancing appreciation for *C. peninsularis* and fostering sustainable management practices are vital for its long-term conservation. Additionally, advocating for the inclusion of its habitat in non-protected areas with Other Effective Area-Based Conservation Measures (OECMs) is crucial. Support from relevant organizations could significantly aid in safeguarding the species, improving its conservation status, and fostering harmonious coexistence with local biodiversity.

Conservation status: *Curcuma peninsularis* is proposed to be classified as Vulnerable [VU B1B2ab (i, ii, iv, v); D2] according to the IUCN Red List Categories and Criteria Version 16 [March 2024] (IUCN, 2024). This assessment is based on the species' currently known extent of occurrence (EOO), which encompasses approximately 6000 km^2, and its area of occupancy (AOO), which is confined to five locations totaling less than 10 km^2, with a total population of about 500 individuals.

4. Discussion

This study provides a critical advancement in the taxonomy of *Curcuma* by resolving the longstanding misidentification of the plant locally known as "Ploy Thaksin", which was previously classified as *C. aurantiaca*. Our detailed morphological analysis has confirmed that the plants under the local name "Ploy Thaksin" represent two distinct species: *C. aurantiaca* in lower Peninsular Thailand, and a new species that we described here, *C. peninsularis*, found in upper Peninsular Thailand. This finding has important implications for our understanding of *Curcuma* diversity and taxonomy.

From the perspective of previous studies, this research addresses significant gaps in the classification of *Curcuma* species in Thailand. Earlier reports and taxonomic revisions have frequently misidentified species due to their morphological similarities, leading to confusion in botanical literature and horticultural practices. For instance, *C. borealis* was previously mistaken for *C. ecomata* [8], and similar issues have been observed with other species. Our findings align with and extend these observations by clarifying the identity

of "Ploy Thaksin" and introducing *C. peninsularis*, which fills a critical gap in the existing taxonomic framework.

The identification of *C. peninsularis* as a new species highlights its distinct morphological traits compared to related species (Table 2) such as *C. sumatrana* and *C. nepalensis*. These differences include unique anther characteristics (Figure 5), floral structure, and rhizome coloration, which contribute to its differentiation from closely related taxa. This differentiation reinforces the need for meticulous morphological analyses and reinforces the validity of our working hypotheses regarding species delineation within the genus. It belongs to the subgenus *Curcuma* due to its present of epigynous glands, well-developed coma bracts and predominantly closed form or bell-shaped flowers, aligning with the characteristics of this subgenus. The discovery of *C. peninsularis* underscores the high level of biodiversity within the *Curcuma* genus and the importance of continued taxonomic research. The accurate classification of this species has implications for conservation efforts, particularly in areas where *C. peninsularis* is found. Despite its economic value, the plant's status as a potential weed in rubber and palm plantations poses a risk to its persistence. This highlights the need for conservation strategies that balance economic interests with ecological preservation. This study not only clarifies the taxonomic status of "Ploy Thaksin" but also contributes to a deeper understanding of *Curcuma* biodiversity. By addressing previous misidentifications, providing a comprehensive description of *C. peninsularis*, and paving the way for more accurate botanical practices and informed conservation efforts.

Table 2. Morphological characteristics of *Curcuma peninsularis* and its closely related species.

Characters	*C. aurantiaca*	*C. nepalensis*	*C. sumatrana*	*C. peninsularis*
Rhizome	Pale Yellow	Light yellowish brown	Light Purple with cream	Pale yellow
Rhizome branches	Present	Absent	Present	Present
Ligule	3–6 mm long, Pubescent	10–13 mm long, Glabrous	c. 3 mm long, Pubescent	16–22 mm long, Pubescent
Petioles	5–20 cm long, Pubescent	16–19 cm long, Glabrous	29–36 cm long, Pubescent	10–40 cm long, Pubescent
Number of leaves per pseudostem	4–8	3–4	2	4–7
Lamina base	Broadly cuneate to rounded	Cordate	Acute	Broadly cuneate to rounded
Lamina size	15–45 × 10–15 cm	44–48 × 16–18 cm	57–64 × 24–30 cm	38–70 × 20–35 cm
Lamina adaxial surface	Glabrous, with pubescent along secondary veins	Glabrous	Glabrous, with pubescent along the main veins	Pubescent, with two rows along the embossed veins and one row along the veins between the embossed
Lamina abaxial surface	Pubescent, Pale green	Glabrous, Pale green	Glabrous, Pale green with maroon tinge towards the margin	Pubescent, Pale green, or with reddish tinge at the distal part near the margin
Midrib of leaves	Green	Green	Green	Green or tinged with reddish brown
Peduncle	10–15 cm long, Densely puberulent	11–13 cm long, Glabrous	4–18 cm long, Pubescent	25–45 cm long, Pubescent
Thyrse	9–20 × 7–9 cm	12–16 × 5–6 cm	14–25 × 5.5–7 cm	25–42 × 10–12 cm

