



Four new *Curcuma* species (*Zingiberaceae*) from Thailand

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Key words

Curcuma globulifera
Curcuma fimbriata
Curcuma micrantha
Curcuma parviflora
Curcuma spathulata
Curcuma subg. *Hitcheniopsis*

Abstract Four new *Curcuma* species (*Zingiberaceae*) from Thailand are described here. *Curcuma fimbriata*, *C. micrantha* and *C. spathulata* belong to *C.* subg. *Hitcheniopsis*, while *C. globulifera* belongs to the nominal *C.* subg. *Curcuma*. Each species is compared to the morphologically closest species and detailed descriptions, colour plates and information on their distribution, ecology, phenology and uses are provided. A preliminary IUCN conservation assessment of each of these species is proposed.

Citation: Leong-Škorničková J, Soonthornkalump S, Thongbai W. 2021. Four new *Curcuma* species (*Zingiberaceae*) from Thailand. *Blumea* 65 (3): 244–253. <https://doi.org/10.3767/blumea.2021.65.03.09>.
Effectively published online: 20 January 2021.

INTRODUCTION

Curcuma L. (*Zingiberaceae*: *Zingibereae*) is widely distributed in South and Southeast Asia, and South China, with a few species extending to northern Australia and the South Pacific (Záveská et al. 2012). Although the exact number of *Curcuma* species remains unknown, it certainly exceeds the 120 species projected by Leong-Škorničková et al. (2007, 2015), making it one of the largest genera in the family. *Curcuma* is well defined in molecular terms, however, a morphological delimitation of *Curcuma* in tribe *Zingibereae* is challenging because this large genus contains numerous highly specialized and morphologically derived species. No character has been found that is both exclusive to *Curcuma* and present in all its species, but the set of characters that is common to the vast majority of species includes basally connate reflexed bracts, well-developed lateral staminodes, versatile anthers, and a cincinnus of two or more flowers (Záveská et al. 2012). The most recent phylogeny of the genus established subg. *Ecomatae* Škorničk. & Šída f. (Záveská et al. 2012) to accommodate a distinct group of species native to the Indochinese floristic region characterised by the presence of epigynous glands and anther spurs, mostly acute fertile bracts connate only at the base and lacking a conspicuous coma of sterile bracts, and leaves with well-developed ligules. This is in addition to the two traditionally recognized subgenera, subg. *Curcuma* L., characterised by the presence of epigynous glands, inflorescences usually with a coma, closed, bullet-type flowers, and the presence of two forward-facing spurs, and subg. *Hitcheniopsis* (Baker) K.Schum. (Schumann 1904), characterised by lack of epigynous glands and the lack of anther spurs.

Thailand is known for its diversity in *Zingiberaceae*, and is also one of the richest areas of *Curcuma* (Larsen & Larsen 2006).

More than 40 species have been reported (Maknoi 2006, Sirirugsa et al. 2007, Leong-Škorničková et al. 2017) with all three subgenera well represented. Many new *Curcuma* species have been described from Thailand due to revision of the family for the Flora of Thailand project (e.g., Maknoi et al. 2011, 2019, Chen et al. 2015, Leong-Škorničková et al. 2017, 2020, Boonma & Saensouk 2019, Soonthornkalump et al. 2020) bringing now the total number to over 50.

During our ongoing work on *Curcuma* in Thailand, we have gathered sufficient material to describe four species. *Curcuma fimbriata*, *C. micrantha* and *C. spathulata* belong to subg. *Hitcheniopsis* and to the taxonomically difficult complex of species related to *Curcuma parviflora* Wall. (see Leong-Škorničková et al. 2013, 2017). *Curcuma globulifera* is from the nominal subg. *Curcuma*.

Numerous undescribed *Curcuma* species have been in cultivation for 10 years or longer, regularly appearing in horticultural markets. There are two main problems with material obtained through the horticultural trade. First is the ability to establish that the entities represent wild species rather than man-made hybrids and, unless it can be established that populations of these species exist in wild habitats, it is not wise to describe them. The second problem is to establish at least their approximate place of origin and extent of distribution, which is often a closely guarded trade secret of the local vendors. For some of the species described in this paper, we have been able to narrow down the area of distribution to subdistrict level through local informants, but the precise locations remain unknown. Even if more precise locations were known, we feel that revealing them may further aggravate harvesting of some of the less common species in the wild. While we cannot stop the harvesting in the wild, we believe that by formally describing these species, we can provide an impetus to horticultural institutions to bring these species into large-scale tissue culture propagation, as is common with many other *Curcuma* species of ornamental value. It will also enable national parks and other legally protected areas to recognize these species within their areas and set up concrete conservation actions. We have been

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greatly encouraged by the rapid responses to our previous two papers (Leong-Škorničková et al. 2020, Soonthornkalump et al. 2020), when *C. cinnabarina* Škorničk. & Soonthornk. and *C. papillionacea* Soonthornk., Ongsakul & Škorničk. were recognized by staff of protected areas who contacted us for further advice on propagation and possible conservation actions. Recently, the establishment of an *in vitro* collection of *Curcuma* species has been initiated for sustainable use and conservation purposes at the Division of Biological Science, Faculty of Science, Prince of Songkhla University, Thailand.

The descriptions below are based mainly on living flowering material from multiple plants and specimens from the type collections. The style of description follows the recent works of Leong-Škorničková et al. (2007, 2013, 2015, 2017, 2020). The general plant terminology follows Beentje (2016). The preliminary conservation assessments are based on the guidelines of the IUCN Standards and Petitions Subcommittee (2019).

