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ASSESSMENT OF GENETIC VARIABILITY, HERITABILITY, AND GENETIC ADVANCE FOR YIELD AND YIELD-RELATED TRAITS IN PEARL MILLET (*PENNISETUM GLAUCUM* L. R. BR.) HYBRIDS

Pinky Choudhary[1]*, P. C. Gupta[2], Sujit K. Yadav[1], Nemi Chand Sharma[3], Aman[1], Pushpa Kanwar Rathore[1], Sanju Choudhary[1] and Manga Tharaka[1]

[1]Department of Genetics and Plant Breeding, Swami Keshwanand Rajasthan Agricultural University, Bikaner (Rajasthan),334006, India.
[2]Agricultural Research Station, Swami Keshwanand Rajasthan Agricultural University, Bikaner (Rajasthan), 334006, India.
[3]ICAR-AICRP on Pearl Millet, ARS, Swami Keshwanand Rajasthan Agricultural University, Bikaner (Rajasthan), 334006, India.
*Corresponding author E-mail: cpinky368@gmail.com
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ABSTRACT

The present study was conducted to evaluate the extent of genetic variability, heritability, and genetic advance among 42 F_1 hybrids along with 3 standard checks of pearl millet (*Pennisetum glaucum*) for 12 agronomic and yield-related traits. The hybrids were evaluated in RBD during *Kharif*-2024 at Agricultural Research Station, SKRAU-Bikaner. Analysis of variance revealed highly significant differences among genotypes for all studied traits, indicating substantial genetic variability. The phenotypic coefficient of variation (PCV) exceeded the genotypic coefficient of variation (GCV) for all traits, suggesting the influence of environmental factors. The highest estimates of GCV and PCV were observed for dry fodder yield per plant, biological yield per plant, grain yield per plant, number of productive tillers per plant, number of total tillers per plant, and harvest index. Moderate estimates were recorded for test weight and panicle diameter. Traits such as dry fodder yield per plant, biological yield per plant, grain yield per plant, number of productive and total tillers per plant, harvest index, panicle diameter, and test weight exhibited high heritability coupled with high genetic advance as percent of mean, indicating their suitability for selection in breeding programs.
***Keywords* :** Genetic variability, heritability, genetic advance, PCV, GCV.

Introduction

Pearl millet [*Pennisetum glaucum* (L.) R. Br.] is a coarse cereal belongs to the family Poaceae, subfamily Panicoideae, and genus *Pennisetum*, with the species designation *glaucum*. Commonly referred to as bajra, bari, sajja, ganti, and kambam, pearl millet is an annual *kharif* crop. It is a diploid species with a chromosome number of 2n=2x=14 and operates under the C_4 photosynthetic pathway, characterized by high photosynthetic efficiency and superior dry matter production. Pearl millet exhibits extensive cross-pollination, primarily due to the protogynous nature of its hermaphroditic flowers. The inflorescence consists of a spike-like panicle containing numerous diminutive spikelets, each producing grain. Anthesis occurs after the desiccation of styles, initiating in the central portion of the spike and subsequently progressing bidirectionally.

Pearl millet grains are nutritionally rich and serve as a primary dietary component for approximately 10% of India's population. The grains contain 11.6% protein, 67.5% carbohydrates, 5% lipids, and 1.2% crude fibre per 100 g. Additionally, they provide essential micronutrients such as iron (2.80%), calcium (42 mg), phosphorus (296 mg), as well as vitamins and bioactive compounds, including antioxidants like ferulic acid and coumaric acid (Chapke *et al.,* 2018). The crop also holds substantial value as a fodder resource, with conserved forms such as hay and silage proving particularly beneficial in drought-prone areas. Compared to sorghum green fodder, pearl millet green fodder contains lower concentrations of hydrocyanic acid (HCN), thereby reducing toxicity risks for ruminants (Hanna *et al.,* 1999).

