

A new species and a new record of *Curcuma* subgen. *Curcuma* (Zingiberaceae) from Northern Thailand

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Manuscript received: 11 July 2021. Revision accepted: 5 August 2021.

Abstract. Saensouk S, Boonma T, Saensouk P. 2021. A new species and a new record of *Curcuma* subgen. *Curcuma* (Zingiberaceae) from Northern Thailand. *Biodiversitas* 22: 3617-3626. Recent fieldwork to study the species diversity of the Zingiberaceae family in Thailand and preparing a revision of the *Curcuma* genus for the Flora of Thailand, an undescribed species of *Curcuma* uses as traditional medicinal for more than two decades well known in the Thai vernacular name “Rang-Jued” was found, this vernacular name is also used to call the other two medicinal plants belonging to different families which are *Thunbergia laurifolia* Lindl. (Acanthaceae), and *Crotalaria spectabilis* Roth (Fabaceae), thus some villagers are named *Curcuma rangjued* as “Rang-Jued-Khamin” to communicate specifically identify species in order to use correct species for each utilization. While *Thunbergia laurifolia* was called “Rang-Jued-Thao”, which “Thao” means “vine” refers to its habit and *Crotalaria spectabilis* was called “Rang-Jued-Ton” which “Ton” means “stem” refers to its erect stems. After comparing this undescribed species of *Curcuma* with its allies species, we found that this species did not match with any existing taxa, thus described with detailed illustrations, photographs, summaries for its distribution, ecology in the name of *Curcuma rangjued* Saensouk & Boonma and followed by a new record of *C. cordata* Wall. for Thailand which in the past has been determined as a synonym of *C. petiolata* Roxb. but now it is back to a recognized name once again. Both species in this study were found distributed in the northern region of Thailand and belong to *Curcuma* subgenus *Curcuma*, their description along with ecology, phenology, and a revised key to 28 species of *Curcuma* subgenus *Curcuma* in Thailand are also present for facilitating identification.

Keywords: *Curcuma*, new species, new record, taxonomy, Zingiberaceae

INTRODUCTION

Turmeric (*Curcuma longa*) and many species of *Curcuma* have been used to treat sprains and swelling throughout history for various purposes for many millennial years, many natural products have biological and pharmacological as prescribed by Ayurveda (Araujo & Leon 2001). *Curcuma* L. belongs to the family Zingiberaceae and is divided into three subgenera namely subgen. *Curcuma*, *Hitcheniopsis*, and *Ecomatae* (Záveská et al. 2012; Leong-Škorničková et al. 2015) with more than 130 species of *Curcuma* in the world were recognized (<http://apps.kew.org/wcsp/>).

Thailand is one of the species diversity hotspots for the *Curcuma* genus with the latest reported 67 species distributed throughout the country and comprised of 23 species belong to subgen. *Hitcheniopsis*, 18 species of subgen. *Ecomatae*, and 26 species of subgen. *Curcuma* (Larsen and Larsen S.S. 2006; Sirirugsa et al. 2007; Saensouk et al. 2021a, 2021b). In this study, the undescribed species of *Curcuma* uses as traditional medicinal for more than two decades well known in the Thai vernacular name “Rang-Jued” was found while investigating the species diversity of the Zingiberaceae family in Northern Thailand. After comparing it with its allies species, we found that this species did not match with

any existing taxa, hence described and illustrated here as new species to science.

And a new record of *Curcuma cordata* Wall. for Thailand. This species was first published as new species to science in 1829, in *Plantae Asiaticae Rariores* by Nathaniel Wallich with its descriptions, habitat, taxonomic treatment, and comparison to the most similar species, *Curcuma petiolata* Roxb., both species are reported from Myanmar. Later in 1894, *C. cordata* Wall. was placed as a synonym of *Curcuma petiolata* Roxb. in *The Flora of British India* Volume VI. – order CXLIX. SCITAMINEAE by J. G. Baker (p. 216). This caused *C. cordata* Roxb. was identified as a synonym of *C. petiolata* all along, both in the specimens collected in herbariums and other relevant research studies in Thailand. Until 2010, Leong-Škorničková J. and her colleagues published the result of their study towards the stability of names in Indian *Curcuma* L. (Zingiberaceae). The result presents *Curcuma petiolata* Roxb. (Fl. Ind. 1: 36. 1820) as an accepted name with only *Curcuma cordifolia* Roxb. as a synonym (Hort. Beng.: 1. 1814, nom. nud.; Fl. Ind. ms. 43; Fl. Brit. India: 216. 1890) but did not appear the name of *C. cordata* Wall. (Leong-Škorničková et al. 2010). Later in 2015, Leong-Škorničková et al. also supported *Curcuma cordata* Wall. as an accepted name belongs to *Curcuma* subgenus *Curcuma* (Leong-Škorničková et al. 2015).

