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A new species and three new records of *Curcuma* subgenus *Curcuma* (Zingiberaceae) for Vietnam with notes on their traditional utilization and conservation status

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ABSTRACT: Knowledge of the diversity of *Curcuma* species in mainland Southeast Asia remains incomplete, and Vietnam is no exception. To address this gap, we conducted extensive field surveys throughout the country to document native taxa and clarify previously uncertain records. As a result of these efforts, we described and illustrated a new species, *Curcuma fibrifera* Boonma, D.D.Nguyen, Saensouk & P.Saensouk. In addition, we confirm the presence of three further species, *C. comosa* Roxb., *C. petiolata* Roxb., and *C. phrayawan* Boonma & Saensouk, in Vietnam for the first time, and we correct the prior misidentifications. To complement the taxonomic findings, we applied species distribution modeling to evaluate both current and future suitable habitats for these taxa under low- and high-emission climate scenarios. The inclusion of these species raises the total number of *Curcuma* subgenus *Curcuma* in Vietnam to 16, though actual diversity may still be underestimated. Full taxonomic accounts are provided for the new species and newly verified records, covering morphological descriptions, distribution, habitat preferences, phenology, taxonomic affinities, traditional uses, and conservation status. This study contributes a more comprehensive account of *Curcuma* diversity in Vietnam, supports conservation planning, and identifies priorities for further taxonomic and ecological investigations.

KEY WORDS: Conservation, *Curcuma comosa*, *Curcuma fibrifera*, *Curcuma petiolate*, *Curcuma phrayawan*, Indochina, Zingibereae.

INTRODUCTION

The genus *Curcuma* L. (Zingiberaceae) comprises perennial, rhizomatous herbs widely distributed across Southeast Asia (Chen and Ling, 1981; Larsen *et al*., 1999; Larsen and Larsen, 2006; Leong-Škorničková and Newman, 2015; POWO, 2025) and is well recognized for its economic, medicinal, and cultural significance (Saensouk *et al*. 2021a,b,c,d, 2023, 2024a,b,c, 2025a,b; Boonma *et al*. 2023, 2024; Nguyen *et al*., 2023a). Several species, such as *Curcuma longa* L., are extensively used as spices, traditional medicines, and in food applications throughout the region (Nguyen 2017; Do *et al*., 2019; Tanaka and Aung, 2019; Tanaka *et al*., 2020; Chen *et al*., 2021, 2022; Boonma *et al*. 2023, 2024; Nguyen *et al*., 2023a,b; Tran-Trung *et al*., 2023; Mai *et al*., 2025; Saensouk *et al*., 2025b). Beyond these widely known species, many other taxa within the genus are utilized in local healthcare practices, highlighting the ethnobotanical relevance of *Curcuma* and the importance of accurate species identification to ensure safe and effective use (Saensouk *et al*. 2021a,b,c; Boonma *et al*., 2023, 2024).

Three accepted subgenera are currently recognized. Subgen. *Hitcheniopsis* (Baker) K.Schum. consists of species lacking both epigynous glands and anther spurs. Subgen. *Ecomatae* Škorničk. & Šída f. is distinguished by its well-developed ligules, the presence of anther spurs, and fertile bracts that are fused only at their bases and do not develop conspicuous coma bracts. Subgen. *Curcuma* L., in contrast, includes species with pronounced coma bracts and closed, bell-shaped flowers that possess epigynous glands (Leong-Škorničková *et al*., 2015).

Within the genus, the subgenus *Curcuma* is of particular interest due to its frequent use in traditional medicine and its morphological complexity (Saensouk *et al*., 2021a,b,c; Boonma, 2023; Mai *et al*., 2025). Species in this subgenus often exhibit highly similar vegetative and floral characters, which make species-level identification challenging (Ardiyani *et al*., 2011; Saensouk *et al*., 2021a,b,c; 2024a,b,d; Chen *et al*., 2021; Sabu *et al*., 2023; Mai *et al*., 2025). Morphological similarity, coupled with overlapping vernacular names, increases the risk of misidentification, which may have direct implications for ethnomedicinal applications, conservation planning, and sustainable use of these plants (Saensouk *et al*., 2021b, 2024a,b,c).

Despite the recognized importance of subgenus *Curcuma*, current knowledge of its distribution and diversity in Vietnam remains incomplete. Previous reports have documented certain species based on photographs or literature records; however, many lack voucher specimens and cannot be formally verified (Leong-Škorničková and Newman, 2015; Nguyen, 2017). Furthermore, existing floristic treatments and databases, such as the Flora of Vietnam and POWO, do not include several species, leaving gaps in the understanding of their national distribution (Nguyen, 2017; POWO, 2025).

To guide our field surveys and identify areas potentially harboring previously unrecorded taxa, we employed ecological niche modelling using MaxEnt, a widely applied machine-learning algorithm for presence-only species distribution data (Phillips *et al*., 2006). Occurrence records of *Curcuma* subgenus *Curcuma* were compiled from our field surveys and the Global Biodiversity Information Facility (GBIF, 2025). Six bioclimatic variables—annual mean temperature, maximum temperature of the warmest month, minimum temperature of the coldest month, annual precipitation, precipitation of the wettest month, and precipitation of the driest month—were selected to model current habitat suitability in Southeast Asia and China (WorldClim, 2023). Model predictions were cross-validated using ten replicates to ensure robust utilization of occurrence data and to reduce potential overfitting (Barbet-Massin *et al*., 2012). The resulting probability maps were converted into binary maps of "suitable" and "unsuitable" habitats using the maximum sum of sensitivity and specificity (maxSSS) threshold, highlighting areas with the highest likelihood of supporting *Curcuma* subgenus *Curcuma* populations. Moreover, this modelling approach can be extended to predict future shifts in suitable habitats under changing climatic conditions, providing valuable information to support the conservation status and management of these species (Liu *et al*., 2016).

During field surveys in Vietnam, an undescribed species of *Curcuma* with a terminal inflorescence was discovered in Tay Ninh Province. Based on the presence of epigynous glands, spurred anthers, and a cylindrical thyrse with coma bracts, it belongs to the subgenus *Curcuma*. After thorough examination, it did not match any known species in the genus and is therefore described here as a new species. Another species, *C. phrayawan* Boonma & Saensouk (Saensouk *et al*., 2021a), was also recorded for the first time in Vietnam, based on detailed morphological comparison with type specimens. Additionally, *C. comosa* Roxb. and *C. petiolata* Roxb., previously reported only from photographic accounts without verified specimens (Leong-Škorničková and Newman, 2015), were confirmed in Vietnam through voucher-based documentation. *Curcuma zedoarioides* Chaveer. & Tanee, recently recorded for Vietnam by Tuan *et al*. (2021), is also noted here; both the original publication and the first Vietnamese record contained an orthographical error, which is corrected in this study (Chaveerach and Tanee, 2008; Tuan *et al*., 2021). Notably, these five species are not yet included in the Flora of Vietnam or in the Plants of the World Online database for Zingiberaceae, highlighting the novelty and significance of these findings (Nguyen, 2017; Nguyen *et al*., 2024; POWO, 2025).

In reviewing previous records, a reported occurrence of *Curcuma rangjued* Saensouk & Boonma in Vietnam was evaluated (Hue *et al*., 2024). Examination of the specimens revealed that they do not correspond to the original description of *C. rangjued* from Thailand, and this misidentification was confirmed by the co-authors who originally described the species (Saensouk *et al*., 2021b). This finding underscores the necessity of taxonomic verification using voucher specimens to ensure accurate species documentation.

The objectives of this study were therefore to: 1) document a new species and three new records of *Curcuma* subgenus *Curcuma* in Vietnam, 2) to clarify previous taxonomic misidentifications, 3) to provide notes on the orthographical error in the literature, and 4) explore potential suitable habitats through predictive distribution modelling, including future projections under climate change. These findings will inform future surveys and conservation strategies for these ethnomedicinally important species.

MATERIALS AND METHODS

The study was conducted in Vietnam, within tropical regions characterized by a monsoon climate with distinct wet and dry seasons. Vegetation at the collection sites varied among localities. In addition to specimens collected in the field, herbarium material from across Vietnam was examined. Field surveys were conducted during September 2024 to 11 August 2025, targeting both previously reported locations and potential new habitats. Voucher specimens, including leaves, rhizomes, flowers, and fruits where available, were collected following standard botanical protocols (Davies *et al*., 2023). Each specimen was carefully pressed, labeled with a unique collection number, and deposited in the VNU University of Science, Hanoi (HNU). Notes on habitats and associated vegetation were recorded in the field for each population.

Species identification and morphological observations were identified using dichotomous keys and relevant taxonomic literature, including the Flora of Vietnam Vol. 21 (Nguyen, 2017), Flora of China Vol. 24 (Wu and Larsen, 2000), Flora of Thailand Vol. 16 Part 2 (Leong-Škorničková and Saensouk, 2023), Checklist of the Zingiberaceae of Malesia (Newman *et al*., 2004), and additional publications on *Curcuma* taxonomy (Leong-Škorničková and Lý, 2010; Leong-Škorničková *et al*., 2010; Záveská *et al*., 2012; Leong-Škorničková and Luu,

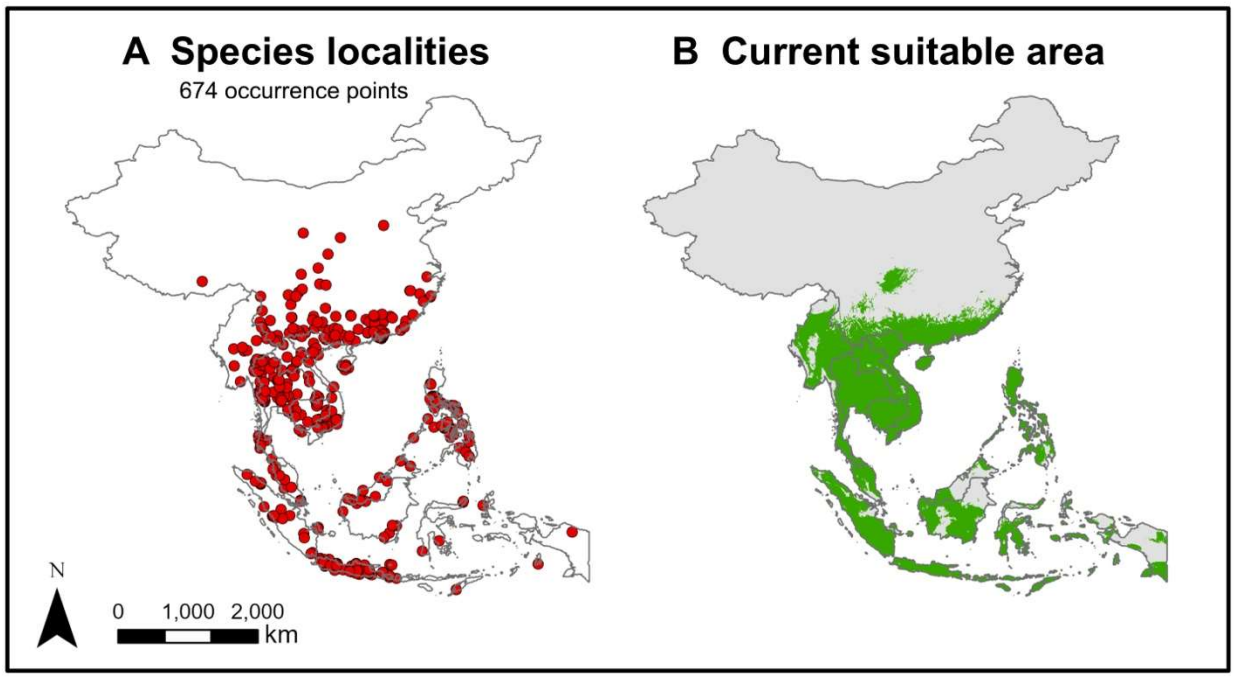

Fig. 1. Distribution map of ***Curcuma*** subgenus ***Curcuma***; **A**. Species occurrence records of and **B.** Predicted distributions under current climatic conditions.

