

A new species of *Gastrodia* (Orchidaceae: Epidendroideae) from East Java, Indonesia

Galuh A.C. Dwitara¹ , Muhammad Al Fatih^{2,3} ,
Yuda R. Yudistira^{4,5}  and Wendy A. Mustaqim^{4,6,*} 

¹ Sahabat Alam Indonesia, Graha Dewata Estate Blok JJ.5 No. 10 RT.01 RW.12, Landungsari, Dau, Malang, East Java 65151, Indonesia

² Yayasan Birdpacker Indonesia Raya, Jalan Dewi Mutmainah No.2 RT.01 RW.5, Banaran, Bumiaji, Batu, East Java 65331, Indonesia

³ Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Sebelas Maret, Jl. Ir. Sutami 36A, Kentingan, Surakarta, 57126 Indonesia

⁴ Tumbuhan Asli Nusantara Foundation, BTN Kopri Blok C1 No 96, Kawatuna, Mantikulore, Palu, Sulawesi Tengah 94233, Indonesia

⁵ Yayasan Konservasi Biota Lahan Basah, Jalan Raya Sawo 17–19, Surabaya, Jawa Timur, Indonesia

⁶ Program Studi Biologi, Fakultas Sains dan Teknologi, Universitas Samudra, Jl. Prof. Dr. Syarief Thayeb, Meurandeh, Langsa Lama, Langsa, Aceh 24416, Indonesia

Author for Correspondence : wendyachmmadm@gmail.com

Abstract

Gastrodia biruensis Dwitara, Fatih, Yudistira & Mustaqim, a new mycoheterotrophic orchid species from the eastern part of Java, Indonesia, is described and illustrated. It is similar to two other Javan endemics *G. crispa* J.J.Sm. and *G. selabintanensis* Tsukaya & A.Hidayat, but differs in several morphological details, as well as flower colour. Information on its distribution and ecology, photographs and illustrations are provided.

Introduction

Despite being one of the most densely populated islands in the world, Java still holds potential for unknown plant diversity, including taxa belonging to the second-largest plant family, Orchidaceae. Comber (1990) listed 731 species of orchids as occurring in Java, with 231 endemics. Since then, further discoveries of orchids have been published from this island, including the new distributional record of *Lecanorchis nigricans* var. *yakusimensis* T.Hashim., and several new species as *Bulbophyllum trinervosum* Victoriano & Yudistira, *Tuberolabium camperenik* Yudistira, Naive & Romiyadi, and *Schoenorchis kembangleutik* Yudistira & Mustaqim (Victoriano & Yudistira 2020; Kurniawan et al. 2021; Naive et al. 2021; Suetsugu et al. 2021; Yudistira & Mustaqim 2023). These bring the total number of endemic orchids on this island to 239 species.

Gastrodia R.Br. (Brown 1810) are terrestrial mycoheterotrophic orchids with a horizontal underground rhizome, flowers arranged in terminal erect racemes, flowers with sepals and petals adnate to each other, the absence of a labellum spur, and two pollinia (Comber 1990). Morphologically, *Gastrodia* is similar to *Ulei orchis* Hoehne of South America, but differs by its membranous perianth, a disc-shaped labellum without basal calli, a V-shaped stigma that protrudes upwards from the basal column, and flower surfaces with flat protuberances (Pridgeon et al. 2005). The genus is widely distributed through South-east Asia and East Asia to New Guinea, Australia and New Zealand (Comber 1990). In recent years, at least seven new species have been described from the Malesian region, including Peninsular Malaysia, Sabah, Philippines, Indonesia and Brunei Darussalam (Ong & O'Byrne 2012; Suetsugu et al. 2018b; Pelsner et al. 2016; Tsukaya & Hidayat 2016; Metusala & Supriatna 2017; Hroneš et al. 2025).

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Prior to the publication of this article, eight *Gastrodia* species were known from Java Island, namely: *G. abscondita* J.J.Sm. (Smith 1903), *G. bambu* Metusala (Metusala & Supriatna 2017), *G. callosa* J.J.Sm. (Smith 1931), *G. crispa* J.J.Sm. (Smith 1921), *G. javanica*, *G. selabintanensis* Tsukaya & A.Hidayat (Tsukaya & Hidayat 2016), *G. spatulata* (Carr) J.J.Wood (Suetsugu & Tsukaya 2018a), and *G. verrucosa* Blume (Blume 1856). The most recently described species, *G. bambu*, was published in 2017 based on plants known from West and Central Java (Metusala & Supriatna, 2017).

