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ANALYSIS OF GENETIC PARAMETERS IN RICE (*Oryza sativa* L.) GENOTYPES INCLUDING VARIABILITY, HERITABILITY AND GENETIC ADVANCE

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ABSTRACT

The current experimental investigation, entitled "Analysis of Genetic Parameters in Rice (*Oryza Sativa* L.) Genotypes Including Variability, Heritability and Genetic Advance" was conducted during the *Kharif*, 2022 at the Agricultural Research Farm, Hirapuri Colony of Institute of Agricultural and Natural Sciences, Deen Dayal Upadhyaya Gorakhpur University, Gorakhpur. The investigation was conducted with 13 promising rice germplasm lines. The nursery sowing for all 13 genotypes of rice in *Kharif* 2022 was completed on June 22 and transplanting was done in field on July 4. A row of 1.5 m in length with 3 replications of each genotype was planted. Analysis of variance (ANOVA) for eleven traits among 13 rice genotypes revealed significant differences for all the studied characters, indicating the presence of substantial genetic variability among the genotypes. This variability provides ample opportunity for the selection of superior genotypes for yield enhancement. During Kharif 2022, the genotypes Damini and Sarjoo-52 exhibited the earliest flowering and maturity, respectively, suggesting their potential use as donor parents in breeding programs aimed at developing early-maturing rice varieties. The phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were moderate for effective tillers per plant, 1000-grain weight, and grains per panicle. Biological yield per plant showed moderate PCV but low GCV, whereas the remaining traits exhibited low PCV and GCV values. High heritability coupled with moderate genetic advance was observed for effective tillers per plant, 1000-grain weight, grains per panicle, and biological yield per plant. Traits such as days to 50% flowering, days to maturity, panicle length, grain length, and grain length-to-breadth ratio recorded high heritability along with low genetic advance. Plant height exhibited high heritability with moderate genetic advance, while grain breadth showed moderate heritability associated with low genetic advance.

Keywords **:** Rice, ANOVA, GCV, PCV, Genetic advance, Heritability.

Introduction

Rice (*Oryza sativa* L.) is one of the most important cereal crops worldwide and acts as the primary food source for more than half of the global population (Darko *et al*., 2025). It plays a significant role in maintaining food and nutritional security, especially in Asian countries where rice forms the major component of the daily diet (Mukka *et al*., 2025; Jukanti *et al*., 2025; Yilmaz and Yilmaz, 2025). In India, rice is grown extensively across diverse agro-climatic regions and contributes substantially to the agricultural economy and rural employment (Gupta *et al*., 2025). Rapid population growth, climate change, reduction in cultivable land and rising food demand have increased the need for developing high-yielding and climate-resilient rice varieties (Molla *et al*., Qiao *et al*., 2026).

The effectiveness of any plant breeding programme mainly depends on the magnitude of genetic variability present in the available germplasm (Modarresi, 2026; Islam *et al*., 2025). Genetic variability serves as the fundamental basis for selection and helps breeders identify superior genotypes with desirable agronomic and yield-related characters (Ali *et al*., 2026; Sadran *et al*., 2025). In rice improvement programmes, sufficient variability for yield and its associated traits provides greater opportunities for the development of improved cultivars with enhanced productivity and wider adaptability (Lin *et al*., 2025; Akter *et al*., 2025). Therefore, evaluating the extent of genetic variability among rice genotypes is an essential prerequisite for successful crop improvement.

Grain yield is a complex quantitative trait that is highly influenced by environmental conditions. Consequently, selection based only on phenotypic performance may not always be reliable (Choi *et al*., 2025; Lixiao *et al*., 2025). The estimation of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) helps in determining the degree of variability present in different characters as well as the influence of the environment on their expression (Modarresi, 2026; Yadav *et al*., 2026). Traits exhibiting high GCV and PCV values indicte greater potential for improvement through selection (Pallavi *et al*., 2025; Islam *et al*., 2025).

