

NOTES ON CHIMONOBAMBUSA QUADRANGULARIS (FRANCESCHI) MAKINO (POACEAE: BAMBUSOIDEAE) AS AN INVASIVE ALIEN PLANT SPECIES IN INDONESIA

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I Putu Gede P. Damayanto & Muhamad Muhaimin. 2017. Catatan *Chimonobambusa quadrangularis* (Franceschi) Makino (*Poaceae*: *Bambusoideae*) sebagai Jenis Tumbuhan Asing Invasif di Indonesia. *Floribunda* 5(7): 253–257. — *Chimonobambusa quadrangularis* (Franceschi) Makino adalah salah satu jenis tumbuhan asing invasif di Indonesia. Jenis ini berasal dari China Selatan, pertama kali diintroduksi dari Jepang di Kebun Raya Cibodas, Jawa Barat. Bambu ini kemudian meliar keluar batas kebun raya dan tumbuh di wilayah Taman Nasional Gunung Gede-Pangrango sebagaimana tercatat dalam beberapa laporan jenis invasif di tanah air. Tulisan ini mengungkapkan peluasan distribusi jenis invasif yang dimaksud dengan modus yang serupa dan menambah catatan jenis tumbuhan asing invasif di Indonesia.

Kata kunci: *Chimonobambusa quadrangularis*, Kebun Raya Cibodas, jenis invasif, Jawa Barat, Sumatra Utara.

I Putu Gede P. Damayanto & Muhamad Muhaimin. 2017. Notes on *Chimonobambusa quadrangularis* (Franceschi) Makino (*Poaceae*: *Bambusoideae*) as an Invasive Alien Plant Species in Indonesia. *Floribunda* 5(7): 253–257. — *Chimonobambusa quadrangularis* (Franceschi) Makino is one of the invasive alien plant species in Indonesia. This species originated from South China that was introduced from Japan in the Cibodas Botanical Garden, West Java. This bamboo then escaped the garden and invades Mt. Gede-Pangrango National Park area as recorded in several report. This paper attempt to report the extension of the species distribution in invading with similar modus which also extend alien plant invasion record in Indonesia.

Keywords: *Chimonobambusa quadrangularis*, Cibodas Botanical Garden, invasive species, West Java, North Sumatra.

Botanical gardens in the world has the tradition of exchange plant collection and used to be the gate for plant introduction. This is also carried in Indonesia, mainly by Bogor and Cibodas Botanical Garden, since their establishment in the 1800 era. Plants that being introduced mostly was species with economical value. However, some of this transferred species were escaped and turned to be invasive in its non-native habitat.

Regulation of the Ministry of Environment and Forestry No. P.94/MENLHK/SETJEN/KUM.1/12/2016 states that invasive alien species (IAS) are plants, animals, microorganisms and other organisms which are not part of the natural ecosystem, damage the ecosystem and environment, and with negative impact to biodiversity and human health. This kind of plants are usually introduced species, was thought to have valuable uses such as ornamentals, medicinal, etc (Tjitrosoe-

dirdjo *et al.* 2016a). They are potentially threatening the ecosystems, disturbing agricultural activities, and may indirectly cause greater disaster to human. Some invasive plant species prevent local species to grow in competition of space and nutrition, which is natural native herbivores food (Tjitrosoedirdjo *et al.* 2016b) and lead to human-animal conflict. They are plant that might release allelopathy which inhibit the growth of neighboring native species (Adkins *et al.* 2014; Sankaran *et al.* 2014; Tjitrosoedirdjo *et al.* 2016b). This might also lead to the loss of biodiversity. On the other case, the loss of local trees that then replaced by invasive species can reduce the storability of groundwater and cause drought or flooding (Tjitrosoedirdjo *et al.* 2016a).

