BIODIVERSITAS
Volume 24, Number 8, August 2023
Pages: 4544-4547

ISSN: 1412-033X
E-ISSN: 2085-4722
DOI: 10.13057/biodiv/d240857

Chromosome number of three *Bambusa* species (Poaceae) in northeastern communities of Thailand

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Manuscript received: 6 May 2023. Revision accepted: 30 August 2023.

Abstract. *Saensouk P, Saensouk S, Sudchaleaw S, Sungkaew S. 2023. Chromosome number of three* Bambusa *species (Poaceae) in northeastern communities of Thailand. Biodiversitas 24: 4544-4547. Bambusa* is a genus within subfamily Bambusoideae, family Poaceae. This study aimed to conduct the chromosome numbers of three *Bambusa* species in the northeastern Communities of Thailand. All three *Bambusa* species were studied with somatic chromosome numbers from root tips by squash methods. The somatic chromosome numbers, ploidy, and chromosome size in length from the root tips of three *Bambusa* species are provided. The somatic chromosome numbers range from $2n = 56$ to $2n = 72$. *Bambusa bambos* (L.) Voss was reported as $2n = 56$ with high ploidy (heptaploid or $7x$), *B. burmanica* Gamble was reported to be $2n = 72$ with high ploidy (nonaploid or $9x$), and *B. tuldoides* Munro was investigated to be $2n = 64$ with high ploidy (octaploid or $8x$). The basic chromosome number of three Bambusa species studied was $x=8$. The chromosome numbers of *B. burmanica* were studied for the first time. The chromosome length of all species was very short between 0.80 μm in *B. burmanica* and 1.30 μm in *B. bambos*.

Keywords: *Bambusa*, bamboo, chromosome number, Poaceae, Thailand

INTRODUCTION

Bamboos are interesting plants in their growth, morphogenesis, taxonomy, distribution, ecology, reproduction as well as diversity (Sungkaew and Teerawatananon 2017). Bamboo belonging to the subfamily Bambusoideae of the family Poaceae and is widely distributed in most areas of the world (Sudchaleaw et al. 2023). In addition, most bamboo species are native to warm and moist tropical and to warm temperate climates. It is well-known plant as the tallest grass in the world (Wong et al. 2016). Seventy-five genera and 1,250 species of bamboo in the world were reported by Bamboo Phylogeny Group (2012) and Kumari (2019). Of which, 45 genera and 750 species are distributed in Southeast Asia (Goh et al. 2020; Liu et al. 2020, 2023). While, 13 genera and 60 species are found in Thailand (Sudchaleaw et al. 2023).

Bambusa is a genus within the subfamily Bambusoideae and is distributed from Southeast Asia, South Asia, China, Taiwan, the Himalayas, New Guinea, Melanesia, to the Northern Territory of Australia (Bamboo Phylogeny Group 2012). About 155 species of the genus *Bambusa* were reported in worldwide (Kew Science 2022). Currently, an account of the genus *Bambusa* for the Flora of Thailand is being undertaken with the collaboration of many grass taxonomists (David Simpson, pers. comm.). *Bambusa* is a versatile plant that humans use for life. It is used as food, raw materials, building homes, musical instruments, and even for medicinal purposes (Sungkaew and Teerawatananon 2017; Sudchaleaw et al. 2023). The indigenous knowledge of the use of *Bambusa* has been passed down from generation to generation in the communities, but some have been lost over time due to the social conditions changed and the rural lifestyle was gradually replaced by urban society.

The chromosome number data of Bamboo was studied by some previous workers, such as Mathu et al. (2015). While, only few scientists reported the chromosome numbers of the genus *Bambusa*. The chromosome number of the genus was reported between $2n=48$ in *B. tuldoides* Munro and $2n=108$ in *B. schizostachyoides* (Kurz) Gamble)Darlington and Wylie 1956; Devi and Sharma 1993; Li et al. 2001; Chen et al. 2004).

We collected three *Bambusa* species in the northeastern communities of Thailand to study chromosome numbers. Two *Bambusa* species including *B. bambos* (L.) Voss and *B. burmanica* Gamble were used for food, medicinal plants, and equipment structure. Whereas, *B. tuldoides* was used as an ornamental plant in the communities of northeastern. The morphological characteristics of all three species were difficult to identify. Therefore, the information on chromosome number might support for identification of these three species of *Bambusa*. Therefore, this study aimed to study the chromosome numbers of three species in *Bambusa* from the northeastern communities of Thailand.

