Int.J.Curr.Microbiol.App.Sci (2026) *15*(7): 165-170

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 15 Number 7 (2026)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2026.1507.015

Analysis of Variability, Heritability and Genetic Advance in F_3 Generation of Bhendi [*Abelmoschus esculentus* (L.) Moench]

R. Vinothmani* and V. Sundaram

Department of Horticulture, Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, UT of Puducherry, India

**Corresponding author*

Keywords

Bhendi, F_3 generation, genetic variability, heritability, genetic advance, selection.

Article Info

Received:
16 May 2026
Accepted:
24 June 2026
Available Online:
10 July 2026

A B S T R A C T

The field experiment was carried out to analyze the extent of genetic variability, heritability and genetic advance in F_3 populations of bhendi [*Abelmoschus esculentus* (L.) Moench]. Sixty F_3 families derived from each two crosses, namely SKY/DR/RS/107 × Tiruchi Local and IC 69257 × 770, were evaluated during Kharif at the Department of Horticulture, Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal. The research was conducted in a Randomized Block Design with two replications. Observations were recorded on twelve quantitative characters. Analysis of variance revealed significant differences among the families for all the characters studied, indicating the presence of substantial variability. High phenotypic coefficient of variation was observed for fruit yield per plant (26.13%), while moderate PCV and GCV were recorded for fruit weight, number of primary branches at final harvest and number of fruits per plant. High heritability coupled with high genetic advance as percent of mean was observed for number of primary branches at final harvest (62.32% and 23.36%, respectively). Moderate heritability (55.33%) with high genetic advance (22.15%) was recorded for fruit weight. The results indicated the predominance of additive gene action for these traits and suggested that direct selection would be effective for their improvement. Notably, the study resulted in genetic variability among the F_3 families, providing ample scope for selection and advancement of superior segregants in bhendi breeding programs.

Introduction

Bhendi [*Abelmoschus esculentus* (L.) Moench] also known as okra, is an important vegetable crop belonging to the cotton family Malvaceae and is widely cultivated in both tropical and subtropical regions of the world. India is the largest producer of bhendi accounting 70 per cent of world production. The annual production of bhendi is 6.8 million tonnes from an area of 5.2 L. ha. in India, and Tamil Nadu cultivates bhendi in a 22000 ha

area, producing 2.2 million tonnes of annual production (Horticultural Statistics, 2023-24). The crop is valued for its tender green fruits, nutritional richness and adaptability to diverse agro-climatic conditions. Bhendi contributes significantly to vegetable production and plays an important role in nutritional security and income generation. Yield improvement remains a major objective in bhendi breeding programmes. However, fruit yield is a complex quantitative trait controlled by several component characters and influenced by environmental factors. Therefore, the success of any breeding programme depends largely on the availability and utilization of genetic variability present in the breeding material. Segregating generations provide valuable opportunities for identifying desirable recombinants and superior genotypes. Among them, F_3 populations exhibit considerable variability due to segregation and recombination of genes inherited from parental lines. Evaluation of such populations facilitates the identification of promising families for advancement and cultivar development. The effectiveness of selection depends not only on the magnitude of variability but also on the extent to which the variability is heritable. Estimates of phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability and genetic advance provide valuable information regarding the nature and magnitude of genetic variability. Heritability estimates indicate the proportion of observed variability that is genetically controlled, while genetic advance predicts the expected improvement from selection. The combined assessment of heritability and genetic advance is useful in identifying traits governed by additive gene action. Therefore, the present investigation was undertaken to assess genetic variability, heritability and genetic advance among 60 F_3 families of bhendi and to identify important traits for effective selection and genetic improvement.

Materials and Methods

The experiment was conducted during Kharif at the Department of Horticulture, Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, UT of Puducherry. The material consist of thirty superior F_3 plants from each two crosses, namely SKY/DR/RS/107 × Tiruchi Local and IC 69257 × 770 were advanced and evaluated as sixty F_3 families. The experiment was laid out in a Randomized Block Design (RBD) and replicated in twice. Five randomly selected plants were observed in each family for twelve quantitative characters *viz.,* days to flowering, first flowering node, plant height at flowering, days to first harvest, internodal length, plant height at final harvest, number of primary branches at final harvest, fruit length, fruit girth, fruit weight, number of fruits per plant and fruit yield per plant. Analysis of variance was performed to assess the significance of differences among the families. Phenotypic variance (PV) and genotypic variance (GV) were estimated following standard biometrical procedures. Phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were calculated according to Burton (1952). Heritability in broad sense was estimated following the method suggested by Lush (1940). Genetic advance and genetic advance as percentage of mean were calculated following Johnson *et al.,* (1955).

