

## EXPANSION OF *COSTUS* DIVERSITY: DOCUMENTING THE OCCURRENCE OF SIX NEWLY CULTIVATED SPECIES ON JAVA

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### ABSTRAK

Muhammad Fabio Rayhan Kurniawan, Muhammad Hisyam Fadhil, Zakaria Al Anshori, Asih Perwita Dewi, Peniwidiyanti, Muhammad Hisyam Baidlowi, Muhammad Rifqi Hariri, Arifin Surya Dwipa Irsyam, Dian Rosleine 2025. Perluasan Keanekaragaman *Costus*: Mendokumentasikan keberadaan enam jenis yang baru dibudidayakan di Jawa. *Floribunda* 8(1): 1 – 10 – Enam jenis tambahan *Costus* budi daya telah didokumentasikan dari Jawa, Indonesia: *C. comosus* var. *bakeri*, *C. erythrophyllus*, *C. osae*, *C. pictus*, *C. productus* var. *productus*, dan *C. stenophyllus*. Spesies-spesies ini sengaja diintroduksi dari Amerika Tropis ke Jawa untuk keperluan ornamen. Temuan kami meningkatkan jumlah total *Costus* yang tercatat di Jawa menjadi 15 jenis.

Kata kunci: Costaceae, Malesia, Introduksi, Taksonomi, Zingiberales

Muhammad Fabio Rayhan Kurniawan, Muhammad Hisyam Fadhil, Zakaria Al Anshori, Asih Perwita Dewi, Peniwidiyanti, Muhammad Hisyam Baidlowi, Muhammad Rifqi Hariri, Arifin Surya Dwipa Irsyam, Dian Rosleine 2025. Expansion of *Costus* Diversity: Documenting the Occurrence of Six Newly Cultivated Species on Java. *Floribunda* 8(1): 1 – 10 – Six additional cultivated species of *Costus* have been documented from Java, Indonesia: *C. comosus* var. *bakeri*, *C. erythrophyllus*, *C. osae*, *C. pictus*, *C. productus* var. *productus*, and *C. stenophyllus*. These species were intentionally introduced from the Tropical Americas to Java for ornamental use. Our findings bring the total number of *Costus* species recorded in Java to 15.

Keywords: Costaceae, Malesia, Introduced, Taxonomic, Zingiberales

The genus *Costus* L. (Family: Costaceae) includes 99 species and is distributed worldwide, occurring across tropical to subtropical regions, with significant diversity

in the Neotropics and Tropical Africa (Maas, 1979; Wu & Larsen, 2000; Specht, 2006; Salzman *et al.*, 2015; POWO, 2023). This genus is distinguished by a monostichous leaf

arrangement, the absence of axillary branches, and inflorescences that are either terminal or, in some epiphytic species (e.g., *C. talbotii* Ridl. and *C. lateriflorus* Baker), lateral. Additionally, species within this genus typically possess a tubular labellum (Specht & Stevenson, 2006; Salzman *et al.*, 2015).

A total of nine species of *Costus* have been documented in Java, Indonesia: *C. afer* Ker Gawl. (Irsyam *et al.*, 2019), *C. dubius* (Afzel.) K. Schum. (Mustaqim & Setiawan, 2021), *C. elegans* Veitch ex J. Dix (Backer & Bahkuizen van den Brink, 1968), *C. laevis* Ruiz & Pav. (Maas, 1979), *C. lucanusianus* J. Braun & K. Schum. (Suwandi, 1995), *C. phyllocephalus* K. Schum. (Irsyam *et al.*, 2024), *C. scaber* Ruiz & Pav. (Nisyawati & Mustaqim, 2017), *C. spicatus* (Jacq.) Sw. (Irsyam *et al.*, 2024), and *C. villosissimus* Jacq. (Irsyam *et al.*, 2024). Certain species, including *C. afer*, *C. dubius*, *C. phyllocephalus*, *C. spicatus*, and *C. villosissimus*, demonstrate the capacity to establish in the natural environment autonomously, without human intervention in Java (Irsyam *et al.*, 2019; Mustaqim & Setiawan, 2021; Irsyam *et al.*, 2024). These species were initially introduced to the island as ornamental plants and later proliferated spontaneously due to their ability to reproduce vegetatively through rhizome fragmentation and bulbils.

