International Journal of Forestry and Crop Improvement
Volume **8** | Issue 1 | June, 2017 | 58-61 | ■Visit us : *www.researchjournal.co.in*
e ISSN-2230-9411

RESEARCH ARTICLE

DOI: 10.15740/HAS/IJFCI/8.1/58-61

Productivity studies in marihal bamboo (*Oxytenanthera stocksii*) under agroforestry system

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ABSTRACT : An experiment was conducted to know the performance of marihal bamboo (*Oxytenanthera stocksii*) under Agroforestry system in rainfed conditions during 1999 -2006 on red gravelly soils of Main Agricultural Research Station, University of Agricultural Sciences, Dharwad. The bamboo was planted in three spacings *viz.*, S_1 – 4x2m, S_2 – 4 x 3m, S_3 – 4x4m, S_4 – 4 x 5m and S_5 – Field crop. Sesamum crop was grown for four years. At the end of 2006-07, bamboo culm height and diameter were significantly higher in spacing of 4 x 5 m as compared to 4 x 2 m. Harvestable culms and gross return were higher in wider spacing (4x5m) as compared to narrow spacing (4 x 2m). The sesamum grain yields were higher in wider spacing than narrow spacing.

KEY WORDS : *Oxytenanthera stocksii*, Riparian filter, Pulp, Paper, Intercropping, Live fencing, Rural community

HOW TO CITE THIS ARTICLE : Patil, H.Y. and Mutanal, S.M. (2017). Productivity studies in marihal bamboo (*Oxytenanthera stocksii*) under agroforestry system. *Internat. J. Forestry & Crop Improv.,* **8** (1) : 58-61, **DOI: 10.15740/HAS/IJFCI/8.1/58-61.**

ARTICLE CHRONICAL : Received : *08.02.2017;* Revised : *09.05.2017;* Accepted : *23.05.2017*

INTRODUCTION

Bamboo is a fast growing, perennial, renewable natural resource and wonderful gift of nature to mankind. Importance of bamboo is very well known in daily life of human beings especially in rural areas. There are more than 1500 recorded uses of bamboo. It provides food, fodder, timber for construction, tool and implements for agriculture, raw material for pulp and paper, and for handicrafts. In addition, it conserves soil, stabilize slopes, river banks and ravines wastelands. Many cultural traditions in rural areas are intimately connected with bamboos.

Bamboo as a woody grass is perfectly suited to agroforestry. Under agroforestry systems, it is suitable for intercropping, soil conservation, wind break, riparian filter and yields value added products, timber, forages, edible shoots, fibre and craft wood. Bamboo farming has assured market which makes cultivation of bamboo on private land (Suri and Choudhari, 1994).

The cultivation of soybean along with *Dendrocalamus strictus* was technically feasible and economically viable. The scope for bamboo in agroforestry in India is very wide because of the uncertain weather conditions and increasing cost of labour involved in raising agricultural crops in marginal lands (Saxena *et al.*, 2001). Turmeric yields were higher when grown with

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bamboo as compared to sole turmeric crop (Shanmughavel and Francis, 2001).

In Madhya Pradesh, the impact of bamboo based agroforestry models with short rotation agricultural crops namely soybean, niger, greengram, mustard, wheat, blackgram and pigeonpea were investigated. The model has played a significant role in soil management including checking soil erosion and improvement of soil fertility of degraded agricultural lands (Behari, 2004). Banik *et al.* (2008) have reported development of bamboo based nine agroforestry models for eco-rehabilitation.

Higher annual net returns (Rs. 13,300) were obtained when pigeonpea was intercropped in 1:1 rows at 3x3 m^2 spacing (250 plants/ha). The cost benefit analysis of bamboo (*D. strictus)* plantation at Gaul Pahari, Haryana revealed that this system yielded better economic returns (Rawat *et al*., 2002). Growth and yield of bamboo depends upon sources of planting material and method of planting and spacing (Gupta and Sood, 1978).