During continuous fieldwork in Mount Biru, Batu, East Java, Indonesia, a population of plants belonging to *Gastrodia* was found. The plants were then collected and efforts made to identify them using literature and specimens, including types. However, the plants do not match any previously described species. Hence, it is described as a new species endemic to the eastern part of Java.

Material and methods

The specimens examined were collected during our observation in early 2025 at Mount Biru, Batu, East Java, Indonesia. Morphological descriptions were prepared based on examination of fresh material in the field and herbarium specimens as well as living plant photographs. Terminology used in this morphological description follows Beentje (2016). Primary literature (Blume 1856; Comber 1990; Comber 2001; Smith 1921; Suddee & Harwood 2009; Seidenfaden & Wood 1992; Metusala & Supriatna 2017; Tsukaya & Hidayat 2016), herbarium specimens, and type specimen images accessed from JSTOR Global Plants (<https://plants.jstor.org>) were used to establish the identity of the Mount

Biru plants. A preliminary conservation status assessment was done by calculating the Extent of Occurrence (EOO) and Area of Occupancy (AOO) using a standard (2 × 2 km square grid) following the guidelines (IUCN Standards and Petitions Committee 2024) through GeoCAT (Bachman et al. 2011) and the results then evaluated against the criteria in IUCN (2012).

Taxonomic treatment

Gastrodia biruensis Dwitara, Fatih, Yudistira & Mustaqim, sp. nov.

Type: INDONESIA. Java: East Java province, Batu, Bumiaji, Tulungrejo, Mount Biru (7°47'33.208"S, 112°30'22.004"E), 1373 m a.s.l, 21 Jan 2025, *Dwitara 1* (holotype: UIDEP, isotype: GEN).

Diagnosis: *Gastrodia biruensis* is similar to *G. crispa* J.J.Sm., but differs in having larger flowers (3.2–3.8 × 1.2–1.7 cm vs 1.8–2 × 0.9–1.3 cm), smooth (vs warty) outer sepal surface, petals white with an orange center extending to the apex (vs pure white), a larger labellum (11–13 × 7–10 mm vs 7–7.6 × 6–7 mm), labellum whitish-orange in the basal half and orange in the upper half, with two orange calli (vs white suffused pale yellowish green near apex), apex of labellum obtuse (vs acute), a longer column (10 mm vs 6.5–7 mm), orange (vs white) column margin, and orange (vs white) stelidia. *Gastrodia biruensis* is also similar to *G. selabintanensis* Tsukaya & A.Hidayat but differs in having larger flowers (3.2–3.8 × 1.2–1.7 cm vs c. 1.7 × 0.9 cm), labellum much longer than the column by c. 1.6 times (vs 1.1–1.3), yellowish basal calli (vs pure white), labellum orange in the upper half distal calli (vs yellowish white), orange (vs white) column margin, and orange (vs white) stelidia. (Table 1)

Table 1. Morphological comparison between *G. biruensis*, *G. crispa* and *G. selabintanensis*

Characters	<i>G. biruensis</i>	<i>G. crispa</i>	<i>G. selabintanensis</i>
Inflorescence			
Length (cm)	18–32	6.5–21	15–25
Number of flowers	3–5	1–8	2–4
Bract			
Shape	ovate-triangular	narrowly triangular	triangular
Flower			
Length (cm)	3.2–3.8	1.8–2.1	1.7
Width (cm)	1.8–2	0.9–1.3	0.9
Sepal			
Colour outside	yellowish brown	greenish brown	greenish brown
Lobes	triangular	semi-oval triangular	triangular
Texture	smooth	warty	verrucose
Petal			
Shape	ovate	oblong or quadrangular ovate	ovoid
Length (mm)	4–6	3.7–4	4
Width (mm)	4–5	4	4
Colour	white at the base and margin, orange from the center half to apex	pure white	white-tinged with yellow at apices
Labellum			
Shape	ovate	ovate	rectangular
Length (mm)	11–13	7–7.6	10–12