Heritability is an important genetic parameter that indicates the proportion of phenotypic variation governed by genetic factors (Nanda *et al*., 2026). High heritability estimates suggest that the observed variability is primarily due to genetic causes, making phenotypic selection more effective (Modarresi, 2026; Ghosh *et al*., 2025). However, heritability alone is insufficient for predicting the actual progress from selection. Hence, genetic advance in combination with heritability provides a more dependable estimate of expected genetic gain (Anusha *et al*., 2025). High heritability accompanied by high genetic advance generally reflects the predominance of additive gene action, whereas high heritability with low genetic advance may indicate the role of non-additive gene effects and environmental influence (Naik *et al*., 2025).

Keeping these facts in view, the present study entitled "Analysis of Genetic Parameters in Rice (*Oryza Sativa* L.) Genotypes Including Variability, Heritability and Genetic Advance" was undertaken to assess the extent of genetic variability among rice genotypes and to estimate heritability and genetic advance for yield and related traits. The outcome of this investigation will be useful in identifying superior genotypes and important selection criteria for future rice breeding programmes.

Materials and Methods

The current experimental investigation, entitled "Analysis of Genetic Parameters in Rice (*Oryza Sativa* L.) Genotypes Including Variability, Heritability and Genetic Advance" was conducted during the *Kharif*, 2022 at the Agricultural Research Farm, Hirapuri Colony of Institute of Agricultural and Natural Sciences, Deen Dayal Upadhyaya Gorakhpur University, Gorakhpur. The investigation was conducted with 13 promising rice germplasm lines. The nursery sowing for all 13 genotypes of rice in *Kharif* 2022 was completed on June 22 and transplanting was done in field on July 4. A row of 1.5 m in length with 3 replications of each genotype was planted. In order to analyse the impact of numerous traits for heritability, correlation, path analysis, and genetic divergence on grain production over time, a spacing of 20 cm x 15 cm was provided, and the crop was cultivated in accordance with the suggested package of practices.

Results and Discussion

Analysis of variance and Mean performance

The data were recorded for eleven traits viz., days to 50% flowering, days to maturity, plant height, 1000 grain weight, effective tillers per plant, panicle length, grains per panicle, grain length, grain breadth, grain length breadth ratio and grain yield per plant from experiment and subsequently subjected to statistical analysis. The result obtained in the present investigation has been discussed (Table-1). For all the studied traits, including days to 50% flowering, days to maturity, plant height, 1000 grain weight, effective tillers per plant, panicle length, grains per panicle, grain length, grain breadth, grain length-to-breadth ratio, and grain yield per plant, the analysis of variance revealed significant differences among the genotypes.

All of the quantitative features under study showed a sizable range of variance, indicating that there is room for improvement in a desired direction. Table-2 displays the mean and standard deviation of variation for several characters. The values of range demonstrated significant genotype-to-genotype variation for each character. The distribution of variance was nearly uniform on both sides of the means derived for each attribute, indicating that the genotypes were distributed normally. The minimum number of days to 50% flowering was recorded in Damini (102 days) while the maximum number of DFF was observed in CR Dhan 511 (135.67 days). The general mean for this character recoded was 117.38

