INITIAL PERFORMANCE OF TISSUE CULTURE RAISED BAMBOOS IN RAJASTHAN AND GUJARAT

R.L. SRIVASTAVA, ASHOK KUMAR, S.K. SHARMA*,
C.J.S.K. EMMANUEL AND U.K. TOMAR

Arid Forest Research Institute, Jodhpur (Rajasthan).

Introduction

Bamboo is one of the fast growing, most versatile, 'woody' plants with highest productivity in the world, and is annually renewable and harvestable if managed intensively (Scurlock *et al.*, 2000). Bamboo, is not only of economic importance to rural communities in most Asian countries but also of ecological importance in preventing soil erosion by its strongly developed rhizomes and roots (Bystriakova *et al.*, 2003). Selective harvesting has been practiced for a long time in many countries to obtain multiuse timber, edible shoots and for paper-making (Kochhar, 1986). Another major advantage is that it takes a relatively short time to establish a matured commercial plantation - about 3 years for sympodial (clumping) bamboo and 6 years for monopodial (running) bamboo (Barkley *et al.*, 2005).

In India, there are 20 genera consisting of 339 species, covering about 46,000 km^2 area (Biswas, 1995, 1997).There is a great potential to improve bamboo planting stocks of region specific economically important bamboo species and also develop agroforestry system for sufficing the local need. Bamboos improvement programmes have been emphasized (Banik, 1997) through selection of plus clumps and their further multiplication through macro-propagation (conventional) and micro-propagation (tissue culture) techniques (Saxena and Dhavan, 1999; Gillis *et al.*, 2007).

Arid Forest Research Institute (AFRI) situated in Jodhpur Rajasthan caters the research need of State Forest Department of Gujarat, Rajasthan and Dadra & Nagar Haveli. Two species namely *Dendrocalamus strictus* and *Bambusa bambos* are occurring naturally in some isolated pockets of Rajasthan and Gujarat. Keeping in view the low productivity of forestry plantation in Rajasthan and Gujarat an effort has been initiated to enhance the productivity of bamboo plantations using improved planting material raised either through clonal methods or through tissue culture. These trials have been established at Chakhalia, Jhalod (Gujarat); Kushalgarh (Rajasthan). Experiments have also been conducted with chemical and organic fertilizers to optimize growth of tree species in wastelands. The present paper deals with one and half year studies of these bamboo trials in these two states.

Material and Methods

Raising Planting Stock : Tissue culture

* Presently at RS&M Division, Forest Research Institute, Dehra Dun (Uttarakhand).

plants of *Bambusa bambos* were procured from The Energy and Resources Institute (TERI), New Delhi in October 2005 and *Dendrocalamus strictus* plants were produced at AFRI, Jodhpur. The average plants shoot size at that time was 7.5 - 12.5 cm (3-5") inches. Therefore all these plants were kept in polyhouse at AFRI, Jodhpur for hardening and growing them to reach proper plantable size (22 - 30 cm - 9-12"). All these plants were maintained till end of February 2007. During this period plants attained a height of 30 cm (12"). In March 2007 these plants were transferred to transit nurseries of Kushalgarh and Jhalod sites in April 2007.

Sites : Two sites were selected in such a way that these represent the natural growing area of both the states. Selection of sites was made with the help of Rajasthan Forest Department and Gujarat Forest Department official in September 2005, their locations and other site details are given in Table 1.

Experimental Plantation for each bamboo species : The experimental details of the plantations raised are as follows :

- Each experimental plantation have 3 replicates and each replicate there are two planting distances and 4 fertilizer treatments.

- There are two main plots for two different spacing
  Main plot (S_1) : 5 m x 5 m
  Main plot (S_2) : 6 m x 6 m

- Each main plot would be divided into 4 subplots of equal size; each subplot would represent one fertilizer treatment.

