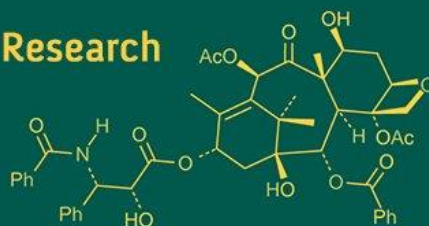


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
IJABR 2026; SP-10(7): 1252-1255
www.biochemjournal.com
Received: 26-04-2026
Accepted: 28-05-2026

Ankita Tiwari
Department of Vegetable
Science, Chandra Shekhar
Azad University of Agriculture
and Technology, Kanpur,
Uttar Pradesh, India

Dr. VK Tripathi
Department of Fruit Science,
Chandra Shekhar Azad
University of Agriculture and
Technology, Kanpur, Uttar
Pradesh, India

Rajeev
Department of Vegetable
Science, Chandra Shekhar
Azad University of Agriculture
and Technology, Kanpur,
Uttar Pradesh, India

Corresponding Author:
Dr. VK Tripathi
Department of Fruit Science,
Chandra Shekhar Azad
University of Agriculture and
Technology, Kanpur, Uttar
Pradesh, India

Studies on genetic variability, heritability and genetic advance for yield and associated traits in bottle gourd [*Lagenaria siceraria* (Mol.) Stand l.]

Ankita Tiwari, VK Tripathi and Rajeev

DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i7So.9218>

Abstract

Using the line $\times$ tester mating design, this investigation assessed combining ability for yield-related traits in bottle gourd. For this, during the summer season of 2025, at the Vegetable Farm, Chandra Shekhar Azad University of Agriculture & Technology, Kalyanpur, Kanpur (U. P.), 30 crosses derived from 10 lines and 3 testers were evaluated. The tests were conducted using a randomized block design with 3 replications; 30 F_1 's and their 13 parents were evaluated. The genotypes exhibited significant differences in all traits in the experiment. The highest phenotypic and genotypic coefficient of variation was recorded for node number to first staminate flower and fruit circumference. The moderate phenotypic and genotypic coefficient of variation was recorded for fruit yield per plant, total yield, number of primary branches per plant, fruit yield per plot, total soluble solids, dry matter, fruit weight and fruit length. The highest heritability and genetic advance were recorded for node number to first staminate flower, followed by fruit circumference, fruit yield per plant, number of primary branches per plant, total soluble solids, fruit weight, vine length, node number to first pistillate flower, dry matter, fruit length, total yield and fruit yield per plot. The substantial heritability and considerable genetic advance observed for most yield and quality characteristics illustrate the ubiquity of additive gene action and highlight the utility of direct phenotypic selection for their improvement.

Keywords: Bottle gourd, *Lagenaria siceraria*, genetic variability, heritability, genetic advance, yield traits

Introduction

The bottle gourd (*Lagenaria siceraria* (Mol.) Standl.) is an annual monoecious crop, often known as the calabash or white-flower gourd, with a chromosome number $2n = 22$ (Kumar *et al.*, 2011) ^[13]. According to Cutler and Whitaker (1967) ^[7], calabash is believed to have originated in Africa and America. In India, it is known for its great production potential and tolerance of a wide range of agroclimatic conditions, and it is grown for its soft fruits, which are largely used for cooking. Fruits are employed as a nutritive agent and have a variety of medical characteristics, including cardioprotective, cardiostonic, diuretic and aphrodisiacal. A total of 3.171 million tonnes of bottle gourd is produced in India on 0.193 million hectares of cultivated land (Anonymous 2022) ^[12]. Still, the supply is insufficient to meet the requirements of the country's huge population. Bottle gourd's high fibre content helps avoid digestive issues, including constipation.