MATERIALS AND METHODS

Plant materials

Three species of the genus *Bambusa* (Figure 1) in the northeastern communities of Thailand were collected in natural areas near the deciduous dipterocarp forest and the mix-deciduous forest near the watercourse from different provinces, namely *B. bambos* or "Phai Pa" in Thai local name (Figure 1A), *B. burmanica* or "Phai Bong Wan" in Thai local name (Figure 1B), and *B. tuldoides* or "Phai Namtao" in Thai local name (Figure 1.C). *Bambusa bambos* and *B. burmanica* were reported as native species to Thailand, whereas, *B. tuldoides* was recognized as introduced species (Kew Science 2022). Plant materials were collected in at least five duplicates per bamboo species with a tag recording vernacular names, name of the locality, collecting date, collector name, place of collection, distribution, ecological, and phenology data. Plant materials are deposited at Mahasarakham University Herbarium. They were cultivated in plots planted in the nursery at Mahasarakham University, Maha Sarakham Province, Thailand.

Procedures

Species identification

Plants used in the study were identified according various botanical documents, e.g., Phengkhlai (1972), Chayamarit (1994), Middleton (2009), Inthachub et al.)2010), Chantaranothai (2011), Poopath et al. (2012), Saensouk et al.)2016), Sungkaew and Teerawatananon (2017), Saensouk and Saensouk (2019, 2020), Boonma et al.)2020,2021), Saensouk et al.)2021a,b), and Sudchaleaw et al. (2023).

Chromosome observation

The chromosome numbers of all materials were studied by squash methods (Senavongse et al. 2018; 2020; Saensouk et al. 2019; Saensouk and Saensouk 2021, 2022). Prepared the root tips of three species of the genus *Bambusa* were pretreated with paradichlorobenzene at 4°C for 6 h then fixed in ethanol–acetic acid (3:1, v:v) at room temperature for 30 min. The samples were kept at 4°C in case they were to be used later. The root tips were washed in distilled water, hydrolyzed in 1M HCl for 5 min at 60°C, and washed again in distilled water. They were stained in 2% aceto-orcein and then analyzed by the squash technique. Observations were made under a light microscope (Zeiss Axiostar Plus) at 400x magnification.

Data analysis

The chromosome numbers were derived from the metaphase chromosomes in photomicrographs, obtained from 10 metaphase plates for each species. The chromosome number for description followed by Levan et al. (1964), Senavongse et al. (2018), and Saensouk and Saensouk (2021a,b).

RESULTS AND DISCUSSION

The photomicrographs of the chromosomes of three *Bambusa* species are presented in Figure 2. The somatic chromosome numbers, ploidy, and chromosome length from the root tips of three *Bambusa* species are summarized in Table 1. The somatic chromosome numbers from root tips of *B. bambos* were investigated as $2n=56$. The basic chromosome number of this species was $x=8$. The somatic chromosome numbers of *B. bambos* were investigated highly polyploid taxon as heptaploid ($7x$). Therefore, it is showing the chromosome number $2n=7x=56$ ($x=8$) (Table 1, Figure 2.A). The chromosome length of *B. bambos* was investigated between 0.9 and 1.3 µm (Table 1). The somatic chromosome numbers from root tips of *B. burmanica* were recognized as $2n=72$ but the basic chromosome number of this species was $x=8$. The somatic chromosome numbers of *B. burmanica* were nonaploid ($9x$). Therefore, it is showing the chromosome number $2n=9x=72$ ($x=8$) (Table 1, Figure 2.B).

