

Short Communications

Praxelis (Asteraceae: Eupatorieae), A Newly Naturalised Genus for Kalimantan and Sumatra, Indonesia

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ABSTRACT

The southern American genus *Praxelis* Cass. has 18 species. In Singapore and Indonesia, notably Java, *P. clematidea* R.M.King & H.Rob. has naturalised. The first record in Indonesia was in Bogor in 2018, although it is unverified elsewhere. *Praxelis clematidea* was found in Bangka, Belitung, Jambi, Lampung, and Palangka Raya during our exploratory field research in 2020–2023. The naturalised populations proliferate in roadsides, ditches, open spaces, and disturbed areas. It thrives in a small swampy peat environment in Palangka Raya. *Praxelis clematidea* has been found outside Java, suggesting it could become an invasive alien species in Kalimantan and Sumatra.

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Asteraceae is one of the largest groups of Angiosperm families, with 1701 genera distributed worldwide except in Antarctica (Funk et al. 2007). As many as 150 genera are found in Malesia, and 70 are naturalised genera (van Steenis 1987; Holmes et al. 2023). The Asteraceae family still has to be revised for the Flora Malesiana. Furthermore, many newly recorded alien species of Asteraceae were reported in Malesia within the past eight years, such as Singapore (Chen et al. 2018) and Java (Irsyam & Hariri 2016; Tjitrosoedirjo & Wahyuni 2018; Irsyam & Irwanto 2019; Irsyam et al. 2020a; Irsyam et al. 2020b; Al Anshori et al. 2022). These findings imply that further taxonomic research on newly discovered

Asteraceae is required to update and improve the knowledge of the Asteraceae of Malesia.

Praxelis Cass is a group of Eupatorieae that is primarily found in South America and comprises 20 species (King & Robinson 1987). Taxonomically, *Praxelis* was previously placed under the *Eupatorium* sect. *Praxelis* (Cass.) Benth. ex Baker, but King and Robinson (1970) reinstated it at the generic level. The genus *Praxelis* is recognised by its caducous involucre bracts, conical receptacle, lack of paleae, the inner surface of corolla lobes with dense papillose hairs, baluster form anther collars, ob-compressed achene, asymmetrical carpodia, and pappus composed of many capillary bristles (King & Robinson 1970; King & Robinson 1987; Hind & Robinson 2007; Grossi et al. 2020).

According to previous studies, only one species of *Praxelis* occurred in Malesia, namely *P. clematidea* (Hieron. ex Kuntze) R.M.King & H.Rob. The species have been naturalised in Singapore and Java (Chen et al. 2018; Tjitrosoedirdjo & Wahyuni 2018). During our field studies from 2020 to 2023, the spontaneous populations of *P. clematidea* were collected in Kalimantan (Central Kalimantan) and Sumatra (Bangka Belitung Islands, Jambi, Lampung, and South Sumatra). The species is considered new to Kalimantan and Sumatra. Hence, this study aimed to report the presence of *Praxelis* in Kalimantan and Sumatra as part of a database update for the Asteraceae of Malesia, particularly Indonesia. Moreover, discovering new alien species and assessing their naturalisation status are essential for their proper management.

This work is based on five field botanical surveys in Kalimantan (Central Kalimantan) and Sumatra (Bangka Belitung Islands, Jambi, Lampung, and South Sumatra) from 2020 to 2023. The field surveys were conducted following the free exploring method (Rugayah et al. 2004). The plant materials were preserved in the field using the Schweinfurt method, according to Bridson and Forman (1998). Thirteen voucher specimens used in this study were deposited in the Herbarium Bandungense (FIPIA), School of Life Sciences and Technology, Institut Teknologi Bandung (ITB), Indonesia. Further specimen examined was also conducted at Herbarium Bogoriense (BO), National Research and Innovation Agency (BRIN), Indonesia.

Taxonomic Treatment

Key to the tribe Eupatorieae in Kalimantan and Sumatra, according to Koster (1935) and Tjitrosoedirdjo (2000).

