

**A NOTE ON THE GENUS *Evolvulus* (CONVOLVULACEAE)
IN JAVA, INDONESIA**

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Abstract. According to the Flora of Java, there is only one species of *Evolvulus* in Java, namely *Evolvulus alsinoides*. Since then, a second species was reported in 2017 from Universitas Indonesia, Depok, West Java, as an alien naturalized species. Some recent field studies have been conducted to provide updated taxonomic information of the genus on this island. The field observations were carried out in Banten, Jakarta, West Java, Yogyakarta and East Java from March to December 2019. The herbarium studies were also conducted in Herbarium Bogoriense, Herbarium of Bogor Botanic Gardens, Herbarium Bandungense and Herbarium of the Department of Biology, Universitas Indonesia. Our study reveals one newly recorded species of *Evolvulus* in Java already grown in cultivation, namely *E. glomeratus* Nees & Mart. subsp. *grandiflorus* (Parodi) Ooststr. Besides that, *Evolvulus nummularius* is now also reported to occur in other sites of West Java and extended to Central Java. An updated key of *Evolvulus* in Java, descriptions to both species, photographs and brief discussions are provided.

Keywords: Convolvulaceae, *Evolvulus*, exotic species, Java

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INTRODUCTION

Evolvulus L. (Convolvulaceae) comprises as many as 100 species widely distributed in the Neotropics (van Oostroom, 1934; Junqueira & Simão-Bianchini, 2006). Morphologically, the genus is characterized by its non-twining habit, unlobed leaves, the

presence of two-branched trichomes, corolla with purple, blue or white color, two forked styles, filiform stigmas and glabrous seeds (Backer & Bakhuizen van den Brink, 1965; Junqueira & Simão-Bianchini, 2006; Staples, 2010; Simões et al., 2011). Two species of the genus, *Evolvulus alsinoides* (L.) L. and *Evolvulus nummularius* (L.) L., have been natural-

ized in the Old World (van Oostroom, 1934).

The taxonomical information on *Evolvulus* of Java was published by Backer & Bakhuizen van den Brink (1965) and van Oostroom (1934; 1953). They recognized only one species of *Evolvulus* in Java, namely *E. alsinoides*. Since then, one alien species was recorded from Depok, namely *E. nummularius* (Nisyawati & Mustaqim, 2017). Some recent field botanical explorations were made in some areas of Java which reveal that there is another species of *Evolvulus* already present in Java. A thorough examination of the herbarium and literature has shown that the species is *E. glomeratus* Nees & Mart. subsp. *grandiflorus* (Parodi) Ooststr. Therefore, there is a need to provide updated taxonomic data on the genus *Evolvulus* in Java as a part of the Alien Flora of Java treatment currently undertaken by the authors.

MATERIALS AND METHODS

The field study was conducted using the exploration method according to Rugayah et al. (2004) from March to December 2019. The plant materials were collected using van Balgooy's method (1987) from several urban localities in Banten (Serpong), Jakarta, West Java (Bandung, Bogor, Depok, Garut, Jatinangor, Pangandaran, Sukabumi), Yogyakarta (Bantul) and East Java (Bondowoso, Malang, Surabaya, Madura Island), i.e. campus areas, pedestrian paths, city parks and agritourism places. These explorations were conducted in urban areas because the spread of alien species often begins in urban ecosystems (Mayer et al., 2017). The plant materials were preserved and observed in Herbarium Bandungense (FIPIA), School of Life Sciences and Technology

(SITH), Institut Teknologi Bandung (ITB).

Two herbarium studies have been carried out between 2016 and 2019. In August 2016, the first have been done in Herbarium of the Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Indonesia. Three years later, in August 2019, further examinations of herbarium have been done in Herbarium Bogoriense (BO), Herbarium of Bogor Botanic Gardens (KRB) and Herbarium Bandungense (FIPIA).

The collected *Evolvulus* specimens were identified by comparing the description of the specimens to the previously published literatures for *Evolvulus* (van Oostroom, 1934; van Oostroom & Hoogland, 1953; Backer & Bakhuizen van den Brink, 1965; Staples, 2010) and literatures for weeds and alien species in Java or Indonesia (Backer & van Slooten, 1924; Everaarts, 1981; Soerjani et al., 1987; Setyawati et al., 2015; Tjitrosoedirdjo et al., 2016; Kementerian Pertanian, 2017; Nisyawati & Mustaqim, 2017).

