Bamboo Diversity in Indrokilo Botanical Garden, Central Java

(Keanekaragaman Bambu di Kebun Raya Indrokilo, Jawa Tengah)

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ABSTRAK

Upaya konservasi bambu telah dilakukan oleh kebun raya di Indonesia, salah satunya Kebun Raya Indrokilo, Jawa tengah. Informasi ilmiah terkait koleksi bambu Kebun Raya Indrokilo, bagaimanapun juga, belum tersedia. Penelitian ini bertujuan mengetahui keanekaragaman jenis serta menyediakan sinopsis dan analisis keserupaan jenis-jenis bambu di Kebun Raya Indrokilo. Eksporasi dan koleksi spesimen bambu telah dilakukan oleh Kebun Raya Indrokilo. Pemrosesan dan identifikasi spesimen dilakukan di Herbarium Bogoriense. Sebanyak 27 karakter morfologi digunakan untuk analisis keserupaan menggunakan metode UPGMA dengan koefisien keserupaan Nei & Li. Data dianalisis secara deskriptif. Terdapat tujuh jenis bambu di Kebun Raya Indrokilo: Bambusa glaucophylla, B. lako, B. multiplex, B. vulgaris, Dendrocalamus sp., Guadua cf. angustifolia, dan Schizostachyum sp. Sinopsis jenis-jenis bambu beserta kunci identifikasi tingkat jenis telah disediakan. Berdasarkan analisis keserupaan, bambu di Kebun Raya Indrokilo terdiri atas lima kelompok pada indeks keserupaan 70%. Keanekaragaman jenis bambu di Kebun Raya Indrokilo tergolong relatif rendah dibanding dengan beberapa kebun raya di Indonesia.

Kata kunci: Bambu, keanekaragaman, Kebun Raya Indrokilo, sinopsis.

ABSTRACT

The efforts of Bamboo conservation have been conducted by botanical gardens in Indonesia, including the Indrokilo Botanical Garden, Central Java. Scientific information regarding the bamboo collection of the Indrokilo Botanical Garden, however, is not yet available. This study aimed to determine the diversity of the species, as well as, to provide a synopsis and the similarity analysis of the bamboo species in the Indrokilo Botanical Garden. Exploration and collection of bamboo specimens have been carried out by the Indrokilo Botanical Garden. Processing and identification of the specimens were carried out at Herbarium Bogoriense. A total of 27 morphological characters were used for similarity analysis using the UPGMA method with Nei & Li similarity coefficients. The data were analyzed descriptively. There are seven species of bamboo in the Indrokilo Botanical Garden: Bambusa glaucophylla, B. lako, B. multiplex, B. vulgaris, Dendrocalamus sp., Guadua cf. angustifolia, and Schizostachyum sp. A synopsis of the bamboo species and their identification keys to the species were provided. Based on the similarity analysis, bamboo in the Indrokilo Botanical Garden consists of five groups at a similarity index of 70%. The diversity of bamboo species in the Indrokilo Botanical Garden is relatively low compared to some botanical gardens in Indonesia.

Keywords: Bamboo, diversity, Indrokilo Botanical Garden, synopsis.
INTRODUCTION

Bamboos belong to the family Poaceae and generally can be recognized by culms cylindrical with the nodes and hollow lumen. Culm is covered by sheaths, branches appeared around the nodes and supporting several leaves, and inflorescences in spikelets. Bamboo has long been used as building materials, baskets, handicrafts, vegetables, paper, musical instruments, furniture, hedge, wind-break or ornamental plant, containers for collecting water or palm juice, for pipes and troughs, pots for cooking food, chopsticks, fish traps, fishing rods, rafts, food wrappers, various poles (carrying poles, vegetable and fruit props, boating poles, and fences) (Dransfield & Widjaja 1995a), and religious ceremony purposes (Wisjaja et al. 2005).

There are more than 116 genera and approximately 1,439 recognized species of bamboo in the world (Wisjaja et al. 2014). Indonesia has 26 genera with estimated 174 species of bamboo (Wisjaja 2019) and recently added new species from Sulawesi and Lesser Sunda Islands (Ervianti et al. 2019a; Wisjaja 2020). In Java alone, there are 60 species of bamboo found (Wisjaja, 2001a) but unfortunately, some of these species of bamboo are rare due to exploitation, land conversion, and natural disasters (Zulkarnaen & Andila 2015). Thus, the efforts for bamboo conservation have been carried out by botanical gardens (BG) in Indonesia (KRIB 2019).

There are few BG in Indonesia, i.e. Bogor BG (Sari et al. 2010; Ariati et al. 2019), Cibodas BG (Wisjatytmoko et al. 2010; Sujarwo et al. 2019), Eka Karya Bali BG (Arinasa et al. 2017; Sujarwo 2018) 2018, and Ecology Park in Cibinong (Damayanto et al. 2019) with well-documented bamboo collections. Indrokilo BG, on the other hand, is a recent BG in Indonesia (master plan in 2015) (KRIB 2019). The Indrokilo BG is located in Keteruharan Kemiri, Mojosongo District, Boyolali Regency, Central Java (7°33’34.81” S, 110°37’41.61” E) with an area of 8.9 ha (KRIB 2019). It served as an educational and recreational venue for the general public and a plant conservation facilities as well. It is composed mainly of lowland rainforest plants of East Java (KRIB 2019) and hosts some bamboo collections from Central Java (Alfian 2019, personal communication). However, the bamboo collection in Indrokilo BG is not yet inventoried and still lacking in identification. The inventory and identification activity will inform the bamboo diversity in Indrokilo BG. Moreover, the additional information such as morphological descriptions and an identification key are essential for proper management and to improve the scientific value of the Indrokilo BG as an ex situ conservation facilities and ecotourism site.