- 1 A Appendages absent in the apex of anthers, pappus glandular...
.....*Adenostemma*
- B Appendages present in the apex of anthers, pappus eglandular
..... 2
- 2 A Vine, the head consists of 4 flowers, receptacle flat
..... *Mikania*
- B Herb to shrub, the head comprises of more than four flowers,
receptacle convex to conical 3
- 3 A Phyllaries multi-seriate, receptacle without paleae, pappus
more than 5 4
- B Phyllaries 2-seriate, receptacle with paleae, pappus 5
.....*Ageratum*
- 4 A Style base hairy..... 5
- B Style base glabrous 6

- 5 A Carpopodia are well differentiated, anther appendages ovate-oblong..... *Austroeupatorium*
- B Carpopodia are slightly scarcely differentiated, anther appendages ovate-triangular..... *Eupatorium*
- 6 A Receptacle to convex, achene prismatic, 5-ribbed..... 7
- B. Receptacle conical, achene flattened, 3–4-ribbed.....*Praxelis*
- 7 A. Shrub, corolla lobes densely papillose on the inner surface
..... *Chromolaena*
- B. Herb, corolla lobes glabrous on the inner surface..... *Ayapana*

Praxelis clematidea (Hieron. ex Kuntze) R.M.King & H.Rob., *Phytologia* 20: 194 (1970). — TYPE: Argentina, Cordoba, 1819–1821, P.G. Lorentz 81 (lecto GOET!-Image seen [GOET001494], designated by Freire & Ariza Espinar, *Flora Argentina* 7 (1): 404. 2014; isolecto GOET!-Image seen [GOET001493]; syn GOET!-Image seen [GOET001492 & GOET001495]). – Figure 1 & 2.

Herb, erect, up to 75–78 cm tall, rooting at nodes, intensely aromatic. *Stem* angular, many-branched, green or purplish, hirsute. *Leaves* opposite; petioles 7–15 mm long, green, hirsute; lamina ovate, 1.2–5 × 1–3.5 cm, base attenuate, margin serrate, ciliate, apex acute, membranous, triplinerved, adaxial surface green, hirsute, uniseriate simple hairs present, abaxial surface pale green, densely hirsute, with simple uniseriate hairs and glandular hairs. *Capitulescence* of densely many-headed corymbiform cymes, terminal, discoid; peduncles 4–15 mm long, green, hirsute; receptacles conical, ca. 1.5 × 1 mm, apex acute, greenish white; phyllaries 18–20, 3–5-seriate, linear, 2.5–7 × 1–1.5 mm, green. *Paleae* absent. *Disc flowers* ca. 30–32, corolla ca. 5–6 mm long, purple, 5-merous; tube ca. 5 mm long, white; lobes triangular, ca. 1 mm long, papillose, purple; stamens 5, ca. 1 mm long; filaments free, filiform, white; anthers linear, ca. 3 mm long, connate, purplish; apical appendices ovate, ca. 0.5 mm long, purple, transparent; styles ca. 5 mm long, glabrous at the base, white; style arms 2, ca. 2–2.5 mm long, papillose, purplish blue. *Achenes* cylindric, ca. 2 mm long, black; *pappus* 1-seriate, numerous, ca. 40, 4–5 mm long, white.

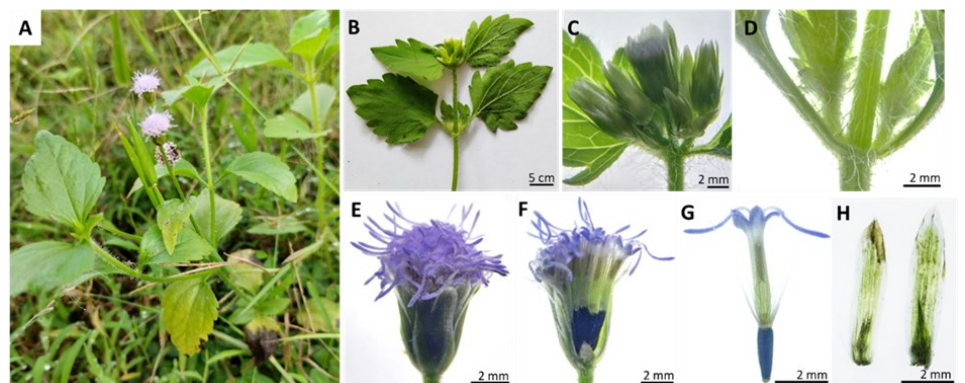


Figure 1. The morphological characteristics of *Praxelis clematidea* (Hieron. ex Kuntze) R.M.King & H.Rob. A. Habit; B. Opposite leaves; C. Capitulescence; D. Hirsute hairs on the stem; E-F. Head; G. Disc flower; H. Phyllaries.