RESULTS AND DISCUSSION

A total of ten specimens of *Evolvulus* were collected from our recent explorations. Four of them belong to *E. nummularius*, a species recorded for the first time in Java by Nisyawati & Mustaqim (2017). The other six were identified as *E. glomeratus* Nees & Mart. subsp. *grandiflorus* (Parodi) Ooststr. (Figure 1). The latter Specimens were collected from West Java (Bandung and Bogor) and East Java (Bondowoso and Malang) (Figure 1). No addition to the specimens of *E. alsinoides*, only one species recorded from the island before present publication.

An updated key to the *Evolvulus* species in Java

1. A. Leaves orbicular, base cordate, glabrous above; sepal ovate; corolla white *Evolvulus nummularius*
- B. Leaves otherwise, base acute to rounded, hairy above; sepal lanceolate; corolla blue 2
2. A. Peduncle up to 3 cm; petiole up to 2 mm long..... *Evolvulus alsinoides*
- B. Peduncle very short or absent; petiole 2 mm or longer *Evolvulus glomeratus* subsp. *grandiflorus*

Evolvulus glomeratus Nees & Mart. subsp. *grandiflorus* (Parodi) Ooststr., Meded. Bot. Mus. Herb. Rijks. Utrecht 14: 232 (1934).

Herb, perennial, prostrate or ascending and stem woody at the base. Stems reddish-brown, with a dense indumentum of white villose or villose-tomentose hairs, appressed. Leaves alternate, oblong, elliptic-oblong or obovate, 16–29 × 8–14 mm, base acute to rounded, margins entire, apex obtuse, triplinerved at the base, adaxial surface sericeous, green, abaxial surface covered by white hairs; petiole 2–4 mm long. Flowers solitary in the axils of leaves or aggregated into a terminal capitulum, sessile. Sepals free, 5, linear-lanceolate, 7 mm long, green, villose and ciliate. Corolla salverform, plicate, blue or lilac, white at the centre, tube 5 mm long, limb 5-lobed, up to 25 mm in diameter. Stamens 5, exserted, adnate to the corolla tube; filaments white, filiform, 5 mm long; anthers oblong, white, 2 mm, dorsifixed. Ovary superior, ovoid, yellowish-green. Styles 2, each 2-branched; stigma 2, filiform, white, 12 mm. Fruits and seeds unknown.

Distribution

Southern Brazil, Bolivia, Paraguay, Uruguay, to North Eastern Argentina (van Ooststroom, 1934). Introduced as cultivated species in Malaysia, Singapore (Chen et al., 2015) and Java.

Habitat

It is usually planted in open areas, shady areas and roadsides.

Notes

Evolvulus glomeratus subsp. *grandiflorus* is native to Tropical America (van Ooststroom, 1934). The species has been widely cultivated as an ornamental due to its beautiful blue-lilac flowers (Staples, 2008; Staples, 2010). The species has also been commonly grown as ornamental in some regions surrounding Indonesia, including Singapore, Thailand and Taiwan (Chen, 2007; Staples, 2008; Chen et al., 2015; Ketjarun et al., 2016). Based on an examination of material in BO, KRB and FIPIA, *Evolvulus glomeratus* subsp. *grandiflorus* has not previously been recorded in Java. We found that this species already cultivated in Java as an ornamental plant, but the information about when it was introduced in Java is uncertain. There is no record that the species has escaped from cultivation and become naturalized.

Specimens Examined

West Java: Cibeunying Park, Bandung, 07 March 2019, *ASD Irsyam 212* (FIPIA); near the West Ceremonial Hall of Bandung Institut of Technology, Bandung, Jl. Ganesha No. 10, 08 July 2019, *ASD Irsyam 280* (FIPIA); Bandung, Jl. Riau, 08 July 2019, *ASD Irsyam 281* (FIPIA); Jl. Raya Bogor, Cibinong, 08 August 2019, *ASD Irsyam 282* (FIPIA).

East Java: Bondowoso, 03 March 2019, *MR Hariri 41* (FIPIA); Kota Batu, Malang, 03 March 2019, *MR Hariri 42* (FIPIA).