1. *Curcuma fimbriata* Škorničk. & Soonthornk., *sp. nov.* (subg. *Hitcheniopsis*) — Fig. 1

Similar to *Curcuma prasina* Škorničk. by its ecomate inflorescence composed of green fertile bracts alone, but readily distinguished by cincinni of 10–12 flowers at the base of the inflorescence, white staminodes, white labellum with pale yellow patch in the basal half, distally pale purple with prominently fimbriate margin (vs cincinni composed of 4 or 5 flowers at the base of the inflorescence, pale to dark purple staminodes, pale to dark purple labellum with entire margins and with a bright yellow and swollen median line extending to 2/3 of the labellum in *C. prasina*). — Type: *Sutthinut Soonthornkalump Sutt-210* (holo QBG, including flowers in spirit as part of a single specimen; iso BK, SING, both including flowers preserved in spirit as part of a single specimen), Thailand, Loei Province, Pha Khao District, Pha Khao Subdistrict, 300 m, 18 Sept. 2019, flowering.

Etymology. The specific epithet is derived from Latin *fimbriatus* = fimbriate, and refers to the margin of the labellum, which readily distinguishes this species from all other species in subg. *Hitcheniopsis*.

Perennial rhizomatous herb, 36–100 cm tall. *Rhizome* ovoid, 1.2–3.4 by 0.9–2 cm, occasionally with lateral branches 1–1.2 by 0.5–0.6 cm, externally yellowish white (young rhizomes) to pale brown, covered with rusty coloured and decayed scales, internally cream white, weakly aromatic and with slightly sweet taste; *root tubers* globular to ovoid, 1.3–2.4 by 1.2–2 cm, externally light brown, internally white. *Leafy shoot* with 2 or 3 leaves at anthesis; *pseudostem* to 80 cm long, composed of 1 or 2 leafless sheaths and 2 or 3 leaf-bearing sheaths, all plain green, glabrous; *ligule* up to 4.3 mm long, bilobed, hyaline, greenish white, semi-translucent, glabrous except sometimes for a few hairs c. 0.1 mm long on upper margin; *petiole* 17–58 cm long, canaliculate, green, glabrous; *lamina* elliptic, 16–36 by 6–17 cm, adaxially dark green, abaxially somewhat paler, glabrous on both sides, midrib green, margin hyaline, c. 0.1 mm wide, glabrous, base obtuse to slightly oblique, apex acuminate to narrowly acuminate. *Inflorescence* central; *peduncle* exceeding pseudostem by (0–)5–15 cm, light green (on exposed part), glabrous; *thyrses* 4–10.5 by 1.5–3 cm, composed of 8–18 fertile bracts, coma bracts absent; *bracts* broadly obovate, c. 2.5 by 2.5 cm, connate in basal 1/2–2/3, light green at base, mid-green to dark green distally, glabrous on both sides, apex obtuse to broadly acute, strongly reflexed; *cincinni* with up to 12 flowers at the most basal bracts, the number gradually decreasing upwards; *bracteoles* triangular to elliptic, 2.5–8 by 2–5 mm wide at base (outer ones largest), hyaline, semi-translucent white, glabrous, apex slightly concave. *Flowers* 2–2.6 cm long, exerted from bracts; *calyx* 4–5 mm long, tridentate, with unilateral incision 2–2.5 mm, teeth 0.7–1 mm long with blunt apex, semi-translucent white, glabrous; *floral tube* 1.5–1.8 cm long, narrowly cylindrical at base, slightly widening distally, externally white, glabrous, internally white and glabrous, distally (near

throat) pale yellow with two bright yellow spots on adaxial part, pale purple abaxially, puberulous in distal 1/3; *dorsal corolla lobe* ovate, 5.5–6 by c. 4 mm, white, glabrous, apex hooded; *lateral corolla lobes* 4–4.5 by 3–3.5 mm wide at base, ovate to bluntly triangular with obtuse reflexed apex, white, glabrous; *labellum* 6.5–8 by 4.5–5 mm, obovate with obscurely bifid apex (incision c. 2 mm long), white with pale yellow median band composed of two swollen central lines extending from base of labellum to about 1/2–2/3 towards apex, basally hairy, sides and apical 1/3 pale purple to purple, glabrous, with prominently fimbriate margin, fimbriae c. 1.5 mm long, curly; *lateral staminodes* narrowly elliptic, 6–6.5 by 1.5–2 mm, apex sometimes with 1 or 2 fimbriae, white (sometimes pale yellow at base) with semi-translucent veins, glabrous on both sides; *stamen* 4.5–5 mm long; *filament* 1.5–2.5 mm long, c. 1.5 mm broad at base, 0.6–0.8 mm at the point of attachment, pale purple, glabrous; *anther* spurless, ovate 2.5–3 mm long (including crest), c. 1.3 mm wide at base, connective tissue white to cream-white, with glandular hairs on sides; *anther crest* present, obtuse, c. 1 by 1.2 mm wide at base, white; *anther thecae* c. 1.5 mm long, dehiscent along entire length, white, pollen white; *epigynous glands* absent; *style* white, glabrous; *stigma* unequally funnel-shaped (dorsally significantly side longer), dorso-ventrally compressed, c. 1.3 by 1.1 mm, white; *ostiole* with smooth to finely irregularly denticulate margin (no hairs), facing forward; *ovary* globose to ovoid, 1–1.5 by c. 1 mm, trilocular, cream white, glabrous, placentation axile. *Fruit* a globular capsule, 0.9–1.2 cm diam (almost ripe) cream white, glabrous, dehiscent irregularly, containing 5–15 seeds (most well-developed, some aborted); *seeds* irregularly obovoid, 3–4 mm long, light brown (almost ripe), shiny, enclosed in translucent white, lacinate aril.

Distribution — *Curcuma fimbriata* is known from the west of the Phetchabun mountain range. It occurs in four provinces in northeastern Thailand, namely Loei, Chaiyaphum, Phetchabun and Nong Bua Lam Phu.

Habitat & Ecology — Lowland deciduous dipterocarp forests and bamboo forests, and limestone hills, at 250–400 m elevation. Flowering starts in the rainy season and lasts from July to September. Dormancy begins in early December. Flowers open in the morning and last a single day.