Pearl millet ranks as the eighth most significant cereal crop globally and holds the fifth position in India following wheat, rice, maize, and sorghum (Rajpoot *et al.,* 2023). It is widely cultivated as a dual-purpose crop across Asia, Africa, and Australia. India represents the leading global producer, with an annual production of 10.72 million tonnes harvested from 7.38 million hectares, yielding an average productivity of 1453 kg/ha (Anonymous, 2023-24). The principal pearl millet-producing states include Rajasthan, Uttar Pradesh, Gujarat, Maharashtra, Haryana, Karnataka, Tamil Nadu, Madhya Pradesh, and Andhra Pradesh. Rajasthan exhibits the highest acreage and production of pearl millet in India, covering 4.57 million hectares and yielding 5.11 million tonnes at an average productivity of 1117 kg/ha. The key pearl millet-producing districts within Rajasthan include Alwar, Sikar, Bharatpur, Karauli, Jaipur, Dausa. The Bikaner region encompasses approximately 120,100 hectares under cultivation, with an average production of 68,457 metric tons and a productivity rate of 570 kg per hectare (Anonymous, 2022–23).

The primary objective of any crop improvement program is to enhance the potential yield of the species. Prior to initiating a varietal development program, it is essential to assess the genetic variability present within the germplasm. Such an evaluation provides insights into the nature and extent of heritable genetic variation available for selection. Furthermore, estimates of heritability and genetic advance offer valuable information regarding the expected response to selection and the reliability of phenotypic selection. In this context, the present investigation was undertaken to assess genetic variability, heritability, and genetic advance for yield and yield-related traits in pearl millet hybrids.

Material and Methods

The study was conducted at Agricultural Research Station, SKRAU, Bikaner, during *Kharif* season of 2024. This region falls under Agro-climatic Zone I-C of Rajasthan. The climate of the region is typically hyper-arid which is characterized by extremes of temperature during summer and winter with aridity of atmosphere. The average rainfall is about 260 mm, which is mostly received during July - September. The experimental material for the present investigation consisted of 42 F_1 hybrids along with 3 checks of pearl millet [*Pennisetum glaucum* (L.) R. Br.]. These pearl millet F_1 hybrids were obtained from the AICRP on Pearl millet, Agriculture Research Station, Bikaner. The experimental material was laid out in a Randomized Block Design (RBD) with three replications during *Kharif*-2024. Each plot consisted of two rows each of 4 m length. The spacing between row to row was 60 cm and between plant to plant was 15 cm. Normal and uniform cultural operations were followed during the crop season to raise a good crop. The experiment material was sown on 10 July 2024.

The observations were recorded on individual plant basis on 5 randomly selected plants from each replication for characters viz., plant height (cm), number of total tillers per plant, number of productive tillers per plant, panicle length (cm), panicle diameter (cm), test weight (g), biological yield per plant (g), harvest index (%), grain yield per plant (g), dry fodder yield per plant (g) while two characters namely days to 50 per cent flowering and days to maturity were recorded on whole plot basis.

The data were subjected to analysis of variance adopting standard statistical methods (Panse and Sukhatme, 1985). Genetic parameters such as phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) as per Burton (1952), heritability in broad sense was computed as per Burton and Devane (1953), genetic advance and genetic advance as percent of mean worked out as per Johnson *et al.* (1955).

Results and Discussion

(a) Analysis of variance

The analysis of variance (ANOVA) revealed highly significant differences among the single-cross hybrids for all 12 evaluated traits viz., days to 50% flowering, days to maturity, plant height, number of total tillers per plant, number of productive tillers per plant, panicle length, panicle diameter, test weight, biological yield per plant, dry fodder yield per plant, harvest index and grain yield per plant, indicating substantial genetic variability within the experimental material. The mean square values for the characters studied presented in Table 1. This genetic variation underscores the potential for effective selection and genetic improvement in pearl millet (*Pennisetum glaucum*) hybrids. Similar results were also observed by Singh *et al.* (2014), Kumar *et al.* (2015), Vidyadhar *et al.* (2007), Basavaraj *et al.* (2017) and Rajpoot *et al.* (2023) in pearl millet.