More than a century, *C. cordata* Wall. has been a synonym but now it is back to a recognized name once again. While investigating fieldwork to study the species diversity of the Zingiberaceae family in Thailand and preparing a revision of the *Curcuma* genus for the Flora of Thailand this species was found distributed in Mae Hong Son Province, Northern Thailand. We examined the living samples and comparing them with the existing taxa, they were found to be the same as *Curcuma cordata* Wall. Several samples of this plant were also collected by other collectors from Mae Hong Son Province in the nearby areas and specimens were kept at QBG Herbarium, but those specimens were mistakenly identified as *Curcuma petiolata* Roxb. (Detailed in the specimens examined below). Moreover, we also compare them with many specimen collections of *Curcuma cordata* Wall. from Myanmar which is available online on the National Museum of Natural History website (detailed in the specimens examined below). Investigating and collecting data from past studies to the present, no record of *Curcuma cordata* Wall. in Thailand. We, therefore, the first report here for a new record of *Curcuma cordata* Wall. for Thailand. Its description along with ecology, phenology, and a revised key to 28 species of *Curcuma* subgenus *Curcuma* in Thailand for facilitating identification is present.

MATERIALS AND METHODS

Plant materials and photographs were collected from 2017 to 2021 from Mae Hong Son Province, northern Thailand [Mae Hong Son Province, Mae Sariang District, 04.08.2017, *T.Boonma* 9 (holo KKU!; iso QBG!, BK!, BKF!, BBRG!); Mae Hong Son Province, Mae Sariang District, 415 m, 18.09.2019, *T.Boonma* 17 (KKU) and living specimens have been planted at Brio Garden (BBRG) in Nakhon Nayok Province] and additional specimens were also compared. The descriptions of morphologically similar species and related information, *Curcuma longa* L. (Sabu M. 2006), *C. sichuanensis* (Chen X.X. 1984), *C. amada* (Roxburgh 1810; Sabu M. 2006), *C. cordata* (Roxb.1829; Leong-Škorničková et al.2015), *C. petiolata* (Roxburgh 1820; Larsen and Larsen S.S. 2006; Siriruga et al. 2007; Leong-Škorničková et al. 2010), and type specimens housed in various herbaria (BK, BKF, K, KKU, QBG, US), digital images, and photos of dry specimens available online in the National Museum of Natural History (NMNH), including all existing published literature of *Curcuma* especially in subgenus *Curcuma* were compared.

RESULTS AND DISCUSSION

During the fieldwork to study the species diversity of the Zingiberaceae family in Thailand and preparing a revision of the *Curcuma* genus for the Flora of Thailand, a new species *C. rangjued* sp. nov. (Figures 1-3 and Tables 1) and a new record of *C. cordata* (Figure 4) have been

found. Both species belong to subgen. *Curcuma* and described here with the taxonomic treatment, description, detailed illustrations, photographs, summaries for its distribution, ecology, and notes, followed by a new record and revised key to 28 species of *Curcuma* Subgen. *Curcuma* in Thailand is provided for facilitating their identification.

Taxonomic treatment

Curcuma rangjued Saensouk & Boonma, sp.nov. – Figures 1–3, Table 1 –subgenus *Curcuma*

Curcuma rangjued is belonged to the subgenus *Curcuma* according to the presence of epigynous glands, inflorescence with coma bracts, flowers closed-form, anther spurs acute and downward-pointed. The morphological description in having rhizome pale yellow tone internally and producing terminal inflorescence of *C. rangjued* make it similar to *C. amada* and *C. sichuanensis*, but differ in having non-aromatic rhizome whereas *C. amada* and *C. sichuanensis* having a smell of green mango and smell of camphor respectively. Moreover, in having leaf-adaxially sparsely hairy along the vein, peduncle long 25–37 cm long, less number of fertile bracts (7–12 per inflorescence), calyx light pale yellow, 1.64–1.75 cm long, floral tube 3.3–3.5 cm long, corolla lobes hairy at distal part and anther spurs 3–4 mm long which distinguishes *C. rangjued* from *C. amada* and *C. sichuanensis* (Table 1).

Type: THAILAND, Mae Hong Son Province, Mae Sariang District, 04.08.2017, *T.Boonma* 9 (holo KKU!; iso QBG!, BK!, BKF!, BBRG!)