Results and Discussion

Analysis of Variance

Among the sixty F_3 families, all twelve quantitative characters show significant differences in variation, indicating substantial genetic variability. This suggests there is an opportunity for effective selection in future studies involving the segregating population.

Variability

The estimates of mean, range, phenotypic variance, genotypic variance, PCV, GCV, heritability and genetic advance are presented in Table 1. A wide range of variation was observed for all the characters studied. Fruit yield per plant ranged from 320.51 g to 793.59 g with a mean value of 541.35 g. Similarly, number of fruits per plant ranged from 18.72 to 39.32, while fruit weight ranged from 13.00 g to 28.00 g, indicating substantial variability among the F_3 families.

Higher phenotypic coefficient of variation than the corresponding genotypic coefficient of variation for all the traits, indicating the influence of environmental factors on character expression was also suggested by Ashita Rana *et al.,* (2020), Badiger *et al.,* (2017). However, the differences between PCV and GCV were comparatively small for several traits, suggesting considerable genetic control over their expression was accordance with the earlier study of Abhishekkatagi *et al.,* (2013). The coefficient of variation was classifies as low (less than 10 per cent), moderate (10 -20 per cent) and high (more than 20 per cent) as suggested by Sivasubramanian and Menon (1973).

Table.1 Mean, Variability, Heritability and Genetic Advance for various characters of bhendi in F3 generation

Character	Mean ±S.E	Range		PV	GV	PCV (%)	GCV (%)	h^2 (%)	GA	GA as per cent of mean
		Min.	Max.							
Days to flowering	37.56±1.03	35.60	44.43	2.34	1.29	4.07	3.02	54.93	1.13	4.61
First flowering node	6.33±0.46	4.55	7.90	0.42	0.22	10.29	7.34	50.91	0.05	10.79
Plant height at flowering (cm)	26.24±3.04	17.90	31.05	13.30	4.04	13.90	7.67	30.43	0.01	8.71
Days to first harvest	43.75±2.65	37.00	50.25	9.82	2.77	7.16	3.80	28.21	0.58	4.16
Internodal length (cm)	3.70±0.39	3.10	4.85	0.27	0.12	14.12	9.38	44.11	0.91	12.84
Plant height at final harvest (cm)	77.98±8.93	52.59	110.00	156.44	76.55	16.04	11.21	48.94	1.01	16.17
Number of primary branches at final harvest	4.02±0.45	2.40	6.00	0.54	0.33	18.20	14.36	62.32	1.28	23.36
Fruit length (cm)	13.73±1.01	11.15	15.89	1.79	0.76	9.73	6.37	42.80	0.88	8.58
Fruit girth (cm)	6.33±0.33	5.50	6.90	0.14	0.03	5.98	2.89	23.46	0.49	2.89
Fruit weight (g)	19.25±2.50	13.00	28.00	13.99	7.75	19.43	14.45	55.33	1.14	22.15
Number of fruits plant^{-1}	28.08±3.42	18.72	39.32	23.79	12.07	17.37	12.37	50.75	1.05	18.16
Fruit yield plant^{-1} (g)	541.35±123.39	320.51	793.59	20013.99	4790.08	26.13	12.78	23.93	0.49	12.88

PV	**- Phenotypic variance**	**PCV**	**- Phenotypic coefficient of variation**
GV	- Genotypic variance	GCV	- Genotypic coefficient of variation
h^2	- Heritability	GA	- Genetic advance

The highest PCV (26.13%) and moderate GCV (12.78%) was observed for fruit yield per plant was already been reported by Archana *et al.,* (2015). The results of fruit weight (19.43%), number of primary branches at final harvest (18.20%) and number of fruits per plant (17.37%) at phenotypic level was moderate. These findings are consonance with the earlier study of Pendyala *et al.,* (2026). Moderate GCV values were observed for fruit weight (14.45%), number of primary branches at final harvest (14.36%), fruit yield per plant (12.78%) and number of fruits per plant (12.37%).

