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ASSESSMENT OF GENETIC VARIABILITY AND PREDICTION OF SELECTION RESPONSE FOR YIELD AND QUALITY TRAITS IN BOTTLE GOURD (*Lagenaria siceraria* MOL. STANDL.) UNDER SALT-AFFECTED SOIL

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ABSTRACT

The present investigation was conducted using thirty-nine genotypes of bottle gourd, comprising 27 F₁ hybrids and 12 parental lines (including 9 lines and 3 testers), in salt affected soil at the Main Experiment Station, Department of Vegetable Science, ANDUAT, Kumarganj, Ayodhya. The study aimed to assess the potential for improvement in available genotypes through selection. The germplasm was evaluated for twenty-three morphological, yield and biochemical traits, including days to first male and female flower anthesis, node number for first male and female flower appearance, pedicel length of male and female flowers, days to first harvest, number of primary branches per plant, vine length, number of nodes per vine, internodal length, picking duration, peduncle length, fruit length, average fruit circumference, average fruit weight, number of fruits per plant, fruit yield per plant, total soluble solids, reducing sugars, non-reducing sugars, total sugars, and dry matter content. The evaluation was carried out during *Zaid* seasons over two consecutive and comparable years, 2019–20 (Y₁) and 2020–21 (Y₂). The results indicated that mean squares due to parents, lines, testers, line × tester interactions, and crosses were significant for most of the traits across both seasons and in pooled analysis. Further analysis revealed high phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), and environmental coefficient of variation (ECV) for number of fruits per plant (36.59, 29.90 and 21.08, respectively) and average fruit weight (26.29, 19.71, and 17.39, respectively). High heritability coupled with substantial genetic advance was observed for yield and several other traits (primary branches per plant, fruit length, days to first female flower anthesis, days to first harvest, dry matter, days to first male flower anthesis, number of node per vine and internodal length) indicating that these characteristics can be effectively improved through selection for salt affected soil.

Key words : Genetic variability, Selection, Bottle gourd, Yield, Quality.

Introduction

Bottle gourd [*Lagenaria siceraria* (Mol.) Standl.], a member of the family Cucurbitaceae, is an economically important vegetable crop with a chromosome number of $2n = 2x = 22$. It is extensively cultivated across tropical and subtropical regions and exhibits excellent adaptability to warm and humid environments. In recent years, its cultivation has expanded beyond the traditional growing season, particularly in the Indo-Gangetic plains, ensuring

year-round availability. The crop is primarily grown for its nutritive fruits, while the seeds constitute a valuable source of edible oil and protein. Due to its monoecious and andromonoecious sex expression, bottle gourd exhibits a high degree of cross-pollination, resulting in considerable genetic variability. This inherent variability provides a strong foundation for genetic improvement through selection and hybridization. Genetic variability, heritability, and genetic advance are critical parameters in plant breeding, as they determine the extent of transmissible

variation and the efficiency of selection. High heritability coupled with substantial genetic advance indicates the predominance of additive gene action and offers greater scope for improvement through selection. Therefore, systematic evaluation of germplasm using these biometrical tools is essential for identifying superior genotypes and enhancing yield and related traits in bottle gourd.

Materials and Methods

The present investigation was conducted during the *Zaid* seasons of 2019–20 (Y_1) and 2020–21 (Y_2) in salt affected soil at the Main Experiment Station (MES), Department of Vegetable Science, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.), India. The study aimed to evaluate the scope for genetic improvement among available genotypes through systematic selection. The experimental field soil was alkaline in nature, with a pH exceeding 8. Observations were recorded for a total of twenty-three quantitative and qualitative traits. The experimental material comprised nine diverse and promising inbred lines and three testers of bottle gourd, selected based on genetic variability from the germplasm maintained in the department. These lines and testers were crossed in a line $\times$ tester mating design, resulting in 27 F_1 hybrids. The parental lines included NDBG-28 (L_1), NDBG-13 (L_2), NDBG-15 (L_3), Narendra Pooja (L_4), NDBG-104 (L_5), NDBG-Sel-1 (L_6), Narendra Kamma (L_7), NDBG-21 (L_8) and NDBG-22 (L_9). These were crossed with three testers, namely Pusa Naveen (T_1), Narendra Prabha (T_2) and Narendra Rashmi (T_3). Additionally, all parents (nine lines and three testers) were selfed to obtain true-to-type seeds. The experiment was laid out in a randomized complete block design (RBD) with three replications to evaluate the performance of 27 F_1 hybrids along with their 12 parents. The crop was sown in rows spaced 3.0 meters apart with a plant-to-plant distance of 0.50 meters. Sowing was carried out on 20 March 2019–20 and 19 March 2020–21. Recommended agronomic practices and plant protection measures were uniformly followed to ensure optimal crop growth. Data were recorded on key growth, flowering, yield, and quality parameters, including days to first male and female flower anthesis, node number for first male and female flower appearance, pedicel length of male and female flowers (cm), days to first harvest, number of primary branches per plant, vine length (m), number of nodes per vine, internodal length (cm), picking duration, peduncle length (cm), fruit length (cm), average fruit circumference (cm), average fruit weight (kg), number of fruits per plant, fruit yield per plant (kg), total soluble