Bamboo based agroforestry models will provide higher economic returns to the farmers, improve the soil, fill the gap of national forest cover (33%) and provide raw material to the industry as well as for domestic use of the rural community (Ahlawat, 2000). Bamboo can be harvested every year from fifth year onwards and hence, regular income will start much earlier than expected from any other woody component. Among the bamboo, *Oxytenanthera stockii* is thornless, grows straight and easily harvestable as compared to other species. Hence, an experiment was planned to assess the productivity of marihal bamboo under agroforestry system in rainfed conditions.

EXPERIMENTAL METHODS

A field experiment to study the performance of marihal bamboo under agroforestry system was conducted on red gravelly soil at MARS, Dharwad from 1999 to 2006. The marihal bamboo was planted at three spacings *viz.*, S_1 – 4x2m, S_2 – 4x3m S_3 – 4x4m; S_4 – 4x 5m. Field crop-sesamum was grown in between two alleys of marihal bamboo. The experiment was laid out with Randomized Block Design with four replications. The soil depth was 45 cm with rocky and grabbles soil. It consisted of 192 N; 22 P_2O_5; 212 K_2O kg/ha with soil pH of 6.5.

The fertilizer dose of 100; 150; 100 N; P_2O_5: K_2O kg/ha was applied in 1st, 2nd and 3rd year. The sesamum was grown during *Kharif* season under rainfed conditions for four years upto 2004-05. Intercropping was stopped due to closure of canopy of bamboo culms. The recommended packages of practices were followed for sesamum. Growing of field crop was limited due to poor soil and also lower yield of field crops. The culms were harvested after the 7th years. The observations on different growth parameters were recorded and presented in the table. At the end of experimentation, the economic analysis was made based on the yield of field crop and income from bamboo culms.

EXPERIMENTAL RESULTS AND ANALYSIS

The results obtained from the present investigation as well as relevant discussion have been summarized under the following heads :

Growth attributes of bamboo :

Height of culms:

In the initial stage, height of marihal bamboo was not influenced by different spacings. The culm height was significantly higher in 4x 5 m spacing as compared to 4 x 2 m spacing at later stages. The height growth of bamboo was increased with wider spacing (Table 1).

Number of culms / clump:

From third year onwards, number of culms differed significantly among different spacings. The number of culms were significantly higher in 4 x 5 m (10.12 culms/ clump) followed by 4 x 4 m (9.49 culms/clump) as compared to 4 x 2 m (3.45 culms/clump). This trend was remained same throughout the experimentation.

Intermodal length:

Length of inter nodes was not influenced by the different spacing of early stages. However, it was highest in wider spacing as compared to the narrow spacing during 2004-05 and 2006-07.

Diameter at breast height (DBH) of culm (cm) :

Growth of DBH of culm was influenced by the different spacings of bamboo. Diameter at breast height of culm was significantly higher (6.25 cm) in wider spacing of 4 x 5 m as compared to narrow spacing of 4 x 2 m (2.36 cm). Similar trend was observed upto 2006-

2007 and growth was positively correlated with spacing.

Sesamum grain yield :

Field crop (sesamum) was grown for four years during initial stages. Yield of sesamum was uniform in all the treatments during the initial years. Grain yield of sesamum was significantly higher in sole sesamum (206.47 kg/ha/yr) followed by sesamum grown in bamboo spaced at 4 x 5 m (173.84 kg/ha/yr) as compared to 4 x 2 m spacing (120.40 kg/ha/yr). Generally yield of sesamum was very low as the soil is poor with low depth (Table 2).

Harvestable culms:

The harvestable culms of marihal bamboo were higher in spacing of 4x5m (4100/ha) followed by spacing of 4x4m (3875/ha) as compared to the narrow spacing 4 x 2m (3750/ha) as the growth of culms in wider spacing was better with more number of harvested culms per clump.