Perennial herb. *Rhizome* ovoid, non-aromatic, brown externally, pale yellowish-white internally with darker core (lighter in dormancy or after harvesting), 3–5 × 4–7 cm, with 2–4 branched rhizome occurs on two opposite sides, straight out from the primary rhizome and develop into a new shoot at the tip, brown externally, two layers internally, pale yellowish-white with darker core, 3–10 cm long, 1–2 cm in diameter, with a sub-branched rhizome downward, branched rhizome covered by white triangle scales and turned to brown while growing. *Root* fibrous with tuberous roots. *Leafy shoot* 70–110 cm tall. *Bladeless sheaths* 1–2, green, wilt while growing. *Leaf-sheaths* green, distichous, (10-)20–38 cm long; *ligule* short and thin, 0.8–2 mm long; *petiole* green, canaliculate, (10-)14–25 cm (except the first leaf has the shortest petiole 1.5–3 cm), glabrous. *Lamina* 5–7, narrowly elliptic to oblanceolate, (17-)30–60 × (8-)12–17 cm (the first leaf shortest and narrowest), apex acuminate with slightly cordate, base attenuate, equal, margin entire, hyaline, translucent white, adaxially green, sparsely hairy along the veins, abaxially paler green, glabrous. *Inflorescence* terminal emerges almost distal part of the pseudostems; *spike* conical, tapered at the base and spread at distal part, 14–18 cm long, ca. 6 cm in diam. in the middle; *peduncle* pale green, 25–37 cm long, very short fine hairy. *Coma bracts* narrowly obovate, 5–8 × 1.5–2.8 cm, lower obtuse apex, upper slightly mucronate apex, margin hyaline, white with pinkish-purple tip (gradually fade to white at base), finely hairy on both surfaces. *Fertile bracts* 7–12 in number, ovate, 3.8–4.5 × 1.5–2 cm, apex obtuse, margin hyaline,

very light pale green, upper bracts with a pinkish-purple tip as coma, finely hairy on both surfaces. *Flower* yellow. *Bracteoles* translucent yellowish-white, rarely with very pale pink tinge at the tip, obovate, 1.5–3.3 cm long, apex obtuse, hooded, sparsely hairy (hairier at distal part). *Calyx* light pale yellow, 1.64–1.75 cm long, apex 3-lobed with unilateral incision up to 9 mm long, sparsely hairy. *Floral tube* tubular, 3.3–3.5 cm long, pale yellow; *dorsal corolla lobe* 1, triangular-ovate, 1.8–2×1.7–2 cm, hooded, apex mucronate with mucro 2.8 mm long, white or very pale yellow, sparsely hairy at distal part; *lateral corolla lobes* 2, triangular-ovate, 1.3–1.6 × 1.1–1.4 cm, apex obtuse with few hairy at distal part. *Lateral staminodes* 2, asymmetrical obovate, 1.7–2.1 × 0.9–1.1 cm, apex rounded to obtuse, pale yellow, outer glabrous, inner surface pubescent in the middle lobe. *Labellum* obovate, 2.2–2.4× 1.6–1.8 cm, apex emarginate with an incision 1.5–2.5 mm, yellow with the dark yellow patch. *Stamen* 1, light pale yellow; *filament* flat 4–4.2 mm long. *Anther* 5.4–6 mm long, spurred; *spurs* at base 3–4 mm long; *crest* yellow, apex obtuse. *Stigma* conical, glabrous, ostiole ciliate. *Epigynous glands* 2, 5–6 mm long, apex acute, pale yellow. *Ovary* subspherical, 2.5–3 × 2.5–3 mm, pubescent. *Ovule* axile placentation. *Fruit and seeds* not seen.

Vernacular name: “Rang-Jued” in Thai language.

Phenology: Flowering in the rainy season (June to October); flowers open in the morning and last a single day. Leafy shoot emerging in late April and dormancy begins in November.

Distribution: Mae Sariang District, Mae Hong Son Province, Thailand, and cultivated throughout Thailand.

Etymology: The specific epithet “rangjued” is derived from Thai vernacular name of this species which means “to make the poison fade or decrease”.

Uses: Thai traditional medicinal use its mature rhizomes (fresh) to treat poisoning, detoxification, and anti-inflammation (Oranuch K. 2007).

Notes: The vernacular name “Rangjued” is also used to call the other two medicinal plants belonging to different families which are *Thunbergia laurifolia* Lindl. (Acanthaceae), and *Crotalaria spectabilis* Roth (Fabaceae), thus some villagers are named *Curcuma rangjued* as “Rang-Jued-Khamin” to communicate specifically identify species in order to use correct species for each utilization. While *Thunbergia laurifolia* was called “Rang-Jued-Thao”, which “Thao” means “vine” refers to its habit, and *Crotalaria spectabilis* was called “Rang-Jued-Ton” which “Ton” means “stem” refers to its erect stems. In our survey, only one natural habitat was found in Mae Sariang District, Mae Hong Son Province, northern Thailand, and cultivated throughout the country, especially grow for wholesale to the herb’s market and there is still a large demand for the use of traditional medicine. Due to the information about distributions and number of mature in the natural habitat of this species is still insufficient for proper assessment of conservation status as Data deficient (DD). Further fieldwork and observations are needed to assess changes in population, distribution, and abundance in the future.

