Nutritional Aspects and Cultivation Prospects of Six Bamboo Species in Peninsular India

Sowmya Chandramouli and Syam Viswanath
Tree Improvement & Genetics Division, Institute of Wood Science & Technology, 18th cross Malleswaram, Bangalore – 560003, India
Email: sowmya.chandramouli@gmail.com; sviswanath@icfre.org

Abstract

Juvenile bamboo shoots have been used as a source of food traditionally by people in bamboo growing regions from North East India to few parts of peninsular India. Studies on nutritional parameters and cultivation potential were conducted on six industrially important species *viz*. *Bambusa bambos, Bambusa balcooa, Dendrocalamus strictus, Dendrocalamus asper, Dendrocalamus stocksii* and *Guadua angustifolia* in two agroclimatic zones *viz.* tropical humid (Koppa) and semiarid(Hosakote) in peninsular India during 2012-14. Analysis of juvenile shoots collected from both the locations, revealed that macro and micronutrient composition of the same species grown at different locations varied significantly . The hydrogen cyanide (HCN) content also varied significantly between species in both locations with maximum variation in *D.asper* shoots. The effect of management practices on shoot emergence were studied through application of organic and inorganic inputs applied in eight combinations in 6 year old clumps of the six species established at IWST (Institute of Wood Science and Technology) field station at Gottipura, Hosakote, Karnataka, India for two consecutive years (2013 & 2014) during May-June. Around 18-20 new shoots emerged in *D.stocksii* as compared to 10-15 shoots in *B. bambos* and *D. strictus* and 8-10 shoots in *D. asper* grown under same conditions. The survival percentage of the emerged shoots varied from around 50-60% to 80-95% over the two years period of study . Appropriate choice of species for cultivation with necessary management techniques may help in increased awareness and acceptance of bamboo shoots. If properly utilized, this enormous untapped resource can help in meeting the increasing demand for food and nutrition especially in rural areas of peninsular India.

Introduction

The health benefits of bamboo shoots were little understood until recently. Except in North East India and few parts of peninsular India, the prevailing myth that bamboo shoots are poisonous and ignorance on the choice of edible species has so far restricted its utility for edible purposes. In Peninsular India, the exploitation of bamboo shoots in traditional cuisines has been confined to Coorg and Malnad area in Karnataka and Waynad in Kerala. However, the availability of fresh edible bamboo shoots is very limited for much of the year and in many places of peninsular India it generally lasts for only one to four months (June – September) during the rainy season. Also its availability during rainy season plays a vital role since the availability of other vegetables in the season will be limited. The shoots of many bamboo species are edible and the selection of species adapted to particular climatic conditions prevalent at a particular location is essential. Bamboo is known to grow extensively in high rainfall regions. Hence the consumption of the shoots has been restricted to these regions. Shoots of *B.bambos* and *D.strictus* are the ones commonly consumed for edible purposes. Another constraint is the restriction imposed by the state forest department on extraction of bamboo in any form from the forests in the region where these two species are commonly found. The usage of shoots in food in other regions has not gained much popularity primarily due to lack of awareness about the nutritional value of the shoots and also the non-availability of choice of species of bamboo. This may be primarily be due to lack of awareness regarding the edible

characteristics of the shoots and lacunae in research on the subject. Despite these constraints, the high returns from bamboo plantations has attracted people to raise plantation in abandoned agricultural lands and tea/coffee estates where availability of labour is a major constraint (Viswanath et al 2007). Though extensive study has been reported in major bamboo growing areas in the North-eastern parts of India not much work has been reported on edible shoots and the sustainable management aspects of bamboo in peninsular India. The present study was taken up to identify appropriate bamboo species for promoting commercial cultivation for edible shoots. Six industrially important species were taken up for the present study viz. *Bambusa bambos, Bambusa balcooa, Dendrocalamus strictus, Dendrocalamus asper, Dendrocalamus stocksii* and *Guadua angustifolia,* to assess the nutritional potential in two different agroclimatic zones *viz.* tropical humid (Koppa,Chickmagalur, Karnataka) and semiarid conditions (Gottipura, Hosakote, India). Since previous studies on these species by IWST, Bangalore revealed that the growth performance of these species in tropical humid conditions is better as compared to semiarid conditions, the site at Hosakote under semiarid condition was selected for studying the effect of management on shoot emergence. The study was taken to emphasize on the importance of managing bamboo plantations for maximising sustainable production of shoots in semiarid conditions which would help address the issues of income generation and nutrition in poverty stricken areas and under nourished population especially in rainfed agriculture dependent regions of Peninsular India.

