

Flowering in *Dendrocalamus hamiltonii* Nees & Arn. and *Schizostachyum dullooa* (Gamble & Majumdar) in Chittagong, Bangladesh

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Abstract

Dendrocalamus hamiltonii and *Schizostachyum dullooa* are the two important threatened bamboo species of Bangladesh. They flowered gregariously during 1996 to 1998 and 1999 at the bambusetum of Bangladesh Forest Research Institute, Chittagong and Rangapani Tea Estate, Hazarikhil, Chittagong respectively. The flowering cycles for *D. hamiltonii* were estimated as 43 ± 5 years and for *S. dullooa* as 45 ± 2 , 35 ± 2 and 15 ± 2 years. Observations were made on flowering nature, death and seed characters of these species. The germination and seedling characters were also recorded. Plantations of both the species were raised with seedlings by the Forest Department and the NGOs. In future these will be used as *ex situ* conservation plots.

সারসংক্ষেপ

পেচাঁ ও ডলু জাতের বাঁশ দু'টি বাংলাদেশের বিলুপ্তিপ্রায় প্রজাতি হিসাবে গণ্য। প্রজাতি দু'টিতে বাংলাদেশ বন গবেষণা ইনস্টিটিউট, চট্টগ্রামে এবং হাজারীখিলের রাঙ্গাপানি চা বাগানে যথাক্রমে ১৯৯৬-১৯৯৮ এবং ১৯৯৯ সনে ব্যাপকভাবে ফুল ফোটে। পেচাঁ এবং ডলু বাঁশের বীজ চক্রকাল যথাক্রমে আনুমানিক 43 ± 5 বছর এবং 45 ± 2 , 35 ± 2 ও 15 ± 2 বছর বলে হিসাব করা হয়েছে। বর্ণিত দু'টি বাঁশ প্রজাতির ঝাড়ে ফুল ফোটার প্রকৃতিসহ ঝাড়ের মৃত্যু এবং বীজের অবয়বের উপর পর্যবেক্ষণ করা হয়। বীজের অঙ্কুরোদগম ও চারা সঞ্চয় আলোচনা করা হয়েছে। প্রজাতি দু'টির চারা রোপণ করে বন বিভাগ ও বেসরকারী পর্যায়ে বাগান উত্তোলন করা হয়েছে -যা ভবিষ্যতে কঙ্জারভেশন প্লট হিসাবে ব্যবহার করা যাবে।

Key words : *Dendrocalamus hamiltonii*, *ex situ* conservation, flowering cycle, *Schizostachyum dullooa*, seed germination, seedling

Introduction

Dendrocalamus hamiltonii Nees & Arn. and *Schizostachyum dullooa* (Gamble & Majumdar) are the two important bamboo species growing naturally in the hilly semi-evergreen to evergreen forests of Bangladesh. Their distributions were restricted to upland areas with moist fertile soil. The local Bangla name of *D. hamiltonii* is *Pecha bans* and that of *S. dullooa* is *Dalu bans*.

Pecha bans is used for walling, construction, basket making, mats, water and milk containers. Large branches are used for weaving material and leaves are used as fodder. Sometimes they are used as fuel and floats for timber rafts, and their shoots are edible. Sheaths are used for making hats. The rhizome with slight trimming and dressing becomes an exact replica of a rhinoceros horn.

Dalu bans are used as umbrella sticks, and for making mats, baskets and novelty items. Such products are shiny, light and have good export market in Europe. Tribal people use the long hollow internode for carrying water in hilly terrain.

