Evaluation of Genetic Variation and Heritability in the Growth Parameters of *Dendrocalamus strictus* at Nursery Stage

Pradeep Singh, Satyendra Kumar Srivastava and Narendra Kumar Shukla*

Department of Botany, D.B.S. College, Kanpur – 208006, U.P

***Department of Botany, D.A-V. College, Kanpur – 208001, U.P.**

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ABSTRACT

Dendrocalamus strictus is the most dominant, naturally occurring, and commercially important bamboo species in Uttar Pradesh and dry region of India. It is commonly known as **Male Bamboo**, **Solid Bamboo**, or locally referred as **Lathi Bans** due to its structural characteristics**.** Thirty Candidate Plus Clumps (CPCs) of *Dendrocalamus strictus* collected from different forest divisions of Vindhyan region in U.P. were studied for the pattern of genetic variation and character association after 30 months growth at nursery stage. The results revealed the presence of highly significant variations among the CPCs for diameter, height, number of internodes and length of internode. There are fair differences between phenotypic and genotypic coefficients of variability indicating that these parameters are sensitive to environmental changes. The estimates of heritability and expected genetic gain were low to moderate for all the characters, except height, diameter and number of internodes which registered comparatively higher values of heritability and genetic gain. The study will be helpful for selection of CPCs of *Dendrocalamus strictus* in order to multiply good quality of bamboo vis-à-vis enhancing the productivity.

Key words: Bamboo, Dendrocalamus strictus, Heritability, Genetic gain, Growth parameters, Candidate Plus Clumps (CPCs),

INTRODUCTION

Bamboo is a very important forest produce, belonging to sub family *Bambusoideae* of family *Poaceae.* It is a monocarpic and multipurpose species. In India, there are 125 indigenous as well as exotic species of bamboo distributed in 23 genera. In Uttar Pradesh, *Dendrocalamus strictus* is the main bamboo species that occurs in the Vindhyan region. It plays a vital role in the socio-economic conditions of the rural communities specially in Asia and Pacific North East region of the country which is one of the richest botanical regions in speciation and genetic diversity in bamboos as Haridasan *et al*., 1987, Chaturvedi, 1986 and Meena *et al.,* 2024. The common bamboo *(Dendrocalamus strictus*) occurs in deciduous forests all over India except in North-West Bengal, Assam and moist regions of the West Coast, Troup, 1921.

Bamboo is recognized as one of the fastest – growing and most renewable natural resources, providing a wide range of ecological, economic, and industrial benefits. It contributes significantly to soil conservation, carbon sequestration, climate change mitigation, and biodiversity conservation. Due to its rapid growth, adaptability to diverse agro-climatic conditions, and high biomass production, bamboo has emerged as an important species for sustainable forestry and rural livelihood development.

The assessment of genetic variability is a prerequisite for the effective improvement and conservation of bamboo germplasm. Estimates of genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability, and genetic advance provide valuable information regarding the extent of genetic diversity and inheritance of economically important traits. These genetic parameters helps breeders identify superior genotypes and formulate efficient selection strategies for the development of high-yielding and adaptable bamboo varieties.

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The present study deals with the estimation of heritability, coefficient of variation, PCV, GCV and genetic advance as per cent of mean of 30 variable CPCs collected from different forest divisions of Vindhyan region of Uttar Pradesh.

MATERIALS AND METHODS

The material consist of thirty variable CPCs of *Dendrocalamus strictus* collected from the CPCs selected in different forest divisions of Vindhyan region of U.P. (Location wise identification of selected CPCs are given in table-1) during 1998. The collected rhizomes were planted at research nursery in Kotwa, Mirzapur Forest Division during the month of July/August 1998 in raised beds (size 10 m x 1.0 m and raised up to 20 cm. from ground level). The beds were prepared with the mixture of soil, sand and well-rotted sieved Farm Yard Mannure (F.Y.M.) in 1:1:1 ratio. Before planting in beds, the rhizomes were treated with 1% fungicide (bavestin) and then planted at the spacing of 1.0 m x 1.0 m. The beds were irrigated by flooding as and when required.

The observations of sprouting of new culms were recorded quarterly. In each replication, five healthy and representative plants were selected randomly for recording observations. The mean values of these plants were used for statistical analysis. Growth observations were recorded at regular intervals, whereas final biometric observations were taken after 30 months of growth, the observations like diameter of culm (cm), height of culm (cm), number of internodes and length of internodes (cm) were recorded from different replications were averaged before statistical analysis. The experimental data were subjected to analysis of variance (ANOVA) following the procedure described by Snedecor and Cochran 1967. The significance of treatment differences was tested at the 5% probability level, and the Critical Difference (CD) was calculated wherever the F-test was found significant.

