



Curcuma stahlianthoides (Zingiberaceae), a new species from northeastern Thailand dispersed by ants

S. Soonthornkalump¹, J. Kongphapa², S. Vianmana¹, N. Kunlapa³,
J. Leong-Škorničková⁴

Key words

ant-aided seed dispersal
Curcuma leonidii
Curcuma subg. *Hitcheniopsis*
myrmecochory
Stahlianthus
vulnerable

Abstract *Curcuma stahlianthoides*, a new species of *Curcuma* subg. *Hitcheniopsis* (Zingiberaceae: Zingiberoideae) from northeastern Thailand is described and illustrated here. The flower morphology of *C. stahlianthoides* resembles several other species formerly classified in the genus *Stahlianthus*, but the inflorescences are composed of up to 11 plain green fertile bracts, conforming to the typical inflorescence structure in the genus *Curcuma*. This combination of characters is similar to *C. leonidii* from Vietnam, to which it is compared for the diagnostic purposes. Previous molecular results indicate that *Stahlianthus* should be merged with *Curcuma* subg. *Hitcheniopsis* and *C. stahlianthoides* is the second species providing morphological justification to do so. A detailed description based on living flowering material, colour plates including the flower dissection, and notes on distribution, habitat and phenology are also provided. The status of Vulnerable is proposed for this species based on the IUCN guidelines and criteria. Observations on ant-aided seed dispersal of this species are reported and discussed within present knowledge of myrmecochory in gingers.

Citation: Soonthornkalump S, Kongphapa J, Vianmana S, et al. 2022. *Curcuma stahlianthoides* (Zingiberaceae), a new species from northeastern Thailand dispersed by ants. *Blumea* 67 (1): 71–75. <https://doi.org/10.3767/blumea.2022.67.01.09>. Effectively published online: 15 June 2022.

INTRODUCION

Curcuma L. is one of the largest genera of Zingiberaceae: Zingiberoideae, best known for the turmeric, *C. longa* L. It is distributed throughout South and Southeast Asia, with a few species extending to China, Australia and the South Pacific, with the highest diversity concentrated in monsoonal Asia from India to Indochina (Záveská et al. 2012). The exact number of *Curcuma* species was estimated to exceed 120 species (Leong-Škorničková et al. 2015). Since then, over 20 new species were described (e.g., Leong-Škorničková et al. 2017, 2020, 2021, Maknoi et al. 2019, Soonthornkalump et al. 2020, 2021, Saensouk et al. 2021), mainly from Thailand, and the total number of species will exceed 150 in the near future. With more than 65 species, and a good representation of all three subgenera, subg. *Curcuma*, subg. *Hitcheniopsis* (Baker) K.Schum and subg. *Ecomatae* Škorničk. & Šída f., Thailand is considered as the centre of *Curcuma* diversity. As part of our ongoing work on *Curcuma* in Thailand, we describe and illustrate here a new species from subg. *Hitcheniopsis*, which

is characterised by a lack of epigynous glands and a lack of anther spurs.

The morphology of the leafy shoots and shape and colours of the flowers somewhat resembles *C. involucreata* (King ex Baker) Škorničk., a species previously classified in the genus *Stahlianthus* Kuntze characterized by campanulate inflorescences comprising two (rarely three) fused bracts. Based on molecular evidence (Záveská et al. 2012), *Stahlianthus* is well nested in *Curcuma*, specifically in subg. *Hitcheniopsis*, and all its species were formally transferred to *Curcuma* by Leong-Škorničková et al. (2015). In 2013, a species with *Stahlianthus*-like flowers, but inflorescences composed of up to 10 bracts, *C. leonidii* Škorničk. & Luu, was described from Vietnam (Leong-Škorničková & Luu 2013). The species we describe here as *C. stahlianthoides* is only the second species from this alliance, which has inflorescences composed of multiple fertile bracts.

The description is based on living flowering material of multiple plants from field surveys including type collection specimens. The description style and level of the detail follow our recent works (Leong-Škorničková et al. 2020, 2021, Soonthornkalump et al. 2021). The general terminology follows Beentje (2016). The preliminary conservation assessment is based on the guidelines of the latest version of IUCN Standards and Petition Subcommittee (IUCN 2022).

