



“GENETIC VARIABILITY OF PROSO MILLET (*Panicum miliaceum* L).”

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Abstract: The present study was conducted during the *Kharif* season of 2023 at the Agricultural Botany Farm, Dr. Sharadchandra Pawar College of Agriculture, Baramati, to assess genetic variability in 37 genotypes using a randomized block design with two replications. Results showed that the phenotypic coefficients of variance were higher than genotypic coefficients for all traits. High genotypic and phenotypic variation was observed in grain yield per plant, fodder yield per plant, peduncle length and flag leaf blade width, while moderate variation was recorded for flag leaf blade length, plant height, panicle length, productive tillers per plant and basal tiller number. Analysis of variance indicated significant differences among genotypes for all traits, suggesting considerable variability and potential for selection. High heritability coupled with high genetic advance as a percentage of the mean was observed for basal tiller number, peduncle length, flag leaf blade length, flag leaf blade width, panicle length, plant height, productive tillers per plant, grain yield and fodder yield per plant. These traits appear to be controlled by additive gene action, indicating that phenotypic selection based on these traits in segregating generations would likely be effective. This information on genetic variability, heritability and genetic advance can help guide breeding strategies.

Keywords: Proso millet, variability, heritability, genetic advance, PCV and GCV.

1. INTRODUCTION

Proso millet (*Panicum miliaceum* L.) is also known as hog millet, common millet, hersey millet, broom millet, white millet, russian millet, cheena (in Hindi) and vari (in Marathi). The chromosome number of Proso millet is $2n = 36$. (Kumar *et al.*, 2022) Proso millet is a C_4 crop. Natural cross-pollination has occurred up to 10% of the time, even though it is primarily self-pollinating. It has a hollow, cylindrical stem that can grow up to 30 to 100 cm in height. The leaves on the stem are grouped in pairs. The fine hair (trichomes) covers the stem and the leaves. The plant has short, fibrous roots and an upright or drooping panicle inflorescence. It completes its life cycle within 60-100 days. The grain colour of Proso millet ranges from white to creamy, yellow, orange, red, brown and black. The grains have an oval to spherical shape and are around 2 mm in diameter and 3 mm in length. The Proso millet inflorescence is a drooping panicle that is between 10- 45 cm long. (Bhat *et al.*, 2019)

Proso millet is an annual cereal crop. It was cultivated in China's semiarid areas around 10,000 years ago. The crop is found around the world in North America, South America, Europe, Asia, Australia and Africa. (Rajasekaran *et al.*, 2023). For the majority of people living in arid and semiarid tropics, including Asia, Africa and parts of Europe, it is a staple food. It is one of the oldest millet crops still grown today. (Mishra *et al.*, 2022). According to Kalinova and Moudry (2006), millet has a higher nutritional value. The essential amino acid index (EAAI) of Proso millet for methionine and cysteine was higher (51%) as compared to wheat. Additionally, Proso millet-based food products have a lower glycemic index (GI) (50-64) than other cereals. Foods with a GI score above 70 are risky because they cause rapid blood sugar spikes and can harm people with diabetes. (Mishra *et al.*, 2022; Sweeney *et al.*, 2017) It shows a wide range of diversity in terms of grain nutrition content: protein, 11%- 19%; carbohydrate, 60% -70%; Zn, 26- 47 mg kg⁻¹; Ca, 91- 241 mg kg⁻¹; and Fe, 41- 73 mg kg⁻¹. (Vetriventhan and Upadhyaya, 2018)

Proso millet is naturally gluten-free. It is rich in vitamins (such as niacin, B-complex vitamins and folic acid) and essential minerals (including phosphorus, calcium, zinc, and iron). Proso millet's nutrient profile supports heart health. It may help to reduce the risk of cardiovascular diseases. Being low in calories and high in fiber can aid in weight management and prevent obesity. The antioxidants (polyphenols) in Proso millet contribute to detoxifying the body and its high lecithin content supports the neural system. (Dayakar *et al.*, 2019). It is a *Kharif* season crop sown in July. Proso millet can be grown in both rich and poor soils, with soils of various textures ranging from sandy loam to black cotton clays. The best soil for Proso millet cultivation is well-drained loams or sandy loams that are kankar-free and have a high organic matter content. It is widely cultivated in warm climate around the world. It can be grown in areas with little rainfall because it is extremely drought-resistant. (Mythri *et al.*, 2024). The variability present in the base population determines the majority of crop improvement program progress. Studies on genetic variability give a foundational understanding of the population's genetic traits, which are then used to develop breeding strategies for crop improvement. (Salini *et al.*, 2010)