Table 1. Morphological comparison of *Curcuma rangjued*, *C. sichuanensis*, *C. longa*, and *C. amada*

Characters	<i>Curcuma rangjued</i>	<i>Curcuma amada</i> (Roxburgh 1810; Sabu 2006)	<i>Curcuma sichuanensis</i> (Chen 1984)	<i>Curcuma longa</i> (Sabu 2006)
Rhizome-size	4–7× 3–5 cm	4–5.3 × 3–4 cm	2–4 × 1–2 cm	2–3 × 2–3 cm
Rhizome-smell	Non-aromatic	Smell of green mango	Smell of camphor	Strongly aromatic
Rhizome internally	Pale yellowish-white	Light yellow, white towards the periphery	Pale yellow	Deep orange-yellow
Leaf-adaxially	Sparsely hairy along the vein	Glabrous, tip hairy	Glabrous	Glabrous, tip hairy
Leaf-abaxially	Glabrous	Puberulous	Glabrous	Glabrous
Leaves-base	Attenuate, equal	Equal	Attenuate, oblique	Cuneate
Inflorescence	Terminal	Terminal and lateral	Terminal	Terminal
Peduncle	25–37 cm long	20–22 cm long	15 cm long	C. 15 cm long
Coma-surface	Finely hairy on both surfaces	Pilose on both surfaces	Glabrous inside, outside pubescent	Pubescent on both surfaces
Coma-color	White with pinkish-purple tip (gradually fade to white at base)	Light violet	Lower half white, sometimes slightly purple-red apically	White with green at tip
Fertile bracts	7–12 per inflorescence	15–18 per inflorescence	18–25 per inflorescence	25–30 per inflorescence
Bract-surface	Finely hairy on both sides	Pilose on both surfaces	Glabrous on both sides	Inner glabrous, Outer minutely pubescent
Bract-color	Very light pale green, upper bracts with pinkish-purple tip as same as coma bract	Green	Green	Pale green
Calyx	Light pale yellow, 1.64–1.75 cm long	White, 1 cm long	White, 1 cm long	White, 1 cm long
Floral tube	3.3–3.5 cm long, pale yellow, glabrous	3 cm long, pale yellow, Minutely pubescent	2.5 cm long, yellowish, Glabrous	2.5 cm long, white, Glabrous
Corolla lobes	Hairy at distal part	Glabrous	Glabrous	Glabrous
Anther spurs	3–4 mm long	1–2 mm long	1–2 mm long	3 mm long
Epigynous glands	5–6 mm long	6 mm long	4.5 mm long	5 mm long
Ovary	2.5–3 mm long, pubescent	3 mm long, densely hairy	5 mm long, villose	5 mm long, pubescent