Newly recorded alien species of *Costus* may still persist on Java, as several non-native species have previously been documented by previous botanists (Irsyam *et al.*, 2019; Mustaqim & Setiawan, 2021; Irsyam *et al.*, 2024). Given that this genus encompasses exotic taxa with the potential for naturalization, continuous taxonomic research remains essential. The present study seeks to deliver an updated and thorough account of the *Costus* species occurring on Java.

During our 2023 botanical survey, we documented six additional cultivated species of *Costus*: *C. comosus* var. *bakeri* (K. Schum.) Maas, *C. erythrophyllus* Loes., *C. osae* Maas & H. Maas, *C. pictus* D. Don, *C. productus* var. *productus*, and *C. stenophyllus* Standl. & L.O.

Williams. These taxa have been primarily introduced to Java for ornamental purposes. With these new records, the total number of *Costus* species recognized on Java now stands at 15. This paper presents detailed descriptions, photographic documentation, and a brief discussion.

## MATERIALS AND METHODS

Botanical exploration was conducted between January and May 2023 across several regions: Jakarta (South Jakarta); West Java (Bandung, Bogor, Cianjur, Pangandaran, Sukabumi, and Sumedang); Central Java (Rembang and Temanggung); and East Java (Malang and Situbondo). Plant material was collected following the standard procedures described by Bridson and Forman (1998). The collected specimens were subsequently processed at the Herbarium Bandungense (FIPIA), School of Life Sciences and Technology, Institut Teknologi Bandung. Specimen examinations were undertaken in March 2023 at both the Herbarium Bogoriense (BO) and FIPIA.

Specimen identification was conducted using references including Backer and Bakhuizen van den Brink (1968), Maas (1972, 1975, 1979), Suwandi (1995), Maas and Maas-van de Kamer (1997), Hammel *et al.* (2003), Leong-Škorničková and Gallick (2010), Fayaz (2011), Chen *et al.* (2015), Maas-van de Kamer *et al.* (2016), Skinner (2016), Mustaqim and Nisyawati (2017), Skinner and Liesenfeld (2020), and Mustaqim and Setiawan (2021). Terminology used in the species descriptions adheres to the standards set by Beentje (2012).

## RESULT AND DISCUSSION

### TAXONOMIC TREATMENT

*Costus* L., Sp. Pl.: 2 (1753). — Type: *Costus arabicus* L.

1. *Costus comosus* var. *bakeri* (K.Schum.) Maas, Fl. Neotrop. Monogr. 8: 85 (1972). *Costus bakeri* K.Schum. in H.G.A.Engler (ed.), Pflanzenr., IV, 46: 387 (1904) — Type:

Guatemala, dep. Amatitlan, Barranca de Eminencia, Guatemala, *Donnell Smith* 2802 (lecto M; islecto GH, K, NY, U, US). Figure 1A

Rhizomatous herb, up to 2 m in height. Rhizomes pink to dark pink at the outside, velutinous, pink at the inside, internodes 1.9–2.7 cm long. Shoots unbranched, spiral, green to pinkish green, glabrous, bulbous at the base; internodes 0.6–5.2 cm long. Leaves monostichous; sheaths dark red to green, up to 9.7 cm wide, puberulous to velutinous; ligule red, truncate, 1–6 mm long; petiole green, 1–5 mm long, fibrous at the apex; lamina yellowish green to dark green above, yellowish green below, elliptic to obovate, 10–33.3 × 3.7–13.5 cm, base auriculate, margin undulate, apex acuminate, acumen 5–12 mm long, upper side glabrous to strigose, lower side velutinous. Inflorescence terminal, cylindric, ca. 20 cm long. Flowers 1 per bract; bracts greenish white to white, or red at the apex, broadly ovate, 1.5–3.5 × 1.7–4.8 cm, velutinous, bearing leaf-like appendage at the apex; appendage greenish to dark red, leaf-like, deltoid, reflexed, 1.8–4.1 × 1.3–3.4 cm, velutinous at the abaxial side; bracteoles dark red, white at the base, boat-shaped, 23 × 11–13 mm, velutinous at the abaxial side; calyx dark red, tubular, 16–19 × 10 mm, 3-lobed, lobes triangular, 5–6 mm wide, persistent, velutinous; corolla 3-lobed; tube yellowish, ca. 5 mm long; lobes bright yellow, membranous, dorsal lobe elliptic, ca. 4 × 2 cm, apex acuminate, acumen 2 mm long, velutinous at the outside, lateral lobes narrowly elliptic, 3.5–3.7 × 1.5–1.6 cm; labellum bright yellow, inner side with central white nectar guide, funnel-shaped, ca. 3.1 × 2.4 cm; stamen reddish at the apex, oblanceolate-oblong, 3.7 × 3.7 cm; anther white, ca. 10 × 4 mm. Ovary white, 3-loculated, ovoid, 7–9 × 6–7 mm; style white, filiform, ca. 4.7 mm long; stigma white, flabellate, ca. 3 × 4 mm.

