

## Short Communication:

# Note on the genus *Dorstenia* Plum. ex L. (Moraceae) in Java (Indonesia) and noteworthy information on the identity of *D. bahiensis* through ITS sequence

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**Abstract.** Irsyam ASD, Hariri MR, Widiyanti P, Irwanto RR. 2021. Short Communication: Note on the genus *Dorstenia* Plum. ex L. (Moraceae) in Java (Indonesia) and noteworthy information on the identity of *D. bahiensis* through ITS sequence. *Biodiversitas* 22: 3358-3363. *Dorstenia* Plum. ex L. grouped within tribe Dorsteneae in the Moraceae. The genus comprises 105 species that are distributed in the African, Asian, and Neotropical regions. Previous studies showed that Java Island has only one species of *Dorstenia*, namely *D. contrajerva* L. This exotic species was introduced a long time ago and naturalized in Java. The field survey was carried out in Banten, Jakarta, West Java, and East Java. Herbarium study was also carried out in Herbarium Bogoriense and Herbarium Bandungense. There are two additional species from Java, *D. bahiensis* Klotzsch ex Fisch. and C.A. Mey. and *D. foetida* (Forssk.) Schweinf. *Dorstenia bahiensis* originated from Eastern Brazil and was found naturalized in Mekarwangi Village, Lembang, Bandung Barat regency, Indonesia. *Dorstenia foetida* is native to Africa and is only found as a popular cultivated plant. A molecular approach was carried out to provide the right identity of *D. bahiensis* because it has been mistakenly labeled as *D. elata* by a Javanese horticulturist. The internal transcribed spacer (ITS) sequence separated and distinguished both *D. bahiensis* and *D. elata* into different clades, which makes the popular name for *D. elata* actually *D. bahiensis*. Based on this study, there are three species of exotic *Dorstenia* in Java. The descriptions, photographs, and further discussions are provided.

**Keywords:** Alien, *Dorstenia*, Java, Moraceae, tusuk konde

## INTRODUCTION

*Dorstenia* Plum. ex L. is the second largest genus in the Moraceae after *Ficus* L. It consists of 105 species that are distributed in Africa, Asia (Arabia, Sri Lanka, and India), and Neotropics (Friis 1983; Berg et al. 2006; Misiewicz and Zerega 2012; Chase et al. 2013; de Oliveira Boeni and Singer 2015). Morphologically, *Dorstenia* has unique characteristics, and it can be easily distinguished from the other genera within Moraceae. This genus includes herbs, shrubs, and succulent species, whereas the woody species are only found in Africa (Berg 2001). The inflorescences of *Dorstenia* are bisexual, borne solitary from the axil of leaves, and vary in shape (discoid, turbinate, orbicular, elliptic, quadrangular, stellate, or lingulate). The receptacle is centrally or eccentrically attached to the peduncle, and it has an entire dentate, crenate, appendiculate, or lobed margin (Berg 2001; Berg et al. 2006). Based on its inflorescence characteristics, the genus is presumed to be the intermediate form between an open inflorescence in *Morus* and the specialized syconium of *Ficus* (Misiewicz

and Zerega 2012).

Berg et al. (2006) and Backer and Bahkuizen van den Brink (1965) only recognized one species of *Dorstenia* in Java, namely *D. contrajerva* L. The species is native to Mexico and Tropical America. It was introduced to Java years ago and became a naturalized alien species on the island (Berg et al. 2006). Based on our recent botanical survey and specimen observation, there are two additional species of exotic *Dorstenia* on Java Island, *D. bahiensis* Klotzsch ex Fisch. and C.A. Mey. and *D. foetida* (Forssk.) Schweinf. Both species are commonly known as *tusuk konde* plants by Javanese people. The presence of both species on the island is reported here.

