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# FLOWERING OF *BAMBUSA TULDOIDES* (POACEAE, BAMBUSOIDEAE, BAMBUSEAE) IN SOUTHERN SOUTH AMERICA

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**Abstract.** Guerreiro, C. I. & M. A. Lizarazu. 2010. Flowering of *Bambusa tuldoides* (Poaceae, Bambusoideae, Bambuseae) in southern South America. *Darwiniana* 48(1): 25-31.

Flowering in bamboo is an unusual event. Documenting flowering individuals or populations provides valuable information about bamboo life cycles. *Bambusa tuldoides* is endemic to China but widely cultivated around the world. In Argentina, the first record of its cultivation dates back to 1943. There are no records of caryopses formation of this species in Argentina. We here report the flowering of a cultivated *B. tuldoides* clump and gather information about previous flowering events for this species in Argentina and neighboring countries occurring in the literature and herbarium collections. With this information, we estimate the flowering cycle of *B. tuldoides* in southernmost America to be approximately 23 years. Viable seed production is reported for the first time in Argentina.

Keywords. Bamboo, flowering period, South America.

**Resumen.** Guerreiro, C. I. & M. A. Lizarazu. 2010. Floración de *Bambusa tuldoides* (Poaceae, Bambusoideae, Bambuseae) en América austral. *Darwiniana* 48(1): 25-31.

La floración de un bambú es un evento particular. El registro de la floración de una mata o una población aporta datos precisos sobre los ciclos biológicos. *Bambusa tuldoides* es una especie endémica de China y está ampliamente cultivada en todo el mundo. En la Argentina, la primera referencia sobre su cultivo es de 1943. No se han registrado fructificaciones de esta especie en la Argentina. Registramos la floración de un ejemplar de *B. tuldoides* en cultivo y recolectamos datos sobre otros eventos de floración de esta especie en la Argentina y países limítrofes. Con esta información, estimamos el ciclo de floración de *B. tuldoides* en América austral en 23 años aproximadamente. Registramos la producción de frutos viables por primera vez en Argentina.

Palabras clave. Bambú, período de floración, Sudamérica.

## INTRODUCTION

Bamboos occur naturally in tropical and temperate regions of Asia, Australia, Africa and the Americas, primarily Central and South America. In North America, they are represented by one genus, *Arundinaria* Michx., with 3 species. No species occur naturally in Europe (Stapleton, 2007a; Franklin, 2008). Their cultivation now is global in extent (Judziewicz et al., 1999).

In Argentina, Chile, Uruguay, southeastern Paraguay and southeastern Brazil, 7 native genera occur: *Apoclada* McClure, *Aulonemia* Goudot, *Chusquea* Kunth, *Guadua* Kunth, *Colanthelia* McClure & E. W. Sm., *Merostachys* Spreng. and *Rhipidocladum* McClure with 20 species approximately (Londoño, 1998; Judziewicz et al., 1999; Morrone et al., 2008). Also, there are several exotic genera such as *Arundinaria* Michx., *Bambusa* Schreb., *Dendrocalamus* Nees and *Phyllostachys* Sieb. & Zucc., and many cultivated species (Rúgolo de Agrasar & Puglia, 2004). Five species of *Bambusa* are registered to be widely cultivated in Argentina: *B. bambos* (L.) Voss, *B. multiplex*

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(Lour.) Raeusch. ex Schult. & Schult. f., *B. tuldoides* Munro, *B. vulgaris* var. *vulgaris* Schrad. ex Wendl. and *B. vulgaris* cv. *vittata* A. & C. Rivière (Rúgolo de Agrasar & Puglia, 2004), although some other cultivated species might be present, they have not been properly recorded yet.

The first record of the cultivation of *Bambusa tuldoides* Munro in Argentina was by Parodi (1943), for Buenos Aires, Jujuy and San Juan Provinces and the neighboring countries: Brazil, Chile and Uruguay. He described vegetative and flowering specimens, but noted the absence of data on the production of viable fruits. Furthermore, Burkart (1969), who reported this species additionally for Entre Ríos Province, reported the absence of records for caryopses formation of this species in Argentina.

