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Flowering of *Bambusa cacharensis* Mazumder in the southern part of North-East India: a case study

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Abstract—Flowering in angiosperms is a phenomenon through which the subsequent generation is continued. Some members of the family Poaceae have the suicidal habit, where the parent plants die after flowering. Bamboos, a member of the sub-family Bambusoideae of Poaceae exhibit similar characteristics. *Bambusa cacharensis*, a species endemic to North-East India, has flowered without producing any viable seeds. Pollen grains studied for their sterility and viability had shown that more than 70% were found to be fertile and viable. A short gynoecium and the unsticky nature of the stigma resulted in failure of fertilization and production of seeds. This natural phenomenon of failure in fertilization has contributed to a reduction of the resource. The destroying of the clumps by the inhabitants of the region has further accelerated this reduction and is contributing to the extinction of the species.

Key words: *Bambusa cacharensis*; flowering; endangered species; gynoecium.

INTRODUCTION

Bamboo has the peculiarity of flowering and seeding at the end of a very long vegetative growth phase, the length of which is considered to be species specific [1]. Flowering in bamboo is periodic or annual, and gregarious, sporadic or both. According to this mode of flowering, bamboos are also been classified as: (1) those which flower annually or nearly so, and do not die after flowering, (2) those which flower gregariously and periodically on a cycle of 25–60 years, in which case the culms and their underground rhizomes die after ripening of seed, and (3) irregularly flowering species in which one or few culms in one clump and all clumps in a particular locality or area are covered with flowers simultaneously [1]. It is known

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that gregarious flowering is usually followed by the death of clumps. It is also noticed that, in many cases, the bamboo clumps do not die after sporadic flowering. The gregarious flowering proceeds from one end of the forest to another in waves. In gregarious flowering, all members of a cohort (plants from seeds of common origin) enter the reproductive phase approximately at the same time, and after flowering and seeding the parents die *en masse* [1, 2]. This death of the bamboo parents used to be given more importance, probably because of their long intermediate periods and arborescent habits, which is a characteristic of the grass family [3].

Bambusa cacharensis is the bamboo species endemic to the southern part of North-East India, locally known as *Betu* by Manipuri and Bengali communities. It was described by Mazumder in *Bulletin of Botanical Survey of India* in 1983, and in *Flowering Plants of India* (1990) by Naithani. To date there has been no report on its flowering and regeneration status. This unique bamboo species is distributed abundantly within the Brahmaputra and Barak valley of Assam of North East India between 91°40′–94°24′ E longitude and 24°00′–26°40′ N latitude, having an altitudinal variation from 30 m to 250 m above mean sea level. It will be worth noting here that not a single home garden in the region could be located without a clump or clumps of *Bambusa cacharensis*. It is also being cultivated at a few research stations or institutes in other parts of India, like Kerala, Dehradun, Arunachal Pradesh and Tripura. Adaptability to different agro-climatic conditions, durable culm quality, high pulping quality, high biomass productivity with quick recovery of clumps after felling made it the most selected bamboo species in the region. This bamboo species covers an area of about 30% of the total cultivatable land area of the home gardens of Southern Assam. In addition to its multipurpose mode of application (shown in Table 1), it also produces edible young shoots that comprise an important component of the traditional delicious dishes of several tribal communities of North-eastern Himalayan region. New shoots generally come out at the beginning of June and remain available till the end of August. Mature culms of this bamboo species are especially used for long-term preservation of dry processed fish and as house poles.

The bloom of *Bambusa cacharensis* in its native place, i.e. the Cachar District of Assam, India, has been traced back to have initiated some 8–10 years ago, and it is a reason for deep concern (Fig. 1). Bloom starts at the onset of the winter season and completes its pollination and fertilization phase before the onset of the rainy season (i.e. October to April). Recently, it has been observed that more than 30% of the individuals in a clump and 10–25% of the clumps in 250 random sampled villages of the region were in full bloom without any seed set. The flower arose in the branchlets of culms irrespective of their age, leaving the plant naked with continuous leaf shed even during the moist season (Fig. 2). In normal years, several new shoots are formed from each rhizome but, in the year of flowering, no new shoots are produced, nor do shoots already formed produce new leaves; rather the shoots gradually changes colour to brown and die off.

