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Genetic Diversity in Proso Millet (*Panicum milliaceum* L.)

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ABSTRACT: The experimental material consists of seventy genotypes with four checks of proso millet germplasms which were collected from NBPGR New Delhi and IIMR, Hyderabad. The experiment was laid out in Randomized Block Design with two replications during late *rabi* 2022. Observations were recorded on nine yield and yield contributing characters i.e. days to 50 per cent flowering, days to maturity, productive tillers per plant, plant height (cm), ear head length (cm), grain yield per plant (g), 1000 grain weight (g), fodder yield per plant (g) and protein content (%). The analysis of variance showed highly significant differences among the genotypes for all characters under study. The estimates of genotypic coefficient of variation (GCV) were lower than phenotypic coefficient of variation (PCV) for all the characters under study. The GCV and PCV both were observed to be high for productive tillers per plant, fodder yield per plant, grain yield per plant and 1000 grain weight. The character 1000 grain weight showed highest heritability followed by days to 50 per cent flowering, protein content, productive tillers per plant, days to maturity, grain yield per plant and fodder yield per plant respectively. The character fodder yield per plant showed highest genetic advance followed by plant height and days to 50 per cent flowering.

Keywords: Proso millet, Variability, GCV, PCV and Heritability.

INTRODUCTION

Proso millet is a potential crop for food and national food security. The extent of food insecurity among the evergreen population as well as prevalence of malnutrition and under nutrition among the children, reinstate the requirement of a nutritious diet that millets and other traditionally important crops can address. The progress made in genetics, genomics and other omnics of proso millet that would pay for improvement using biotechnological as well as breeding investigation (Ravikesavan and Francis 2020). As it is a short duration crop and completes its life cycle within 60 to 100 days with minimum water requirement, it is perfectly suitable to cultivate during hot, dry and short summer seasons. It has high nutritive value as compared to major cereal grains. It contains Protein - 11%, Fat - 3.5%, Crude fiber - 9%, Ash - 3.5%, Starch - 56.1%, Total dietary fiber - 8.5%. Proso millet is a good source of minerals like Calcium, Phosphorus, Potassium, Sodium, Magnesium, Iron, Manganese, Zinc, Thiamin and Nicotonic acid as described by earlier workers Kalinova (2007). It can prevent constipation and is therefore quite effective as preventive food against colon cancer (Das *et al.*, 2019). An insight into the nature and magnitude of genetic variability present in the gene pool is of immense value for starting any systematic breeding programme (Anuradha *et al*., 2017). Proso millet germplasm representing a wide genetic diversity is conserved in gene banks maintained by several countries. There are very low number of high yielding varieties are available in the country. In Maharashtra state, it is cultivated in particular areas with local landraces. Studies on knowledge of genetic variation is essential to start the breeding for the improvement in yield potential along with quality characters. Hence the present investigation was carried out to evaluate the large number of germplasm for further improvement in development of variety of the crop for the state.

MATERIAL AND METHODS

The present investigation to study the genetic diversity in proso millet (*Panicum miliaceum* L.) was conducted at Post Graduate Research Farm, R.C.S.M. College of Agriculture, Kolhapur during late *rabi*, 2022. The experimental material consists of 70 number of proso millet genotypes with 4 checks which were collected from NBPGR and IIMR, Hyderabad. The experiment was laid out in randomized block design. The field was divided into two homogenous replication blocks.

Seventy-four genotypes were planted randomly in two replications. Each entry was represented by a single row of 3 m length spaced at 30 cm between the rows and 10 cm between the plants within the rows. All agronomical practices were followed to maintain plant population.

Observations on the five randomly selected plants from each genotype in each replication were recorded on yield and yield contributing characters during the course of the experiment. The data was recorded for the character days to 50 per cent flowering, days to maturity, productive tillers per plant, plant height (cm), earhead length (cm), grain yield per plant(g), 1000 grain weight (g), fodder yield per plant (g) andprotein content(%).