***Curcuma stahlianthoides* Škorničk. & Soonthornk., sp. nov.**
(subg. *Hitcheniopsis*) — Fig. 1, 2

Similar to *Curcuma leonidii* Škorničk. & Luu in overall habit, having an inflorescence composed of multiple green bracts, and overall shape of the flowers, but differs in having branched rhizomes with short and stout branches, cream

¹ Department of Agriculture and Resources, Faculty of Natural Resources and Agro-Industry, Kasetsart University Chalermphrakiat Sakon Nakhon Province Campus, Chiang Khrua, Mueang Sakon Nakhon, Sakon Nakhon, Thailand 47000.

² Department of Food Technology and Nutrition, Faculty of Natural Resources and Agro-Industry, Kasetsart University Chalermphrakiat Sakon Nakhon Province Campus, Chiang Khrua, Mueang Sakon Nakhon, Sakon Nakhon, Thailand 47000.

³ 135 Moo 3 Ban Na Wai, Takon, Akat Amnuai, Sakon Nakhon, Thailand 47170.

⁴ Singapore Botanic Gardens, National Parks Board, 1 Cluny Rd., 259569 Singapore;
corresponding author e-mail: jana_skornickova@nparks.gov.sg.

in cross section (vs rhizomes not branched, globose, c. 1 by 1 cm, light orange in cross section), leaf blades narrowly elliptic up to 25 by 2.9 cm, plication obscure (vs elliptic, up to 22 by 6.5 cm, prominently plicate) and labellum white with yellow median band (vs labellum with median band red at base, yellow distally). — Type: *Sutthinut Soonthornkalump Sutt-228* (holo BKF!, consisting of a sheet and spirit collection; isotype BK!, E!, P!, QBG!, SING! including flowers in spirit as part of a single specimen), Thailand, Nakhon Phanom Province, Na Wa District, Na Wa Subdistrict, alt. 150 m, 21 May 2022, flowering.

Etymology. The specific epithet '*stahlianthoides*' refers to the flowers, which are so typical for the alliance of species previously treated in the separate genus *Stahlianthus*.

Rhizomatous perennial herb up to 50 cm tall. *Rhizome* irregularly ovoid to pear-shaped, c. 2–3 by 0.8–1.4 cm, often with lateral branches up to 1 cm long, 0.5 cm diam, light brown to brown externally, covered with rusty-coloured and decayed scales, cream internally, weakly aromatic, bitter with menthol-like taste. *Root tubers* ovate to fusiform, 1.5–2 by 0.7–1.2 cm, light brown externally, cream internally. *Leafy shoot* with 2–4(–5) leaves when flowering; *pseudostem* 6–15 cm long, composed of leaf sheaths, more obvious when young as the leaf sheaths disengage with age; *leafless sheaths* 3–4, plain green, glabrous, soon decaying, with shortly mucronate apex (c. 1 mm long), margin hyaline, puberulent; *leaf sheaths* plain green, glabrous, margin hyaline; *ligule* 0.5–1 mm long, obscurely bilobed, semitranslucent white, glabrous, membranaceous, turning papery with age, margin with sparsely stipitate hairs of c. 0.1 mm long at upper margin; *petiole* up to 20 cm long, canaliculate, plain green, adaxially glabrous, abaxially puberulent; *lamina* narrowly elliptic, 8–25 by 0.8–2.9 cm, adaxially green, puberulent, abaxially somewhat paler, densely puberulous, midrib green, adaxially glabrous, abaxially puberulous, base slightly oblique, cuneate to acute, apex acuminate, margin hyaline, semitranslucent white, c. 0.5 mm wide, glabrous. *Inflorescence* lateral, usually appearing before the leafy shoots, often partly embedded in the soil (especially in plants growing in full sun); *peduncle* basally obscured by leafless sheaths and exceeding it by 4–12 cm long, c. 3–5 mm diam, light greenish cream, glabrous; *thyrses* 2–5 cm long, 1–6 cm diam in the middle, *coma bracts* absent; *fertile bracts* 2–11 per inflorescence, broadly ovate to ovate, 2–4 by 1.5–2.4 cm (uppermost bracts are usually smaller), apex strongly reflexed, slightly mucronate (mucro c. 0.1 mm long), plain green, puberulous on both sides, connate in the lower 1/3 to 1/2; *cincinni* with up to 6 flowers at the base of the inflorescence but only 1 or 2 flowers at the top with other flowers in uppermost bracts often underdeveloped or aborted and covered by developed bracteoles; *bracteoles* one per flower, narrowly triangular, boat-shaped with acute apex, up to 8.5 mm long, 2–2.2 mm wide at base (outer ones larger, inner ones gradually smaller), hyaline, semitranslucent white, glabrous. *Flowers* 4.7–5.3 cm long, strongly exerted from the bracts; *calyx* 9.3–9.5 mm long, 3-toothed, with unilateral incision c. 3.5 mm deep, semitranslucent white, glabrous excepted for a few stipitate hairs at margin of c. 0.1 mm long; *floral tube* 2.7–3.2 cm long, narrowly cylindrical at base for 2–2.3 cm above the ovary, narrowly funnel-shaped distally, externally white at base, distally cream to pale yellow, glabrous, internally of the same colours, glabrous in basal half, gradually puberulent with short glandular hair distally, with denser and more prominent yellow hairs near the throat (the yellow-coloured part), groove holding the style positioned dorsally; *dorsal corolla lobe* obovate, 12.5–13 mm long, 2–2.2 mm at base (4.3–4.5 mm at widest point), apex hooded, minutely mucronate (mucro c. 0.4 mm long), white with semitranslucent veins, glabrous, margin hyaline, glabrous; *lateral corolla lobes* elliptic to triangular-oblong, 12.5–12.8 by 4.3–4.8 mm, apex obtuse, white with semitranslucent veins, glabrous, margin hyaline, glabrous; *labellum* broadly obovate to broadly

