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Original Research Article

Genetic Architecture in Proso Millet (*Panicum miliaceum* L.)

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A B S T R A C T

Proso millet (*Panicum miliaceum* L.) is climate resilient crop as it has wider adaptation to many soils and climatic conditions. Thirty five progenies in M_4 generation along with one check revealed significant variation for all the eleven characters under study. The magnitudes of phenotypic variances were found to be greater than genotypic variances. The plant height and 1000 grain weight recorded maximum and minimum phenotypic variance, respectively. Similarly, magnitude of genotypic variance was higher for plant height and minimum for thousand grain weight. In general, phenotypic coefficients of variation were greater in magnitude over the respective genotypic coefficient of variation High heritability with high genetic advance as percentage of mean was observed for grain yield per plant, harvest index, straw yield per plant and panicle weight. High heritability with high genetic advance as percentage of mean was observed for grain yield per plant, harvest index, straw yield per plant and panicle weight can be due to additive gene effects. These traits may be improved through selections.

Introduction

Proso millet (*Panicum miliaceum* L.) is climate resilient crop as it has wider adaptation to many soils and climatic conditions. Proso millet requires very little water, possibly the lowest water requirement of any cereal, and converts water most efficiently to dry matter/grain (Singh *et al.*, 2013). In India, it is cultivated over an area of 9.03 lakh ha with total production of 4.45 lakh tonnes, during 2014-2015. In Maharashtra, largest area is found under millets in Konkan region and on hill slopes of Sahyadri Mountains. The share of proso millet of the total recorded millet trade has been estimated at about two-third (Anonymous, 2014). It also possesses special characters for adoption under adverse climatic conditions such as drought, high temperature, low soil fertility and occurrence of disease and pests. It is important minor millet being a short duration crop (80-120 days) with relatively low water requirement, escapes drought period. Proso millet is known for its nutritional value. The seeds are rich source of protein (12-13%) and have long storability under ambient conditions and hence, suitable as famine reserve (Ramesh, 1998).

The husked grains of proso millet are eaten whole, boiled like rice or eaten after roasting. A variety of products can be prepared from proso millet. It is beneficial in anti-ageing, nervous system, preventing cardiac diseases preventing pellagra and other Niacin dependent conditions, useful for strengthening bones, helps to lower cholesterol, decreases risk of cancer, rich source of essential phosphorus, help prevent gall stones. Apart from these, it has many other benefits too. It is beneficial for post-menopausal women suffering from signs of heart ailments, they combat high blood pressure, provide Iron, Vitamin B6, Zinc which are all essential for our day to day functioning. It is rich in lysine, an amino acid, which is inadequate in most of the cereals. It contains lysine as high as 4.6 per cent of the total proteins. In addition to protein, it also contains about 1.1 per cent crude fat, 68.9 per cent carbohydrates, 2-3 per cent minerals and 2.2 per cent crude fibre, 3.4 per cent ash, calcium 14 mg, phosphorous 206 mg and iron 5 mg per 100 grams (Gopalan *et al.*, 1987).

Materials and Methods

The present investigation was carried out at the Educational Research Farm, Department of Agricultural Botany, College of Agriculture, Dapoli, District Ratnagiri, (M.S) during *kharif* 2016. The soil of the experimental site was lateritic. Geographically, Dapoli is situated in the subtropical region on the 17˚45' North latitude and 73˚12' East longitude having an elevation of 250 meters above mean sea level.

The experimental material for the study consisted of 35 promising plants selected from M_3 generation in *kharif* 2015 and Vari No. 10 as control. The list of genotype is given in Table 1.

The seedlings were prepared on raised beds. Thirty ays old seedlings were transplanted as one seedling per hill in main field. The fertilizer dose of 80 N: 40 P: 40 K kg per hectare and other recommended practices were carried out to grow the healthy crop. The experiment was conducted in randomized block design with three replications. The plot size was 1.20 x 2.25 m with 30 X 15 cm spacing.

Observations were recorded on five randomly selected plants of each genotype in each replication. The randomly selected plants were tagged for recording the observations. Following characters were studied. Eleven characters *viz.*, Days to initiation flowering, Days to fifty per cent flowering, Days to maturity, Plant height (cm), Number of tillers per plant, Panicle length (cm), Panicle weight (g), 1000 grain weight (g), Straw yield per plant (g), Harvest index (%), Grain yield per plant (g). The data available on individual plant characters were subjected to the method of analysis of variance commonly applicable to the randomized block design (Panse and Sukhatme, 1985). Components of variation and geneic advance were analyzed as suggested by Johnson *et al.*, 1955.