Conservation status — Five locations are known in Loei province, and two locations from Chaiyaphum, and one from Phetchabun and Nong Bua Lam Phu provinces. Of these, presence in Loei and Chaiyaphum is supported by existing herbarium specimens, while records in the latter two are based on photographic evidence. The Extent of Occurrence (EOO) was calculated from all records and is estimated at 3844 km², and AOO = 32 km². Little is known about the size and extent of the populations. One small population is found in an agricultural area, but at least some are located within legally protected areas (national parks or forest reserves). However, the species is occasionally collected from the wild for sale as an ornamental which causes some impact on the number of mature individuals in populations in unprotected areas. We therefore propose to treat this species provisionally as Vulnerable (VU B1ab(iii, v), B2ab(iii, v)).

Vernacular names and Uses — Cho morakot Mueang Loei (ชมมรกตเมืองเลย) = Emerald flower of Loei. No uses have been reported, except occasional sale of the plant as an ornamental in local markets.

Other specimens examined. THAILAND, Loei Province, Pha Khao District, Non Po Daeng Subdistrict, disturbed bamboo and dipterocarp forest, 400 m elevation, 18 Sept. 2019, flowering, *Thanaphand Namkanya Namkanya-188* (BK); Phu Kradung, near the foothill quest house (RS-4), 280 m elevation, 27 Aug. 1988, flowering, *M.N. Tamura T-60438* (BKF); Chaiyaphum Province, Thung Lui Lai, N16°31'26" E101°50'06", 27 July 1999, flowering, *C. Ngamri-absakul 59* (BKF, E[E00097671-herbarium specimen; E00830346-preserved in liquid]); ibidem, collected from living collection of RBGE 19991191, 24

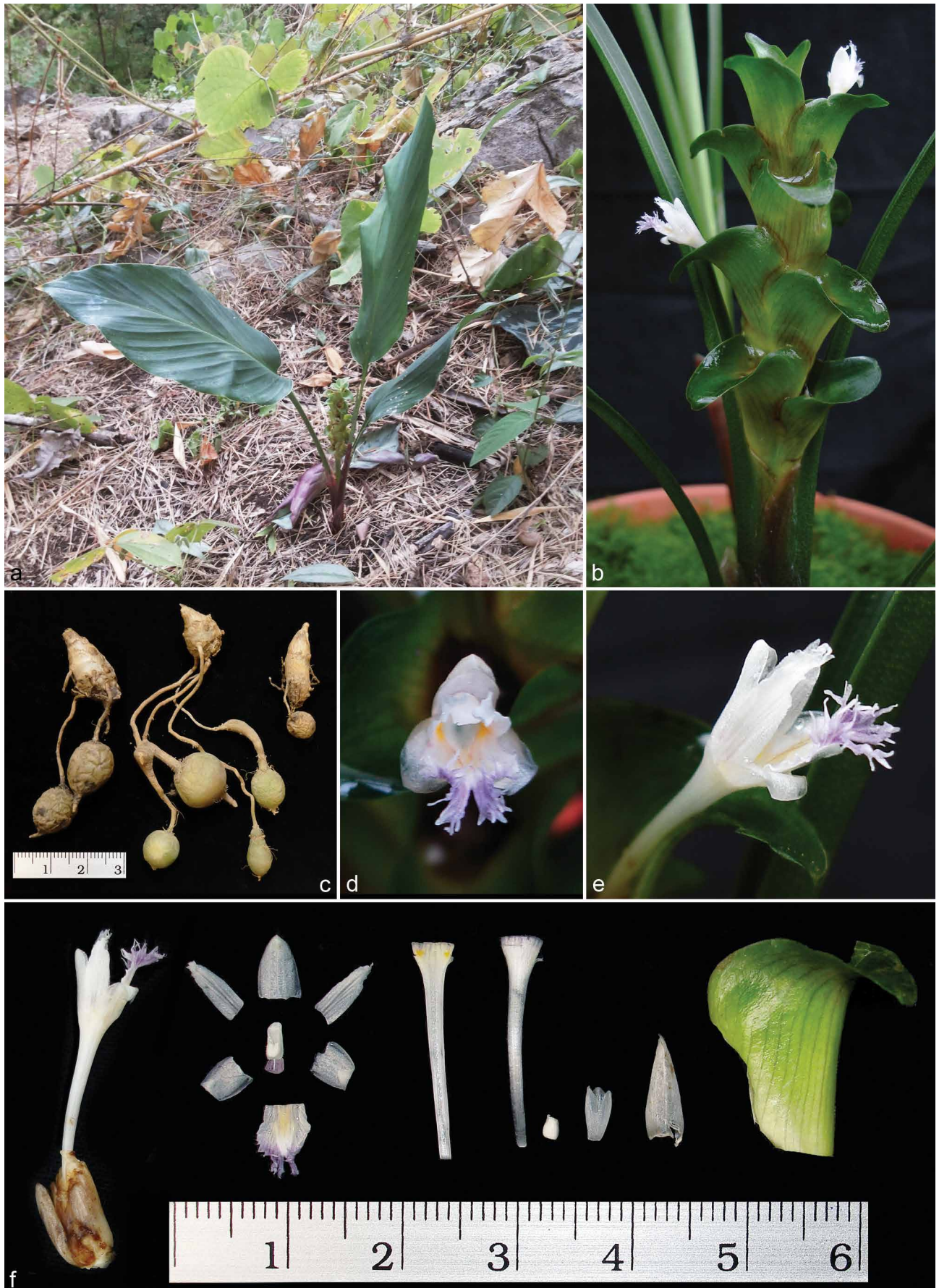


Fig. 1 *Curcuma fimbriata* Škorničk. & Soonthornk. a. Plant in habitat (type locality); b. inflorescence; c. rhizome; d. flower in bract (front view); e. flower in partially opened bract (side view); f. side view of flower embedded in cincinnus and flower dissection (a: *Namkanya-188*; b, d–f: *Škorničková* 73328, from living collection at Royal Botanic Garden Edinburgh; c: *JLS-3493*, from living collection at Singapore Botanic Gardens). — Photos: a. T. Namkanya; b–f. J. Leong-Škorničková.