Distribution: *Praxelis clematidea* is naturally distributed in Argentina, Bolivia, Brazil, Paraguay, and Peru (Veldkamp 1999; Salgado et al. 2022). It has become naturalized in Florida (Gardner & Williges 2015), China (Corlett & Shaw 1995; Veldkamp 1999; Wang et al. 2006a), Thailand (Intanon et al. 2020), Singapore (Chen et al. 2018), Java (Tjitrosoedirdjo

& Wahyuni 2018), and Northern Australia (Veldkamp 1999). Our study discovered the species in Kalimantan and Sumatra (Figure 2).

Habitat: *Praxelis clematidea* is mainly found in open areas, roadsides, ditches, peat swamps, and disturbed areas in Kalimantan and Sumatra. In Central Kalimantan, the species is often found growing at elevations between 11.41 and 23.55 m, while in Sumatra, it can be found at 20 to 530 m asl.

Specimens examined: INDONESIA: – **Kalimantan** • Central Kalimantan, Palangka Raya City, Jekan Raya Subdistrict, Menteng, G. Obos XVI, Cassadova Complex, 13.VI.2023, *RW Lestari 01* (FIPIA); Central Kalimantan, Palangka Raya City, Jekan Raya Subdistrict, Menteng, G. Obos XVI H, 13.VI.2023, *RW Lestari 02* (FIPIA); Central Kalimantan, Palangka Raya City, Jekan Raya Subdistrict, Menteng, Jl. Yos Sudarso 1, near the Merah Putih building, 13.VI.2023, *RW Lestari 03* (FIPIA); Central Kalimantan, Palangka Raya City, Jekan Raya Subdistrict, Palangka, Universitas Palangka Raya, around the Tunjung Nyaho Campus Forest, 13.VI.2023, *RW Lestari 04* (FIPIA); Central Kalimantan, Palangka Raya City, Jekan Raya Subdistrict, Palangka, Universitas Palangka Raya, near the library building, 13. VI.2023, *RW Lestari 05* (FIPIA); Central Kalimantan, Palangka Raya City, Jekan Raya Subdistrict, Palangka, Universitas Palangka Raya, near the LPPM building, Jl. Hendrik Timang, 13.VI.2023, *RW Lestari 06* (FIPIA). – **Sumatra** • Bangka Belitung Islands, Pangkal Pinang City, Bukitintan Subdistrict, Air Itam, Jl. Raya Pasir Padi, October 2020, *MR Hariri s.n.* (FIPIA); Bangka Belitung Islands, Belitung Regency, Membalong, Bantan, Jl. Serai Wangi, November 2020, *MR Hariri s.n.* (FIPIA); Jambi, Muaro Jambi Regency, Maro Sebo, Menapo Parit Duku Complex, Jl. Danau Lamo, August 2022, *MR Hariri s.n.* (FIPIA); Jambi, Muaro Jambi Regency, Maro Sebo, Candi Kotomahligai Complex, Jl. Danau Lamo, June 2021, *MR Hariri s.n.* (FIPIA); Sumatra Selatan, Ogan Komering Ulu Regency, Semidang Aji Subdistrict, Suka Merindu, Semidang Aji, Padang Bindu, June 2021, *MR Hariri s.n.* (FIPIA); Lampung, Tanggamus Regency, Semaka Subdistrict, Sedayu, Jl. Kota Agung-Bengkunat, 16.III.2023, *ASD Irsyam & The team of Tropical Forest Ecology Course TGGMS01-02* (FIPIA).