Fibre intake has been linked to lower rates of cardiovascular disease and diabetes (Hemeda *et al.*, 2008) ^[12]. Bottle gourd juice is traditionally used to alleviate acidity, indigestion and ulcers, in addition to being a thirst quencher. The fruit contains antidotes for poisons and scorpion stings, as well as purgative and cooling properties. The fruit is used to treat asthma and other bronchial conditions, as it is said to reduce discomfort and effectively combat fever. According to Deore *et al.* (2009) ^[9], it is also an excellent source of natural antioxidants. Due to its high dietary fibre content and low fat and cholesterol content, it aids in rapid weight loss (Parle and Kaur, 2011) ^[17]. A leaf decoction is used to treat jaundice. It has the ability to chill. To lessen the effects of heat during the hot season, the sliced surface of a small fruit is rubbed on the hands and the soles of the feet. A breeder can choose a genotype with the best qualities for yield by using genetic indices including heritability, genetic advance and genotypic and phenotypic coefficients of variability. The current study

Was conducted to examine the genetic variability, heritability and genetic progress characteristics in bottle gourd germplasm in light of the aforementioned facts (Singh *et al.*, 2021)^[19].

Material and Methods

The study was carried out during the summer season of 2024 at the Department of Vegetable Science, Chandra Shekhar Azad University of Agriculture & Technology, Kalyanpur, Kanpur (U.P.), India. Thirteen promising genotypes VRBG-21 (L₁), VRBG-67 (L₂), SBC/DRB-201-3 (L₃), SBC/DRB-125-1 (L₄), SBC/DRB-75 (L₅), SBC/DRB-201-1 (L₆), SBC/DRB-206-1 (L₇), SBC/DRB-201-2 (L₈), NDBG-18 (L₉), BGP-6 (L₁₀) and Tester Kalyanpur Long Green (T₁), Pusa Nveen (T₂) and Kashi Ganga (T₃) were chosen for use in the crossing program. During the summer of 2024, 30 hybrids and their parents (obtained via selfing) were harvested individually after crosses were made in a Line × tester pattern in all possible combinations. For a total of 44 genotypes, the experimental material comprised 30 F₁ hybrids, 13 parental lines (10 lines plus 3 testers) and one standard check variety. Using a Randomised Block Design (RBD) with three replications, the experiment was conducted on the experimental farm during the 2025 growing season. A single 4.0-meter-long row with a 3.0-meter row-to-row spacing and a 75-cm plant-to-plant distance was used to seed each genotype. In each plot, six healthy, consistently growing plants were maintained to collect data on numerous growth, yield, and yield-attributing traits. For successful crop production, all prescribed agronomic techniques and plant protection measures were followed. Observations were recorded on five randomly selected plants per genotype in each replication. The mean value was calculated by adding all observations from the five plants and dividing by five. The data were analysed to estimate genetic and phenotypic coefficients of variation (Burton *et al.*, 1952)^[4], broad-sense heritability (Burton and Devane, 1953)^[5], and genetic advance (Allard, 1999)^[1]. The data were analyzed using SPAR-1, created by the Indian Agricultural Statistical Research Institute in New Delhi.

Result and discussion

Phenotypic and genotypic coefficient of variation

The genetically inherited part of total variation is called genotypic variance and reflects variation between genotypes. The total variation within a population is termed phenotypic variance. Phenotypic variance is the sum of environmental and genotypic variances. The findings from the computation of Genotypic and Phenotypic Coefficients of Variation (GCV & PCV) for yield and yield-attributing traits across environments are presented in Table 1 and Figure 1. The findings showed that, across contexts, the phenotypic coefficient of variation was greater than the genotypic coefficient of variation for every trait in the pooled data. The highest phenotypic and genotypic coefficient of variation (>20%) was recorded for node number to first staminate flower (23.55%, 23.71%) and fruit circumference (19.96%, 20.13%). The moderate phenotypic and genotypic coefficient of variation (10-20%) was recorded for fruit yield per plant (17.25%, 17.44%), total yield (16.76%, 17.97%), number of primary branches per plant (16.10%, 16.33%), fruit yield per plot (15.94%, 17.66%), total soluble solids (14.59%, 14.84%), node

