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Effect of culm number in mother seedlings on growth and proliferation of *Dendrocalamus strictus* propagules

R. KUMAR * and M. PAL

Plant Physiology, Botany Division, Forest Research Institute, Dehra Dun, Uttaranchal, India

Abstract—Considering the problem of low proliferation rate of bamboo propagules, a study was conducted to see the effect of culm number, fertilizer application and their interaction on growth and proliferation behaviour of *Dendrocalamus strictus* Roxb. at the nursery of the Plant Physiology Branch, Forest Research Institute, Dehra Dun, India. Results of the study indicate that culm number and fertilizer application affect only the biomass of the plants, while the proliferation of the bamboo propagules was unaffected by these treatments ($P \leqslant 0.05$).

Key words: Proliferation; biomass; culm number; fertilizer

INTRODUCTION

Being a fast growing species, bamboo is a good plant for afforestation programmes. *Dendrocalamus strictus* is one of the most important bamboo species in India [1]. Due to long seeding cycles, the availability of bamboo seed is a major problem for large-scale production of planting stock. Now the time has come when rhizome banks should be established to meet this problem. Rhizome banks can supply the planting stock for plantation or multiplication purposes for a long time.

The growth and proliferation of bamboo propagules is affected by many factors [2]. The number of culms or tillers in bamboo seedlings shows a great variability; this may be due to environmental or genetic factors. These factors may be used as indicators of high proliferation capacity of bamboo propagules. Keeping in view the above-mentioned items, the present study was conducted to see the effect of different planting stocks with different number of culms on growth and proliferation of bamboo propagules. Further, the interaction of culm number with fertilizer application was also studied.

*To whom correspondence should be addressed. E-mail: sajwalr@yahoo.com

MATERIALS AND METHODS

Outline of the study

The study was initiated in August 1998. From the stock of six-month-old seedlings, two types of seedlings that were containing either two or four culms per seedling were selected for the study. Both types of seedlings were separated using the technique of macro proliferation and planted separately in polybags of 2 kg capacity. From each type of seedling, 30 propagules were taken, and divided into two sets of 15 propagules each. While one set did not receive any fertilizer treatment, the other set was treated with NPK (urea = 0.05 g/polybag; super-phosphate = 0.59 g/polybag and muriate of potash = 0.04 g/polybag) through the potting mixture.

Observations. After a period of again six months, plants were sampled and following observations were recorded.

Morphological parameters. Number of culms per clump (NOC), mean height of culms (HOC), mean basal diameter of culms (BDC), mean number of leaves (NOL), number of rhizome sub-units (NORSU).

Biomass parameters. Fresh weight of culms (FWC), fresh weight of leaves (FWL), fresh weight of rhizome (FWRZ), fresh weight of roots (FWRT), dry weight of culms (DWC), dry weight of leaves (DWL), dry weight of rhizome (DWRZ), dry weight of roots (DWRT).

Measurements of all parameters, except those pertaining to dry weights were carried out at the time of sampling. Length of culms was measured using a meter scale with markings down to 1 mm. Basal diameter of culms was recorded using a digital Vernier calliper. Weights were recorded on a digital pan balance. For dry weight determination, the plant components viz., culms, leaves, rhizomes and roots, were dried in an oven at 85°C, until their weight was constant, before final weighing. Total fresh and dry weights were calculated by summation of the weight of all parts of bamboo clumps in fresh and dry samples, respectively.

RESULTS

The propagules from different seedlings having different number of culms, i.e. 2 and 4 culms were planted in polybags and maintained under natural nursery conditions. After six months of planting the propagules, the data on growth and proliferation were recorded. The data are presented in Tables 1–3.

The results of analysis of variance (ANOVA) reveal that fresh and dry weights of rhizome and roots, and total fresh and dry weights were affected significantly ($P \leqslant 0.05$) by the culm number present in a clump of mother bamboo seedlings

Table 1.
Growth and proliferation behaviour of *Dendrocalamus strictus* seedlings influenced by number of culms per clump

Culm number	Parameter														
	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)
2	2.5	32.2	2.6	27.0	3.6	3.4	1.8	4.2	1.5	10.9	1.5	1.0	1.7	0.8	5.0
4	2.9	26.2	2.4	31.5	3.4	2.7	1.7	1.5	0.6	7.5	1.4	0.9	1.0	0.3	3.6
$CD_{(0.05)}$	NS	NS	NS	NS	NS	NS	NS	1.12	0.76	2.61	NS	NS	0.54	0.26	1.02

NOC = number of culms, HOC = height of culms, BDC = basal diameter of culms, NOL = number of leaves, NORSU = number of rhizome sub-units, 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.

