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Study on the Genus *Plectranthus* (Lamiaceae) in Java: *P. verticillatus*, a captivating new alien species

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ABSTRACT. *Plectranthus* (Lamiaceae) is a popular ornamental plant all over the world. The study of the genus *Plectranthus* in Java was considered complete after the publication of Flora of Java Vol. II. Many authors, however, have reported the presence of numerous alien species on the island in recent years. The aim of this research is to provide current information on *Plectranthus* in Java, particularly the newly recorded alien species. The study was carried out using the free exploration method in the provinces of Banten, Jakarta, West Java, and East Java. We reported the first occurrence of *P. verticillatus* (L.f.) Druce in Java in this paper. The species is a succulent herb native to Southern Africa that has grown in popularity as an ornamental plant throughout the world. It is a newly discovered alien species to the Alien Flora of Java. The species appears to have escaped cultivation, with spontaneous populations found in Jatihandap and Cipadung, both in Bandung City. We also reported that *P. verticillatus* is the only member of *Plectranthus* found in Java in a recent taxonomic study. There is a description, photographs, botanical illustrations, and a brief discussion.

Keywords: Alien species; herbarium specimens; Lamiaceae; ornamental plant; *Plectranthus verticillatus*

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INTRODUCTION

The genus *Plectranthus* L'Hér. (Lamiaceae) has a high level of diversity along the eastern seaboard of South Africa (Edwards, 2005). It consists of 84 species distributed from Cameroon to Ethiopia and South Africa, Madagascar, the Arabian Peninsula, India, and Sri Lanka (POWO, 2022). *Plectranthus* is grouped into the subtribe Plectranthinae and is closely related to the *Coleus* Lour. (Suddee et al., 2004; Paton et al., 2019). A french botanist, Charles Louis L'Héritier de Brutelle, described Plectranthus in 1788, while *Coleus* was described for the first time by de Loureiro in 1790 (L'Héritier, 1788; de Loureiro, 1790). The latter was distinguished from *Plectranthus* by having four stamens fused to their base into a sheath (Bentham, 1832; Codd, 1971). Other botanists, such as Brown (1810), Morton (1962), Keng (1974), and Bramley (2019), merged *Coleus* into *Plectranthus* because the characteristic of fused stamens was more fluid than previously thought. Recent phylogenetic studies have revealed that *Coleus* was a separate genus from *Plectranthus* (Paton *et al*., 2019). The genus *Coleus* have one to many flowers per cyme while *Plectranthus* is rarely has more than three flowers per cyme (Paton *et al*., 2019).

Backer & Bakhuizen van den Brink (1965) distinguished *Plectranthus* from *Coleus*. There are five different *Plectranthus* species, including *P. javanicus* (Bl.) Bth., *P. petraeus* Back. ex Adelb., *P. steenisii* H. Keng, *P. teysmanni* Miq., and *P. zollingeri* Briq., have been identified in Java (Backer & Bakhuizen van den Brink, 1965). However, those names have been synonymized under *Coleus* and

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Isodon (Schrad. ex Benth.) Spach (Paton *et al*., 2019). The five previously recognized species in the Flora of Java are no longer sufficient to represent the genus *Plectranthus* (Paton et al., 2019). Therefore, the information on the Lamiaceae of Java needs to be updated. This study aims to present current knowledge regarding the genus *Plectranthus* in Java. The ongoing Alien Flora of Java project that the Authors are working on includes this research.

In this paper, we formally reported the occurrence of *P. verticillatus* (L.f.) Druce, a newly recorded alien species, for Java. The species is a native herb from Southern Africa (Codd, 1975; Codd *et al*., 1985; Sunojkumar *et al*., 2012) and has been introduced to Java as an ornamental plant. The plant was discovered in Banten, Jakarta, West Java, and East Java. The occurrence of *P. verticillatus* has not been recorded yet by Backer & Bakhuizen van den Brink (1965), Keng (1974), and Bramley (2019). According to Codd *et al.* (1985), *P. verticillatus* is distinguished by its succulent orbicular leaves, crenate-serrate leaf margin, shiny green adaxial leaf surface, glaucous abaxial leaf surface, leaf gland dots, and white or mauve colored petals. Description, photograph, and brief discussion are provided.