Materials and methods

The locations selected for the present study fall within a latitude of 13°49'26.43" and 13° 06' 08. 20" N and the longitude of 75°39'16.97" and 77° 50' 44. 04" E for Koppa and Bangalore. The altitude of the site ranged from 892 to 920 m a.m.s.l with a mean annual rainfall from 885.05 to 3403.1 mm for Koppa, Chickmagalur and Hosakote, Bangalore. The study site of Hosakote, Bangalore falls under semiarid climate and Koppa, Chickmagalur falls under tropical humid climate. The soil properties of study areas selected for the present investigation are presented in Table 1.

Table 1: Soil properties of the study area – Koppa and Hosakote

Soil properties	Koppa, Chickmagalur	Hosakote, Bangalore
pH	7.3	5.80
SOC %	2.46	0.49
Nitrogen (kg/ha)	400	102.96
Phosphorus (kg/ha)	5.5	4.65
Potassium (kg/ha)	147	90.92
Calcium (ppm)	0.5	0.89
Magnesium (ppm)	0.1	0.16
Sulphur (ppm)	25	7.91

The shoots were harvested from just above the base before they reach 30 cm in height, when they are two weeks old (Muktesh Kumar, 2009) from the study sites. The fresh weight of the harvested shoots were recorded and the shoots wrapped in cling wrap film to prevent moisture loss during transportation to laboratory for further analysis. In the lab the shoots were washed to remove the soil and sheath hairs. The outer sheath of the shoots were removed. The inner tender creamy white portion was used for analysis. The weight of shoot was recorded after removal of outer sheath. Only the tender portion was used for analysis the hard fibrous portion was discarded. The percentage of edible portion was also recorded after discarding the hard fibrous portion. The nutritional analysis was done for shoots collected from both the locations using different standard methods. The moisture content was estimated by drying the sample at 100°C for 6 -8 hours in hot air oven (AOAC, 2005), total protein was calculated by estimating the nitrogen present in the sample (AOAC, 1995), fat content was estimated by Soxhlet extraction with petroleum ether (AOAC, 2005), carbohydrate content was estimated by spectrophotometric method (AOAC, 2005), crude fibre content was estimated by alternate acid and alkali treatment of fat free samples (AOAC, 2005) and total ash content was estimated by charring the sample at 600°C for 5 hours in a muffle furnace (AOAC, 2005). The Hydrogen cyanide content was estimated using picrate paper method as described by Bradbury et al. (1999). The data obtained were subjected to statistical analysis.

For studying the effect of management on shoot emergence, organic and inorganic inputs were applied on 6 year old clumps established at IWST field station at Gottipura, Hosakote, Karnataka, India .Organic and inorganic inputs were applied in eight combinations on clumps of all the six species in triplicates for two consecutive years (2013 & 2014) during May-June. Control was maintained without any soil working and application of inputs. Watering of shoots was done once a week till the end of shooting season in December for all the tagged clumps except control during the non-rainy period. The shoot emergence was recorded monthly till December and correlated with the rainfall data. Requirement per clump: N - 300g P - 150g K - 450g (Muktesh Kumar, 2009 & NMBA, 2004), Compost – 10kg (NMBA, 2004), Biochar – 500g (Julie Major, 2010)

Treatment No.	Combination
T_0	$F_0C_0BC_0$
T1	C
T2	F
T3	BC
T4	F+BC
T5	C+BC
T6	F+C
T7	F+C+BC

Inorganic Fertilizers (F), compost (C) and biochar (BC).

Results and Discussion

The typical "shooting season" of most bamboo species rarely exceeds two months in low rainfall regions which may be extended by modifying the cultivation and management practices since it is an intensively managed process (Decipulo et al 2009). The shoots have to be harvested within two weeks of emergence when they reach 30-40 cm height. Continuous monitoring is essential as to harvest the shoots at the appropriate time to get the maximum volume of edible portion. After harvest, deterioration of shoot quality is rapid especially if the outer sheath is removed. The growth of the six species varied significantly in Koppa, Chickmagalur as compared to Hosakote, Bangalore (Table 2). Except for *D. asper* and *G. angustifolia,* two species that grows well in high rainfall conditions, the percentage of edible portion of all the other species in semiarid conditions was found to be on par with those shoots of the

same species harvested from tropical humid conditions (Fig. 1). Shoots with maximum quantity of edible portion are produced from the fifth year onwards. There are lot of opportunities for exploitation of bamboo shoots as an alternate source of nutrition during rainy season when other vegetables are scarce to come by.