A study on the diversity of bamboo species in the Indrokilo BG is needed to obtain a synopsis of the bamboo species and provide an identification key to the species. Analysis of the relationship among the bamboo species in Indrokilo BG also needed to know the diversity of bamboo which is conserved in the area. Thus, this study aimed to inventory, characterize, and assess the diversity information of bamboo species in the Indrokilo BG. Furthermore, this study also provided a synopsis and the similarity analysis of the bamboo species in the Indrokilo BG. This study, overall, can be used as a reference to enhance the number of bamboo collections and to compile a list of plant species in Indrokilo BG.

MATERIAL AND METHOD

The study was conducted at the Indrokilo BG, Central Java from December 2019 to March 2020. The processing and identification of bamboo were conducted at Herbarium Bogoriense (BO), Research Center for Biology, Indonesian Institute of Sciences (LIPI). Bamboo exploration was conducted following the taxonomic data collection method by Rugayah et al. (2004). Bamboo materials, such as young shoots, culm-sheaths, leaves, and flowers (if available), were collected and information on location, coordinates, uses, and local name were recorded. The photograph of the fresh bamboo was taken.

The bamboo material was processed into herbarium specimens following the Djarwansih et al. (2002) guidelines. The bamboos were identified based on the reference specimen in the
BO and based on the previous studies (Widjaja 1987; Dransfield and Widjaja 1995a; Widjaja 2001a, 2001b; Widjaja et al. 2004, 2005; Widjaja 2009; Dransfield and Widjaja 2000; Damayanto and Widjaja 2016, 2017; Ervianti et al. 2019a; Widjaja 2020). The names of bamboo species were validated using Vorontsova et al. (2016) and based on online database portal (Damayanto et al. 2020a). Data were analyzed descriptively and an identification key to the species was provided.

A total of 27 morphological characters were used to characterized the bamboo conserved at Indrokilo BG. Some of the data gathered are young shoot (color and hairs color), culm (color, straightness, and existence of the white ring on the nodes), branching (type and existence of the spine), culm-sheath (attachment and hairs color), culm-sheath auricles (existence of the auricles, shapes arch, and existence of the bristles), culm-sheath ligule (shapes and existence of the bristles), culm-sheath blade (position and shapes), leaves (color, length, wide, and adaxial-abaxial surface), leaf-sheath auricles (high, the existence of the bristles, and bristles length), and leaf-sheath ligule (shapes and existence of the bristles). Morphological characters were then scored and arranged in a matrix following the analyses using the multivariate statistical package (MVSP) software (Kovach 2007) with the unweighted pair group with arithmetic mean (UPGMA) grouping method and Nei & Li similarity coefficient (Nei and Li 1979).

### RESULTS AND DISCUSSION

#### Bamboo Diversity of Indrokilo Botanical Garden

There were 47 bamboo plant found in Indrokilo BG that belong to four genera and 7 species of bamboo (Table 1). The *Bambusa vulgaris* were the most abundant species among the bamboos grown in Indrokilo BG. The same with Ecology Park, Cibinong, this species also dominant in the garden (Damayanto et al. 2019). On the other hand, only a few of *B. glaucophylla*, *B. lako*, *B. multiplex*, *Dendrocalamus sp.*, *Guadua cf. angustifolia*, and *Schizostachyum sp.* were grown in Indrokilo BG. Bamboo *B. glaucophylla* was reported to be introduced from Singapore around 1970 (Widjaja 1997) and recently become an ornamental plant in the cities of Indonesia (Widjaja 2001a). While *B. lako* was known originated from Timor Leste (Widjaja 1997) and was reported to be spread to Java (Widjaja 2001a) and Australia (Widjaja 1997). Bamboo *B. multiplex*, on the other hand, originated from Indo-China and southern China and is widely grown as an ornamental plant in Southeast Asia (Dransfield and Widjaja 1995b).

*Guadua cf. angustifolia* in this study was still in cf. (confer) which means very similar to the species of *G. angustifolia*. This species, unfortunately, does not have culm-sheath, which is essential in distinguishing the species level (Widjaja 2001a). The flower of *G. cf. angustifolia* were deciduous and limited characters were observed. *G. angustifolia* was originated from South America (Judziewicz et al. 1999) and it was introduced to Indonesia (Londoño 2001), especially to Java, Bali (Widjaja 2019) and probably Lombok (Putri et al. 2016). However, *G.

| Species                          | Number of clumps | Status           |
|----------------------------------|------------------|-----------------|
| *Bambusa glaucophylla* Widjaja   | 6                | Introduced species |
| *Bambusa lako* Widjaja           | 10               | Introduced species |
| *Bambusa multiplex* (Lour.) Raeusch. ex Schult.f. | 5 | Introduced species |
| *Bambusa vulgaris* Schrad. ex J.C.Wendl. | 17 | Native species |
| *Dendrocalamus sp.*              | 4                | Probably native species |
| *Guadua cf. angustifolia* Kunth  | 4                | Introduced species |
| *Schizostachyum sp.*             | 1                | Probably native species |
angustifolia found in Lombok was reported to be still doubtful (Damayanto et al. 2020b). Seedling of G. cf. angustifolia in Indrokilo BG was obtained from PT. Bamboo of Nusa Verde, a bamboo seedling seller in Yogyakarta (Alfian 2019, personal communication). On the other hand, there were two collections of bamboo that cannot be identified up to the species level (Dendrocalamus sp. and Schizostachyum sp.) due to incomplete material available.