number to first pistillate flower (14.18%, 14.50%), dry matter (12.64%, 12.92%), vine length (12.42%, 12.68%), fruit weight (11.49%, 11.70%) and fruit length (10.64%, 10.96%). The lowest value of the phenotypic and genotypic coefficient of variation (< 10%) was recorded for total sugars (8.36%, 8.67%), ascorbic acid content (7.03%, 7.52%), number of fruits per plant (6.57%, 19.65%), days to first staminate flower anthesis (6.18%, 6.74%), days to first pistillate flower anthesis (6.01%, 6.70%) and days to first fruit harvest (3.47%, 4.36%). The narrow differences between GCV and PCV for the majority of the traits suggested that the observed variability was primarily genetic in nature. In contrast, the larger difference observed in the number of fruits per plant indicated a greater influence of environmental factors on trait expression. Duhan *et al.* (2022), Kumar *et al.* (2020), Harika *et al.* (2024)^[10, 11, 14], and Chakraborty *et al.* (2023) reported similar findings in bottle gourd, with moderate to high GCV and PCV for fruit yield and component characteristics.

Heritability in broad sense (%)

The estimation of heritability (broad sense) for all characters is presented in Table 1 and Figure 1. The estimates of broad-sense heritability (H²) revealed considerable variation among the studied traits, ranging from 21.18% to 98.68%. The highest heritability (>75%) was recorded for node number to first staminate flower (98.68%), followed by fruit circumference (98.38%), fruit yield per plant (97.84%), number of primary branches per plant (97.26%), total soluble solids (96.56%), fruit weight (96.35%), vine length (96.05%), node number to first pistillate flower and dry matter (95.64% each), fruit length (94.30%), total sugars (93.04%), ascorbic acid content (87.40%), total yield (86.99%), days to first staminate flower anthesis (83.86%), fruit yield per plot (81.46%) and days to first pistillate flower anthesis (80.45%). Moderate heritability (50-75%) was observed only for days to first fruit harvest (63.35%). In contrast, the lowest heritability (<50%) was observed for the number of fruits per plant (21.18%), indicating a substantial environmental influence on its expression. The presence of high heritability estimates for most characteristics indicated that these traits were largely genetic, determined by genetic factors and amenable to selection. Similar findings were reported in bottle gourd by Bashir *et al.* (2024)^[3], Singh *et al.* (2014)^[20], Sultana *et al.* (2018)^[21], and Mandal *et al.* (2015)^[16], who also reported high heritability estimates for fruit yield and associated characters, suggesting that these traits are primarily under genetic control.

Genetic advance (%)

The more accurate estimate is still genetic gain or advancement. It is a measure of how much the new population's genotypic value has improved relative to the base population presented in Table 1 and Figure 1. The estimates of genetic advance expressed as a percentage of the mean showed significant heterogeneity across the examined variables, ranging from 4.53% to 48.19%. The highest genetic advance (>20%) was recorded for node number to first staminate flower (48.19%), followed by fruit circumference (40.79%), fruit yield per plant (35.15%), number of primary branches per plant (32.72%), total yield (32.20%), fruit yield per plot (29.63%), total soluble solids (29.53%), node number to first pistillate flower (28.56%), dry matter (25.46%), vine length (25.08%), fruit weight

(23.23%) and fruit length (21.29%). Moderate genetic advance (10-20%) was exhibited by total sugars (16.62%), ascorbic acid content (13.54%), days to first staminate flower anthesis (11.65%) and days to first pistillate flower anthesis (11.11%), suggesting fair improvement possibilities. All the remaining traits, namely days to first fruit harvest (5.69%) and number of fruits per plant (4.53%), showed low genetic advance as a percentage of the mean,

indicating limited scope for improvement through simple selection. Similar findings have been reported by Das *et al.* (2024)^[8], Rambabu *et al.* (2017)^[18], Yadav *et al.* (2011)^[22] and Kumar *et al.* (2018)^[15]; the combination of high heritability and significant genetic advance found for most yield and quality variables demonstrates the prevalence of additive gene action and underlines the usefulness of direct phenotypic selection for their improvement.