Fertilizer treatments

T_1 – No Fertilizer,
T_2 – FYM (10kg),
T_3 – NPK (50g N + 50g P + 25g K)
T_4 – FYM + NPK (5kg FYM + 50g N + 50g P + 25g K)

Irrespective of the planting distance, there are 36 plants in each sub plot :
Planting distance (5 m x 5 m) :
S_1T_1 36 Plants

Table 1

Site details

Site Characteristics	Site 1 in Rajasthan	Site 2 in Gujarat
	Khajurawala chuna, Kushalgarh range, Distt. Banswara	Chakhalia Village, Jhalod range, Distt. Dahod
Latitude, Longitude	23°18'45" N, 74°29'15" E	23°02'42" N, 74°15'59" E
Elevation	1500 ft	850 ft
Soil Type	Sandy Loam	Brown loamy sand with small gravels
pH	6.1-7.0 (av. 6.5)	6.1-7.9 (av. 6.6)
Average Rainfall	700-900 mm	400-900 mm
Period of Rainfall	July – September	July- September
Max. Temp. (°C)	33 - 46	30 - 47
Min. Temp. (°C)	10 - 20	7 - 10

S_1T_2 36 Plants
S_1T_3 36 Plants
S_1T_4 36 Plants

Planting distance 6 m x 6 m :
S_2T_1 36 Plants
S_2T_2 36 Plants
S_2T_3 36 Plants
S_2T_4 36 Plants

Plot design for the 3 replicates

Replication 1 :
S_1T_1 36 Plants
S_1T_2 36 Plants
S_1T_3 36 Plants
S_1T_4 36 Plants
S_2T_1 36 Plants
S_2T_2 36 Plants
S_2T_3 36 Plants
S_2T_4 36 Plants

Replication 2 :
S_2T_1 36 Plants
S_1T_1 36 Plants
S_2T_2 36 Plants
S_1T_2 36 Plants
S_2T_3 36 Plants
S_1T_3 36 Plants
S_2T_4 36 Plants
S_1T_4 36 Plants

Replication 3 :
S_2T_4 36 Plants
S_1T_4 36 Plants
S_2T_3 36 Plants
S_1T_3 36 Plants
S_2T_2 36 Plants
S_1T_2 36 Plants
S_2T_1 36 Plants
S_1T_1 36 Plants

Data on growth parameters (number of culms per clump and culm height) were recorded at the time of planting as base data and after one month to see the survival percentage and replacement of casualties. Subsequently, data on growth parameters (number of culms and shoot height) were recorded at six months intervals.

Results

Initial data collected from all the trails after one month indicates that survival percentage was 100% in *Dendrocalamus strictus* and 99% in *Bambusa bambos* at Jhalod site in Gujarat, whereas survival percentage was relatively less in both the species (95% in *Dendrocalamus strictus* and 96% in *Bambusa bambos*) at Kushalgarh site in Rajasthan. Survival percentage further decreased after one year and it was ranging from 97.2% to 100.0% for both the species in Gujarat and 67.6% to 96.8% Kushalgarh site in Rajasthan.

Spacing effect : As these results pertain to only one year's growth hence, no significant differences were observed in growth parameters (with respect to height and number of culms) due to two spacing after one year. Significant impact of spacing can be realized only after third year of growth when plants will compete for nutrient in the soil (below ground resources) as well for light (above-ground resources).

Effect of fertilizer treatment : Experiment conducted with four fertilizer treatments namely :
T_1 – No Fertilizer,
T_2 – FYM (10kg),
T_3 – NPK (50g N + 50g P + 25g K), and
T_4 – FYM + NPK (5kg FYM + 50g N + 50g P + 25g K).

Effect of fertilizer treatment on height is clearly visible irrespective of the site.