The mean values of five randomly selected observational plants for nine different characters were used for statistical analysis. The analysis of variance was done as suggested by Panse and Sukhatme (1985). The phenotypic and genotypic variances were calculated by utilizing the respective mean square values from the variance table (Johnson *et al.*, 1955). Heritability percentage in broad sense was estimated for various characters as per the formulae given by Burton and Devane (1953). The genetic advance was calculated in per cent by the formulae suggested by Johnson *et al.* (1955).

RESULT AND DISCUSSION

The analysis of variance for nine characters is presented in Table 1. It was revealed that there were highly significant differences among the genotypes for all characters under study, showing wide variation in 74 genotypes of proso millet.

Table 1: Analysis of variance for different characters in proso millet.

Sr. No.	Characters	Mean Sum of Square		
		Replication (df=1)	Treatment (df=73)	Error (df=73)
1.	Days to 50% flowering (No.)	0.027	45.283**	1.580
2.	Days to maturity (No.)	0.168	37.952**	2.770
4.	Plant height (cm)	39.129	260.171**	60.450
3.	Productive tillers/plant (No.)	0.011	9.338**	0.400
5.	Ear head length (cm)	9.180	18.192**	3.750
6.	1000 grain weight (g)	0.001	1.582**	0.027
7.	Grain yield/plant (g)	0.037	21.927**	1.780
8.	Fodder yield/plant (g)	11.132	271.396**	22.840
9.	Protein content (%)	0.004	1.536**	0.069

*,** significant at 5% and 1% probability respectively.

A. Mean performance

Highly significant differences among 74 genotypes were obtained. Among 74 genotypes PRO 1395 for grain yield per plant, productive tillers per plant, fodder yield per plant, PRO 1288 for days to 50 per cent flowering and days to maturity, PRO 835 for plant height, PRO 1408 for ear head length, PRO 796 for 1000 grain weight and PRO 887 for protein content. The genotype PRO 1288 (33.00 days) was the earliest for 50 percent flowering followed by PRO 1283, PRO 1236 (34.00 days) and PRO 1395, PRO 923 (51.00 days) was late. The variation for grain yield per plant ranged between 8.30 to 25.30 g. The general mean value for grain yield per plant is 16.77 g. The genotype PRO 1395 (25.30 g) possessed the highest grain yield per plant followed by PRO 1197 (24.25 g), PRO 652 (24.10 g), PRO 737 (23.15 g) and PRO 941 (22.15 g). The genotype PRO 618 (8.3 g) possessed the least grain yield per plant. Fourty nine genotypes showed the high grain yield than population mean whereas in case of twenty five genotypes it was below the population mean. The variation for protein content ranged between 10.45 to 13.9 % with mean is 12.43 %. The genotype PRO 887 (13.90 %) possessed highest protein content followed by PRO 583 (13.85 %), PRO 795 (13.80 %) while PRO 1123 (10.45 %) possessed the least protein content.

These genotypes were found to be superior on the basis of mean performance. Therefore, these genotypes should be considered for use in future breeding programme.

Table 2: Mean performance of 74 genotypes for 9 characters in proso millet.

Genotype	Days to 50% flowering (No.)	Days to maturity (No.)	Plant height (cm)	Productive tillers/ plant (No.)	Ear head length (cm)	1000 Grain weight (g)	Grain yield/ plant (g)	Fodder yield/ plant (g)	Protein content (%)
Highest	51.50 (PRO 1197)	81.50 (PRO 1197)	155.95 (TNAU 145)	12.70 (PRO 1395)	39.15 (PRO 1408)	7.66 (PRO 796)	25.30 (PRO1395)	88.55 (PRO1395)	13.90 (PRO 887)
Lowest	33.00 (PRO1288)	64.00 (PRO1288)	97.45 (PRO 1407)	4.60 (PRO583)	27.58 (PRO580)	4.23 (PRO1326)	8.30 (PRO 618)	29.05 (PRO 618)	10.45 (PRO1123)
Mean	42.64	73.61	124.39	8.69	33.48	5.71	16.77	58.80	12.43
Range	33.00-51.50	64.00-81.50	97.40-155.95	4.60-12.70	27.58-39.15	4.23-7.66	8.30-25.30	29.05-88.55	10.45-13.90
C.V. %	2.95	2.26	6.25	8.45	5.78	2.92	7.96	8.12	2.12
S.E.	0.89	1.77	5.49	0.51	1.37	0.11	0.94	3.37	0.18
C.D.(5%)	2.51	3.31	15.49	1.46	3.86	0.33	2.66	9.52	0.52