spathulate, 23.4–25.6 by 21.5–23 mm, apex bilobed with an incision c. 7 mm long, pointing more or less horizontally to slightly downward, white with bright warm yellow swollen median extending from the base to about 3/4 towards the apical margin (ending approximately at the incision separating the two lobes), adaxially with sparse short glandular hairs throughout, much denser and with longer hairs on entire median, especially toward the base; *lateral staminodes* irregularly narrowly obovate to obscurely spathulate with obtuse apex curving towards the labellum, 19.5–20.6 by 1.1–1.2 mm at base (6.9–8.1 mm at widest point), very pale yellow at base, white distally, glabrous on both sides with sparse glandular hairs basally; *stamen* c. 9 mm long; *filament* 2.4–2.5 mm long, 1.5–1.8 mm broad at base, less than c. 0.6 mm broad at the point of attachment, very pale yellow with semitranslucent veins, with sparse glandular hairs abaxially, denser adaxially; *anther* 6.7–7.1 mm long, connective white, glabrous with glandular hairs on the sides, *anther spurs* absent, anther crest obovate to obscurely bluntly rhomboid, 3.2–3.7 by 2.6–3.2 mm, white, rather thick, glabrous; *anther thecae* 2.7–3 mm long, dehiscing along their entire length, *pollen* white; *epigynous glands* absent; *style* white, glabrous; *stigma* funnel-shaped, dorsoventrally flattened, c. 1.5 by 1.3 mm, white; *ostiole* with irregularly serrulate margin, facing forwards; *ovary* ovoid, 3–3.7 by 1.3–1.4 mm, trilocular, pale yellowish cream, glabrous. *Fruits* obovoid to subglobular capsules, 10–12 by 6–7 mm (almost ripe), greenish white, glabrous, dehiscing irregularly, with 18–30 seeds; *seeds* irregularly obovoid to ovoid, 2.9–3.2 by 1.7–2.3 mm, brown (almost ripe) shiny, with basally attached semitranslucent white, lacinate aril.

Distribution — Known only from Nakhon Phanom Province in northeastern Thailand.

Habitat & Ecology — The species grows in edges of the scrub forest mixed with bamboos, usually in occasionally flooded areas, at ± 150 m elevation. Flowering between April to May; fruiting around late of May to June.

Conservation status — The species is only known from a single location. While the type population consists of over a thousand mature individuals with likely more populations in similar habitats in this or adjacent provinces, the Extent of Occurrence and Area of Occupancy remain at this point unknown. Although the species does not have a good horticultural potential for cut-flower industry or landscaping, it is still occasionally sold as an ornamental at local markets, and may likely be targeted by local plant collectors and ginger enthusiast growers. Also, the area with the existing population is not under any legal protection and is in close proximity to land used for agriculture. We therefore propose the category of Vulnerable (VU D2).