Table 1.
Summary of applications of *Bambusa cacharensis*

SI No.	Part of the bamboo used	Uses	Tribes/Communities accessing the resource
1	Young shoot	a. Pickle	Khasi, Garo, Riang, Naga, Nepali
		b. Fermented	Manipur, Khasi, Nepali, Naga
		c. Boiled vegetable	All the communities/tribals of the region including Mizo except Bengali
		d. Fried vegetable	Manipur, Bengali, Assamese, Bodo and Nepali
		e. Mixed fry with other vegetables and non-vegetable components	Bengali, Manipur, Nepali, Assamese and Naga
2	Culm	a. Agricultural implements b. House pole, ceiling, partition wall, fencing water pipe etc. c. Fishing rod and other fishing implements d. Bridge and supporting materials for concrete building and bridge construction e. Implements for handloom f. Handicrafts, animal cage and farm house, etc. g. Food container for long-term preservation and use h. Musical instruments i. Incense sticks, broom, toothbrush and toothpick j. Kitchen and cookware components like spoon, spatula, fork and noodle stick k. Paper and pulp industry l. Firewood	Common applications experienced by all the tribes/communities of the region
3	Branch	a. Physical support for climber and twined agricultural crops b. Map pointer c. Fire wood	
4	Leaf	a. Fodder for cattle and goat b. House roofing and partition wall making	
5	Matured/ dry rhizome	a. Handle for tools and agricultural implements b. Traditional hockey stick and ball	

Figure 1. Spikelets of *B. cacharensis,* where anther lobes are exposed outside but the gynoecium is invisible due to its short height remaining inside the hard palea coat.

Figure 2. Flowering and defoliation of leaves in flowered culms irrespective of their age and size.

This intriguing phenomenon is a matter of interest to botanists in general and bamboo specialists in particular, as flowering is followed by death of the plants [4]. There is also a possibility that this could even lead to the species becoming endangered [5] or even extinct [6], when all the individuals in all populations flower simultaneously. To date, it has been impossible to locate any clump regenerating with young shoots in the area after full bloom. Bamboo flowering is considered as a bad omen in several states of India, especially where accompanied by an increase in rodent populations. It is believed to lead to famine and natural calamities. There is also a superstition that 'flowering of bamboo heralds disaster', which compelled the villagers to fell and burn them down completely. It has not only prevented understanding of the phenomenon of natural mode of regeneration in those bloomed clumps, but also accelerated the species towards extinction.

To study the extent of pollen sterility, mature pollen grains were stained in a 1 : 1 mixture of glycerine and 2% acetocarmine and examined under a microscope. Those which stained were considered as fertile and the unstained ones as sterile. Pollen viability was assessed using the tetrazolium test. Freshly collected mature pollen grains were dusted on a drop of 0.5% TTC (2,3,5-triphenyltetrazolium chloride) in sucrose solution and incubated in a humidity chamber at room temperature in the dark for 30 minutes. They were observed under the microscope and pollen grains which stained red were scored as viable. The degree of sterility as revealed by the acetocarmine staining test was $30.02 \pm 0.011\%$ and that of pollen viability as $70.01 \pm 0.035\%$. As observed (Fig. 1) in a majority of flowers, the pistils are shorter than the palea, just as reported to happen in *Bambusa vulgaris* [7]. The short stature of the pistil coupled with the close overlapping of lemma and palea force the former

Figure 3. Natural mode of death of *B. cacharensis* after full bloom without seed set.

to remain inside the floret, denying the chance for pollination. Due to the dry nature of the stigma, no pollen grains are found on it. There are also reports on induction of bamboo flower *in vitro* by tissue culture methods and utilization for perennial seed production and hybridisations [8].

The evidence that implies imminent danger of extinction of this needed but mysterious species includes (1) destruction of the clumps by burning, (2) the natural death of the clumps after flowering (Fig. 3), (3) the lack of fruit or seed set, and (4) the inherent unhealthy nature of the gynoecium. If the flowering continues in the same frequency, there are chances for this important natural resource to become endangered and even extinct within a few years. Hence, it is now required to develop a common interest amongst the scientists of relevant field in the region, especially the biotechnologists to make attempts to propagate and conserve this species so that it can be saved from such germplasm erosion.

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