These findings are in line with Kerure *et al.,* (2017) for Fruit weight, Sravanthi (2017) for number of primary branches at final harvest, Chandramouli *et al.,* (2016) for number of fruits plant^{-1} and Badiger *et al.,* (2017) for plant height at final harvest in bhendi. These results indicated the existence of adequate variability and scope for improvement through selection. Low PCV and GCV values were observed for days to flowering, days to first harvest and fruit girth, indicating relatively lower variability for these traits. Such reports are conformity to the previous findings of Bhambaniya *et al.,* (2024).

Heritability and Genetic Advance

Heritability estimates ranged from 23.93% for fruit yield per plant to 62.32% for number of primary branches at final harvest. The values of heritability classified as low (less than 30 per cent), moderate (30 – 60 per cent) and high (more than 60 per cent) as suggested by Johnson *et al.,* (1955). And the genetic advance classified as low (less than 10 per cent), moderate (10 -20 per cent) and high (more than 20 per cent) which also suggested by Johnson *et al.,* (1955). Owing to that, high heritability (62.32%) coupled with high genetic advance (23.36%) was recorded for number of primary branches at final harvest, indicating the preponderance of additive gene action in control of this trait.

This ensures higher response for selection of high yielding genotypes based on this character and such a finding in bhendi had already been published by Chandramouli *et al.,* (2016) and Sravanthi (2017). Moderate level of heritability and genetic advance was observed for four of the twelve characters *viz*., first flowering node (50.91% and 10.79%), number of fruits per plant (50.75% and 18.16%), plant height at final harvest (48.94% and 16.17%) and intermodal length (44.11% and 12.84%). These observations were in line with the earlier findings of Badiger *et al.,* (2017) for first flowering node, Raju *et al.,* (2010) for number of fruits plant^{-1} and Priyanka *et al.,* (2018) for internodal length. Such a moderate estimate of heritability and genetic advance suggested the influence of environmental factors in the expression of these characters as reported earlier by Kerure *et al.,* (2017). The fruit weight could also be considered an important character for yielding a greater selection response as it had recorded a higher genetic advance (22.15%) with moderate heritability (55.33%), equaling almost the range of high heritability class in numerical terms. Such a combination indicates the predominance of additive gene action and suggests that these traits can be effectively improved through simple phenotypic selection.

These findings were in corroboration with the earlier findings of Badiger *et al.,* (2017). Fruit yield per plant exhibited low heritability (23.93%) despite high variability, indicating substantial environmental influence on the expression of the trait. Badiger *et al.,* (2017) reported moderate heritability and genetic advance as per cent over mean for the above trait. Therefore, indirect selection through component traits may be more effective than direct selection for yield.

The low estimate of heritability as well as genetic advance recorded for days to first harvest and fruit girth are in agreement with the earlier study of Singh *et al.,* (2017) in bhendi. This indicated that these characters are highly influenced by environmental effects and consequently selection based on these traits proves ineffective as suggested by Kumar and Kumar (2014).

In the present study, growth, yield and fruit characters showed substantial genetic variability among the sixty F_3 families. Number of primary branches at final harvest and fruit weight exhibited desirable combinations of variability, heritability and genetic advance, indicating the predominance of additive gene action and the effectiveness of selection for these traits. The superior families identified in the study may be utilized for further selection and advancement in bhendi improvement programmes.

Acknowledgement

The authors express their sincere gratitude to the Department of Horticulture, Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, for providing the facilities and support required for conducting this investigation.

Author Contributions

R. Vinothmani: Investigation, formal analysis, writing—original draft. V. Sundaram: Validation, methodology, 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.

References

Abhishekkatagi, Shantappatirakannanvar, R.C. Jagadeesha, J. Jayappa and K.S. Shankarappa. 2013. Genetic analysis of association studies in segregating population of okra [*Abelmoschus esculentus* (L.) Moench]. *Int. J. forestry and Crop Improv.,* 4(1): 13-18.

Akhila Srinidhi Pendyala, S. J. Shinde, D. K. Zate, V. S. Khandare, A.T. Daunde, P. R. Zanwar and Manisha Kharat. 2026. Studies on Variability, Heritability and Genetic Advance in Okra [*Abelmoschus esculentus* (L.) Moench.]. *Int.J.Curr.Microbiol.App.Sci.* 15(1): 70-75.