**Distribution.** Native to Mexico and Central America, extending southward to El Salvador and Colombia (Maas, 1972), this species has been documented in Java, specifically in West

Java (West Bandung).

**Habitat.** The species grows in wet thickets, mountain forests, riverbank forests, or on wooded slopes of volcanos, usually at high elevations from (250–)600 to 1300(–2000) m (Maas, 1972). *Costus comosus* var. *bakeri* is planted in an open garden at 1022–1232 m asl in West Java.

**Specimen examined.** INDONESIA. Java: West Java, West Bandung Regency, Parongpong Subdistrict, Cihideung Village, Jl. Terusan Sersan Bajuri, 24.IV.2023, *ASD Irsyam & MH Fadhil* 01 & 03 (FIPIA!).

**Vernacular names.** *Pacing* (Bahasa Indonesia).

**Note.** In Maas' 1972 classification, *C. comosus* was taxonomically divided into two infraspecific level: *C. comosus* var. *comosus* and *C. comosus* var. *bakeri* (K.Schum.) Maas. These varieties were differentiated based on the type of hairs present on the adaxial leaf surface and bracts. The adaxial leaf of *C. comosus* var. *comosus* is consistently puberulo-villous, and the bract is smooth. In contrast, the material collected from West Java exhibits a glabrous to strigose adaxial leaf surface and scabrous bracts, characteristics typical of *C. comosus* var. *bakeri* (K.Schum.) Maas (Maas, 1972). The species' inflorescence is notable, featuring reflexed, bright red bracts and vivid yellow flowers that resemble *Tapeinochilos* Miq. However, *C. comosus* var. *bakeri* is often mistakenly identified as *C. barbatus* Suess., which also displays red bracts and yellow flowers but lacks a leaf-like appendage at the apex of the bract (Skinner, 2016).

2. *Costus erythrophyllus* Loes., Notizbl. Bot. Gart. Berlin-Dahlem 10: 707 (1929). — Type: Peru, Loreto, Marafion River Region, the mouth of Rio Apaga, *Tessmann* 4813 (holo F, MO, NY photographs). Figure 1B

Rhizomatous herb, up to 1 m in height. Rhizomes pale brown on the outside and inside, internodes 5–10 mm long. Shoots unbranched, spiral, reddish green, glabrous; internodes 2.5–7 cm long. Leaves

monostichous; sheaths brownish red, up to 6.5 cm wide, glabrous; ligule brownish red, truncate, 6–8 mm long; petiole brownish red, ca. 5 mm long; lamina dark green above, brownish red below, obovate to broadly obovate, 2.7–21.3 × 0.9–10.9 cm, base truncate, margin entire, apex rounded or acute to acuminate, acumen ca. 5 mm long, glabrous on both sides, young leaves puberulous. Inflorescence terminal, ovoid, ca. 7.5 cm long. Flowers 1 per bract; bracts purplish-red, obovate to ovate, 0.5–3.7 × 0.5–4.2 cm, bearing leaf-like appendage at the apex; appendage green, deltoid to elliptic, 2.7–9 × 0.8–6.9 cm; bracteoles purplish-red, boat-shaped, 0.2–2.5 × 0.2–1 cm, red, glabrous to puberulous; calyx tubular, brownish red, ca. 15 × 7 mm, 3-lobed, lobes triangular, ca. 7 mm wide, persistent, puberulous; corolla 3-lobed; tube white, 0.5 cm long; lobes white, membranous, dorsal lobe elliptic, ca. 3.6 × 1.3 cm, apex acute, lateral lobes narrowly elliptic, ca. 4 × 1.2 cm;

labellum white, inner side purple with central yellow nectar guide, funnel-shaped, ca. 5 × 4.5 cm, margin undulate; stamen pinkish-white, lanceolate-oblong, 2.6 × 1.2 cm, anther white, ca. 12 × 5 mm. Ovary white, 3-loculated, globose, ca. 7 × 7 mm; style white, filiform, ca. 5.3 mm long; stigma white, flabellate, ca. 4 mm wide.