## MATERIALS AND METHODS

### Botanical exploration and specimen observation

The field survey was conducted in Jakarta, Banten (Tangerang), West Java (Bandung, Bogor, and Sumedang), and East Java (Surabaya, Madura) from August 2019 to

March 2020. The field exploration followed Rugayah et al. (2004). The materials from the field were collected following van Balgooy (1987). The data recorded includes collector name, collection number, locality, habitat, date, vernacular name, and morphological characteristics (*i.e.*, the color of exudates, stem, leaves, inflorescences, and infructescences). The materials were observed at Herbarium Bandungense (FIPIA), School of Life Sciences and Technology (SITH), Institut Teknologi Bandung, and Bogor Botanic Gardens (BBG). Specimen examination was also carried out at Herbarium Bogoriense (BO), Indonesian Institute of Sciences (LIPI), Cibinong, Bogor. As many as seven sheets of herbarium specimens were observed for this study.

### DNA extraction, amplification, and sequencing

Molecular analysis was carried out to confirm the identity of *D. bahiensis* as well as to compare it to the sequences of *D. elata* using the internal transcribed spacer (ITS) sequence following Sun et al. (1994). The DNA extraction and PCR process were conducted at Treub Laboratory, Bogot Botanic Gardens. The DNA was extracted using Tiangen Plant Genomic DNA Kit (Tiangen Biotech Co., Ltd.), following the manufacturer's protocol. The polymerase chain reaction was carried out in a total volume of 50 µL, consisting of a 5 µL DNA sample, 1.5 µL each of ITS forward (5'-ACGAATCATGGTCCGGTG AAGTGTTCG-3') and reverse (5'-TAGAATTCCCC GGTTCGCTCGCCGTTAC-3') primer, 25 µL MyTaq PCR mix, and 17 µL ddH<sub>2</sub>O through the following reaction [95°C 3 min, (95°C, 30 s, 58°C for 45 s, 72°C for 45 s) × 35 cycles], 72°C for 5 min. The PCR products were sent to be sequenced at 1<sup>st</sup> Base, Singapore.

### Sequence editing, alignment, and phylogenetic tree reconstruction

The contig sequence was aligned to their homologous sequences and analyzed using MEGA X software using the Kimura 2-parameter model (Kimura 1980; Kumar et al. 2018). The reconstruction of a phylogenetic tree was achieved through the neighbor-joining (NJ) method with 1000 replicate bootstraps (Saitou and Nei 1987; Felsenstein 1985). The evolutionary distances were computed using the Kimura 2-parameter method (Kimura 1980). The rate variation among sites was modeled with a gamma distribution (shape parameter = 5). All ambiguous positions were removed for each sequence pair (pairwise deletion option).

## RESULTS AND DISCUSSION

### Taxonomic Treatment of *Dorstenia* in Java

Updated key to the *Dorstenia* of Java

1. A. Acaulescent, leaves shallowly to deeply lobed ..... *D. contrajerva*
- B. Caulescent, leaves unlobed ..... 2
2. A. Stem terete, sap milky yellow, leaf blade oblong, margin entire or dentate, receptacle irregularly lobed to angular in outline, unappendaged ..... *D. bahiensis*
- B. Stem tuberous, sap milky white, leaf blade oblong, obovate, to elliptic, margin crisped, receptacle circular in outline, linear appendages present ..... *D. foetida*

*Dorstenia bahiensis* Klotzsch ex Fisch. and C.A. Mey., Index Seminum (LE) 11: 64 1846; Berg, Fl. Neotropica Monogr. 83: 187-188 2001. Type: *Luschnath s.n.*; 25 Jun 1837; Brazil: Bahia: Ilhéus (holo: LE; iso: B, BR). —Fig. 1

*Dorstenia anthuriifolia* S.F. Blake, Contr. U. S. Natl. Herb. 20: 237 1919.

*Dorstenia cordifolia* Mart. Ex Miq., Fl. Bras. 4(1): 165 1853.

*Dorstenia longipes* Mart. Ex Bureau, Prodr. 17: 262 1873.

*Dorstenia martiana* Miq., Fl. Bras. 4(1): 165 1853.

