

Taxonomic notes of *Alpinia* subsect. *Catimbium* (Zingiberaceae) in Vietnam: The first record of *Alpinia nobilis* and description of a new species *Alpinia hoangviet*

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Manuscript received: 11 May 2023. Revision accepted: 12 October 2023.

Abstract. Nguyen DD, Saensouk S, Nguyen VC, Nguyen VK, Pham TTD, Nguyen DK, Nguyen TLT. 2023. Taxonomic notes of *Alpinia* subsect. *Catimbium* (Zingiberaceae) in Vietnam: The first record of *Alpinia nobilis* and description of a new species *Alpinia hoangviet*. *Biodiversitas* 24: 5293-5301. *Alpinia* subsect. *Catimbium* is characterized by the inflorescences being a raceme, panicle or spike; bracts usually absent; prominent bracteoles, if present, almost enclosing the flower buds, calyx deeply split unilaterally, deeply concave labellum usually over 3 cm long and yellow-orange marked crimson red, reduced staminodes being subulate to lightly swollen (nearly absent), and anther usually not crested. The revision of subsect. *Catimbium* in Vietnam is not completed yet. We estimate that the number of this subsect. is roughly 50% of *Catimbium* species of the World. As a result of the examination of our living specimens collected during 2019-2022, *Alpinia nobilis* was defined as a new record in southern Vietnam, and *Alpinia hoangviet*, a new species belonging to subsect. *Catimbium* (Zingiberaceae: Alpinieae) from Central Vietnam is described. The taxonomic treatment with a description, photographs, distribution, ecology, conservation assessment, and morphological comparison of the new species with their allies are provided. Moreover, a revised key to all species of *Alpinia* subsect. *Catimbium* in Vietnam, is included. *Alpinia hirsuta* and *A. latilabris* were eliminated from this key. *Alpinia hirsuta* is considered a member of subsect. *Alpinia*, whereas the presence of *A. latilabris* in Vietnam is a misidentification.

Keywords: *Alpinia nobilis*, *A. hoangviet*, subsect. *Catimbium*, taxonomic, Vietnam, Zingiberaceae

INTRODUCTION

Alpinia Roxb. is one of the largest genera of evergreen shrubs in the family Zingiberaceae (tribe Alpinieae) with about 230 species occurring in tropical and subtropical Asia, and extending from Malesian islands to the North Australian continent (Leong-Škorničková and Newman 2015; Luru et al. 2019). This genus is characterized by frond-like leafy shoots having many leaves (except for sect. *Didymanthus* K.Schum.), terminal inflorescence, white flowers with colorful labellums (yellow to red), and reduced or absent lateral staminodes (Leong-Škorničková and Newman 2015).

Following this traditional classification proposed by Smith (1990), more than 30 native *Alpinia* species recorded in Vietnam (Nguyen 2017) belong mainly to sect. *Alpinia* (subgenus *Alpinia*) is characterized by inflorescence erect or pendulous, branched or unbranched; bracts often soon deciduous, rarely persistent, occasionally calyprate, sometimes absent; flowers single or in cincinni; capsule spherical or elongate (Smith 1990).

Catimbium (Horan.) R.M. Smith is one of only two subsections (the other is *Alpinia*) of section *Alpinia* subgenus *Alpinia* found in Vietnam. This subsect. is often grown as ornamental plants with the commercial name

‘shell zinger’ getting its name from their shell-like bracteoles enclosing whole buds. This subsection is characterized by the inflorescences being a raceme, panicle or spike; bracts usually absent; prominent bracteoles, if present, almost enclosing the flower buds, calyx deeply split unilaterally, deeply concave labellum usually over 3 cm long and yellow-orange marked crimson red, reduced staminodes being subulate to lightly swollen (nearly absent), and anther usual not crested (Smith 1990; Tanaka et al. 2023). From subsect. *Alpinia*, it is easily distinguished by its labellum rarely under 3 cm long, often much more (vs. up to 2.5 cm long, commonly much less) and bracteoles usually completely enclosing the buds (vs. not completely enclosing the buds) (Smith 1990; Lý 2017) supplied a key for 12 species of subsect. *Catimbium* in Vietnam, including new species described by himself, *A. newmania* N.S.Lý. Then three more new species were described for science namely, *A. vietnamica* H.Đ. Trần, Luu & Škorničková, *A. hongiaoensis* Tagane, and *A. nelumboides* Nob.Tanaka, T.T.K.Van & V.Hoang (Luru et al. 2019; Shuichiro et al. 2020; Tanaka et al. 2023), of which the first name is used to apply for the Vietnamese rugosa leaf taxon was misidentified as Hainanese species, *A. rugosa* S.J. Chen & Z.Y. Chen (Huong et al. 2017). In total, Vietnam has become a biodiversity hotspot of the subsect. *Catimbium*

with 14 taxa. This is roughly 50% of *Catimbium* species of the World with at least 33 species throughout their native range from tropical and subtropical Asia to West Pacific (Lý 2017).