Vernacular name & Uses — Thai common name Bussarin (บุศรินทร์) = Lotus of Indra (a deity in Hinduism, Buddhism and Jainism). No uses were reported, but the species is occasionally sold in local markets as an ornamental and the flowers are used for offerings.

Notes — As outlined in the introduction and the diagnosis, we consider *C. leonidii* as morphologically the most similar species due to the inflorescence composed of up to 11 fertile bracts, which is rare in species with pure white and yellow gullet-shaped flowers. Because the rhizome of *C. stahlianthoides* is branched, it usually produces multiple shoots that can develop an inflorescence from each shoot, unlike *C. leonidii* which has unbranched rhizomes with one leafy shoot per rhizome. In addition, these two species are about 900 km apart with *C. stahlianthoides* occurring only in Nakhon Phanom province in northeastern Thailand, while *C. leonidii* occurs in the south of Vietnam. The inflorescence structure distinguishes *C. stahlianthoides* from all other species from the former genus *Stahlianthus*. The mature plants are easy to recognize in both herbarium and living

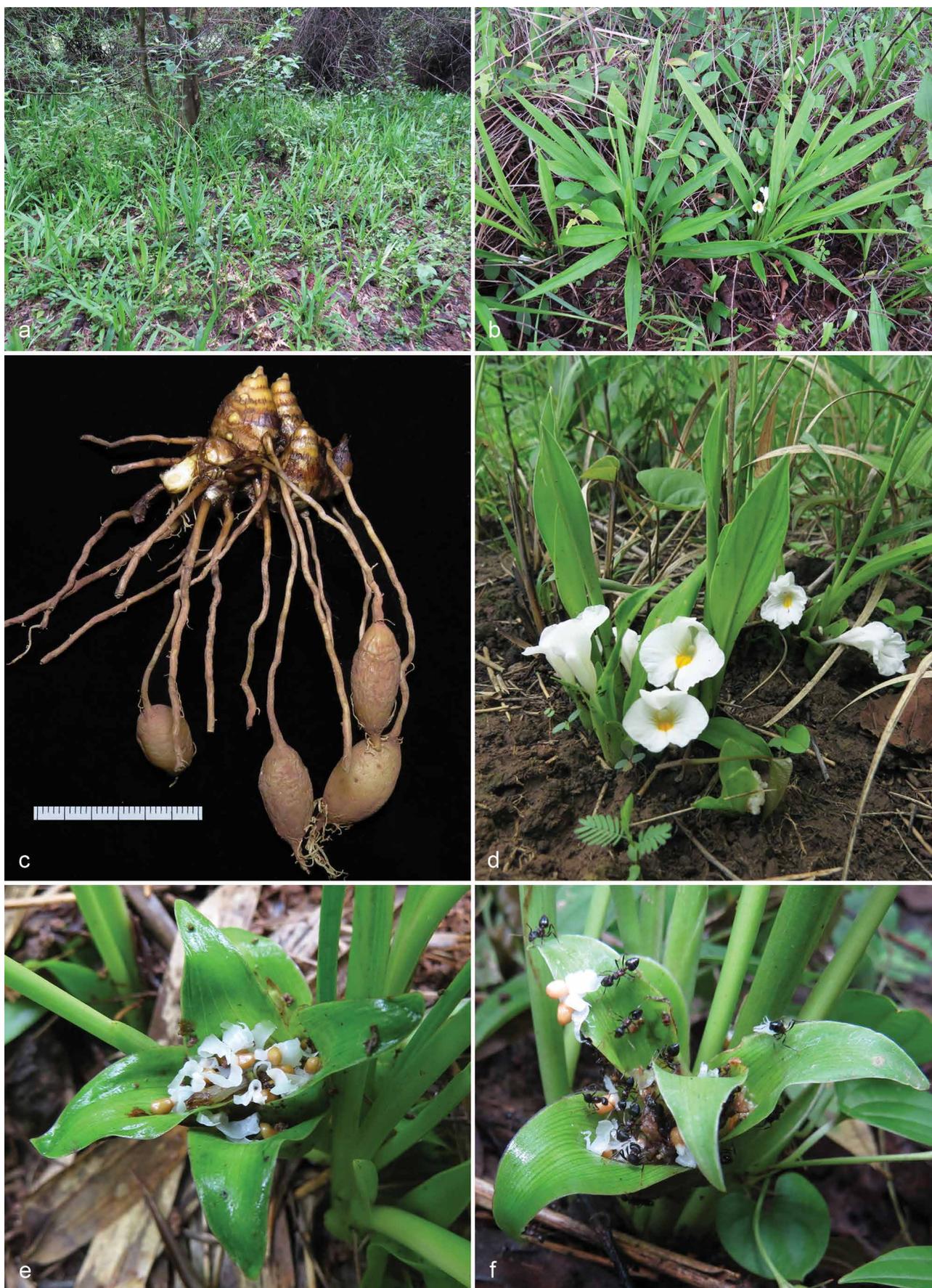


Fig. 1 *Curcuma stahlianthoides* Škorničk. & Soonthornk. a. Habitat; b. habit of the plants growing in areas shaded by bamboos; c. rhizome with root tubers; d. habit of plants growing in grassy areas in full sun; e. inflorescences with dehiscent capsules; f. inflorescences with seeds being carried away by ants (*Sutthinut Soonthornkalump Sutt-228*). — Photos: S. Soonthornkalump.

