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Planting stock selection of bamboo (*Dendrocalamus strictus*) using macro proliferation technique

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Abstract—A study was conducted to determine the effects of age of seedlings, position of rhizome subunits, removed and used as propagules, on growth and proliferation of *Dendrocalamus strictus*. The results showed that age of seedlings did not affect the proliferation rate, while position of rhizome subunits varied in growth and proliferation rate. The material taken from first position of rhizome subunits showed maximum proliferation, while material taken from third position of rhizome showed maximum growth and biomass. The position of rhizome subunits in bamboo clump is an important parameter in using this macro proliferation technique to obtain planting material for mass propagation.

Key words: Seedling; proliferation; rate of growth; position of rhizome.

1. INTRODUCTION

Bamboos are perennial woody, tree-like grasses of the family Poaceae (syn. Graminae), with a natural habitat between 46 southern and northern latitudes. Excluding Europe, it thrives at altitudes from sea level to as high as 4000 meters in elevation. More than 130 genera of woody bamboos and 25 grass bamboos with about 1300 species are distributed in tropical, subtropical and mild temperate zones covering a total area of over 25 million hectares.

Dendrocalamus strictus (Roxb.) Nees is the best known, commonest and most widely distributed of all Indian bamboos, occurring in deciduous forests all over India except in northern Bengal, Assam and moist regions of the west coast. It is cultivated throughout the country in the plains and foothills [1].

Bamboos are the best species for afforestation. Survivability of planted stock is a critical problem and there is an urgent need for well-screened planting material that can survive in adverse field conditions. This paper provides guidelines to practice the macro proliferation method.

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2. MATERIAL AND METHOD

The experiments were conducted in the Plant Physiology Discipline, Botany Division, Forest Research Institute, Dehra Dun, India, in 1997–1999 under open conditions. Six-month and one-year-old seedlings of *Dendrocalamus strictus* were separated by a macro proliferation technique using a sharp secateur. Each separated unit had its own roots, rhizome, and shoot. The propagules belonging to each age group were further divided into three sub-groups depending upon the position of rhizome subunits. As the seedlings grow, they produce successively larger