Aug. 2005, J. Škorničková 73328 (E [E00211374-herbarium specimen, E00211514-preserved in liquid]); Khon San District, Thung Lui, Lai, collected from living collections at BK, 29 June 1999, P. Triboun 612(I) (BK-preserved in liquid); Kaeng Kho District, 7 Aug. 2003, flowering, W. Somprasong s.n. (BK [BKs00946-preserved in liquid]).

Additional photographic material. THAILAND, Phetchabun, Nam Nao National Park, 2013, (provided by Dr. Sunisa Sangvirojanapat); Nong Bua Lam Phu Province, Na Wang District, Na Lao subdistrict, 2019 (provided by Thanaphand Namkanya).

2. *Curcuma micrantha* Škorničk. & Soonthornk., sp. nov. (subg. *Hitcheniopsis*) — Fig. 2

Similar to *Curcuma parviflora* Wall. in its small habit, inflorescence with distinct white coma bracts and flowers with purple labellum, but differs by fertile bracts supporting 4–6 flowers, flowers small and sunken into the subtending bract with labellum facing upwards and not reflexing out of the bract, and purple staminodes and filament (vs fertile bracts supporting 2 or 3 flowers, flowers with labellum reflexed out of the bracts, and white staminodes and filament in *C. parviflora*). — Type: *Sutthinut Soonthornkalump Sutt-214* (holo BKF, including flowers in spirit as part of a single specimen; iso QBG, SING, both including flowers in spirit as part of a single specimen), Thailand, Kamphaeng Phet Province, Phran Kratai District, Wang Khuang Subdistrict, c. 100 m elevation, 27 May 2020, flowering.

Etymology. The specific epithet is derived from Greek *micro-* = little, small and *-anthos* = flower: small flower.

Perennial rhizomatous herb, 25–60 cm tall. *Rhizome* globular to ovoid, 0.8–1.4 by 0.75–1.5 cm, occasionally with lateral branches 0.8–1 by c. 0.4 cm, externally yellowish white (young rhizome) to pale brown, covered with rusty coloured and decayed scales, internally cream-white, slightly aromatic with insipid taste; *root tubers* ovoid to fusiform, 1–1.9 by 0.8–1.5 cm, externally light brown, internally white. *Leafy shoot* with 3 or 4 leaves at anthesis; *pseudostem* up to 40 cm long, composed of 1 or 2 leafless sheaths and 3 and 4 leaf sheaths, green with reddish brown tinge basally, glabrous; *ligule* 1–2.5 mm long, bilobed, hyaline, greenish white, semi-translucent, glabrous except for a few hairs c. 0.1 mm long on upper margin; *petiole* 13–33 cm long, canaliculate, green, glabrous; *lamina* narrowly elliptic, (9.5–)12–27 by (2.5–)4.5–7.8 cm, adaxially dark green, abaxially somewhat paler, glabrous on both sides, midrib green, margin hyaline, c. 0.1 mm wide, glabrous, base obtuse to oblique, apex acuminate to narrowly acuminate. *Inflorescence* central; *peduncle* exceeding pseudostem by 10–15 cm, light green (on exposed part), glabrous; *thyrses* 5–7.5 by 2.2–3 cm, composed of 8–13 fertile bracts and 2–9 coma bracts; *coma bracts* elliptic to ovate, 7–23 by 5–12 mm (basal large, uppermost smallest), apex acuminate, white with green tip, most often with pink to reddish tinge (degree of tinge varying from slight to heavy), glabrous on both sides except for a few hairs c. 0.1 mm long on abaxial side of apex; *bracts* broadly obovate, 13–17 by 15–18 mm, connate in basal 1/2, green with rich reddish brown tinge (rarely plain green), glabrous on both sides, apex broadly acute to obtuse, strongly reflexed; *cincinni* with up to 6 flowers at most basal bracts, the number gradually decreasing upwards; *bracteoles* triangular, 3–5 by 2.5–5 mm wide at base (outer ones largest), hyaline, semi-translucent white, glabrous (or rarely with a few hairs c. 0.1 mm long at apex), apex slightly concave. *Flowers* 2–2.1 cm long, barely exerted from bracts; *calyx* 4–5 mm long, tridentate, with unilateral incision 0.7–1 mm, teeth c. 0.5 mm long with blunt apex, semi-translucent white, glabrous (occasionally a few hairs present on teeth); *floral tube* 1.2–1.5 cm long, narrowly cylindrical at base, slightly widening distally, externally white, glabrous, internally white and glabrous, distally (near throat) pale yellow adaxially, pale purple abaxially, puberulous in apical half; *dorsal corolla lobe* elliptic, 4.5–5 by c. 2.5 mm, white, glabrous, apex blunt, concave, with a few short hairs; *lateral corolla lobes* 4–5 by 2–2.5 mm wide at base, elliptic to slightly triangular with obtuse concave apex, white,

glabrous; *labellum* 6–6.5 by 3.5–4 mm, obovate with obscurely bifid apex (incision 0.6–1.5 mm long), white with pale yellow median band of two swollen central lines extending from base of labellum to about 1/2–2/3 towards apex, basally hairy, sides and apex dark purple, with paler lines radiating from centre towards irregularly serrate margin, glabrous; *lateral staminodes* elliptic, 5–6 by 1.5–2 mm, white or very pale purple, glabrous on both sides; *stamen* c. 4 mm long; *filament* 1.9–2 mm long, c. 1.5 mm broad at base, c. 0.9 mm at the point of attachment, pale pink to purple, glabrous; *anther* spurless, ovate, 2–2.5 mm long (including crest), 1.3–1.5 mm wide at base, connective tissue white sometimes with pink tinge, with glandular hairs on sides and back; *anther crest* obtuse 0.5–1 by 0.95–1.25 mm wide at base, white or with pink tinge; *anther thecae* c. 1.5 mm long, dehiscing along entire length, cream-white, pollen white; *epigynous glands* absent; *style* white, glabrous; *stigma* unequally funnel-shaped (dorsal side longer), dorso-ventrally compressed, c. 1 by 0.75 mm, white; *ostiole* smooth to finely irregularly denticulate margin (no hairs), facing forward; *ovary* globose to ovoid, 1.5–2.2 by 1–1.5 mm, trilobular, cream white, glabrous, placentation axile. *Fruit* and *seeds* not seen.