*Bambusa tuldoides* is native to China, has spread all over Southeastern Asia and is widely cultivated in tropical and subtropical regions of America. In Argentina, it is found in the Northwest and Northeast down to the Paraná River Delta where apparently it has become naturalized (Parodi, 1943).

Flowering in woody bamboos historically has been of great interest to biologists. Woody bamboos will flower cyclically. Monocarpic flowering of bamboo is considered a genetic characteristic since an entire stand flowers gregariously and simultaneously (Janzen, 1976). Gregarious flowering of bamboo can have a profound effect on the environment since most of the species die soon after flowering. The flowering cycle of the woody bamboos varies a great deal, from 3 to 120 year intervals (Janzen, 1976).

Certain environmental characteristics such as temperature, light quality, photoperiod, etc. are well-known stimuli for the flowering process in most plant species (Ramanayake, 2006). However, in most bamboo species, factors triggering flowering are unknown. Many explanations have been proposed but none has proved consistent. Flowering has been related to extreme climatic events like droughts and floods concerning El Niño Southern Oscillation (Campbell, 1986; Widmer, 1998; Williamson, 2002). Also, depletion of nourishments, natural fire cycle and genetic factors have been proposed as possible explanations (Janzen, 1976; Keeley & Bond, 1999; Ramanayake, 2006).

Any record of a bamboo flowering event, being an individual clump or at a populational level, provides valuable information about bamboo life cycles. Populations from different parts of the range of a species may flower at different times although the actual cycle length may be more or less constant. Regarding this, we recorded the flowering of a cultivated clump of *Bambusa tuldoides* Munro and performed a phenological analysis in order to determine the flowering period of this species in southernmost America.

## MATERIALS AND METHODS

Due to a communication about a flowering event of a *Bambusa tuldoides* stand cultivated in San Isidro, Buenos Aires Province, Argentina, we recorded measurements and information on the stand, culms, nodes, internodes, branching pattern, flowering branches and inflorescences.

The phenological analysis consisted in gathering information from the literature and herbarium collections about other flowering events of *B. tuldoides* recorded in Argentina and neighboring countries. We visited the following herbaria: BA, BAA, BAB, CTES, K, P and SI (Holmgren et al., 1990). We determined the flowering period of *B. tuldoides* using this information and following the methodology proposed by Kawamura (1927) which consists of taking the intervals between the recorded flowering events and finding a repeated multiple. When working with historical data, lack of complete chronological records is usually found. So, when this is the case and different intervals are found, the method suggests reducing them to a repeated multiple.

A thorough description of *Bambusa tuldoides*, its distribution and ecology can be found in Nianhe et al. (2006). An illustration of this species is presented in Fig. 1.

### Specimens examined

ARGENTINA. **Capital Federal.** Jardín Botánico, Facultad de Agronomía, Universidad de Buenos Aires, II-1960 (fl), *Cámara Hernández s. n.* (BAA 2838); XI-1962 (fl), *Burkart 23911* (SI); X-1967 (fl), *Cámara Hernández s. n.* (BAA 6233); X-1979 (fl), *Valla s. n.* (BAA 17068); II-2003 (fl),


**Fig. 1.** *Bambusa tuldoides*. **A,** flowering branch. **B,** detail of flowering branch base. **C,** culm sheath, distal portion showing blade, ligule and auricles. **D,** foliage leaf ligular area. **E,** pseudo-spikelet, distal part. **F,** palea, dorsal view. **G, H,** anterior lodicules. **I,** posterior lodicule. **J,** gynoecium. **K,** stamen. From *Rúgolo 2302* (SI).