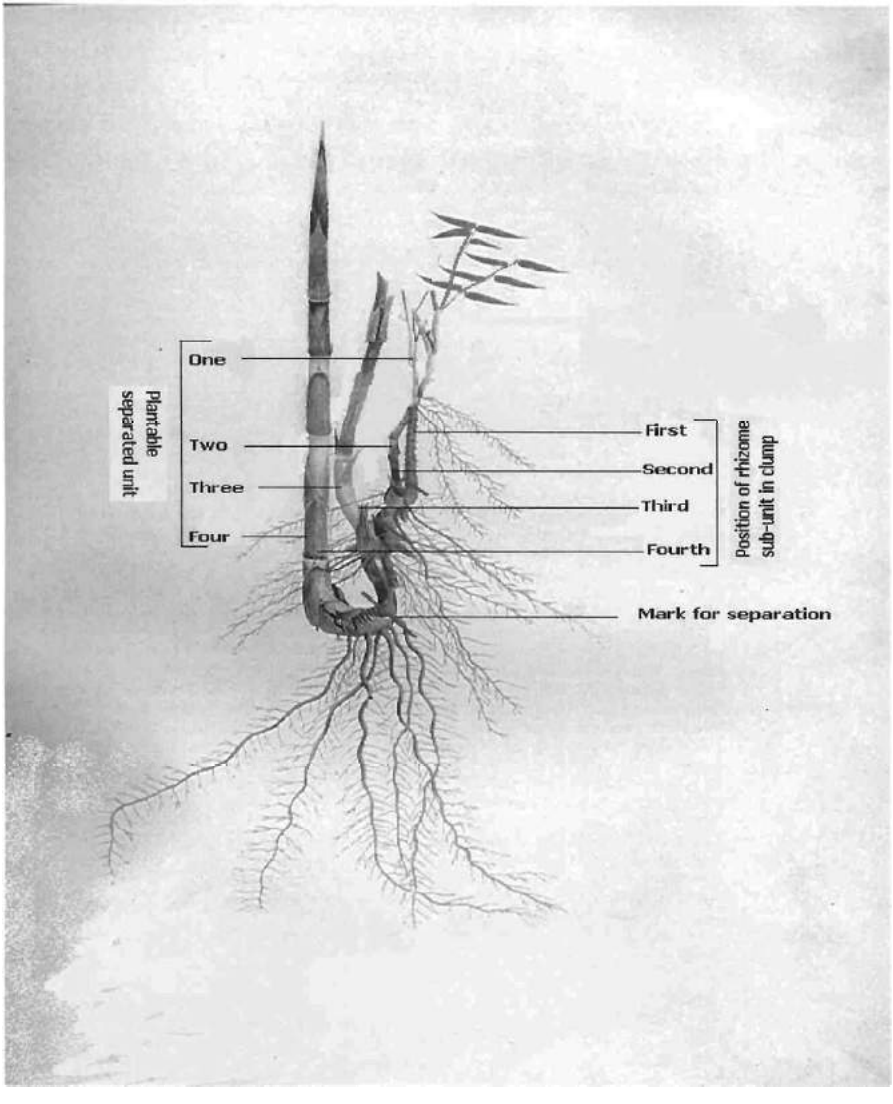

Figure 1. Seedling of *D. strictus* showing successive growth of rhizome subunits bearing culms.

rhizome subunits [1] (see Fig. 1). These propagules were planted separately in polythene bags filled with the potting mixture (soil, 2 parts: sand 1 part: farm yard manure 1 part) and arranged in completely randomised block design (CRD) with three replications of five plants each. After a period of eight months the plants were dug out and different morphological and growth parameters were measured (Table 1). During the experimentation, regular watering and weeding operations were conducted.

All parameters except those pertaining to dry weight were carried out in the nursery at the time of sampling. Length of culms was measured using a meter scale with marking down to 1 mm. Basal diameter of culms was recorded using digital calipers. Weights were recorded on a digital pan balance. For dry weight determination, the plant components, namely, culms, leaves, rhizome and roots, were dried in an oven at 70°C, till their weight was constant, and the dry weights were recorded.

For analysis, means were estimated for each parameter based on the available plants of that replication. The used model for analysis was

$$Y_{ijk} = \mu + A_i + S_j + I_{ij} + \varepsilon_{ijk},$$

where μ is the general mean, A_i is the effect of ith seedling age ($i = 1, 2$), S_j is the effect of jth rhizome position [$j = 1(1)3$], I_{ij} is the interaction effect of ith seedling age with jth rhizome position, Y_{ijk} is the response of ith seedling age with jth rhizome size of kth replication, ε_{ijk} is an error term, $N \sim (0, \sigma^2)$.

For homogenous groups, Scheffe's test was used and groups marked alphabetically.

3. RESULTS AND DISCUSSION

Results (Table 1A) show that proliferation rates are comparatively higher in propagules derived from younger (6-month-old) seedlings than those of propagules derived from older (one-year-old) seedlings. The culm height and the number of leaves are significantly higher in propagules derived from 1-year-old seedlings than those of 6-month-old seedlings. The details indicate that proliferation rates decrease while overall growth increases with age of mother stock.

Results (Table 1B) show that the position of rhizome subunits used as propagules show variation in growth and proliferation. The propagules obtained from rhizome subunits at position 1 (i.e. primary rhizome unit) exhibit highest rates of proliferation and multiplication, while the reverse is true in the case of those obtained from the rhizome subunit at position 3 (i.e. the tertiary unit). This might be due to the difference in age of the two rhizome units. The primary unit is older than the tertiary, so the buds on the primary rhizome unit are more advanced for new shoot development than the other, whereas in the tertiary rhizome unit the available buds are bigger in size due to larger units and thereby produced larger and bigger shoots

Table 1.
Mean values of growth parameters for different main effects (age of seedling, position of rhizome subunit) and interactions in *D. strictus* seedlings

A. Effect of age of seedling on different growth and proliferation parameters

Age (months)	Parameters														
	NOC	*HOC* (cm)	*BDC* (mm)	*NOL*	*NORSU*	*FWC* (g)	*FWL* (g)	*FWRZ* (g)	*FWRT* (g)	*TFW* (g)	*DWC* (g)	*DWL* (g)	*DWRZ* (g)	*DWRT* (g)	*TDW* (g)
Six	3.03	28.17	2.65	30.53	4.08	3.89	1.83	3.34	1.31	10.33	1.62	1.12	1.41	0.68	4.81
Twelve	2.44	38.24	2.82	63.67	3.42	3.93	1.73	3.07	1.19	9.74	1.93	1.07	1.42	0.65	4.98
$CD_{(0.05)}$ *	NS	6.78	NS	11.79	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