Distribution — Known only from Kamphaeng Phet and Tak provinces in northern Thailand.

Habitat & Ecology — Lowland deciduous dipterocarp forest, at 100–150 m elevation. Flowering starts in the rainy season and lasts from late May till October. Plants enter dormancy in November to early December. Flowers open in the morning and last a single day.

Conservation status — Information on the Extent of Occurrence, Area of Occupancy and population sizes remains unknown. The populations from Kamphaeng Phet Province are supported by herbarium material, while evidence for this species in Tak is derived from photographs. We therefore propose the category of Data Deficient. The population size was reported by local sellers as large, consisting of thousands of individuals. However, as large numbers of *C. micrantha* plants have appeared periodically in local markets in the last 4 years, this may become a significant threat to this species over time. *Watthana 1509* (QBG) indicates that at least one population is within the legally protected area of Khlong Lan National Park. More fieldwork to better understand the population sizes as well as introduction of this species into tissue culture to satisfy the demand of the horticultural market, and therefore relieve pressure of harvesting from the field, are needed.

Vernacular names and Uses — Krachiao dong (กระเจียวดง) = wild curcuma. No uses have been reported, except for the occasional sale of plants as ornamentals. In horticulture, it is known by the name ‘Chocolate curcuma’, a common name referring to the morphotype with rich dark rusty red tinge on the bracts.

Other specimens examined. THAILAND, Kamphaeng Phet Province, Phran Kratai District, Wang Khuang Subdistrict, c. 100–150 m elevation, 13 Aug. 2019, *Sutthinut Soonthornkalump Sutt-208* (SING, including flowers preserved in spirit as part of a single specimen); Kosamphi Nakhon District, Kosamphi Subdistrict, c. 150 m elevation, 14 July 2020, *Sutthinut Soonthornkalump Sutt-218* (BKF, SING, including flowers preserved in spirit as part of a single specimen); Khlong Lan District, Khlong Lan National Park, Namtok Khlong Lan (Khlong Lan Waterfall), 200–400 m elevation, 25 Oct. 2001, *S. Watthana 1509* (QBG); province and exact location unknown, collected from the living collections of Singapore Botanic Gardens, 27 July 2012, J. Leong-Škorničková GRC-111 (SING, including flowers preserved in spirit).

Note — *Curcuma micrantha* has been cultivated at Singapore Botanic Gardens for more than 15 years, following the introduction of plants received in 2003. These were originally purchased by Mr. Tan Jiew Hoe from a nursery in Thailand and their precise location was unknown. This species is one of several commonly subsumed under the name *Curcuma parviflora*, which has been widely applied to a variety of small,



Fig. 2 *Curcuma micrantha* Škorničk. & Soonthornk. a. Inflorescence *in situ*, typical form (type locality); b. inflorescence *in situ*, green form (type locality); c. inflorescence in cultivation; d. coma (from above); e. flower in bract (front view); f. flower in bract (side view); g. base of the pseudostem, rhizome and root tubers; h. flower in side view and flower dissection (inset: detail of stamen in front and side view) (c–f, h: Leong-Škorničková GRC-111, g: Sutt-214). — Photos: a, b. W. Thongbai; c–f, h. J. Leong-Škorničková; g. S. Soonthornkalump.



Fig. 3 *Curcuma spathulata* Škorničk. & Soonthornk. a. Plant habit in cultivation; b. inflorescence; c. rhizome; d. flower in partly opened bract (side view); e. flower in bract (front view); f. inflorescences (detail of flower in inset); g. flower in side view and flower dissection (inset: detail of stamen in front, side and back view) (a–e, g: *Sutt*-212). — Photos: a–e, g. S. Soonthornkalump; f. W. Thongbai.

purple-flowered species in Thailand. Leong-Škorničková et al. (2013, reprinted in colour in 2014) showed that the complex was in need of further study and have since described *Curcuma prasina* from this complex (Leong-Škorničková et al. 2017).

3. *Curcuma spathulata* Škorničk. & Soonthornk., sp. nov.
(subg. *Hitcheniopsis*) — Fig. 3

Similar to *Curcuma parviflora* Wall. in its small habit, inflorescence with distinct white coma bracts and flowers with distally purple labellum, but differing by coma bracts pure white without green tips, fertile bract supporting 4–6 flowers, flowers with prominently spathulate deeply bilobed labellum blotched red at base and almost linear staminodes, with red streaks at base (vs coma bracts with green tips, fertile bract supporting 2 or 3 flowers, flowers with obovate labellum white at base, pure white and bluntly triangulate staminodes in *C. parviflora*). — Type: *Sutthinut Soonthornkalump Sutt-212* (holo BKF, including flowers in spirit as part of a single specimen; iso SING, including flowers preserved in spirit as part of a single specimen), Thailand, Tak Province, Sam Ngao District, Sam Ngao Subdistrict, Bhumibol Dam, 400 m elevation, 24 July 2020.

Etymology. The specific epithet is derived from Latin *spathulatus* = spathulate, and refers to the shape of the labellum.