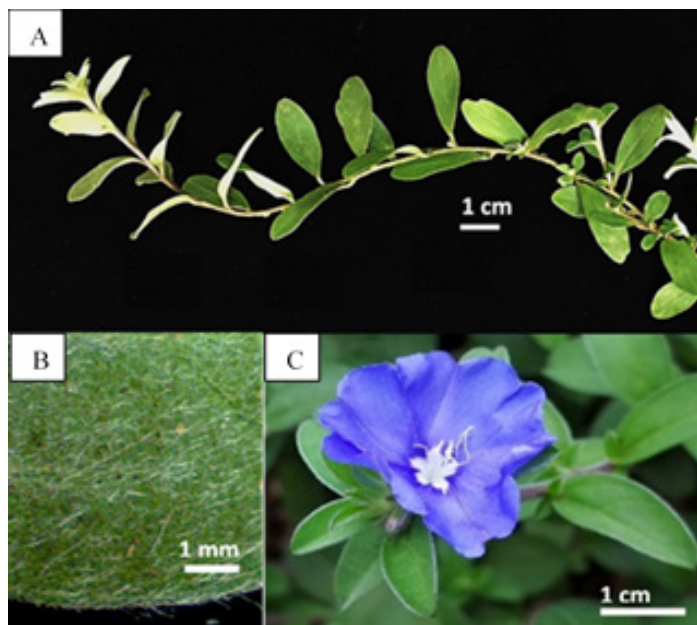


Figure 1. *Evolvulus glomeratus* Nees & Mart. subsp. *grandiflorus* (Parodi) Ooststr. (A) habit, (B) hairs on the abaxial leaf surface, (C) flower

Evolvulus nummularius (L.) L., Sp. Pl. (ed. 2) 1: 391 (1762).

Herb, perennial, prostrate, pubescent. Stems slender, brown, villous or scabrous, rooting at nodes. Leaves distichous; orbicular to orbicular-obovate, 1.3–1.7 × 1.2–1.4 cm, base cordate to rounded, apex rounded or emarginate; glabrous or appressed pilose abaxially, rarely sparsely pubescent beneath; lateral veins 2 or 3 pairs; petiole 2–4 mm. Flowers axillary, 1 or 2 per leaf axil, peduncles up to 5 mm long. Sepals persistent, oblong-ovate to oblong, 3–4 × 2–3 mm, outer 2 sepals slightly longer than the inner sepals, pilose abaxially, margin ciliate. Corolla white, broadly campanulate or nearly salverform, ca. 6 mm wide; limb ca. 7–8 mm in diam., 5-lobed. Stamens 5, inserted at middle of corolla tube; filaments ca. 1.5 mm long, glabrous basally; anthers oblong. The ovary is superior, globose. Styles 2, lobes linear, ca. 3 mm; stigma 2, minutely capitate. Fruits ovoid capsule, 2–3 mm in diam. Seeds 2–4 per fruit, brown to black, shiny, ovoid-trigono-

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nous, ca. 1 × 0.5 mm, minutely tuberculate.

Distribution

This species is native to Continental America from Mexico to N. Argentina, West Indies; tropical Africa, Madagascar: British India (Van Oostroom, 1934; van Steenis, 1953).

Habitat. The species grows on open areas, gaps area between paving blocks or stones, and along the footpath at BBG, Universitas Indonesia (UI) and National Nuclear Energy Agency of Indonesia (BATAN).

Specimens Examined

Special Capital Region of Jakarta: research garden of BATAN, Pasar Jumat, 20 June 2019, *MR Hariri 40* (FIPIA). West Java: Bogor Botanic Gardens, Bogor, 20 March 2019, *MR Hariri 21-22* (FIPIA); Universitas Indonesia, Depok, 2015, *WA Mustaqim 1217* (UI). Central Java: Wonogiri Regency, near the city center and settlement at near limestone hill, 28 September 2015, *WA Mustaqim 1363* (UI); Wonogiri Regency, Jatisrono, open fields, 28 September 2015, *WA Mustaqim 1368* (UI).