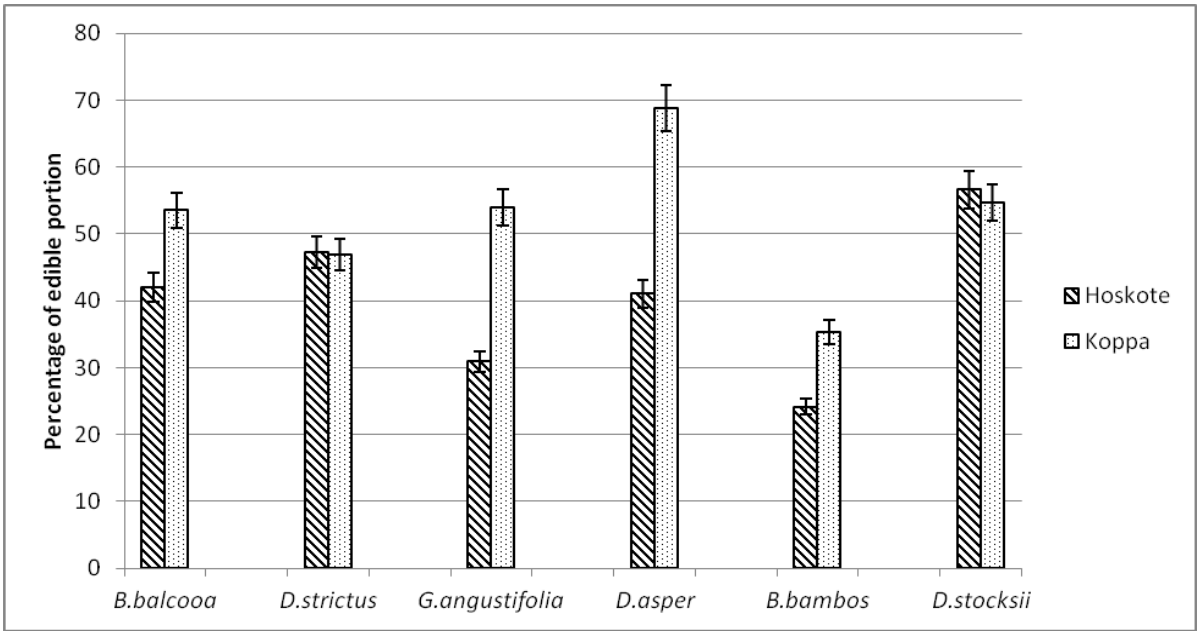

Fig 1. : Volume of edible portion in six bamboo species in Koppa and Hosakote sites

The main nutrients in bamboo shoots are protein, carbohydrates, amino acids, minerals, fat, sugar, fiber, and inorganic salts. The shoots have a good profile of minerals, consisting mainly of potassium (K), calcium (Ca), manganese (Mn), zinc (Zn), chromium (Ch), copper (Cu), iron (Fe), and lower amounts of phosphorus (P), and selenium (Se). Fresh shoots are a good source of thiamine, niacin, vitamin A, vitamin B6, vitamin C and vitamin E (Nirmala et al 2011). Composition of nutrients like carbohydrates, proteins, vitamins and dietary fibers may vary considerably among different species and also on conditions of growth. Thus it becomes imperative to understand the nutrient composition of a particular bamboo species growing in a particular region to exploit its edible potential. It was observed that macro and micronutrient composition of the same species grown at different locations varied significantly upon statistical analysis (Table 3). It was observed that the hydrogen cyanide content also varied significantly between species in both locations with maximum variation in *D. asper* shoots (Table 3).

The shoot emergence of all the clumps under treatment was recorded on monthly basis from July till December. The shoot emergence was found to significantly vary between treatments in all the six species. Fertilizers have been reported to increase shoot production in various bamboo species (Kleinhenze et al 2000; Decipulo et al 2009. Significant variation was observed in overall emergence pattern between months also in each of these species. The pattern of shoot emergence over the two year period was correlated with the monthly rainfall data of the region (Fig 2). The successful cultivation of bamboo in semiarid parts depend primarily on frequent but non-excessive additions of water through precipitation and irrigation (Midmore et al1998). It was observed that in most species there is maximum shoot emergence during the rainy period between August and October. Observations on the average number of new shoots emerging *D. stocksii* clumps per year at IWST field station indicate that around 18-20 new shoots emerge as compared to 10-15 shoots in *B. bambos* and *D. strictus* and 8-10 shoots in *D.*

asper grown under same conditions which indicate that after scientifically harvesting 20-30% of the emerging shoots for edible purposes, the mature culms can still be exploited for other commercial uses. Also, the shoot emergence was found to be more cosistent during the second year after application of inputs.

Theme: Food and Pharmaceuticals