solids (%), reducing sugars (%), non-reducing sugars (%), total sugars (%), and dry matter content (g/100 g). The recorded data were subjected to analysis of variance (ANOVA) appropriate for randomized block design, following the methodology suggested by Panse and Sukhatme (1984). Genotypic and phenotypic coefficients of variation were estimated as per Singh *et al.* (2023). Broad-sense heritability (h^2_{bs}) was calculated following the procedure outlined by Yadav and Yadav (2022). Expected genetic advance and genetic advance as a percentage of the mean were computed using the method proposed by Johnson *et al.* (1955).

Statistical analysis

For the purpose of statistical analysis, mean values of each genotype across all replications were utilized for the traits under investigation. The data pertaining to component traits were analyzed using the analysis of variance (ANOVA) following the model proposed by Panse and Sukhatme (1984). The calculated F-values were compared with the corresponding tabulated F-values at the 5% level of significance. Traits exhibiting significant differences among genotypes were further subjected to detailed statistical analysis. The phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), and environmental coefficient of variation (ECV), along with broad-sense heritability (h^2) and expected genetic advance (GA), were estimated in accordance with the methods described by Burton and De Vane (1953) and Johnson *et al.* (1955). For interpretation of variability parameters, the following classification criteria were adopted: The PCV, GCV and ECV were classified as low, moderate and high with value of <10%, 10–20% and >20%, respectively.

Results and Discussion

The analysis of variance (Table 1) revealed that mean squares due to parents, lines, testers, line $\times$ tester interactions, parents $\times$ crosses, and crosses were significant for most of the traits across both seasons (Y_1 and Y_2) as well as in the pooled analysis. These findings indicate the presence of substantial genetic variability among the genotypes and also justify for further analysis for other parameters. Similar results have been reported by earlier researchers, including Yadav and Yadav (2022), Yadav *et al.* (2023), Hegde *et al.* (2024), Patel (2025), thereby supporting the present results.

The perusal of Table 2 showed that phenotypic coefficients of variation (PCV) were consistently higher than genotypic coefficients of variation (GCV) for all the traits across both seasons (*Zaid* 2020, Y_1 and 2021, Y_2) and under pooled conditions, indicating the influence of

Table 1 : Analysis of variance for growth, yield and biochemical attributes of bottle gourd during *Zaid* season 2019-20 (Y_1), 2020-21 (Y_2) and Pooled.

Traits Component of variation	Years	df	Days to first male flower anthesis	Days to first female flower anthesis	Node number to first male flower appearance	Node number to first female flower appearance	Length of pedicel of male flower	Length of pedicel of female flower	Days to first harvest	Primary branches per plant
Replications	Y_1	2	18.47**	20.52*	23.44**	37.41**	5.65	13.23**	25.19**	6.78
	Y_2	2	69.14 **	177.55**	27.14**	9.41**	4.34*	26.27**	188.96**	4.73*
	Pooled	2	76.05**	154.65**	50.12**	37.54**	8.17*	38.39**	169.24**	11.00**
Parents	Y_1	11	15.17**	12.27**	3.21**	8.39**	17.30**	8.99**	15.48**	11.94**
	Y_2	11	42.19**	39.23**	3.32**	7.24**	14.17**	11.23**	42.63**	10.26**
	Pooled	11	40.35**	38.39**	6.27**	7.88**	29.95**	19.82**	41.25**	20.47**
Parents (Line)	Y_1	8	16.83**	11.79**	3.68**	7.50**	19.93**	10.62**	12.68**	11.59**
	Y_2	8	56.42**	52.58**	4.04**	2.58	15.07**	13.82**	48.76**	10.12**
	Pooled	8	50.25**	48.29**	7.50**	2.46*	32.92**	23.94**	46.04**	19.38**
Parents (Testers)	Y_1	2	5.44	4.78	1.78*	4.11*	13.00*	6.78**	4.78	6.78
	Y_2	2	1.33	5.44	2.11**	27.44**	15.44**	5.33**	38.11**	7.00*
	Pooled	2	5.72*	10.17*	3.72**	21.50**	28.39**	12.06**	33.50**	13.72**
Lines vs Testers	Y_1	1	21.33**	31.15**	2.37*	24.08**	4.89	0.45	59.26**	25.04**
	Y_2	1	10.08**	0	0.04	4.08	4.48	2.37	2.68	17.93**
	Pooled	1	30.38**	15.57*	1.50*	24.00**	9.38*	2.45	18.38*	42.67**
Parents vs Crosses	Y_1	1	0	0.024	20.24**	8.84**	98.77**	26.96**	6.39	537.04**
	Y_2	1	191.88**	302.09**	64.69**	39.33**	115.67**	33.57**	291.99**	492.31**
	Pooled	1	95.94**	153.73**	78.66**	42.74**	214.11**	60.35**	106.01**	1028.86**
Crosses	Y_1	26	27.38**	30.34**	9.09**	10.69**	13.42**	5.04**	23.85**	90.97**
	Y_2	26	42.15**	37.37**	12.03**	16.43**	11.03**	6.67**	27.69**	90.31**
	Pooled	26	64.99**	61.53**	20.73**	17.02**	23.56**	11.27**	43.58**	181.22**
Error	Y_1	76	2.26	2.89	0.45	0.84	2.83	0.89	2.99	2.72
	Y_2	76	1.08	2.67	0.27	1.47	1.2	0.63	3.89	1.46
	Pooled	152	1.67	2.78	0.36	1.16	2.01	0.76	3.45	2.09