**Distribution.** The species is native to western South America, with its range extending into northern Brazil (POWO, 2023). In Java, it has been recorded in several regions, including West Java (Bogor, Sukabumi, and Sumedang) and East Java (Malang).

**Habitat.** The species thrives in humus-rich, well-drained, friable, and moist soils, with partial to full shade (Lim, 2014a). *Costus erythrophyllus* is cultivated in open areas at elevations ranging from 208 to 992 meters above sea level in Java.

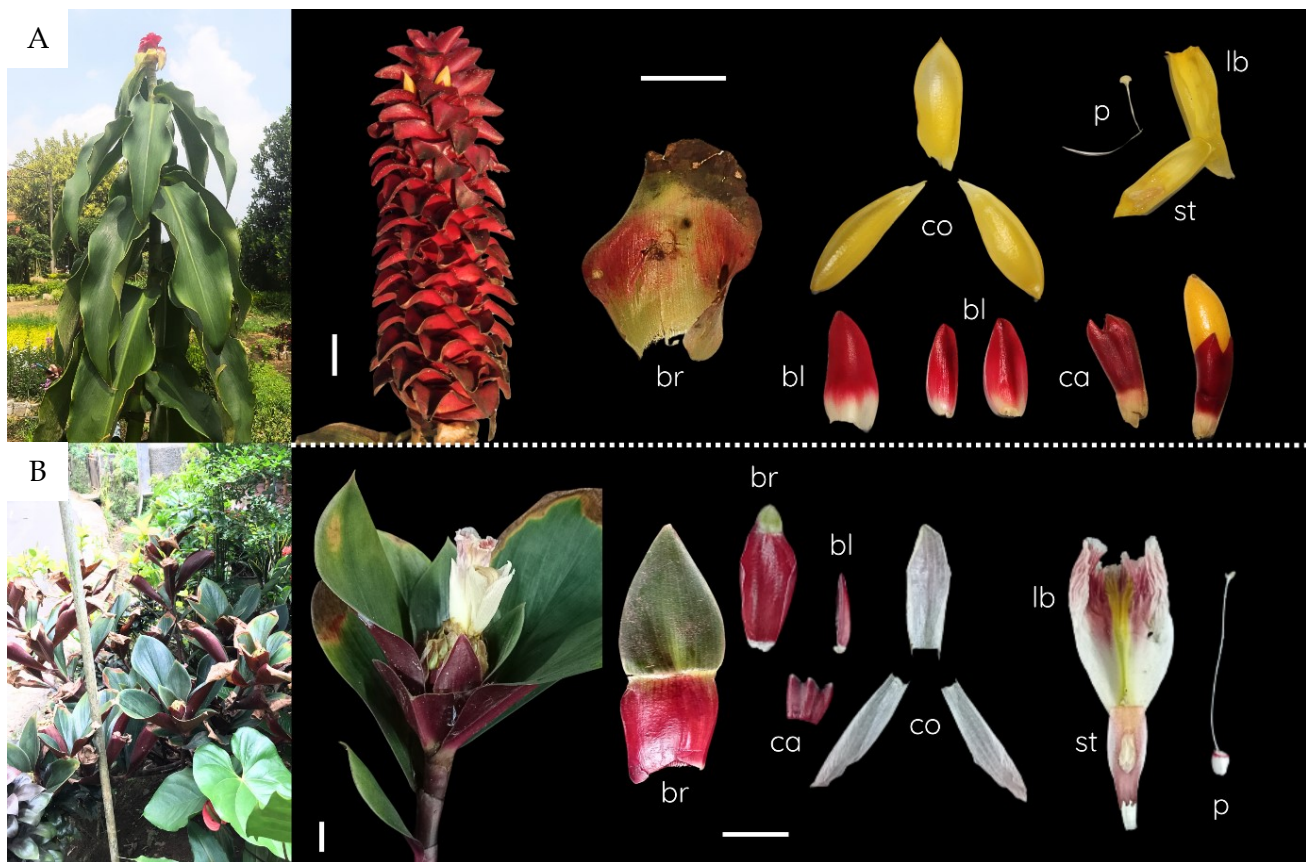




Figure 1. The additional cultivated *Costus* in Java. A. *Costus comosus* var. *bakeri*; B. *C. erythrophyllus*; C. *C. osae* (bl=bracteole, br=bract, ca=calyx, co=corolla lobes, lb=labellum, p=pistil, st=stamen. Bar=2 cm). Photos by A.S.D.Irsyam and M.R.Hariri.