Invasive bamboo are species with monopodial growth modus. Their rhizome might creep underground and develop stands away from its pa-

rent. *Chimonobambusa quadrangularis* (Franceschi) Makino is one of the kind and known to invade the Gede-Pangrango National Park which bordered Cibodas Botanical Garden (Mutaqien *et al.* 2011, Wahyuni & Tjitrosoedirdjo 2013, Junaedi 2014, Tjitrosoedirdjo *et al.* 2016a, 2016b). Based on herbarium examination housed in Bogor (BO), we found that this bamboo is not only grown and become invasive in Java but also in Sumatra. This paper attempt to report the extension of the species invasion in the country with notes on taxonomy, ecology, and other additional information.

MATERIAL AND METHODS

This research was carried by observing specimens of *Chimonobambusa quadrangularis* housed in Herbarium Bogoriense (BO), living material at Cibodas Botanical Garden and Mt. Gede-Pangrango National Park. We also surveyed related literature on establishment and collection of the garden and tracing the journey of a natural park.

RESULT AND DISCUSSION

Taxonomy

Chimonobambusa quadrangularis (Franceschi) Makino, Bot. Mag. Tokyo 28 (329): 153. 1914.

Basionym: *Bambusa quadrangularis* Franceschi, *Tetragonocalamus quadrangularis* (Franceschi) Nakai.

Synonym: *Arundinaria quadrangularis* Makino, *Bambusa angulata* Munro, *Tetragonocalamus angulatus* (Munro) Nakai, *Chimonobambusa angulata* Nakai.

Rhizomes leptomorph, stolon long up to 4 m, easily rising to the ground surface or rock gap. *Shoot* purplish green with scattered brown hairs particularly near the nodes. The shoot can grow far from the main clump. *Culm* green, straight, erect to tip, 2–4 m tall, 2–3 cm in diameter, internode 20–25 cm, quadrangular but cylindrical in the upper part, rough with the scattered small white spine (less than 1 mm long). Culm node is swollen, prominent, with the spines, spines verticillate to the node and curved downward. Branch complements with three (-5) subequal branches arising together. *Culm-sheath* 10–22.6 × 4–5 cm, triangular, thin, covered by scattered brown hairs and become glabrous when older, persistent, sheath apex margin with hair up to 1 mm long, auricles none and glabrous. *Culm-sheath ligule* very small and glabrous;

blade 0.5–2 cm long, very small and slim, linear, erect and easily fall. *Leaves* 16–21 × 2–2.1 cm, linear, glabrous; pubescent adaxially, petiole very short; auricles inconspicuous with well-developed bristles, 2–5 mm long and curly; ligule very small and glabrous. *Inflorescence* not seen.

Introduction and Distribution

Chimonobambusa quadrangularis is originated from China and Formosa (Suzuki 1978). This species was introduced from Japan around 1920 to Cibodas Botanical Gardens (Widjaja 2001). Based on Bruggeman (1927), several species of Japanese bamboo has been brought into the garden that might included this species. Boerlage (1898) stated that these introduced bamboo were planted at V and W block. However, Dakkus (1930) reported that *Phyllostachys quadrangularis* was grown at P block (P 56). Later, this plant were being re-identified as *Tetragonocalamus quadrangularis* (Nasution 1963) and listed as such years after (Sastrapradja 1977). Other studies has recognized the plant as *Bambusa angulata* [Roemantyo *et al.* (1988), Roemantyo *et al.* (1993), Purwantoro *et al.* (2000), Imamudin *et al.* (2005)] or as *C. quadrangularis* [Widyatmoko *et al.* (2010), SINDATA (2017)] (Fig. 1). Widjaja *et al.* (2014) confirmed that this particular plant most likely the one that being introduced around the 1920s from Japan.

This species were suspected to invade Mt. Gede-Pangrango National Park between 1987 to 2002 (Widjaja pers. comm.). It was noticed in 1987 that column remains from coppiced stands in the garden were piled temporarily at the border between the garden and national park. No stand were encountered inside the park. A visit in 2002 has suggested that the species spread in the park, further deep into an area called *Pasarean*. No attempt was taken to eradicate this species. It was reported then to grow further to *Topos* and behave as an invasive species (Tjitrosoedirdjo *et al.* 2016b). Mutaqien *et al.* (2011) stated that this species becomes invasive apparently since the species is used as a barrier plants between the garden and national park. It is a short-day plant that can grow well under the tree in the forest that explain its survival (Taihui 1994).