The diversity of bamboo species in the Indrokilo BG is quite low compared to other BGs in Indonesia (Figure 1). There were 36 and 52 species of bamboo found in the Kuningan BG (with an area of 172 ha) and Eka Karya Bali BG (with an area of 157.5 ha), respectively (Cahyanto et al. 2016; Sujarwo 2018). Meanwhile, only seven species of bamboo were found in the Indrokilo BG. However, this is understandable if we look at the area of the Indrokilo BG that only 8.9 ha (KRIB 2019) or about 5% of the Kuningan BG and Eka Karya Bali BG areas. In addition, the Indrokilo BG is relatively new, only a few species of bamboo have been currently cultivated. The diversity of bamboo species in the Indrokilo BG was still quite low even compared to other Indonesian BGs which had smaller areas, such as the Bogor BG (87 ha), Purwodadi BG (85 ha), and Cibodas BG (85 ha) (Astuti et al. 2001; Roemantyo et al. 2010; Widyatmoko et al. 2010) with 44, 35, and 39 species of bamboo, respectively (Ariati et al. 2019; Sujarwo et al. 2019; Wigunanto 2019) (Figure 1).

The diversity of bamboo species in the Indrokilo BG was higher compared to the Ecology Park in Cibinong (34 ha area with 3 species of bamboo only) (Damayanto et al. 2019). The low diversity of bamboo species in the Indrokilo BG and Ecology Park, compared with other Indonesian BGs, may relate to the lack of addition of the bamboo collection. There are still many potentially bamboo species (Astuti et al. 2001) from Java that can be conserved at the Indrokilo BG due to abundant bamboo species (60 species) that was reported to be grown in Java (Widjaja 2001a). Most of those species are Indonesian native bamboo.

### Synopsis of Bamboo in Indrokilo Botanical Garden

A dichotomous key to species and a description of each species of bamboo in Indrokilo BG were provided as follows. A description of bamboo species was arranged alphabetically based on the species name.

![Figure 1. Comparison of bamboo diversity in several Indonesian BGs and ecology parks [Processed from Astuti et al. (2001), Roemantyo et al. (2010), Widyatmoko et al. (2010), Cahyanto et al. (2016), Sujarwo (2018), Damayanto et al. (2019), KRIB (2019), Sujarwo et al. (2019), Ariati et al. (2019), Wigunanto (2019); and research data)].](image-url)
1.a. Branches bearing spines
   *Gigantochloa cf. angustifolia*

1.b. Branches without spines

2.a. Branch with several slender sub-equal branches
   *Schizostachyum* sp.

2.b. Branch with one dominant primary branch and several smaller branches

3.a. Culm slightly zigzag; culm-sheath auricles with bristles

3.b. Culm relatively straight; culm-sheath auricles glabrous
   *Dendrocalamus* sp.

4.a. Leaves green with white stripes
   *Bambusa glaucophylla*

4.b. Leaves green without white stripes

5.a. Leaves usually at the end of the branches; culm-sheath auricles small or rim-like
   *Bambusa multiplex*

5.b. Leaves scattered along the branches; culm-sheath auricles big, rounded

6.a. Mature culm purplish-green or blackish
   *Bambusa lako*

6.b. Mature culm green or yellow with green stripes
   *Bambusa vulgaris*

*Description:* Young shoots green covered with black hairs. *Culm* green, 0.5–2 m high, 1.5–2.5 cm in diameter, internode 20–25 cm long; branch complements with one dominant primary branch and several smaller branches. *Culm-sheath* 8.3–8.5 × 3.5–4.4 cm, deciduous, covered with dark brown hairs; auricles rounded, 2–4 mm high, bristles 2–3 mm long; ligule entire, 1–3 mm high, bristles 2–3 mm long; blade erect, narrowly triangular, base narrow, 2.5–3.3 × 1–1.5 cm. *Leaves* green with longitudinal white stripes, 12.2–18.2 × 0.8–1.9 cm, glabrous; auricles rounded, 1–2 mm high, glabrous; ligule entire, 1–2 mm high, glabrous. *Inflorescences* were unavailable.

*Distribution:* Cultivated at the cities in Java (Widjaja 2001a), Bali (Widjaja et al. 2005), Lombok (Huzaemah et al. 2016; Damayanto et al. 2020b), Mataram, Bima, Manggarai, Maumere, Kupang, Dili (Widjaja 2001b), and Sulawesi (Ervianti et al. 2019b).