**Specimens examined.** INDONESIA. Java: West Java, Sukabumi Regency, Kabandungan subdistrict, 08.V.2023, PNW 385 (FIPIA!); West Java, Bogor Regency, Dramaga Subdistrict, Perumahan Salak View, 04.III.2023, MR Hariri & ASD Irsyam DRMG-P-014 (FIPIA!); West Java, Bogor City, Loji Subdistrict, Haruman Residence, 13.V.2023, PNW 384 (FIPIA!); West Java, Sumedang Regency, Pamulihan Subdistrict, Cigendel Village, Jl. Nasional 5, 01.III.2023, ASD Irsyam 795 (FIPIA!); West Java, Sumedang Regency, Pamulihan Subdistrict, Cilembu Village, Kampung Babakan Anjun, 29.IV.2023, ASD Irsyam 804 (FIPIA!); West Java, Sumedang Regency, Jatinangor Subdistrict, Sayang Village, Caringin, 11.IV.2023, ASD Irsyam 802 (FIPIA!); East Java, Malang Regency, Poncokusumo Subdistrict, Karanganyar Village, Karanganyar Kidul, Jl. Pancuran, 11.IV.2023, MH Badlowi 03 (FIPIA!).

**Vernacular names.** *Pacing merah*, *pacing marun*, *pacing bulu merah* (Bahasa Indonesia).

**Uses.** *Costus erythrophyllus* is primarily cultivated for ornamental purposes. However, a previous study indicated that its flowers are edible (Lim, 2014a). The leaves of the plant are traditionally used in the treatment of arthritis, with the leafy shoots being pounded and their water extracted to create eye medication. Furthermore, based on field observations, decoctions of the leaves and shoots are

consumed by women who have experienced miscarriage. In Kampung Babakan Anjun, Cilembu Village, the water derived from boiled leaves is also ingested to alleviate abdominal pain.

3. *Costus osae* Maas & H.Maas, Brittonia 49: 277 (1997). — Type: Costa Rica, Puntarenas, Parque Nacional Corcovado, Cerro Brujo, Quebrada Vaquedano, 8°38'N, 83°35'W, 400 m, 20 July 1990, G.Herrera Ch. 3979 (holo U; iso CR, F, K, MO). Figure 1C

Rhizomatous herb, 34.9–50 cm in height. Rhizomes red outside, pinkish inside, internodes 3–12 mm long. Shoots unbranched, spiral, yellowish green, villous; internodes 2.5–7 cm long. Leaves monostichous; sheaths reddish to red, up to 3.8 cm wide, villous; ligule reddish, truncate, 3–10 mm long, fibrous at the apex; petiole green, 3–10 mm long; lamina green or yellowish green above, glaucous below, broadly obovate-elliptic, 4–27 × 2–11.5 cm, base truncate, margin entire, ciliate, apex acute to acuminate, acumen ca. 10 mm long, villous on both sides, veins yellowish on the adaxial surface. Inflorescence terminal, obtrulloid to cylindric, 12–18 cm long. Flowers 1 per bract; bracts red, broadly elliptic, 2–2.6 × 2–2.6 cm, puberulous, bearing leaf-like appendage at the apex; appendage red, ovate-deltoid, 2.2–2.5 × 1.9–2.5 cm, puberulous; bracteoles red, opposite the bract, boat-shaped, 2.8–3 × 1 cm, puberulous; calyx

tubular, red, 15–17 × 7–9 mm, 3-lobed, lobes triangular, 5–6 mm wide, persistent, puberulous; corolla 3-lobed; tube white, ca. 1.6 cm long; lobes reddish, white at the base, membranous, dorsal lobe elliptic, 3.3–4 × 1–1.3 cm, apex acuminate, acumen 2 mm long, lateral lobes narrowly subobovate, 3.3–3.6 × 0.9–1.3 cm; labellum reddish, inner side with central creamy nectar guide, funnel-shaped, ca. 4 × 1.6 cm, 4-lobed at apex; stamen ob lanceolate-oblong, ca. 2.8 × 0.9 cm, reddish at the apex; anther ca. 8 × 6 mm, yellow. Ovary white, 3-loculated, subglobose, ca. 5 × 5 mm; style white, filiform, ca. 4.4 cm long; stigma yellowish, flabellate, ca. 3 × 5 mm.