MATERIALS AND METHODS

Study area. The study was conducted in Banten Province (Tangerang City), Jakarta (South Jakarta Regency), West Java Province (Bandung Barat Regency, Bandung Regency, Bandung City, Bogor City, Bogor Regency, Cianjur Regency, and Sumedang Regency) and East Java (Jember Regency, Malang Regency, and Situbondo Regency) from October 2022 to April 2023. The field study was carried out using the explorative method, according to Rugayah *et al.* (2004). Samples from the field were collected following van Balgooy's guidelines (1987).

Material Collection and Observation. Plant materials from the field were preserved and observed at Herbarium Bandungense (FIPIA), School of Life Sciences and Technology, Institut Teknologi Bandung. Botanical illustration and description were prepared based on the living samples and herbarium specimens deposited in FIPIA. The gland dots on the abaxial leaf surface have been observed with a microscope of NIKON SMZ 745. Specimens were identified using literature such as Codd (1975), Codd *et al*. (1985), Suddee *et al*. (2004), Sunojkumar *et al*. (2012), and Paton *et al*. (2019).

Data analysis. The data were analyzed descriptively following Veldkamp (1987).

RESULTS AND DISCUSSION

Taxonomic treatment

Plectranthus verticillatus (L.f.) Druce, Rep. Bot. Soc. Exch. Club Brit. Isles 4: 640 (1916 publ. 1917); Codd, Bothalia 11 (4): 407 (1975). Type: Cape, “India, Montin" (holo: LINN 749.4).

Ocimum verticillatum L.f., Suppl. Pl. 276 (1781), as “Ocymum". *O. racemosum* Thunb., Prodr. 96 (1800), as “Ocymum"; FI. Cap. ed. Schult. 448(1823). Type: Cape, "Houteniquas”, Thunberg (holo: SBT).

Herb, prostrate to ascending, glabrous, aromatic. Stem quadrangular, internodes up to 25 mm long, purple, or reddish purple, rooting at nodes. Leaves simple, opposite; petiole slender, 1.8–3.7 cm long, canaliculate, purple; lamina broadly ovate to orbicular, 2.3–6 × 2.5–6 cm, base rounded, margin crenate-serrate, apex rounded, vein 4 pairs, adaxial surface shiny green, abaxial surface glaucous with sessile glandular trichomes (gland dots). Inflorescences terminal, verticillate, 11 cm long; 3–4 flowers per cyme; peduncle 12 mm long, quadrangular, purplish green; rachis 1–1.3 mm long; pedicels filiform, 2.5–3 mm long, attached at the calyx base, purplish; calyx bilabiate, campanulate, ca. 2 mm long, lobes triangular, unequal, lateral lobes closer to anterior than posterior lobes, purplish green with red dots glands; corolla bilabiate, zygomorphic; tube exserted from calyx, gibbous at base, 9–10 × 2.5–3 mm, curved, white; upper lip short 4-lobed, curved, up to 5 mm wide, purplish white with dark purple blotches; lower lip entire, cucullate longer than upper, ca. 7 mm long, purplish white with dark purple blotches; stamens 4 didynamous; filaments filiform, curved, ca. 12–16 mm long, white;

anthers oblong, dorsifixed, ca. 0.5 mm long, purplish brown; ovary superior, 4-lobed, greenish with red dots glands; style filiform, ca. 15 mm long, white; stigma bifid, white.

Distribution. The species is distributed from South Mozambique to South Africa (Codd, 1975; Codd *et al*., 1985; Paton *et al*., 2019). In Java, *P. verticillatus* were collected from Banten (Tangerang), Jakarta (South Jakarta), West Java (Bandung City, Bogor Regency, Sumedang Regency), and East Java (Jember Regency).