During our floristic explorations in 2019-2022 in South and Central Vietnam, we collected specimens of many unidentified *Alpinia* taxa belonging to subsect. *Catimbium*. After studying the morphological characteristics of our collections with the described taxa of this subsect., we confirm that one taxon matches with characteristics of *A. nobilis* Ridley. The second taxon is confirmed as an undescribed species. Hence, we make a protologue for these plants in the present article. The taxonomic treatment with descriptions, photographs, distribution, ecology, conservation assessment, and morphological comparison of new species with its closely related species are provided. Therefore, this study aimed to present the updated taxonomic status of *Alpinia* subsect. *Catimbium* (Zingiberaceae) in Vietnam with description and illustration the newly recorded species, *A. nobilis*, and the new species for science, *A. hoangviet*.

MATERIALS AND METHODS

Twenty-five specimens belonging to 13 taxa were collected during fieldwork in periods 2019-2022. The floral parts were dissected in the field, and preserved in ethanol 70% for subsequent studies. In addition, flowering shoots were cut for voucher specimen preparation. Some rhizomes were collected and planted in the Botanic Garden of Thu Dau Mot University, Vietnam. At least 2 herbarium sheets were made for each collection number and they were deposited at the Herbarium of Vietnam National Museum of Nature (VNMN), Hanoi and the University of Science (HNU), Ho Chi Minh City, Vietnam.

A careful study of materials was conducted by a detailed comparison with relative taxa from the neighboring countries, especially China, based on living materials, dry herbarium specimens (digital images from <https://plants.jstor.org/>, <https://powo.science.kew.org/>, <https://science.mnhn.fr/>, AAU: https://www.aubot.dk/search_form.php) and relevant literatures, such as Roxburgh (1810), Ridley (1899), Schumann (1902, 1904), Wu and Larsen (2000), Saensouk et al. (2003), Tseng and Wang (2011), Zou et al. (2012), Lý (2017), Nguyễn (2017), Luu et al. (2019), and Shuichiro et al. (2020). The data used for the description is based on measurements of the living plant specimens, combined with dried material and alcohol-treated flowers mentioned above. The morphological characteristics of living specimens, which we identify as *A. nobilis*, are compared to those of type specimens based on protologue (Ridley 1899), and relevant literature having photos of live specimens collected at the type locality in Peninsular Malaysia (Lim 2013). The morphological characteristics of new species are compared to those of *A. macroura* K.Schum. based on the dried type specimens in the herbarium and digital images of live type specimens provided by Dr. Surapon Saensouk recently from the type locality of this species in Thailand. The general plant

terminology used to describe this species follows Beentje (2016) and Lý (2017).

RESULTS AND DISCUSSION

During the fieldwork to study the species diversity of the plants in the southern part of Vietnam, we found an undescribed species for science, namely *Alpinia hoangviet*, and a newly recorded species, namely *A. nobilis*, in the genus *Alpinia* subsect. *Catimbium*, the family Zingiberaceae. The taxonomic treatment, description, flowering period, etymology, distribution, preliminary conservation status, ecology, vernacular names, uses, notes, illustrations, and photographs of both taxa were observed. Additionally, two taxa, namely *A. hirsuta* (Lour.) Horan. and *A. latilabris* Ridl., were eliminated from the checklist of Vietnamese *Catimbium*. We rediscovered the first taxon after 200 years of publication, its morphological character appropriate to those of subsect. *Alpinia* instead of subsect. *Catimbium*. The presence of the second taxon in Vietnam is a misidentification. This work results in the number of recognized species of subsect. *Catimbium* in Vietnam is still 14 and present here in the revised key.

Taxonomic treatment

Alpinia nobilis Ridl., a new record species for Vietnam

***Alpinia nobilis* Ridl.**, J. Straits Branch Roy. Asiat. Soc. 32 (1899) 169. Homotypic Synonyms: *Alpinia malaccensis* var. *nobilis* (Ridl.) I.M.Turner, Novon 6 (1996) 223 - Type: Ridley, H.N. [4617] (holotype K); Other cited specimens: Pahang, Kuala Tembeling, Ridley s.n., 1891 (SING), Ginting Bidai, Ridley 7795; Corner SFN 32516 (Figure 1)

Description. Large clump-forming herb up to 4 m tall with 5-10 pseudostems per clump. *Rhizome* creeping with the distance between two neighboring leaf shoots ca. 5-10 cm, 10-20 mm in diam., outside pale green turning brown with age, inside cream white internally, slightly aromatic; rhizome scales broadly triangular, brown, soon decaying. *Leafy* shoots of mature flowering individuals ca. 3 m long, with 9-12 leaves, leafless in lower 1/3; bladeless sheaths 3-5, 5-30 cm long, striated, the innermost one light dull green, the outermost ones mid-green turning tinged brown with age, puberulent externally, glabrous internally; leaf sheath striated, dark green with various degree of small purplish-red blotches, puberulent; ligules entire to emarginate, ca. 10 mm long, leathery, yellowish-green with sparsely small purplish-red blotches, rusty villous, margin entire and ciliate; petiole 3-5 cm long, pubescent; lamina oblong-lanceolate, lightly plicate, 60-90 x 13-20 cm, leathery, adaxially dark green, glabrous, abaxially light green, glabrous to puberulent, base attenuate, apex caudate. *Inflorescence* terminal raceme, erect, ca. 20 cm long, bearing 30-50 cincinnus, 1-flowered per cincinni; peduncle 5-7 cm long, ca. 10 mm in diam., pale green, rusty villous, with 2 sheathing bracts, soon caducous; rachis thick, stout, 10-13 cm long, pale green, rusty villous; sheathing bract narrowly elliptic to lanceolate, 10-15 cm long, externally dark green soon turning dry and brown, glabrous, internally paler, shiny, and glabrous, the outer one with a leaflet at the