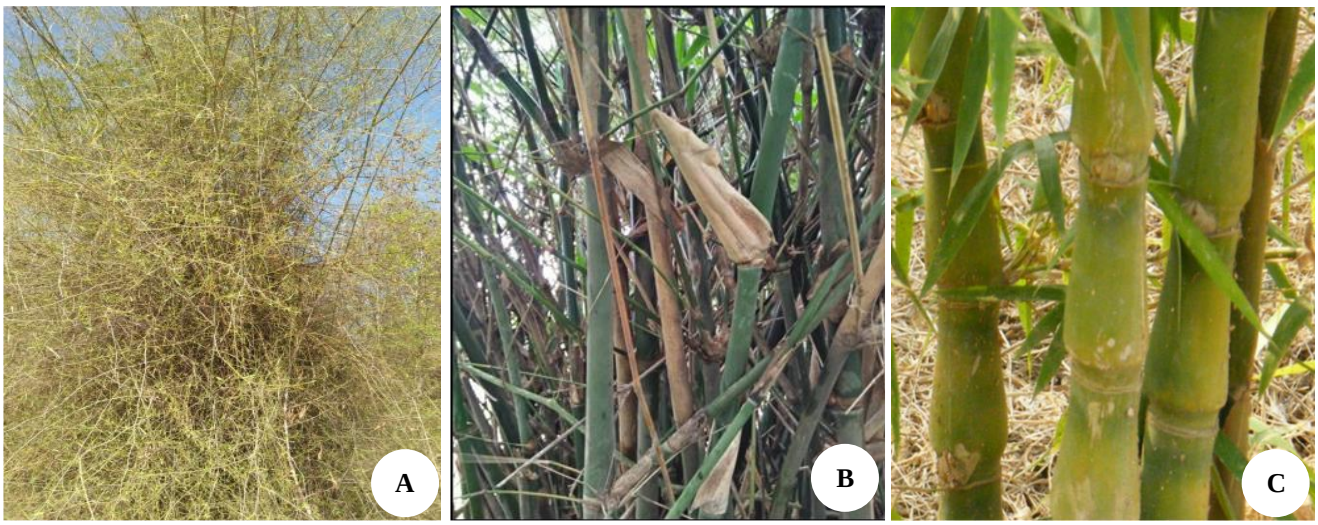

Figure 1. The three *Bambusa* species in the northeastern communities of Thailand used in the study: A. *B. bambos*, B. *B. burmanica*, and C. *B. tuldoides*

The chromosome length of *B. burmanica* was investigated between 0.80 and 1.00 μm (Table 1). The somatic chromosome numbers from root tips of *B. tuldoides* were investigated as 2*n*=64 but the basic chromosome number of this species was *x*=8. The somatic chromosome numbers of *B. tuldoides* were octoploid (8*x*). Therefore, it is showing the chromosome number 2*n*=8*x*=72 (*x*=8) (Table 1, Figure 2.C). The chromosome size in length of *B. tuldoides* was investigated between 0.85 and 1.05 μm (Table 1).

The chromosome numbers of *B. bambos* (2*n*=7*x*=56 (*x*=8)) differ from previous studies by Li et al. (2001), who reported the somatic chromosome numbers of *B. bambos* as 2*n*=64, 68, 70 due to the environmental factors change such as different region, soil, air, weather, moist and may be different nutrients (Saensouk and Saensouk 2021, 2022). Moreover, this study differs from the previously reported chromosome numbers in *B. schizostachyoides* as 2*n*=108)Li et al. 2001(. The somatic chromosome numbers from root tips of *B. burmanica* (2*n*=9*x*=72 (*x*=8)) were the first time reported in the world. The somatic chromosome numbers from root tips of *B. tuldoides* (2*n*=8*x*=72 (*x*=8)) differ from previous studies by Li et al. (2001) and Darlington and Wylie (1956), while Huang et al. (1988) reported the same chromosome number with this study. This result found that the chromosome numbers with highl ploidy (7*x*, 8*x*, 9*x*) and the basic chromosome number or *x* to be 8 of all three *Bambusa* species which agree with previously studied by Mathu et al. (2015) who reported chromosome numbers (2*n* = 72 – 192), the basic chromosome number (*x* to be 12) and the high ploidy (6*x*, 7*x*, 16*x*) from five species of the genus *Pseudoxytenanthera*)Tribe Bambuseae(from India. The chromosomes were very small size in length between 0.90 and 1.30 μm which is the same with previously studied by Mathu et al. (2015) who recognized the chromosome length from 0.50 to 1.20 μm of four species of the genus *Pseudoxytenanthera* from India.

Bambusa bambos, *B. burmanica*, and *B. tuldoides* in this study can be used for species classification by chromosome numbers which is consistent with Stebbins (1971), Chaiyasut (1989), Saenprom et al. (2018), Saensouk and Saensouk (2021, 2022) who reported that the chromosome number can be providing valuable data to understand the relationships of taxa at generic level. Chromosome numbers, the chromosome morphologies, and chromosome structures will be different for taxonomic purposes. However, according to Shaw (1973), the chromosome numbers of different species can have the same number of chromosomes and it cannot used for taxonomic purposes. For this reason, scientists do not use the number of chromosomes to differentiate between species. Further studies using more species will provide a more complete and comprehensive understanding whether the number of chromosomes is useful character as a basis for plant classification, mainly in *Bambusa*.