Habitat. Naturally, the species commonly grows in forest borders, rocky places, and dry woodlands (Codd, 1975; Codd *et al*., 1985). In this study, *P. verticillatus* is grown at an altitude of 30 to 700 meters above sea level. It has escaped from cultivation and grows in urban wildly, such as on roadsides and gaps between paving blocks.

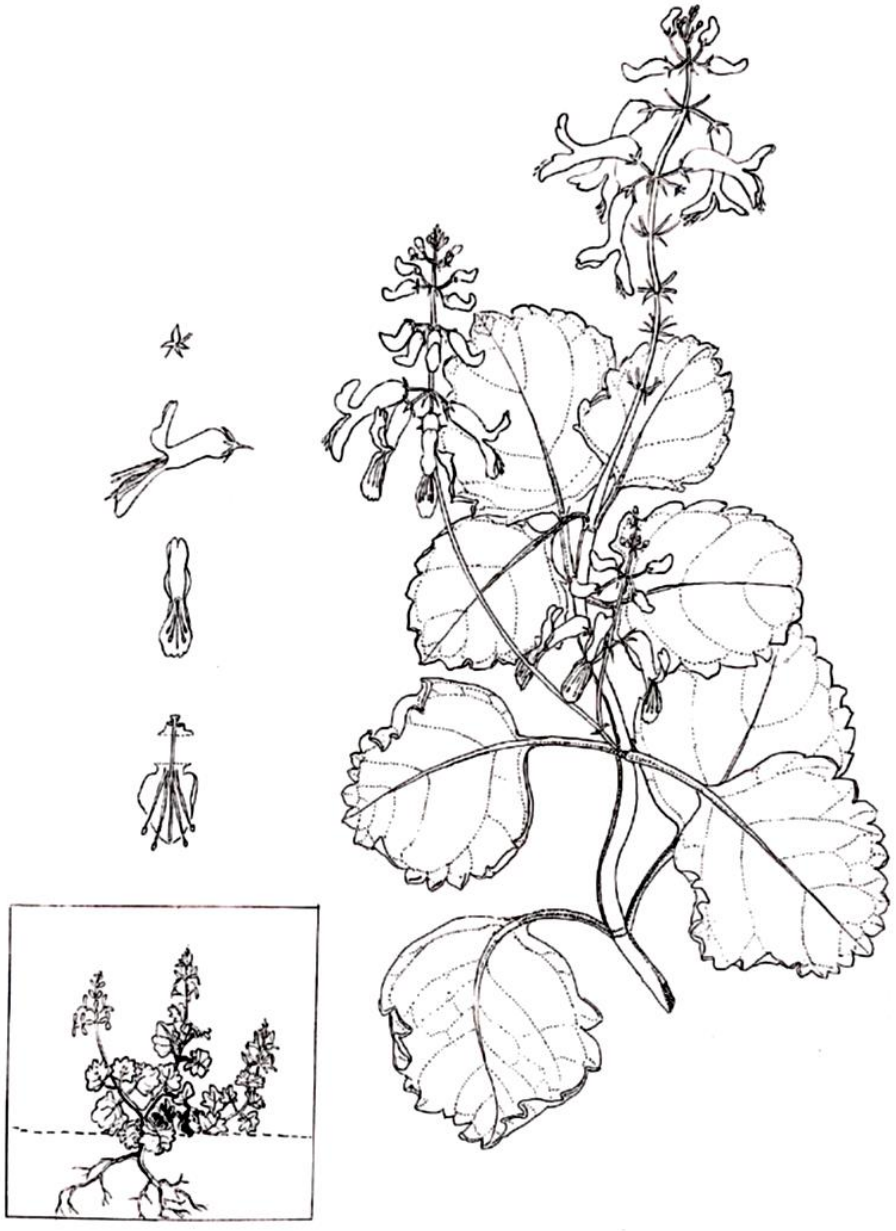

Fig. 1. *Plectranthus verticillatus* (L.f.) Druce (Illustration by Kurniawan MFR)