*Valla s. n.* (BAA 25072); XII-2009 (fl), *Guerreiro 1* (SI); Jardín Botánico Municipal, XII-1917 (fl), *Clos 830* (BAB); IX-1960 (fl), *Buceta s.n.* (BAB); Jardín Zoológico, next to the lake, I-1947 (fl), *Dimitri & Martínez Crovetto s.n.* (BAB 67937). **Buenos Aires.** Partido de Avellaneda, Villa Domínico, cultivated in CEAMSE park, III-2007 (fl), *Rúgolo 2302* (SI); Partido de La Plata, La Plata, II-1928 (fl), *Parodi 8219* (BAA); Isla Martín García, in front of Governor's residence, X-2009 (fl), *Peña s.n.* (SI); Partido de Lomas de Zamora, Lomas de Zamora, X-1937 (fl), *Parodi 14433* (BAA); Partido de San Isidro, Martínez, cultivated in a park, X-1943 (fl), *Clos & Dimitri s.n.* (BAB 65449), San Isidro, cultivated for 20 years in H. Bentel's private garden, III-2009 (fl), *Rúgolo 2328* (SI). Partido de Tigre, Islas del Tigre, XI-1905 (fl), *Hauman s. n.* (BAA 10155). **Jujuy.** Depto. Ledesma, Calilegua, cultivated in the hotel's garden, V-1942 (fl), *Hunziker 1550* (SI); Establecimiento Leach, III-1943 (fl), *Hunziker 2510* (BAA); Depto. San Pedro, El Quemado, cultivated in fences, II-1943 (fl), *Parodi 14591* (BAA); Ingenio La Esperanza, X-1938 (fl), *Eyerdam & Beetle 22554* (K); XI-1974 (fl), *Burkart 30397* (SI). **Misiones**. Depto. L. N. Alem, 7.5 km E of L. N. Alem, I-1989 (fl), *Maruñak 667* (CTES, K). **San Juan**. Depto. Capital, Desamparados, XII-1939 (fl), *Carrizo s.n.* (BAA).

BRAZIL. **Distrito Federal.** Brasilia, XI-1907 (fl), *SC s.n.* (K). **Espírito Santo.** Muqui, IV-1972 (fl), *Soderstrom & Sucre 1959* (K). **Rio de Janeiro.** Rio de Janeiro, X-1868 (fl), *Glaziou 2832* (P); VIII-1980 (fl), *Da Rocha 152* (K); Jardim Botânico, II-1978 (fl), *Soderstrom 2253* (K). **Rio Grande Do Sul.** Porto Alegre, II-1941 (fl), *Leal 13916* (BAA). **São Paulo.** São Paulo, Jardim Botânico, V-1907 (fl), *Barbosa 720* (K); M´Boi, XII-1947 (fl), *Brandao Joly s.n.* (BAB).

CHILE. **Región Metropolitana de Santiago.** Santiago de Chile, Quinta Normal, II-1939 (fl), *Parodi 13241* (BAA). **V Región de Valparaíso.** Valparaíso, I-1966 (fl), *Meyer 9722* (K).

PARAGUAY. **Guairá.** 17 km. N of Villarica, IV-1992 (fl), *Morrone & Pensiero 317* (SI).

URUGUAY. **Colonia.** Miguelete, X-1933 (fl), *Herter 1746* (SI); V-1934 (fl), *Rosa Mato 442* (BAA). **Montevideo.** Montevideo, Jardín Botánico, VII-1941 (fl), *Lombardo 14390* (BAA).

From literature (Filgueiras & Castro de Silva, 2007).

BRAZIL. **Distrito Federal.** Brasilia, IBGE Nature Reserve, 2005 (fl), *Filgueiras 3666* (IBGE). **Goiás.** Santa Teresinha, 2005 (fl), *Filgueiras & Silva s.n.* (UB); Turvânia, 2005 (fl), *Filgueiras & Silva 36700* (UB). **Minas Gerais.** Paraopeba, 1954 (fl), *Heringer 3612* (UB). **São Paulo.** Campinas, 1984 (fl), *Aranha s.n.* (IAC 25237; UB).

## RESULTS

The recent flowering of a *Bambusa tuldoides* clump cultivated in San Isidro, Buenos Aires Province was communicated to us by the owner of this clump. The specimen, numbered *Rúgolo 2328* (SI), was cultivated in a private property for 20 years before it started flowering. The *B. tuldoides* clump is 10 m high and has a diameter of 1.60 m. It possesses green, smooth, round, hollow culms of 3 cm in diameter and the culm walls are 3 mm thick. Nodes are parallel and smooth. Culm sheaths are deciduous, scarcely pilose abaxially, the blade is erect and it has round pilose auricles. Branches are in most of the nodes, leafless flowering branches are located from base upwards.