apex, ca. 2 cm long, the inner one smaller, apex acute; *fertile bracts* absent; *bracteoles* open to base, shell-shaped, ca. 30 x 50 mm, semi-translucent, white tinged red or not at the tip, glabrous, apex acute, margin entire and ciliate. *Flowers* 5-6 cm long; pedicel 5-7 mm long, 2-2.5 mm in diam., pale green, rusty villous; *calyx* tubular, hairy outside, glabrous inside, narrowed at the base, gradually dilate above, ca. 20 mm long, ca. 10 mm in diam. at widest point (ca. 20 mm when stretched), cream white, shiny, semi-translucent, apex 3- to 5-toothed, and split to 7 mm on one side, margin ciliate; *floral tube* 12-14 mm long, widening gradually towards the apex, externally white throughout, sparsely short white-pubescent, internally white and glabrous at base turning red and hairy at apex; *dorsal corolla lobe* obovate to elliptic, 25×20 mm, white, margins inward wrapping, translucent, shiny, externally rusty villous, internally glabrous, margin ciliate; *lateral corolla lobes* triangular, ca. 20×10 mm, concave, white, shiny, its margins slightly translucent, cucullate at apex, rusty villous, margin ciliate; *labellum* broadly ovate, 3-lobed, strongly concave at base half, flattened in the apex half, ca. 30 mm long, ca. 30 mm wide when stretched, base half yellow tinged orange-red blotch with yellow margins, apex half (mid lobe) pale yellow with finely dark red stripes; slightly deflexed near the apex, apex oblong, shallowly 2-lobed, incision ca. 5 mm long; lobes nearly equal, glabrous; lateral staminodes nearly absent (lightly swollen) sometime the tip elonging into hook-shaped spurs 3-4 mm long, dark red, adnate to the base of labellum at transitional position with filament. *Stamen* attached to floral tube at ca. 180°, curved inwards; filament 15×5 mm, cream white, pubescent throughout; *anther* 15×5 mm, sparsely tomentose on the base; *thecae* parallel, as long as anther, ca. 5 mm wide, bright yellow with red blotch, dehiscing through their entire length, glabrous; *anther crests* absent. *Style* ca. 38 mm long, white, hairy near the apex; stigma funnel-shaped, 1 mm in diameter, white, sparsely hairy; *ostiole* ciliate. *Epigynous* 2, 2-3 mm long, 1.5-2 mm wide, pale yellow, glabrous, apex truncate. *Ovary* globose to elliptic, ca. 3×3 mm, green, golden pubescent, 3-locular, placentation axile. *Immature fruit* capsular, indehiscent, globose, 1.7-1.9 × 1.5-1.7 cm, mid-green, densely pubescent. Flowering in late March to May and fruiting is prior from April and predicted to extend to Fall.

Distribution: Peninsular Malaysia, southern Vietnam.

Habitat and ecology. *Alpinia nobilis* inhabits in semi-shaded and humid conditions of forest margins of lowland evergreen forests, usually in the foothills, along the trails or stream valleys, and in moist soil on granite at an elevation of 100-300 m asl.

IUCN preliminary assessment. It is locally common in open areas of lowland evergreen forest in foothills of southern Vietnam. The Vietnamese subpopulation occurs in an area of occupancy (AOO) of about 50 km². The distance from the Vietnamese population to the type population is more than 1,000 km. We estimate that the extent of occurrence (EOO) is more than 20,000 km².

However, both populations have to deal with habitat loss due to deforestation. To evaluate exactly its population size, we and other teams need a few years to conduct further expeditions to collect more specimens. Hence, we highly suggest assessing its conservation status at the moment as Data Deficient (DD) following the IUCN criteria (2022).

Specimens examined: –Vietnam. Lam Dong Pro., Da Teh Dis., My Duc Com., elevation 300 m, April 2022, 11°28'02.8"N 108°03'49.6"E, *Nguyen Danh Duc NDD-22237* (HNU!); Lam Dong Pro., Da Teh Dis., Da Pal Com., elevation 300 m, March 2023, 11°31'14.1"N 107°34'20.2"E, *Nguyen Danh Duc NDD-23010* (HNU!) (Figure 1).