Table 1. Chromosome number, ploidy, and chromosome size in length of three *Bambusa* species from Thailand studied

Species (Coll. No.)	Locations (Provinces)	Thai Local Name	Chromosome Numbers	*x*	Polyploid*	Chromosome Length (μm)*	Previous Study	
							Chromosome Numbers	Reference
B. bambos (L.) Voss (Samruay 45)	Nong Khai	Phai Pa	2*n*=56	*x*=8	7*x*	0.9-1.3	2*n*=64, 68, 70	Li et al. (2001)
B. burmanica Gamble (Samruay 46)	Khon Kaen	Phai Bong Wan	2*n*=72*	*x*=8	9*x*	0.80-1.00	-	The first report*
B. tuldoides Munro (Samruay 47)	Maha Sarakham	Phai Namtao	2*n*=64	*x*=8	8*x*	0.85-1.05	2*n*=64, 68, 70	Li et al. (2001)
							2*n*=72	Huang et al. (1988)
							2*n*=48	Darlington and Wylie (1956)

Note: * = The first report

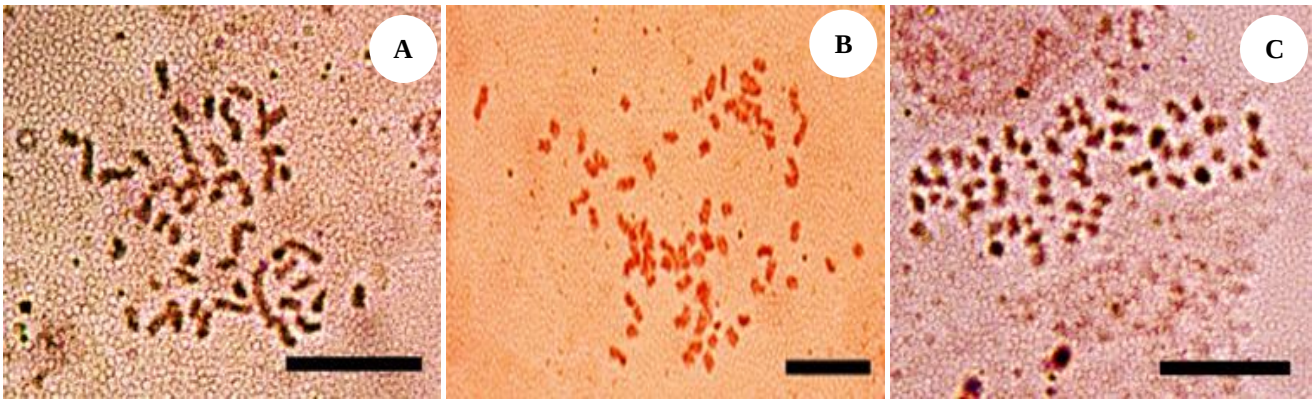

Figure 2. The somatic chromosome numbers of three *Bambusa* species: A. *B. bambos* (2*n* = 56), B. *B. burmanica* (2*n* = 72), C. *B. tuldoides* (2*n* = 64), scale bars = 5 μm

In conclusion, the three species of the genus *Bambusa* (*B. bambos*, *B. burmanica*, *B. tuldoides*) in the northeastern communities of Thailand were collected from Khon Kaen, Maha Sarakham, Nong Khai provinces. The somatic chromosome numbers study from root tips of three *Bambusa* species in this research was studied belonging *B. bambos* (2*n*=7*x*=56), *B. burmanica* (2*n*=9*x*=72), and *B. tuldoides* (2*n*=8*x*=64). The basic chromosome number of these three *Bambusa* species in this study was investigated to be *x*=8. Chromosome number of *B. burmanica* were reported here in the first time. The chromosome length were very short between 0.80 µm in *B. burmanica* and 1.30 µm.

ACKNOWLEDGEMENTS

This work was financially supported by Mahasarakham University, Thailand. We are grateful to Mahasarakham University and Walai Rukhavej Botanical Research Institute, Maha Sarakham Province, Thailand, for their facilities during this study. We would like to thank Dr. Jolyon Dodgson for language editing and suggestions to improve the manuscript.