Both the species are light demanding early successional species, the former being more relatively shade tolerant. They prefer shade and are not available on drier, open and scrubby hills. The present destruction of forests has decreased the crown cover, and the lands become mostly exposed creating unfavourable conditions for these species. There are specimens of *S. dullooa* in Kew Herbarium, collected by Hooker around 1880's from Sitakunda Hill near Chittagong (Gamble 1896). But at present, one can seldom find a clump of the species in the area. Similar situation also exists in different forests of Bangladesh. Both the species are very much susceptible to biotic interference. Based on leaf characteristics Rao and Ramakrishnan (1988) described *S. dullooa* as *periodic growth-evergreen type* whereas *D. hamiltonii* a *periodic growth-deciduous type*. Due to the destruction of both semi-evergreen and semi-deciduous

natural forest habitats, *D. hamiltonii* and *S. dullooa* have now become **threatened bamboo species** in Bangladesh (Banik 1992, 1994). As regards reproductive behaviour both the bamboo species have gregarious flowering habit, and their clumps die after flowering. During 1997-1999, *D. hamiltonii* and *S. dullooa* flowered in some parts of Chittagong followed by the death of all the clumps. This has created an alarming situation for these two threatened bamboo species.

Therefore it was felt necessary to estimate the interseeding period of both the species which would help understand their natural regeneration after flowering. Studies were also undertaken on seed character, germination and seedling management for facilitating the artificial regeneration.

Materials and methods

There were two clumps of *D. hamiltonii* growing at the bambusetum of Bangladesh Forest Research Institute (BFRI), Chittagong. The clumps were raised in 1978 through planting offsets collected from the Patharia reserve, Sagornal block of Sylhet forest. Both the clumps of *D. hamiltonii* flowered during 1996 to 1998. Many clumps of *S. dullooa* growing naturally at Rangapani Tea Estate, Hazarikhil flowered gregariously in 1999.

Estimation of flowering cycle: Flowering dates of *D. hamiltonii* and *S. dullooa* species were collected from existing literatures. Occurrence of flowering during the last 20 years in Bangladesh was also recorded. Tabulating the consecutive flowering dates of each of these two species, the flowering interval/cycle was calculated.

Seed morphology and germination: Bamboo fruit is one seeded which is known as *caryopsis*. However, the term "seed" will be used instead of *caryopsis* as foresters commonly use the word. Seeds were collected and brought to the nursery bed of Bangladesh Forest Research Institute, Chittagong. At first seeds were qualitatively described. In each species, the measurements for size including length, width, breadth and

diameter were recorded from 50 samples randomly drawn from the collected stock. As the pericarp and the seed coat were fused, it was not possible to separate the seed from the fruit cover without any injury. However, the measurements were made with glumed (covered with glumes) and deglumed (glume removed) seeds. Glumed seeds of these bamboo species were separated from debris and empty seeds by floating in water. Floated materials were thrown away and the seeds which sank were used in the studies.

Germination tests : At the beginning, both glumed and deglumed seeds were sown in nursery bed. Germination response from broadcasting glumed seeds in nursery beds was studied. Germination trials were made during the months of March and June. The average climatic conditions in the nursery during that time of the year were : maximum daily temperature 31.1-29.8°C, minimum temperature 22.8-23.4°C, relative humidity 64.7-68.6%, and montly total rainfall 278.0-800.0 mm.

Observations and discussions

A) *Dendrocalamus hamiltonii*

Flowering nature : During October - December 1996 all the two clumps growing at BFRI bambusetum produced 0.5-2.5 m long leafless pendulous floral shoots, sometimes much branched, and nodes were covered with boat shaped sheaths. When floral shoot is branched it is usually long, up to 5.0 m. Floral shoots, at the beginning, develop directly on the younger culm nodes and as well as from the leafy branches. The internodes (rachies-joints) on floral shoots are 2-7 cm long, scabrous and white pruinose especially below the swollen nodes, furrowed on one side.

These floral shoots start dislodging the nodal sheaths gradually from the base to the tip. But the buds on each node of floral shoot starts producing pseudospikelets from the tip to the base bearing half-verticillate semi-globular heads (inflorescence) of flowers with reddish purple anthers. Each inflorescence contained 45-139 spikelets. Spikelets are fertile having 4-7 florets

per spikelet; stamens are 12-14 mm long, exerted, pendulous with white filaments; anther is 5-7 mm, 4-lobed, tip acuminate, pollen smooth; stigma trifold-plumose exerted.