2013; Leong-Škorničková *et al*., 2015; Liên *et al*., 2019; Saensouk *et al*., 2021a,b,c; 2022a,b, 2024a,b,d; Chen *et al*., 2022; Nguyen *et al*., 2022; Mai *et al*., 2025). Morphological traits of both vegetative and reproductive structures were measured using a ruler and vernier caliper (Mitutoyo Vernier Caliper; Mitutoyo Corporation, Kawasaki, Japan) and examined in detail under a stereoscopic microscope (Stemi 2000-C; Zeiss, Oberkochen, Germany). Examined specimens onsite at BK, BKF, DUMTP, HN, HNU, IMDY, KKU, QBG, VMSU, and VNM. High-resolution images of specimens examined were consulted through various herbaria (A, AAU, B, BM, C, CAL, E, HN, IBK, K, L, P, and VNMN), via JSTOR Global Plants (https://plants.jstor.org, accessed 9 September 2025) and the Global Biodiversity Information Facility (GBIF, 2025). Nomenclature follows Plants of the World Online (POWO, 2025) and the International Plant Names Index (IPNI, 2025), while herbarium acronyms conform to the Index Herbariorum standards (Index Herbariorum, 2025), and the terminology for describing plant morphological characteristics follows Beentje (2016).

Information on traditional uses of *Curcuma* subgenus *Curcuma* in Vietnam was compiled from published literature, herbarium notes, and botanical references (e.g. Nguyen, 2017; Nguyen *et al.*, 2023a; Tran-Trung *et al*., 2023). These records allowed for a general summary of uses in various aspects, including culinary, medicinal, and other applications, without emphasizing any particular use. However, no comprehensive ethnobotanical survey or quantitative assessment was conducted. Semi-structured interviews with local informants were used only as supplementary information, asking specifically about the plant's name, the part used, and the purpose of use. The purpose of the inquiry was explained to the informants in advance, and questions were asked only if they consented.

Species data were compiled from field surveys and the Global Biodiversity Information Facility (GBIF). After cleaning and processing to remove duplicates and erroneous records, a total of 674 occurrence points from China and Southeast Asia were retained for analysis (Figure 1). Species distribution models were constructed using MaxEnt version 3.4.4, which is particularly suitable for presence-only data (Phillips *et al*., 2006). Each model was run with 10 replicates under a cross-validation technique to ensure the use of all available data (Barbet-Massin *et al*., 2012). Climate data were obtained from WorldClim version 2.1 at a spatial resolution of 30 arc-seconds (~1 km²) (https://www.worldclim.org/). Future climate projections for 2050 were derived from the HadGEM3 global circulation model under two shared socioeconomic pathways: SSP126 (low-emission scenario) and SSP585 (high-emission scenario). Six bioclimatic variables, including mean annual temperature (BIO1), maximum temperature of the warmest month (BIO5), minimum temperature of the coldest month (BIO6), annual precipitation (BIO12), precipitation of the wettest month (BIO13), and precipitation of the driest month (BIO14) were selected for model calibration because temperature and precipitation are recognized as the primary climatic factors influencing the distribution

of *Curcuma* subgenus *Curcuma*. Model outputs were converted into binary maps of suitable and unsuitable habitats using the maximum sum of sensitivity and specificity (MaxSSS) threshold, which is recommended for presence-only data (Liu *et al.*, 2016). These maps provided estimates of the current distribution of *Curcuma* and projections of potential range shifts under future climate scenarios.

The conservation status of each species was evaluated following IUCN Red List criteria (IUCN, 2024), using specimen records, field surveys, and distribution data. Extent of distribution, population occurrence in specific areas, and major threats, including habitat loss and anthropogenic pressures, were considered. The predicted distributions from the species distribution models were integrated to support the assessment, highlighting areas that are currently suitable and may remain or become unsuitable in the future (Liu *et al*., 2016; Boonma *et al*., 2023).

Field surveys and specimen collections were conducted in accordance with national regulations and institutional guidelines for plant research. Voucher specimens were collected with care to minimize impact on natural populations and deposited in the VNU University of Science, Hanoi, Vietnam (HNU), and Department of Pharmacy, Danang University of Medical Technology and Pharmacy (DUMTP). For semi-structured interviews with local informants, prior informed consent was obtained, and questions were asked only with their agreement. No endangered or protected species were collected without appropriate permits. Ethical approval for the study was not required, as it involved plant specimens and non-invasive ethnobotanical information.

RESULTS

In this study, a new species, *Curcuma fibrifera* Boonma, D.D.Nguyen, P.Saensouk & Saensouk, together with three new records of subgenus *Curcuma* for the flora of Vietnam (*C. comosa* Roxb., *C. petiolata* Roxb., and *C. phrayawan* Boonma & Saensouk) are documented, with notes on their traditional utilization and conservation status. Voucher specimens of each species were collected and deposited in HNU! and DUMTP!. Detailed morphological observations were made on both vegetative and reproductive characters. Distribution maps, based on field surveys and species distribution modelling, were prepared to identify suitable habitats for these taxa. In addition, previously reported occurrences of *C. rangjued* Saensouk & Boonma in Vietnam were re-examined and shown to represent misidentifications. These findings provide verified national records of subgenus *Curcuma* in Vietnam, which are presented in detail below.

A new species for Vietnam

Curcuma fibrifera Boonma, D.D.Nguyen, P.Saensouk & Saensouk, ***sp. nov.*** **Fig. 2 & 3**

Type**:** VIETNAM. Southern: Tay Ninh Province, Tan Chau District, ca. 65 m, 25 August 2025, *T.Boonma, S.Phimpha & D.D.Nguyen TNH001* (holotype HNU!).

Diagnosis**:** *Curcuma fibrifera is similar to C. wanenlueanga* Saensouk, Thomudtha & Boonma (Saensouk *et al*., 2021c, 2025b) in having terminal inflorescences, coma bracts, epigynous glands, spurred anthers, and flowers of the gullet type, but differs in having *rhizomes* ovoid to subglobose, 3–4 × 3–4 cm, ivory to cream (vs. ovoid, 5–9 × 3–5 cm, yellow); *branches rhizome* internal ivory with cream core, fibrous threads visible when broken (vs. yellow with darker yellow core, no fibrous threads when broken); *leafy shoot* 60–85 cm tall (vs. 100–150 cm); *leaf sheaths* 15–32 cm long (vs. 10–60 cm); *petiole* 5–13 cm long, green (vs. 15–35 cm long, green with reddish tinge); *lamina* lanceolate to elliptic, 28–45 × 8–14 cm, base cuneate to rounded, midrib green (vs. narrowly lanceolate, 50–70 × 15–18 cm, base attenuate, midrib reddish-purple, fading with age); *peduncle* 20–24 cm long (vs. 30–40 cm); *lateral staminodes* asymmetrical ovate, apex obtuse to acute, 1.4–1.6 × 1.0 cm (vs. irregularly obovate, apex rounded, 1.3–1.4 × 0.7–0.8 cm); *filament* 3.2–3.5 mm long (vs. ca. 4 mm); *anther spurs* narrowly conical, ca. 1.5 mm, curved inward (vs. ca. 4 mm, pointing downward); and *ovary* oblate, 3–4 × 2 mm (vs. subglobose, ca. 3 × 3 mm).

Description**:** Perennial herb with rhizome. ***Rhizome*** ovoid to subglobose, 3–4 × 3–4 cm, internally ivory to cream, branched in opposite directions, slightly fragrant; *branches* with internal ivory and cream core, 8–18 cm long, 1.5–2.0 cm in diameter, fibrous threads visible when broken apart, covered by triangular sheaths scales; *sub-branches* arising from the lower part of the rhizome branch, initially descending and then curving to lie parallel to the ground, some with tips curved upward to grow as shoots, forming a naturally clumping habit. ***Roots*** fibrous. ***Leafy shoot*** 60–85 cm tall, with 7 leaves. ***Bladeless sheaths*** 3–5, green, or green with vinaceous tinge distally, turning papery and brownish with age. ***Leaf sheaths*** alternate, 15–32 cm long, green, or with vinaceous tinge, faded with age, pubescent; *ligule* bilobed, triangular, 5–7 mm long, green and turning brownish with age, apex obtuse, pubescent; *petiole* canaliculate, 5–13 cm long, green, puberulent. ***Lamina*** lanceolate to elliptic, 28–45 × 8–14 cm, adaxial surface green with green midrib, venation prominent, and sparsely puberulent, abaxial surface paler green, puberulent, margin entire, base cuneate to rounded, slightly oblique, apex acuminate. ***Inflorescence*** terminal; *peduncle* pale greenish to white at base, 20–24 cm long, puberulent, with or without sterile bract; *sterile bract* oblanceolate green with reddish brown tinge, 10–12 × 3–4 cm; *thyrse* 11.0–14.0 × 6.0–6.5 cm; *fertile bracts* broadly elliptic to obovate, 3.5–4.0 × 2.5–