Table 2. *Cont.*

Characters	*C. aurantiaca*	*C. nepalensis*	*C. sumatrana*	*C. peninsularis*
Bracts per inflorescence	15–30	14–28	15–29	70–98
Fertile bracts	Ovate, Apex rounded to obtuse	Ovate–elliptical, Apex obtuse or slightly acuminate	Ovate-elliptic, Apex rounded	Broadly obovate, Apex rounded to narrowly obtuse
Fused of bracts	2–3 cm long	1.8–2.2 cm long	3–3.3 cm long	3.6–4.2 cm long
Bracts size	3–7 × 2–4 cm	3.5–4 × 2–2.7 cm	6–6.5 × 5–6.5 cm	5–6.5 × 3–5 cm
Bracts surface	Puberulent	Glabrous	Pubescent	Pubescent
Bracteoles	c. 7 mm long, Pubescent	12–18 mm long, Glabrous	c. 13 mm long, Pubescent	18–30 mm long, Pubescent
Flowers	c. 5.5 cm long	4.5–5 cm long	c. 6.5 cm long	5.3–5.8 cm long
Floral tube	2.5–3 cm long, Pubescent	2.7–3 cm long, Glabrous	4.1–4.4 cm long, Glabrous	4.0–4.5 cm long, Pubescent
Corolla lobes	Light yellow orange	White (dorsal with pink tinged at the apex)	White	Pale yellowish
Dorsal corolla lobe	c. 1.5 × 1 cm	1.3–1.5 × 1–1.2 cm	c. 1.8 × 0.9 cm	1.4–1.6 × 1–1.3 cm
Lateral corolla lobes	c. 1.5 × 0.7 cm	1.4–1.6 × 0.8–1 cm	c. 1.7 × 0.7 cm	1.3–1.5 × 1–1.2 cm
Lateral staminodes	1.8–2 × 0.8 cm	2–2.1 × 1–1.2 cm	c. 11 × 5 mm	1.2–1.3 × 0.8–1 cm
Labellum	2–2.2 × 2–2.2 cm	2–2.3 × 1.5–1.6 cm	c. 1.5 × 1.7 cm	1.5–1.6 × 1.75–1.8 cm
Anther	4–5 mm long	3.5–4 mm long	c. 8 mm long	7–7.5 mm long
Anther spurs	Absent	2–2.5 mm long	c. 3 mm long	1.5–2 mm long
Epigynous glands	c. 4 mm long	2.5–3 mm long	2–3 mm long	c. 4 mm long