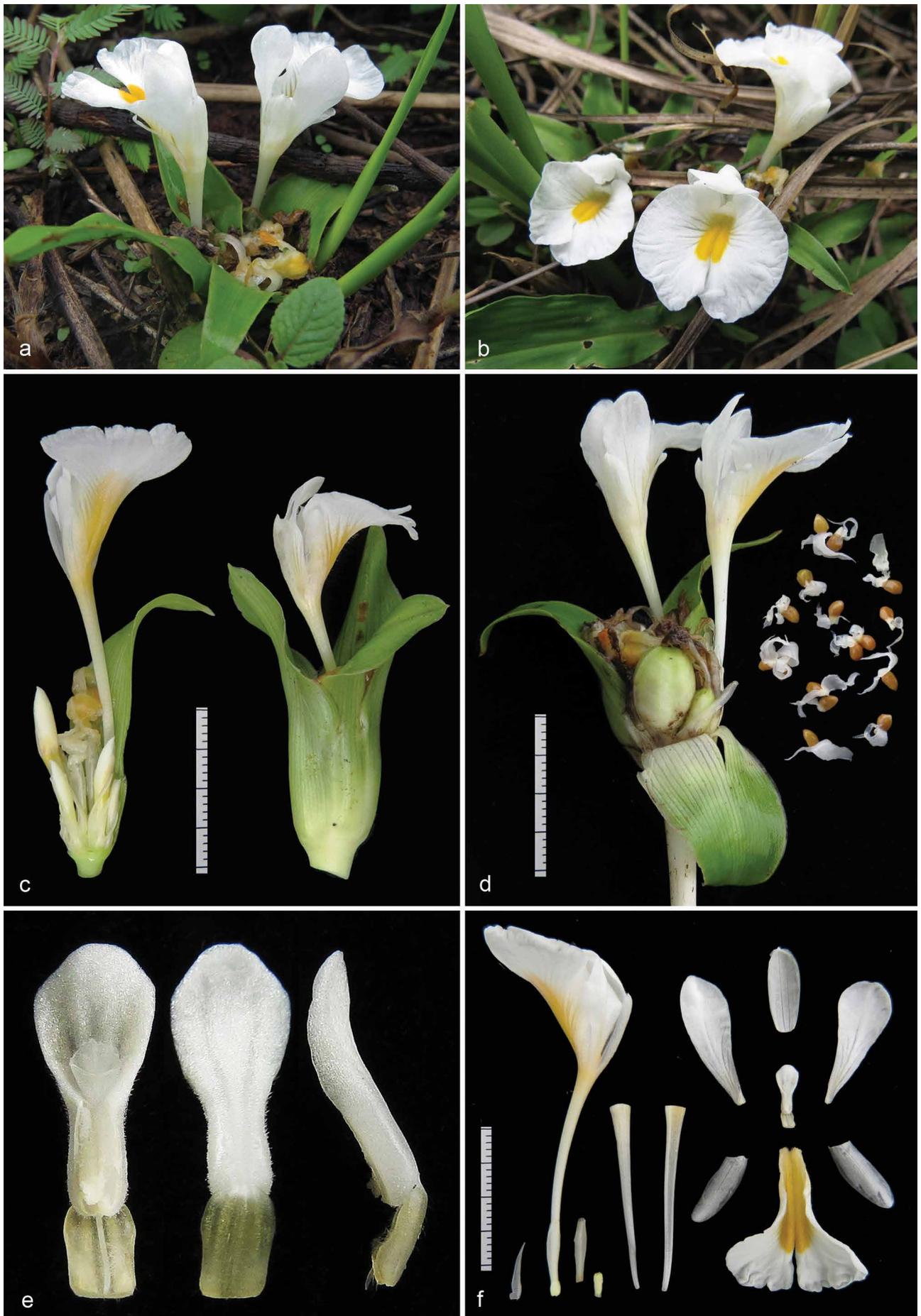


Fig. 2 *Curcuma stahlianthoides* Škorničk. & Soonthornk. a–b. Inflorescences with flowers shown in different angles *in situ*; c. flower in bracts (right) and partially removed bract showing the cincinnus (left); d. flower and fruits in partly opened bract, and seeds; e. detail of stamen in front, back and side view; f. flower dissection (Sutthinut Soonthornkalump Sutt-228). — Photos: S. Soonthornkalump.

material by the slender habit with narrow leaves. While other species in subg. *Hitcheniopsis* having such narrow leaves exist, e.g., *C. rufostriata* Škorničk. & Soonthornk. (Soonthornkalump et al. 2021) or *C. prasina* Škorničk. (Leong-Škorničková et al. 2017), these have central inflorescences on long slender peduncles (easily seen in herbarium specimens) and predominantly purple flowers. In addition, *C. rufostriata* has pink fertile bracts with rusty-red-brown striation.

As observed in the field, the ripe capsules of *C. stahlianthoides* dehisce irregularly, releasing prominently arillate seeds, which were carried away by ants (see Fig. 1f). Ant-aided seed dispersal, myrmecochory, is a short-distance mechanism of dispersal. It has been shown to be an important drive for plant diversification and has evolved in at least 77 families and over 11 000 species (Lengyel et al. 2009, 2010). In general, there are not many works on seed-dispersal in *Zingiberaceae*, but myrmecochory has been previously documented for several *Globba* L. species (Pfeiffer et al. 2004, Zhou et al. 2007), *Renealmia* Houtt. (Mabberley 2008), *Roscoea* Roxb. (Nordhagen 1932, Cowley 2007) and also suggested for *Curcuma* (Leong-Škorničková & Newman 2015). Pfeiffer et al. (2004) reported that seed arils of *Globba francisci* Ridl. and *G. propinqua* Ridl. in Borneo function as an elaiosome (i.e., lipid-rich seed appendages that attract ants and serve as rewards in