Table 1: Mean, range, variance components, GCV, PCV, heritability and genetic advance for different traits

Traits	Grand Mean	Min	Max	Gen. Var.	Phen. Var.	GCV (%)	PCV (%)	H ² (b.s. %)	GA	GA % of Mean
DFSFA	49.07	41.00	60.00	9.19	10.95	6.18	6.74	83.86	5.72	11.65
DFPFA	56.86	49.00	67.00	11.68	14.52	6.01	6.70	80.45	6.31	11.11
NFSFA	7.55	5.24	11.81	3.16	3.20	23.55	23.71	98.68	3.64	48.19
NFPFA	13.67	10.27	17.11	3.76	3.93	14.18	14.50	95.64	3.90	28.56
NPB	8.23	5.43	11.10	1.76	1.81	16.10	16.33	97.26	2.69	32.72
VL	5.70	3.10	6.82	0.50	0.52	12.42	12.68	96.05	1.43	25.08
DFFH	68.38	58.00	76.00	5.62	8.88	3.47	4.36	63.35	3.89	5.69
FL	36.55	27.82	43.27	15.13	16.05	10.64	10.96	94.30	7.78	21.29
FC	7.39	5.09	10.57	2.18	2.21	19.96	20.13	98.38	3.01	40.79
FW	1.00	0.79	1.33	0.01	0.01	11.49	11.70	96.35	0.23	23.23
NFP	9.10	6.30	12.00	-0.05	0.45	6.57	19.65	21.18	0.15	4.53
TSS	4.18	3.06	5.69	0.37	0.38	14.59	14.84	96.56	1.23	29.53
ASC	8.86	7.17	10.06	0.39	0.44	7.03	7.52	87.40	1.20	13.54
TS	2.77	2.07	3.13	0.05	0.06	8.36	8.67	93.04	0.46	16.62
DM	8.88	6.02	11.33	1.26	1.32	12.64	12.92	95.64	2.26	25.46
FYPP	9.11	5.53	13.69	0.79	0.81	17.25	17.44	97.84	1.81	35.15
FYPLO	145.69	88.62	219.35	171.35	210.35	15.94	17.66	81.46	24.34	29.63
TY	93.95	98.46	243.51	247.85	284.92	16.76	17.97	86.99	30.25	32.20

Abbreviations: DFSFA = Days to first staminate flower anthesis, DFPFA = Days to first pistillate flower anthesis, NFSFA= Node number to first staminate flower appearance, NFPFA= Node number to first pistillate flower appearance, NPB = No. of primary branches/plant, VL = Vine length (cm), DFFH = Days to first female harvest, FL = Fruit length (cm), FC = Fruit circumference (cm) FW= Fruit weight (kg), NFP= Number of fruits per plant, FYPP = Fruit yield per plant (kg), TY = Total yield (kg), TSS = Total soluble solids (°Brix), ASC= Ascorbic acid (mg/100g), TS= Total sugar (%), DM = Dry matter (%)