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**Figure 2.** *Bambusa glaucophylla.* A = clump, B = branch, C = culm-sheath, D = culm-sheath auricle with bristles, and E = leaf-sheath auricle and ligule (Photos: Sri Mulyani).
Vernacular names and uses: The vernacular names of this bamboo are *bambu putih* (Indonesia) (Widjaja 2001a; Ervianti et al. 2019b) or *santong hias* (Huzaemah et al. 2016) or *bamboo hias* (Lombok) (Darmayanto et al. 2020b). This bamboo is used as ornamental due to the beautiful leaves pattern and also for hedges due to densely tufted clumps (Widjaja 2001a).

Specimens examined: Central Java, Boyolali, Indrokilo BG, block of Madrim Bamboo Park, 7°33′34″ S, 110°37′47″ E, 28 December 2019, Sri Mulyani 09 (BO), Sri Mulyani 26 (BO); West Java, Bogor, Kedung Halang, Widjaja s.n. (BO); East Java, Malang, Bantur, Karangsari, 21 November 2015, Hidayatullah 08 (BO); East Java, Malang, Tirtoyudo, Sumbertangkil, 8°31′22.03″ S, 112°86′16.05″E, 30 November 2015, Romi Abrori 02 (BO).

Bambusa lako Widjaja, Reinwardtia 11(2): 61 (1997) (Figure 3)

Description: Young shoots green covered with brown hairs. Culm green when young, becoming purplish-black to black when mature, 7–15 m high, 5–8 cm in diameter, internode 25–35 cm long; branch complements with one dominant primary branch and several smaller branches. Culm-sheaths 7.7–10.8 × 7.4–9.5 cm, deciduous, covered with black hairs; auricles rounded and slightly curved outward, 2–4 mm high, bristles 2–3 mm long; ligule denticulate, glabrous; blade erect, broadly triangular, 1.5–3.6 × 1.1–2 cm. Leaves green 22.5–27.3 × 1.7–4 cm, glabrous; auricles horn-like, curved outward, 2–3 mm high, bristles 1–4 mm long; ligule denticulate, 1–3 mm high, glabrous. Inflorescences were unavailable.

Distribution: This species was originally found in Timor Leste (Widjaja 1997) then introduced to Bogor BG, Java (Widjaja 2001a) and also to Australia (Widjaja 1997).

Vernacular names and uses: The vernacular name of this bamboo is *bambu lako* (Tetun). This bamboo is used for building materials (Widjaja 1997).

Specimens examined: Central Java, Boyolali, Indrokilo BG, block of Madrim Bamboo Park, 7°33′31″ S, 110°37′47″ E, 28 December 2019, Sri Mulyani 11 (BO), 7°33′34″ S, 110°37′46″ E, 28 December 2019, Sri Mulyani 12 (BO), 7°33′38″ S, 110°37′45″ E, 29 December 2019, Sri Mulyani 24 (BO), 7°33′38″ S, 110°37′45″ E, 29 December 2019, Sri Mulyani 25 (BO), 7°33′34″ S, 110°37′47″E, 29 December 2019, Sri Mulyani 27 (BO), 7°33′34″ S, 110°37′47″ E, 29 December 2019, Sri Mulyani 28 (BO), 7°33′34″ S, 110°37′47″E, 29 December 2019, Sri Mulyani 29

Figure 3. *Bambusa lako*. A = habit, B = culm, C = branch, D = leaf-sheath auricle and ligule, E = culm-sheath, F = culm-sheath ligule, and G = culm-sheath auricle (Photos: Sri Mulyani).
Bambusa multiplex (Lour.) Raeusch. ex Schult.f., Syst. Veg., Ed. 15 Bis 7(2): 1350 (1830) (Figure 4)

Description: Young shoot green, glabrous. Culm yellow with green stripes, up to 8 m high, 1–2 cm in diameter, internodes up to 40 cm long; branch complements with primary branch hardly prominent. Culm-sheath 4.5–4.7 × 0.9–1 cm, deciduous; auricles rim-like or very small, up to 1 mm high, bristles short; ligule irregularly denticulate, glabrous; blade erect, broadly triangular, base asymmetric, 3.5–4.7 × 1–1.5 cm. Leaves green, 8.2–10.2 × 1.1–1.2 cm, glabrous; auricles small, 1–2 mm high, bristles 3–4 mm long; ligule irregularly denticulate, 1–2 mm high, glabrous. Inflorescences were unavailable.

Distribution: This species is introduced bamboo that commonly cultivated in Java (Widjaja 2001a), Bali (Widjaja et al. 2005), Lombok (Huzamah et al. 2016; Putri et al. 2016; Damayanto et al. 2020b), Sumbawa, Flores, Timor Timur, Timor Leste (Widjaja 2001b), Sulawesi (Ervianti et al. 2019b), and Aceh (Ritonga et al. 2020).

Vernacular names and uses: The vernacular names of this bamboo are bambu cina (Indonesia), bambu pagar (Indonesia), pring gendani (Java), awi krisik (Sunda) (Widjaja 2001a), santong hias cina (Lombok) (Huzamah et al. 2016), bamboo hias (Mataram) (Damayanto et al. 2020b), bambu pagar, bamboo pancing (Aceh) (Ritonga et al. 2020). This bamboo is used as ornamental (Dransfield and Widjaja 1995b), fence, and fishing rod (Ritonga et al. 2020).