Taxonomic note: *Alpinia nobilis* is most similar to *A. latilabris* in the overall view of habit and inflorescence, but lacks anther crest of the latter. It is used to misidentified as *A. malaccensis* (Burm.f.) Roscoe in an erect raceme, white flower with yellow crimson labellum enclosing in white shell-shaped (ovoid) bracteoles, but differs in (i) pubescent ligule (vs. glabrous), (ii) hirsute bracteoles and calyx throughout (vs. almost glabrous, hirsute in apex and base), (iii) broadly oblong-lanceolate (vs. linear-lanceolate) lamina, (iv) inflorescence more densely flowered, (v) corolla lobes densely yellow silky (vs. glabrous). In Vietnam, it is somewhat similar to *A. hainanensis* K. Schum. in an erect raceme, white flower with yellow crimson labellum enclosing in white shell-shaped (ovoid) bracteoles, but differs in (i) hirsute habit (vs. glabrous, rarely hirsute in lamina abaxially), (ii) broadly oblong-lanceolate (vs. linear-lanceolate) lamina, (iii) corolla lobes yellow silky (vs. glabrous), (iv) bract absent (vs. 4-5 cm). This species is also similar to *A. nelumboides* in the size and general view of habit, one flower per cincinni, milky shell-shaped bracteoles, and white flowers with yellow-crimson labellums but differs in (i) rhizome cream white inside (vs. pale orange), (ii) inflorescence less densely flowered, up to 50 cincinnus (vs. up to 100 cincinnus) per inflorescence, (iii) shorter bracteoles 3.5-4 (vs. 5-14) cm long, (iv) adaxially glabrous (vs. pubescent), (v) corolla lobes yellow silky (vs. glabrous or sparsely hairy outside), (vi) labellum having well-elonging apex forming oblong mid lobe (vs. short and acute apex forming triangular mid lobe), and (vii) smaller capsule ca. 2 cm (vs. 4.5-5 × 2-2.5 cm) and globose (vs. ovoid).

Alpinia hoangviet sp. nov., the new species from Vietnam

***Alpinia hoangviet* D.D. Nguyen & V.C. Nguyen, sp. nov.** (Figure 2; Figure 3A and 3B)

Diagnosis: It is similar to *Alpinia macroura* K.Schum. (Figures 3C and 3D) in small glabrous habit, narrowly lanceolate lamina, inflorescence erect panicle with a few cincinnus, but differ in (i) bladeless and leaf sheaths tinged purplish-red blotches (vs. pale green), (ii) longer ligule ca. 10 (vs. ca. 4) mm, (iii) narrowly tubular pinkish bracteoles (vs. bubbling white bracteoles), (iv) smaller labellum ca. 3 (vs. 4) cm long.