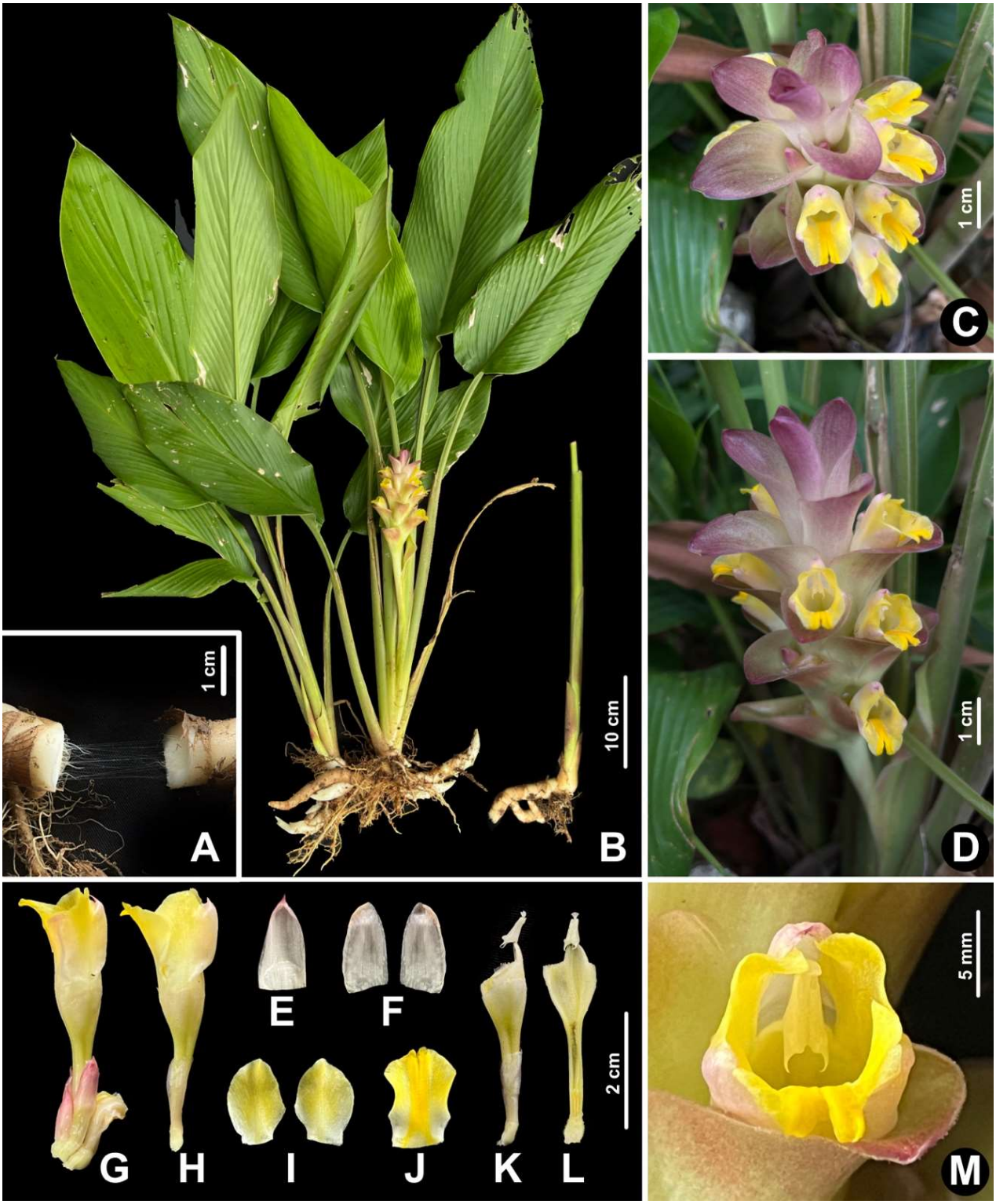

Fig. 2. ***Curcuma fibrifera*** Boonma, D.D.Nguyen, P.Saensouk & Saensouk. **A.** Dissection of branches rhizome, and fibrous threads visible when broken apart of branches rhizome. **B.** Habits. **C.** Semi-top view of inflorescences. **D.** Side view of inflorescence with flowers. **E.** Dorsal corolla lobe. **F.** Lateral corolla lobes. **G.** Cincinnus with flower and young buds. **H.** Side view of flower. **I.** Lateral staminodes. **J.** Labellum. **K.** Side view of anther with floral tube. **L.** Front view of anther with dissected floral tube to show the epigynous glands. **M.** Front view of flower. Photos by Thawatphong Boonma.

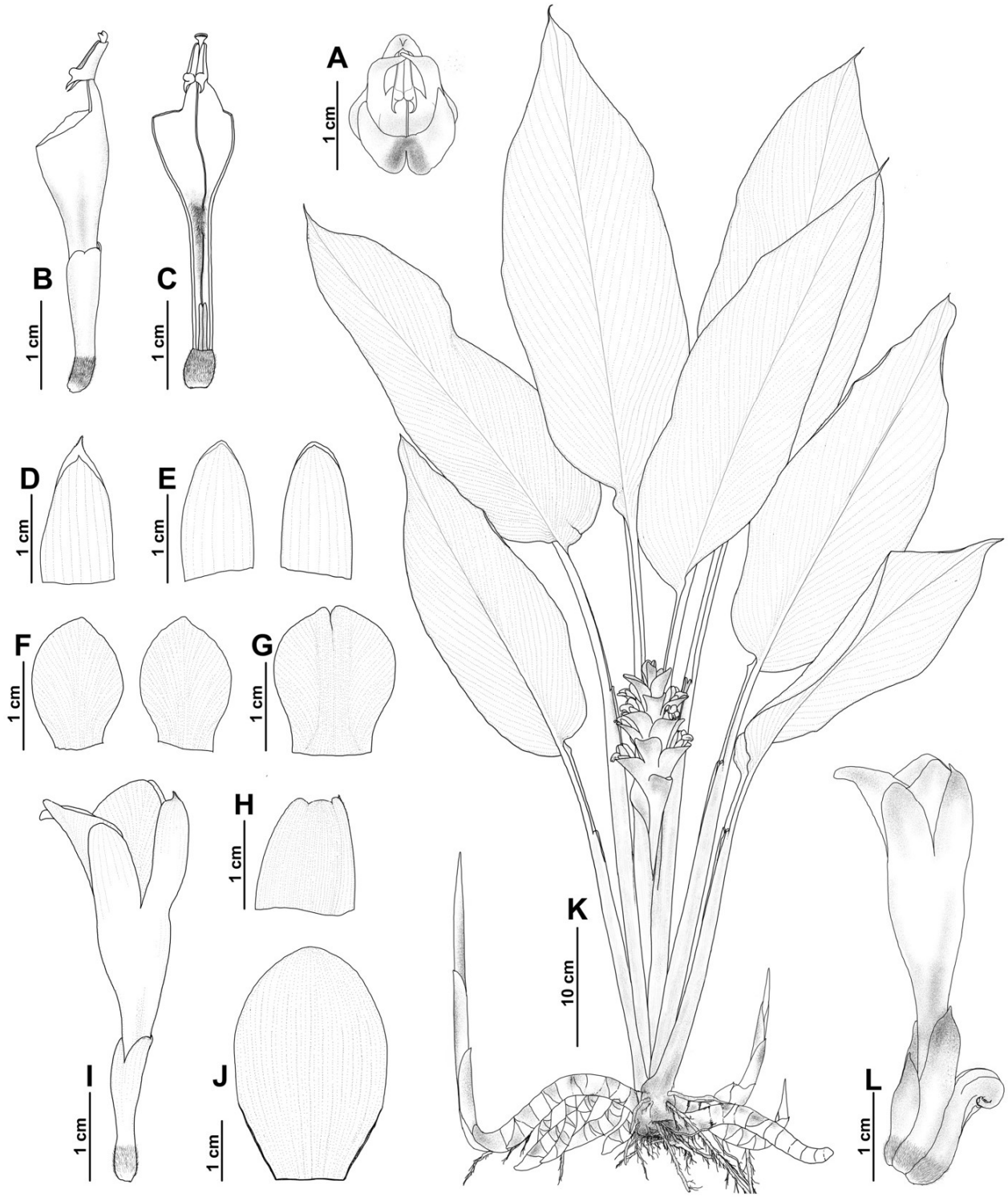

Fig. 3. ***Curcuma fibrifera*** Boonma, D.D.Nguyen, P.Saensouk & Saensouk. **A.** Front view of flower. **B.** Side view of anther with floral tube. **C.** Front view of anther with dissected floral tube to show the epigynous glands. **D.** Dorsal corolla lobe **E.** Lateral corolla lobes. **F.** Lateral staminodes. **G.** Labellum. **H.** Dissected calyx. **I.** Side view of flower. **J.** Fertile bract. **K.** Habit. **L.** Cincinnus with flower and young buds. Photos by Thawatphong Boonma.

3.0 cm, lower bract apex broadly obtuse, upper bract apices obtuse, pale green with a pale vinaceous mid-region, gradually becoming more vinaceous toward the distal part, puberulent; *cincinnus* with 4–5 flowers; *coma bracts* oblanceolate to elliptic, 3.5–4.0 × 1.0–2.0 cm, apex obtuse and hooded, white with vinaceous at distal part; *bracteoles* ovate, apex obtuse, slightly hooded, 0.8–1.0 cm long, translucent white, pubescent. ***Flowers*** gullet, 4.6–4.8 cm long; *calyx* 13–15 mm long, semi-translucent white with pinkish tinged, apex trilobed, with unilateral incision ca. 5 mm long, sparsely hairs at distal part and at base; *floral tube* narrowly cylindrical at base, funnel-shaped in distal 1/3, externally pale yellow, external glabrescent, internal with hairs; *dorsal corolla lobe* ovate–triangular, hooded, apex mucronate, 1.6–1.7 × 0.9–1.0 cm, mucro ca. 1.5 mm long, white with pale pink tinge at distal part, glabrous except for hairs at the tip; *lateral corolla lobes* ovate–triangular, apex obtuse, shallowly concave, 1.5–1.6 × 0.9–1 cm, white with pale pink tinge at distal part, glabrous; *lateral staminodes* asymmetrical ovate, apex obtuse to acute, 1.4–1.6 × 1.0 cm, longitudinally raised along the midlobe, inward toward the flower, pale yellow; *labellum* broadly obovate, 1.6–1.7 × 1.3–1.4 cm, apex emarginate with midlobe bilobed, incision up to 4 mm long, side lobes folding upwards, pale yellow with yellow median band. ***Stamen*** single, 8–9 mm long; *filament* 3.2–3.5 mm long, ca. 5 mm wide at base, pale yellow, puberulent; *anther* spurred, ca. 7 × 3 mm (including crest and spurs), connective pale yellow, puberulent; *anther crest* present but not prominent, apex rounded; *spurs* narrowly conical, ca. 1.5 mm long, pointing downward and curved inward, pale yellow; *anther thecae* ca. 4 mm long, dehiscing throughout, pollen cream-white. ***Epigynous glands*** 2, cylindrical, ca. 5 mm long, yellow. ***Stigma*** exerted above the anther, ca. 1.2 × 1.4 mm, white. ***Ovary*** oblate, ca. 3–4 × 2 mm, pale yellow, pubescent. ***Fruit*** not seen.

***Vernacular name*:** Nghệ Sợi Trắng.

***Distribution and habitat*:** *Curcuma fibrifera* is currently known only from its type locality in Tan Chau District, Tay Ninh Province, Southern Vietnam. It grows on sandy loam soil, beneath a semi-open canopy of deciduous forest, at an elevation of approximately 65 m a.s.l.

***Phenology*:** Flowering were observed in August.

***Etymology*:** The specific epithet "*fibrifera*" is derived from the Latin words *fibra* meaning "fiber" and *fero*, *ferre* meaning "to bear, to produce, to carry." Thus, *fibrifera* means "bearing fibers" or "producing fibers," in reference to the characteristic fibrous threads that appear when the branches rhizome is broken, resembling the breaking of the petioles of *Nelumbo nucifera* Gaertn.