Specimens examined: Central Java, Boyolali, Indrokilo BG, block of Madrim Bamboo Park, 7°33'34" S, 110°37'47" E, 28 December 2019, Sri Mulyani 18 (BO); Central Java, Salatiga, Kopeng, 11 November 1976, Widjaja 119 (BO); West Java, Bogor, 250 m, 10 March 1941, de Wit 4092 (BO).

Bambusa vulgaris Schrad. Ex J.C.Wendl., Coll. Pl. 2: 26 (1808) (Figure 5–6)

Description: Young shoot yellow or green covered with brown hairs. Culm green (var. striata yellow with green stripes), erect, slightly zigzag, var. wamin with inflated internodes in the lower part, 6–12 m high, 6–8 cm in diameter, internode 34–35 cm long; branch complements with one dominant primary branch and several smaller branches. Culm-sheath 10.5–29.5 × 8.9–16.8 cm, deciduous, covered with dark brown to black hairs; auricles rounded, 1–2 cm high, bristles 4–5 mm long; ligule denticulate, 2–4 mm high, bristles short; blade erect, broadly triangular, 3.7–20 × 3.1–9.7 cm, hairy on both surfaces. Leaves green, 17.4–28.2 × 2.5–4 cm, glabrous; auricles small, 1–2 mm high, bristles 1–2 mm long; ligule entire, 1–2 mm high, glabrous. Inflorescences were unavailable.
Distribution: This bamboo can be found almost everywhere in Indonesia (Widjaja 2019), such as in Java (Widjaja 2001a), Bali (Widjaja et al. 2005), Lesser Sunda Islands (Widjaja, 2001b), Sulawesi (Ervianti et al. 2019b), Aceh (Ritonga et al. 2020), Kalimantan (Widjaja 2019), and Papua (Damayanto et al. 2016).

Notes. There are three varieties of this bamboo: *B. vulgaris* var. *vulgaris* (culm green), var. *striata* or var. *vitata* (culm yellow with green
Vernacular names and uses: The vernacular names of B. vulgaris var. vulgaris are bambu ampel (Indonesia), pring ampel (Java), awi ampel (Sunda), and var. striata is known as pring kuning (Java) and awi koneng (Sunda). Meanwhile, var. wamin is known as bambu blenduk (Java). This species is used as fence and building materials, furniture, ornamental plant (Widjaja 2001a), and mat (Putro et al. 2014).

Specimens examined. Central Java, Boyolali, Indrokilo BG, block of Madrim Bamboo Park, 7°33’33’’ N, 110°37’46’’E, 28 December 2019, Sri Mulyani 14 (BO), 7°33’34’’ N, 110°37’47’’E, 28 December 2019, Sri Mulyani 15 (BO), 7°33’31’’ N, 110°37’47’’ E, 28 December 2019, Sri Mulyani 16 (BO), 7°33’34’’ N, 110°37’47’’ E, 28 December 2019, Sri Mulyani 19 (BO), 7°33’34’’ N, 110°37’47’’ E, 28 December 2019, Sri Mulyani 20 (BO), 7°33’39’’ N, 110°37’42’’ E, 29 December 2019, Sri Mulyani 21 (BO), 7°33’34’’ N, 110°37’47’’ E, 29 December 2019, Sri Mulyani 22 (BO), 7°33’38’’ N, 110°37’45’’ E, 29 December 2019, Sri Mulyani 23 (BO); Cibitung, Gunung Salak, 18 February 1998, Widjaja 1805 (BO); East Java, Banyuwangi, S. M. Merubetiri Timur, blok Pancur, 24 November 1982, Widjaja 1778 (BO).

*Dendrocalamus* sp. (Figure 7)

**Description:** Young shoot green, covered with dark brown hairs. *Culm* erect, dark green; branch complements with one dominant primary branch and several smaller branches. *Culm-sheath* of the mature culm is unavailable, based on the young shoot: auricles rounded and curved outward, glabrous; ligule denticulate with short bristles. Leaves green, glabrous, 19.4–27.3 × 3.7–4.2 cm; auricles small, 1–2 mm high, glabrous; ligule irregularly denticulate, 1–3 mm high, glabrous. *Inflorescences* were unavailable.

**Distribution:** This bamboo is only found in Indrokilo BG.

**Notes:** This bamboo is placed as *Dendrocalamus* sp. due to incomplete material.

**Specimen examined:** Central Java, Boyolali, Indrokilo BG, block of Madrim Bamboo Park, 7°33’32’’ N, 110°37’46’’ E, 28 December 2019, Sri Mulyani 10 (BO).

*Guadua* cf. *angustifolia* Kunth. Syn. Pl. 1: 252 (1822) (Figure 8)

**Description:** Young shoot green, covered with light brown hairs. *Culm* erect, dark green with white bands below the nodal line; branch complements with one dominant primary branch and few or no smaller branches, branches bearing spines. *Culm-sheath* of the mature culm is...
unavailable, based on *culm-sheath* of branch, deciduous, covered with light brown hairs; auricles rounded, 1–2 mm high, bristles 5–10 mm long; ligule denticulate, 1–2 mm high, bristles 2–5 mm long; mature blade unavailable. *Leaves* green, 11.9–21 × 3–3.5 cm, glabrous above, glabrescent below; auricles small, up to 1 mm high, bristles 4–9 mm long; ligule denticulate, sometimes with short bristles. *Inflorescences* 8–9.5 cm long, emerging from the leaf-branches; floret ovate, 1–1.2 cm long; lemma 1–1.2 cm long, apex acuminate; palea 0.8–1 cm long, apex acuminate.