First blooming starts from the upper part of culms at the end of December and continues through the next calendar year till the whole clump completes flowering. Almost all the culm tips (irrespective of young and old culm) flowered within first week of February during which leaves were also shedded off. Anthesis started in the morning at about 10 a. m, and pollen grains were usually discharged in the form of cloud after shaking. Blooming is not continuous, rather occurs in successive flushes (flush periods) with non-blooming (rest periods) periods in between. The seeds matured at the end of February (about 55-60 days after blooming) and attained milky stage during January to first week of February (i. e. in about 30-40 days). Squirrels and birds were found to eat softer part of the inflorescence and milky to mature seeds respectively; thus they might have a role on pollination and seed dispersal. Five new culms emerged during June to September from the clump that started flowering in November-December.

Estimated flowering cycle : This bamboo species often flowers sporadically almost every year (Rogers 1900). The species may also flower gregariously. Clumps flowered gregariously in Cachar, Assam (India) in 1912 and again in 1956 after 44 years of interval (Table 1). In 1996 - 97 clumps started flowering in Patharia reserves of Sylhet forest bordering Indian Cachar area of Assam after 43 ± 5 years of interval. Two clumps at BFRI bambusetum also started flowering in November 1996, continued for 5 months and completed within April 1997.

It is also reported that the species flowered after a long 98 ± 2 years interval in Sikkim and Dehra Dun in 1894 and again in 1992. However, the species in Sikkim and Dehra Dun might have flowered after 45 years during 1940s and may remained unnoticed or unreported.

Table 1. Past flowering records and estimated flowering cycle in *Dendrocalamus hamiltonii*.

Country/locality	Flowering date (calendar year)	Estimated flowering cycle (year)	References
India <i>Sikkim, Dehra Dun</i> <i>Dehra Dun</i>	1894 1992 (gregarious)	98 ± 2 (1894 - 1992)	Gamble (1896) Tewari (1992)
<i>Darjeeling</i>	1900	Continuous flowering	Rogers (1900)
<i>Central Province</i>	1901 (2849 ha flowered gregariously)	-	Smythies (1901)
<i>Assam</i> Lakhimpur Cachar hills	1905 1912 1955,56	44 (1912-1955,56)	Cavendish (1905) Nath (1959)
<i>Arunachal Pradesh</i> Western Kameng Kameng Siang Subansiri Siang & Papum Pare	1983 - 84 1990 1994 1993 - 94 1994 - 95	90 ± 10 (1894-1983, 84,90,93, 94,95)	Anon. (1996)
Bangladesh <i>Chittagong</i> BFRI bambusetum (clump source Patharia reserve, Sylhet, near Cachar hills)	1997 - 1998	43 ± 5 (1955,56 - 1997,98)	Author (present observation)

Seeds, seed germination and seedling character : Seeds are broadly ovoid and rounded at the base, each 10 g containing 264 glumed seeds or 277 deglumed seeds. The weight of 100 glumed and deglumed seeds are 4.50 and 3.45 gm respectively. Seed germination starts within 3-10 days of sowing with 80-85% germination of fresh seeds. Deglumed seed loses viability within 16 days of sowing, whereas glumed seed remains viable up to 25 days.

Seedlings are grass-like and starts forming a miniature clump by producing many shoots within 40-50 days.