Specimen examined. Indonesia: BANTEN: Tangerang City, Cipondoh, 23.XII.2022, *MR Hariri ASP012* (FIPIA). SPECIAL CAPITAL REGION OF JAKARTA: South Jakarta Regency, Cilandak Subdistrict, Lebak Bulus Village, 20.XII.2022, *MFR Kurniawan 02* (FIPIA). WEST JAVA:

Sumedang Regency, Cinanjung Subdistrict, Cinanjung Village, Komp. Puri Pajajaran Indah, 19.XII.2022, *ASD Irsyam 780* (FIPIA); Sumedang Regency, Jatinangor Subdistrict, Sayang Village, 19.XII.2022, *ASD Irsyam 782-783* (FIPIA); Bandung City, Mandalajati Subdistrict, Jatihandap, Jl. A.H. Nasution, 23.XII.2022, *ASD Irsyam 784* (FIPIA); Bandung City, Arcamanik Subdistrict, Cisaranten, Jl. Ujungberung KM 10, 23.XII.2022, *ASD Irsyam 785* (FIPIA); Bandung City, Cibiru Subdistrict, Cipadung, 23.XII.2022, *ASD Irsyam 786* (FIPIA); Bogor Regency, Ciomas Subdistrict, Ciherang Village, 18.XII.2022, *MR Hariri ASP011* (FIPIA). EAST JAVA: Jember Regency, Sumberjambe Subdistrict, Sumberjambe Village, 18.XII.2022, *ASD Irsyam 781* (FIPIA); Malang Regency, Poncokusumo Subdistrict, Karanganyar Village, Karanganyar Kidul, Jl. Pancuran, 18.IV.2023, *MH Badlowi 04* (FIPIA).

Uses. Ornamental plant and groundcover (van Jaarsveld, 1998; Rice *et al*., 2011). In Java, the species is only used for ornamental purposes.

Plectranthus verticillatus, a newly recorded alien species, has recently been cultivated in Java, Indonesia (Fig. 1–2). The species was found in Banten, Jakarta, West Java, and East Java. Its existence in Java has not previously been noted in Flora of Java (Backer & Bakhuizen van den Brink, 1965) or Flora Malesiana Ser. 1 (Keng, 1974; Bramley, 2019). The history of this species' introduction into Java is currently unknown. So far, there is no report in recent publications on Malesia. However, *P. verticillatus* could be cultivated elsewhere in Java.

Taxonomically, *P. verticillatus* is the only member of the genus *Plectranthus* in Java. The previous species of *Plectranthus* in Flora of Java have been grouped into other genera (Table 1). The genus is distinguished from *Coleus* based on its generative characteristics, i.e., each cyme consists of three flowers or rarely more, pedicel attached at the calyx base, lateral calyx lobes closer to anterior than posterior lobes, and corolla tube straight or curved downwards, usually gibbous at the base (Paton *et al*., 2019). These characteristics are observed in *P. verticillatus* (Fig. 1–2). Flowers in the genus *Isodon* are dichasial, with a relatively straight corolla tube that is not markedly ventricose or saccate at the base, three corolla limb upper lips that are 4-fid, and posterior filaments that are not dilated outside at the base (Codd, 1984; Li, 1988).

