GENETIC VARIABILITY AND SELECTION PARAMETERS IN *DENDROCALAMUS STRICTUS*

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SINGH, P., SRIVASTAVA, S. K., KUMARI, N., SRIVASTAVA, R. J. & DUBEY, P. 2004. Genetic variability and selection parameters in *Dendrocalamus strictus*. An experiment was conducted with 18 candidate plus clumps to measure the variability and association of different traits (diameter of culms, height of culms as well as number of internodes and length of internode). Ways to improve diameter of culms in *Dendrocalamus strictus* at the nursery stage were discussed. Analysis of variance showed differences in all the traits studied. High heritability with high genetic gain was observed for all the traits studied except for length of internode. Length of internode showed moderate heritability with moderate genetic gain. Both additive and non-additive genes were found effective for all the traits. Diameter of culm showed positive and significant association at the phenotypic, genotypic and environmental levels. Path correlation analysis, both at genotypic and phenotypic levels revealed that number of internodes showed maximum direct effect on diameter of culms.

Key words: Bamboo – heritability – genetic gain – candidate plus clumps traits – genotypic – phenotypic

SINGH, P., SRIVASTAVA, S. K., KUMARI, N., SRIVASTAVA, R. J. & DUBEY, P. 2004. Variasi genetik dan parameter pemilihan dalam *Dendrocalamus strictus*. Satu kajian dijalankan terhadap 18 rumpun buluh terbaik untuk menilai variasi dan hubungan antara ciri-ciri seperti diameter batang, ketinggian batang, bilangan ruas dan panjang ruas. Cara untuk membesarkan diameter batang *Dendrocalamus strictus* pada peringkat tapak semaian dibincangkan. Analisis varians menunjukkan perbezaan dalam ciri-ciri yang dikaji kecuali panjang ruas. Panjang ruas menunjukkan keterwarisan yang sederhana dengan gandaan genetik yang sederhana. Kedua-dua gen tambahan dan gen bukan tambahan didapati berkesan untuk semua ciri. Diameter batang menunjukkan hubungan yang positif dan bererti pada peringkat-peringkat fenotip, genotip dan persekitaran. Analisis korelasi pada peringkat-peringkat genotip dan fenotip menunjukkan bilangan ruas mempunyai kesan maksimum ke atas diameter batang.

Introduction

Bamboos are often giant, woody evergreen, perennial arborescent grasses belonging to the subfamily Bambusoideae of the family Poaceae. In India, there are 125 indigenous as well as exotic species spread over 23 genera. In Uttar Pradesh, *Dendrocalamus strictus* is the main bamboo species that occurs in the Vindhyan region. *Bambusa bambos* is found to a very limited extent occurring naturally in Haldwani forest division. Species mostly cultivated in the state of Uttar Pradesh are *B. tulda, B. nutans* and *D. strictus.* Bamboos are monocarpic and multi-purpose species that provide basic necessities of life such as fuel, food, shelter and play a significant role in national economy.

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Materials and methods

An extensive survey was conducted in natural forests/plantation areas of bamboo. A total of 18 candidate plus clumps were selected from different forest divisions of Vindhyan region. The details of the site are given in Table 1. Five rhizomes were randomly collected from each candidate plus clump. The selected rhizomes were planted in nursery at Kotwa at latitude 24° 28'–25° 31' N, longitude 82° 36'–83° 36' E and altitude 205 m asl, Mirzapur forest division in a randomised block design with four replications in raised beds (size 10 × 1 m and raised up to 20 cm from ground level). The beds were prepared with a mixture of soil, sand and well-rotted sieved farm yard manure (FYM) in 1:1:1 ratio. Before planting in beds, the rhizomes were treated with Bavestin fungicide (Carbendazim 50% WP) and then planted at a spacing of 1 × 1 m. The beds were irrigated by flooding as and when required.

The observations of sprouting of new culms were recorded quarterly. After one year of growth, the diameter of culms (cm), height of culms (cm), number of internodes and length of internode (cm) were recorded. Observations were based on one year's growth parameters.

Data were subjected to statistical analysis (Snedecor & Cochran 1967). The coefficients of variation were estimated using the formula of Burton and De Vane (1953). The broad sense (BS) heritability and expected genetic gain at 5% selection intensity were measured using the procedure of Allard (1960), while different association of characters were estimated as per Miller *et al.* (1958). Similarly, the path of action was worked out through the formula by Dewey and Lu (1959).

Results and discussion

Analyses of variance revealed highly significant differences for all the traits (Table 2). The highest phenotypic coefficient of variation (PCV) was observed for diameter of culms (44.5), followed by height (38.4), number of internodes (28.1) and length of internode (17.1). The highest genotypic coefficient of variation (GCV) was observed for diameter of culms, followed by height, number of internodes and length of internode. The highest difference observed between the two parameters was length of internode (3.2), followed by height of the culms (2.3) and number of internodes, indicating that these characters were more influenced by the environment. The difference between PCV and GCV was minimum for diameter of culms (0.5) indicating the stability of this character. The results were in accordance with the findings of Subramanian *et al.* (1995).