Table 1: Analysis of variance for different characters of pearl millet hybrids

S. No.	Characters	Replication (df = 2)	Treatments (df = 44)	Error (df = 88)
1	Days to 50% flowering	2.022	34.312**	0.999
2	Days to maturity	1.427	104.961**	1.191
3	Plant height (cm)	129.073	731.895**	65.699
4	No. of total tillers / plant	0.203	1.854**	0.237
5	No. of productive tillers / plant	0.047	0.990**	0.104
6	Panicle length (cm)	2.571	12.259**	1.496
7	Panicle diameter (cm)	0.048	0.357**	0.020
8	Test weight (g)	0.475	4.422**	0.615
9	Biological yield per plant (g)	1000.213	20115.662**	565.360
10	Dry fodder yield per plant (g)	237.438	12532.939**	306.370
11	Grain yield per plant (g)	38.073	580.948**	25.501
12	Harvest index (%)	74.013	112.932**	21.650

* Significant at 5% probability level ** Significant at 1% probability level

(b) Genetic variability parameters

Phenotypic variation alone is not a precise indicator of the extent of genotypic variation within a population. Therefore, to obtain a more accurate assessment of genetic variability, key genetic parameters such as the genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability, and genetic advance were analysed in the present study. These parameters provide a comprehensive understanding of the genetic diversity available for each trait in the experimental material.

The comparative analysis of coefficients of variation revealed that the PCV was consistently higher than the GCV for all studied traits, suggesting a significant influence of environmental factors on trait expression. This observation underscores the necessity of considering both genetic and environmental components when evaluating variability and selecting traits for genetic improvement programs. Similar results were also observed by Singh *et al.* (2014), Kumar *et al.* (2015), Sumathi *et al.* (2016), Vidyadhar *et al.* (2007), Basavaraj *et al.* (2017) and Rajpoot *et al.* (2023) in pearl millet.

The highest GCV and PCV were recorded for dry fodder yield per plant, biological yield per plant, and grain yield per plant, indicating the presence of substantial genetic variability and the potential for effective selection in these traits. Traits such as number of productive tillers per plant, number of total tillers per plant, and harvest index also exhibited high GCV and PCV values, suggesting that these traits are largely influenced by genetic factors and can be improved through breeding programs. High PCV and GCV were also reported by Kumari *et al.* (2013), Kumar *et al.* (2015) and Rajpoot *et al.* (2023) for biological yield per plant, grain yield per plant, number of productive tillers per plant and harvest index in pearl millet. Vagadiya *et al.* (2013) and Gowswami *et al.* (2023) reported high PCV and GCV for grain yield per plant and dry fodder yield per plant in pearl millet.

Moderate GCV and PCV values for test weight and panicle diameter indicate that while these traits have a genetic basis, they may also be influenced by environmental factors. Similar results were also observed by Kumari *et al.* (2013) and Gowswami *et al.* (2023) in pearl millet. Moderate PCV and GCV were also reported by Kumar *et al.* (2014), Kumar *et al.* (2015), Vagadiya *et al.* (2013) for test weight and Rajpoot *et al.* (2023) for panicle diameter in pearl millet.

Conversely, low GCV and PCV values for panicle length, plant height, days to maturity and days to 50% flowering suggest limited genetic variability, implying that selection for these traits might be less effective in achieving rapid genetic improvement. Consistently low phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) for plant height, days to maturity, and days to 50% flowering in pearl millet have been reported by several researchers. Kumari *et al.* (2013), Kumar *et al.* (2015), Gowswami *et al.* (2023), and Rajpoot *et al.* (2023) observed low PCV and GCV values for these traits. Similarly, Kumar *et al.* (2014) and Vagadiya *et al.* (2013) also reported low estimates of PCV and GCV specifically for days to maturity and days to 50% flowering in pearl millet.