II.MATERIALS AND METHODS:

The experimental material used in the present investigation comprised 35 genotypes of Proso millet obtained from ICAR-Indian Institute of Millet Research (IIMR) Rajendranagar, Hyderabad and 2 checks from Zonal Agricultural Research Station (ZARS), Kolhapur. The study was conducted at the Agricultural Botany Farm, Dr. Sharadchandra Pawar College of Agriculture, Baramati, during the *Kharif* season of 2023. The genotypes were planted with a spacing of 30 x 10 cm in a randomized block design (RBD) with two replications. Observations were recorded from five randomly selected plants in each accession for 14 traits, including basal tiller number, days to 50% flowering, days to maturity, peduncle length, flag leaf blade length, flag leaf blade width, panicle length, plant height, productive tillers per plant, grain yield per plant, 1000-grain weight, fodder yield per plant, protein content and carbohydrate content. ANOVA for RBD and variability was obtained using the standard methods given by Panse and Sukhatme (1978). Genotypic and phenotypic coefficients of variation (GCV and PCV) were estimated using the formula given by Lush (1940) and Burton and Devane (1952). Broad-sense heritability was estimated to determine the proportion of genetic variance and genetic advance was calculated using the approach suggested by Johnson *et al.* (1955) to assess the potential for selection gain.

III.RESULTS AND DISCUSSION

Genetic variability studies provide essential insights into the genetic parameters of genotypes, forming the basis for designing effective breeding methods for crop improvement. The statistical analysis of the numerical data collected for 14 quantitative traits revealed highly significant differences among the genotypes. (Table. 1) This indicates substantial genetic variability, consistent with the findings of Calamai *et al.* (2020), who also reported a wide range of variability in traits like plant height, grain yield and days to maturity in Proso millet accessions. Similarly, Anuradha *et al.* (2020) reported significant variability in Proso millet genotypes.

High genotypic and phenotypic coefficients of variation were recorded by grain yield per plant, fodder yield per plant, peduncle length and flag leaf blade width. Moderate genotypic and phenotypic coefficients of variation were observed in flag leaf blade length, plant height, panicle length, productive tillers per plant and basal tillers number. However, low genotypic and phenotypic coefficients of variation were observed for characters, 1000 grain weight, protein content, days to 50% flowering, days to maturity and carbohydrate content. (Table. 2) Similar findings were also reported by Salini *et al.* (2010), who recorded high GCV and PCV for grain yield per plant, while plant height and panicle length showed moderate GCV and PCV. In contrast, the days to 50% flowering exhibited low GCV and PCV. Anuradha *et al.* (2020) reported high values of GCV and PCV for both fodder yield and grain yield, with moderate values for plant height, productive tillers per plant and panicle length. Additionally, they noted low values for days to 50% flowering and days to maturity.

The character peduncle length recorded the highest heritability, followed by fodder yield per plant, grain yield per plant, plant height, productive tillers per plant, panicle length, basal tillers number, flag leaf blade width, flag leaf blade length, protein content and 1000 grain weight. The character carbohydrate content recorded a moderate estimate of heritability. However, low heritability was observed for character days to 50% flowering and days to maturity. (Table. 2) Salini *et al.* (2010) observed high heritability for grain yield per plant, plant height, number of basal tillers, productive tillers per plant and panicle length. A similar result was also found by Pallavi *et al.* (2020) for peduncle length, number of basal tillers, flag leaf blade width and flag leaf blade length.

The highest magnitude of genetic advance was observed for plant height. The character grain yield per plant and fodder yield per plant recorded a moderate estimate of genetic advance. basal tillers number, days to 50% flowering, days to maturity, peduncle length, flag leaf blade length, flag leaf blade width, panicle length, productive tillers per plant, 1000 grain weight, protein content, carbohydrate content recorded low values for the genetic advance. (Table. 2) Anuradha *et al.* (2020) also reported similar results for plant height, days to 50% flowering, days to maturity, number of productive tillers, panicle length and fodder yield.

The highest magnitude of genetic advance as a percent mean was observed for grain yield per plant followed by fodder yield per plant, peduncle Length, flag leaf blade width, plant height, basal tillers number, panicle length, productive tillers per plant and flag leaf blade length. The trait and 1000 grain weight and protein content recorded a moderate magnitude of genetic advance as a percent of the mean. The other traits, days to 50% flowering, days to maturity and carbohydrate content recorded a low

magnitude of genetic advance as a percent of mean. (Table. 2) Salini *et al.* (2010) observed high genetic advance as % of mean for grain yield per plant, productive tillers per plant, plant height and basal tillers number.