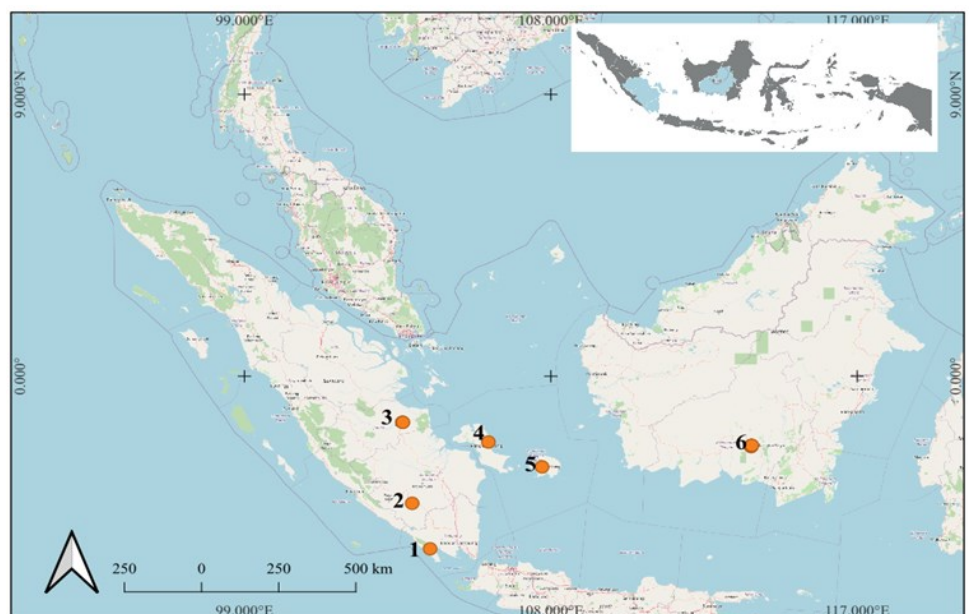


Figure 2. The Distributional map of *Praxelis clematidea* in Kalimantan and Sumatra. 1=Lampung, 2=South Sumatra, 3=Jambi, 4=Bangka, 5=Belitung, 6=Central Kalimantan.

Praxelis clematidea is a new addition to the exotic flora of Sumatra and Kalimantan. This species was reported for the first time in Indonesia in 2018 from Bogor, West Java (Tjitrosoedirdjo & Wahyuni 2018). Since then, it has expanded to several regions in West Java, including Sumedang Regency, Bandung City, and Bandung Regency. The genus *Praxelis* has not been recorded taxonomically in Kalimantan and Sumatra by previous botanists. Alien naturalised species are understudied in Sumatra and Kalimantan, Indonesia, because they tend to thrive in disturbed habitats less favourable to botanical research, according to Mustaqim and Putra (2020). As a result, many newly naturalised alien species will be discovered in the future.

Earlier botanists from the late 19th to the early 21st centuries addressed the taxonomical investigations on the Sumatran Asteraceae (Miquel 1861; Boerlage 1891; Koster 1935; Soerjani et al. 1987; Tjitrosoedirdjo 2002). As many as 133 species of Asteraceae, representing 74 genera, occur in Sumatra (Tjitrosoedirdjo 2002). Most of the members of Eupatorieae in Sumatra are introduced, such as *Ageratum* L., *Austroeupatorium* R.M.King & H.Rob., *Eupatorium* L., *Chromolaena* DC., and *Mikania* Willd. (Tjitrosoedirdjo 2002). The occurrence of *Praxelis* had never been reported in Sumatra at the beginning of the twenty-first century. On the other hand, the taxonomical information on the tribe Eupatorieae of Borneo was published by J.Th. Koster in 1935. There are four genera in Borneo: *Adenostemma* J.R.Forst. & G.Forst., *Ageratum*, *Eupatorium*, and *Mikania* (Koster 1935). It should be noted that the *Eupatorium* reported by Koster has since been split up into other genera, including *Austroeupatorium*, *Ageratina* Spach, *Ayapana* Spach, *Bartlettina* R.M.King & H.Rob., and *Chromolaena*. According to Koster (1935), *P. clematidea* is not mentioned as *Eupatorium* or *Praxelis*.