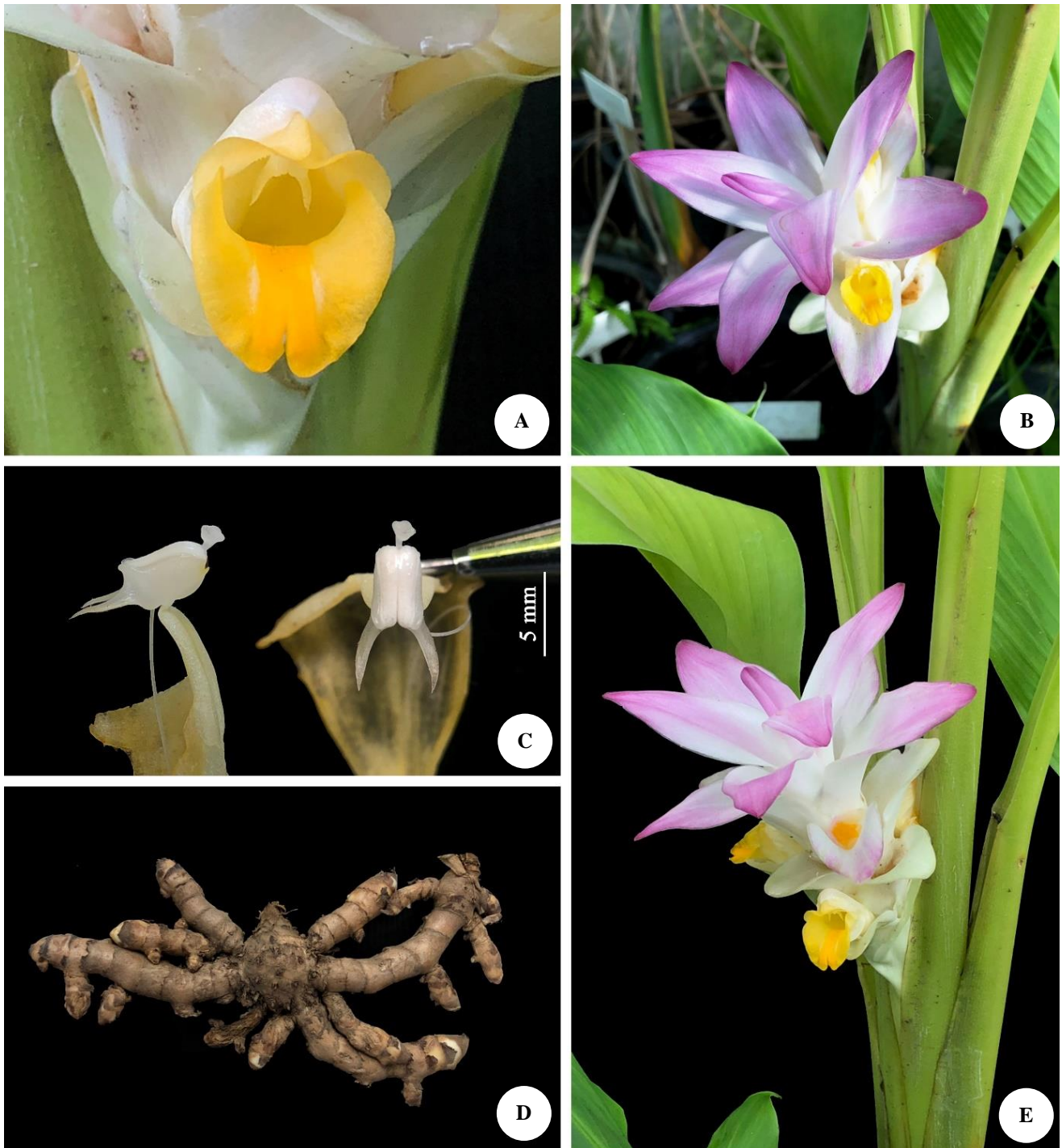


Figure 1. *Curcuma rangjued* Saensouk & Boonmasp. nov. (A) flower-top view, (B) inflorescence with flowers-top view, (C) anther - side and front view, (D) rhizome, (E) inflorescence with flowers - side view. Photographed by Thawatphong Boonma.

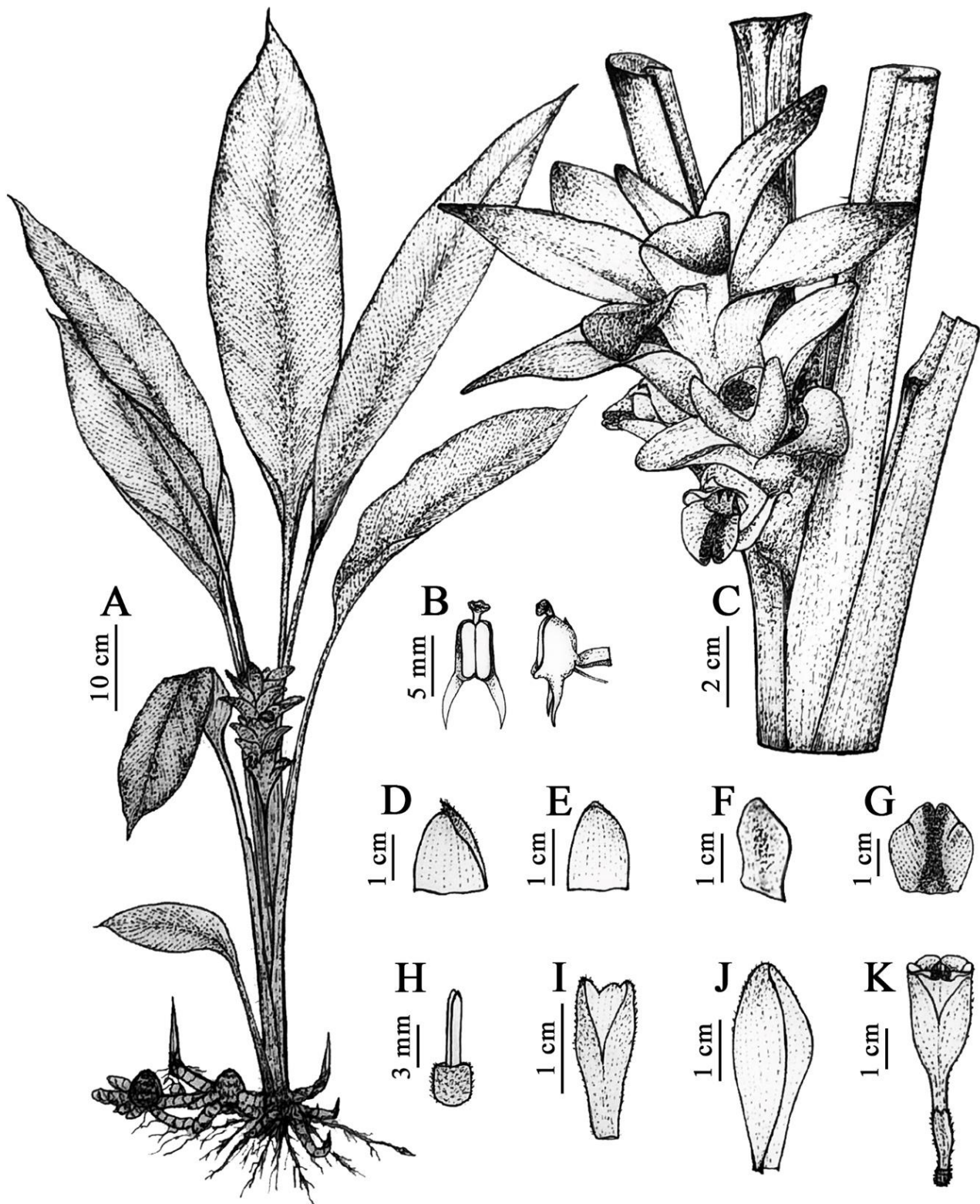


Figure 2. *Curcuma rangjued* Saensouk & Boonma sp. nov. (A) habit, (B) front and side view of anther, (C) side view of terminal inflorescence in the leaf-sheaths, (D) dorsal corolla lobe, (E) lateral corolla lobe, (F) lateral staminode, (G) labellum, (H) epigynous glands with ovary, (I) calyx; J, bracteole; K, side view of flower. Drawn by Thawatphong Boonma.