**Distribution:** *G. angustifolia* originated from South America (Judziewicz et al. 1999) and it was introduced to Indonesia (Londono 2001), especially to Java and Bali (Widjaja 2019).

**Notes:** Bamboo *G. angustifolia* in their origin areas found at an altitude of 1,500 m with high rain density. This bamboo is used as building materials, furniture, paper industries, and the young shoot can be eaten (Viswanath et al. 2012).

**Specimen examined:** Central Java, Boyolali, Indrokilo BG, block of Madrim Bamboo Park, 7°33'34" S, 110°37'47" E, 28 December 2019, Sri Mulyani 17 (BO).

**Schizostachyum sp.** (Figure 9)

**Description:** Young shoot was unavailable. *Culm* erect, green; branch complements with several slender sub-equal branches. *Culm-sheath* unavailable, based on *culm-sheath* of branch, covered with light brown hairs; auricles inconspicuous, bristles 5–7 mm long; ligule

Figure 8. *Guadua cf. angustifolia*. A = habit, B = culm, C = branch with spines, D = leaf-sheath auricle and ligule, E = inflorescences, and F = palea (left) and lemma (right) (Photos: Sri Mulyani).

Figure 9. *Schizostachyum* sp. A = habit and B = leaf-sheath auricles and ligule (Photos: Sri Mulyani).
with a narrow base on *B. glaucophylla*; broadly triangular with broad base on *B. vulgaris*), bristles of leaf-sheath auricles (glabrous on *B. glaucophylla*; present on *B. vulgaris*), and leaf color (green with white stripes on *B. glaucophylla*; green on *B. vulgaris*). Cluster B was comprised of *B. multiplex* and *B. lako*. Several morphological characters that clearly distinguish these species were the color of the culm (purplish-green on *B. lako*; yellow with green stripes on *B. multiplex*), culm-sheath auricles (rounded and slightly curved outward on *B. lako*; rim-like or very small on *B. multiplex*), and adaxial of leaves (glabrous on *B. lako*; hairy on *B. multiplex*). Clusters C until E were comprised of only one species respectively, namely *Dendrocalamus sp.*, *G. cf. angustifolia*, and *Schizostachyum sp.*. Several morphological characters that clearly distinguish these species are branch complements (one dominant primary branch and several smaller branches on *Dendrocalamus sp.*; one dominant primary branch and few or no smaller branches on *G. cf. angustifolia*; several slender sub-equal branches on *Schizostachyum sp.*), culm-sheath auricles (rounded and curved outward on *Dendrocalamus sp.*; rounded on *G. cf. angustifolia*; inconspicuous on *Schizostachyum sp.*), branch spines and thick white bands below the nodal line (present on *G. cf. angustifolia*; absent on *Dendrocalamus sp.* and *Schizostachyum sp.*).

Clusters A and B belong to the same genus: *Bambusa*, however, those species were separated

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**Figure 10.** Dendrogram of similarity analysis of bamboo species in the Indrokilo BG using the UPGMA method and Nei & Li similarity coefficient.
into two different clusters with a similarity index of 51%. It is similar to a study by Fitriana et al. (2017) that reported B. multiplex and B. vulgaris were separated to be two clusters with a similarity index of 65%. There were only one species (Dendrocalamus sp.) that belongs to cluster C and was closely related to cluster B (Bambusa) with a similarity index of about 60%. In the phylogeny analysis, Dendrocalamus spp. was reported very closely related to Bambusa spp. (Zhou et al. 2017), therefore, it allegedly had several similar characters. Cluster E also consisted of one species (G. cf. angustifolia) that was separated farthest apart from other clusters based on a similarity index of about 40%. Several characters, such as branches bearing spines and branch complements with one dominant primary branch and few or no smaller branches, were distinctive characters that separate G. cf. angustifolia from other species.

CONCLUSION

There were seven species and four genera of bamboo found in the Indrokilo BG, namely Bambusa glaucophylla, B. lako, B. multiplex, B. vulgaris, Dendrocalamus sp., Guadua cf. angustifolia, and Schizostachyum sp. The diversity of bamboo species in the Indrokilo BG was relatively low compared to other BGs in Indonesia. Based on the similarity analysis, bamboo in the Indrokilo BG consisted of five groups at a similarity index of 70%. Since the diversity of bamboo species in the Indrokilo BG was relatively low and still many potential bamboo species which are native in Indonesia, we suggested that Indrokilo BG should conserve Indonesian native bamboo for the new collection within the botanical garden.

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DAFTAR PUSTAKA

Ariati, S.R., Astuti, R.S., Supriyatna, I., Yuswandi, A.Y., Setiawan, A., Saflamningsih, D. & Pribadi, D.O. (2019) An alphabeticical list of plant species cultivated in the Bogor Botanic Gardens. Bogor, Indonesian Institute of Sciences, Center for Plant Conservation, Bogor Botanic Gardens.

Arinasa, I.B.K., Adjie, B. & Putri, D.M.S. (2017) An alphabetic list of plant species cultivated in the Bali Botanical Garden. Jakarta, LIPI Press.