The genetic coefficient of variation does not explicitly indicate the proportion of heritable components within the total variation. Instead, the proportion of genetic variability that is transmitted from parents to offspring is best represented by heritability. The present study revealed high heritability estimates for key agronomic traits, including days to maturity, dry fodder yield per plant, biological yield per plant and grain yield per plant. Other traits, such as panicle diameter, plant height, number of productive tillers per plant, days to 50% flowering, number of total tillers per plant, panicle length, test weight and harvest index also exhibited strong genetic influence. These findings align with previous studies, confirming the trends observed in key agronomic traits. Singh *et al.* (2014) reported similar results for days to 50% flowering, days to maturity, plant height, panicle length, panicle diameter, biological yield per plant, dry fodder yield per plant, grain yield per plant, harvest index, and test weight. Consistent trends were also observed by Kumari *et al.* (2013) for most of these traits, along with the number of productive tillers per plant. Similarly, Rajpoot *et al.* (2023) validated these findings, particularly for plant height, panicle characteristics, yield components, and harvest index. Kumar *et al.* (2014) further supported these results, emphasizing flowering time, plant height, panicle traits, and yield attributes. Additionally, Sumathi *et al.* (2010) reported comparable patterns for plant height, panicle length, panicle diameter, and grain yield.

Genetic advance serves as a valuable parameter for estimating the expected improvement in a trait resulting from selection applied to a given population. The present study revealed that the highest genetic advance was observed for biological yield per plant, dry fodder yield per plant, plant height and grain yield per plant indicating substantial potential for selection and genetic improvement. Traits such as days to maturity and harvest index exhibited moderate genetic advance, suggesting a reasonable scope for enhancement through selection. In contrast, days to 50% flowering, panicle length, test weight, number of total tillers per plant, number of productive tillers per plant and panicle diameter demonstrated the lowest genetic advance, reflecting limited genetic variability and lower selection potential for these traits.

Heritability estimates, when considered alongside genetic advance, provided a more accurate prediction of the response to selection than heritability estimates alone. Under present investigation high heritability coupled with a high genetic advance as a percentage of the mean, was observed for dry fodder yield per plant, biological yield per plant, grain yield per plant, number of productive tillers per plant, number of total tillers per plant, harvest index, panicle diameter, and test weight. This suggests that these traits are largely governed by additive gene action and can be effectively improved through selection. High heritability coupled with high genetic advance as a percentage of the mean has been reported for key yield-related traits in pearl millet by several researchers. Kumari *et al.* (2013) and Gowswami *et al.* (2023) observed this association for dry fodder yield per plant, grain yield per plant, number of productive tillers, test weight, panicle diameter, and harvest index. Similarly, Kumar *et al.* (2015) reported it for biological yield, grain yield, number of productive tillers, test weight, and harvest index. Kumar *et al.* (2014) noted it for biological yield, grain yield, and test weight, while Vagadiya *et al.* (2013) reported it for dry fodder yield, grain yield, and test weight.

Furthermore, high heritability with moderate genetic advance as a percentage of the mean was recorded for days to maturity, days to 50% flowering, plant height, and panicle length. This indicates that while these traits are heritable, their expression is likely influenced by both additive and non-additive gene effects, suggesting a more cautious approach in selection strategies. High heritability coupled with moderate genetic advance as a percentage of the mean has been reported for key yield-related traits in pearl millet by several researchers. Kumari *et al.* (2013) and Gowswami *et al.* (2023) observed this association for days to 50% flowering and days to maturity. Similarly, Kumar *et al.* (2015) reported it for days to 50% flowering, days to maturity and panicle length, while Kumar *et al.* (2014) noted it for days to 50% flowering, plant height and panicle length.

Importantly, none of the studied traits exhibited low heritability coupled with low genetic advance as a percentage of the mean, implying that all traits hold potential for genetic improvement. The genetic parameters were presented character-wise in Table 2.

Table 2: Estimates of range, genotypic and phenotypic coefficient of variation, heritability (broad sense%) and genetic advance of different characters of pearl millet hybrids

Characters	Mean	Range	G.C.V. (%)	P.C.V. (%)	Heritability (%) (bs)	Genetic Advance (%)	GA as% of mean (5%)
DF	49.16	41.67-58.33	6.78	6.88	97.10	6.76	13.76
DM	81.12	68.33-90.93	7.25	7.29	98.90	12.05	14.85
PH	200.93	160.07-229.75	7.42	7.77	91.00	29.29	14.58
NTT	2.66	1.47-5.13	27.57	29.52	87.20	1.41	53.05
NPT	1.95	1.1-3.52	27.89	29.49	89.50	1.06	54.35