The same species was also collected from Sibolangit Tourist Park, North Sumatra by Soejatmi Soenarko in 1975, EA Widjaja in 1982, and recollected in 1998 by EA Widjaja & IS Sangaji. It was written on the notes of the first specimen that this species occupied a large area of the garden in Sibolangit. This record can be regarded as first

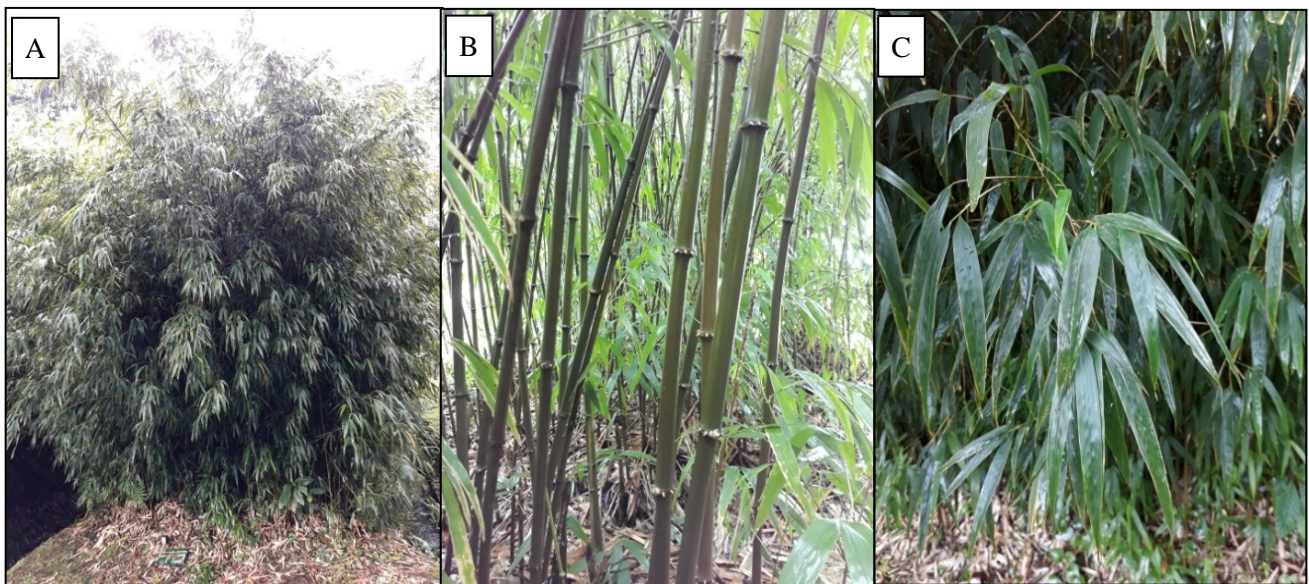


Fig. 1. *Chimonobambusa quadrangularis* collection of Cibodas Botanical Garden. A. Habit, B. Culm, C. Leafy branch (Photos: Muhamad Muhaimin 2017).

report of *C. quadrangularis* as an invasive. It is also supported by a report (Rahmawati 2007) which stated that there is a bamboo forest inside the park although without listing the species. Sibolangit park was initiated by JC Koningsberger, Director of Bogor Botanical Gardens in 1914 that JA Lörzing were appointed as the keeper of this gardens (DEPHUT 2002, Ginting 2011). It occupies an area of 127 ha and experience several management status revision. In 1927 with a governor of East Coast Sumatra decree, No. 171/B/AZ, the park were switched into a nature reserve, which then were given expansion area and agreed by Ministry of Agriculture under regulation no. 104/KA/1957 in 1957. Later in 1980, this area were split into two management: 95,15 ha of a nature reserve and 24,85 ha as tourist park (DEPHUT 2002). However, there is no report that could clarify when was this species were brought into the park and invade area as in 1975. Moreover, Maryanto *et al.* (2013) & Widjaja *et al.* (2014) reported that *C. quadrangularis* were occurred in Mt. Sibayak. It is suspected that this bamboo encroached the neighbouring area with similar modus as it does in Java. When Lörzing has been appointed as the keeper of the garden, he also visited Mt. Sibayak (Steenis-Kruseman 1950) but no information whether he introduced *C. quadrangularis* either to Sibolangit or Mt. Sibayak during the visit or anytime under his administration (Lörzing 1921).