**Distribution.** The species is endemic to Costa Rica and Colombia (POWO, 2023). In Java, the species has been recorded in several locations across West Java, including West Bandung, Bogor, Sukabumi, and Sumedang

**Habitat.** Maas and Maas-van de Kamer (1997) documented that the species occurs at elevations between 0 and 400 meters above sea level in undisturbed montane forests, frequently on steep slopes. In West Java, *C. osae* is cultivated in open habitats at elevations between 186 and 700 meters above sea level.

**Specimens examined.** INDONESIA. Java: West Java, Sukabumi Regency, Kabandungan subdistrict, 08.V.2023, PNW 386 (FIPIA!); West Java, Bogor Regency, Dramaga Subdistrict, parking area in front of the Department of Agronomy and Horticulture, 04.III.2023, ASD Irsyam & MR Hariri DRMG-P-012 (FIPIA!); West Java, West Bandung Regency, Parongpong Subdistrict, Cihideung Village, Jl. Terusan Sersan Bajuri, 24.IV.2023, ASD Irsyam & MH Fadhil 02 (FIPIA!); West Java, Sumedang Regency, Jatinangor Subdistrict, ITB campus, in front of the Gedung Utama ITB Jatinangor, 16.II.2023, ASD Irsyam 791 (FIPIA!); West Java, Sumedang Regency, Jatinangor Subdistrict, Hegarmanah Village, 10.IV.2023, ASD Irsyam 801 (FIPIA!).

**Vernacular names.** *Pacing beludru*, *pacing bulu* (Bahasa Indonesia).

**Note.** *Costus osae* can be cultivated as a vegetable, as its flowers possess a sweet and mild fragrance and flavor, making them an ideal ingredient for salads (Carle, 1995; Lim, 2014b). Morphologically, *C. osae* closely resembles *C. productus* var. *productus*, although the latter is distinguished by reddish-orange bracts and an orange labellum with a red apex

4. *Costus pictus* D.Don, Edwards's Bot. Reg. 19: t. 1594 (1833). — Type: Mexico, D. Don, Bot. Reg. 19: t. 1594 (1833). Figure 2A

Rhizomatous herbs up to 2.5 m in height. Rhizomes pinkish at the outside and inside, internodes up to 3 cm long. Shoots unbranched, spiral, green, glabrous; internodes up to 9 cm long. Leaves monostichous; lower sheaths dark red, upper sheaths green, up to 4.3 cm wide, glabrous or strigose; ligule red to green, truncate, 2 mm long; petiole green, 2–5 mm long; lamina dark green (exposed environment) to purple (shaded environment) above, shiny pale green or purple below, elliptic to broadly obovate-elliptic, 4–30 × 2.2–8 cm, base truncate, cuneate or slightly cordate, margin entire to undulate, apex acute, acuminate to caudate, acumen up to 2.5 cm long, upper side glabrous, lower side puberulous. Inflorescence terminal, ovoid, up to 5.3 cm long. Flowers 1 per bract; bracts red, green at the apex, ovate, 1.5–2.5 × 0.8–2.4 cm, puberulous, bearing leaf-like appendage at the apex; appendage green on the adaxial surface and green to purplish-green on the abaxial surface, ovate to deltoid, 0.6–2.1 × 0.5–1.9 cm, puberulous; bracteoles reddish, opposite the bract, boat-shaped, 1–1.3 × 0.4–0.7 cm, glabrous; calyx reddish-purple with green at the tip, tubular, 0.6–0.9 × 1.2–1.5 cm, 3-lobed, lobes triangular, 3–5 mm wide, persistent, glabrous; corolla 3-lobed; tube yellowish, ca. 1.4 cm long; lobes yellow, membranous, dorsal lobe elliptic, 2.3 × 1 cm, apex acute to acuminate, acumen 1 mm long, lateral lobes elliptic, 2.3–2.5 × 0.5–0.7 cm; labellum yellow, striped with dark red, sometimes reddish-yellow at the apex, funnel-

shaped, ca.  $2.5 \times 1.8$  cm, margin undulate; stamen yellowish-white, reddish-orange at the apex, oblong, up to  $1.8 \times 0.5$  cm, fimbriate; anther yellowish, ca.  $1.7 \times 1$  mm. Ovary white, 3-loculated, obovoid, up to  $4 \times 5$  mm; style white, filiform, 2 cm long; stigma whitish, unequal bifid, ca.  $1 \times 1$  mm.