Table 2.
Growth and proliferation behaviour of *Dendrocalamus strictus* seedlings influenced by fertilizer application

Fertilizer treatment	Parameter														
	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)
Yes	2.8	29.4	2.8	29.7	3.6	3.6	1.7	3.9	1.2	10.4	1.6	0.9	1.6	0.6	4.7
No	2.6	28.9	2.2	25.7	3.5	2.6	1.8	2.8	0.9	8.1	1.2	1.0	1.1	0.5	3.8
$CD_{(0.05)}$	NS	NS	NS	NS	NS	NS	NS	NS	NS	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 sub-units, 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.

Table 3.
Growth and proliferation behaviour of *Dendrocalamus strictus* seedlings influenced by interaction between culm number and fertilizer application

Culm number	Fertilizer treatment	Parameter														
		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)
2	Yes	2.3	31.2	2.8	27.3	3.4	3.4	1.3	4.2	1.5	10.4	1.5	0.7	1.8	0.8	4.8
	No	2.6	33.1	2.5	26.7	3.8	3.4	2.4	4.1	1.5	11.4	1.5	1.3	1.5	0.8	5.1
4	Yes	3.3	27.5	2.8	38.4	3.8	3.8	2.1	3.5	0.9	10.3	1.8	1.2	1.3	0.4	4.6
	No	2.5	24.8	2.0	24.7	3.1	3.1	1.2	1.5	0.3	4.7	0.9	0.7	0.6	0.2	2.5
$CD_{(0.05)}$		NS	NS	NS	NS	NS	NS	NS	NS	NS	3.69	0.60	0.29	NS	NS	1.44

(Table 1). Higher values of these parameters were recorded in propagules derived from seedlings bearing 2 culms only. Other all parameters were unaffected significantly by culm number at $P \leqslant 0.05$.

The fertilizer application did not have any significant effect on all growth and proliferation parameters at $P \leqslant 0.05$ (Table 2). Overall the higher values of all parameters were recorded in propagules treated with NPK fertilizer; except the dry weight of leaves (DWL) where the situation was reverse.

The interaction between culm number and fertilizer application affected only dry weight of culms and leaves, and total fresh and dry weights significantly at $P \leqslant 0.05$ (Table 3). In general, higher values were recorded in propagules derived from bamboo seedlings having 2 culm number which did not receive any fertilizer, except dry weight of culms, where higher value was recorded in propagules derived from bamboo seedlings having 4 culm number and treated with NPK fertilizer. In other parameters no specific pattern was found.

DISCUSSION

The results of this study show that the presence of the variable number of culms in mother seedlings did not have any statistically significant effect on proliferation rates of propagules. However the propagules derived from mother seedlings that had fewer culms exhibited superior growth over those derived from seedlings with higher number of culms. This can be concluded from higher values of fresh and dry weights of rhizome and total fresh and dry weights of the seedlings. The smaller number of culms in mother seedlings can provide a growth benefit to propagules, whereas a larger number of culm in mother seedlings does not give any benefit in proliferation rates. No report is available in literature on the effect of number of culms in mother seedlings on the growth or proliferation behaviour of propagules.

NPK fertilizer application did not influence significantly ($P \leqslant 0.05$) the growth and proliferation of propagules in terms of number of culms and total biomass of plants; on the contrary in propagules derived from seedlings with 2 culms it had negative effect. It may be due to the sufficient availability of mineral nutrients in the potting mixture. Uchimura [3] and Li *et al.* [4] have reported similar findings.

The present findings attract the consideration of the researchers working in this field and invite to study the important plant factors responsible for growth and proliferation rate of bamboo. Further, the study on fertilizer application should be conducted to optimise the proper dose for good growth and proliferation rates of bamboo seedlings.

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