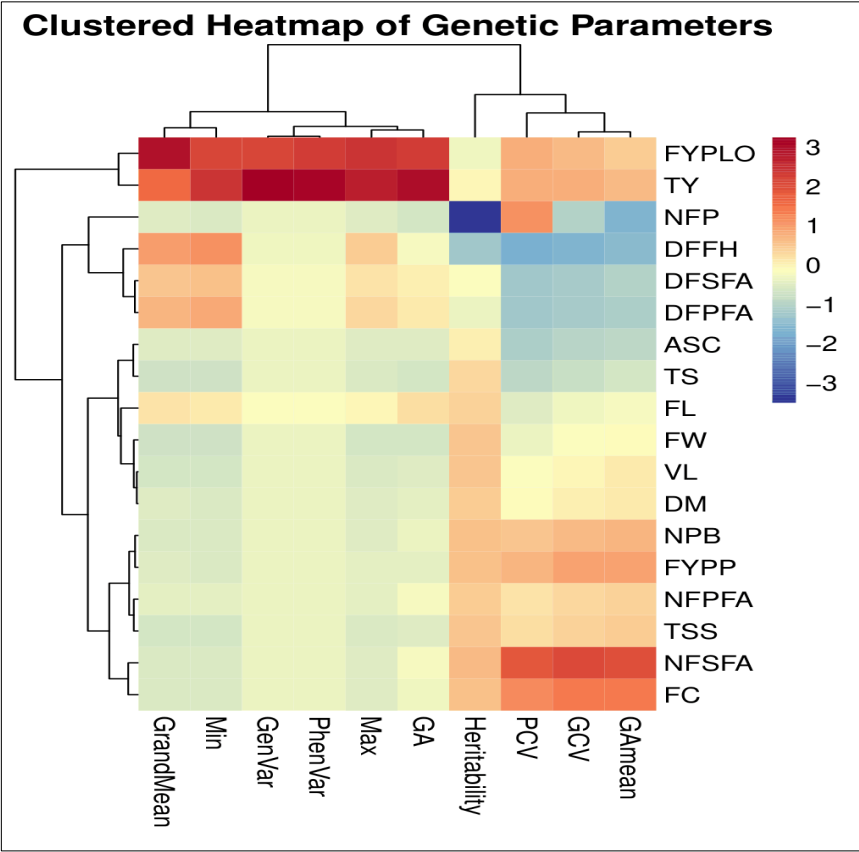


Fig 1: Mean, range, variance components, GCV, PCV, heritability and genetic advance for different traits

Conclusion

There is substantial room for genetic improvement through selection, as the current study found significant genetic heterogeneity among bottle gourd genotypes for yield and yield-related traits. For every trait, the Phenotypic Coefficient of Variation (PCV) values were often marginally greater than the Genotypic Coefficient of Variation (GCV) values, indicating a comparatively small environmental impact on trait expression. Node number to first staminate flower, fruit circumference, fruit yield per plant, number of primary branches per plant, total yield, total soluble solids, vine length, fruit weight and fruit length were all found to have high heritability and high genetic advance. This suggests that additive gene action predominates in these traits and that direct phenotypic selection is effective. In contrast, the number of fruits per plant showed low heritability and limited genetic progress, indicating a stronger environmental effect and a limited response to simple selection. Overall, the revealed highly heritable features with significant genetic advance may serve as reliable selection criteria for producing high-yielding, superior-quality bottle gourd cultivars in future breeding programs.