Characters	<i>G. biruensis</i>	<i>G. crispa</i>	<i>G. selabintanensis</i>
Width (mm)	7–10	6–7	4
Colour	whitish orange in the basal half, orange in the upper half, with two orange calli	white suffused pale yellowish green near apex	white with yellow apex, with two white calli
Keels	4	4	4
Margin	broadly wavy	irregular	undulate
Apex	obtuse	acute	rounded
Length index relative to column	1.1–1.3	1.1	1.6
Column			
Length (mm)	10	6.5–7	7.5
Colour	white with greenish base with orange wings	greenish at the base with apical half white	White
Stelidia			
Colour	orange	white	white
Sources	-	(Smith, 1921; Metusala & Supriatna 2017; Mustaqim, pers. obs.)	(Tsukaya & Hidayat 2016)

Terrestrial, mycoheterotrophic, plant in flower 20–45 cm tall. *Rhizome* tuberous, dark brown, cylindrical, up to 9.5 × 0.7 cm, round at apex, cover by scattered, narrowly triangular, acute, scales. *Roots* filiform, cream, 20–35 cm long, mostly extending from base and middle of rhizome. *Inflorescence* erect, peduncle dark brown, slightly greenish, 18–32 cm × c. 0.5 cm, with up to 7 sterile nodes, glabrous, peduncular scales, 6–7 mm long; flowers 3–5, spreading, flowers open almost simultaneously; *bract* dark brown, ovate-triangular c. 9 × 5 mm, acute, glabrous. *Pedicel* and *ovary* greenish brown, 8–12 mm long, ovary sulcate, slightly verrucose, glabrous. *Flower* resupinate, tubular, 3.2–3.8 cm long, 1.2–1.7 cm wide, yellowish brown, pale at the apex; not opening widely, slightly shiny, odourless. *Sepals and petals* united, forming a tube, 5-lobed, outer surface slightly verrucose with pale dots at the dorsal sepal and upper half of the lateral sepal, other half smooth and plain surface, inner surface smooth. *Sepals* ± similar, fleshy, lateral sepals connate to each other for 70–75% of their length and connate to dorsal sepals for 82–85% of their length; free part of lateral sepal broadly triangular, 0.8–1 × 1.2–1.6 cm, margin entire, obtuse; free part of the dorsal sepal triangular, 0.6–0.8 × 0.6–1 cm, apex retuse. *Petals* adnate to sepal, free part triangular-ovate, 4–6 × 4–5 mm, pale orange with darker tip, margin entire, obtuse. *Labellum* adnate to column at the apex, enclosed within the perianth tube, fleshy, ovate, 1.1–1.3 × 0.7–1 cm; hypochile white with 2 prolate pale yellow calli, epichile white with orange apex, narrowed to obtuse apex, disc convex with 4 longitudinal keels, 2 keels in the middle running from the basal calli to labellum apex, two outer keels extends from the basal calli to the middle of the labellum length, abruptly narrowed and anastomosing toward the middle keels; labellum with margin broadly wavy, apex obtuse. *Column* elongate, straight, white, greenish near base, c. 10 mm long, c. 4 mm wide at the apex, winged along the length, wing with acuminate tip, downward facing; stelidia orange, triangular, falcate, c. 4 mm long, acute; stigma at the base almost parallel to column, U-shaped. *Anther cap* white, obovate, c. 3 × 3 mm, broadly rounded to almost truncate at apex; pollinia 2, lenticular, c. 2 × 2 mm. *Fruit and seed* unknown. (Figs 1 & 2)

Distribution and Ecology: Endemic to Java: only known from the type locality on Mount Biru, East Java Province (Fig. 3). This species grows among grass in slightly shaded sites and is also found under bamboo clumps in tropical submontane forest. The population of this species was recorded during fieldwork from an elevation of 1373 to 1421 m.

Phenology: Flowering in the wild January; fruiting unknown. The flowers of this new species open almost concurrently, with the basal flowers being the first to open.

Conservation Status: *Gastrodia biruensis* so far known from a very narrow distribution range with an EOO and AOO of 8 km². All sixteen known individuals were recorded from an unprotected forest fragment near agricultural fields for vegetables. The ongoing habitat conversion also threatens the forest. With this situation, using criterion B in the IUCN (2012) and IUCN Standards and Petitions Committee (2024), the species is best assigned as Critically Endangered (B2ab(iii)).