Herb, caulescent with milky yellow sap; internodes short. *Stipules* subulate, 5–6 × 2–7 mm, fleshy, brownish to blackish green. *Leaves* spirally arranged; petiole 4–18 cm long, brownish to blackish green, slender; leaf blade oblong, 10–27 × 4.5–13 cm, base cordate or truncate, margin entire to denticulate, apex acuminate; adaxial surface pale green to shiny dark green, glabrous, abaxial surface pale, glabrous; veins prominent on abaxial surface. *Inflorescence* bisexual, axillary, discoid, green to purplish green; peduncle up to 15 cm long, slender, curved, glabrous, green to purplish green; receptacle centrally attached, concave, irregularly lobed to angular in outline, 2.5 cm wide, margin lobed, purple. *Staminate flowers* numerous; tepals connate; stamens 2; filament white; anthers purple. *Pistillate flowers* numerous; tepals tubular, membranous, white; ovary free, ovoid, white; stigma filiform, white. *Fruits* drupelet, ovoid, up to 1.5 mm wide, tuberculate, exocarp white.

**Distribution.** Native to Pernambuco and Bahia, Eastern Brazil (Berg 2001; de Castro 2006).

**Habitat.** The species grows in moist and shaded places at low elevations (Berg 2001).

**Specimen examined.** West Java: Cult. in Hort. Bog., *leg ign s.n.* (BO); in front of Treub Laboratory, BBG, Bogor, 12 August 2019, *MR Hariri 45* (FIPIA); Mekarwangi Village, Lembang, Bandung Barat Regency, 12 August 2019, *ASD Irsyam 282* (FIPIA).

**Vernacular name.** *Tusuk konde, anthurium konde* (Bahasa Indonesia).

**Etymology.** The epithet refers to the species being native to Bahia (Gledhill 2008).

**Status.** Cultivated. However, a wild population of *D. bahiensis* was found in Mekarwangi Village, Lembang, and it is presumed to have escaped from cultivation. The wild population grows in a shaded and moist habitat near a home garden. In BBG, the species were also growing outside the collection block. This finding showed that *D. bahiensis* has the potential to become naturalized in Java. The species was previously reported as a naturalized alien species from Kerala, India, in 2008 (Upadhyay et al. 2008). Based on direct observation, the infructescence of *D. bahiensis* is capable of exploding, which catapults the small fruits into the adjacent area. Moreover, the fruit is easily dispersed by water after the explosion.

*Dorstenia contrajerva* L., Sp. Pl. 121 1753; Overbeck, Jahrb. Wiss. Bot. 66 467 1924; Woodson, Ann. Missouri Bot. Gard. 47 177, f. 62 1960; Backer and Bakh. f., Fl. Java 2: 17 1965; Berg, Fl. Neotrop. Monogr. 83: 198 2001;

Berg, Corner & Jarrett, Fl. Males. Ser. I, 17(1): 145-146 2006. — *Dorstenia quadrangularis* Stokes, Bot. Mat. Med., 4, 338 1812. Type: *Habitat in nova Hispania, Mexico, Peru, Vera Cruce, insula Vicentii*, "Dorstenia" in Plumier, Nov. Pl. Amer., 29, t. 8, 1703 (lecto).

*Dorstenia contrajerva* L. var. *Houstonii* L., Sp. Pl. 121 1753. — *Dorstenia houstonii* (L.) L., Sp. Pl. ed. 2. 176 1762-1763. — *Dorstenia quadrangularis* Stokes var. *Integrifolia* Stokes, Bot. Mat. Med., 4, 339 1812.

*Dorstenia alexiteria* L., Syst. Nat., Ed. 10 2: 889 1759.

*Dorstenia quadrangularis* Stokes var. *pinnatifida* Stokes, Bot. Mat. Med., 4, 341 1812.

*Dorstenia quadrangularis* Stokes var. *sinuata* Stokes, Bot. Mat. Med., 4, 339 1812.