Astuti, I.P., Soewilo, L.P., Said, T.D. & Kosasih, R.N.A. (2001) An alphabetic list of plant species cultivated in the Bogor Botanical Garden. Bogor, Riza Graha Jaya.

Cahyanto, T., Arigustin, D., Efendi, M. & Suryani, Y. (2016) Keanekearagaman jenis bambu di Taman Bambu Siageung Kebun Raya Kuningan Jawa Barat. Prosiding Seminar Nasional MIPA & PMIPA 2016, 11, 161–168. doi: 10.24252/bio.v4i2.2513.

Damayanto, I.P.G.P. & Widjaja, E.A. (2016) A new species of Schizostachyum (Poaceae-Bambusoideae) from Sumba Island, Indonesia. Reindhwartia, 15 (2), 119–122. doi: 10.14203/reindhwartia.v15i2.2946.

Damayanto, I.P.G.P., Mambrasar, Y.M. & Hutabarat, P. (2016) Bamboos (Poaceae: Bambusoideae) of Papua, Indonesia. Jurnal Biologi Papua, 8 (2), 57–61. doi: 10.31957/jbp.52.

Damayanto, I.P.G.P. & Widjaja, E.A. (2017) A noteworthy Dendrocalamus (Poaceae: Bambusoideae) from Sumatra, Indonesia. Garden Bulletin Singapore, 69 (1), 75–80. doi: 10.3850/S2010098116000058.

Damayanto, I.P.G.P., Mulyani, S. & Wahidah, B.F. (2019) Inventarisasi, kunci identifikasi, pemetaan, dan rekomendasi pengelolaan jenis-jenis bambu di Ecology Park, Pusat Konservasi Tumbuhan, Kebun Raya–LIPI, Kabupaten Bogor, Jawa Barat. Jurnal Arsitektur Lanskap, 5 (1), 114–124. doi: 10.24843/JAL.2019.v05.i01.p13.

Damayanto, I.P.G.P., Fastanti, F.S. & Dalimunthe, S.H. (2020a) Pemanfaatan portal basis data dari dalam validasi nama ilmiah jenis dan suku tumbuhan. Berkala Ilmu Perpustakaan dan Informasi, 16 (2), 170–183. doi: 10.22146/bip.v16i2.770.

Damayanto, I.P.G.P., Rustiami, H., Miftahudin & Chikmawati, T. (2020b) A synopsis of Bambusoideae (Poaceae) in Lombok, Indonesia. Biodiversitas, 21 (10), 4489–4500. doi: 10.13057/biodiv/d211004.