***Additional specimens examined (paratype)*:** VIETNAM. Southern: Tay Ninh Province, Tan Chau District, ca. 65 m, 25 August 2025, *T.Boonma & S.Phimpha TNH002* (HNU!). Tay Ninh Province, Tan Chau District, ca. 65 m, 25 August 2025, *T.Boonma & S.Phimpha TNH003* (HNU!, spirit collection!).

Three new records for Vietnam

1. *Curcuma comosa* Roxb., Roxburgh, Asiat. Res. 11: 336 (1810). ***Type***: *Curcuma comosa* Roxb., Icones Roxburghianae Ineditae No. 1925 (Lectotype K, designated by Saensouk *et al*., 2025b). **Fig. 4**

Specimens from Vietnam examined: Vietnam, Dak Lak Province, Yok Đôn National Park, 27 Apr 2025 (in flower), *N.H.Tuan and V.V.Sy VVS250427* (DUMTP, duplicate at HNU).

Description of specimens collected in Vietnam: Perennial herb with rhizome. ***Rhizome*** ovoid to globose, 8–9 × 6–9 cm, internally ivory, rarely branched, rhizome branches very short, ivory to cream. ***Leafy shoot*** 0.6–1.4 m tall. ***Leaf sheaths*** 25–40 cm long, green; *ligule* indistinct; *petiole* sessile to sub-sessile, up to 4 cm long. ***Lamina*** elliptic to oblanceolate, 15–60 × 12–22 cm, green with red patches along both sides of the midrib when young, plain green when mature, glabrous on both surfaces, base cuneate, apex acute. ***Inflorescence*** lateral; *peduncle* pale green, glabrous, 5–10 cm long, covered with green scales, partly embedded in the ground; *thyrse* 14–20 cm long; *fertile bracts* ovate, apex obtuse to rounded, white to pale green with pink apices, sparsely puberulent to glabrous above; *cincinnus* with 6–7 flowers at basal bracts; *coma bracts* with obtuse to rounded apex, pink; *bracteoles* broadly obovate, apex acute to retuse, 1.0–2.5 × 1.0–1.7 cm, semitranslucent white or with pink tinge at apex, glabrous. ***Flowers*** gullet-type, ca. 5 cm long; *calyx* 9–11 mm long, with a tridentate apex and a unilateral incision 3–4 mm long, semitranslucent white and glabrous; *floral tube* is narrowly cylindrical at the base and funnel-shaped in the distal 1/3, 2.5–3.0 cm long, cream white to very pale yellow, glabrous but with a ring of hairs around the constriction; *dorsal corolla lobe* ovate–triangular, prominently concave, hooded with a mucronate apex, 1.3–1.5 × 1.0–1.2 cm, ivory or cream, sometimes with a pale pink tinge at the apex, glabrous with a few hairs at the mucro; *lateral corolla lobes* triangular with a blunt apex, shallowly concave, 1.2–1.4 × 0.9–1.0 cm, ivory to cream, sometimes with a pale pink tinge, glabrous; *lateral staminodes* irregularly elliptic to obovate with an obtuse apex folded inwards at the center, 1.0–1.2 × 0.6–0.8 cm, very pale yellow at the base, more yellowish toward the apex; *labellum* obovate and trilobed, ca. 1.5–1.6 × 1.5 cm, midlobe bilobed with an incision of ca. 3 mm, side lobes fold upwards, pale yellow with a bright yellow median band, glabrous but with glandular hairs along the sides of the median band. ***Stamen*** single, 7–8 mm long; *filament* 3–4 mm long and 3 mm wide at the base, tapering to 1.5 mm at the point of attachment, pale yellow and glabrous; *anther* spurred, ca. 6 × 3 mm with pale yellow connective tissue, glabrous; *anther crest* negligible, merely a thickened ridge; *spurs* narrowly conical, ca. 2.5 mm long, pale yellow, glabrous; *anther thecae* 3–4 mm long, dehiscing throughout, with cream-white pollen. ***Epigynous glands*** cylindrical with acute

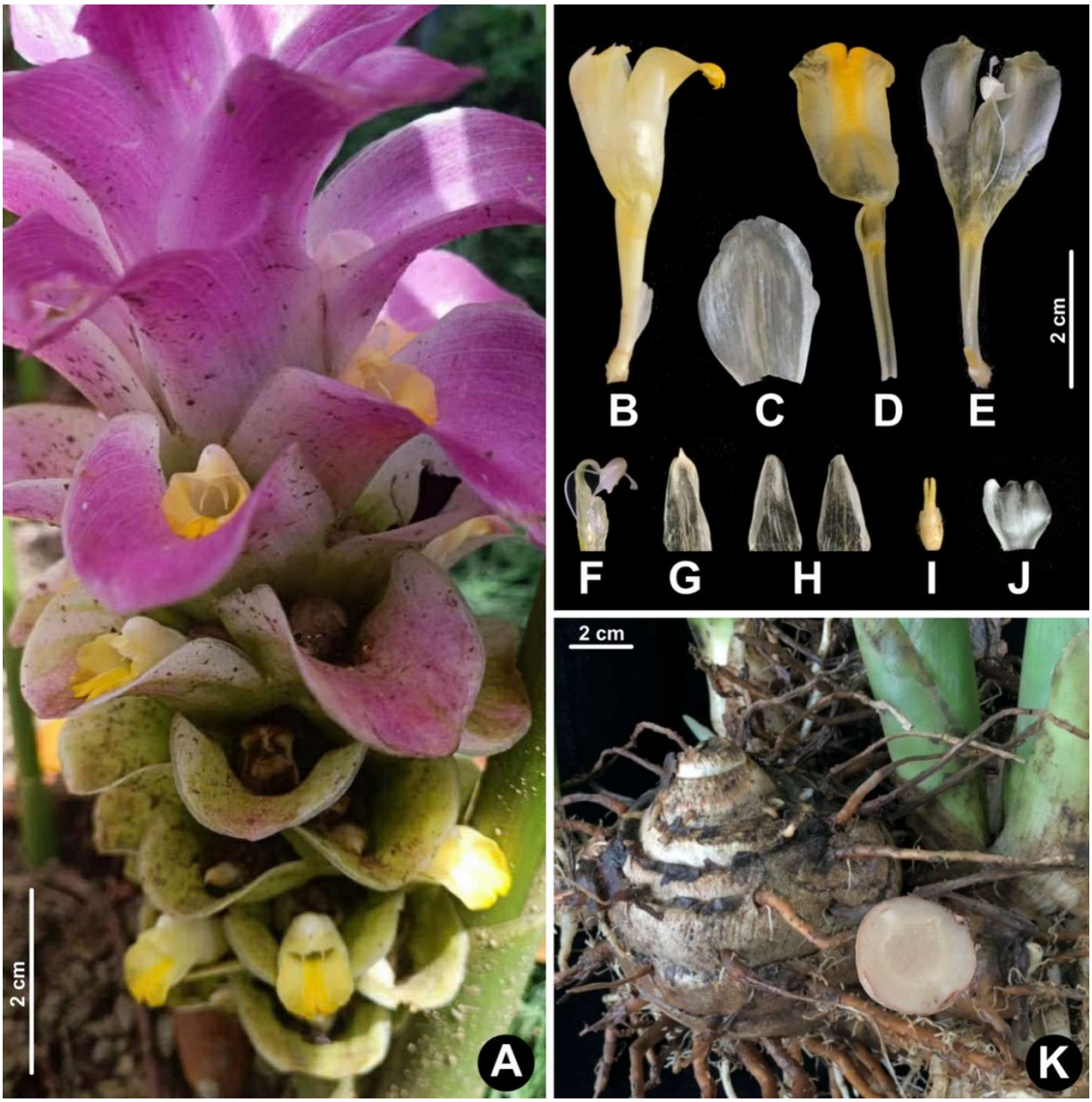

Fig. 4. ***Curcuma comosa*** Roxb. in Vietnam: **A.** Inflorescence with flowers. **B.** Side view of flower. **C.** Bracteole. **D.** Labellum with dissected floral tube. **E.** Staminodes with stamen and floral tube. **F.** Side view of anther. **G.** Dorsal corolla lobe. **H.** Lateral corolla lobes. **I.** Ovary with epigynous glands. **J.** Dissected calyx. **K.** Rhizome with dissected branched rhizome and roots. Photographs by Vo Van Sy. Designed by Thawatphong Boonma.

apex, ca. 5 mm long, pale yellow at the base, darker distally. ***Stigma*** irregularly capitate with two blunt dorsal bulges and a lateral ostiole, ciliate. ***Ovary*** barrel-shaped, c. 4 × 3 mm, cream-white to white, glabrous at the base, pubescent distally. ***Fruit*** not observed.

Vernacular name**:** Nghệ Gió, Nghệ Đắng.

Ecology**:** Deciduous forest, at an elevation of ca. 185 m a.s.l.

Phenology**:** Flowering in late April to May.

Distribution**:** Native to Assam, Laos, Myanmar, Thailand, and Vietnam (Leong-Škorničková and Saensouk, 2023; Saensouk *et al*., 2025b; POWO, 2025).

Utilization**:** The rhizome is used in traditional medicine to treat uterine symptoms.

Morphological notes on variation**:** *Curcuma comosa* (Figure 4) shows largely consistent morphology across its range, with minor differences among sources. The original description by Roxburgh (Roxburgh, 1810), based on plants collected from Pegu and cultivated at the Botanic Garden, Calcutta, emphasizes uniformly green foliage, young leaves faintly ferruginous along the midrib, large ovoid rhizomes, and numerous pink-and-yellow flowers. Modern populations in Thailand, Laos, and Vietnam have rhizomes of similar size, typically ovoid to

globose with short, rarely branched rhizome branches (Leong-Škorničková and Saensouk, 2023; Saensouk *et al*., 2025b). Inflorescence structure is comparable, though Roxburgh described the spike as "clavate" with numerous flowers, whereas modern specimens record thyrse lengths of 14–22 cm and 6–8 flowers per cincinni. Flower coloration is generally consistent—pink exterior and yellow interior—but modern descriptions provide more detailed measurements of floral organs including labellum, staminodes, corolla lobes, and bracteoles. Minor variation in bracteole size, number of flowers per cincinni, and subtle floral measurements among Thailand, Laos, and Vietnam likely reflects environmental influences rather than taxonomic divergence. These morphological variations are minor and fall within the natural phenotypic range of the species and therefore do not affect the circumscription or concept of *Curcuma comosa* (Roxburgh, 1810).

2. *Curcuma petiolata* Roxb., Roxburgh, Fl. Ind. 1: 36 (1820) ***Type***: [icon] "*Curcuma cordifolia*" in Icones Roxburghianae Ineditae No. 2156 (Lectotype K, designated by Leong-Škorničková *et al*., 2010).