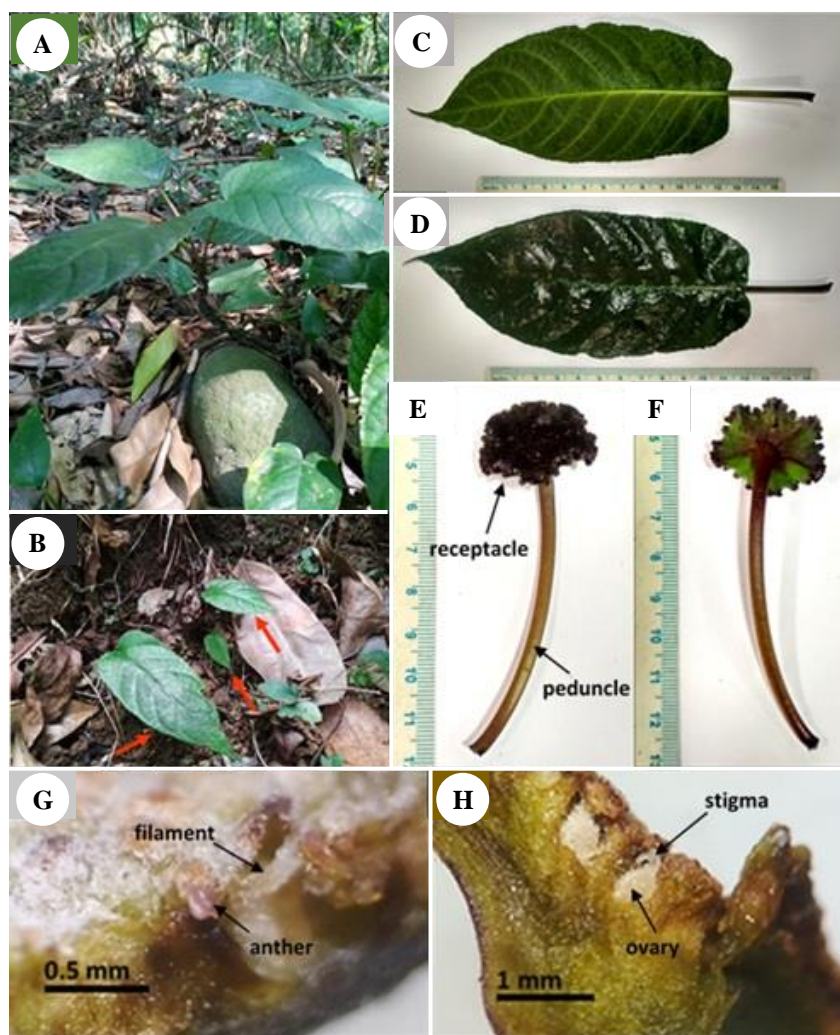
*Dorstenia palmata* Willd. ex Schult., Mant. 3: 317 1827.

*Dorstenia maculata* Lem., Ill. Hort. 10: t. 362 1863. — *Dorstenia contrajerva* L. var. *maculata* (Lem.) Bureau in DC., Prodr. 17: 260 1873.

*Dorstenia contrajerva* L. subsp. *tenuiloba* Blake, Contr. U.S. Natl. Herb. 24: 2, t. 1. 1922 — *Dorstenia contrajerva*

L. var. *tenuiloba* (Blake) Standl. and Steyererm., Publ. Field Mus. Nat. Hist., Bot. Ser. 23: 40 1944.

Herb, acaulescent with milky sap; internodes short. *Stipules* subulate, 3–6 × 2.5–5 mm, fleshy, green, puberulous. *Leaves* spirally arranged; petiole 13–23 cm long, green, slender; leaf blade lobed to parted or cordate to hastate, 7–22 × 7–26.5 cm, base cordate or hastate, apex acuminate; adaxial surface yellowish green to dark green, hirtellous to subhirsute or scabrous, abaxial surface glaucous, puberulous to hispidulous; veins prominent beneath. *Inflorescence* bisexual, axillary, discoid, green; peduncle 22.5–31.5 cm long, slender, scabrous, green; receptacle eccentrically attached, irregularly lobed to quadrangular in outline, 2.5–3 cm wide, margin lobed, green. *Staminate flowers* numerous; tepals connate; stamens 2; filament white; anthers yellow. *Pistillate flowers* numerous; tepals tubular, membranous, yellowish-white; ovary free, compressed ovoid, cream; stigmas 2, filiform, white. *Fruits* drupelet, ovoid, up to 2 mm wide, tuberculate, exocarp white.