within the range of 102 to 135.67 days. The range of days to maturity was varying between 132.67 to 161.33 days and mean performance for this character was recorded 148. The genotype Sarjoo-52 (132.67 days) recorded the least number of the days to maturity while the genotype CR Dhan 511 (161.33 days) recorded maximum number of days to maturity. The maximum plant height was recorded by genotype Varsha Dhan (150 cm) and minimum plant height was recorded by genotype Chintua (97.33 cm). The mean value for this character was recorded 117.51 and range varying from 150 to 97.33 cm. The range of 1000 grain weight was recorded from 14.48 to 24.87 g. The minimum 1000 grain weight was recorded genotype Chintua (14.48 g) and the maximum 1000 grain weight was recorded genotype Dhanrekha (24.87 g) while general mean value for this trait was obtained at 21.76. The range of effective tillers per plant varied from 5.67 (Damini) to 13 (Dhanrekha), the general mean was recorded 9.56 while the maximum effective tillers per plant was recorded Damini (5.67) and minimum effective tillers per plant was recorded Dhanrekha (5.67). The maximum panicle length was recorded genotype Sarjoo-52 (28.04 cm) while minimum panicle length was recorded genotype Swarna Sub-1 (20.25 cm) and the general mean value was recorded 24.78 and the range was varying between from 20.25 to 28.04 cm. The lowest value for grains per panicle was recorded genotype Swarna Sub-1 (143.33) and highest value for grains per panicle was recorded genotype Sarjoo-52 (289.67) and recorded mean value for grains per panicle was 197.64 while range varying from 143.33 to 289.67. The minimum value for grain length was recorded genotype Chintua (4.40 mm) and maximum value for grain length was recorded genotype CR Dhan 503 (5.65 mm) and range for this trait was varying from 4.40 to 5.65 mm while mean value for this trait was 5.16. The mean for grain breadth was 2.12 recorded which ranged varying from 1.83 to 2.43 mm while Chintua was the highest grain breadth value and CR Dhan 1009 was the lowest grain breadth value was recorded. The genotype CR Dhan 1009 (2.07) obtained least number of grain length breadth ratio and the highest grain length breadth ratio was recorded genotype Badshah Bhog (2.87). The range observed for this character was 2.07 to 2.87 with a mean value of 2.46. The mean performance for grain yield per plant was observed 24.99 gm/plant while the range varying for this trait was from 14.71 to 21.46 g. The highest value for grain yield per plant was recorded genotype Swarna and lowest value for this trait was recorded genotype Sarjoo-52.

Parameters of variability, Heritability and Genetic advance:

In Table-3, the estimates of the mean range and the parameters of variability, including phenotypic and genotypic coefficients of variability (PCV and GCV), as well as heritability (h2bs) in the broad sense and predicted genetic gain as a percentage of mean, are given for various traits. The range for days to 50% flowering was from 102 to 135.67 days. Low estimations for PCV (10.25%) and GCV (10.13%) were recorded. This character had a high heritability (97.60%) but a poor genetic advance (20.61%). The range for days to maturity varied from 13267 to 161.33 days. Low estimations for PCV (6.30%) and GCV (6.25%) were recorded. This trait showed a high heritability (98.39%) and a low genetic advance (12.77%). The ranges of plant height from 97.33 to 150.00 cm. Low estimations were recorded for PCV (15.11%) and GCV (15.09%). High heritability (99.68%) and modest genetic advance (31.03%) were present in this trait. Effective tillers per plant had a maturity range of 5.67 to 13.00. PCV and GCV estimations were also in the moderate (21.33% and 20.13%) range. This character's heritability was high (89.07%) and its genetic advance was moderate (39.14%). 1000 grain weight range between 14.48 and 24.87 g were present. PCV estimations (16.00%) and GCV estimates (15.98%) were both moderate type. High heritability (99.76%) and moderate genetic advance (32.88%) were present in this feature. The range of panicle length was between 20.25 and 28.04 cm. PCV (11.31%) and GCV (11.29%) had poor estimations. High heritability (99.65%) and modest genetic advance (23.22%) were characteristics of this person. Range of grain per panicle varied between 143.33 and 289.67. Both PCV (19.86%) and GCV (19.80%) were moderate for this characteristic. This trait has a high level of heritability (99.43%) and a moderate level of genetic advance (40.68%), both of which imply additive gene action for highly effective selection. For the trait grain length range between 4.40 and 5.65 mm. PCV (6.63%) and GCV (4.95%) traits were underwhelming. High heritability (80.39%) and low genetic advance (10.99%) were characteristics of this genotype. Grain breadth was in the 1.83 to 2.43 mm range. Low PCV (9.81%) and GCV (7.63%) figures were provided. This person's genetic advance was only 12.24%, and heritability was only modest (60.57%). Length breadth ratio varied between 2.07 and 2.87. PCV (10.34%) and GCV (9.84%) had low estimations. This trait's genetic advance was only 19.31% and heritability was 90.63 %. Biological yield per plant varied between 21.46 and 36.17 g. PCV (16.06%) and GCV (14.92%) estimates were moderate and low, respectively. Heritability (86.32%) and genetic advance (28.55%) estimates were high and moderate, respectively. Although mean square for all of these features of the genotypes was substantial, moderate genetic variability for the yield and other morphological characters has been detected; as a result, selection will not be effective. For the tillers per plant and grain yield per plant in the current study, PCV and GCV were modest. However, because additive gene action is so common, and PCV and GCV for 1000 grain weight, grains per panicle, and biological yield were moderate, along with high to moderate heritability and genetic progress, led to the conclusion that these features may be further enhanced through selection. The low PCV and GCV values for the quality's days to 50% flowering, plant height, panicle length, days to maturity, grain length, grain breadth, and L: B ratio show that these features have very little room for development. However, hybridization can enhance these characteristics. Similar findings for days to 50% blooming, plant height, panicle length, fertility percentage, 1000-grain weight, grain length, grain width, L: B ratio, and elongation ratio reported by Nanda *et al*., 2026; Ghosh *et al*., 2025; Anusha *et al*., 2025 suggest that these features are under genotypic control. Strong heritability does not always imply strong genetic gain, and it is insufficient on its own to drive improvement through natural selection. When used to predict genetic progress, heritability is more useful. As a result, genetic progress has an advantage over heritability as a deciding factor for breeders in selection programs.