REFERENCES

Bamboo Phylogeny Group. 2012. An updated tribal and subtribal classification of the bamboos)Poaceae: Bambusoideae(. Bamboo Sci Cult: J Am Bamboo Soc 24)1(: 1-10.

Boonma T, Saensouk S, Saensouk P. 2020. Two new species of *Kaempferia* L.)Zingiberaceae(from Thailand. Taiwania 65)3(: 371-381. DOI: 10.6165/tai.2020.65.371.

Boonma T, Saensouk S, Saensouk P. 2021. *Kaempferia nigrifolia*)Zingiberaceae(, a new species from Central Thailand. Rheedea 31)1(: 11-17. DOI: 10.22244/rheedea.2020.31.01.02.

Chaiyasut K. 1989. Cytogenetics and Cytotaxonomy of the Genus *Zephyranthes*. Department of Botany, Faculty of Science, Chulalongkorn University, Bangkok.

Chantaranothai P. 2011. A revision of the genus *Vitex*)Lamiaceae(in Thailand. Trop Nat Hist 11)2(: 91-118.

Chayamarit K. 1994. Preliminary checklist of the family Anacardiaceae in Thailand. Thai For Bull)Bot(22: 1-25.

Chen R, Li X, Song W, Liang G, Zhang P, Lin R, Zong W, Chen C, Fung H. 2004. Chromosome Atlas of Major Economic Plants Genome in China (Tomus IV): Chromosome Atlas of Various Bamboo Species. Science Press, Beijing.

Darlington CD, Wylie AP. 1956. Chromosome Atlas of Flowering Plants. George Allen and Unwin Ltd., London.

Devi TS, Sharma GJ. 1993. Chromosome numbers in some bamboo species of Manipur. BIC India Bull 3 (1): 16-21.

Goh WL, Sungkaew S, Teerawatananon A, Ohrnberger D, Widjaja AW, Sabu KK, Gopakumar B, Koshy KC, Xia NH, Wong KM. 2020. The phylogenetic position and taxonomic status of the Southeast and South Asian bamboo genera *Neohouzeaua* and *Ochlandra* (Poaceae: Bambusoideae). Phytotaxa 472 (2): 107-122. DOI: 10.11646/phytotaxa.472.2.2

Huang S, Wang Y, Lou Y, Xiao J. 1988. A report on chromosome numbers in Bambusoideae. Forest Res (China) 1 (1): 109-111.

Inthachub P, Vajrodaya S, Duyfjes BEE. 2010. Census of *Stemona*)Stemonaceae(in Thailand. Blumea Biodivers Evol Biogeogr Plants 55)2(: 143-152. DOI: 10.3767/000651910X526717.

Kew Science. 2022. World Checklist of Selected Plant Families (WCSP). http://apps.kew.org/wcsp/

Kumari P. 2019. The Bambusoideae in India: An updated enumeration. Plantae Sci 1)6(: 99-117. DOI: 10.32439/PS.V1I06.99-117.

Levan A, Fredga K, Sandberg AA. 1964. Nomenclature for centromeric position on chromosomes. Hereditas 52: 201-220.

Li XL, Lin RS, Fung HL, Qi ZX, Song WQ, Chen RY. 2001. Chromosome numbers of some caespitose bamboos native in or introduced to China. Acta Phytotax Sin 39 (5): 433-442.

Liu JX, Xu ZC, Zhang YX, Zhou MY, Li DZ. 2023. The identity of Dinochloa species and enumeration of *Melocalamus* (Poaceae: Bambusoideae) in China. Plant Divers 45 (2): 133-146. DOI: 10.1016/j.pld.2022.07.001

Liu JX, Zhou MY, Yang GQ, Zhang YX, Ma PF, Guo C, Vorontsova MS, Li DZ. 2020. ddRAD analyses reveal a credible phylogenetic relationship of the four main genera of *Bambusa-Dendrocalamus-Gigantochloa* complex)Poaceae: Bambusoideae(. Mol Phylogenet Evol 146: 106758. DOI: 10.1016/j.ympev.2020.106758.

Mathu AJ, Mathew PM, Mathew PJ, Harikumar D, Koshy KC. 2015. Cytological Study in *Pseudoxytenanthera*)Tribe Bambuseae(Occurring in India. J Cytol Genet 16: 61-68.