**Figure 1.** Morphology of *Dorstenia bahiensis*: A. Living plant. B. A small wild population in Mekarwangi Village, Bandung (arrows). C. Abaxial surface of the leaf. D. Adaxial surface of the leaf. E. Uppersed of inflorescence. F. Lower side of inflorescence. G. Male flowers. H. Female flowers. Photo A taken from MR Hariri 45 and photos B–H taken from ASD Irsyam 282.

**Distribution.** Mexico to Panama, West Indies, Colombia, northern Venezuela, western Ecuador, northern Amazonian Peru. The species was introduced to Malesia (Java) (Berg 2001; Berg et al. 2006).

**Specimen examined.** Jakarta: Parapatan, Weltevreden, Batavia, 18 March 1903, *C.A. Backer 33665* (BO); Parapatan, Weltevreden, Batavia, 19 June 1903, *C.A. Backer 33666* (BO). West Java Cult. in Hort. Bog., *Leg ign s.n.* (BO); Cult. in Hort. Bog., 12 May 1893, *Hallier D573a* (BO); Cult. in Hort. Bog., 10 April 1893, *Hallier D573b* (BO); in front of Treub Laboratory, BBG, Bogor, 12 August 2019, *MR Hariri 44* (FIPIA); Schoolweg, 700 m, Bandoeng, Preanger Reg., 22 November 1922, *C.A. Wisse 973* (BO).

**Vernacular name.** *Tusuk konde* (Bahasa Indonesia).

**Etymology.** The epithet '*contrajerva*' means counter herb in Spanish, because the root of *D. contrajerva* is used as an antidote to snakebite (Cassidy and Le Page 2002).

**Status.** Naturalized.

*Dorstenia foetida* (Forssk.) Schweinf., Bull. Herb. Boissier 4 (App. 2): 120 1896; Friis, Nord J Bot 3(5): 536 1983. — *Kosaria foetida* Forssk., Fl. Aegypt.-Arab. Cxxi 1775. Type: Hadie, Yemen, *Forsskål s.n.* (Holo C). — Fig. 2  
*Cosaria forskahlii* J.F. Gmel., Syst. Nat. 2(1): 22, 71 1791.

*Dorstenia arabica* Hemsl., Hooker's Icon. Pl. 26: t. 2503 1899.

*Dorstenia crispa* Engl., Monogr. Afrik. Pflanzen-Fam. 1: 27 1898.

*Dorstenia foetida* subsp. *lancifolia* (Rendle) Friis, Nordic J. Bot. 3: 538 1983. — *Dorstenia crispa* var. *lancifolia* Rendle, J. Bot. 53: 302 1915.

*Dorstenia crispa* var. *pachypoda* Chiov., Result. Sci. Miss. Stefanini-Paoli 1. 1916.

*Dorstenia foetida* var. *obovata* (A. Rich.) Engl., Monogr. Afrik. Pflanzen-Fam. 1: 27 1898. — *Dorstenia obovata* A. Rich., Tent. Fl. Abyss. 2: 1851.

*Dorstenia phillipsiae* Hook. f., Bot. Mag. 125: t. 7676 1899.

*Dorstenia radiata* Lam., Encycl. 2: 318 1786.

Herb, succulent with milky white latex; internodes short. *Stipules* fleshy, subulate from a broad base, 1–2 mm, very minute, white. *Leaves* spirally arranged; petiole 17–23 mm long, green, slender; leaf blade obovate, oblong, to elliptic, 43–60 × 20–25 mm, base cuneate, margin crisped, apex acute to obtuse; adaxial surface dark green,

scabridulous, abaxial surface glaucous, sparsely puberulous; veins prominent beneath; leaves foetid when bruised. *Inflorescence* bisexual, axillary, discoid, green; peduncle 6–20 mm long, slender, green; receptacle green, circular in outline, 9–14 mm wide; appendages 8–10, linear-triangular, 1–6 mm long, green. *Staminate flowers* numerous; tepals connate; stamens 2; filament white; anthers white. *Pistillate flowers* numerous; tepals tubular, membranous, greenish-white; ovary free, ovoid, trigonous, cream; stigma simple, unbranched, white. *Fruits* drupelet, ovoid, trigonous, up to 1 mm wide, tuberculate, exocarp pale brown.