Ecology

Based on Taihui (1994) *C. quadrangularis*

in the sub-tropics are found at an altitude 1,000–2,000 m, with average annual rainfall 1,000–1,400 mm, temperature of 8–16°C with extreme low temperature of -14°C, and air humidity of 70–80%. This species behaves differently in the tropics as Cibodas has an average annual rainfall 2,950 mm, temperature of 20.06°C (KRC 2017, Junaedi 2014), while Sibolangit Nature reserve and park lies at altitude 550 with average annual rainfall 3,000–4,000 mm, temperature 13°C–28°C and air humidity above 90 % (DEPHUT 2002, Ginting 2011). This bamboo known to survive under the shade and grows about 30-40 culms/m² in West Java (Tjitrosoedirdjo *et al.* 2016b).

Threat to the Ecosystem

Bamboo *C. quadrangularis* can grow under the shade (Widjaja 2001, Tjitrosoedirdjo *et al.* 2016b) as a short-day plant (Taihui 1994). It can spread vegetatively and fill the forest gaps without seed (Tjitrosoedirdjo *et al.* 2016a). The creeping roots and rhizome allow this species to form stands away from the parent, scattered and uniformly (Widjaja 2001, Mutaqien 2011). This character explains the way the species become invasive in Indonesia. *C. quadrangularis* is also considered as an invasive weed in Hawaii and other areas where it has been introduced (Bystriakova *et al.* 2003).

Uses

This species is used as ornamental plant for its quadrangular culm. Local peoples have used the young shoot as vegetables (*lalapan*, fresh or boiled) (Widjaja 2001). Vernacular name of this

bamboo is *bambu kimono* or *bambu krisik* (Tjitro-soedirdjo *et al.* 2016b). *Bambu krisik* is also used for the name of *Bambusa multiflex* (Lour.) Raeusch. ex. J.A. & J.H. Schult. (Widjaja 2001).

Specimen Examined

USA, California: San Francisco, Golden Gate Park, Japanese Tea Garden, near the street at the end near the California Academy of Sciences, 25 January 1941, *FA McClure 20907* (BO); INDONESIA, Java: West Jawa, Cianjur, Cibodas Botanical Garden, 15 February 1999, *EE Ariyanti 01* (BO); *EE Ariyanti 05* (BO), cultivated at Vak IL.8, 7 July 2017, *Damayanto & Muhaimin 461* (BO). Sumatra: North Sumatra, Sibolangit, 9 November 1975, *S Soenarko 392* (BO); 5 April 1982, *EA Widjaja 1438* (BO); Taman Hutan Wisata Sibolangit, Kec. Sibolangit, Kab. Deli Serdang, 22 February 1998, *EA Widjaja & IS Sangaji 7096* (BO).

CONCLUSION

Chimonobambusa quadrangularis was originated in South China and introduced from Japan to the Cibodas Botanical Garden around 1920. This species escapes the garden, grows widely in the neighboring Mt. Gede-Pangrango national park and considered as an invasive alien plant species. Later finding reveal that this species was also introduced to Sumatra, particularly Sibolangit Tourist Park and Mt. Sibayak with similar modus. This species has tolerate wider environmental condition in the tropics.

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REFERENCES

Adkins S, Shrestha S, Shabbir A & Shrestha BB. 2014. The biology and management of

parthenium weed: an invasive weed now affecting the native and agro-ecosystems of Nepal. *In*: Thapa GJ, Subedi N, Pandey MR, Thapa SK, Chapagain NR & Rana A [editors]. *Proceedings of the International Conference on Invasive Alien Species Management*. National Trust for Nature Conservation, Nepal. pp. 23–29.