It flowered from October 2008 until April 2009. Flowering branches died after a few weeks but the clump remained in good condition. Caryopses were collected and illustrated (Fig. 2). In the same garden where the clump was cultivated, we could confirm the presence of seedlings of *B. tuldoides* grown from seeds produced by the flowering clump (Fig. 3). Thus, viable seed production occurred.

There are 23 records of *Bambusa tuldoides* flowering events in Argentina according to herbarium collections, there are 19 records in neighboring countries (Brazil, Chile, Paraguay and Uruguay) from both examined material and review of the literature. According to the methodology proposed by Kawamura (1927), we calculated flowering intervals of 43, 26, 23, 22 and 24 years. The first interval can also be thought as two intervals of 21.5 years when considering that another unre-

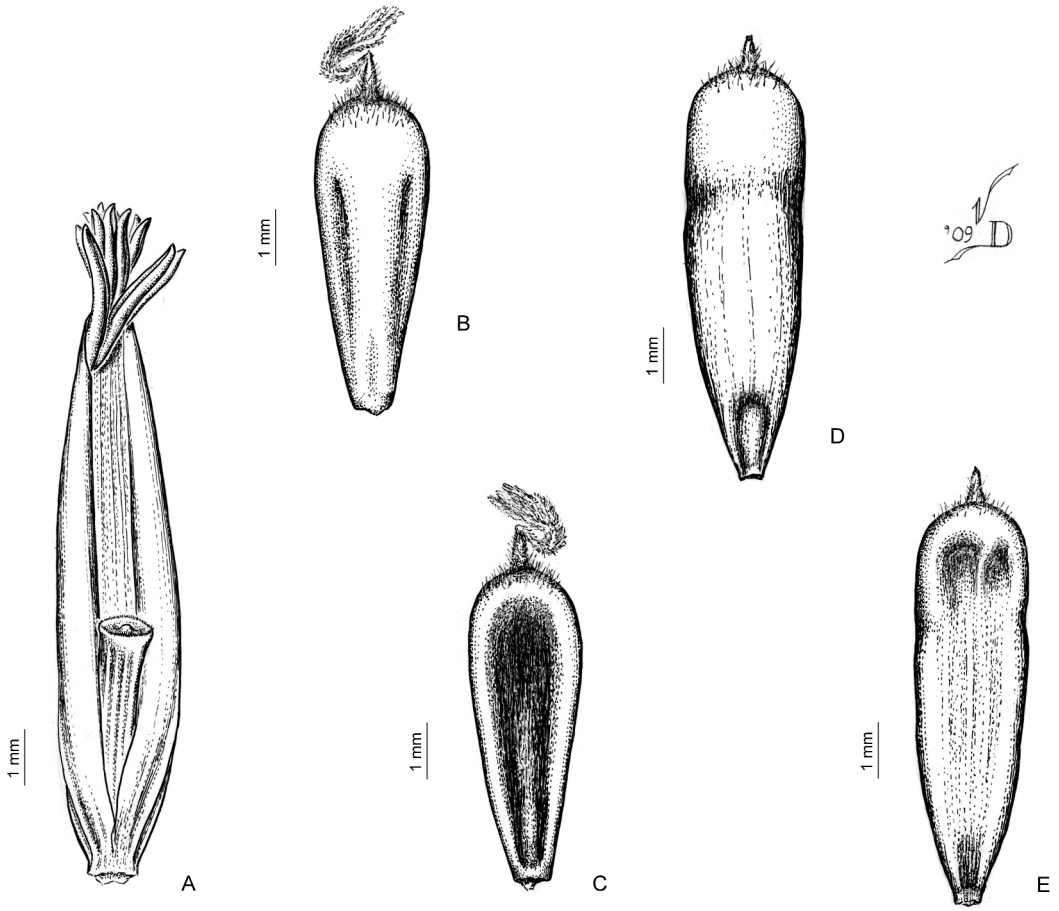


**Fig. 2.** *Bambusa tuldoides* caryopses and anthecium. **A,** anthecium in anthesis, showing rachilla internode and stamens. **B,** immature caryopses, dorsal view. **C,** immature caryopses, ventral view. **D,** mature fruit, dorsal view. **E,** mature fruit, ventral view. From *Rúgolo 2328* (SI).

corded flowering event of *B. tuldoides* might have occurred. Therefore, we estimated the flowering cycle of *B. tuldoides* in southernmost America to be 23 years approximately (Fig. 4).