**Distribution.** Yemen, Somalia, Ethiopia, Sudan, Kenya, and Tanzania (Friis 1983).

**Habitat.** Limestone, dry woodland, and deciduous bushland at elevation 100–2100 m alt (Friis 1983).

**Specimen examined.** Banten: culta, Tangerang Selatan, 3 November 2019, *MR Hariri 62* (FIPIA); Jakarta: Culta, Jakarta Utara, 11 August 2019, *MR Hariri 43* (FIPIA); East Java: Culta, Surabaya, 3 November 2019, *MR Hariri 63* (FIPIA).

**Vernacular name.** *Tusuk konde hias* (Bahasa Indonesia).

**Etymology.** The epithet '*foetida*' refers to the foul-smelling of this species (Gledhill 2008).

**Status.** Cultivated.

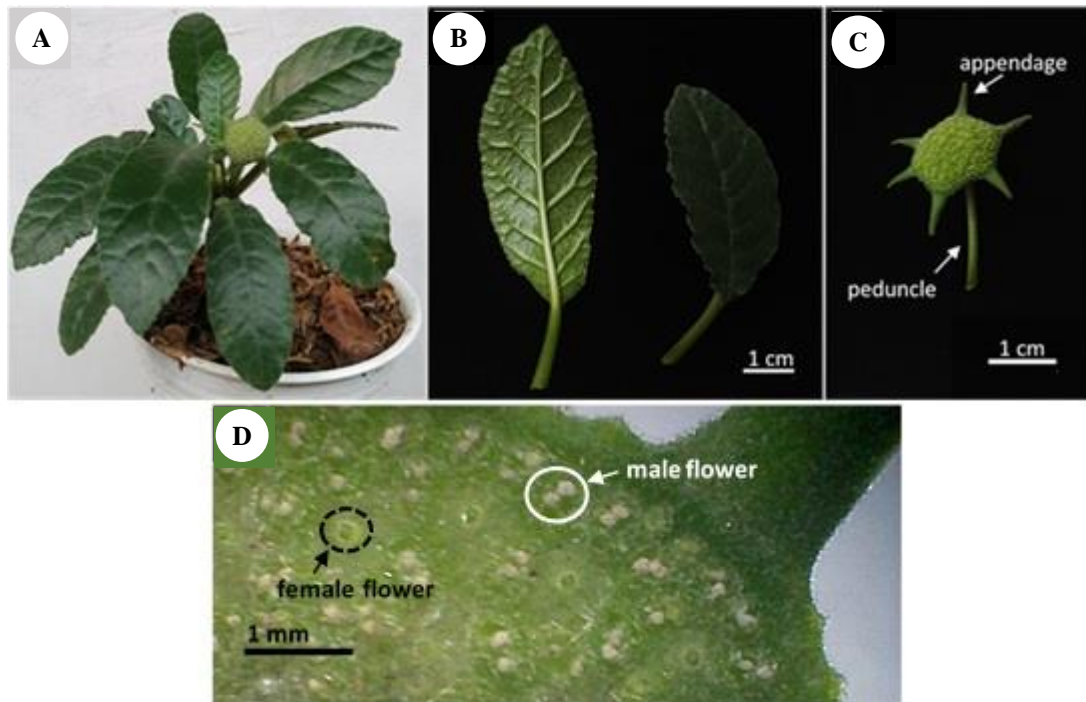
#### Molecular analysis of *Dorstenia bahiensis* in Java

*Dorstenia bahiensis* is commonly and mistakenly identified as *D. elata* by Javanese horticulturists. Both *D. bahiensis* and *D. elata* are native to Eastern Brazil. However, their morphological characteristics are different and can be easily distinguished, as listed in Table 1. The morphological characteristics of *D. elata* used as a comparison to *D. bahiensis* are taken from dos Santos et al. (2016) because *D. elata* presence, currently, is not known in Indonesia.