Figure 3. Inflorescence of four *Curcuma* spp. (A) *Curcuma rangjued* Saensouk & Boonma, (B) *C. sichuanensis* Chen X.X., (C) *C. amada* Roxb., (D) *C. longa* L. Photographs: (A) and (D) by Thawatphong Boonma, (B) by Bing Liu from <http://plantsoftheworldonline.org/taxon/urn:lsid:ipni.org:names:903993-1>, and (C) by Surapon Saensouk.

A new record of *Curcuma cordata* Wall. for Thailand

Curcuma cordata Wall., Pl. Asiat. Rar. 1:8-9, 1829 – Figures 4–subgenus *Curcuma*

Type: THAILAND, Mae Hong Son Province, Mae Sariang District, 415 m, 18.09.2019, *T.Boonma* 17 (KKU)

Perennial herbs 60–120 cm tall. *Rhizome* ovoid, 3–5 × 2–4 cm, brown externally, pale yellow internally, produced 2–3 horizontal branches rhizome in the opposite side, brown externally, pale yellow internally; several *root tubers*, sub-rotunda to subglobose, 2–3 × 1–2, white internally, developing some distance from the rhizome. *Leafy shoot* with 3–5 leaves; *pseudostem* composed of sheathing bracts and leaf sheaths; *sheathing bracts* 2–3, apex slightly mucronate, drying out and decaying while growing; *leaf sheaths* distichous, green with reddish-brown tinge, villous; *ligule* bilobed, hyaline, green with reddish tinge, sparsely hairy, apex obtuse; *petiole* erect and spreading, up to 25 cm long (petiole of innermost leaves longest, outermost leaf shortest), canaliculate, green or green with reddish-brown tinge at the base, villous; *lamina* ovate, 25–40 × 14–20 cm, apex acuminate, base cordate or retuse, membranous margin, adaxially green, abaxially lighter green, soft and villous, rib green with fine hairy. *Inflorescence* terminal, in the middle between leaf-sheaths, barely reaching the peak of the pseudostems, erect; peduncle cylindrical between leaf-sheaths, 20–32 cm long, 7–8(–10) mm diam., pale green, villose; *spike* 15–20(–25) cm long, 5–6 cm diam. in the middle, villous; *coma* white to pale green with violet tip, rarely all violet, erect, a little longer than fertile bracts, villous, fused only at base; *fertile bracts* ovate, 2.5–4 × 2–3 cm, apex rounded to obtuse, upper bracts with slightly mucronate, villous, pale green with darker green at distal part, a violet tinge always extends more or less downwards upon the exterior margins of the fertile bracts, connate in the lower 1/3 to 1/2 forming a porch; *cincinni* with 2–3 flowers. *Bracteoles* one per flower, broadly triangular, 17–22 × 14–17 mm, pubescent, translucent white, apex acute. *Calyx* tubular, short, 10–12 mm long, apex 3-toothed, with unilateral incision up to 5 mm long; *floral tube* slim, cylindrical, 33–36 mm long, internally hairy at the throat, externally yellowish; *dorsal corolla lobe* narrowly triangular-ovate 13–15 × 4–6 mm, concave, yellowish, apex mucronate, c. 1 mm long; *lateral corolla lobes* narrowly triangular-ovate, 12–15 × 4–6 mm, concave, yellowish, apex obtuse. *Staminodes* irregularly obovate, 9–11 × 5–6 mm, apex rounded, with short fine hairy on the adaxial side, yellow. *Labellum* broadly obovate to suborbicular with 3-lobed, 14–16 × 13–15 mm, the apex of mid lobe emarginate, incision to 4 mm long, yellow with a darker yellow median band. *Filament* flat, 4–5 mm long, c. 5 mm broad at the base; *anther* 6 × 2.5–3

mm, glabrous, yellowish, spurred; *spurs* triangular, flat, 2–2.5 mm long, yellowish, apex acute, pointing downwards; anther crest c. 1 mm long, 1–1.2 mm wide, apex rounded. Epigynous glands two, 4–5 mm long. Style thin, white, glabrous, placed in the groove in a dorsal side of floral tube; stigma c. 1 × 1 mm; ostiole ciliate. Ovary 3.8–4 × 2.5–3 mm, trilocular, glabrous. Fruit and Seeds not seen.

Ecology: In deciduous forest and bamboo forest, from 220–1,100 m above sea level.