Djarwaningsih, T., Sunarti, S. & Kramadibrata, K. (2002) Panduan pengolahan dan pengelolaan material herbarium serta pengendalian hama terpadu di Herbarium Bogoriense. Bogor, Herbarium
Bogoriense, Bidang Botani, Pusat Penelitian Biologi-LIPI.
Dransfield, S. & Widjaja, E.A. (1995a). *Plant resources of South-East Asia* No. 7. *Bamboos*. Leiden, Netherlands, Backhuys.
Dransfield, S. & Widjaja, E.A. (1995b). *Bambusa multiplex* (Lour.) Raeschel ex J.A. & J.H. Schultes. In: Dransfield, S. & Widjaja, E.A. (editors) *Plant resources of South-East Asia No 7. Bamboos*. Leiden, Netherlands, Backhuys, pp. 65–67.
Dransfield, S. & Widjaja, E.A. (2000) *Dinochloa matmat*, a new bamboo species (Poaceae-Bambusoideae) from Java, Indonesia. *Kew Bulletin*, 55 (2), 495–497. doi: 10.2307/4115668.
Ervianti, D., Widjaja, E.A. & Sedayu, A. (2019a) New species of climbing and scrambling bamboo from Sulawesi, Indonesia. *Reinwardtia*, 18 (2), 115–132. doi: 10.14203/reinwardtia.v18i2.3774.
Ervianti, D., Widjaja, E.A. & Sedayu, A. (2019b) Bamboo diversity of Sulawesi, Indonesia. *Biodiversitas*, 20 (1), 91–109. doi: 10.13057/bdivd200112.
Fitriana, R.A., Yulistiyanin, T., Soegianto, A. & Ardian, N.R. (2017) Hubungan kekerabatan plasma nutfah bambu koleksi Kebun Raya Purwodadi berdasarkan karaker morfologi. *Jurnal Produksi Tanaman*, 5 (5), 812–820.
Huzaimah, Mulyaningsih, T. & Aryanti E. (2016) Identifikasi bambu pada daerah aliran sungai Tiupupus Kabupaten Lombok Utara. *Jurnal Biologi Tropis*, 16 (2), 23–36. doi: 10.29303/jibt.v16i2.221.
Judziewicz, E.J., Clark, L.G., Londono, X. & Stren, M.J. (1999) *American bamboo*. New York, Smithsonian Institution.
Kovach, W.L. (2007) *MVSP, a multivariate statistical package for Windows*, Versi 3.1. United Kingdom, Kovach.
KRIB (Kebun Raya Indrokilo Boyolali) (2019) *Kebun Raya Indrokilo Boyolali*. [Online] Available from http://kebunrayadaerah.krbogor.lipi.go.id/kebun-raya-indrokilo-boyolali.html [Accessed 26 September 2019].
Londono, X. (2001) The cultural significance of *Guadua angustifolia* in Colombia. *Bamboo: Magazine of the American Bamboo Society*, 22 (5), 7.
Nei, M. & Li, W.H. (1979) Mathematical model for studying genetic variation in terms of restriction endonucleases. *Proceeding of the National Academy of Sciences of USA*, 76 (10), 5269–5273. doi: 10.1073/pnas.76.10.5269.
Putri, R.J.C., Mulyaningsih, T. & Aryanti, E. (2016) Identifikasi bambu di daerah aliran sungai Meninting Lombok Barat. *BioWallacea*, 2 (2), 97–101. doi: 10.20886/jppdas.2018.2.2.111-122.
Putro, D.S., Jamari & Murningsih (2014) Keanekaragaman jenis bambu di Desa Lopai Kabupaten Semarang Jawa Tengah. *Jurnal Akademika Biology*, 3 (2), 71–79.
Ritonga, M.A., Navia, Z.I., Arico, Z. & Damayanto, I.P.G.P. (2020) Keragaman jenis bambu di Kawasan Ekosistem Leuser, Kecamatan Tenggulun, Kabupaten Aceh Tamiang, Aceh. *Buletin Plasma Nutfah*, 26 (2), 109–122. doi: 10.21082/blpn.v26n2.2020.p109-122.
Roemantyo, Suyono, Astuti, I.P., Supriadi, D., Wahyuninggih, R.S., Munawaroh, E., Purwantero, R.S., Widyatmoko, D. & Imamuddin, H. (2010) *An alphabetical list of plant species cultivated in the Bogor Botanical Gardens*. Bogor, Indonesian Institute of Sciences.
Rugayah, Retnowati, A., Windadri, F.I. & Hidayat, A. (2004) Pengumpulan data taksonomi. In: Rugayah, Widjaja, E.A. & Praptiwi (editors) *Pedoman Pengumpulan Data Keanekaragaman Flora*. Bogor, Pusat Penelitian Biologi-LIPI, pp. 5–42.
Sari, R., Ruspandi & Ariati, S.R. (2010) *An alphabetical list of plant species cultivated in the Bogor Botanical Gardens*. Jakarta, LIPI Press.
Sujarwo, W. (2018) Bamboo resources, cultural values, and ex-situ conservation in Bali, Indonesia. *Reinwardtia*, 17 (1), 67–75. doi: 10.14203/reinwardtia.v17i1.3569.
Sujarwo, W., Gunilang, A.R. & Hidayat, I.W. (2019) *List of living plants collection cultivated in Cibodas Botanic Gardens*. Cianjur, Cibodas Botanic Gardens, Indonesian Institute of Sciences.
Viswanath, S., Jshi, G., Somasekhar, P.V. & Jagadish, M.R. (2012). *Guadua angustifolia* Kunth: Potential bamboo species for humid tropics of Peninsular India. *IWST Technical Bulletin*, 9, 1–19.
Vorontsova, M.S., Clark, L.G., Dransfield, J., Govaerts, R.H.A. & Baker, R.W. (2016) World checklist of bamboos and rattans. *INBAR Technical Report*, 37, 1–454.
Widjaja, E.A. (1987) A revision of Malesian *Gigantochloa* (Poaceae-Bambusoideae). *Reindwartia*, 10 (3), 291–380. doi: 10.14203/reinwardtia.v10i3.274.
Widjaja, E.A. (1997) New taxa in Indonesian bamboos. *Reindwartia*, 11 (2), 57–152. doi: 10.14203/reinwardtia.v11i2.588.
Widjaja, E.A. (2001a) *Identifikasi jenis-jenis bambu di Jawa*. Bogor, Pusat Penelitian Biologi-LIPI.
Widjaja, E.A. (2001b) *Identifikasi jenis-jenis bambu di Kepulauan Sundaland Kecil*. Bogor, Pusat Penelitian dan Pengembangan Biologi-LIPI.
Widjaja, E.A. (2009) Three new species of *Dinochloa* (Poaceae, Bambusoideae) with erect culm sheath blades from Sulawesi, Indonesia. *Reinwardtia*, 12
Widyatmoko, D., Suryana, N., Suhatman, A. & Rustandi, B. (2010) List of living plants collection cultivated in Cibodas Botanic Gardens. Cianjur, Cibodas Botanic Gardens, Indonesian Institute of Sciences.

Wigunanto, P. (2019) Pengembangan media pembelajaran berbasis web pada mata kuliah sistematika tumbuhan untuk karakterisasi subfamili Bambusoideae di Kebun Raya Purwodadi. Skripsi S1. Semarang, Universitas Islam Negeri Walisongo.

Zhou, M.Y., Zhang, Y.X., Haevermans, T. & Li, D.Z. (2017) Towards a complete generic-level plastid phylogeny of the paleotropical woody bamboos (Poaceae-Bambusoideae). Taxon, 66 (3), 539–553. doi: 10.12.12705/663.2.

Zulkarnaen, R.N. & Andila, P.S. (2015) Dendrocalamus spp.: Bambu raksasa koleksi Kebun Raya. Prosiding Seminar Nasional Masyarakat Biodiversitas Indonesia, 1 (3), 534–538. doi: 10.13057/psmnb/m010326.