B) *Schizostachyum dullooa*

Flowering nature: On 24th April 1999 while I was visiting the old biodiversity plantation plot at Hazarikhil field station of Silvicultural Research Division of the BFRI, I heard from the forester/mali about the flowering of several clumps of a bamboo species in the nearby forest. I visited the area and identified the species as *Schizostachyum dullooa*. Earlier, during the first week of April Dr. M. K. Alam of BFRI had also informed me about the incidence of flowering in bamboos growing in Hazarikhil forest area. I observed that a hundred of clumps growing by the side of hill slope on the bank of a hilly stream

flowered gregariously inside the 12th block of Rangapani Tea Estate. It was learnt from the local people that the clumps of *S. dullooa* started flowering during February 1999. During April, when I visited, all the clumps were on complete bloom, and each clump was looking as a giant inflorescence without any green leaf. During this time some seeds were found in milky stage. The inflorescence is a panicle of spiciform branches bearing verticils of few spikelets. The *spikelets* are 1-2.5 cm long, softly pubescent, glumes hairy and 8-10 reeved. Each floret had six stamens, monadelphous in nature with 7-9 mm long *anthers.*, stigma 3, short, red, *Ovary* elongate.

Estimated flowering cycle : The past records reveal that flowering in this bamboo species is mostly sporadic and occasionally gregarious. Estimated flowering cycles are 45 ± 2 , 35 ± 2 and 15 ± 2 years (Table 2).

Seeds, seed germination and seedling character : The seeds are small, elongated

grain-like, somewhat broader and flat base with cylindrical top terminating in a long beak formed by the persistent base of the style. Seeds are covered with glabrous glumes. The length of glumed seed (grain part) is 1.0 - 1.9 cm and that of persistent style is 1.1 - 1.7 cm. The breadth and width of basal part is 0.14 - 0.19 cm and 0.18 - 0.26 cm respectively. The ripe deglumed seeds are blackish brown. The weight of hundred glumed seeds and deglumed seeds are 3.03 gm and 2.51 gm respectively. On an average, 10.0 gm contains 406 glumed seeds. Both the seeds and wild seedlings were collected several times from the flowering site during June and July 1999. Fresh seed germinated within 3-7 days of sowing, and germination rate varied from 60 - 70% .

A germinating seedling was grass-like. The wild seedlings, 4 - 6 leaves stage, were collected. These were planted in a nursery bed (soil 3 : cowdung 1) within 1-2 days of collection, and regular watering was maintained. The survival

Table 2. Past flowering records and estimated cycle in *Schizostachyum dullooa*.

Country/locality	Flowering date (calendar year)	Estimated flowering cycle (year)	References
India Assam Cachar, Mizo hill	1951-53 1962 (Gregarious) 1967-68	14 - 17 (1951, 53 - 1967, 68)	Gupta (1972) Nath (1962) Gupta (1972)
Bangladesh Chittagong Hill Tract Rangamati	1880 1927	44 (1880-1927)	Gamble (1896) Trevor (1927)
Kassalong Reserve	1974	47 (1927-1974)	Hasan (1973)
Shishak	1990 (Sporadic)		Banik (1991)
Chittagong Hazarikhil (Rangapani Tea Estate)	1999 (Gregarious)	37 (1962 - 1999)	Author (present observation)

percentage was 30 to 70, and it was mostly dependent on collection, damage of the seedlings and care at the nursery. The internodes of seedling culm are long like those of adult plant. Culm sheaths are pale green.

Seedling plantation of *D. hamiltonii* and *S. dullooa* : About 7000 seedlings of *D. hamiltonii* and 5000 seedlings of *S. dullooa* were raised and maintained at the Silviculture Genetics Nursery of

BFRI. Seedlings of both the species, 12 to 15 months of age, were later planted at the BFRI bambusetum. During 1997 - 1999, about 6200 seedlings of *D. hamiltonii* were distributed to the Cox's Bazar Ganosasthaya Kendra, Dhaka Forest Division and a Tea Estate of Bangladesh. Till July 2000, approximately 4600 seedlings of *S. dullooa* were distributed to the Sylhet and Chittagong Forest Division and some tribal farmers of Bandarban Hill district for *ex situ* conservation plantations.

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