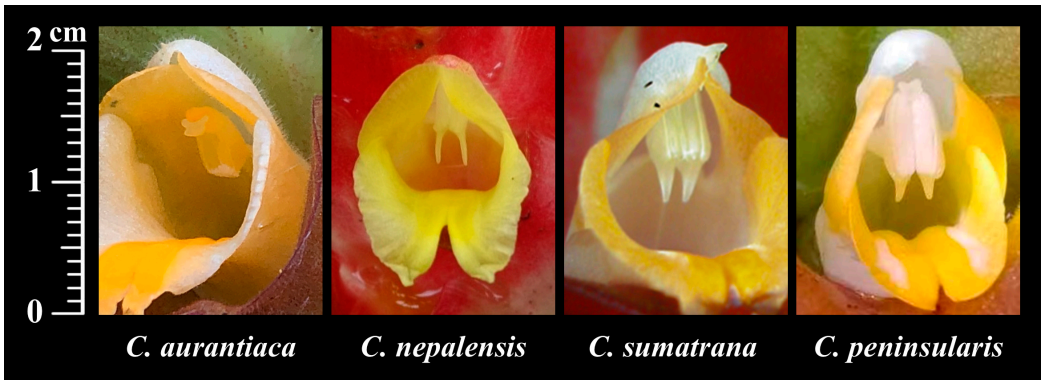

Figure 5. Anther characteristics of *Curcuma aurantiaca* Zijp, *C. nepalensis* M.Sabu, Kasaju and S.Subedi, *C. sumatrana* Miq., and *C. peninsularis* Saensouk, P.Saensouk, Maknoi, and Boonma. (Anther of *C. aurantiaca* and *C. peninsularis* by Thawatphong Boonma, while those of *C. nepalensis* and *C. sumatrana* were adapted from the protologue publications [20,21]). Designed by Thawatphong Boonma.

5. Conclusions

In this study, we resolved the taxonomic confusion surrounding the plant locally known as "Ploy Thaksin", which was previously misidentified as *Curcuma aurantiaca*. Our detailed morphological analysis revealed that plants labeled as "Ploy Thaksin" actually represent two distinct species: *C. aurantiaca* in lower Peninsular Thailand and the newly described *C. peninsularis* in upper Peninsular Thailand. This clarification not only corrects previous misidentifications but also underscores the rich biodiversity within *Curcuma*. Our findings emphasize the critical need for accurate species classification to support effective conservation efforts and horticultural practices.

Author Contributions: Conceptualization, P.S., S.S. and T.B.; methodology, P.S., S.S., C.M., A.D.S. and T.B.; software, T.B.; validation, P.S., S.S., C.M., A.D.S. and T.B.; formal analysis, P.S., S.S., C.M., A.D.S. and T.B.; investigation, T.B.; resources, T.B.; data curation, T.B.; writing—original draft preparation, T.B.; writing—review and editing, P.S., S.S., C.M., A.D.S. and T.B.; visualization, T.B.; supervision, P.S., S.S. and C.M.; project administration, S.S.; funding acquisition, S.S. All authors have read and agreed to the published version of the manuscript.

Funding: This research was financially supported by Mahasarakham University.

Data Availability Statement: The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author.