Table 1: Analysis of variance for yield and its attributing traits in rice genotypes:

Source of variation	df	DFF	DM	PH (cm)	1000 GW (g)	ETPP	PL (cm)	Grains/ panicle	GL[L] (mm)	GB[B] (mm)	L/B	GY/P(g)
Replication	2	9.92	10.23	14.33	0.04	2.87	0.24	9.95	0.216	0.014	0.002	3.41
Treatment	12	427.32**	258.17**	943.92**	36.28**	11.58**	23.51**	4604.41**	0.306**	0.095**	0.183**	43.90**
Error	24	3.48	1.40	1.00	0.03	0.46	0.03	8.75	0.023	0.017	0.006	2.20
Total	38	137.66	82.95	299.47	11.48	4.09	7.46	1460.08	0.123	0.042	0.062	15.43

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

Table 2: Mean performance for yield and its attributing traits in rice genotypes:

Genotypes	DFF	DM	PH (cm)	1000 GW (g)	ETPP	PL (cm)	Grains/ panicle	GL[L] (mm)	GB[B] (mm)	L/B	GY/P(g)
Pooja	126.33	151.00	107.00	20.13	10.33	27.63	171.00	5.08	2.00	2.53	25.55
Chintu	107.33	145.33	97.33	14.48	9.00	23.14	205.33	4.40	1.83	2.41	25.37
Badshah Bhog	106.67	145.00	107.33	14.53	9.67	23.04	173.00	5.07	1.88	2.87	25.13
Swarna Sub-1	108.33	143.00	101.33	21.60	10.33	20.25	143.33	5.08	2.09	2.42	22.77
Sarju-52	104.33	132.67	117.33	24.13	9.67	28.04	289.67	5.27	2.35	2.25	36.17
Damini	102.00	134.00	101.00	23.10	5.67	25.90	161.67	5.16	2.22	2.32	21.99
Varsha Dhan	130.00	158.67	150.00	24.57	7.67	27.47	223.33	5.57	2.00	2.78	26.02
Swarna	123.67	147.67	105.00	22.50	8.33	20.57	213.67	5.03	2.10	2.39	21.46
CR Dhan 501	123.67	154.00	131.00	24.03	11.33	27.93	180.33	5.57	2.06	2.70	22.02
CR Dhan 1009 (sub 1)	118.00	154.00	119.33	23.13	12.00	23.27	219.00	5.04	2.43	2.07	25.00
Dhanrekha	107.00	139.00	108.33	24.87	13.00	24.00	223.67	5.10	2.23	2.29	27.31
CR Dhan 503(Jalamani)	133.00	158.33	140.00	23.93	7.67	27.60	155.00	5.65	2.04	2.76	22.42
CR Dhan 511	135.67	161.33	142.67	21.80	9.67	23.34	210.33	5.09	2.28	2.23	23.65
Mean	**117.38**	**148.00**	**117.51**	**21.76**	**9.56**	**24.78**	**197.64**	**5.16**	**2.12**	**2.46**	**24.99**
Min	**102.00**	**132.67**	**97.33**	**14.48**	**5.67**	**20.25**	**143.33**	**4.40**	**1.83**	**2.07**	**21.46**
Max	**135.67**	**161.33**	**150.00**	**24.87**	**13.00**	**28.04**	**289.67**	**5.65**	**2.43**	**2.87**	**36.17**
SE(d)	**1.52**	**0.97**	**0.82**	**0.14**	**0.55**	**0.14**	**2.42**	**0.12**	**0.11**	**0.06**	**1.21**
C.D.	**3.16**	**2.00**	**1.70**	**0.29**	**1.14**	**0.28**	**5.02**	**0.26**	**0.22**	**0.13**	**2.52**
C.V.	**1.59**	**0.80**	**0.85**	**0.78**	**7.05**	**0.67**	**1.50**	**2.94**	**6.16**	**3.16**	**5.94**