Fig. 5

Heterotypic synonyms: *Curcuma petiolaris* T.Moore & Mast. (POWO, 2025)

Specimens from Vietnam examined: Vietnam, Tay Ninh Province, Tan Chau District, 25 August 2025 (with flower), *T.Boonma and S.Phimpha VN258251* (HNU!). Vietnam, Dak Lak Province, Yok Don National Park, 23 September 2023, *N.H.Tuan 239231* (HNU!). Vietnam, Ho Chi Minh City, Vung Tau, 24 August 2025, *T.Boonma VN258252* (HNU!). Vietnam, Lam Dong Province (Thuan Hai, Song Mao, NW of the station), 21 September 1940, *E.Poilane 30458* (E–image!). Vietnam, Ho Chi Minh City (Chau Thoi Mountain), 28 August 2008, *H.Đ.Trần and N.S.Lý 126* (E–image!).

Description of specimens collected in Vietnam: Perennial herb with rhizome. ***Rhizome*** ovoid, 5–8 × 3–5 cm, internally cream to yellow, branched, short, cream. ***Leafy shoot*** 0.5–1.0 m tall. ***Leaf sheaths*** green, puberulent; *ligule* bilobed, 0.5–1.0 cm long, sparsely pubescent; *petiole* up to 25 cm long, green, glabrous to puberulent. ***Lamina*** elliptic to broadly elliptic, 25–60 × 12–20 cm, green, glabrous on both surfaces with few hairs along secondary veins on adaxial surface, base cuneate, apex acuminate. ***Inflorescence*** terminal; *peduncle* pale green, densely puberulent, 20–43 cm long, mostly hidden within pseudostem; *thyrse* cylindrical, 15–32 × 6–8 cm; *fertile bracts* obovate, apex rounded with reflexed apex, pale green to whitish with pink apices, puberulent on both surfaces, 3.5–5.5 × 1.5–3.2 cm; *cincinnus* with 5–7 flowers; *coma bracts* elliptic with acute to obtuse apex, white to pale pink at base, pink to dark pink distally, pilose on both surfaces; *bracteoles* obovate, apex rounded, slightly hooded, 1.5–2.0 × 1.0–1.4 cm. ***Flowers*** gullet-type, ca. 5 cm long; *calyx* is 8–9 mm long, with a tridentate apex and a unilateral incision 3–4 mm long, semitranslucent white and glabrous; *floral tube* narrowly cylindrical at the base and funnel-shaped in the distal 1/3, 2.0–3.0 cm long, externally white to pale yellow, glabrous, internally bright yellow and with a ring of hairs around the constriction; *dorsal corolla lobe* ovate–triangular, prominently concave, hooded with a mucronate apex, 1.3–1.7 × 1.0–1.2 cm, ivory or cream, sometimes with a pale pink tinge at the apex, glabrous; *lateral corolla lobes* triangular with a blunt apex, shallowly concave, 1.1–1.4 × 0.6–0.9 cm, ivory to cream, glabrous; *lateral staminodes* irregularly obovate with an obtuse to rounded apex, with a conspicuous midrib, thicker than the margins, 1.1–1.4 × 0.6–0.8 cm, pale yellow at the base, more yellowish toward the apex; *labellum* broadly ovate, obscurely trilobed, 1.8–2.0 × 1.8–1.9 cm, midlobe emarginate with an incision of 2–3 mm, side lobes fold upwards, pale yellow with a bright yellow median band, glabrous but with glandular hairs along the sides of the median band. ***Stamen*** single, 7–8 mm long; *filament* 3–4 mm long and ca. 5 mm wide at the base, tapering to 1.5–2.0 mm at the point of attachment, ivory to cream and glabrous; *anther* spurred, ca. 6.0 × 2.5–3.0 mm with ivory to cream connective tissue, glabrous; *anther crest* bluntly quadrangular, concave; *spurs* conical, ca. 2 mm long, ivory to cream; *anther thecae* ca. 4 mm long, dehiscing throughout. ***Epigynous glands*** cylindrical with rounded apex, 4–5 mm long, cream. ***Stigma*** ca. 1 mm, ostiole ciliate. ***Ovary*** barrel-shaped, 3–4 × 2 mm, cream to ivory, pubescent. ***Fruit*** not observed.

***Vernacular name in Vietnam*:** Nghệ Sen.

***Ecology*:** Dry evergreen forest to deciduous forest, at an elevation of ca. 45–58 m a.s.l.

***Phenology*:** Flowering in July to September.

***Distribution*:** Native to Jawa, Laos, Myanmar, Thailand, and Vietnam (Leong-Škorničková and Saensouk, 2023; POWO, 2025).

***Utilization*:** The whole plant is cultivated as an ornamental, either in pots or planted in the ground to decorate gardens, houses, or buildings.

***Morphological notes on variation*:** The Vietnamese specimens of *Curcuma petiolata* match the protologue (Roxburgh, 1820) and the Flora of Thailand (Leong-Škorničková and Saensouk, 2023) in key morphological characters. Rhizomes are ovoid, branched, and internally pale yellow; leaves elliptic to broadly elliptic, glabrous except for few hairs along secondary veins; inflorescences terminal and central, with obovate fertile and elliptic coma bracts; flowers gullet-type, 5 cm long, with calyx tridentate and floral tube funnel-shaped, internally bright yellow with a ring of hairs. Minor variations in leaf length and floral color fall within intraspecific variation. Compared to Roxburgh's original description (ovate-oblong leaves, lilac coma bracts, deep bract pouches), the Vietnamese plants share diagnostic traits, confirming their identity as *C. petiolata* Roxb.

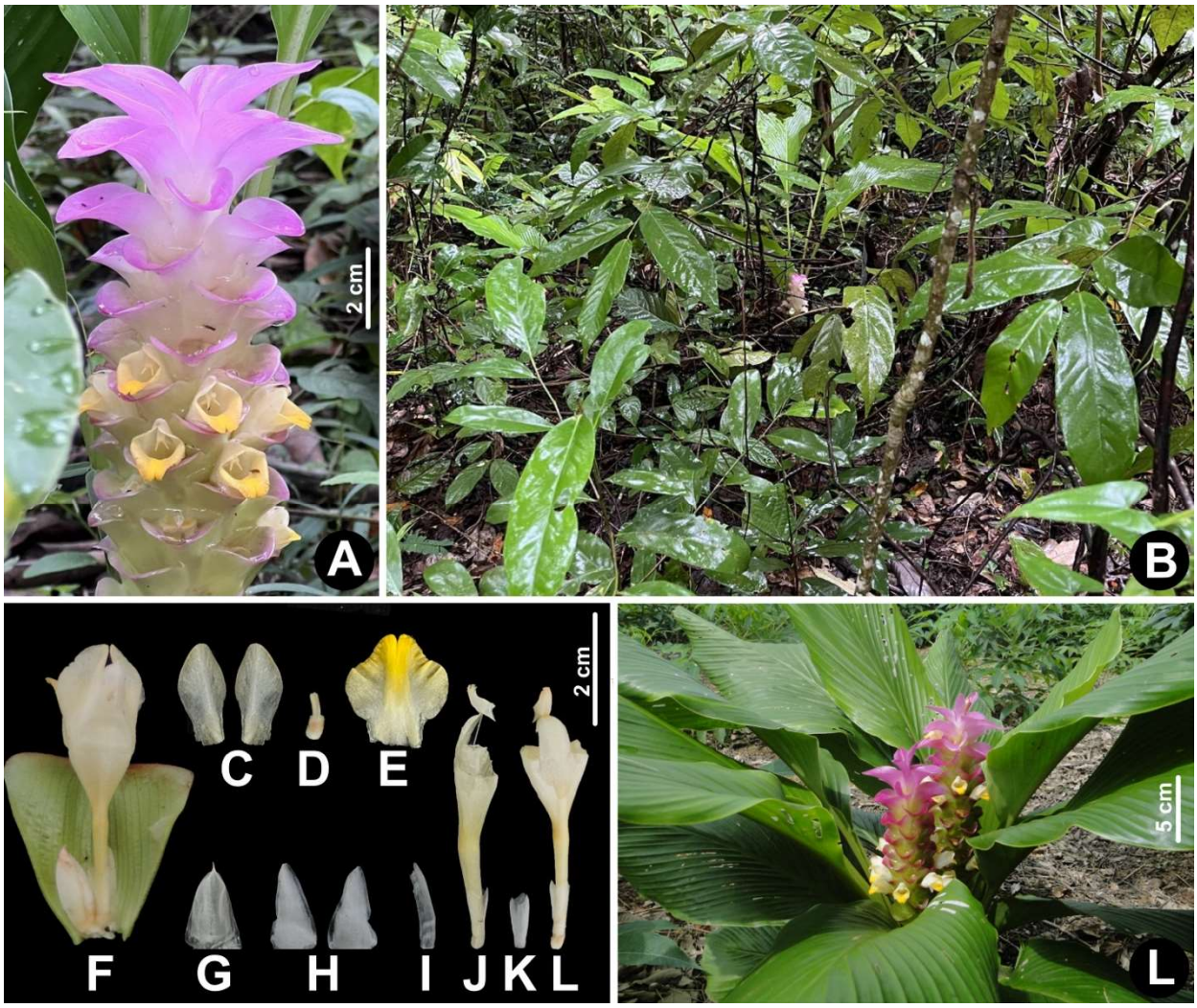

Fig. 5. ***Curcuma petiolata*** Roxb. in Vietnam: **A.** Inflorescence (from Dak Lak Province). **B.** Natural habitat in Tay Ninh Province. **C.** Staminodes. **D.** Ovary with epigynous glands. **E.** Labellum. **F.** Flowers with fertile bract and buds. **G.** Dorsal corolla lobe. **H.** Lateral corolla lobes. **I.** Bracteole. **J.** Side view of anther with floral tube **K.** Calyx. **L.** Back view of anther with floral tube. **M.** Habits in Vung Tau. Photographs (A) by Tran Minh Phuong, (B,C,E,G,H,J) by Thawatphong Boonma, and (D,F,I,K,L,M) by Danh Duc Nguyen. Designed by Thawatphong Boonma.

3. *Curcuma phrayawan* Boonma & Saensouk, Saensouk *et al*., Biodiversitas 22: 1668 (2021a). ***Type*:** Thailand. Nakhon Nayok Province, Ban Na District, 1 September 2019, *Boonma 5* (holotype: KKU) (Saensouk *et al.*, 2021a). **Fig. 6**

Specimens from Vietnam examined: Vietnam, Ha Tinh Province, Son Tay Commune, 31 August 2016, *N.H.Tuan 060* (HNU).