**Distribution.** *Costus pictus* is naturally distributed from Mexico to Costa Rica (Maas, 1972). In the present study, it was recorded in West Java, specifically in the regions of Bandung and Bogor

**Habitat.** The species inhabits rainforests, forest clearings, hill forests, areas along water-courses, and roadsides at elevations ranging from 300 to 1800 meters above sea level (Maas, 1972). On Java, it is cultivated as an ornamental plant at elevations between 250 and 700 meters asl.

**Specimens examined.** INDONESIA. Java: Bogor, 'Mexico Garden' Bogor Botanic Garden, culta, May 1981, J.J. Afriastini s.n. (BO!); West Java, Bandung City, Coblong Subdistrict, ITB Ganesha campus, Kebun Botani, 19.III.2019, ASD Irsyam 218 (FIPIA!); West Java, Bogor City, Paledang Subdistrict, Bogor Botanic Garden, 4.IV.2023, MR Hariri 218-219 (FIPIA!).

**Vernacular names.** *Pacing, pacing belang* (Bahasa Indonesia).

**Note.** *Costus pictus* is distinguished by its reddish-yellow labellum, an inflorescence with inconspicuous or absent callus on the bracts, and a short ligule, which is typically reddish-brown when dry (Maas, 1972). The species also features a broadly obovate yellow labellum, with the lateral lobes frequently striped with dark red (Maas, 1972). Specimens of this species are located at the Bogor Botanic Gardens (BBG) and the Kebun Botani of the Institut Teknologi Bandung (ITB). At BBG, it is cultivated as a non-collection species in the Orchidarium and in a garden behind the Seed Bank building. The population in the Orchidarium exhibits a purple coloration on

the abaxial leaf surface, while specimens from ITB and the Seed Bank garden display a green abaxial leaf surface. The oldest specimen collected from Java is J.J. Afriastini s.n. (BO-0087278), which was obtained from the Mexico Garden at BBG by Ms. Afriastini in May 1981.

5. *Costus productus* var. *productus*, Acta Bot. Neerl. 24: 471 (1975 publ. 1976). — Type: Peru, Junin, 700 m, Rio Paucartambo Valley, Perene Bridge, Killip & Smith 25317 (holo US; iso NY). Figure 2B

Rhizomatous herbs up to 75 cm in height. Rhizomes pinkish outside, pinkish white inside, internodes 4–10 mm long. Shoots unbranched, spiral, yellowish green, glabrous; internodes 2–4.8 cm long. Leaves monostichous; sheaths green, up to 3.8 cm wide, puberulous; ligule reddish green, 2-lobed, 10 mm long, fibrous at the apex; petiole green, 4–13 mm long; lamina green above, glaucous below, broadly obovate,  $7.3\text{--}25.5 \times 5\text{--}12.2$  cm, base truncate, margin entire, ciliate, apex acute to acuminate, acumen ca. 15 mm long, upper side hirsute on the costa, lower side glabrous. Inflorescence terminal, ovoid, 3.5–7 cm long. Flowers 1 per bract; bracts white, reddish-orange at the apex, broadly elliptic,  $2.5\text{--}3.2 \times 1.5\text{--}2.4$  cm, puberulous, bearing leaf-like appendage at the apex; appendage deltoid,  $1\text{--}8 \times 1\text{--}9$  mm, reddish-orange, puberulous; bracteoles white, red at the apex, opposite the bract, boat-shaped,  $13\text{--}19 \times 5\text{--}9$  mm, glabrous; calyx reddish-orange, tubular, ca.  $16 \times 6$  mm, 3-lobed, lobes triangular, ca. 6 mm wide, persistent, puberulous; corolla 3-lobed; tube yellowish-white, ca. 4 mm long; lobes yellowish-orange, membranous, dorsal lobe elliptic, ca.  $3.6 \times 2.2$  cm, apex retuse, lateral lobes narrowly elliptic,  $3.6\text{--}3.7 \times 1.4\text{--}1.5$  cm; labellum orange, red at the apex, funnel-shaped, ca.  $3.7 \times 1.7$  cm, 3-lobed at apex; stamen orange, yellow at the apex, oblong, ca.  $3.2 \times 1$  cm; anther yellow, ca.  $7 \times 5$  mm. Ovary orange, 3-loculated, subglobose, ca.  $7 \times 6$  mm, pubescent; style white, filiform, ca. 3.5 cm long; stigma white, flabellate, ca.  $2.5 \times 4$  mm.