Table 3: Parameters of variability, Heritability and Genetic advance for yield and its attributing traits in rice genotypes:

Genotypes	Mean	Min	Max	Heritability (%)	GA	GA% mean	GCV (%)	PCV (%)
DFF	117.38	102.00	135.67	97.60	24.19	20.61	10.13	10.25
DM	148.00	132.67	161.33	98.39	18.90	12.77	6.25	6.30
PH(cm)	117.51	97.33	150.00	99.68	36.46	31.03	15.09	15.11
1000 GW(g)	21.76	14.48	24.87	99.76	7.15	32.88	15.98	16.00
ETPP	9.56	5.67	13.00	89.07	3.74	39.14	20.13	21.33

PL(cm)	24.78	20.25	28.04	99.65	5.75	23.22	11.29	11.31
Grains/panicle	197.64	143.33	289.67	99.43	80.40	40.68	19.80	19.86
GL[L](mm)	5.16	4.40	5.65	80.39	0.57	10.99	5.95	6.63
GB[B](mm)	2.12	1.83	2.43	60.57	0.26	12.24	7.63	9.81
L/B	2.46	2.07	2.87	90.63	0.48	19.31	9.84	10.34
GY/P(g)	24.99	21.46	36.17	86.32	7.14	28.55	14.92	16.06

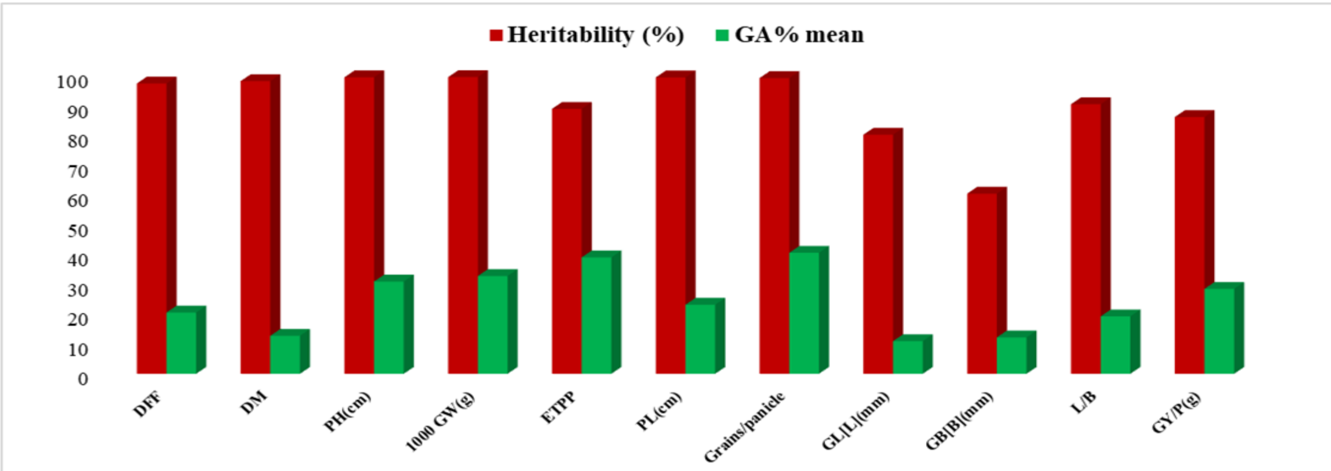

Fig. 1: Estimates of Heritability & Genetic advance yield and its attributing traits in rice genotypes.