Boerlage JG. 1898. *Der Planten Gekweekt in Den Bergtuin van Tjibodas, Behoorende Bij 's Lands Plantentuin. Verslag Omtrent Den Staat van 's Lands Plantentuin te Buitenzorg Over Het Jaar 1898*. Landsdrukkerij. Batavia. pp. 112–132.

Bruggeman MLA. 1927. *Gids Voor Den Bergtuin te Tjibodas, Sindanglaja. 's lands Plantentuin Buitenzorg*. Buitenzorg. pp. 1–62.

Bystriakova N, Kapos V, Stapleton C & Lysenko I. 2003. *Bamboo Biodiversity*. UNEP-WCMC/INBAR. UK. pp. 1–71.

Dakkus PMW. 1930. *An Alphabetical List of Plants Cultivated in the Botanic Gardens, Buitenzorg*. Archipel Drukkerij. Buitenzorg. pp. 1–325.

DEPHUT (Departemen Kehutanan). 2002. *Data dan Informasi Kehutanan Propinsi Sumatera Utara*. Pusat Inventarisasi dan Statistik Kehutanan, Badan Planologi Kehutanan, Departemen Kehutanan. Jakarta. pp 1–42.

Ginting KEM. 2011. *Komposisi Jenis dan Struktur Tegakan Hutan di Cagar Alam Sibolangit, Sumatra Utara. Skripsi*. Departemen Silviculture, Fakultas Kehutanan, Institut Pertanian Bogor. Bogor. pp. 1–61.

Imamudin H, Suryana N, Suhatman A & Hidayat A [editors]. 2005. *An Alphabetical List of Plant Species Cultivated in the Cibodas Botanic Garden*. Cibodas Botanic Gardens, Indonesian Institute of Sciences. Cianjur. pp. 1–95.

Junaedi DI. 2014. Exotic plants in the Cibodas Botanic Gardens remnant forest: inventory and cluster analysis of several environmental factors. *Buletin Kebun Raya* 17(1): 1–8.

KRC (Kebun Raya Cibodas). 2017. *Sejarah KR Cibodas*. <https://krcibodas.lipi.go.id/sejarah.php> (last accessed: 21 March 2017).

Lörzing JA. 1921. *De afdeeling Sibolangit van 's lands plantentuin (oostkust van Sumatra)*. *Tectona* 14: 693–711.

Makino T. 1914. Observations on the flora of Japan. *Botanical Magazine, Tokyo* 28(329): 153–160.