Table 1: Analysis of variance for 14 characters of 37 Proso millet genotypes.

Sr. No.	Character	Mean sum of squares		
		Replications	Treatment	Error
	DF	1	36	36
1.	Basal tillers: Number (no.)	17.03**	3.84**	0.26
2.	Days to 50% flowering (no.)	19.51*	7.73*	4.32
3.	Days to maturity (no.)	50.28**	10.07**	4.22
4.	Peduncle: Length (cm)	3.86**	6.44**	0.11
5.	Flag leaf blade: Length (cm)	56.08**	29.04**	2.89
6.	Flag leaf blade: Width (cm)	0.57**	0.08**	0.00
7.	Panicle: Length (cm)	14.54*	37.61**	2.44
8.	Plant: Height (cm)	161.44**	277.61**	11.84
9.	Productive tillers/ plant (no.)	18.70**	4.26**	0.39
10.	Grain yield/ plant (g)	20.12*	180.50**	4.18
11.	1000 grain weight (g)	1.30**	0.72**	0.16
12.	Fodder yield/ plant (g)	5.20*	59.01**	1.26
13.	Protein content (%)	3.04*	2.74**	0.57
14.	Carbohydrate content (%)	4.00*	1.57**	0.57

*, ** denotes significance at 5% and 1% levels respectively.

Table 2: Estimates of variability parameters for yield and its contributing characters in 37 genotypes of Proso millet.

Sr. No.	Character	Mean	Range		GCV (%)	PCV (%)	ECV (%)	Heritability (b.s) %	Genetic Advance	GA as % of Mean
1.	Basal Tillers: Number (no.)	7.10	4.25	10.25	18.84	20.18	7.23	87.16	2.57	36.23
2.	Days to 50% Flowering (no.)	44.62	40.00	48.50	2.93	5.50	4.66	28.33	1.43	3.21
3.	Days to Maturity (no.)	73.58	68.50	78.00	2.28	3.66	2.86	38.97	2.16	2.94
4.	Peduncle: Length (cm)	4.36	2.25	11.90	40.76	41.48	7.73	96.53	3.60	82.49
5.	Flag leaf blade: Length (cm)	18.70	11.35	26.00	19.34	21.36	9.09	81.91	6.74	36.05
6.	Flag leaf blade: Width (cm)	0.94	0.61	1.59	20.45	22.21	8.68	84.75	0.37	38.78
7.	Panicle: Length (cm)	21.96	11.10	31.85	19.09	20.38	7.12	87.79	8.09	36.85
8.	Plant Height (cm)	59.61	40.60	89.20	19.34	20.18	5.77	91.82	22.75	38.17
9.	Productive Tillers/ Plant (no.)	6.85	3.10	9.95	20.31	22.28	9.16	83.08	2.61	38.13
10.	Grain yield/ Plant (g)	22.19	11.45	52.00	42.31	43.30	9.21	95.48	18.90	85.16
11.	1000 Grain weight (g)	5.40	3.85	6.71	9.76	12.28	7.44	63.25	0.86	15.99
12.	Fodder yield/ Plant (g)	13.09	7.05	30.25	41.04	41.93	8.57	95.82	10.84	82.76
13.	Protein content (%)	10.72	8.25	12.75	9.72	12.02	7.08	65.34	1.73	16.18
14.	Carbohydrate content (%)	61.79	59.75	63.60	1.14	1.67	1.22	46.60	0.99	1.61

GCV = Genotypic coefficient of variation, PCV = Phenotypic coefficient of variation, ECV= Environmental coefficient of variation, GA = Genetic advance.

IV. CONCLUSION:

Analysis of variance revealed highly significant differences among the 37 genotypes for all the traits studied in Proso millet species, indicating that there is sufficient variability present among the genotypes for these characters. High genotypic and phenotypic coefficient of variation were recorded for grain yield per plant, fodder yield per plant, peduncle length, flag leaf blade width and productive tillers per plant. Hence these traits are to be considered as important quantitative traits in the Proso millet improvement programme and direct selection for these traits would be fruitful. High estimates of heritability coupled with high genetic advance as percent mean showed by basal tiller number, peduncle length, flag leaf blade length, flag leaf blade width, panicle length, plant height, productive tillers per plant, grain yield per plant and fodder yield per plant. Indicated additive gene action in the inheritance of these characters.

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