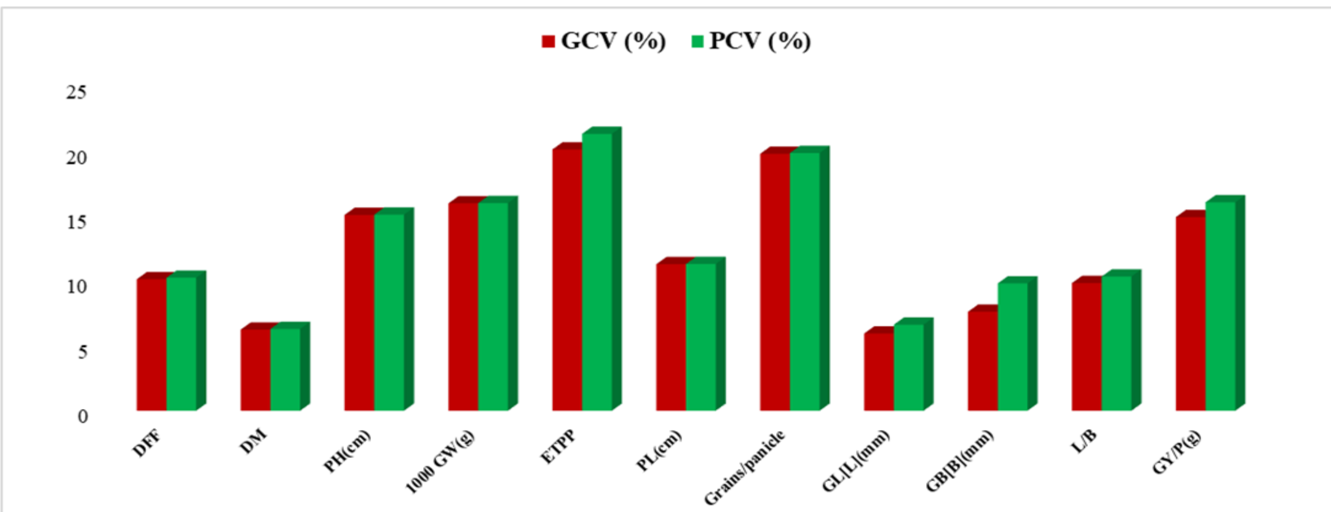

Fig. 2: Genotypic Coefficient of Variation & Phenotypic Coefficient of Variation yield and its attributing traits in rice genotypes.

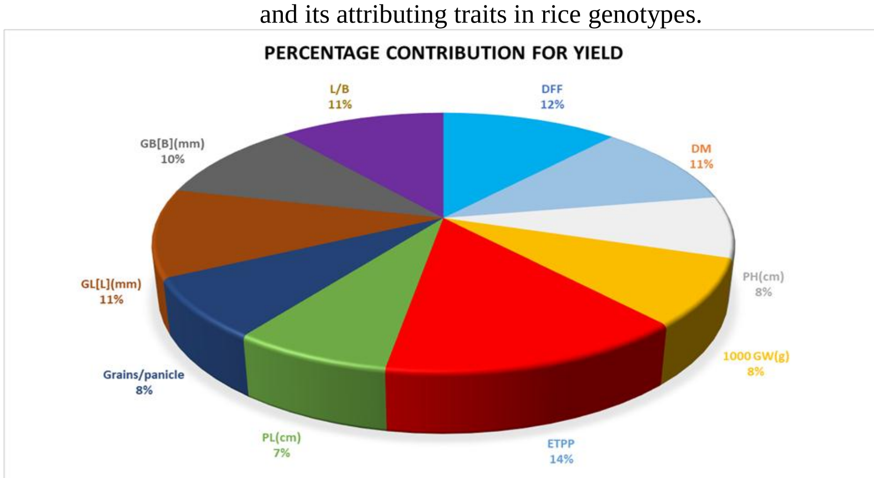

Fig. 3 : Percentage attributing traits for yield in rice genotypes.