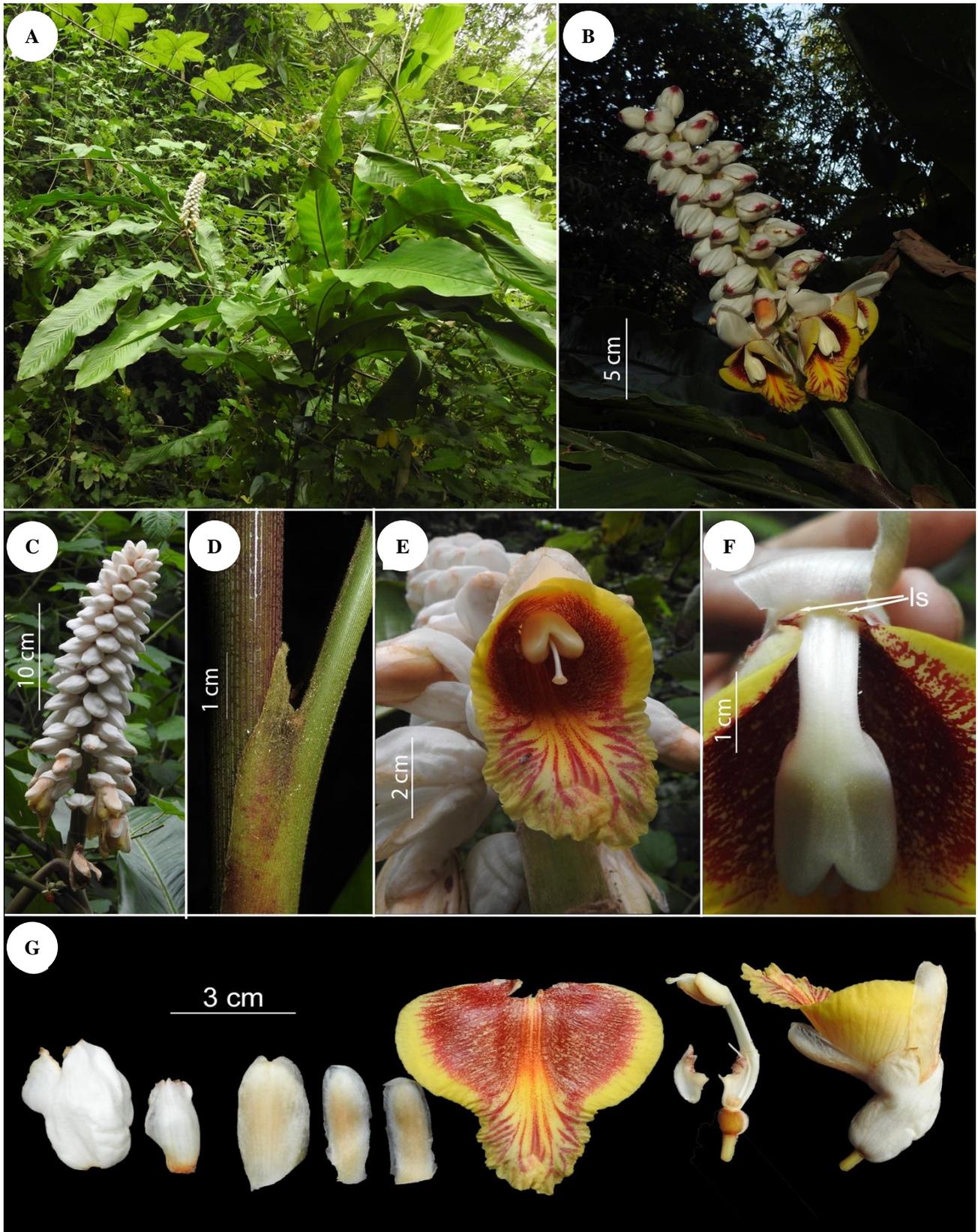


Figure 1. *Alpinia nobilis*. A. Habitus. B. Inflorescence with bracteoles tinged red at tip. C. Inflorescence with white bracteoles without red tinge at tip. D. Ligule E. An opening flower in frontal view. F. Flower removed dosal corolla lobe showing lateral staminodes at base of labellum and filament. G. Dissected flower (from left): bracteoles, calyx, corolla lobes, labellum, a flower removed labellum and corolla lobes with splitted corolla tube showing epigynous glands at the base, entire flower. Note: ls: lateral staminodes. Photos by Danh Duc Nguyen

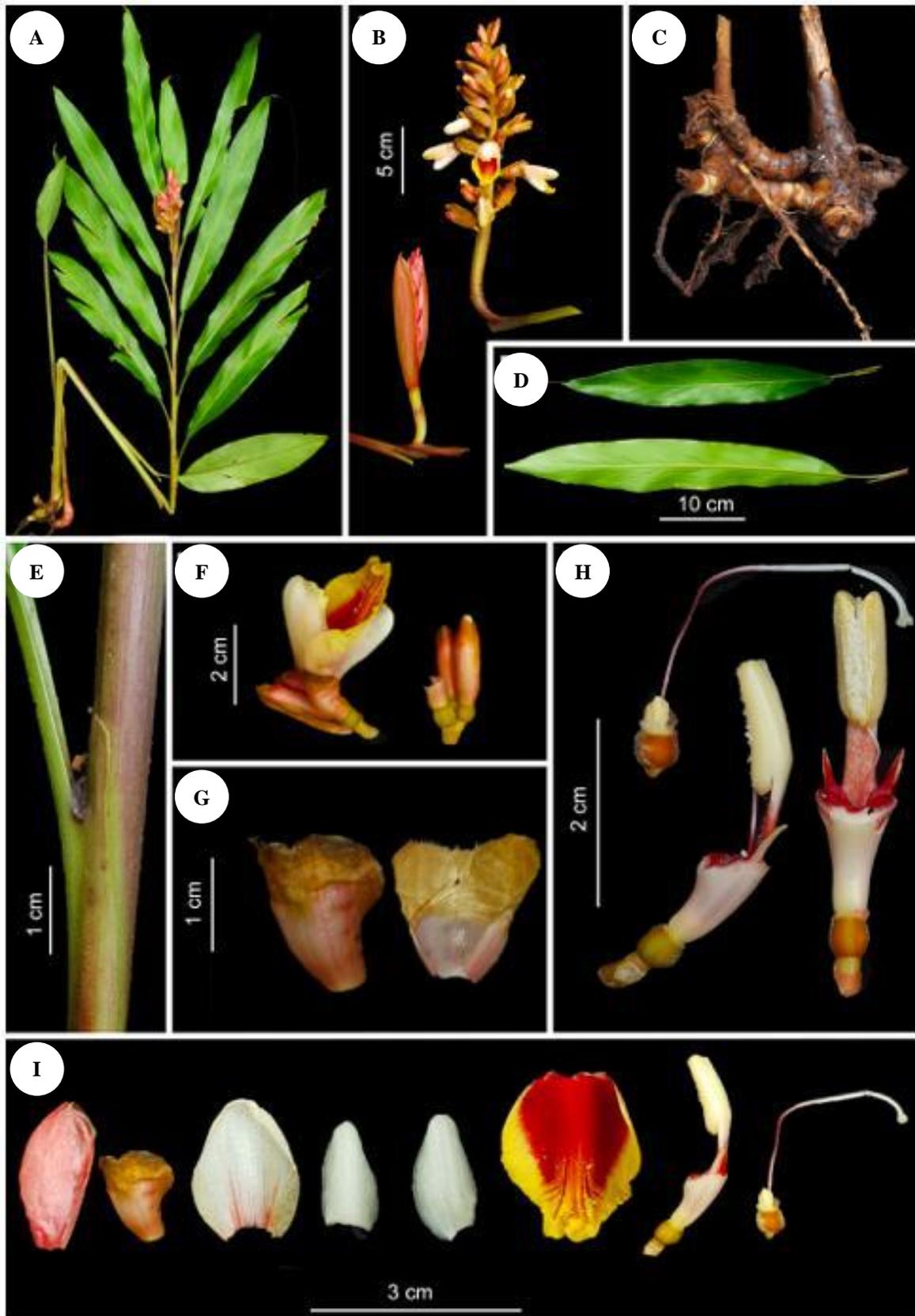


Figure 2. *Alpinia hoangviet* D.D. Nguyen & V.C. Nguyen, sp. nov. A. Flowering habit. B. Young inflorescence and inflorescence in anthesis. C. Rhizome. D. Lamina adaxially and abaxially. E. Ligule and leaf sheath. F. Cincinnus with buds and opening flower. G. Calyx (outer and inner surfaces). H. Ovary with epigynous glands and style, anther in side view and I front view. I. Dissected flower (from left): bracteoles, calyx, corolla lobes, labellum, a flower removed labellum and corolla lobes. Photos by Van Canh Nguyen from type specimen *NDD-23004*

Etymology: The species epithet was named after Hoang Viet School, which serves students ranging from Grade 1 to 12 and is located in Buon Ma Thuoc City, Dak Lak Province, in the center of Highland of Central Vietnam. The authors are so grateful to the owner of this school, Mr. Le Dinh Hien, for his financial support for our team to collect wild gingers from all over Vietnam and transplant them to this schoolyard for both landscape and research purposes.