exchange for dispersal), and attracted 23 different ant species, with some carrying seeds for over 8 m from the source. Subsequently, Zhou et al. (2007), studied *G. lancangensis* Y.Y.Qian in China, and concluded that 12 species of ants visited and moved seeds up to 3.35 m from the original plant. The ant-aided dispersal of *C. stahlianthoides* fits well with our observation of the type population, where a large number of plants are more or less evenly spread over the area, even though the morphology of the rhizomes does not support this distribution pattern. Myrmecochory, as a secondary seed-dispersal mode was also reported in the Neotropical *Renealmia alpinia* (Rottb.) Maas (García-Robledo & Kuprewicz 2009), and ants were also observed to disperse seeds of *Globba leucantha* Miq. in Bukit Timah Nature Reserve (Singapore), as well as various seed-setting *Curcuma* species (e.g., *C. petiolata* Roxb.) in cultivation at the Singapore Botanic Gardens by the last author. Given that seed morphology across the *Globba* and *Curcuma* is highly similar, and occurs in number of other *Zingiberaceae* genera, it is very likely that myrmecochory is a common, but grossly under-reported seed dispersal mode in ginger, and certainly deserves future studies. Better understanding of mutualistic relationships with other species will shed more light on provisioning ecological services gingers and other plants offer within their ecosystem.

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 Dr. Thaya Jenjittikul, Dr. Saroj Ruchisansakun and Faculty of Natural Resources and Agro-Industry, Kasetsart University Chalermphrakiat Sakon Nakhon Province Campus for facilities and support. We thank Dr. Axel Poulsen for his constructive comments and language improvements of this manuscript. The research of JL-Š is supported by the National Parks Board, Singapore.

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