Int.J.Curr.Microbiol.App.Sci (2025) *14*(07): 34-38

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 14 Number 7 (2025)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2025.1407.004

Study of Genetic Parameters for Yield and Yield Attributing Traits in Inbred Lines of Pearl Millet (*Pennisetum glaucum* L.)

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Keywords

Pearl millet, Genetic variability, GCV, PCV, Heritability, Genetic advance

Article Info

Received:
08 May 2025
Accepted:
19 June 2025
Available Online:
10 July 2025

A B S T R A C T

The investigation was conducted at Agricultural Research Station, Ananthapuram during *kharif*, 2024to study the extent of genetic variability in of pearl millet for yield and its attributing traits. Analysis of variance indicated highly significant differences among the genotypes for all nine traits, confirming the existence of substantial genetic variability. The narrow variation between Phenotypic Coefficient of Variation (PCV) and Genotypic Coefficient of Variation (GCV) for all traits suggested minimal environmental influence on trait expression. Number of productive tillers per plant exhibited higher estimates of PCV and GCV, indicating the potential for effective selection. Number of productive tillers per plant, grain yield per plant, harvest index, 1000-grain weight, and days to 50% flowering showed higher heritability coupled with higher genetic advance as a percentage of the mean reflecting the predominance of additive gene action and favourable for improvement through selection.

Introduction

Pearl millet [*Pennisetum glaucum* (L.) R. Br.] is a coarse cereal in the *Poaceae* family and is believed to have originated in West Africa (Vavilov, 1950). It is a C_4 grass, diploid (2n = 2x = 14) in nature with high photosynthetic efficiency and biomass production capacity (Varshney *et al.,* 2017). The protogynous nature of its hermaphrodite flowers, makes pearlmillet extensively cross-pollinated. Pearl millet ranks sixth among major cereal crops in terms of area in the world and fourth most grown cereal crop in India. It is cultivated in an area of 6.835 Mha, with production and productivity of 9.490 Mt and 1388Kg ha^{-1}, respectively, in 2024-25 (Indiastat, 2025). It is a preferred crop for growing in arid and semi-arid because of its drought tolerance and low inorganic fertilizer requirement.

Genetic variability, heritability, and genetic advance offer insights into the kind and degree of genetic control for agronomic and economic variables. Heritability estimates indicate the observed variation that is

genetically inherited, whereas genetic variability provides the basis for selection. Heritability along with genetic advance helps breeders to adopt selection procedure. The present investigation was undertaken with the objective of estimating genetic variability, heritability and genetic advance for yield and its attributes.

Materials and Methods

The experiment was carried out during *kharif,* 2024 at Agricultural Research Station, Ananthapuramu located at 14º 41'N latitude and 77º 40'E longitude from an altitude of 373 m above mean sea level, and situated in scarce rainfall zone of Andhra Pradesh. The experimental material comprising 97 pearl millet inbred lines developed at Agricultural Research Station, Ananthapuramu and three checks i.e., ABV04 (Composite variety), SBH 888 (Hybrid), Pittaganti (local variety) were evaluated in an Alpha lattice Design with two replications. Each genotype was sown in single row of four meters length with a spacing of 45 cm between rows and 15 cm between the plants within the rows. The crop was raised under irrigated conditions. All the recommended cultural and agronomic measures were followed in raising a healthy crop. Observations on traits like plant height (PH) (cm), number of productive tillers per plant (NPT), panicle length (PL)(cm), panicle girth (PG)(cm), thousand grain weight (TGW)(g), harvest index(HI)(%)and grain yield per plant (GYP)(g) were recorded on five randomly selected competitive plants in each genotype and each replication. Days to 50% flowering (DFF) and days to maturity (DM) observations were recorded on whole plot basis. Mean of five plants was taken for statistical analysis using R studio version 2024.12.1+563. The analysis of variance (ANOVA) was done based on model proposed by Panse and Sukhatme (1961) for alpha lattice design. The genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were computed according to Burton (1952). Heritability in broad sense [$h^2_{(b)}$] was calculated following the formula given by Lush (1940). Genetic advance was estimated by the adopting the formula of Johnson *et al.,* (1955).

Results and Discussion

Analysis of variance revealed significant difference among genotypes for all the nine traits studied, (Table 1) demonstrating the existence of a substantial amount of genetic variation. The estimates of phenotypic and genotypic coefficients of variation (PCV, GCV), heritability in broad sense, genetic advance and genetic advance as percent of mean for 14 characters of pearl millet are furnished in Table 2, Fig1 and 2.

In the present study, differences between the phenotypic coefficient of variations and genotypic coefficient of variations were low for all the traits, indicating the less effect of environment on the expression of the traits. Number of productive tillers per plant (22.37%; 23.20%) exhibited higher estimates of PCV and GCV, respectively indicating the potential for effective selection. Similar results were reported by Narasimhulu *et al.,* (2021); Rajpoot *et al.,* (2023) and Andhale *et al.,* (2024) in pearl millet.