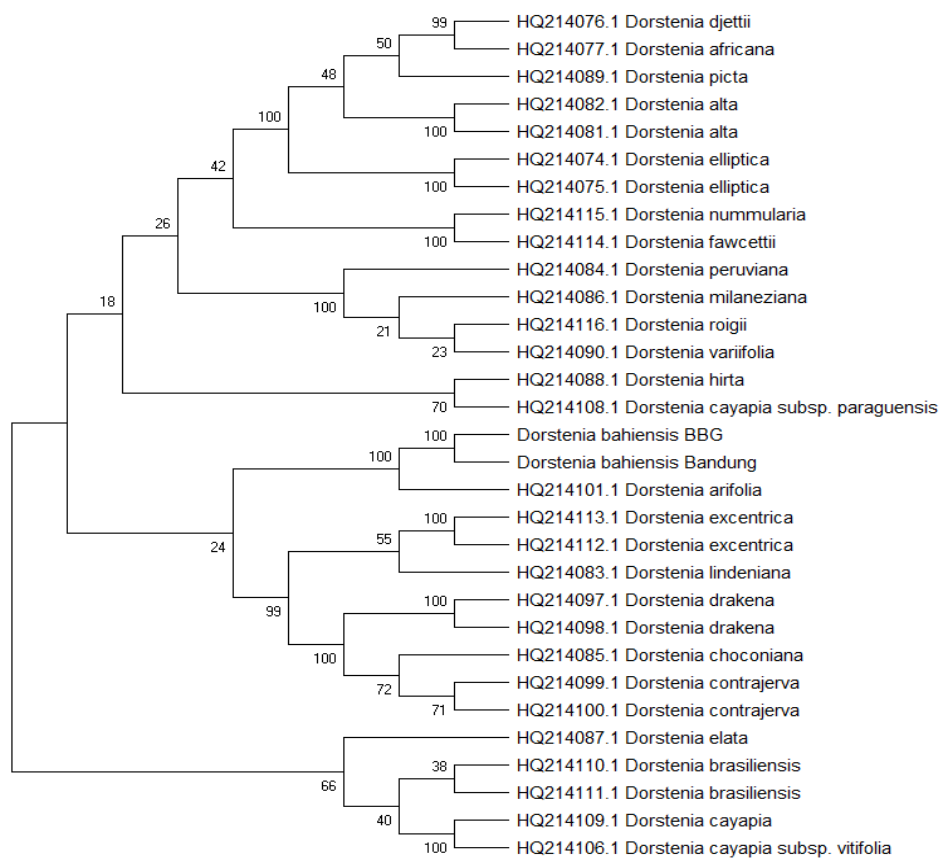
The molecular approach using ITS sequence was carried out to ensure the species delimitation between *D. bahiensis* and *D. elata*. The reconstructed phylogenetic tree generated through the NJ method and the Kimura 2-parameter model with gamma distribution showed that both samples of *D. bahiensis* are clustered together with *D. arifolia* HQ214101. Those three are in a different cluster than *D. elata* HQ214087.1, as shown in Figure 3, which clearly states that *D. bahiensis* in Java is a different species from *D. elata*.

**Table 1.** Distinguishable morphological characteristics between *Dorstenia bahiensis* and *D. elata*

Distinguishable characteristics	<i>D. bahiensis</i>	<i>D. elata</i> (dos Santos et al. 2016)
Shape of stipule	Subulate	Foliateous
Leaf blade	Oblong	Elliptic-obovate
Leaf apex	Acuminate	Acute to obtuse-rounded
Abaxial surface	Glabrous	Puberulous to pubescent
Indument on peduncle	Glabrous	Puberulous to pubescent
Appendages on receptacle	Present	Absent
Shape of fruit	Ovoid	Globose



**Figure 2.** Morphology of *Dorstenia foetida*: A. Living plant. B. Abaxial surface (left) and adaxial surface (right) of the leaf. C. The whole inflorescence. D. Zoom in of inflorescence shows female and male flowers. All photos taken from MR Hariri 63.



**Figure 3.** The evolutionary tree of *Dorstenia* generated from internal transcribed spacer sequence using the neighbor-joining method and Kimura 2-parameter



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