The genotypic and phenotypic coefficients of variations were calculated as per the formulae given by Burton and De vane (1953). Range of Variation was categorized as proposed by Siva Sivasubramanian and Menon (1973). Heritability in broad sense estimated for various characters by the formula suggested by Lush (1949) and catogorised as suggested by Stansfield (1969).

Experimental results

Genetic variability

The results of analysis of variance are presented in Table 2. The mean sum of square among the genotypes was significant for all the eleven characters under study. It showed that all these characters have significant variation. The genotype and error mean sum of squares were further used for analysis of genotypic and phenotypic variances.

Components of variation

The total variation was partitioned into genotypic, phenotypic and environmental variance. The estimates of variance due to these three components for eleven characters are presented in Table 3. The phenotypic, genotypic and environmental variances for various characters ranged from 0.02 to 92.53, 0.01 to 23.72 and 0.02 to 68.81 respectively. The magnitudes of phenotypic variances were greater than genotypic variances. The phenotypic variance was maximum for plant height (92.53) and minimum for 1000 grain weight (0.02). Similarly, magnitude of genotypic variance was higher for plant height (23.72) and minimum for thousand grain weigh (0.01). The magnitude for environmental variance was higher for plant height (68.81) and lowest for thousand grain weight (0.02).

Coefficient of variation

The estimates of coefficient of variation at phenotypic level and genotypic level are given in Table 4. The amount of genetic variation present in the M_4 generation was worked out in terms of the genotypic coefficient of variation. In general, phenotypic coefficients of variation were greater in magnitude over the respective genotypic coefficient of variation. The moderate genotypic coefficient of variation was exhibited by grain yield per plant (11.32%), while the lowest GCV was by days to fifty per cent flowering (2.83%). Similar result also reported by Nirmalakumari *et al.,* (2007) in little millet.

Table.1 List of genotypes for M_4 generation study on proso millet

Sr. No.	Genotypes	Designated as	Sr. No.	Genotypes	Designated as
1	20 KR 21-1-1	No.1	19	20 KR 223-4-21	No.19
2	20 KR 13-10-3	No.2	20	20 KR 5-6-23	No.20
3	20 KR 2-1-4	No.3	21	20 KR 221-7-24	No.21
4	20 KR 41-1-5	No.4	22	20 KR 106-1-25	No.22
5	20 KR 23-20-7	No.5	23	20 KR 42-19-26	No.23
6	20 KR 18-1-8	No.6	24	30 KR 15-1-27	No.24
7	20 KR 8-1-9	No.7	25	30 KR 1-6-28	No.25
8	20 KR 205-12-10	No.8	26	30 KR 2-9-29	No.26
9	20 KR 229-13-11	No.9	27	30 KR 194-2-32	No.27
10	20 KR 43-1-12	No.10	28	40 KR180-1-34	No.28
11	20 KR 9-3-13	No.11	29	40 KR 190-2-37	No.29
12	20 KR 216-8-14	No.12	30	50 KR 35-17-38	No.30
13	20 KR 107-1-15	No.13	31	60 KR 101-19-41	No.31
14	20 KR 218-19-16	No.14	32	60 KR 102-2-46	No.32
15	20 KR 230-5-17	No.15	33	60 KR 87-1-48	No.33
16	20 KR 197-1-18	No.16	34	60 KR 25-5-51	No.34
17	20 KR 11-1-19	No.17	35	60 KR 93-7-52	No.35
18	20 KR 118-3-20	No.18	36	Vari No.10 (Control)	No.36

Table.2 Analysis of variance in proso millet

Sr. No.	Characters	Mean sum of squares		
		Replications (2)	Genotypes (35)	Error (70)
1.	Days to initiation flowering	9.59	30.09**	13.55
2.	Days to fifty per cent flowering	10.73	30.21**	15.49
3.	Days to maturity	75.70	62.07**	31.67
4.	Plant height (cm)	108.20	139.96**	68.81
5.	Number of tillers per plant	0.02	0.50**	0.22
6.	Panicle length (cm)	3.58	17.49**	7.29
7.	Panicle weight (g)	0.15	1.31**	0.23
8.	1000 grain weight (g)	0.031	0.035**	0.018
9.	Straw yield per plant (g)	7.25	55.32**	9.44
10.	Harvest index (%)	0.84	11.94**	0.96
11.	Grain yield per plant (g)	0.07	2.64**	0.51