Perennial rhizomatous herb, 30–40 cm tall. *Rhizome* ovoid, 1.5–3.4 by 0.9–1.5 cm, occasionally with a lateral branch 1.8–2 by c. 0.5 cm, externally yellowish white (young rhizome) to pale brown, covered with rusty coloured and decayed scales, internally yellow, aromatic and with slightly sweet taste; *root tubers* ovate to fusiform, 1–1.5 by 0.4–0.8 cm, externally light brown, internally white. *Leafy shoot* with 5 or 6 leaves at anthesis; *pseudostem* 10–26 cm long, composed of 1 or 2 leafless sheaths and 5 or 6 leaf sheaths, all plain green, glabrous; *ligule* up to 1 mm long, obscurely bilobed, hyaline, greenish white, semi-translucent, glabrous; *petiole* 6.5–14 cm long, canaliculate, green, glabrous; *lamina* elliptic-ovate to elliptic, 9.5–14.6 by 3.8–4.5 cm, adaxially dark green, abaxially somewhat paler, glabrous on both sides, midrib green, margin hyaline, c. 0.1 mm wide, glabrous, base obtuse to slightly oblique, apex acuminate to narrowly acuminate. *Inflorescence* central; *peduncle* exceeding pseudostem by 2–4.5 cm, light green (on exposed part), glabrous; *thyse* 5–7.2 by 2–2.5 cm, composed of 12–18 fertile bracts and 3 or 4 coma bracts; *coma bracts* ovate, 1.8–1.9 by 0.8–0.9 cm, apex acute, white, glabrous on both sides; *bracts* broadly ovate to obovate, 19–20 by 15–18 mm, connate in basal 1/2, pale green to cream with white, glabrous on both sides, apex broadly acute to almost obtuse, strongly reflexed; *cincinni* with up to 6 flowers at the most basal bracts, the number gradually decreasing upwards; *bracteoles* triangular to elliptic, 5–7 by 3–3.5 mm wide at base (outer ones largest), hyaline, semi-translucent white, glabrous, apex obtuse, slightly concave. *Flowers* 2–2.3 cm long, exerted from bracts; *calyx* 3.5–4 mm long, tridentate, with unilateral incision 0.5–0.7 mm deep, teeth c. 0.5 mm long with blunt apex, semi-translucent white, glabrous; *floral tube* 9.5–10 mm long, narrowly cylindrical at base, slightly widening distally, externally white, glabrous, internally white and glabrous, distally (near throat) white, puberulous in apical half; *dorsal corolla lobe* broadly ovate, 3.9–4.5 by 3.3–3.5 mm, white, glabrous, apex hooded; *lateral corolla lobes* ovate to bluntly triangular, 4–4.3 by c. 3.9 mm wide at base, apex obtuse reflexed, white, glabrous; *labellum* spathulate, 10–10.5 by 7–8 mm (gradually narrowing to 2 mm at base), bifid with an incision c. 4 mm long, white with bright red patches and spots in basal half, distally purple, lobe margins irregularly undulate, glabrous; *lateral staminodes* oblong, 2.3–3 by 0.6–0.7 mm, white with two red streaks in basal 1/3–1/4, glabrous on both sides; *stamen* c. 3.5 mm long; *filament* c. 1.5 mm long, c. 1.2 mm broad at base, c. 0.5 mm at point of attachment, white, glabrous; *anther* spurless, ovate, 2–2.1 mm long (including crest), 1–1.2 mm wide at base, connective tissue

white, with glandular hairs on sides and abaxially; *anther crest* obtuse (sometimes slightly emarginate), c. 0.4 by 1.5 mm wide at base, white; *anther thecae* c. 1.5 mm long, dehiscing along entire length, white, pollen white; *epigynous glands* absent; *style* white, glabrous; *stigma* unequally funnel-shaped (dorsal side longer), c. 0.9 by 0.7 mm, white; *ostiole* with smooth to finely irregularly denticulate margin (no hairs), facing forward; *ovary* ovoid, 1.3–1.5 by 1.0–1.4 mm, trilobular, white to cream white, glabrous, placentation axile. *Fruit* and *seeds* not seen.

Distribution — Known only from Tak Province in northern Thailand.

Habitat & Ecology — Mixed deciduous forest and hill evergreen forest at 400–700 m elevation. Flowering starts in the rainy season and lasts from June to September, although in cultivation the species may start flowering in May. The plants enter dormancy in November. The flower opens in the morning and wilts in the afternoon or even earlier if exposed to strong sunlight and high temperature.

Conservation status — The number and extent of populations of this species, which we obtained from a local market, are unknown, and the species has to be treated as Data Deficient.

Vernacular names and Uses — Dok khao tok noi (ดอกข้าวตอกน้อย) = little popped rice flower. There are no uses recorded but the plants are sold as ornamentals in local markets.

Notes — *Curcuma spathulata* is a small plant and in herbarium material most likely to be confused with *C. parviflora* to which it is compared in the diagnosis. *Curcuma thorelii* Gagnep. is another species with a white coma, green fertile bracts and purple flower with prominently bi-lobed labellum. However, this species is far more robust with more rigid bracts and therefore not likely to be confused even in herbarium material. Furthermore, the flowers of *C. thorelii* have a labellum with white base and staminodes which are of the same purple colour as the labellum, extending far beyond the corolla lobes and well visible in front and side view (see Leong-Škorničková et al. 2013: f. 2B, reprinted in colour in 2014) as oppose to labellum with white base with reddish spots and narrow almost linear white staminodes which are hardly visible in both views.

4. *Curcuma globulifera* Škorničk. & Soonthornk., sp. nov.
(subg. *Curcuma*) — Fig. 4

Similar to *C. strobilifera* Wall. ex Baker in its dense globular to elliptic inflorescences on short peduncle composed of green bracts and yellow flowers, but differs in prominently branched rhizome structure, lateral inflorescences which appear just before the leaves, flowers with pale yellow staminodes and pale yellow labellum with darker median band (vs rhizome consisting of series of a few unbranched globular rhizomes, inflorescences central and flowers with uniformly warm yellow labellum and lateral staminodes in *C. strobilifera*). — Type: *Sutthinut Soonthornkalump Sutt-213* (holo BKF, including flowers preserved in spirit as part of a single specimen; iso QBG, SING, both including flowers preserved in spirit as part of a single specimen), Thailand, Tak Province, Mae Ramat District, Sam Muen Subdistrict, c. 500 m elevation, 4 May 2020, flowering.