Conclusion

ANOVA for eleven characters in 13 rice genotypes: The analysis of variances revealed the differences between all the genotypes for each of the eleven examined variables, indicating that there was enough diversity among all the genotypes. This shows that there is plenty of room to choose favorable genotypes for yield improvement from the current pool of genotypes. Range and mean performance for the genotypes Damini and Sarjoo-52 were the earliest in kharif-2022 in terms of flowering and maturity, respectively, suggesting that these genotypes may be employed as donors in a hybridization program for early maturing rice varieties. Phenotypic and genotypic coefficient of variation was moderate for effective tillers per plant, 1000 grain weight and grains per panicle and biological yield per plant had moderate PCV and low GCV and remaining all the traits had phenotypic coefficient of variation and genotypic coefficient of variation low. Effective tillers per plant, 1000 grains weight, grains per panicle and biological yield per plant had high heritability coupled with moderate genetic advance. Days to 50% flowering, days to maturity, panicle length, grain length and grain length breadth ratio had high heritability coupled with low genetic advance. Plant height had high heritability and moderate genetic advance. Grain breadth had moderate heritability with low genetic advance.

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References

Akter, T., Afrad, M. S. I., Habib, M. A., Zhang, Y., Sarkar, M. A. R., Nayak, S., ... & Kamal, M. Z. U. (2025). Farmers' Adoption of Newly Released Climate Resilient Rice Varieties in the Coastal Ecosystem of Bangladesh: Effectiveness of a Head-To-Head Adaptive Trial. *Food and Energy Security*, **14**(2), e70075.

Ali, Z., Naeem, M., Rafiq, I., Rehman, A., Ahmad, S., Alwutayd, K. M., ... & Iqbal, R. (2026). Evaluation of Genetic Diversity, Yield, and Its Associated Traits in Rice (*Oryza sativa* L.) Genotypes. *Plant Molecular Biology Reporter*, **44**(1), 1-13.

Anusha, B., Veni, B. K., Lal Ahamed, M., & Rani, Y. A. (2025). Variability studies for yield, yield components and quality characters in M.

Choi, J. W., Hidayat, M. S., Cho, S. B., Hwang, W. H., Lee, H., Cho, B. K., ... & Kim, G. (2025). Recent trends in machine learning, deep learning, ensemble learning, and explainable artificial intelligence techniques for evaluating crop yields under abnormal climate conditions. *Plants*, **14**(18), 2841.

Danquah, F. O. (2025). Global rice production: Current status, challenges, and future scenarios. In *Rice Cultivation Under Abiotic Stress* (pp. 3-21). Academic Press.

genotypes for yield, and some agronomic traits. *Reproduction and Breeding*, **6**(1), 9-20.

Ghosh, S., Chetariya, C. P., Walia, P., & Chaudhary, N. (2025). Genetic variability, correlation, path and PCA for yield and its component traits in pan India elite cultivars of rice (*Oryza sativa* L.). *Plant Archives (09725210)*, **25**(1).

Gupta, D. K., Pramanick, S., Singh, A. K., Singh, V., Singh, D. K., Tariq, A., ... & Singh, G. (2025). Long-term impact of aerosols and climate variability on rice yields across agroclimatic zones in India. *Earth Systems and Environment*, **9**(3), 2001-2021.

Islam, M. Z., Chakrabarty, T., Akter, N., Khalequzzaman, M., Prince, M. F. R. K., Pittendrigh, B. R., ... & Ali, M. P. (2025). Genetic variability, correlation and path coefficient analysis of phenotypic traits and genetic diversity of Aman rice landraces (*Oryza sativa* L.). *Scientific Reports*, *15*(1), 18606.