Description of specimens collected in Vietnam: Perennial herb with rhizome. ***Rhizome*** ovoid, 6–9 × 4–6 cm, internally deep yellow, branched, fragrant; *branches* yellowish with darker yellow core, 2.0–2.5 cm diam. ***Leafy shoot*** 1.5–2.0 m tall, with 6–9 leaves. ***Leaf sheaths*** alternate, 30–55 cm long, dark red, minutely pubescent; *ligule* bilobed, triangular, 2.5–4.0 × 2.0–3.0 mm, translucent white, apex acute, pubescent; *petiole* 15–30 cm long, reddish, glabrous. ***Lamina*** oblanceolate, 60–75 × 12–17 cm, upper surface green with red along midrib almost to apex, lower surface pale green with red along midrib almost to apex, glabrous on both surfaces, base attenuate, apex caudate. ***Inflorescence*** terminal; *peduncle* reddish, 40–50 cm long, minutely pubescent, with or without sterile bracts; *thyrse* cylindrical, 15–25 cm long; *fertile bracts* broadly elliptic, apex rounded, pale green with pale pink at middle and distal part, minutely pubescent on both surfaces; *cincinnus* with 3–5 flowers; *coma bracts* elliptic with obtuse apex, white with pink at distal part; *bracteoles* obovate, apex obtuse, slightly hooded, 2.1–2.5 × 1.5–1.8 cm, pale yellow, pubescent. ***Flowers*** gullet-type; *calyx* 12–13 mm long, translucent white, pubescent; *floral tube* narrowly cylindrical at base, funnel-shaped in distal 1/3, externally pale yellow, glabrous, with a ring of hairs around constriction; *dorsal corolla lobe* ovate–triangular, prominently hooded, apex

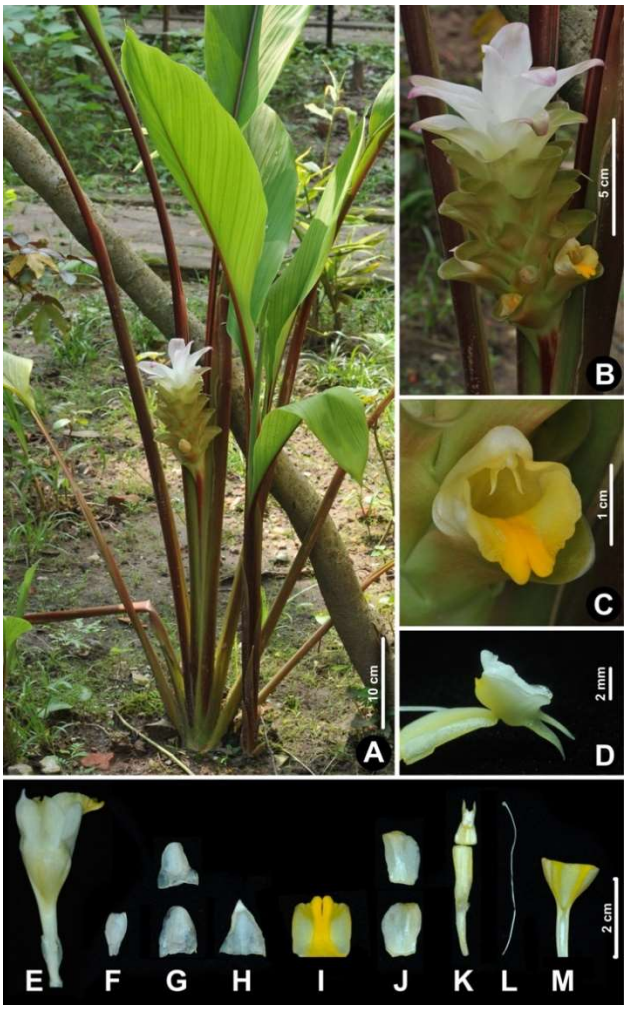

Fig. 6. ***Curcuma phrayawan*** Boonma & Saensouk in Vietnam: **A.** Habit. **B.** Inflorescence. **C.** Flower-front view. **D.** Anther–side view. **E.** Flower–side view. **F.** Calyx. **G.** Lateral corolla lobes. **H.** Dorsal corolla lobe. **I.** Labellum. **J.** Lateral staminodes. **K.** Floral tube with anther. **L.** Style and stigma. **M.** Dissected floral tube showing the hairy throat of the floral tube. Photographs by Nguyen Hoang Tuan. Designed by Thawatphong Boonma.

mucronate, 1.4–1.5 × 1.2–1.3 cm, white to pale yellow with pale pink tinge at apex, pubescent; *lateral corolla lobes* ovate–triangular, apex obtuse, shallowly concave, 1.4–1.5 × 1.2–1.3 cm, white to pale yellow with pale pink tinge at apex, glabrous; *lateral staminodes* obovate, apex rounded, 1.0–1.1 × 0.7–0.8 cm, pale yellow; *labellum* broadly obovate, 1.6–1.7 × 1.7–1.8 cm, apex emarginate with midlobe bilobed, incision ca. 2 mm, side lobes folding upwards, pale yellow with bright yellow median band. ***Stamen*** single, 4.5–5.0 mm long; *filament* 2.5–3.0 mm long, 4–5 mm wide at base, tapering to ca. 2 mm at point of attachment, pale yellow, glabrous; *anther* spurred, 2.8–3.0 × 2.5 mm, connective pale yellow, glabrous; *anther crest* present but not prominent; *spurs* narrowly conical, ca. 3.5 mm long, pointing downward, pale yellow, glabrous, tips directed outward in opposite directions; *anther thecae* 3–4 mm long, dehiscing throughout, pollen cream-white. ***Epigynous glands*** cylindrical, ca. 4 mm long, pale yellow. ***Stigma*** white. ***Ovary*** subglobose, ca. 3 × 3 mm, pale yellow, pubescent. ***Fruit*** not observed.

***Vernacular name in Vietnam*:** Nghệ Vua.

***Ecology*:** Found in deciduous to dry evergreen forests, typically in shady areas.

***Phenology*:** Flowering in rainy season between July and September.

***Distribution*:** Previously known from central Thailand and Laos (Saensouk *et al* 2021a; 2025b), here reported for the first time from Vietnam, extending the known range eastward to Hà Tĩnh Province.

***Utilization*:** Rhizome used as traditional medicine.

***Morphological notes on variation*:** The specimens collected in Vietnam are morphologically identical to those from Laos and closely match the protologue from Thailand. All agree in rhizome form, leaf size and coloration, inflorescence structure, bract and bracteole morphology, and floral characters including corolla, labellum, lateral staminodes, stamen, and ovary. Minor differences, such as slightly smaller rhizomes in the type of material from Thailand, somewhat larger floral parts, and a deeper calyx incision, are quantitative only and fall within the range of intraspecific variation expected in Zingiberaceae. These minor variations fall within the normal variation of the species, and the plants from Vietnam can be confidently identified as *Curcuma phrayawan* Boonma & Saensouk, representing a new record for the country.

Impact of climate change on habitat suitability for *Curcuma* subgenus *Curcuma*

The species distribution models for *Curcuma* subgenus *Curcuma* demonstrated strong discriminatory ability, with an average AUC of 0.874, indicating reliable predictive performance. The predicted current distribution is concentrated in the tropical and subtropical regions of Southeast Asia and southern China. Areas of high habitat suitability were identified in Thailand, Laos, Vietnam, Cambodia, Myanmar, and Malaysia, with additional suitable areas extending into Sumatra, Java, and parts of Borneo. In southern China, suitable habitats were primarily concentrated in Yunnan, Guangxi, and Guangdong, reflecting the ecological tolerance of the genus across a range of climatic conditions (Figure 7).

Future projections under both emission scenarios suggest that Southeast Asia will remain the primary stronghold for *Curcuma* subgenus *Curcuma* distribution, despite localized range contractions. Under both SSP126 (Figure 7B) and SSP585 (Figure 7C), suitable habitats are predicted to expand overall, although the magnitude of change differs slightly between scenarios. The low-emission scenario (SSP126) projects a 35.25% increase in suitable area, while the high-emission scenario (SSP585) predicts a 34.50% increase. These gains are

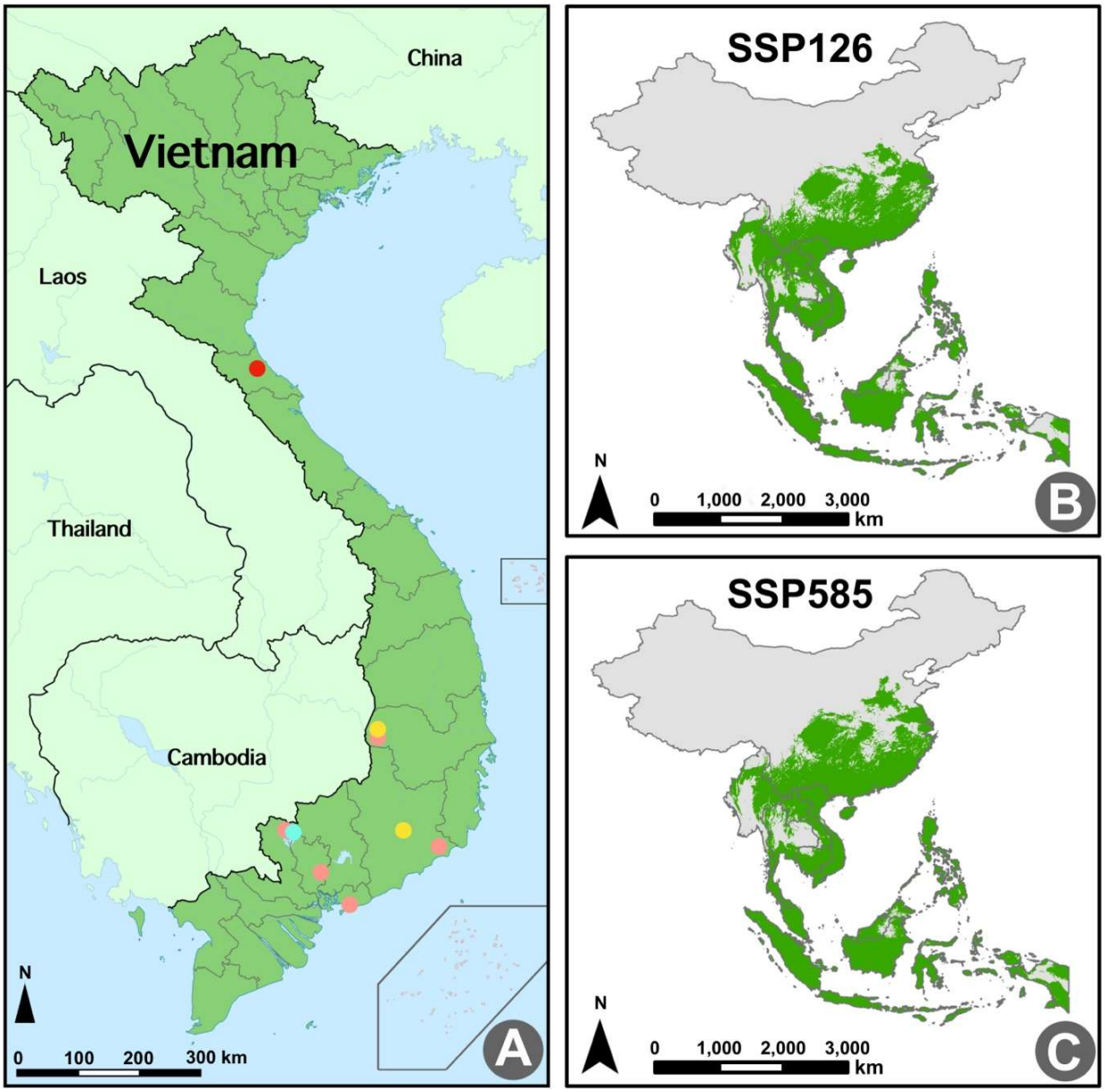

Fig. 7. A. Distribution of a new species, ***Curcuma fibrifera*** Boonma, D.D.Nguyen, P.Saensouk & Saensouk (**light blue**), and three new records of *Curcuma* subgenus *Curcuma* in Vietnam: ***C. comosa*** Roxb. in Dak Lak and Lam Dong Provinces (**yellow**), ***C. petiolata*** in Tay Ninh, Dak Lak, Lam Dong Provinces, and Ho Chi Minh City (**pink**), and ***C. phrayawan*** Boonma & Saensouk (**red**) in Ha Tinh Province. Data include both field-collected specimens and examined herbarium records. Map created with "Pixelmator Pro", designed by Thawatphong Boonma). **B.** Predicted distributions in future scenarios SSP126, and **C.** Predicted distributions in future scenarios SSP585. for 2050 across Southeast Asia and China for *Curcuma* subgen. *Curcuma,* the green areas indicate suitable habitats, while grey areas represent unsuitable habitats.

accompanied by localized contractions, particularly in parts of Thailand and Myanmar, but are offset by northward range expansions into China and the emergence of more extensive suitable areas in East Malaysia and Borneo (Figure 7).