Middleton DJ. 2009. An update on the Apocynaceae in Thailand. Thai For Bull)Bot(37: 143-155.

Phengkhlai C. 1972. The genus *Diospyros* L.)Ebenaceae(in Thailand. Thai For Bull)Bot(6: 1-27.

Poopath M, Sookchaloem D, Santisuk T. 2012. The Dipterocarpaceae of Hala-Bala forest complex, Narathiwat and Yala Provinces, Peninsular Thailand. Thai For Bull)Bot(40: 57-101.

Saenprom K, Saensouk S, Saensouk P, Senakun C. 2018. Karyomorphological analysis of four species of Zingiberaceae from Thailand. Nucleus 61 (2): 111-120. DOI: 10.1007/s13237-018-0235-x

Saensouk P, Saensouk S. 2021. Diversity and cytological studies on the genus Amomum Roxb. former *Elettariopsis* Baker (Zingiberaceae) in Thailand. Biodiversitas 22 (6): 3209-3218. DOI: 10.13057/biodiv/d220624

Saensouk P, Saensouk S. 2022. Karyological study of five species *Boesenbergia* (Zingiberaceae) in Thailand. Cytologia 87 (2): 123-128. DOI: 10.1508/cytologia.87.123.

Saensouk S, Boonma T, Saensouk P. 2021a. Six new species and a new record of *Curcuma* L.)Zingiberaceae(from Thailand. Biodiversitas 22)4(: 1658-1685. DOI: 10.13057/biodiv/d220410.

Saensouk S, Boonma T, Thomudtha A, Thomudtha P, Saensouk P. 2021b. *Curcuma wanenlueanga*)Zingiberaceae(, a new species of subgenus *Curcuma* from Thailand. Biodiversitas 22)7(: 2988-2994. DOI: 10.13057/biodiv/d220752.

Saensouk S, Saensouk P, Pasorn P, Chantaranothai P. 2016. Diversity, traditional uses and new record of Zingiberaceae in Nam Nao National Park, Petchabun Province, Thailand. Agric Nat Resour 50: 445-453. DOI: 10.1016/j.anres.2016.08.002.

Saensouk S, Saensouk P, Senavongse R. 2019. Karyological study in three Thailand species of *Colocasia* (Araceae). Cytologia 84: 179-182. DOI: 10.1508/cytologia.84.179.

Saensouk S, Saensouk P. 2019. *Kaempferia mahasarakhamensis*, a new species from Thailand. Taiwania 64)1(: 39-42. DOI: 10.1007/s13237-020-00318-z.

Saensouk S, Saensouk P. 2020. Comparative leaf surfaces of Orchidaceae species from Thailand. Suranaree J Sci Technol 27)3(: 030032)1-8(.

Senavongse R, Saensouk S, Saensouk P. 2018. Comparative karyotype analysis in five strains of *Colocasia esculenta* (L.) Schott (Araceae) in Thailand. Cytologia 83 (2): 169-173. DOI: 10.1508/cytologia.83.169.

Senavongse, R., Saensouk, S. and Saensouk, P. 2020. Karyological study in three native species of genus *Alocasia* (Araceae) in the northeast of Thailand. Nucleus 63: 81-85. DOI: 10.1007/s13237-019-00278-z.

Shaw MA. 1973. Chromosome Studies. The Whitefriars Press, London.

Stebbins GL. 1971. Chromosomal Evolution in Higher Plants. Addison-Wesley Pub. Co., California.

Sudchaleaw S, Saensouk S, Saensouk P, Sungkaew S. 2023. Species diversity and traditional utilization of bamboos)Poaceae(on the Phu Thai Ethnic Group in northeastern Thailand. Biodiversitas 24 (1): 2261-2271. DOI: 10.13057/biodiv/d240439.

Sungkaew S, Teerawatananon A. 2017. Survey of flood-tolerant bamboos in 2011 flooding in Thailand. Agric Nat Resour 51 (6): 499-503. DOI: 10.1016/j.anres.2018.03.001.

Wong KM, Goh WL, Chokthaweepanich H, Clark LG, Sungkaew S, Widjaja EA, Xia NH. 2016. A subtribal classification of Malesian and Southwest Pacific woody bamboos)Poaceae: Bambusoideae: Bambuseae(informed by morphological and molecular studies. Sandakania 22: 1-36.