To have an over all ideal data collected from one year was pooled and analyzed

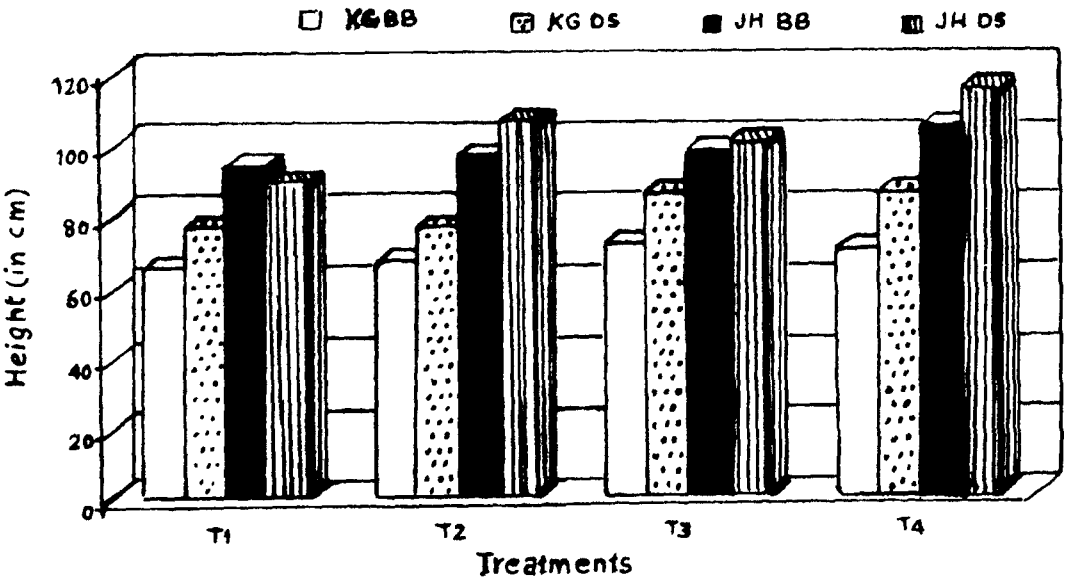
species-wise. In case of *Dendrocalamus strictus* average height in control (without fertilizers) was 82 cm. Average height increased with the application of fertilizers and maximum average height reached up to 99.5 cm. Similar trend was recorded in *B. bambos*. Minimum average height was recorded in control (78.9 cm) and maximum average height (85.5 cm) was in T_4 treatment. In this pooled data significant difference were not recorded on number of shoots in both the species.

Data was also analyzed separately for site and experiment-wise. There was no significant difference due to spacing in any of the species after one year of growth on any of the growth parameters. Difference observed in height due to fertilizer treatments have shown in Fig. 1.

Relative average height was higher at Jhalod site in both the species. Overall T_4 treatment was the best where combinations of chemical and organic fertilizers were applied. Effect of fertilizers was not clearly visible on number of culms developed after one year. The same is shown in Fig. 2. Number of shoots varies from 2 to 12 in whole population. However average number of shoots varies from 4.8 to 6.1 in all experiment conducted with both the species at two sites.

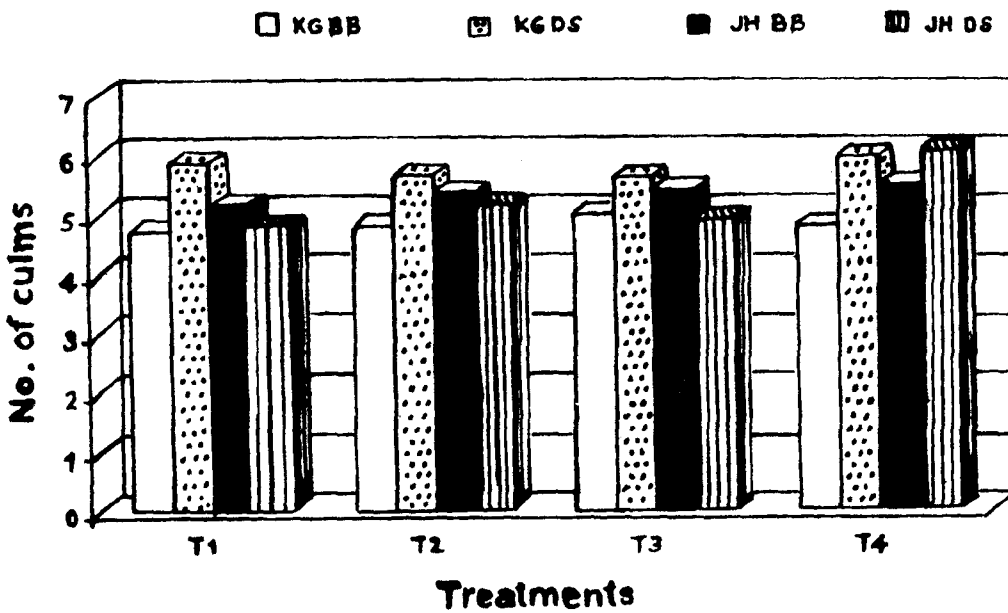
These are initial trends observed after one year of growth period, which indicate that fertilizer treatment boost the plant growth and it is more useful if applied in wastelands. However, these experiments are progressing some more interesting results are expected after few years when spacing will also influence the growth of these plants and differences will be of higher magnitude for both growth parameters.