Table 1. The updated name of Plectranthus in the Flora of Java Vol. II

No	Scientific names in The Flora of Java	Accepted names	References
1	*Plectranthus javanicus* (Bl.) Bth.	*Isodon coetsa* (Buch. -Ham. ex D.Don) Kudô	Paton *et al.* (2019)
2	*Plectranthus petraeus* Back. ex Adelb.	*Coleus petraeus* (Backer ex Adelb.) A.J.Paton	Paton *et al.* (2019)
3	*Plectranthus teysmanni* Miq.	*Isodon teysmannii* (Miq.) H.W.Li	Li (1988); Paton *et al.* (2019)
4	*Plectranthus zollingerii* Briq.	*Isodon teysmannii* (Miq.) H.W.Li	Li (1988); Paton *et al.* (2019)

Another captivating characteristic observed in *P. verticillatus* is the presence of the sessile glandular trichomes on the abaxial leaf surface resembling gland dots (Fig. 2e). These gland dots have also occurred on the generative parts, such as the calyx, corolla, and ovary. In some species such as *P. verticillatus*, *P. strigosus* and *P. purpuratus*, there is a red gland-dot situated between the anther cells and it is evident that these three species are closely related (Codd *et al*., 1985). The glandular trichomes present in *P. verticillatus* may be involved in the chemical defence of plants or may act as floral rewards to pollinators. However, the specific function is unknown (Ascensão *et al*., 1999; Galbiatti *et al*., 2021). According to previous histochemical studies (Ascenso *et al*., 1999; Kalicharan *et al*., 2015; Galbiatti *et al*., 2021) the glandular trichomes in *Plectranthus* secrete oleoresin-containing terpenoids (essential oils and resiniferous acids), flavonoid aglycones, polysaccharides, and flavonoids with small amounts of essential oils.