Etymology: The epithet refers to the type locality, Mount Biru in Batu, East Java Province, Indonesia.

Notes: *Gastrodia biruensis* is unique in Java due to its larger flowers and orange labellum. So far, the species appears to be endemic to the eastern part of Java. The most similar species is *G. crispa*, a species also endemic to Java. However, *G. crispa* is restricted to the western part of the island (Comber 1990). The second most similar species is *G. selabintanensis*, a narrow endemic species also known only from the mountainous regions of western Java at an elevation of around 1030 m (Tsukaya & Hidayat 2016).

With this addition, the number of *Gastrodia* species in Java is now nine. The new species was found in the shade cast by bamboo clumps, similar to the sites in which *G. crispa* (Mustaqim, pers. obs.) and *G. bambu* (Metusala & Supriatna 2017) have been found. This adds to the record of bamboo clumps as a suitable habitat for the genus, which may be worthy of further exploration.

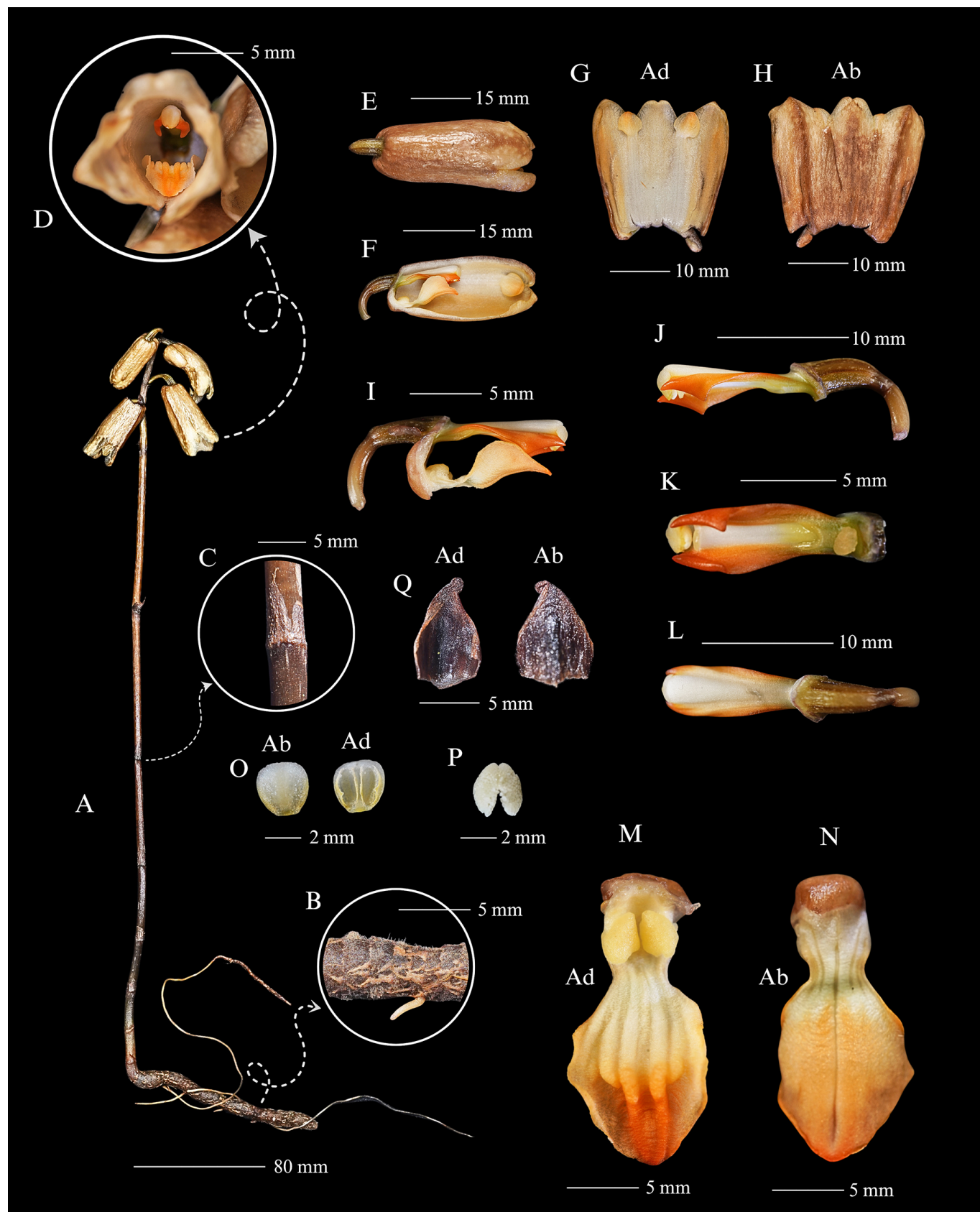


Figure 1. Morphology of *Gastrodia biruensis*. A. Plant habit, B. Rhizome, C. Scale, D. Flower frontal view, E. Dorsal view, F. Flower lateral dissection, G. Sepals and petal adaxial view, H. Sepals and petal abaxial view, I. Pedicel, ovary, column and labellum lateral view, J. Column with ovary, K. Column stelidia, L. Column dorsal view, M. Labellum adaxial surface, N. Labellum abaxial surface, O. Anther-cap, abaxial and adaxial view, P. Pollinarium, Q. Floral bract, adaxial (ad) and abaxial view (ab). All from type material. Photograph by Fariq I. A. Shidiq and design by Yuda R. Yudistira.