**Distribution.** Endemic to southern Colombia and Peru (POWO, 2023), the species has been

documented in Java, with records specifically from West Java (Bogor).



Figure 2. The additional cultivated *Costus* in Java. A. *Costus pictus*; B. *C. productus* var. *productus*; C. *C. stenophyllus* (bl=bracteole, br=bract, ca=calyx, co=corolla lobes, lb=labelum, p=pistil, st=stamen. Bar=2 cm). Photos by A.S.D.Irsyam, M.R.Hariri and M.F.R. Kurniawan.

**Habitat.** The species demonstrates optimal growth under warm, humid tropical climatic conditions with partial to dappled shade (Lim, 2014b). It has been successfully cultivated in a garden setting at an elevation of 176 m asl in Dramaga, Bogor.

**Specimen examined.** INDONESIA. Java: West Java, Bogor Regency, Dramaga Subdistrict, Postgraduate Garden, 04.III.2023, ASD Irsyam & MR Hariri DRMG-P-013 (FIPIA!).

**Vernacular names.** *Pacing naga*, *pacing bulu* (Bahasa Indonesia).

**Note.** Horticulturists in Java have mistakenly identified *C. productus* as *C. curvibracteatus* Maas, and it has been commercially sold under this name. A similar misidentification was reported by Skinner and Liesenfeld (2020) in the United States. *C. productus* is distinguished by its red-orange bracts, orange tubular flowers, and an orange labellum with a red apex. In contrast, *C. curvibracteatus* features red bracts with bright yellowish-orange appendages (Skinner, 2016). Maas (1975) classified *C. productus* into two varieties: *C. productus* var. *productus* and *C. productus* var. *strigosus* (Maas) Maas. The sample from Bogor was identified as *C. productus* var. *productus* due to its hairy sheaths and costa. *C. productus* also shares morphological similarities with *C. osae*, although the latter has red bracts and a reddish labellum with a central creamy nectar guide.

6. *Costus stenophyllus* Standl. & L.O.Williams, Ceiba 3: 38 (1952). — Type: Costa Rica, Prov. Puntarenas, Esquinas Forest, at 60 m altitude, P. H. Allen 6037 (holo US; iso NY, EAP). Figure 2C

Rhizomatous herbs up to 2 m in height. Rhizomes creamy white to reddish on the outside, creamy white inside, internodes 5–12 mm long. Shoots unbranched, spiral, green, glabrous; internodes 2–6 cm long. Leaves monostichous; sheaths reddish brown margined, up to 15 mm wide, glabrous; ligule red, 1-lobed, 1–2 mm long; petiole green, 2–5 mm long, glabrous; lamina green, linear, 15–30 × 0.8–2 cm, base cuneate, margin entire, apex long-caudate, pilose to pubescent on the adaxial side, puberulent on the abaxial side. Inflorescences and flowers not observed.

**Distribution.** *Costus stenophyllus* originates from Costa Rica (Maas, 1972). In Java, it has been observed in Jakarta, particularly in South Jakarta.

**Habitat.** Within its native distribution, the

species inhabits forested environments at elevations of approximately 60 meters above sea level (Maas, 1972). On the island of Java, it was recorded from an open area at around 30 meters asl in Lebak Bulus village, South Jakarta.

**Specimen examined.** INDONESIA. Java: Jakarta, South Jakarta, Cilandak Subdistrict, Lebak Bulus Village, The Riverville, 24.II.2023, MRF Kurniawan 04 (FIPIA!).

**Vernacular names.** *Pacing bambu* (Bahasa Indonesia).

**Note.** Generative organs were not observed during fieldwork. Nevertheless, *C. stenophyllus* is a distinctive species, readily identifiable in both flowering and vegetative states. It can be distinguished from other ornamental *Costus* species by its linear leaves and the characteristic banding on its leafy shoots. According to Maas (1972), the species is characterized by yellow flowers, prominent stamens, and a relatively small labellum. The vernacular name *pacing bambu* refers to its bamboo-like morphology (Figure 2C). During our botanical survey, *C. stenophyllus* was recorded exclusively in South Jakarta. Among the taxa examined, *C. stenophyllus* exhibits the narrowest leafy shoots, with diameters reaching up to 1.6 cm.

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