B. Genetic variability

The estimates of genotypic coefficient of variation were lower than phenotypic coefficient of variation for all the characters under study. The GCV and PCV both were observed to be high for productive tillers per plant, fodder yield per plant, grain yield per plant and 1000 grain weight. Thus, these characters provide good source of variation and hence they are useful in proso millet improvement programme. The lowest phenotypic coefficient of variation was observed for days to maturity (5.91). The lowest genotypic coefficient of variation was observed for days to maturity (5.69). Similar results were reported by Hawlader (1991); Ali and Saha (1996); Baghel and Maloo (2002); Ganapathy *et al.* (2011); Ghimire *et al.* (2017); Devaliya *et al.* (2018).

The variation observed for days to 50 per cent flowering ranged between 33.00 to 51.50 days with mean of 42.64 days. Other characters also recorded considerable range of variability *viz.*, days to maturity (64.00 to 81.50 days), plant height (97.45 to 155.95 cm), productive tillers per plant (4.60 to 12.70), ear head length (27.58 to 39.15 cm), 1000 grain weight (4.23 to 7.66 g), grain yield per plant (8.30 to 25.30 g), fodder yield per plant (29.05 to 88.55 g) and protein content (10.45 to 13.90 %).

Table 3: Estimates of different parameters of genetic variability for 9 characters in proso millet.

Characters	General Mean	Range	GCV	PCV	h^2(%) bs	GA	GAM (%)
Days to50%flowering (No.)	42.64	33.00 - 51.50	10.95	11.15	96.49	9.45	22.17
Days to maturity (No.)	73.61	64.00 - 81.50	5.69	5.91	92.70	8.31	11.30
Plant height (cm)	124.39	97.45 -155.95	8.03	9.16	76.76	18.03	14.50
Productive tillers per plant (No.)	8.69	4.60 - 12.70	24.13	24.86	94.21	4.79	48.25
Ear head length (cm)	33.48	27.58 - 39.15	8.02	9.00	79.35	4.93	14.72
1000 grain weight (g)	5.71	4.23 - 7.66	15.42	15.66	98.23	1.80	31.50
Grain yield per plant (g)	16.77	8.30 -25.30	18.91	19.73	91.85	6.26	37.34
Fodder yield per plant (g)	58.80	29.05 - 88.55	18.95	19.80	91.58	21.97	37.37
Protein Content (%)	12.43	10.45 - 13.90	6.88	7.05	95.45	1.72	13.86

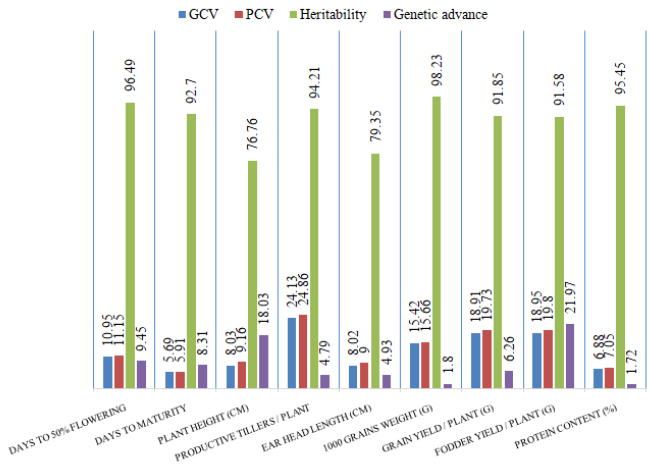

Fig. 1. Genetic variability parameters for 9 characters in 74 genotypes of proso millet.