Moderate estimates of coefficient of variation were recorded for grain yield per plant (18.31%; 18.76%) followed by harvest index (15.59%; 15.88%), thousand grain weight (11.18%; 11.32%) and days to 50% flowering (11.02%; 11.63%).

This suggested that there was enough variation among the genotypes for the above traits under study and to make selections to enhance these traits. Similar observations were made by Jain *et al.,* (2023) for grain yield per plant; Goswami *et al.,* (2023) for harvest index and thousand grain weight and Singh *et al.,* (2023) for days to 50% flowering. Low GCV and Moderate PCV were observed for panicle length (9.09%; 10.22%) and similar findings were registered by Narasimhulu *et al.,* (2021).

Low estimates of coefficient of variation recorded for panicle girth (8.05%; PCV = 9.02%), plant height (7.01%; 7.24%) and days to maturity (5.38%; 5.92%) demonstrating a limited range of variability for these traits constraining the potential for selection. Similar results were reported by Jaiswal *et al.,* (2025) for panicle grith; Rajpoot *et al.,* (2023) for plant height and days to maturity.

Higher estimates of heritability were recorded for thousand grain weight (97.53%) followed by harvest index (96.35%), grain yield per plant (95.18%), plant height (93.64%), number of productive tillers per plant (93.05%), days to 50% flowering (89.75%), days to maturity (82.70%), panicle girth (79.63%) and panicle length (79.19%).

Table.1 Analysis of variance for yield and yield attributes in pearl millet inbreds

Source of Variation	df	Mean sum of squares								
		DFF	DM	PH	NPT	PG	PL	TGW	HI	GYP
Replication	**1**	7.22	12.01	15.16	0.63	2.71	0.02	0.01	5.04	5.30
Genotype	**99**	56.41**	41.13**	238.70**	0.50**	12.12**	0.12**	3.33**	80.40**	60.18**
Block	**6**	3.54	5.74	3.46	0.01	0.82	0.01	0.10	2.04	3.46
Error	**93**	3.04	3.89	7.84	0.02	1.41	0.01	0.04	1.50	1.49

*, ** Significant at 5% and 1% level, respectively

Table.2 Mean, range, coefficients of variation, heritability (broad sense) and genetic advance as per cent of mean for yield and yield attributing characters

S. No.	Characters	Mean	Range		GCV	PCV	$h^2_{(b)}$	Genetic advance	GAM
			Min	Max					
1	Days to 50% flowering	46.88	39.00	58.00	11.02	11.63	89.75	10.08	21.50
2	Days to maturity	80.13	71.00	89.50	5.38	5.92	82.70	8.08	10.09
3	Plant height (cm)	153.29	123.10	179.82	7.01	7.24	93.64	21.42	13.97
4	Number of productive tillers	2.19	1.10	3.30	22.37	23.20	93.05	0.97	44.46
5	Panicle length (cm)	25.38	20.50	31.55	9.09	10.22	79.19	4.24	16.67
6	Panicle girth (cm)	2.92	1.86	3.75	8.05	9.02	79.63	0.42	14.79
7	1000-grain weight (g)	11.47	7.78	14.33	11.18	11.32	97.53	2.61	22.75
8	Harvest Index (%)	40.30	24.31	56.97	15.59	15.88	96.35	12.70	31.51
9	Grain yield per plant (g)	29.59	18.47	53.95	18.31	18.76	95.18	10.89	36.79

Figure.1 Graphical representation of GCV (%) and PCV (%) estimates for yield and its attributes