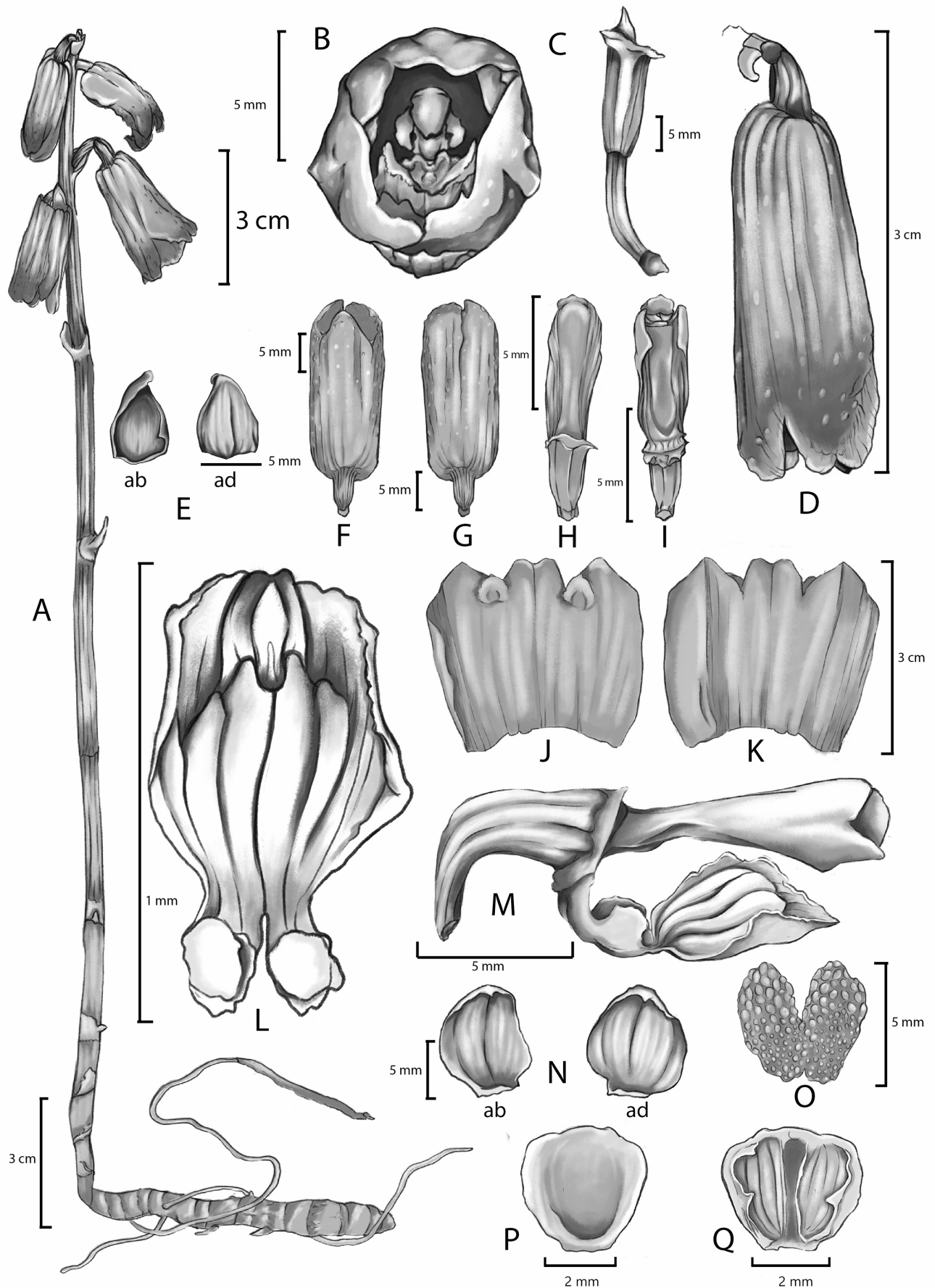


Figure 2. Morphology of *Gastrodia biruensis*. A. Plant habit, B. Flower front view, C. Pedicel and ovary, D. flower lateral view, E. floral bract (ab: abaxial, ad: adaxial), F. Flower dorsal view, G. flower ventral view, H. Column dorsal view, I. Column ventral view, J. Sepal and petal adaxially, K. Sepal (abaxial) with petals apex in the sinus, L. Labellum adaxial surface, M. Pedicel, ovary, column and labellum lateral view, N. Petals (ab: abaxial, ad: adaxial), O. Pollinarium, P. Anther-cap abaxial view, Q. Anther-cap adaxial view. Drawn from the type material by Lathifatul Khodijah.



Figure 3. Distribution of *Gastrodia biruensis* in Java (●).

The discovery of *Gastrodia biruensis* contributes to a better understanding of *Gastrodia* diversity in Indonesia. This finding increases the number of recorded *Gastrodia* in Indonesia from 11 (Comber 1990, 2001; Mustaqim et al. 2021-onwards) to 12. It also adds to the number of narrow endemic *Gastrodia* in the country alongside *G. abscondita* (Smith 1903), *G. celebica* Schltr. (Sulawesi; Schlechter 1913), *G. crassisejala* L.O.William (Indonesian New Guinea; Williams 1942), *G. crispa* (Western Java; Smith 1921; Muhaimin et al. 2017), and *G. selabintanensis* (Java; Tsukaya & Hidayat 2016), underscoring the region's significance for mycoheterotrophic orchid diversity and the urgency of continued botanical exploration on an island with a continuing habitat loss.