The values of phenotypic coefficient of variation obtained for yield and its attributing characters ranged from days to maturity (5.91) to productive tillers per plant (24.86). Highest phenotypic coefficient of variation was exhibited by productive tillers per plant (24.86), followed by fodder yield per plant (19.80), grain yield per plant (19.73) and moderate phenotypic coefficient variation was observed for 1000 grain weight (15.66), days to 50 per cent flowering (11.15), plant height (9.16), ear head length (9.00), protein content (7.05) and the lowest phenotypic coefficient of variation was observed for days to maturity (5.91).

The inherent genetic variability is expressed by the genotypic coefficient of variation. Highest genotypic coefficient of variation was exhibited by productive tillers per plant (24.13) followed by fodder yield per plant (18.95), grain yield per plant (18.91) and moderate genotypic coefficient of variation was observed for 1000 grain weight (15.42) followed by days to 50 per cent flowering (10.95), plant height (8.03), ear head length (8.02) and protein content (6.88). The lowest genotypic coefficient of variation was observed for days to maturity (5.69). Similar results reported by Panwar and Kapila (1992); Prasad *et al.* (1995); Baghel and Maloo (2002); Nirmalakumari and Ventriventhan (2010); Devaliya *et al.* (2018); Anuradha *et al.* (2020); Ganapathy *et al.* (2011); Verulkar *et al.* (2014).

Very high estimate of heritability was recorded for 1000 grain weight (98.23%) followed by days to 50 per cent flowering (96.49%), protein content (95.45%), productive tillers per plant (94.21%), days to maturity (92.70%), grain yield per plant (91.85%), fodder yield per plant (91.58%) while ear head length (79.35%) and plant height (76.76%) shows moderate heritability.

Estimates of genetic advance were ranged from 1.80 to 21.97. Highest estimate of genetic advance was recorded for fodder yield per plant (21.97) and moderate genetic advance was observed for plant height (18.03). The lower estimates of genetic advance were observed for characters days to 50 per cent flowering (9.45), days to maturity (8.31), grain yield per plant (6.26), ear head length (4.93), productive tillers per plant (4.79) and protein content (1.72).

High heritability estimates along with high genetic advance were obtained for several characters. The character 1000 grain weight showed highest heritability followed by days to 50 per cent flowering, protein content, productive tillers per plant, days to maturity, grain yield per plant and fodder yield per plant. Similar studies were reported by Sasamala *et al.* (2011); Anuradha *et al*. (2020); Karam *et al*. (2014); Verulkar *et al.* (2014); Panwar and Kapila (1992); Hawlader (1991); Prasad *et al*. (1995).

The character fodder yield per plant showed highest genetic advance followed by plant height and days to 50 per cent flowering. This suggest that the characters are governed by additive gene action and selection will be effective. Therefore, it can be concluded that environmental effects are least on the character studied. Therefore, there is scope for improvement of these characters having high heritability in breeding programme.

The lowest genetic advance along with high heritability was observed for 1000 grain weight followed by protein content this shows the presence of non-additive gene action and therefore, heterosis breeding will be effective for improving these characters.

CONCLUSIONS

Wide range of variation was observed for all the nine characters under study. The analysis of variance exhibited significant difference among the genotypes for all the characters. Estimates for the genotypic coefficients of variation (GCV) were lower than the phenotypic coefficient of variation (PCV) for all the characters. High heritability estimates along with high genetic advance were obtained for several characters. The character 1000 grain weight showed highest heritability followed by days to 50 per cent flowering, protein content, productive tillers per plant, days to maturity, grain yield per plant and fodder yield per plant. The character fodder yield per plant showed highest genetic advance followed by plant height and days to 50 per cent flowering.

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