Acknowledgments: We sincerely thank all who supported us during our field trip and manuscript preparation. Special thanks to Ornicha Chinkam for sharing the beautiful photographs of *Curcuma peninsularis* featured in Figures 2 and 3. Additionally, we acknowledge the invaluable support of all the curators of the visited herbarium collections. Special thanks are extended to the Walai Rukhavej Botanical Research Institute (WRBRI), Mahasarakham University (MSU) for their stereo microscopy and laboratory facilities.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. POWO. Plant of the World Online, Facilitated by the Royal Botanic Gardens, Kew. Available online: http://www.plantsoftheworldonline.org/ (accessed on 1 August 2024).
2. Záveská, E.; Fér, T.; Šída, O.; Krak, K.; Marhold, K.; Leong-Škorničková, J. Phylogeny of *Curcuma* (Zingiberaceae) based on plastid and nuclear sequences: Proposal of the new subgenus *Ecomata*. *Taxon* **2012**, *61*, 747–763. [CrossRef]
3. Boonma, T.; Saensouk, S.; Saensouk, P. Diversity and Traditional Utilization of the Zingiberaceae Plants in Nakhon Nayok Province, Central Thailand. *Diversity* **2023**, *15*, 904. [CrossRef]
4. Islam, M.Z.; Akter, J.; Hossain, M.A.; Islam, M.S.; Islam, P.; Goswami, C.; Nguyen, H.T.T.; Miyamoto, A. Anti-Inflammatory, Wound Healing, and Anti-Diabetic Effects of Pure Active Compounds Present in the Ryudai Gold Variety of *Curcuma longa*. *Molecules* **2024**, *29*, 2795. [CrossRef] [PubMed]
5. Chen, T.V.; Lam, D.N.X.; Thong, C.L.T.; Nguyen, D.D.; Nhi, N.T.T.; Triet, N.T. Morphological characters, pharmacognostical parameters, and preliminary phytochemical screening of *Curcuma sahuynhensis* Škorničk. & N.S.Lý in Quang Ngai Province, Vietnam. *Biodiversitas* **2022**, *23*, 3907–3920. [CrossRef]
6. Larsen, K.; Larsen, S.S. *Gingers of Thailand. Queen Sirikit Botanic Garden*; The Botanical Garden Organization: Chiang Mai, Thailand, 2006.
7. Leong-Škorničková, J.; Saensouk, S. Curcuma. In *Flora of Thailand*; Newman, M.F., Barfod, A.S., Esser, H.J., Simpson, D., Parnell, J.A.N., Eds.; The Forest Herbarium, Department of National Parks, Wildlife and Plant Conservation: Bangkok, Thailand, 2023; Volume 16, pp. 415–476.
8. Saensouk, P.; Saensouk, S.; Maknoi, C.; Boonma, T. *Curcuma borealis* sp. nov. and *C. retrocalcaria* sp. nov. (Zingiberaceae): Two Novel Taxa from Northern Thailand. *Horticulturae* **2024**, *10*, 787. [CrossRef]
9. Craib, W.G. Contributions to the Flora of Siam. II. List of Siamese plants, with descriptions of new species. *Bull. Misc. Inform. Kew* **1912**, *10*, 401–402. [CrossRef]
10. Boonma, T. *Curcuma suraponii* sp. nov. (Zingiberaceae), a new species of *Curcuma* subgen. *Curcuma from Thailand. Biodiversitas* **2023**, *24*, 4885–4895. [CrossRef]
11. Škorničková, J.; Sabu, M.; Prasanthkumar, M.G. A new species of *Curcuma* L. (Zingiberaceae) from Mizoram, India. *Gard. Bull. Sing.* **2003**, *55*, 89–95.
12. Saensouk, S.; Boonma, T.; Saensouk, P. Six new species and a new record of *Curcuma* L. (Zingiberaceae) from Thailand. *Biodiversitas* **2021**, *22*, 1658–1685. [CrossRef]
13. Roxburgh, W. Descriptions of several of the Monandrous Plants of India (*Curcuma*). *Asiat. Res.* **1810**, *11*, 329–342.
14. Wannakrairoj, S. *Pathumma and Krachiao (Curcuma): Ornamental*, 1st ed.; Amarin Printing and Publishing Public Co.: Bangkok, Thailand, 1996.
15. Zijp, C.V. Beiträge zur Kenntnis der Zingiberaceën. Mit 1 Textfig. und Tab. II and III. *Recueil Trav. Bot. Néerl.* **1915**, *12*, 345.
16. Sabu, M. *Zingiberaceae and Costaceae of South India*; Indian Association for Angiosperm Taxonomy, Calicut University: Kerala, India, 2006.
17. Rahman, M.A.; Yusuf, M. Three new species of *Curcuma* L. (Zingiberaceae) from Bangladesh. *Bangladesh J. Plant Taxon* **2012**, *19*, 79–84. [CrossRef]
18. Škorničková, J.L.; Sída, O.; Marhold, K. Back to types! Towards stability of names in Indian *Curcuma* L. (Zingiberaceae). *Taxon* **2010**, *59*, 269–282. [CrossRef]
19. Amalraj, V.A.; Velayudhan, K.C.; Muralidharan, V.K. *Curcuma aurantiaca* van Zijp (*Zingiberaceae*): A new record for India. *Indian J. Forest.* **1992**, *15*, 88–89.

20. Ardiyani, M.; Anggara, A.; Leong-Škorničková, J. Rediscovery of *Curcuma sumatrana* (Zingiberaceae) endemic to West Sumatra. *Blumea* **2011**, *56*, 6–9. [CrossRef]
21. Sabu, M.; Kasaju, S.K.; Sebedi, S. *Curcuma nepalensis* (Zingiberaceae), a new species from Nepal. *Ann. Bot. Fenn.* **2023**, *60*, 185–189. [CrossRef]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.