The persistence and even expansion of suitable habitats across Southeast Asia and China under both climate pathways highlight the climatic resilience of *Curcuma*. These results suggest that unlike many tropical taxa projected to experience severe range losses under climate change, *Curcuma* may benefit from its broader ecological niche and capacity to track shifting climatic conditions. As warming progresses, subtropical and temperate regions are likely to provide suitable habitats for the establishment of tropical taxa such as *Curcuma*. Nevertheless, the predicted contractions in parts of Thailand and Myanmar raise important conservation concerns. These regions are centers of species diversity and may contain locally adapted populations that could be at risk. Conservation strategies should therefore

emphasize both the protection of core habitats in mainland Southeast Asia and the monitoring of newly emerging suitable habitats in northern and insular regions. Such an approach will ensure that management efforts account not only for the persistence of *Curcuma* subgenus *Curcuma* at the regional scale but also for the conservation of genetic diversity across its range.

Conservation status of a new species and three new records for Vietnam

A new species (*Curcuma fibrifera*) and three new records for Vietnam (*C. comosa*, *C. petiolata*, and *C. phrayawan*) occur within regions identified by species distribution modelling (SDM) as areas of high current and future habitat suitability for *Curcuma* subgenus *Curcuma*. Projections under both low-emission (SSP126) and high-emission (SSP585) climate scenarios indicate that Vietnam, together with much of mainland Southeast Asia, will remain a stronghold for the subgenus, with stable or expanding suitable habitats. This suggests that climate change does not represent an immediate threat to these taxa in the country. Nonetheless, localized pressures, including deforestation, shifting cultivation, infrastructure development, and collection for medicinal or ornamental use, pose potential risks to wild populations. Based on field data and IUCN Red List Categories and Criteria (IUCN, 2024), the following preliminary conservation assessments are proposed:

Curcuma fibrifera is currently known only from the type locality. Further field surveys and collections are needed to determine its full distribution. Due to insufficient data on its geographic range, population size, and potential threats, it is provisionally assessed as Data Deficient (DD) following the IUCN Red List criteria (IUCN, 2024).

Curcuma comosa Roxb. Found in deciduous forests of Dak Lak Province, within a protected area (Yok Don National Park). The species is locally common in Indochina and occurs in climatically stable habitats, but its populations may be affected by forest disturbance outside protected areas. Proposed status: Near Threatened (NT), stable under climate change, but potentially vulnerable to land-use change and collection.

Curcuma petiolata Roxb. Recorded from multiple sites in southern Vietnam (Tay Ninh, Ho Chi Minh City, and Dak Lak). Widely cultivated as an ornamental species, which reduces extinction risk, but wild populations are scattered and subject to habitat loss.

Proposed status: Least Concern (LC) at the national level, broad distribution and ex situ cultivation provide resilience, although continued monitoring of natural populations is recommended.

Curcuma phrayawan Boonma & Saensouk, newly recorded from Ha Tinh Province in north-central Vietnam. Known from only two localities in Vietnam, but both lie within zones of high predicted habitat suitability. The species has a narrow natural distribution (Thailand, Laos, and Vietnam) and is collected for traditional medicine. Proposed status: Vulnerable (VU D2), restricted distribution with potential pressure from harvesting and habitat fragmentation.

The persistence of suitable climatic conditions across Vietnam ensures that these species are not immediately threatened by climate change. However, their restricted natural populations and human-related pressures highlight the need for targeted conservation strategies, including: (i) protection of natural habitats, especially in Vietnam's central and southern forests; (ii) monitoring of wild populations for evidence of decline; and (iii) promotion of sustainable use and ex situ cultivation for species of medicinal or ornamental value.

Taxonomic clarification of *Curcuma rangjued* Saensouk & Boonma in Vietnam

The specimens from Dak Glong District, Dak Nong Province, Vietnam, previously misidentified as *Curcuma rangjued* Boonma & Saensouk and locally known as "scorpion turmeric" (Nghệ Bọ Cạp), by Hue *et al*. (2024), exhibit a suite of morphological characters that clearly contradict the protologue of *C. rangjued* (Saensouk *et al*., 2021b). Notably, Hue *et al*. (2024) did not cite or deposit any specimens in any herbarium, rendering their record unverified, but the morphology illustrated in their publication shows features inconsistent with *C. rangjued.* The Vietnamese plants (Hue *et al.*) possess ovoid, distinctly aromatic rhizomes with a yellow internal color, bitter taste, and 5–6 branched rhizomes curved like a scorpion's tail, characters that are absent in *C. rangjued*, which has non-aromatic, cream-colored rhizomes with 2–4 straight branches. Additional discrepancies occur in the leaf morphology and floral dimensions; the misidentified material shows elliptic leaves sometimes with faint red patches along the midvein and consistently smaller floral organs (calyx, floral tube, corolla lobes, staminodes, anther, and epigynous glands) than those described for *C. rangjued* (Table 1).

In contrast, the Vietnamese specimens match closely with *Curcuma daknongensis* D.D.Nguyen (Mai *et al*., 2025), a species originally described from the same locality (Dak Glong District) and also known locally as "Nghệ Bọ Cạp". Key congruent traits include the yellow, aromatic rhizomes; bitter taste; scorpion-tail-like rhizome branches; and similar shape and size of the lateral staminodes and labellum. Minor differences in leaf size or bract proportions fall within the known morphological variation documented for *C. daknongensis*, and no discontinuous or diagnostic character separates the misidentified material from this species.

Based on these consistent morphological and geographical evidences, the specimens previously misidentified as *C. rangjued* by Hue *et al*. (2024) should be referred to *C. daknongensis*. The co-authors who originally

Table 1. Morphological comparison between ***Curcuma rangjued*** Saensouk & Boonma (Saensouk *et al*., 2021b), the Vietnamese specimens misidentified as ***Curcuma rangjued*** (Hue *et al*., 2024), and *C. daknongensis* (Mai *et al*., 2025).

Characters	Protologue of *C. rangjued*	Recorded of *C. rangjued* in Laos	Specimens misidentified as *C. rangjued*	*C. daknongensis* D.D.Nguyen
Primary rhizome	Cream	Cream	Yellow	Pale yellow
Scent of rhizome	Non-aromatic	Non-aromatic	Aromatic	Aromatic
Taste of rhizome	Not bitter	Not bitter	Bitter	Bitter
Branched rhizome	Cream, 2–4 branched, Straight out from the primary rhizome	Cream, 2–4 branched, Straight out from the primary rhizome	Yellow, 5–6 branched, Curved like a scorpion's tail	Yellow, 4–8 branched, Curved like a scorpion's tail
Lamina shape and size	Narrowly elliptic to oblanceolate, (17-)30–60 cm long, (8-)12–17 cm wide	Narrowly elliptic to oblanceolate, 20–60 cm long, 10–17 cm wide	Elliptic, 40–45 cm long, 15–18 cm wide	Narrowly elliptic to oblanceolate, (15)25–40 cm long, (4)7.5–9.5 cm wide
Lamina – adaxial color	Green	Green	Green, with red patches alongside of the midvein, then become faint	Green
Thyrse (length)	14–18 cm	15–20 cm	12–15 cm	10–15 cm
Calyx (color and length)	Light pale yellow, 1.64–1.75 cm	Pale yellowish white, 16–18 mm	Translucent white, 1.2–1.4 cm	Translucent white, ca. 1.5 cm
Floral tube length	3.3–3.5 cm	3.3–3.5 cm	2.3–2.5 cm	2.8–3.3 cm
Dorsal corolla lobe	1.8–2 cm long, 1.7–2 cm wide	1.8–2.1 cm long, 1.7–2 cm wide	1.3–1.5 cm long, 1.2–1.4 cm wide	ca. 1.5 cm long, ca. 1.2 cm wide
Labellum	2.2–2.4 cm long, 1.6–1.8 cm wide	2.2–2.5 cm long, 1.5–1.8 cm wide	1.6–1.8 cm long, 1.5–1.6 cm wide	ca. 1.7 cm long, ca. 1.6 cm wide
Staminodes	1.7–2.1 cm long, 0.9–1.1 cm wide	1.7–2.1 cm long, 0.9–1.1 cm wide	1.2–1.3 cm long, 0.7–0.9 cm wide	1.5–1.6 cm long, ca. 0.9 cm wide
Anther (including spurs)	8.4–9 mm long	9–9.5 mm long	6–7 mm long	ca. 7 mm long
Anther spurs	3–4 mm long, Pointing downward	3.5–4 mm long, Pointing downward	ca. 3 mm long, Curved inward	3–4 mm long, Curved inward
Epigynous glands	5–6 mm long	5–6 mm long	4–5 mm long	ca. 4 mm long
Reference	Saensouk *et al*., 2021b	Saensouk *et al*., 2025b	Hue *et al*., 2024	Mai *et al*., 2025

described *C. rangjued* have confirmed that the morphological characters reported by Hue *et al*. (2024) do not match *C. rangjued*, further supporting misidentification. Consequently, *C. rangjued* is excluded from the flora of Vietnam.

Moreover, we encourage a careful re-evaluation of the "Nghệ Bọ Cạp" in Vietnam, particularly from the type locality, because several characters in the description of *C. daknongensis* appear to have been modified from the original protologue of *C. rangjued*. A thorough future reassessment will help clarify whether the misidentified material is truly conspecific with *C. daknongensis*. However, based on the current evidence, we are confident that it does not belong to *C. rangjued*.