B. Effect of position of rhizome subunits in mother seedling on different growth and proliferation parameters

Position rhizome subunits	Parameters														
	NOC	*HOC* (cm)	*BDC* (mm)	*NOL*	*NORSU*	*FWC* (g)	*FWL* (g)	*FWRZ* (g)	*FWRT* (g)	*TFW* (g)	*DWC* (g)	*DWL* (g)	*DWRZ* (g)	*DWRT* (g)	*TDW* (g)
First	3.58	22.59	1.75	38.83	4.33	2.01	1.35	1.90	0.79	5.96	0.91	0.84	0.87	0.43	3.01
Second	2.50	31.05	2.54	39.42	3.75	3.27	1.63	3.04	1.13	8.96	1.51	1.02	1.24	0.64	4.36
Third	2.13	45.97	3.91	63.04	3.17	6.45	2.35	4.67	1.85	15.20	2.90	1.42	2.12	0.93	7.31
$CD_{(0.05)}$	0.85	8.30	0.62	14.44	NS	1.62	0.57	1.09	0.45	2.86	0.73	0.33	0.55	0.24	1.48

Table 1.
(Continued)

C. Mean values of growth parameters for interaction effects (age of seedlings × position of rhizome (subunits)															
Age (months)	Position	Parameters													
		NOC	*HOC* (cm)	*BDC* (mm)	*NOL*	*NORSU*	*FWC* (g)	*FWL* (g)	*FWRZ* (g)	*FWRT* (g)	*TFW* (g)	*DWC* (g)	*DWL* (g)	*DWRZ* (g)	*DWRT* (g)	*TDW* (g)
6	1	3.38	18.90	1.78	21.75	4.42	1.42	1.08	1.53	0.68	4.57	0.57	0.72	0.74	0.43	2.35
	2	3.03	25.66	2.26	26.67	4.25	3.35	1.77	3.26	0.97	9.35	1.35	1.04	1.22	0.64	4.24
	3	2.67	39.94	3.90	43.17	7.84	6.92	2.64	5.23	2.29	17.07	2.94	1.61	2.27	1.02	7.84
12	1	3.83	26.29	1.73	55.92	4.42	2.60	1.63	2.27	0.89	7.72	1.25	0.97	1.01	0.47	3.83
	2	1.92	36.43	2.81	52.17	3.08	3.19	1.49	2.83	1.28	8.16	1.68	1.00	1.27	0.63	4.32
	3	1.58	52.00	3.93	82.92	2.75	5.99	2.07	4.10	1.42	13.33	2.86	1.24	1.97	0.83	6.79
$CD_{(0.05)}$		NS	NS	NS	NS	NS	NS	NS	NS	0.62	NS	NS	NS	NS	NS	NS

NOC = number of culms, *HOC* = height of culms, *BDC* = basal diameter of culms, *NOL* = number of leaves, *NORSU* = number of rhizome subunits, *FWC* = fresh weight of culms, *FWL* = fresh weight of leaves, *FWRZ* = fresh weight of rhizomes, *FWRT* = fresh weight of roots, *TFW* = total fresh weight, *DWC* = dry weight of culms, *DWL* = dry weight of leaves, *DWRZ* = dry weight of rhizomes, *DWRT* = dry weight of roots and *TDW* = total dry weight.

* $CD_{(0.05)}$ — critical differences at 5% level of significance; NS not significant.

than primary rhizome units. The propagules with larger rhizome subunits proliferate at a slower rate. This is in contrast to other rhizomatous crop like turmeric [2, 3] and ginger [4–6], where an increase in the size of rhizome of propagules leads to increased growth and yield of the crop.

The findings are significant and only propagules with larger rhizomes may be selected for field planting because they will result in faster growth. The propagules with smaller (primary) rhizome units show higher proliferation rates, and these should be retained in a rhizome bank for further multiplication work. The results indicate the criteria that can be used for selection of planting stock. If the age of seedlings is considered, the six-month-old seedlings are better than one-year-old ones.

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