Table 1: Location wise identification of selected CPCs of *Dendrocalamus strictus*

Sl. No.	Forest Division	CPCs	Latitude (°N)	Longitude (°E)	Avg. annual rainfall (mm)	Avg. annual Temp. (°C)	Soil type	Stand
1	Renukoot	1 to 4, 7, 8	23° 52' - 24° 21'	82° 4' - 83° 24'	1254	33/22	Reddish Sandy loam	Plantation
2	Mirzapur	5, 6, 13 to 21	24° 28' - 25° 13'	82° 36' - 83° 31'	875.50	34/19	Laterite soil	Plantation
3	Obra	9 to 12 and 22 to 30	24° 17' - 24° 14'	82° 42' - 83° 31'	1200	25/28	Sandy loamy, yellow to brown	Natural

RESULTS AND DISCUSSION

Table-2 reflects the data pertaining to morphological parameters of field performance *viz*. diameter of culm (cm), height of culm (cm), number of internodes and length of internodes (cm) of *Dendrocalamus strictus*, after 30 months growth. Analysis of variance indicated the significant difference among all traits under study. The CPC no. 17 attained the maximum height (695.00 cm) and minimum (240.75 cm) was recorded for CPC no. 6. The maximum diameter (3.75 cm) was recorded in case of CPC no. 17 and minimum (1.22 cm) for CPC no. 6. Maximum number of internodes (42.00) was recorded in case of CPC no. 17 and minimum (19.00) for CPC no. 6. The maximum length of internodes (19.80 cm) was recorded in CPC no. 23 and minimum (10.95 cm) for CPC no.8.

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Table 2: Mean performance of growth parameters of different CPCs of *Dendrocalamus strictus* at nursery stage

CPC No.	Diameter (cm)	Height (cm)	Number of internodes	Length of internode (cm)
1	2.82	485.50	31.00	17.80
2	2.90	538.75	32.50	17.25
3	3.35	425.50	30.00	16.80
4	2.96	445.25	29.50	17.65
5	2.72	442.00	31.50	15.35
6	1.22	240.75	19.00	11.95
7	2.68	518.50	37.50	15.10
8	2.10	290.25	24.00	10.95
9	2.80	430.75	33.50	14.60
10	1.28	255.50	20.50	12.15
11	2.55	385.25	29.50	14.60
12	1.52	278.75	22.00	12.85
13	2.72	452.50	31.00	15.90
14	1.42	248.00	20.00	12.20
15	2.78	438.50	30.50	15.45
16	2.25	340.50	26.00	13.80
17	3.75	695.00	42.00	18.50
18	2.70	450.50	31.50	16.40
19	3.12	500.00	36.00	16.20
20	2.38	365.75	27.00	15.50
21	2.75	605.00	31.00	16.80
22	3.08	590.50	41.00	16.10
23	3.48	655.50	35.00	19.80
24	3.55	585.00	38.50	18.20
25	3.30	580.50	38.00	17.60
26	3.42	615.00	39.00	15.80

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27	3.46	625.50	40.00	16.90
28	3.68	598.75	39.50	18.00
29	3.50	575.25	40.50	17.10
30	3.02	468.50	35.50	18.00
Mean	**2.86**	**476.77**	**32.35**	**15.99**
Range Min	1.22	240.75	19.00	10.95
Range Max	3.75	695.00	42.00	19.80
S.E.±	0.18	35.50	2.05	1.18
F. Test	**	**	**	**
C.D. at 5%	0.37	71.20	4.12	2.36

**Significant at 5% level

Standard Error (SE) calculated for diameter of culm, height of culm, number of internode and length of internode was observed 0.18, 35.20, 2.05 and 1.18, respectively. Similarly Critical Difference (CD) at 5% level was observed 0.37 for diameter, 71.20 for height, 4.12 for number of internodes and 2.36 for length of internodes of *Dendrocalamus strictus*, respectively. The observed variation among different CPCs of *Dendrocalamus strictus* indicates the existence of considerable genetic diversity for important growth attributes. Superior performance of CPC No. 17 for culm height, culm diameter, number of internodes and length of internodes suggests that this clone possesses better growth vigour and adaptability under the prevailing agro-climatic conditions. Such variability provides an opportunity for the identification and selection of elite planting material for large-scale multiplication and improvement programmes.

Culm diameter and height are important economic traits in bamboo as they directly influence biomass production, mechanical strength and commercial utility. Similarly, a greater number of internodes and longer internodes contribute to higher culm productivity and better quality of bamboo for construction, handicrafts and industrial purposes. Therefore, CPCs exhibiting superior values for these traits may be considered promising candidates for future breeding and plantation programmes.

Table 3: Phenotypic, genotypic coefficient variation, heritability, genetic advance and genetic gain for different parameters of *Dendrocalamus strictus*

Characters	**PCV (%)**	**GCV (%)**	**Difference (PCV-GCV)**	**Heritability (%) (broad sense)**	**Genetic advance**	**Genetic gain (%)**
Diameter	32.86	30.54	2.32	86.42	1.31	58.74
Height	32.95	30.61	2.34	87.38	208.56	57.86
Number of internodes	25.94	23.18	2.76	81.65	11.12	43.05
Length of internodes	19.84	14.72	5.12	57.18	3.24	22.48