** Significant at 1% level (Figures in parentheses denotes degrees of freedom)

Table.3 Estimate of phenotypic (σ^2p), genotypic (σ^2g) and environmental (σ^2e) variance in M4 generation of proso millet

Sr. No.	Characters	σ^2p	σ^2g	σ^2e
1	Days to initiation flowering	19.07	5.51	13.55
2	Days to fifty per cent flowering	20.40	4.91	15.49
3	Days to maturity	41.81	10.13	31.68
4	Plant height (cm)	92.53	23.72	68.81
5	Number of tillers per plant	0.32	0.09	0.23
6	Panicle length (cm)	10.70	3.40	7.30
7	Panicle weight (g)	0.60	0.36	0.24
8	1000 grain weight (g)	0.02	0.01	0.02
9	Straw yield per plant (g)	24.73	15.29	9.44
10	Harvest index (%)	4.63	3.66	0.97
11	Grain yield per plant (g)	1.23	0.71	0.52

Table.4 Estimates of genetic parameters for various characters in M_4 generation of proso millet

Sr. No.	Characters	PCV (%)	GCV (%)	h^2bs (%)	GA	GAM (%)
1.	Days to initiation flowering	5.99	3.22	28.92	2.60	3.57
2.	Days to fifty % flowering	5.78	2.83	24.06	2.24	2.86
3.	Days to maturity	5.79	2.85	24.24	3.23	2.89
4.	Plant height (cm)	7.09	3.59	25.63	5.08	3.74
5.	Number of tillers per plant	11.83	6.36	28.91	0.34	7.05
6.	Panicle length (cm)	8.10	4.56	31.78	2.14	5.30
7.	Panicle weight (g)	12.53	9.75	60.52	0.96	15.62
8.	1000 grain weight (g)	10.11	4.92	23.65	0.08	4.92
9.	Straw yield per plant (g)	14.18	11.15	61.83	6.33	18.06
10.	Harvest index (%)	12.25	10.89	79.12	3.51	19.96
11.	Grain yield per plant (g)	14.90	11.32	57.72	1.32	17.71

The moderate phenotypic coefficient of variation was observed for grain yield per plant, straw yield per plant, harvest index, panicle weight, number of tillers per plant and thousand grain weight, while low for panicle length and plant height. The moderate genotypic coefficient of variation was observed for grain yield per plant, straw yield per plant and harvest index, while low for panicle weight, number of tillers per plant, thousand grain weight and panicle length. The days to fifty per cent flowering and days to maturity exhibited least GCV and PCV. Similar results were also recorded by Verulkar *et al.,* (2014), Dikshit and Natarajan (2013) and Bhave *et al.,* (2016) in proso millet.

Heritability and genetic advance

Heritability in broad sense ranged from 23.65 to 79.12 per cent. High heritability values were computed for harvest index (79.12%) followed by straw yield per plant (61.83%).

Similar kinds of result also reported by Baghel and Maloo (2002), Salini, *et al.,* (2010) in proso millet. The moderate heritability estimate were recorded in thousand grain weight (23.65%) followed by days to fifty percent of flowering (24.06) and days to maturity (24.24%).

Genetic advance gives the magnitude of improvement per cycle in the base population by selection. The genetic advance was ranged from 0.08 to 6.33. The highest estimates of genetic advance were recorded in character, straw yield per plant (6.33) followed by plant height (5.08), whereas lowest estimates of genetic advance recorded in thousand grain weight (0.08) followed by number of tillers per plant (0.34). Similar kinds of result also reported by Salini, *et al.,* (2010) in proso millet.

The range of genetic advance as percentage of mean was from 2.86 to 19.96 per cent. The moderate value was observed in harvest index (19.96%) followed by straw yield per plant (18.06%), grain yield per plant (17.71%) and panicle weight (15.62%), while the low value in days to fifty per cent flowering (2.86%) followed by days to maturity (2.89%).

High heritability with high genetic advance as percentage of mean was observed for grain yield per plant, harvest index, straw yield per plant and panicle weight. High heritability accompanied with high genetic advance indicates that mostly likely the heritability is due to additive gene effects and selection may be effective.

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