Notes on the correct spelling of *Curcuma zedoarioides*

Curcuma zedoarioides Chaveer. & Tanee, recently recorded from Vietnam by Tuan *et al*. (2021), was originally published as *C. zedoaroides* (Tanee *et al*., 2008). The original epithet "*zedoaroides*" represents an orthographical error. According to the International Code of Nomenclature for algae, fungi, and plants (ICN) Art 60 (Turland *et al*., 2018), spelling errors in the formation of names must be corrected. The epithet was intended to mean "resembling *Curcuma zedoaria*," and the correct formation combines the noun *zedoaria* with the suffix -*oides*, resulting in *zedoarioides*. In the original publication, the letter "*i*" was omitted, yielding the incorrect spelling *zedoaroides*. The orthographically correct form is therefore *Curcuma zedoarioides* Chaveer. & Tanee, which should be adopted in all subsequent references.

The checklist of *Curcuma* subgen. *Curcuma* in Vietnam

As a result of the discovery of a new species and three new records of the subgenus *Curcuma* in Vietnam, together with the taxonomic clarification of *C. rangjued* Saensouk & Boonma, showing that previous records (Hue *et al*., 2024) represent a misidentification, and the note on the orthographical error of *C. zedoarioides* Chaveer. & Tanee (Tuan *et al*., 2021), the checklist has been updated accordingly. Additionally, although *C. phaeocaulis* is recorded in the Flora of China as being cultivated in Vietnam, and the Plants of the World Online lists it as native to China (South-Central), Java, and Vietnam, it is not included in the Flora of Vietnam (Nguyen, 2017), and there is currently no voucher specimen confirming its presence in the country. Therefore, we exclude this species from the checklist until a verified specimen is available. Consequently, the total number of recognized species of this subgenus in Vietnam currently amounts to 16 species, as listed in Table 2.

Table 2. Checklist of ***Curcuma*** subgenus ***Curcuma*** in Vietnam.

Species	Voucher specimens	References
Native		
1. *Curcuma aeruginosa* Roxb.	Yen Lang, *B.Balansa 4217* (P); Bin Phuoc, *PKL 16010C* (HN) and *PKL 16047C* (HN); Son La, *N.Q.Binh 609* (HN)	Nguyen, 2017
2. *Curcuma angustifolia* Roxb.	Dak Lak, *N.T.Hiep 356* (HN!, HN0000079740); *VH 1145* (HN!, HN0000079741)	Present study
3. *Curcuma aromatica* Salisb.	Ninh Binh, *NMC 2139* (HN!, HN0000079743); Hanoi, *QB 698* (HN!, HN0000079744); Xuan Nha Moc Chau, Son La, *QB 585* (HN!, HN0000079748)	Present study
4. *Curcuma comosa* Roxb.	Dak Lak, Yok Đôn National Park, *N.H.Tuan and V.V.Sy VVS250427* (DUMTP!); Phu Quoc, *Contest-Lacour 87* (P)	Present study
5. *Curcuma daknongensis* D.D.Nguyen	Dak Nong, *D.D.Nguyễn and T.C.Mai NDD 24050* (VNMN, LE); Kien Giang, *D.D.Nguyễn and T.T.Lê NDD 532* (LE)	Mai *et al*., 2025
6. *Curcuma elata* Roxb.	Gia Lai, *Fiona Willis, Peter Boyce, N.V.Dzu 11* (HN); Lam Dong, *A.J.B.Chevalier 40301* (P); Lam Dong, *A.J.B.Chevalier 40483* (P); Lam Dong, *A.J.B.Chevalier 40543* (P); Phu Mieng, *F.Evrard 834* (P); Kon Tum, *E.Poilane 32321* (P); Lagna, *M.Schmid s.n.* (P)	Nguyen, 2017 & Present study
7. *Curcuma fibrifera* Boonma, D.D.Nguyen, P.Saensouk & Saensouk	Tay Ninh, Tan Chau, *T.Boonma, S.Phimpha & D.D.Nguyen TNH001* (holotype HNU!)	Present study
8. *Curcuma kwangsiensis* S.G.Lee & C.F.Liang	Kon Tum, *QB 619* (HN!, HN0000079755)	Present study
9. *Curcuma petiolata* Roxb.	Tay Ninh, Tan Chau, *T.Boonma and S.Phimpha VN258251* (HNU!); Dak Lak, Yok Don National Park, *N.H.Tuan 239231* (HNU!); Ho Chi Minh City, Vung Tau, *T.Boonma VN258252* (HNU!); Thuan Hai, *E.Poilane 30458* (E); Thuan Hai, *E.Poilane 30460* (E); Dong Nai, *H.Đ Trần. and N.S.Lý 126* (E)	Present study
10. *Curcuma phrayawan* Boonma & Saensouk	Ha Tinh, Son Tay Commune, *N.H.Tuan **0**60* (HNU!)	Present study
11. *Curcuma plicata* Wall. ex Baker	Kon Tum, *VH 992* (HN!, HN0000079742); Dak Lak, *Trần H.Đ. 80* (E)	Present study
12. *Curcuma trichosantha* Gagnep.	Cao Bang, *X.Trường, s.n.* (HNPI)	Nguyen, 2017
13. *Curcuma zedoarioides* Chaveer. & Tanee	Thai Nguyen, Dong Hy, Minh Lap, *N.H.Tuan, N.V.Hoa, P.N.Khanh, N.T.Thu, and D.T.Ha s.n.* (HNU!, HNU022611)	Tuan *et al*., 2021
Introduced		
14. *Curcuma longa* L.	Hanoi, *QB 626* (HN!, HN0000079756)	Present study
15. *Curcuma zanthorrhiza* Roxb.	Kon Tum, *N.H.Hieu 304* (HN!, HN0000079763); Vietnam, *M.F.Newman 2548* (E); Nghe An, *C.J.Spire 1188* (P)	Ho, 1993, Škorničková & Sabu, 2005 & Present study
16. *Curcuma zedoaria* (Christm.) Roscoe	Quang Nam-Da Nang, *J.Clemens and M.S.Clemens 3984* (P); Ho Chi Minh, *J.B.L.Pierre s.n.* (P)	Nguyen, 2017

DISCUSSION

This study documents a newly described species, *Curcuma fibrifera*, together with three newly verified records (*C. comosa*, *C. petiolata*, and *C. phrayawan*) for Vietnam, thereby clarifying the taxonomy and distribution of *Curcuma* subgenus *Curcuma* in the country. In addition to these findings, the clarification of misidentified material previously attributed to *C. rangjued*, and the exclusion of *C. phaeocaulis* due to the lack of verified voucher specimens, further refine the national inventory of the subgenus. As a result, the updated checklist now recognizes 16 confirmed species of subgenus *Curcuma* in Vietnam. Collectively, these results significantly advance knowledge of Zingiberaceae diversity in Indochina and contribute to ongoing regional efforts to document overlooked or misidentified taxa.

Curcuma fibrifera is described from Vietnam as a member of subgenus *Curcuma*. It is most similar to *C. wanenlueanga* (Saensouk *et al*., 2021c, 2025b) but is clearly distinguished by rhizome morphology, especially the presence of fibrous threads visible when broken, as well as several vegetative and floral traits. Species distribution modelling indicates that suitable habitats for subgenus *Curcuma* remain available in Vietnam, suggesting that additional taxa may still await discovery. The recognition of *C. fibrifera* therefore has broader implications: it not only adds to the documented diversity of Zingiberaceae in the country but also highlights the importance of continued field exploration and conservation of habitats that may harbor yet-undescribed species.

The verification of *C. comosa*, *C. petiolata*, and *C. phrayawan* extends their known distributions into Vietnam, highlighting floristic continuity with Laos, and Thailand. All three species match their protologues and descriptions from neighboring regions (Roxburgh, 1810, 1820; Leong-Škorničková and Saensouk, 2023; Saensouk *et al*., 2021a). Minor morphological variation in Vietnamese material, such as differences in rhizome size or floral proportions, falls within the expected intraspecific

range of Zingiberaceae (Vanijajiva *et al*., 2005; Leong-Škorničková *et al*., 2015), confirming these records as genuine distributional extensions rather than distinct taxa.

The identification of *Curcuma rangjued* in Vietnam by Hue *et al*. (2024) appears to be a misidentification. Misidentified specimens can misrepresent species distributions and challenges in conservation planning and may also affect pharmacological interpretations if tested materials do not correspond to the described species. In this case, the specimens should be recognized as *C. daknongensis* D.D.Nguyen (Mai *et al*., 2025). Fortunately, most *Curcuma* species are used as herbs and are generally non-toxic compared to species in other families, so reported inhibitory activities against cancer cell lines likely pose limited immediate safety concerns. Nevertheless, accurate taxonomic verification based on voucher specimens rather than photographs or vernacular names is essential for maintaining reliable floras and conservation assessments (Saensouk *et al*., 2024a,b,c).

Species distribution modelling (SDM) revealed that Vietnam and much of mainland Southeast Asia will remain strongholds for *Curcuma* under both low- and high-emission climate scenarios. Unlike many tropical taxa projected to undergo severe range contractions (Corlett and Westcott, 2013; Newbold, 2018), *Curcuma* species are predicted to maintain or even expand suitable habitats, likely due to their ecological breadth and adaptability (Leong-Škorničková and Saensouk, 2023; Saensouk *et al*., 2025b). Potential range expansion into subtropical China and Borneo suggests resilience to future warming, although localized contractions in Thailand could threaten current centers of species diversity.

The discovery of *Curcuma fibrifera* and additional records of congeners highlights that Vietnam still harbors underexplored diversity within subgenus *Curcuma*. Suitable habitats exist in in both protected and unprotected areas, providing opportunities for conservation. Targeted field surveys are needed to determine population sizes, distribution ranges, and habitat requirements for newly recorded species and *C. fibrifera*. Protecting key localities, particularly the type locality of these species will be important to safeguard populations from habitat degradation or unsustainable collection. Conservation strategies should integrate both in situ and ex situ measures. In situ approaches may include establishing the Other Effective Area-Based Conservation Measures (OECMs) areas in climatically suitable but unprotected areas to maintain habitat connectivity and support naturally occurring populations (IUCN-WCPA, 2019). Ex situ strategies, such as cultivation in botanical gardens, seed banks, or tissue cultures, can complement in situ efforts and provide material for restoration or sustainable use (Engels and Ebert, 2021). Community involvement is also crucial to promoting awareness of the ecological and cultural value of these species can encourage sustainable harvesting practices and local stewardship (Cunningham, 2001).

While the present study relied on morphological evidence and herbarium records, integrating molecular phylogenetics in the future would strengthen our understanding of species relationships within subgenus *Curcuma* (Záveská *et al*., 2012; Leong-Škorničková *et al*., 2015). Field-based studies on reproductive biology, ecological requirements, and ethnobotanical relevance are also needed, especially for *C. fibrifera*. Long-term monitoring should be prioritized to detect population trends and habitat shifts. Substantial portions of suitable habitat remain outside protected areas, promoting these areas as the Other Effective Area-Based Conservation Measures (OECMs) could strengthen conservation outcomes while supporting sustainable use by local communities (IUCN-WCPA, 2019; IUCN, 2024).

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