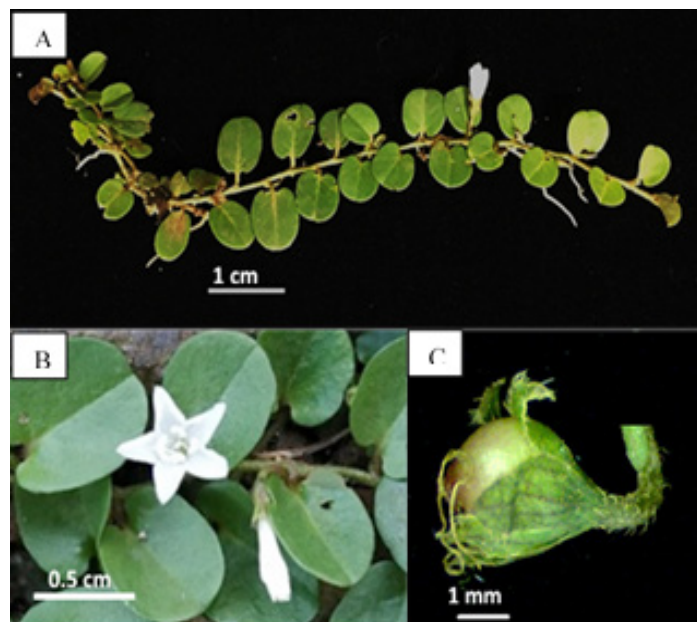


Figure 2. *Evolvulus nummularius* (L.) L. (A) habit, (B) flowers, (C) fruit

Evolvulus nummularius is distributed from Central to South America and it has just been recently recorded in Java. Although there is no clear evidence, there is a possibility that it was accidentally introduced to Java as a soil contaminant. Previous studies showed that some small-seeded alien species were unintentionally introduced into Java as a contaminant, such as *Erechtites valerianifolia* (Link ex Wolf) Less. ex DC. and *Praxelis clematidea* (Griseb.) R.M.King & H.Rob. (Tjitrosoedirdjo et al., 2016; Tjitrosoedirdjo & Wahyuni, 2018). *Evolvulus nummularius* was collected for the first time from Wonogiri Regency, Central Java, in September 2015, but this information still not published elsewhere until now. Later, the species has been previously reported from Depok (Nisyawati & Mustaqim, 2017) and Jakarta (Mustaqim et al., 2019). In this study, the species was also collected from Bogor Botanical Gardens (BBG) and the National Nuclear Energy Agency of Indonesia (BATAN), Jakarta. It is now concluded that this species has been

found in two of three main phytogeographical regions of Java, a quite significant geographic extension from the previous publication by Niswayati & Mustaqim (2017).

There is no record on the intended introduction of *E. nummularius* according to our examination in many previous publications (Blume, 1823; Binnendijk & Teysmann, 1855; Boerlage, 1901; Boldingh, 1914; Danimihardja & Notodihardjo, 1978; Danimihardja & Notodihardjo, 1985; Astuti et al., 2001; Sari et al., 2010; Nisyawati & Mustaqim, 2017; Ariati et al., 2019). Therefore, we concluded that the presence of this species in BBG was not made by the human. *Evolvulus nummularius* is a small-seeded species, and the seeds are possibly dispersed by wind, water and ectozoochory, i.e. by transported on human feet at BBG. Lakshminarayana & Raju (2017) reported that the seeds of *E. nummularius* had been dispersed by wind and rainwater in India.

The pollination mechanism of *E. nummularius* in our research sites is not known. But, the previous study has suggested that the

pollinator of *E. nummularius* during a rainy season in India is a snail (*Lamellaxis gracile*), due to its flower position is located close to the ground surface (Sarma et al., 2007). Moreover, *E. nummularius* also produces nectars and pollinated by several species of bees (*Apis cerana* and *Trigona iridipennis*) or butterflies (*Zizeeria karsandra*, *Zizina otis*, *Chilades laius*, *Chilades pandava* and *Euchrysops cnejus*) (Lakshminarayana & Raju, 2017).

Other than Indonesia, *E. nummularius* was also reported as a newly recorded alien species in Southern China, Singapore and Taiwan (Fang & Staples, 1995; Chen et al., 2009; Chua, 2016). The further ranges of *E. nummularius* in Java after Nisyawati & Mustaqim (2017) needs to be noticed, due to its potential as an invasive alien species. Moreover, it has been considered as invasive alien species in India and Vietnam (Tan et al., 2012; Desmukh et al., 2017). In India, the species has also been reported as a weed of agricultural fields (Naidu, 2012; Gaddeyya & Kumar, 2014; Khobragade & Sathawane, 2014; Kaur et al., 2018).

Evolvulus nummularius are traditionally used as Asian herbal medicine, especially in North-East India (Ketjarun et al., 2016; Saha et al., 2016). Previous pharmacological studies showed that *E. nummularius* has antibacterial, anthelmintic, antioxidant and wound healing activities (Dash et al., 2003; Saini et al., 2007; Pavithra et al., 2009; Saha et al., 2016). The methanol extract of *E. nummularius* is effective against *Bacillus subtilis*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae* and *Escherichia coli* (Pavithra et al., 2009). The presence of tannins, flavonoids and triterpenoids in the methanol extract might play an important role as antioxidant properties (Pavithra et al., 2009). Based on these studies, the species can be developed as a medicinal plant in Indonesia. On the other hand,

the pharmacological studies of *E. glomeratus* subsp. *grandiflorus* are not provided yet and require further research.

Three species of *Evolvulus* (Convolvulaceae) are now recognized in Java. *Evolvulus glomeratus* Nees & Mart. subsp. *grandiflorus* (Parodi) Ooststr. is a new record for Java which has been collected from Jakarta, West Java (Bandung and Bogor) and East Java (Bondowoso and Malang). *Evolvulus nummularius*, previously only known from West Java, is shown to have a much wider geographic range within Java. The results of our study suggested that the taxonomy of Convolvulaceae in Java needs to be updated to accommodate the species that have not been included in Flora of Java.

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