Etymology. The specific epithet is derived from Latin *globuliferus* = bearing small globes, globular, and refers to the almost globular shape of the inflorescences, which appear on the ground just before the leaves.

Perennial rhizomatous herb, 25–50(–60) cm tall. *Rhizome* branched, main rhizome globose to ovoid, 3.5–4 by 4–5 cm, lateral branches of first order horizontal, 3–6 by 1–1.7 cm, second order branches perpendicular or diagonal to lateral branches, 2–3.5 by c. 1 cm, externally pale brown, covered with rusty coloured and decayed scales, internally pale to straw yellow, aromatic with pungent smell, taste bitter; *root tubers* ovate to fusiform, 2.3–4 by 1.6–2.3 cm, externally light brown, internally white. *Leafy shoot* with up to 5 leaves, appearing shortly after inflorescence; *pseudostem* 15–35 cm long, composed of 2 leafless sheaths and 2 or 3 leaf sheaths,

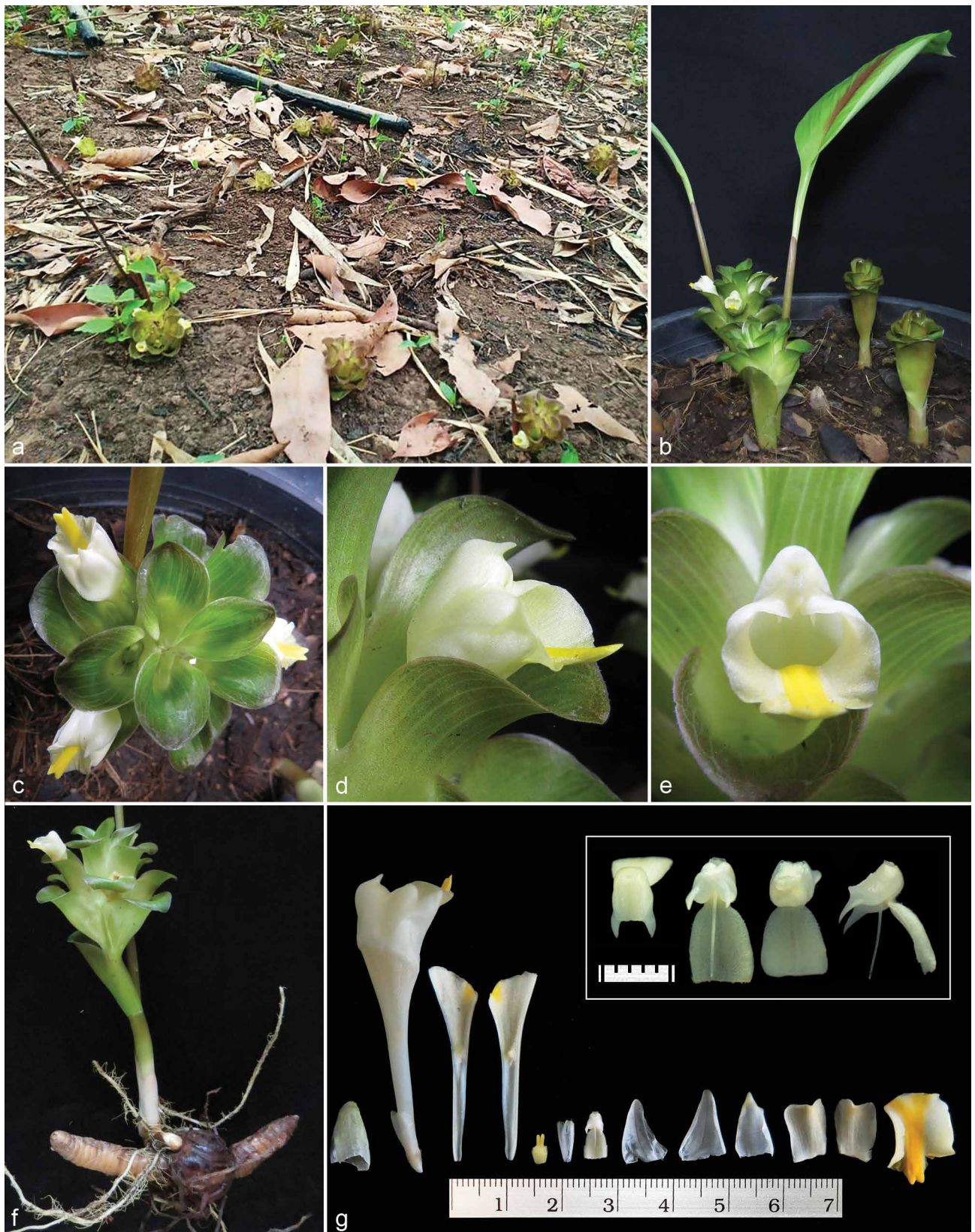


Fig. 4 *Curcuma globulifera* Škorničk. & Soonthornk. a. Inflorescence *in situ* (type locality); b. inflorescence in cultivation; c. inflorescence (from above); d. flower in bract (side view); e. flower in bract (front view); f. base of the inflorescence and rhizome; g. flower in side view and flower dissection (inset: detail of stamen in front, side and back view) (b–g: Sutt-213). — Photos: a. W. Thongbai; b–g. S. Soonthornkalump.