Type: VIETNAM, Dak Lak Pro., M'Drăk Dis., Cu Kroa Com., Chu Mu Peak, elevation 1500 m asl., February 2023, *Nguyen Van Canh NDD-23004* (holotype VNMN!, Isotype HNU!).

Description. Large clump-forming herb up to 1 m tall with 10-20 pseudostems per clump. *Rhizome* creeping with the distance between two neighboring leaf shoots ca. 3-5 cm, 5-10 mm in diam., outside pale green turning brown with age, inside cream white internally, slightly aromatic; rhizome scales broadly triangular, brown, soon decaying. *Leafy shoots* of mature flowering individuals ca. 1 m long, with 9-12 leaves, leafless in lower 1/3; bladeless sheaths 3-5, 5-30.0 cm long, striated, the innermost one light dull green, the outermost ones mid-green turning tinged brown with age, puberulent externally, glabrous internally; leaf sheath striated, yellow-green with various degree of small purplish-red blotches, puberulent; *ligules* entire to emarginate, ca. 10 mm long, leathery, yellowish-green with sparsely small purplish-red blotches, glabrous, margin entire and ciliate; petiole 3-5 cm long, glabrous; lamina narrowly lanceolate, lightly plicate, 35-45 x 5-6 cm, leathery, adaxially dark green, glabrous, abaxially light green, glabrous to puberulent, base attenuate, apex caudate. *Inflorescence* terminal panicle, erect, ca. 20 cm long, bearing ca. 10 cincinnus, 2- to 3-flowered per cincinni; peduncle 5-7 cm long, 3-5 mm in diam., yellowish brown with various levels of purplish-red tinge, puberulent, with 2 sheathing bracts, soon caducous; rachis thick, stout, 10-13 cm long, yellowish brown, sparsely rusty puberulent; sheathing bract narrowly elliptic to lanceolate, 10-15 cm long, externally pinkish green soon turning dry and brown, glabrous, internally paler, shiny, and glabrous, the outer one with a leaflet at the apex, ca. 2 cm long, the inner one smaller, apex acute; *fertile bracts* absent; *bracteoles* open to base, tubular when inflated, ca. 26-28 x 10 mm, semi-translucent, pinkish turning brown with age, glabrous, apex acute, margin entire and ciliate. *Flowers* 4 cm long; pedicel reduced, 2-4 mm long, 2-2.5 mm in diam., reddish, rusty puberulent; *calyx* tubular, sparsely hairy outside, glabrous inside, narrowed at the base, gradually dilate above, ca. 15 mm long, ca. 10 mm in diam. at widest point (ca. 15 mm when stretched), pinkish white, shiny, semi-translucent, apex 3- or 4-teethed, and split to 7 mm on one side, margin ciliate; *floral tube* 12-14 mm long, widening gradually towards the apex, externally white throughout, sparsely short white-pubescent, internally white and glabrous at base turning red and hairy at apex; *dorsal corolla lobe* obovate to elliptic, 25x20 mm, white, margins inward wrapping, translucent, shiny, externally sparsely hairy, internally glabrous, margin ciliate; *lateral corolla lobes* triangular, ca. 20x10 mm, concave, white, shiny, its

margins slightly translucent, cucullate at apex, glabrous, margin ciliate; *labellum* broadly ovate, 3-lobed, strongly concave at base half, flattened in the apex half, ca. 30 mm long, ca. 30 mm wide when stretched, base half yellow tinged orange-red blotch with yellow margins, apex half (mid lobe) pale yellow with finely dark red stripes; slightly deflexed near the apex, apex acute, shallowly 2-lobed, incision ca. 5 mm long; lobes nearly equal, glabrous; lateral staminodes narrowly triangular, 3-4 mm, glabrous, dark red inside, adnate to the base of labellum at transitional position with filament. *Stamen* attached to floral tube at ca. 180°, curved inwards; *filament* 9x3 mm, cream white tinged pinkish-red throughout, pubescent throughout; *anther* 15x5 mm long, sparsely tomentose on the base; *thecae* parallel, as long as anther, ca. 5 mm wide, bright yellow with red blotch, dehiscing through their entire length, glabrous; *anther crests* absent. *Style* ca. 38 mm long, white, hairy near the apex; *stigma* funnel-shaped, 1 mm in diameter, white, sparsely hairy; ostiole ciliate. *Epigynous* 2, 2-3 mm long, 1.5-2 mm wide, pale yellow, glabrous, apex truncate. *Ovary* globose to elliptic, ca. 3x3 mm, green, golden pubescent, 3-locular, placentation axile. *Immature fruit* capsular, indehiscent, globose, 1.7-1.9 x 1.5-1.7 cm, mid-green, densely pubescent. Flowering in February to May and fruiting is prior from March and predicted to extend to Fall.