The introduction of *Praxelis* in Kalimantan and Sumatra may occur simultaneously. Its spontaneous populations are thought to have arisen due to naturalisation. According to a previous study, the species was intentionally introduced to Java as a contaminant (Tjitrosoedirdjo & Wahyuni 2018). A similar mechanism might develop in Kalimantan and Sumatra. *Praxelis clematidea* occupy many habitats, such as roadsides, ditches, open areas, and disturbed areas in Kalimantan and Sumatra. Surprisingly, it was also collected in peat swamps and sandy soils in Central Kalimantan, along with other weeds such as the families of Cyperaceae and Fabaceae. This species could spread widely throughout Kalimantan and Sumatra in the future.

Praxelis clematidea grows quickly and can produce numerous seeds and tiller stems. In general, small-seeded species can produce much more seeds than large ones. Seed traits include many seeds, a tiny seed size, and seed hair, which are crucial for alien species to propagate and settle in new locations successfully (Intanon et al. 2020). Its small achenes have bristly pappus, allowing the wind, animals, and farm equipment to spread them quickly (Veldkamp 1999; Salgado et al. 2020). Furthermore, since the species grows in ditches and peat swamp areas, the seeds may be transported by water in Central Kalimantan. *Praxelis clematidea* has invaded several countries worldwide over the past 40 years (Salgado et al. 2022). The species have been considered invasive alien species in China and Australia (Zhang et al. 2021; Simla et al. 2022). Previous studies revealed that its seeds could also generate allelopathy, promoting invasiveness in new locations (Wang et al. 2006b; Intanon et al. 2020). The species can establish dense stands in the wild that suffocate native species because it can produce many fertile seeds that will fall near the parent plant (Qin et al. 2008). Therefore, further research is required to compre-

hend the ecological implications of *P. clematidea* in Kalimantan and Sumatra.

Praxelis clematidea is frequently mistaken for other Eupatorieae species, such as *Ageratum conyzoides* L., due to direct visual observation (Corlett & Shaw 1995; Veldkamp 1999; Chen et al. 2018; Tjitrosoedirdjo & Wahyuni 2018). Mistakes in identifying *P. clematidea* impact inaccurate distribution maps and delays in eradication management, resulting in high control costs and low success rates (Marble et al. 2021). As the result, the distribution of *P. clematidea* in Kalimantan and Sumatra is under-reported. Morphologically, the generative characters distinguish both species. Within the tribe Eupatorieae, *Ageratum* is classified in the subtribe Ageratinae Less., which is distinguished by its paleate receptacle, 2–3-seriate phyllaries, and 0–5 pappus (King & Robinson 1987; Robinson et al. 2007). On the other hand, *Praxelis* is grouped into the subtribe Praxelinae R.M.King & H.Rob. This genus has an epaleate receptacle, 3–4-seriate phyllaries, and numerous pappus (King & Robinson 1987).

Praxelis clematidea is commonly found in fields, forest edges, and abandoned land, where it disrupts the natural regeneration process, particularly in tropical regions. Khamare et al. (2020) mentioned that management of *P. clematidea* requires a strategic integration of manual and chemical control techniques. Mechanical removal techniques, including uprooting and cutting, are effective; however, they require ongoing follow-up to prevent regrowth. Chemical control, generally executed via targeted herbicide applications, effectively manages extensive infestations; however, it necessitates meticulous management to avert harm to native plants.

AUTHORS CONTRIBUTION

M.R.H. and A.S.D.I. designed the research. M.R.H., A.S.D.I., P., R.W.L., L.R., R.N.Z., A.H.W., S., D.L., P.Y., N.B., Y.S., and E.S. collected the plant materials, observed the specimen, and analysed the data. M.R.H., A.S.D.I., P., R.W.L., L.R., R.N.Z., A.H.W., S., D.L., P.Y., N.B., Y.S., D.R., and E.S. wrote the original draft and agreed to the final manuscript.

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CONFLICT OF INTEREST

All authors declare no conflict of interests.

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