Islam, M., Parveen, S., Arun, G., Sachan, V., & Pathak, S. K. (2025). Studies on Genetic Variability in Rice (Oryza sativa L.) Genotypes Collected from Eastern India. *Ecology, Environment & Conservation (0971765X)*, **31**(2).

Jukanti, A. K., Karapati, D., Bharali, V., Gudla, M., Thati, S., Yadla, S., ... & Sundaram, R. M. (2025). From gene to plate: Molecular insights into and health implications of rice (Oryza sativa L.) grain protein. *International Journal of Molecular Sciences*, **26**(7), 3163.

Lin, Q., Ouyang, Q., & Huang, S. (2025). The application of big data technology in the study of rice variety adaptability: Current status, challenges, and prospects. *Resources Data Journal*, **4**, 126-140.

Lixiao, N., Xiayu, G., Weiqin, W., Yucheng, Q., Zhiyong, A., & Aibin, H. (2025). Regulation of regeneration rate to enhance ratoon rice production. *Rice Science*, **32**(2), 177-192.

Modarresi, M. (2026). Genetic variability, heritability and genetic advance in Iranian local rice genotypes for yield, and some agronomic traits. *Reproduction and Breeding*, **6**(1), 9-20.

Modarresi, M. (2026). Genetic variability, heritability and genetic advance in Iranian local rice genotypes for yield, and some agronomic traits. *Reproduction and Breeding*, **6**(1), 9-20.

Molla, J., Murshed, S. R., & Molla, K. (2025). High-Yield Crops Developed by Climate-Resilient Strategies. In *Stress-Resilient Crops: Coordinated omics-CRISPR-nanotechnology strategies* (pp. 27-37). GB: CABI.

Mukka, S., Vasa, H., & Mekam, M. (2025). Evaluating the advantages and disadvantages of rice fortification for improved food and nutrition security. In *Agriculture, Nutrition, and Resilience* (pp. 118-146). CRC Press.

Naik, M. K., Ch, S. R., Kumar, C. S., & Mangrauthia, S. K. (2025). Genetic Variability and Principal Component Analysis of Phenotypic Traits in Aromatic Rice Genotypes. *Journal of Experimental Agriculture International*, **47**(7), 728-735.

Nanda, K. P., Vavdiya, P. A., Asondariya, K. H., Jadav, R. V., Mungra, K. S., & Naghera, Y. V. (2026). Assessment of genetic variability, heritability and genetic advance for yield and yield components in red rice (*Oryza sativa* L.). *Plant Archives*, **26**(1), 2361-2365.

Pallavi, M., Shanthi, P., Prasad, B. M., & Sinchana, B. (2025). Genetic variability and correlation analysis among grain yield and early seedling vigour in rice. *Bangladesh Journal of Botany*, **54**(4), 1027-1033.

Qiao, X., Waheed, A., Dong, C., Aili, A., Muhammad, M., & Xu, H. (2026). Harnessing Genetic Innovations for Climate-Resilient and High-Yield Crops: A Pathway to Sustainable Agriculture. *Plant and Soil*, 1-27.

Sakran, R. M., Ghazy, M. I., Gaballah, M. M., Hussein, F. A., Aamer, S. M., Ghazy, H. A., ... & Abdelghany, A. M. (2025). Genetic variability in physiological and agronomic traits of newly developed rice lines under well-watered and water-deficit conditions. *BMC Plant Biology*, **25**(1), 1291.

Yadav, S., Arsode, P., Yadav, D., Maurya, P., Singh, K., Jaiswal, A., ... & Yadav, A. K. (2026). Estimation of genetic variability, heritability and genetic advance in rice (*Oryza sativa* L.). *Plant Archives*, **26**(1), 3060-3065.

Yilmaz, H., & Yilmaz, A. (2025). Hidden hunger in the age of abundance: the nutritional pitfalls of modern staple crops. *Food Science & Nutrition*, **13**(2), e4610.