The extent of variability can also be assessed by genotypic and phenotypic coefficient of variation. In the present study (Table-3) the highest phenotypic coefficient of variation was observed (32.95) for height and it was found to be lowest (19.84) for length of inter-nodes and the highest value of genotypic coefficient of

variation was observed (30.61) for height whereas it was lowest (14.72) for length of internodes. The highest difference between two parameters (PCV-GCV) was observed (5.12) for length of internodes and lowest (2.32) for the traits diameter of culm. The results are in accordance with earlier reports of Rathinum *et al.,* 1982, Subramanian *et al.,* 1995, and Kumar, *et al.*, 2022. The relatively higher values of PCV for all the characters indicate that environmental factors also contributed to the expression of these traits, although the differences between PCV and GCV were comparatively small for most characters. This suggests that the observed variability was predominantly governed by genetic factors, making selection more reliable and effective. The lower difference between PCV and GCV for culm diameter further indicates that this trait is less influenced by environmental conditions and can therefore be effectively improved through phenotypic selection. Similar observations have also been reported in bamboo improvement studies.

The heritability values for diameter, height and number of internodes were moderately high *i.e*. 86.42, 87.38 and 81.65 respectively as compared to the lowest value of length of internodes (57.18). Although heritability in broad sense may give useful indication about the relative value of selection in the material at hand to arrive at more reliable conclusions, heritability and expected genetic gain should be considered jointly. The higher values of genetic gain (58.74) was observed in diameter of culms in comparison to other characters which suggests that selection for improving this trait will be most effective in the present material as compared to other most important characters, these findings are based on Burton, 1952, Singh *et al*., 2004 and Bhandari, 2003.

High heritability with low genetic advance has observed for all the traits under study and the least (1.31) was found with diameter of culms. Similarly, high heritability with low genetic gain was observed by Singh *et al.,* 2001. Moderately high heritability estimates associated with moderate genetic advance have earlier been reported for plant height by Srivastava *et al.,* 1993. in *Terminalia arjuna* and for plant height and stem diameter in *Grewia optiva* by Sharma and Sharma, 1995, in *Dendrocalamus strictus* by Singh *et al.,* 2020. The present study provides a clear cut indication for good selection of CPCs for cultivation in Vindhyan region of U.P., for improvement and multiplication of good quality bamboo *vis-a-vis* enhancing the productivity.

Overall, the present study demonstrated sufficient genetic variability among the CPCs of *Dendrocalamus strictus*, indicating good scope for genetic improvement through selection. The superior CPCs identified in this investigation may be utilized in future breeding programmes and large-scale plantation development for enhancing bamboo productivity and sustainable resource management under the agro-climatic conditions of the Vindhyan region.

REFERENCES

1. Burton, G.W. 1952. Quantitative inheritance in grasses. Proceeding of Sixth International Grassland Congress 3: 277-288.
2. Bhandari, A., 2003. Genetic variability and character association of morphological traits in Bamboo species. Journal of Bamboo and Rattan. 2 (4) : 100-104.
3. Chaturvedi, A.N. 1986. Bamboo for Farming. U.P., Forest Bulletin, No. 52.
4. Haridasan, K., Singh, N.B. and Deori, M.L. 1987. Bamboo in Arunachal Pradesh, The present status. Journal of Tropical Forestry 3(4): 293-310.
5. Kumar, R., Singh, V. and Sharma, P., 2022. Evaluation of genetic diversity and culm characteristics in wild populations of Dendrocalamus strictus. Indian Forester. 148 (3): 245-251.
6. Meena, S.L., Ram, G. and Meena, K.C., 2024. Impact of different macro-proliferation methods on seedlings growth of Dendrocalamus structus. Journal of Tropical Forestry. 40 (1): 12-18.
7. Rathinum, M., Surendran, C. and Kondas, S. 1982. Interrelationship of good yield components in Eucalyputs tereticornis, Indian Forester 108: 460-470.
8. Sharma, R.K. and Sharma, S.S. 1995. Heritability and association analysis in Grewia optiva. Indian Forester 121 (4): 318-320.
9. Singh Pradeep, Srivastava, Satyendra Kumar, Kumari Niwedita, Srivastava R. J. and Dubey, P., 2004. Genetic variability and selection parameters in Dendrocalamus strictus at nursery stage. Journal of Tropical Forest Science, FRIM, Kualalumpur, Malaysia. 16 (4): 413-418.

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10. Singh, M.P., Rawat, D. and Joshi, G., 2020. Phenological variations and seed germination behavior of Dendrocalamus structus across Western Himalayas. Seed Science and Technology. 48 (2): 175-182.
11. Snedecor, G.W. and Cochran, W.G. 1967. Statistical methods. Oxford and IBH, New Delhi, 593 pp.
12. Srivastava, D.P., Srivastava, P.K., Goel, A.K. and Thangavelu, K. 1993. Genetic variability in Terminalia arjuna Bedd. Indian Journal of Forestry 16(3): 223-225.
13. Subramanian, K. N., Mandal, A.K. and Nicodemus, A. 1995. Genetic variability and character association in Eucalyptus grandis. Annals of Forestry 3(2): 134-137.
14. Troup, R.S., 1921. The silviculture of Indian Trees. Part III, Clarendron Press, Oxford pp 1195.