Phenology: Flowering in August to October; flowers open in the morning and last a single day. Leafy shoot emerging in late May and dormancy begins in November.

Distribution: Mandalay and Bago Division (Pegu) of Myanmar, and Mae Hong Son province, northern Thailand.

Uses: Ornamental plants.

Specimen examined: Thailand: Northern; Mae Hong Son province; *Larsen et al.* 2338, Ban Mae Pang 30 km North of Mae Sariang, 400 m, 11 July 1968 (AAU!), *Larsen et al.* 2087, 20 kms W of Bo Luang towards Mae Sariang, 1,100 m, 4 July 1986 (AAU!, BKF!), *Larsen et al.* 2240, S of Mae Sariang, 220 m, 8 July 1968 (AAU), *Maknoi* 386, Mae Sariang, Mae Hong Son, 26 July 2003 (AAU!, BKF!, PSU!, QBG!), *Maknoi* 562, Mae Sariang, Mae Hong Son, 25 July 2004 (AAU!, BKF!, PSU!, QBG!), *Maknoi C.* 394 (QBG 29156), in the bamboo forest, route from Mae Hong Son to Mae Sariang, Mae Hong Son, 25 July 2003 (QBG!), *Suksathan P.* 4215 (QBG 30495), 410 m., Mae Hong Son, 23 June 2007 (QBG!), *Pongamornkul W.* 3497 (QBG 66915), 300 m., in mixed deciduous forest, Ban Sob Mae Pae, Sob Mei, Mae Hong Son, 10 July 2013 (QBG!), *Phaosrichai P. & Wongnak M.* 13 (QBG 67703), 451 m., Mae Hong Son, 3 September 2013 (QBG!), *Pongamornkul W. & Panya R.* 462 (QBG 15355), 190 m., in mixed deciduous forest, Baan Taa Ruea, Sob Moei, Mae Hong Son, 5 August 1999 (QBG!), *Pumicong S.* 404 (QBG 28523), on the slope near a stream, Mae Hong Son, 29 August 2006 (QBG!). Additional living and spirit specimens from Mae Hong Son Province, Mae Sariang District, 415 m, 18.09.2019, *T.Boonma* 170, 171 (BBRG). **Myanmar:** *Wallich N.* Cat. No. 6598 (K001124266, EICH number 6598 C), Rangoon; *Kress W.J.* 98-6166 (USNM 1998133), Toungoo Township, Bago Division, 11 July 1998 (US!), *Kress W.J.* 99-6435 (USNM 1999119), 240 m., Pysinmana Township, Mandalay Division, 24 June 1999 (US!), *Kress W.J.* 99-6469 (USNM 1999151 b), 800 m., Kyaukpadaung township, Mandalay Division, 29 June 1999 (US!), *Kress W.J.* 02-7152 (USNM 2002164), 400 m., Paungpyin township, Bago Division, 13 July 2002 (US!), *Kress W.J.* 96-5653 (USNM 1996230), 900 m., Kyaukpadaung township, Mandalay Division, 18 May 1996 (US!).

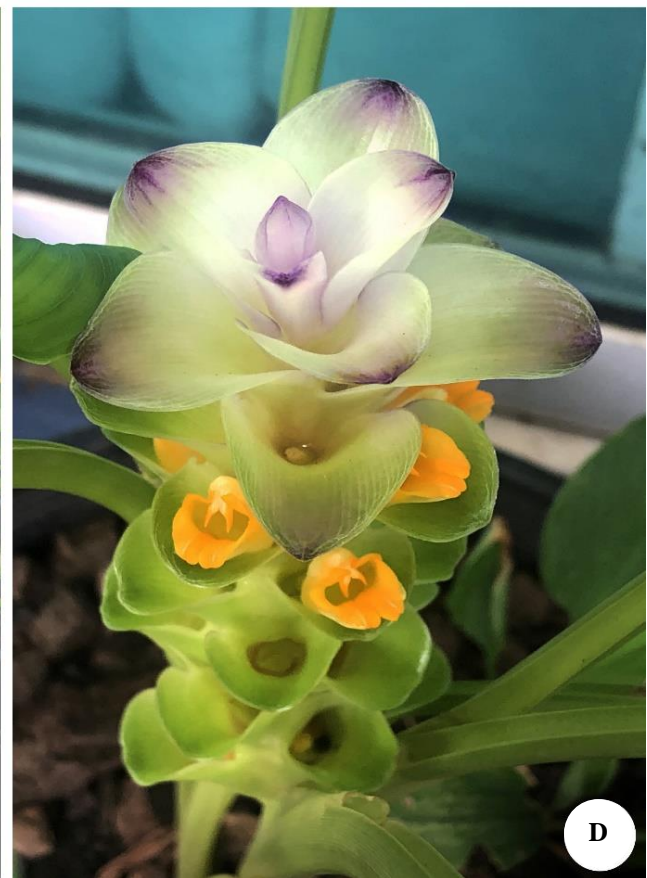


Figure 4. *Curcuma cordata* Wall. (A) illustration by N. Wallich, (B) specimen of *C. cordata*, Wallich N. Cat. No. 6598, K001124266, (C) inflorescence with flowers-side view, (D) Inflorescence with flowers-oblique view. Photo (A) from *Plantae Asiaticae Rariores*, Vol. 1 plate 10 (1830), (B) from <http://www.kew.org/herbcatimg/717660.jpg>, (C) and (D) by Thawatphong Boonma.