Distribution: Central of highland Vietnam

Habitat and ecology. It inhabits in semi-shaded forest margins, along the trails or stream valleys, in shady partially and humid conditions, and moist soil on granite under the canopy of the montane evergreen broadleaved forest at an elevation of about 1500 m asl.

IUCN preliminary assessment. We counted more than 100 adult plants in an area of occupancy (AOO) of about 2 km², concentrated along the bank of a stream. This species is verified in certainty only in Chu Mu range between three provinces: Dak Lak, Phu Yen and Khanh Hoa. This species is barely present in adjacent areas at the same altitude and habitat such as Langbiang Plateau, Ngoc Linh Range, Mang Den Plateau, and Kon Ha Nung Plateau. Therefore, we can conclude that this species is uncommon in its distribution range. We estimate that the extent of occurrence (EOO) is less than 500 km². To evaluate its population size better, we and other teams need a few years to conduct further expeditions to collect more specimens. Hence, we highly suggest assessing its conservation status at the moment as Category Endangered (EN) B1ab(iii) following the IUCN criteria (2022). Further exploration of the region is needed as this species may be Critically Endangered.

Taxonomic Notes: The new species is easily confused at a glance with *Alpinia hongiaensis* (Figures 3E, F) in the size and general view of habit, erect inflorescent with a few cincinni, leaf sheath tinged dark reddish brown pinkish tubular bracteoles but differs in (i) glabrous habit (vs. outside of sheaths and both surfaces of lamina minutely pubescent), (ii) panicle inflorescence with 2-3 flowers per cincinni (vs. raceme, 1-flowered), (iii) peduncle and rachis yellowish brown, glabrous or sparsely hairy (vs. dark red, villous), (iv) bracteole twice as long as calyx (vs. as long as

calyx), (v) apex half pale yellow with finely dark red stripes (vs. some bold red stripes or patches), (vi) Epigynous gland 2 (vs. 1). It is also similar to *Alpinia napoensis* but differs in: (i) smaller habit ca. 1 m tall (vs. 1.5-2 m), (ii) inflorescence is a panicle (vs. raceme) and shorter ca. 10 cm (vs. 13-27 cm), (iii) shorter bracteoles 2.6-2.8 (vs. 2.5-5) cm long, (iv) smaller labellum ca. 3 (vs. 3.8-5.5) cm, (v) shorter lateral staminodes ca. 3 (vs. 4-8) mm. A detailed comparison of these four species is presented in Table 1.

Key to the *Alpinia* species of subsect. *Catimbium* in Vietnam

The Vietnamese taxon identified as *A. malaccensis* by Gagnepain (1908) is still undiscovered. This species was recorded by Gagnepain for more than 2 centuries, but botanists have not found a species with characteristics matching with those in Gagnepain’s description. The characteristic differs from those of the real *A. malaccensis* discovered from the type locality, Ambon Island (Far East Indonesia) by Lim (2016). This Vietnamese taxon is a high-potential undescribed species.

Alpinia latilabris was recorded by Nguyen (2017) from Central and North Vietnam. However, photos and drawings of his collections illustrate two taxa not close relative to *A. latilabris* (lacking anther crest of the latter). The color plate 31 tagged as *Alpinia latilabris* shows characteristics similar to *A. kwangsiensis*. Whereas the taxon drawn in figure 39 (page 108) (can be referred to *A. macroura*).

Alpinia hirsuta is the most poorly known species in Vietnam. It was described more than two centuries ago by Loureiro (1790) as *Amomum hirsutum*. The description is not detailed (lack of measurement) without citing any specimen or drawing. The type locality is not mentioned particularly except minor note that ‘cochichin’ can be referred to a large area in South and Central Vietnam. The type specimen could not be found and may be lost.



Figure 3. *Alpinia hoangviet* and closely related species. *Alpinia hoangviet*: (A) habitus and (B) inflorescence; *A. macroura*: (C) inflorescence and (D) capsular; *Alpinia hongiaoensis*: (E) habitatus and (F) opening flower in frontal view. Photos A and B by Van Canh Nguyen; C and D by Surapon Saensouk; E and F by Quang Cuong Truong

Table 1. Comparison of morphologically vegetative and reproductive characteristics of *Alpinia hoangviet* sp. nov. with its closely related species

| Character | <i>A. hoangviet</i> | <i>A. macroura</i> | <i>A. hongiaoensis</i> | <i>A. napoensis</i> |
|-----------------------|----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| Habit (m tall) | 1.0 | 1.0 | 0.7 | 1.5-2 |
| Ligule | ca. 1 cm, glabrous | 4 mm, glabrous | pubescent | 4-8 mm, glabrous |
| Lamina | glabrous | glabrous | minute pubescent | unknown |
| Inflorescence | panicle | panicle | raceme | raceme |
| Rachis and peduncle | yellowish brown, puberulent | mid-green, villous | dark red, villous | densely brown hispid |
| Bracteoles | 2.6-2.8 cm long pinkish soon dry and brown, tubular (narrowly elliptic when stretched) | 4-5 cm long milky white, ovoid (broadly elliptic when stretched) | ca. 2 cm long pinkish soon dry and brown, tubular (narrowly elliptic when stretched) | 2.5-4.5 cm long, narrowly elliptic |
| Calyx (color, length) | pinkish, 1.5 cm | white, 3-3.7 cm | pinkish, 1.8 cm | pinkish, 1.5-2 cm |
| Lateral staminodes | ca. 3 mm | ca. 3mm | ca. 3mm | 4-8mm |
| Labellum size | 2.7 × 2.5 cm, | ca. 4 cm long | 3 × 2.1 | 3.8-5.5 × ca. 2 cm |
| Labellum color | bright red with yellow or white margin and yellow apex with a few finely red stripes | bright red with yellow or white margin and yellow apex with a few finely red stripes | orangish red center with yellow margin yellow apex with some bold red stripes or patches | bright red with yellow or white margin and yellow apex with a few red stripes |
| Epigynous gland | 2 | 2 | 1 | unknown |