PL	23.94	20.73-28.73	7.91	8.45	87.80	3.66	15.27
PD	2.87	2.28-3.66	11.65	12.00	94.30	0.67	23.30
TW	8.92	6.67-11.61	12.63	13.62	86.10	2.15	24.15
BYLD	129.21	70.01-582.22	62.48	63.38	97.20	163.94	126.89
DYLD	96.25	55.86-458.39	66.33	67.15	97.60	129.89	134.96
GYLD	31.55	15.03-94.49	43.13	44.10	95.60	27.41	86.87
HI	26.17	12.88-46.62	21.08	23.45	80.80	10.22	39.04

DF= Days to 50 Percent Flowering, DM= Days to Maturity, PH= Plant Height, NTT= Number of Total Tillers Per Plant, NPT= Number of Productive Tillers Per Plant, PL= Panicle Length, PD= Panicle Diameter, TW= Test Weight, BYLD= Biological Yield Per Plant, DYLD= Dry Fodder Yield Per Plant, GYLD= Grain Yield Per Plant, HI= Harvest Index, PCV = Phenotypic coefficient of variance, GCV = Genotypic Coefficient of variance

Table 3: Grain yield and associated agronomic traits of 10 superior hybrids of pearl millet identified in the study

Hybrids	**DF**	**DM**	**PH (cm)**	**NTT**	**NPT**	**PL (cm)**	**PD (cm)**	**TW (g)**	**BYLD (g)**	**DYLD (g)**	**HI (%)**	**GYLD (g)**
274A ×BIB4	48.33	77.00	204.82	5.13	3.52	23.13	2.63	9.37	338.14	277.46	27.97	94.49
HHB 299	58.33	83.33	189.13	4.40	2.20	21.33	3.52	9.02	582.22	458.39	13.05	75.90
RHB 223	50.33	78.33	198.33	4.27	2.33	26.27	3.35	10.00	223.94	151.44	22.35	47.67
ICMA13666 × BIB12	48.00	83.60	194.00	2.47	1.87	22.40	2.94	9.30	127.99	74.37	32.89	42.11
ICMA06888 × BIB63	52.00	90.20	193.33	3.87	3.07	23.33	2.28	7.44	149.32	85.69	27.83	40.71
BHB 1602	49.33	76.33	195.73	3.00	2.47	21.93	2.99	9.68	165.95	90.71	24.96	40.31
ICMA04999 × BIB62	49.00	78.00	207.53	2.47	2.13	28.73	2.48	6.87	145.93	122.60	26.30	37.91
ICMA04999 × BIB4	46.33	74.33	218.75	2.57	1.91	26.27	2.74	7.93	126.76	101.80	29.76	37.63
ICMA98222 × BIB23	50.33	79.67	224.62	2.20	1.61	25.80	3.30	9.20	115.01	89.41	32.09	37.09
ICMA07222 × BIB69	49.67	86.53	202.40	2.40	1.60	23.53	3.09	8.77	79.03	65.60	46.62	36.72

Conclusion

The study revealed significant genetic variability among the evaluated genotypes for key agronomic and yield-related traits, providing substantial scope for genetic improvement through selection. High heritability combined with high genetic advance in traits such as grain yield, dry fodder yield, biological yield, tiller number, harvest index, panicle diameter, and test weight indicate predominant additive gene action, making them suitable targets for selection. Several hybrids 274A × BIB4, HHB299, RHB223, ICMA13666 × BIB12, ICMA06888 × BIB63, BHB1602, ICMA04999 × BIB62, ICMA04999 × BIB4, ICMA98222 × BIB23, and ICMA07222 × BIB69 demonstrated superior per se performance for grain yield, highlighting their potential for inclusion in future breeding programs.

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References

Anonymous, (2022). Directorate of Economics and Statistics (DES) (2022-23). Department of Planning, Rajasthan, Jaipur.

Anonymous, (2023). Directorate of Economics and Statistics (DES). 2023-24. Ministry of Agriculture and Farmers Welfare (MA and FW), Government of India.