Maryanto I, Rahajoe JS, Munawar SS, Dwiyanto

- W, Asikin D, Ariati SR, Sunarya Y & Susiloningsih S [editors]. 2013. *Bioresources Untuk Pembangunan Ekonomi Hijau*. LIPI Press. Jakarta. pp 1–229.
- Mutaqien Z, Maria V, Tresnanovia & Zuhri M. 2011. Penyebaran Tumbuhan Asing di Hutan Wornojiwo Kebun Raya Cibodas, Cianjur, Jawa Barat. In: Widyatmoko D, Puspitaningtyas DM, Hendrian R, Irawati, Fijridiyanto FA, Witono JR, Rosniati R, Ariati SR, Rahayu S & Praptosuwiryo TN [editors]. *Konservasi Tumbuhan Tropika: Kondisi Terkini dan Tantangan ke Depan. Proceeding Seminar/UPT Balai Konservasi Tumbuhan in Cibodas 7 April 2011*. pp. 550–558.
- Nasution RE. 1963. *An Alphabetical List of Plant Species Cultivated in the Hortus Botanicus Tjibodasensis*. Archipel. Bogor. pp 1–65.
- Peraturan Menteri Lingkungan Hidup dan Kehutanan Republik Indonesia Nomor P.94/MENLHK/SETJEN/KUM.1/12/2016 tentang Jenis invasif. pp. 1–23.
- Purwantoro RS, Surya N & Soewilo RLP [editors]. 2000. *An Alphabetical List of Plants Species Cultivated in the Cibodas Botanical Garden*. Botanic Gardens of Indonesia, Indonesian Institute of Sciences. Bogor. pp. 1–83.
- Rahmawati NE. 2007. Dampak Pembukaan Lahan Hutan Terhadap Sifat Fisik, Kimia, dan Biologi Tanah (Studi Kasus di Taman Wisata Alam Sibolangit Deli Serdang). *Skripsi*. Program Studi Budi Daya Hutan, Fakultas Kehutanan, Institut Pertanian Bogor. Bogor. pp 1–33.
- Roemantyo, Astuti IP, Somaatmaja G, Imanuddin H, Soewilo LP & Darmadi D [editors]. 1988. *An Alphabetical List of Plants Species Cultivated in the Cibodas Mountain Garden*. Indonesian Institute of Sciences, Botanic Gardens of Indonesia. Bogor. pp 1–76.
- Roemantyo, Astuti IP, Soewilo LP, Muditha IGG, Munawaroh E, Said TD & Notodihardjo D [editors]. 1993. *An Alphabetical List of Plant Species Cibodas Mountain Garden*. The Indonesian Botanic Garden. Bogor. pp 1–93.
- Sankaran KV, Sajeev TV & Suresh TA. 2014. Invasive plants threats to forests in the humid tropics: A case study from Kerala State, India. In: Thapa GJ, Subedi N, Pandey MR, Thapa SK, Chapagain NR & Rana A [editors]. *Proceedings of the International Conference on Invasive Alien Species Management*. National Trust for Nature Conservation, Nepal. pp. 7–17.
- Sastrapradja DS. 1977. *An Alphabetical List of Plant Species Cultivated in the Hortus Botanicus Cibodasensis*. Archipel. Bogor. pp 1–67.
- SINDATA (Sistem Informasi Data Tanaman). 2017. Katalog Kebun Raya Cibodas. <http://sindata.krcibodas.lipi.go.id/Cibodas-Botanic-Gardens-Record/> (last accessed: 20 March 2017).
- Steenis-Kruseman MJ van. 1950. Malaysian plant collectors and collections. *Flora Malesiana* 1(1): 1–639.
- Suzuki S. 1978. *Index to Japanese Bambusaceae*. Gakken Co. Ltd. Tokyo. pp 1–384.
- Taihui W. 1994. The taxonomy and cultivation of *Chimonobambusa* Makino. *J. Amer. Soc.* 11 (1&2): 1–80.
- Tjitrosoedirdjo S, Tjitrosoedirdjo SS & Setyawati T. 2016a. *Tumbuhan Invasif dan Pendekatan Pengelolaannya*. SEAMEO BIOTROP. Bogor. pp 1–282.
- Tjitrosoedirdjo SS, Mawardi I & Tjitrosoedirdjo S. 2016b. *75 Important Invasive Plant Species in Indonesia*. SEAMEO BIOTROP. Bogor. pp 1–101.
- Wahyuni I & Tjitrosoedirdjo SS. 2013. Observation on the development of important weeds and invasive alien plant species in Indonesia. In: Bakar BH, Kurniadie D & Tjitrosoedirdjo S [editors]. *The Role of Weed Science in Supporting Food Security by 2020. Proceeding 24th Asian-Pacific Weed Science Society Conference*, October 22–25, 2013, Bandung, Indonesia. pp 159–165.
- Widjaja EA. 2001. *Identikit Jenis-jenis Bambu di Jawa*. Puslitbang Biologi-LIPI. Bogor. pp 1–101.
- Widjaja EA, Rahayuningsih Y, Rahajoe JS, Ubaidillah R, Maryanto I, Walojo EB & Semiadi G [editors]. 2014. *Kekinian Keaneekaragaman Hayati Indonesia 2014*. LIPI Press. Jakarta. pp. 1–90.
- Widyatmoko D, Suryana N, Suhatman A & Rustandi B [editors]. 2010. *List of Living Plants Collection Cultivated in Cibodas Botanic Gardens*. Cibodas Botanic Gardens, the Indonesian Institute of Sciences. Cianjur. pp 1–131.