Note: Details showing the differences between each species with the new species are given in bold

Horaninow (1862) established the new combinations to transfer this taxon to the genus *Alpinia* and *Cardamomum*, respectively. Smith (1990) suspected that this species belongs to subsect. *Catimbium*. and Ly (2017) also placed it in his subsect. *Catimbium* key. Apart from information in Loureiro's description: 'Perianthium... aequalibus. NeEtarium petaliforme..., 4-fidum...' meaning labellum 4-lobed. Because the flowers of subsect. *Catimbium* usually have 3-lobed labellum, it takes a long time to find out a species having labellum 4-lobed in Vietnam. The *hirsuta*'s collections cited by Nguyen (2017) from Northern Vietnam were lost and can't be identified in certainty. Recently, we discovered a species of subsect. *Alpinia* matches very well with *A. hirsuta*'s protologue with hirsute habit, small 4-lobed labellum 2 cm long proving that it is not belonging subsect. *Catimbium* (labellum larger than 3 cm long). We will show the identity of this taxon in further work.

Identification key to the subsect. *Catimbium* in Vietnam

- 1a. Inflorescence a panicle 2
 1b. Inflorescence a raceme 8
 2a. Capsule ribbed *A. zerumbet*
 2b. Capsule not ribbed 3
 3a. Petiole absent; bracteoles flat or slightly concave or absent 4
 3b. Petiole 2-10 cm; bracteoles shell-shaped, enclosing flower buds 5
 4a. Bracteoles absent; labellum yellow, spotted red at the center, with red stripes at apex, 3-lobed *A. mutica*
 4b. Bracteoles 1.4-1.7 cm. lightly concave; labellum white with rose red and purple streaks, not lobed *A. calcarata*
 5a. Plant ca. 1 m (-1.2m); leaf blade narrowly lanceolate, abaxially glabrous 6
 5b. Plant 1.5-3 m; leaf blade oblong-lanceolate, abaxially pubescent 7
 6a. Leaf sheath mid-green, ligule ca. 4 mm, labellum ca. 4 cm *A. macroura*
 6b. Leaf sheath tinged brownish red, ligule ca. 10 mm, labellum ca. 3cm *A. hoangviet*
 7a. Bracteoles brown, calyx 4 toothed *A. menghaiensis*
 7b. Bracteoles white, calyx 3-toothed *A. aff. malaccensis*
 8a. Fertile bracts present 9
 8b. Fertile bracts absent 10
 9a. Lamina rugose; bracteoles red and narrowly elliptic, labellum with very dense red stripes at basal lobes *A. vietnamica*
 9b. Lamina not rugose; bracteoles white and broadly elliptic, labellum yellow with many red spots at center *A. hainanensis*
 10a. Leaf blade abaxially hirsute 11
 10b. Leaf blade abaxially glabrous 15
 11a. Leaf blade adaxially glabrous 12
 11b. Leaf blade adaxially pubescent 14
 12a. Bracteoles milky white *A. nobilis*
 12b. Bracteoles greenish or pinkish soon turning dry and brown 13
 13a. Petioles 2 cm long; inflorescence drooping, sparsely flowered; labellum red with yellow center 3-3.5 cm *A. roxburghii*
 13b. Petioles 4-8 cm long; inflorescence erect, densely flowered; labellum ca. 2.5 cm *A. kwangsiensis*
 14a. Pseudostem 2-2.5 m tall, lamina plicate, longer bracteoles white tinged pink or not, three-times longer calyx, epigynous gland many ca. 10 *A. nelumbooides*
 14b. Pseudostem less than 0.7 m tall, lamina smooth, shorter bracteoles, epigynous gland 1 *A. hongiaoensis*

- 15a. Plant up to 3 m tall, larger lamina, corolla lobes densely rusty serocious outside *A. nobilis*
 15b. Plant up to 1.7 m tall, smaller lamina 34.7-35.5 x 3.8-4.9 cm, corolla lobes outside *A. newmanii*

In conclusion, After the examination living specimens of subsect. *Catimbium* collected during fieldwork in periods 2019-2022 in Vietnam, two species, *A. nobilis* and *A. hoangviet* were added to the flora of Vietnam. *A. nobilis* is the newly recorded species, whereas *A. hoangviet* is described as a new species for science. Additionally, two taxa, namely *A. hirsuta* and *A. latilabris* were eliminated from the checklist of Vietnamese *Catimbium*.

ACKNOWLEDGEMENTS

This research is funded by Thu Dau Mot University, Binh Duong Province, Vietnam under grant number: NNC.22.1-008. We are grateful to Dr. Truong Quang Cuong, a researcher from Bidoup-Nui Ba National Park for sharing photos of *Alpinia hongiaoensis*.

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