Fig. 1



Effect of chemical and organic fertilizer on shoot growth of *D. strictus* and *B. bambos*

Fig. 2



Effect of chemical and organic fertilizer on no. of culms induced of *D. strictus* and *B. bambos*

Since bamboos are one of the fast growing species and have the capabilities to fulfill the basic needs of rural and tribal peoples, further the production of utilizable culms can be started after six year of growth hence, the species have good potential to be incorporated in the agroforestry systems specifically on the farm bunds as protective wind breaks.

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SUMMARY

Keeping in view the low productivity of forestry plantations in Rajasthan and Gujarat, an effort has been initiated to enhance the productivity of bamboo plantations using improved planting material raised either through clonal methods or through tissue culture. These trials have been established at Chakhalia, Jhalod (Gujarat); Kushalgarh (Rajasthan). In total 50 ha area has been covered under these specialty plantations, the bamboo species considered for planting are *Dendrocalamus strictus* and *Bambusa bambos*. In these performance trials some experimentation were also laid out to see the effect of soil amelioration using organic and inorganic manures and effect of spacing on the growth and productivity of the bamboo plantations. The spacing used are 5 m x 5m and 6 m x 6m. The initial establishment's results

are quite encouraging in both the states. In Gujarat survival percentage ranges from 97.2 % to 100.0% for both the species whereas in Rajasthan sites it was 67.6% to 96.8% (Kushalgarh). The differences observed in the survival percentage may be due to altitudinal variations as the altitude of Gujarat site is 259 m amsl whereas it was 457.20 m amsl for Rajasthan sites. The overall growth performance of both the species is quite satisfactory. Initial inferences can be drawn from these trials is that bamboos can be introduced in both the states in Agroforestry systems.

Key words **: Bamboo plantations, *Dendrocalamus strictus, Bambusa bambos*, Productivity, Tissue culture, Rajasthan, Gujarat.**

राजस्थान और गुजरात में ऊति–संवर्धन विधि से उगाए बांसों की प्रारम्भिक क्रियाशीलता

आर०एल० श्रीवास्तव, अशोक कुमार, एस०के० शर्मा, सी०जे०एस०के० इम्मैनुअल व यू०के० तोमर

सारांश

राजस्थान और गुजरात राज्यों के वानिकी रोपवनों की कम उत्पादकता को ध्यान में रखकर कृन्तकीय अथवा ऊति संवर्धन विधियों द्वारा तैयार परिष्कृत रोपण सामग्री उपयोग कर बांस रोपवनों की उत्पादकता बढ़ाने को यह प्रयास आरम्भ किया गया। ये परीक्षण चखलिया, झालौद (गुजरात) और कुशलगढ़ (राजस्थान) में स्थापित किए गए। कुल मिलाकर 50 हेक्टे० क्षेत्रफल इन विशिष्ट रोपवनों में लिया गया है, बांस जातियां जिन्हें रोपणार्थ लिया गया, *डेण्ड्रोकैलेमस स्ट्रिक्टस* और *बैम्बूसा बैम्बोस* (*बै० अरुनडिनेसिया*) रही। इस क्रियाशीलता को जानने के परीक्षणों में कुछ संपरीक्षण भी यह देखने को रखलिए गए कि जैव और अजैव खाद डलवाने का मृदा परिष्कार पर और भिन्न भिन्न फासला बीच में छोड़ने का बांस रोपवनों की बढ़वार और उत्पादकता पर कैसा प्रभाव पड़ता है। दो फासले 5 x 5 मी० और 6 x 6 मी० लिए गए। रोपवनों की आरम्भिक स्थापना के परिणाम दोनों राज्यों में उत्साहप्रद रहे हैं। गुजरात में इन दोनों जातियों का अतिजीविता प्रतिशत 97.2% और 100% के बीच रहा जबकि राजस्थान के स्थलों में यह 67.6% से 96.8% (कुशलगढ़) रहा। अतिजीविता प्रतिशत में जो अन्तर दिखाई पड़ रहा है वह इन स्थानों की समुद्र तल से ऊंचाई के कारण हो सकता है क्योंकि गुजरात का स्थल 850 फुट ऊंचाई पर है जबकि राजस्थान के स्थलों की समुद्रतल से ऊंचाई 1500 फुट है। इन दोनों जातियों की समग्र बढ़वार सक्रियता पूर्णतया सन्तोषजनक है। इन परीक्षणों से आरम्भिक परिणाम ये निकाले जा सकते हैं कि बांसों की कृषिवानिकी प्रणालियों के अन्तर्गत इन दोनों राज्यों में लगवाया जा सकता है।

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