References

- Allard RW. Principles of Plant Breeding. 2nd ed. New York: John Wiley & Sons; 1999. p. 92-94.
- Anonymous. Estimate of Area and Production of Horticulture Crops: Third Advance Estimates, 2022. Gurugram (Haryana): Ministry of Agriculture and Farmers Welfare, Government of India; 2022. p. 230-260.
- Bashir K, Masoodi UH, Ali G, Nazir N, Malik AR, Nazir G, *et al.* Genetic variability, correlation and path coefficient analysis in bottle gourd [*Lagenaria siceraria* (Molina) Standl.] genotypes. *J Sci Res Rep.* 2024;30(5):760-771.
- Burton GW. Quantitative inheritance in grasses. In: Proceedings of the Sixth International Grassland Congress. Vol. 1. Pennsylvania (USA); 1952. p. 277-283.
- Burton GW, Devane EW. Estimating heritability in tall fescue (*Festuca arundinacea*) from replicated clonal material. *Agron J.* 1953;45:468-471.
- Chakraborty S, Chaurasiya AK. Studies on genetic variability, heritability and genetic advance in bottle gourd (*Lagenaria siceraria* (Mol.) Standl.) germplasms in West Garo Hills of Meghalaya, India.
- Cutler HC, Whitaker TW. Cucurbits from the Tehuacan caves. Austin (TX): University of Texas Press; 1967. p. 212-219.
- Das T, Kumar A, Ram CN, Kumar V, Patel S. Assessment of genetic variability, heritability and genetic advance in bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] genotypes. *J Sci Res Rep.* 2024;30(9):845-849.
- Deore SL, Khadabadi SS, Patel QR, Deshmukh SP, Jaju MS, Junghare NR, *et al.* In vitro antioxidant activity and quantitative estimation of phenolic content of *Lagenaria siceraria*. *Rasayan J Chem.* 2009;2(1):129-132.
- Duhan DS, Gill V, Panghal VPS, Karande PJ. Studies on genetic variability, heritability, genetic advance and character association for various quantitative traits in bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] genotypes. *Veg Sci.* 2022;49(2):204-210.
- Harika N, Murthy GN, Padma E, Umakrishna K, Sekhar PGRV. Variability studies in F_3 population of bottle gourd (*Lagenaria siceraria* (Molina) Standl.). *Int J.* 2024;8(9 Suppl):1200-1203.
- Hemeda HM, Ibrahim HS, Khattab HAH, El-Bendary SAA. Bakery fortification and biological evaluation of bottle gourd seeds (*Lagenaria siceraria*). *Egypt J Food Sci.* 2008;36(1):93-113.
- Kumar A, Kumar M, Singh B, Naresh RK. Genetic variability, heritability and genetic advance for yield and its components in bottle gourd (*Lagenaria siceraria*). *Ann Hortic.* 2011;4(1):101-103.
- Kumar D, Kumar V, Kumar A, Prakash S, Singh R. Studies on genetic variability, heritability and genetic advance among quantitative and qualitative characters in bottle gourd (*Lagenaria siceraria* Standl.). *Int J Curr Microbiol Appl Sci.* 2020;10:617-621.
- Kumar L, Trivedi J, Sharma D, Janghel AK, Ansari M. Genetic diversity, heritability and agromorphological characterization in bottle gourd [*Lagenaria siceraria* (Mol.) Standl.]. *Int J Curr Microbiol Appl Sci.* 2018;6:264-271.
- Mandal J, Tirumalesh M, Dhangra VK. Studies on genetic variability and trait inter-relationship in bottle gourd (*Lagenaria siceraria* (Mol.) Standl.). *HortFlora Res Spectr.* 2015;4(1):34-38.
- Parle M, Kaur S. Is bottle gourd a natural guard? *Int Res J Pharm.* 2011;2(6):13-17.
- Rambabu E, Mandal AR, Hazra P, Senapati BK, Thapa U. Morphological characterization and genetic variability studies in bottle gourd [*Lagenaria siceraria* (Mol.) Standley]. *Int J Curr Microbiol Appl Sci.* 2017;6(9):3585-3592.
- Singh R, Singh B, Prakash S, Kumar M, Kumar V, Chand P, *et al.* Genetic variability, heritability and genetic advance in bottle gourd (*Lagenaria siceraria* (Mol.) Standl.). *Ann Hortic.* 2021;14(1):72-78.
- Singh SP, Singh B, Mohan M, Rao S, Soni S. Genetic variability for some quantitative traits in bottle gourd [*Lagenaria siceraria* (Molina) Standl.]. *Ann Hortic.* 2014;8(1):113-115.
- Sultana S, Rahman MS, Ferdous J, Ahamed F, Chowdhury AK. Studies on genetic variability and interrelationship in bottle gourd [*Lagenaria siceraria* (Mol.) Standl.]. *Int J Agric Res Innov Technol.* 2018;8(1):14-17.
- Yadav YC, Kumar S. Determination of variability for yield advancement in bottle gourd (*Lagenaria siceraria* (Molina) Standl.). *Ann Hortic.* 2011;4(2):151-164.