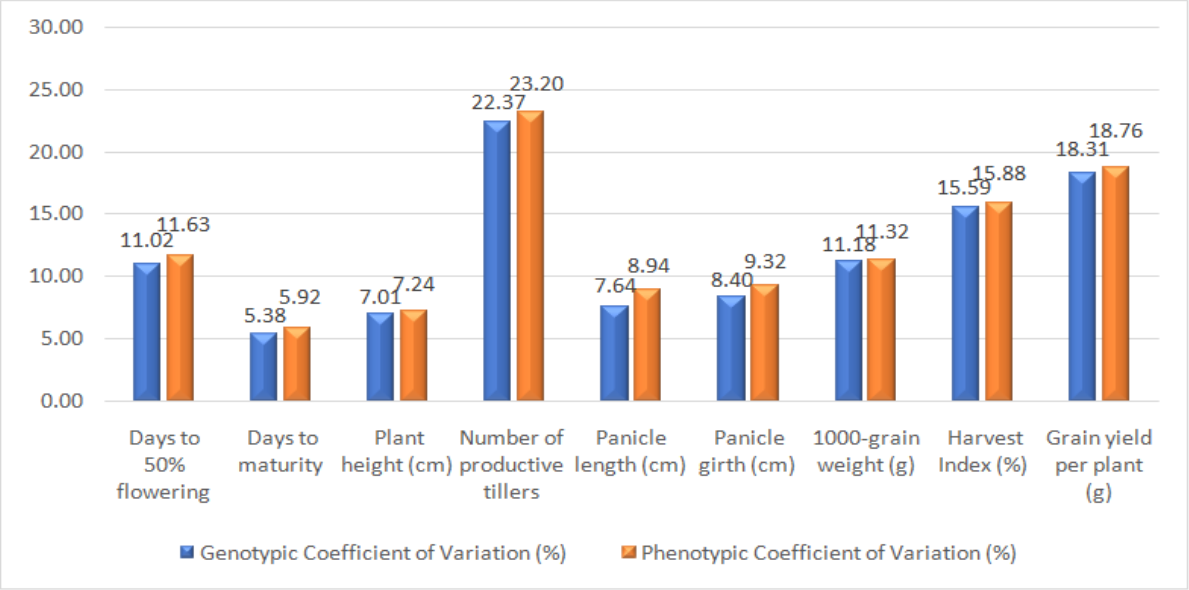
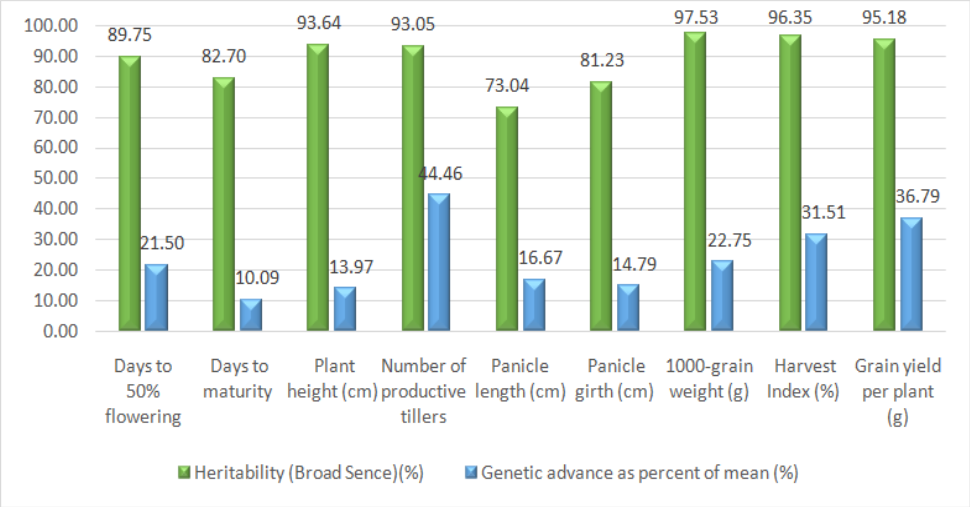


Figure.2 Graphical representation of Heritability in broad sense (%) and Genetic advance as percent of mean (%)



These findings are in accordance with the results of Singh *et al.,* (2023) and Andhale *et al.,* (2024) in pearl millet.

The higher estimates of genetic advance as percent of mean were recorded for number of productive tillers per plant (44.46%), grain yield per plant (36.79%), harvest index (31.51%), thousand grain weight (22.75%) and days to 50 % flowering (21.50%) while moderate estimates of genetic advance as percent of mean for panicle length (16.67%), panicle girth (14.79%), plant height (13.97%) and days to maturity (10.09%).

Higher heritability coupled with high genetic advance as percent of mean noted for number of productive tillers per plant followed by grain yield per plant, harvest index, thousand grain weight and days to 50 % flowering signifies that these traits are predominantly governed by additive gene action and an early and simple selection is advisable due to fixable additive gene effects. Similar findings were reported by Goswami *et al.,* (2023) and Jaiswal *et al.,* (2025).

High heritability coupled with moderate genetic advance over percent mean was registered for panicle length, panicle girth, plant height and days to maturity also indicating that these traits are governed by additive genes and might consistently manifest in future generations, resulting in increased effectiveness of the breeding program. These findings are in conformity with finding of Sumathi and Revathi (2017).

High heritability coupled with high genetic advance as a percentage of the mean was observed for number of productive tillers per plant, grain yield per plant, harvest index, thousand grain weight, and days to 50% flowering. This indicates that these traits are largely controlled by additive gene action, suggesting the effectiveness of early and simple selection.

High heritability combined with a moderate genetic advance over the mean recorded for panicle length, relative water content, panicle girth, plant height, and days to maturity. Number of productive tillers per plant showed high GCV, heritability, and genetic advance, indicating the influence of additive gene effects and the potential for improvement through simple selection.

Author Contributions

P. Lakshmi Jyothika: Investigation, formal analysis, writing—original draft. N. Sabitha: Validation, methodology, writing—reviewing. L. Madhavilatha:—Formal analysis, writing—review and editing. G. Mohan Naidu: Investigation, writing—reviewing. M. Reddi Sekhar: Resources, investigation writing—reviewing.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

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How to cite this article:

Putsala Lakshmi Jyothika, N. Sabitha, L. Madhavilatha, G. Mohan Naidu and Reddi Sekhar, M. 2025. Study of Genetic Parameters for Yield and Yield Attributing Traits in Inbred Lines of Pearl Millet (*Pennisetum glaucum* L.). *Int.J.Curr.Microbiol.App.Sci.* 14(07): 34-38. **doi:** https://doi.org/10.20546/ijcmas.2025.1407.004