## DISCUSSION

In this work we estimate the flowering interval of *Bambusa tuldoides* in southernmost America to be about 23 years. According to Parodi (1943) and Burkart (1969) fructification of *B. tuldoides* has never been recorded for Argentina. Thus, the confirmation of the production of viable seeds of this species in this work is the first record for it for Argentina. Also, viable seed production of *B. tuldoides* has recently been recorded for the first time for Brazil (Filgueiras & Castro de Silva, 2007).

On the basis of their flowering behavior, there are three groups of bamboos defined: those that flower annually or nearly so; those that flower gregariously and periodically; and those that flower irregularly (McClure, 1966; Judziewicz et al., 1999). However, plants of a given species may show diverse flowering behavior under different environmental conditions. Regarding *B. tuldoides*, McClure (1966) points out observations in southern China and Honduras showing different fates of the flowering clump. In the first case, death of the plant usually follows promptly upon flowering and very few seeds are produced. In contrast, cultivated plants of *B. tuldoides* in Honduras have shown culms in a flowering state for more than 40 years,

**Fig. 3.** *Bambusa tuldoides* seedling growing in the same garden as the flowering clump.

with no apparent diminution of their vegetative vigor and no record of any of the plants having either produced fruits or died. Some species of bamboos are facultatively monocarpic, that is they may or may not die after blooming (Judziewicz et al., 1999). This seems to be the case of *B. tuldoides*.

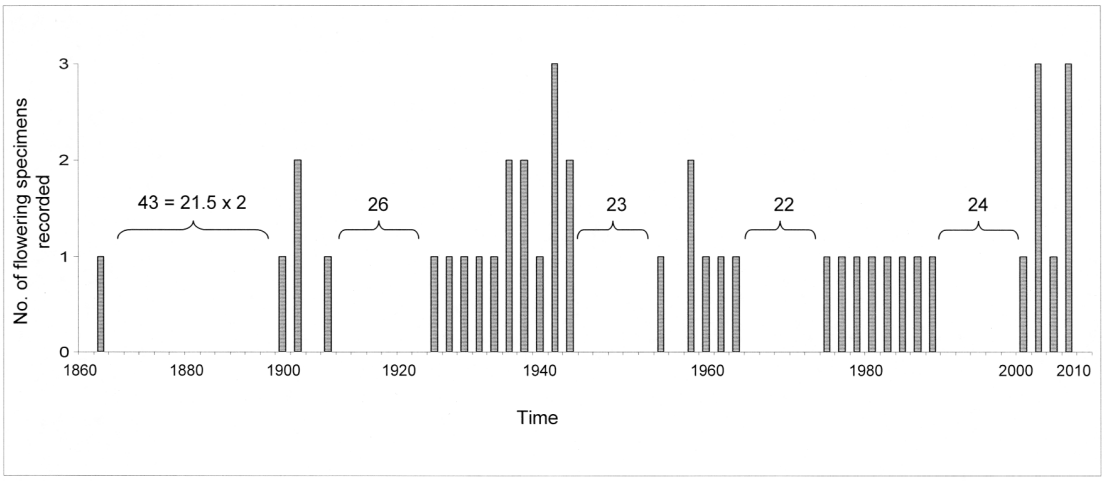


**Fig. 4.** Number of flowering specimens of *Bambusa tuldoides* recorded per year in southernmost America showing flowering intervals.

Wherever man has come into contact with bamboo, he has found multiple uses for it. In the case of *Bambusa tuldoides*, its culms have been used in construction, scaffolding, tool handles, furniture and crafts. It is also used to make hats, ropes and baskets, its shoots are edible (Watson & Dallwitz, 1992; Rúgolo de Agrasar & Puglia, 2004; Stapleton, 2007b). As an ornamental, it is mainly used as a barrier to wind or soil erosion especially when planted along river banks. In Chinese traditional medicine, an extract of the culm cortex is used to treat fever or epilepsy in children, among other disorders. The culms of the flowering *B. tuldoides* clump reported here were used to construct a bicycle. In Argentina and neighboring countries, this bamboo species could represent a greater economic value if its cultivation was promoted and its applications were widely communicated.

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