Other specimens examined: *Gastrodia crispa*: Java: Dogo waterfall, 3 March 1940, *Holstvoogd* 479 (BO, L image [L.1521222]).

Key to the Species of *Gastrodia* in Java (modified from Comber 1990 and Tsukaya & Hidayat 2016)

1. Plants 50 cm or taller; sepal tube split open along lateral sepal margin almost to the base *G. javanica*
- 1: Plants 45 cm or shorter; sepal tube split open along lateral sepal margin to not more than 3/4 their length 2
2. Inflorescence 1- or 2-flowered only; stelidia on top of the column projecting well beyond the anther cap *G. callosa*

- 2: Inflorescence usually with 3 or more flowers, rarely fewer; stelidia as long as or shorter than the anther cap 3
3. Flowers up to 10 mm long; petals more or less spherical, c. 2 mm long *G. verrucosa*
- 3: Flowers at least 13 mm long; petals distinctly longer than wide, 3.5 mm or longer 4
4. Flower $\pm$ 13 mm long; labellum margin straight *G. abscondita*
- 4: Flower $\geq$ 16 mm long; labellum margin wavy 5
5. Labellum with 3 keels 6
- 5: Labellum with 4 keels 7
6. Labellum 6–8 mm long, shorter than column, white, yellowish green near apex *G. crispa*
- 6: Labellum 10–12 mm long, same length as column, whitish-brown in middle, tinged orange at apex *G. bambu*
7. Flowers 1.7 $\times$ 0.9 cm; labellum distinctly longer than column *G. selabintanensis*
- 7: Flowers 3.2–3.8 $\times$ 1.2–1.7 cm; labellum slightly longer the column *G. biruensis*

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