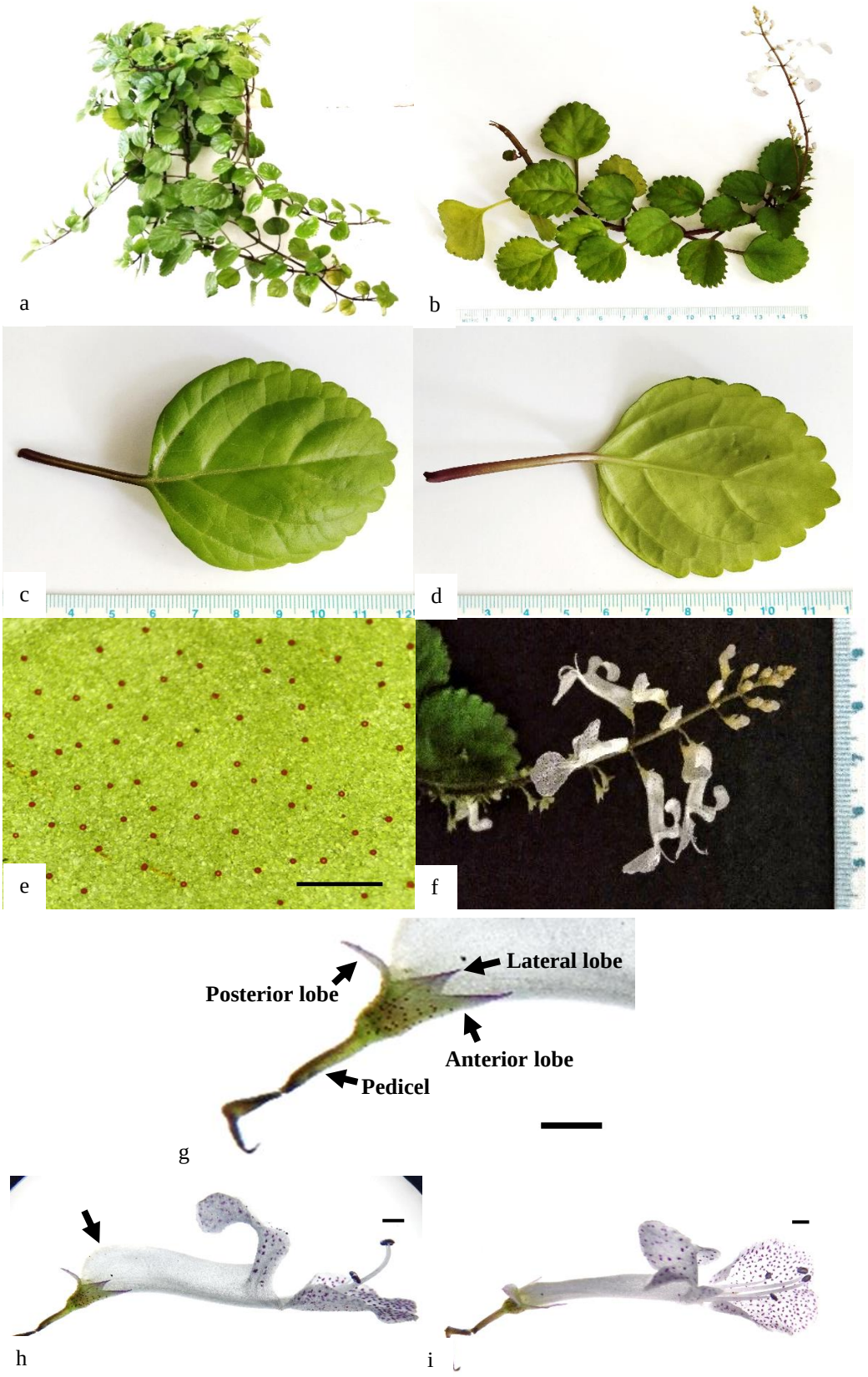

Fig. 2. *Plectranthus verticillatus* (L.f.) Druce: a. habit; b. flowering branch; c. adaxial leaf surface; d. abaxial leaf surface; e. sessile glandular trichomes on the abaxial leaf surface resembling gland dots; f. inflorescence with three flowers per cyme (arrow); g. calyx with pedicel attached at center of calyx base with the lateral lobe closer to the anterior lobe; h. curved corolla tube with gibbous base (arrow); i. the dorsal view of flower (scale bar = 1 mm)

Plectranthus is a promising genus for ornamental and medicinal purposes (Rice *et al*., 2011). On the other hand, ornamental horticulture is the most important pathway for alien plant introductions worldwide. The escaped ornamentals could establish long-term populations and spread quickly (Kowarik, 2005; van Kleunen *et al*., 2018). Some horticultural characteristics, such as rapid growth, promote the introduced species to naturalize (van Kleunen *et al*., 2018). Previous studies revealed that *P. verticillatus* has the potential to naturalize and spread outside of its native ranges. In Bandung, it has been noted that some vegetative plants have escaped from cultivation. In addition, the spesies is being listed as a naturalized species in the Hawaiian Islands (Starr *et al*., 2004) and India (Sunojkumar *et al*., 2012).

Fig. 3. The spontaneous population of *Plectranthus verticillatus* (L.f.) Druce found in: a. Jatihandap, Mandalajati Subdistrict; b-d. Cipadung, Cibiru Subdistrict.

The spontaneous populations of *P. verticillatus* have been found in roadsides and gaps between concrete paving slabs at Jatihandap and Cipadung, Bandung City (Fig. 3). It appears to spread through stem fragments and vegetatively rather than spread through seeds. The seeds or vegetative fragments are possibly spread by water. The similar dispersal mechanism was also observed in *Coleus monostachyus* (P.Beauv.) A.J.Paton (Irsyam & Mountara, 2018; Kiew & Kamin, 2021). It has spread rapidly and grow as a weed in Java, Malaysia, and Singapore (Chung et al., 2015; Irsyam & Mountara, 2018; Kiew & Kamin, 2021). In the future, *P. verticillatus* may have the same potential as *C. monostachyus*.

CONCLUSION

Plectranthus verticillatus (L.f.) Druce, a previously unreported alien species, was discovered for the first time in Java. This species was introduced to Java as an ornamental plant from Southern Africa. It represents the only remaining *Plectranthus* species on the island. *Plectranthus verticillatus* has also escaped from cultivation. Its spontaneous populations have been discovered in Jatihandap and Cipadung, both in Bandung City.

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