outer leafless sheath green with brownish tinge, puberulent, margin hyaline; *ligule* 1.5–2 mm long, bilobed, hyaline, greenish white, semi-translucent, glabrous except for a few stipitate hairs c. 0.1 mm long on upper margin; *petiole* 20–45(–60) cm long, canaliculate, green, adaxially glabrous (groove), abaxially puberulent; *lamina* elliptic to slightly obovate, 20–48 by 7–12.5 cm, plicate, adaxially mid to dark green, often with a narrow or broad red patch along midrib that may or may not show through to the underside, running almost entire length of lamina, abaxially somewhat paler, glabrous on both sides, midrib green with slight red tinge adaxially (plain green on plants without red patch), green with sparse hairs (c. 0.5 mm long) abaxially, margin hyaline, semi-translucent white, c. 0.1 mm wide, base obtuse to slightly oblique, apex acuminate to narrowly acuminate. *Inflorescence* lateral, emerging before leafy shoots; *peduncle* basally embedded in ground, usually with 2 leafless sheaths, cream-white basally, light green with reddish to brown tinge, puberulent, margin hyaline; *thyrses* c. 5–9 by 5–7 cm, composed of 14–30(–40) fertile bracts, coma bracts absent; *bracts* broadly obovate to ovate, 3.8–5.5 by 3.5–6 cm, connate in basal 1/3–1/2, bright green to brownish green with pale green venation, adaxially puberulent, abaxially glabrous, apex broadly acute to obtuse, strongly reflexed, margin hyaline, finely hairy (c. 0.1 mm long); *cincinni* with up to 3 or 4 flowers at basal bracts (2 or 3 lowermost bracts without flowers), the number gradually decreasing upwards, flowers in uppermost bracts often underdeveloped or aborted and covered by developed bracteoles; *bracteoles* broadly ovate to triangular, 7.5–11 by 9–14 mm wide at base (outer ones largest), hyaline, semi-translucent white at base with green tinge distally, apex broadly acute, slightly concave, glabrous. *Flowers* c. 5 cm long, exserted from bracts; *calyx* 6.5–7 mm long, tridentate, with unilateral incision 1.5–2 mm long, teeth c. 0.5–0.7 mm long with blunt apex, semi-translucent white with green tinge distally, glabrous; *floral tube* 3–3.5 cm long, narrowly cylindrical at base, widening distally, externally white to cream-white, glabrous, internally white and glabrous in basal 1/2, distally cream-white with bright yellow patch on ventral side, puberulous; *dorsal corolla lobe* broadly ovate to triangular, 10–11 by 9.5–10 mm wide at base, semi-translucent cream-white to pale yellow, glabrous, apex hooded and mucronate, mucro c. 1 mm long, margin hyaline; *lateral corolla lobes* triangular with obtuse concave apex, 9.1–10 by 7.1–7.5 mm wide at base, semi-translucent cream-white to pale yellow, glabrous, margin hyaline; *labellum* broadly ovate to irregularly orbicular, 13–15 by 13–16 mm, obscurely trilobed, side lobes folding upwards, midlobe straight with an incision c. 1 mm long, labellum cream-white to pale yellow with bright yellow median band extending from base of labellum to margin, glabrous throughout except for some hair at base; *lateral staminodes* irregularly broadly oblong, 10.5–11 by 7–8 mm, apex obtuse, folded inwards at centre of apex, cream-white to pale yellow, adaxially with glandular hair, abaxially glabrous; *Stamen* c. 7 mm long; *filament* 5.5–6 mm long, 4–5 mm broad at base, c. 1.5 mm broad at point of attachment, cream-white to very pale yellow, abaxially hairy with glandular hairs; *anther* spurred, ovate, 5.5–6 mm long (including spurs), c. 2.5–3 mm wide at base, connective tissue cream-white to very pale yellow, with glandular hairs on sides and abaxially, *anther spurs* narrowly triangular, c. 2 mm long, apex sharp, slightly curved downward, *anther crest* absent; *anther thecae* c. 3 mm long, dehiscing along entire length, white, glabrous, pollen white; *epigynous glands* 2, cylindrical, with irregularly blunt apex, 2–2.5 mm long, c. 0.7 mm diam, yellow; *style* white, glabrous; *stigma* capitate, c. 1 by 0.5 mm, white; *ostiole* smooth, sparsely ciliate, facing forward; *ovary* ovoid, 2.5–2.6 by 1.5–1.9 mm, trilobular, white to cream, placentation axile, pubescent. *Fruit* and *seeds* not seen.

Distribution — Known only from Tak and Kanchanaburi Provinces.

Habitat & Ecology — Bamboo and deciduous dipterocarp forest at 400–800 m elevation. Flowering starts in the rainy season and lasts from May to August. The plants enter dormancy in December. Flowers open in the morning and last a single day.

Conservation status — Only the population from Tak Province is supported by herbarium material, while evidence for the distribution of this species in Kanchanaburi Province (Thong Pha Phum and Sangkhla Buri Districts) is derived from photographs. We obtained this species from a local market. Although the precise location of this species and information on population sizes remain unknown, locations in both provinces are in proximity of National Parks and the species evidently sets seed. Judging by the photographs, it forms large populations. Although we propose the status as Data Deficient, we feel that this species is in least danger of the four described in this paper.

Vernacular names and Uses — Salika lin thong (สาลิกาลิ้นทอง) = golden-tongued myna. The plant is sold as an ornamental in local markets, and is used locally in spiritual practices, where dried rhizome and inflorescences are an ingredient in the preparation of an amulet to attract attention and popularity.

Other specimen examined. THAILAND, Tak Province, Mae Ramat District, Sam Muen Subdistrict, c. 500 m elevation, 14 May 2020, flowering, *Sutthinut Soonthornkalump Sutt-215* (BKF, including flowers preserved in spirit as part of a single specimen).

Acknowledgements We thank the curators of AAU, BK, BKF, CMU, E, QBG, K, P and SING, for letting us examine and photograph *Curcuma* specimens in their care (for the acronyms see Thiers continuously updated). SS thanks all local informants, Dr. T. Puangpairrote and the Division of Biological Science, Faculty of Science, Prince of Songkla University for facilities and support. We thank the staff of the Royal Botanic Garden Edinburgh and the Singapore Botanic Gardens for taking care of the living collections and providing access to them. We would also thank T. Namkanya and to Dr. S. Sangvirodjanapat for sending us their photographs of the species described and letting us use some of them in this paper. We thank Dr. Mark Newman and an anonymous reviewer for constructive feedback and language improvements of this manuscript. The research of JL-Š is supported by the National Parks Board, Singapore.

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