Notes: The flowers of this species are a darker tone of yellow or orange-yellow, while the flowers of *C. petiolata* are pale tone of yellow. The size of *C. cordata* in natural habitat is much larger and statelier and with silky hairs, the leaves are more decidedly cordate, soft, and villous, while in *C. petiolata* are glabrous. The spike is villous whereas *C.*

petiolata is smooth. Moreover, this species is also similar to one form of *Curcuma aurantiaca* in Southern Thailand which has pale green fertile bracts and violet coma, it was called ‘Amethyst’ but distinguishable by its spurless anther whereas *C. cordata* has calcarate anther.

Key to 28 species of *Curcuma* subgenus *Curcuma* in Thailand

1. Branches rhizome not produced
 2. Inflorescence lateral and terminal *C. angustifolia*
 2. Inflorescence terminal
 3. Sheaths glabrous; leaf abaxially glabrous *C. plicata*
 3. Sheaths pubescent; leaf abaxially hairy or glabrescent at least at the apex *C. attenuata*
1. Branches rhizome produced or well developed
 4. Inflorescence terminal
 5. Rhizome creeping *C. rubrobracteata*
 5. Rhizome with branches non-creeping
 6. Anther ecalcarate
 7. Flowers yellow or orange-yellow *C. aurantiaca*
 7. Flowers cream-white with yellow in the center of labellum *C. roscoeana*
 6. Anther calcarate
 8. Bracts glabrous
 9. Ovary glabrous *C. antinaia*
 9. Ovary pubescent *C. sattayasaiorum*
 8. Bracts pubescent
 10. Coma bracts greenish-white *C. viridiflora*
 10. Coma bracts pink or white with pink at tip
 11. Peduncle red *C. phrayawan*
 11. Peduncle green
 12. Ovary glabrous
 13. Leaves glabrous; coma pink *C. petiolata*
 13. Leaves pubescent; coma white with violet tip *C. cordata*
 12. Ovary pubescent
 14. Leaf adaxially green with reddish-purple along the midrib *C. wanenlueanga*
 14. Leaf adaxially green with green midrib
 15. Rhizome deep orange-yellow, strongly aromatic *C. longa*
 15. Rhizome pale yellowish-white to pale yellow
 16. Leaf-abaxially glabrous; rhizome non-aromatic *C. rangjued*
 16. Leaf-abaxially puberulous; rhizome with smell of green mango *C. amada*
 4. Inflorescence usually lateral
 17. Leaves lower surface pubescent
 18. Leaf-adaxially green with green midrib
 19. Rhizome yellow; lamina broadly lanceolate *C. aromatica*
 19. Rhizome pale yellow; lamina oblong *C. elata*
 18. Leaf-adaxially green with red or reddish-purple patch along midrib
 20. Bracts glabrous *C. zedoaroides*
 20. Bracts pubescent
 21. Inflorescence cylindrical >10 cm long; bracts green, short-hairy on both surfaces *C. latifolia*
 21. Spike almost globular shape <10 cm long; bract bright green to brownish green with pale green venation, adaxially puberulent, abaxially glabrous *C. globulifera*
 17. Leaves lower surface glabrous
 22. Petioles and leaf-sheaths reddish-brown *C. rubescens*
 22. Petioles and leaf-sheaths green
 23. Leaf-adaxially green with red or reddish-purple patch along the midrib
 24. Rhizome aeruginous green *C. aeruginosa*
 24. Rhizome yellow or orange
 25. Corolla lobes nearly white or with very slight pinkish shade; rhizome pale straw to yellowish-white *C. picta*
 25. Corolla lobes conspicuously pink to reddish; rhizome deep bright orange to yellow-orange *C. zanthorrhiza*
 23. Leaf-adaxially green without red patch along midrib
 26. Fertile bracts pale pink; rhizome pale ochraceous *C. comosa*
 26. Fertile bracts green; rhizome white to pale yellow
 27. Bracts glabrous *C. leucorrhiza*
 27. Bracts minutely puberulous on both sides *C. mangga*

ACKNOWLEDGMENTS

This research project is financially supported by National Science and Technology Development Agency (FDA-CO-2563-11240-TH). We thank Walai Rukhavej Botanical Research Institute, Mahasarakham University, Brio Garden (BBRG), our family, and botanist friends for their facilities and support during this study although in the hardest time of the Covid-19 pandemic. And also warm thanks to all curators of all herbaria visited (BK, BKF, K, KKU, NMNH, QBG, US).

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