Economics of marihal bamboo farming:

Gross returns was higher in sesamum with marihal bamboo at 4 x 5 m (Rs. 7298/ha/yr) followed by marihal bamboo at 4 x 4 m (Rs. 6695/ha/yr) as compared to marihal bamboo at 4 x 2m (Rs. 6192/ha/yr). Net returns and benefit cost ratio were higher in 4m x 5m spaced bamboo (Rs. 4606/ha/yr and 1:1.71, respectively) followed by spacing of bamboo at of 4x4m (Rs. 3720/ha/yr and 1:1.25, respectively) compared to marihal bamboo at 4 x 2 m spacing (Rs. 2344/ha/yr and 1:0.6, respectively). Economically bamboo cultivation ensures Internal Rate of Returns (IRR) of more than 25 per cent which is almost equal to eucalyptus and returns are recurrent on

Table 1 : Growth of marihal bamboo with sesamum under different spacings

Treatments	Height of culm (m)					Number of culms/clump				
	2000-01	02-03	03-04	04-05	05-06	2000-01	02-03	03-04	04-05	05-06
S_1 - 4 x 2 m + S	1.73	2.99	2.76	2.80	3.80	2.21	4.45	3.25	3.45	12.25
S_2 - 4 x 3 m + S	1.97	2.09	3.04	3.25	4.35	2.63	3.00	4.0	4.12	15.52
S_3 - 4 x 4 m + S	1.82	2.29	3.42	3.75	4.95	2.46	5.12	7.95	9.49	22.21
S_4 - 4 x 5 m + S	1.74	3.09	3.17	4.07	5.27	2.91	5.12	8.35	10.12	24.73
S_5 – Sesamum (S)	--	--	--	--	--	--	--	--	--	--
S.E. ±	0.22	0.42	0.43	0.37	0.52	0.95	0.84	1.26	1.41	1.92
C.D. (P=0.05)	NS	NS	NS	1.18	1.65	NS	NS	4.03	4.51	6.14

NS=Non-significant

Table 2 : Growth of marihal bamboo and sesamum yield under different spacings

Treatments	DBH of Culm (cm)					Sesamum grain yield (kg/ha)			
	2000-01	02-03	03-04	04-05	05-06	2000-01	02-03	03-04	04-05
S_1 - 4 x 2 m + S	1.00	1.66	1.80	2.36	6.32	246	103.3	65.5	64.8
S_2 - 4 x 3 m + S	1.65	1.72	2.30	3.10	7.81	262	119.8	78.7	84.4
S_3 - 4 x 4 m + S	1.36	1.92	3.80	4.25	8.42	275	158.3	82.5	76.8
S_4 - 4 x 5 m + S	1.76	2.36	4.78	6.25	10.10	280	227.9	96.2	91.2
S_5 – Sesamum (S)	--	--	--	--	--	293	248.2	147.3	137.5
S.E. ±	0.96	0.86	0.41	0.75	0.43	12.3	8.3	5.2	6.6
C.D. (P=0.05)	NS	NS	1.31	2.39	1.37	NS	25.5	16.0	20.3

NS=Non-significant

Table 3 : Economics of bamboo based agroforestry system

Treatments	Grain yield sesamum (kg/ha/yr)	Harvestable culms/ha	Average cost of cultivation (Rs/ha/yr)	Average grass return	Net returns (Rs./ha/yr)	Benefit cost ratio
S_1 - 4 x 2 m + S	120.40	3750	3848	6192	2344	0.61
S_2 - 4 x 3 m + S	136.24	3748	3542	6388	2846	0.80
S_3 - 4 x 4 m + S	148.14	3875	2975	6695	3720	1.25
S_4 - 4 x 5 m + S	173.84	4100	2692	7298	4606	1.71
S_5 – Sesamum (S)	206.47	--	2525	5160	2635	1.04

annual basis (Table 3).

Bamboo plants will share the inputs of moisture, manure and fertilizer and weeding applied to agriculture. Hence, bamboo quality and yield would be more in bamboo agroforestry system. Therefore, marihal bamboo can be grown successfully at 4 x 5m spacing under agroforestry system with suitable intercrops. Marihal bamboo can also be grown by the farmers on bunds, along nalas, water streams, rivers etc at a spacing of 5m apart as live fencing.

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