Basavaraj, P. S., Biradar, B. D. and Sajjanar, G. M. (2017). Genetic variability studies for quantitative traits of restorer (R) lines in pearl millet [*Pennisetum glaucum* (L.) R. Br.]. *International Journal of Current Microbiology and Applied Sciences,* **6**(8):3353-3358.

Burton, G.W. (1952). Quantitative inheritance in pearl millet (*Pennisetum glaucum*). *Agronomy Journal,* **43**: 409-417.

Burton, G.W. and Dewane, E.M. (1953). Estimating heritability in tall fescue (*Fistula arundinacea* L.) from replicated clonal material. *Agronomy Journal,* **45**: 478 – 481.

Chapke, R. R., Prabhakar, S. G., Das, I. K. and Tonapi, V. A. (2018). Improved millets production technologies and their impact. ICAR-Indian Institute of Millets Research, Hyderabad, p. 84.

Goswami, P. A., Patel, H. S., Patel, P. R. and Donga, A. R. (2023). Study of genetic variability, heritability and genetic advance for yield and its component traits in pearl millet [*Pennisetum glaucum* (L.) R. Br.]. *The Pharma Innovation Journal,* **77**: 23-41.

Hanna, W. W., Gupta, S. K. and Khairwal, I. S. (1999). Breeding for forage, pearl millet breeding. *Oxford and IBH,* New Delhi: 303-316.

Johanson, H.W., Robinson, H.F. and Comstock, R.E. (1955). Estimates of genetic and environmental variability in soyabean. *Agronomy Journal,* **47**(7): 314-315.

Kumar, M., Gupta, P. C. and Kumar, M. (2015). Genetic variability, heritability and genetics advance studies for yield and its contributing traits in pearl millet [*Pennisetum glaucum* (L.) R. Br.] hybrids. *Indian Research Journal of Genetics and Biotechnology,* **7**(02): 271-273.

Kumar, Y., Lamba, R. A. S., Yadav, H. P., Kumar, R. and Vart, D. (2014). Studies on variability and character association under rainfed conditions in pearl millet [*Pennisetum glaucum* (L.) R. Br.] hybrids. *Forage Research,* **39**(4): 175-178.

Kumari, M., Garg, D. K., Saini, R. S. and Jat, B. L. (2013). Genetic variability and correlation coefficient in pearl millet [*Pennisetum glaucum* (L.) R. Br. Emend Stuntz]. *Forage research,* **39**: 83-87.

Panse, V.G. and Sukhatme, P.V. (1985). Statistical methods for agricultural workers. I.C.A.R. New Delhi.

Rajpoot, P., Tripathi, M. K., Solanki, R. S., Tiwari, S., Tripathi, N., Chauhan, S. and Khandelwal, V. (2023). Genetic variability and multivariate analysis in pearl millet [*Pennisetum glaucum* (L.) R. Br.] germplasm lines. *The Pharma Innovation Journal,* **12**(4): 216-226.

Singh, B., Upadhyay, P. K. and Sharma, K. C. (2014). Genetic variability, correlation and path analysis in pearl millet [*Pennisetum glaucum* (L.) R. Br.]. *Indian Research Journal of Genetics and Biotechnology,* **6**(3): 491-500.

Sumathi, P., Lalithkannan, R. and Revathi, S. (2016). Genetic analysis and diversity studies in pearl millet [*Pennisetum glaucum* (L.) R. Br.]. *Electronic Journal of Plant Breeding,* **7**(4): 1014-1019.

Sumathi, P., Madineni, S. and Veerabadhiran, P. (2010). Genetic variability for different biometrical traits in pearl millet genotypes [*Pennisetum glaucum* (L.) R. Br.]. *Electronic journal of plant breeding,* **1**(4): 437-440.

Vagadiya, K. J., Dhedhi, K. K. and Joshi, H. J. (2013). Genetic variability, heritability and genetic advance of grain yield in pearl millet. *Agricultural Science Digest,* **33** (3): 223 – 225.

Vidyadhar, B., Chand, P., Devi, I. S., Reddy, M. and Ramachandraiah, D. (2007). Genetic variability and character association in pearl millet [*Pennisetum glaucum* (L.) R. Br.] and their implications in selection. *Indian Journal of Agricultural Research,* **41**(2): 150-153.