Archana, M., H.N. Mishra, N. Senapati and P. Tripathy. 2015. Genetic variability and correlation studies in okra [*Abelmoschus esculentus* (L.) Moench].*Electronic J.Plant Breeding*, 6(3): 866-869.

Ashita Rana, Sanjay Singh, Manish Bakshi and Shailesh K. Singh. 2020. Studied on Genetic Variability, Correlation and Path Analysis for Morphological, Yield and Yield attributed traits in okra [*Abelmoschus esculentus* (L.) Monech]. *Int. J. Agricult. Stat. Sci.* 16(1): 387-394.

Bambhaniya, U.B., SM Makwana, Patoliya Armi and Lata J Raval. 2024. Studies on genetic variability, heritability and genetic advance in okra [*Abelmoschus esculentus* (L.) Moench]. *International Journal of Advanced Biochemistry Reseacrh*. 8(7): 536-540.

Badiger, M., M. Pitchaimuthu and P. Pujer. 2017. Genetic variability, heritability, genetic advance and correlation studies among quantitative traits in okra [*Abelmoschus esculentus* (L.) Moench]. *Global J. Biosci.and Biotech.,* 6(2): 314-319.

Burton GW. 1952. Quantitative inheritance in grasses. Proceedings of the Sixth International Grassland Congress. 1:277–283.

Chandramouli, B.D., D. Shrihari, A.V.D.D. Rao and M.P. Rao. 2016. Studies on genetic variability, heritability and genetic advance in okra [*Abelmoschus esculentus* (L.) Moench] genotypes. *Plant Archives*, 16(2): 679-682.

Department of Agriculture and Farmers Welfare. 2024. *Third Advance Estimates of Area and Production of Horticultural Crops for 2023–24*. Ministry of Agriculture and Farmers Welfare, Government of India, New Delhi.

Johnson HW, Robinson HF, Comstock RE. 1955. Estimates of genetic and environmental variability in soybeans. *Journal of Agronomy*. 47:314–318.

Kerure, P., M. Pitchaimuthu and A. Hosamani. 2017. Studies on variability, correlation and path analysis of traits contributing to fruit yield and its components in okra [*Abelmoschus esculentus* (L.) Moench]. *Electronic J. Plant Breeding*, 8(1): 134-141.

Kumar, P. and R. Kumar. 2014. Variability, heritability and character association in okra [*Abelmoschus esculentus* (L.) Moench].*Asian J. Bio-sci*., 10(1): 60-63.

Lush JL. 1940. Intra-sire correlations and regression of offspring on dams as a method of estimating heritability of characteristics. Proceedings of the American Society of Animal Production. 33: 293–301.

Priyanka, D.V., M.T. Reddy, H. Begum, N. Sunil and M. Jayaprada. 2018. Studies on genetic variability, heritability and genetic advance in genotypes of okra [*Abelmoschus esculentus* (L.) Moench]. *Int. J. Curr. Microbiol. App. Sci*., 7(5): 401-411.

Raju, C., R.G. Satish, Rajesab, G. Shanthakumar and A. Nayak. 2010. Genetic variability created through biparental mating in bhendi [*Abelmoschus esculentus* (L.) Moench]. *Gregor Mendel Foundation J*., 1: 33-35.

Robinson HF, Comstock RE, Harvey PH. 1949. Estimates of heritability and degree of dominance in corn. Agronomy Journal. 41:353–359.

Singh, A.P., P.P. Kumar, B.A. Kumar and V. Bahadur. 2017. Studies on genetic variability, heritability and character association in okra. *Int. J. Bio-resource and Stress Management*, 8(3): 457-462.

Sivasubramaniam, S. and P.M. Menon. 1973. Genotypic and phenotypic variability in rice. *Madras Agric. J.*, 60(9-13): 1093-1096.

Sravanthi, U. 2017. Studies on variability, heritability and gentic advance in okra [*Abelmoschus esculentus* (L.) Moench]. *Int. J. Curr. Microbiology App. Sci*., 6(10): 1834-1838.

How to cite this article:

Vinothmani R. and Sundaram V. 2026. Analysis of Variability, Heritability and Genetic Advance in F_3 Generation of Bhendi [*Abelmoschus esculentus* (L.) Moench]. *Int.J.Curr.Microbiol.App.Sci.* 15(7): 165-170.
doi: https://doi.org/10.20546/ijcmas.2026.1507.015