The heritability estimates indicate the heritable portion of the variation and estimates of genetic advance show the genetic gain that could be expected through selection in the character to be improved upon. Heritability in broad-sense includes additive and epistatic genetic effects; it is realised only if accompanied by high genetic advance (Allard 1960, Burton 1952). It is also suggested that

Table 1 Site details of candidate plus clump selected from different forest divisions of Vindhyan region

Location (forest division)	Forest type	Soil type	Latitude N	Longitude E	Mean temp. Max/Min (°C)	Mean annual rainfall (mm)
Renukoot	Tropical dry deciduous	Redish, sandy loam	23° 52'–24° 21'	82° 40'–83° 40'	33/22	1254
Renukoot	Tropical dry deciduous	Redish, sandy loam	"	"	33/22	1254
Obra	Tropical dry deciduous	Sandy loam yellow to brown in colour	24° 17'–24° 14'	82° 42'–83° 31'	25/8	1200
Obra	Tropical dry deciduous	Sandy loam yellow to brown in colour	"	"	25/8	1200
Obra	Tropical dry deciduous	Sandy loam yellow to brown in colour	"	"	25/8	1200
Obra	Tropical dry deciduous	Sandy loam yellow to brown in colour	"	"	25/8	1200
Obra	Tropical dry deciduous	Sandy loam yellow to brown in colour	"	"	25/8	1200
Obra	Tropical dry deciduous	Sandy loam yellow to brown in colour	"	"	25/8	1200
Obra	Tropical dry deciduous	Sandy loam yellow to brown in colour	"	"	25/8	1200
Obra	Tropical dry deciduous	Sandy loam yellow to brown in colour	"	"	25/8	1200
Mirzapur	Tropical dry deciduous	Laterite soil	24° 28'–25° 13'	82° 36'–83° 31'	34/19	875.50
Mirzapur	Tropical dry deciduous	Laterite soil	"	"	34/19	875.50
Mirzapur	Tropical dry deciduous	Laterite soil	"	"	34/19	875.50
Mirzapur	Tropical dry deciduous	Laterite soil	"	"	34/19	875.50
Mirzapur	Tropical dry deciduous	Laterite soil	"	"	34/19	875.50
Mirzapur	Tropical dry deciduous	Laterite soil	"	"	34/19	875.50
Mirzapur	Tropical dry deciduous	Laterite soil	"	"	34/19	875.50
Mirzapur	Tropical dry deciduous	Laterite soil	"	"	34/19	875.50

Table 2 Mean, range, phenotypic and genotypic coefficients of variation, heritability and genetic advance for four morphological traits in *Dendrocalamus strictus*

Character	Mean (μ)	PCV (%)	GCV (%)	Difference (PCV – GCV)	Heritability (%)	Genetic advance	Genetic gain (%)
Diameter	1.17**	44.50	44.00	0.50	97.8	1.05	89.92
Height	195.25**	38.44	36.17	2.27	88.5	136.88	70.10
Number of internodes	17.55**	28.06	25.85	2.21	84.9	8.60	49.20
Length of internode	10.91**	17.14	13.97	3.17	66.4	2.56	23.48

GCV along with heritability estimates would give the best picture of genetic advance for selection.

High heritability and sufficient genetic advance indicate the presence of additive genes for better selection. High heritability with high genetic gain was observed for all traits studied except for number of internodes and length of internode where high heritability with moderate genetic gain was observed, indicating the importance of both additive and non-additive gene effects.

The genotypic correlation coefficients were generally higher than the corresponding phenotypic values (Table 3). Diameter of culms showed highly significant and positive correlation with height (0.886), number of internodes (0.925) and length of internode (0.582). Likewise, culm height was highly associated with number of internodes (0.957) and length of internode (0.796). Similarly, number of internodes showed positive correlation with length of internode (0.619) but had negative environmental effect with length of internode (-0.275). The results were in accordance with earlier reports of mulberry and (Tikader & Ray 1999) *Dalbergia sissoo* (Dhillon *et al.* 2000).

The genotypic path analysis (Table 4) showed that number of internodes had high positive and direct effect on diameter of culms. The number of internodes,

Table 3 Correlation coefficients between different morphological traits in *Dendrocalamus strictus*

Character		Diameter of culms	Height	Number of internodes
Height	rg	0.886**		
	rp	0.845**		
	re	0.405**		
Number of internodes	rg	0.925**	0.957**	
	rp	0.857**	0.914**	
	re	0.247	0.640**	
Length of internode	rg	0.582**	0.796**	0.619**
	rp	0.493**	0.696**	0.403**
	re	0.272**	0.435**	-0.275*

rg = Genotypic correlation; rp = phenotypic correlation; re = environmental correlation
* Significant at the 0.05 probability level; ** Significant at the 0.01 probability level

Table 4 Genotypic path for four morphological traits in *Dendrocalamus strictus*

Character	Height	Number of internodes	Length of internode	Genotypic correlation for diameter
Height	-0.107	0.953	0.040	0.886**
Number of internodes	-0.102	0.997	0.031	0.925**
Length of internode	-0.085	0.617	0.050	0.582**

Values underlined show direct effect; Residual effect = 0.1433

Table 5 Phenotypic path for four morphological traits in *Dendrocalamus strictus*

Character	Height	Number of internodes	Length of internode	Phenotypic correlation for diameter
Height	-0.118	0.637	0.090	0.845**
Number of internodes	-0.108	0.697	0.052	0.857**
Length of internode	-0.082	0.281	0.130	0.493**

Values underlined show direct effect; Residual effect = 0.2387

via height and length of internode helped in the improvement of diameter of culms. At the phenotypic level (Table 5), number of internodes had the highest positive direct effect, followed by length of internode. Culm height also improved the diameter of culms.

Results showed that diameter of culms was a principal characteristic which might be used in selection of superior candidate plus clumps of *D. strictus*.

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