*, **Significant at 5 and 1% probability levels, respectively.

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Table 1 : Analysis of variance for growth, yield and biochemical attributes of bottle gourd during *Zaid* season 2019-20(Y_1), 2020-21 (Y_2) and Pooled.

Traits Component of variation	Years	df	Vine length	Number of node per vine	Internodal length	Picking duration	Peduncle length	Fruit length (cm)	Average fruit circumference (cm)	Average fruit weight (kg)
Replications	Y_1	2	1.12**	43.41	1.13	2.19	19.14**	640.82**	2.54	0.03
	Y_2	2	1.02**	70.78	0.15	3.09	17.44**	362.29**	32.32**	0.035 *
	Pooled	2	2.13**	111.09*	1.04	5.24	36.55**	983.03**	22.49*	0.01
Parents	Y_1	11	2.68**	157.18**	4.45**	118.61**	13.91**	3.20	1.62	0.21**
	Y_2	11	4.40**	124.76**	2.77**	127.30**	11.51**	18.93	8.54	0.20**
	Pooled	11	6.39**	277.68**	6.29**	245.56**	25.09**	10.84	4.58	0.40**
Parents (Line)	Y_1	8	2.89**	105.75**	5.04**	31.00**	17.25**	3.16	1.95	0.25**
	Y_2	8	4.15**	71.73*	3.28**	36.51**	14.51**	22.82	10.33	0.24**
	Pooled	8	6.33**	173.13**	7.29**	67.09**	31.51**	11.79	5.45	0.48**
Parents (Testers)	Y_1	2	3.13**	219.44**	1.53	312.33**	5.44*	3.58	1.10	0.15**
	Y_2	2	7.57**	257.45**	1.15*	334.11**	3.00**	0.33	5.44	0.14**
	Pooled	2	9.78**	475.39**	2.02*	646.22**	7.72**	1.33	3.29	0.29**
Lines vs Testers	Y_1	1	0.038	444.08**	5.58**	432.00**	4.08	2.78	0.00	0.01
	Y_2	1	0.11	283.57**	1.86*	440.04**	4.48**	25.04	0.33	0.01
	Pooled	1	0.14	718.69**	6.95**	872.02**	8.56**	22.25	0.19	0.01
Parents vs Crosses	Y_1	1	43.49**	1545.02**	16.71**	97.25**	52.22**	209.92*	27.58*	2.09**
	Y_2	1	33.48**	1307.79**	2.95**	71.82**	55.16**	73.39	23.41*	2.79**
	Pooled	1	76.64**	2847.86**	16.86**	168.10**	107.36**	265.78**	50.90**	4.86**
Crosses	Y_1	26	2.56**	570.987 ***	12.07**	56.59**	36.41**	79.96*	29.41**	0.08**
	Y_2	26	3.99**	654.51**	8.44**	65.16**	37.39**	132.37**	17.28**	0.18**
	Pooled	26	6.15**	1221.38**	20.09**	121.40**	73.40**	173.79**	36.91**	0.05**
Error	Y_1	76	0.15	25.18	0.61	2.13	1.19	45.23	6.59	0.02
	Y_2	76	0.12	26.49	0.35	2.71	0.60	23.51	5.58	0.01
	Pooled	152	0.13	25.84	0.49	2.42	0.90	34.37	6.09	0.02

*, **Significant at 5 and 1% probability levels, respectively.

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Table 1 : Analysis of variance for growth, yield and biochemical attributes of bottle gourd during Zaid season 2020-21 (Y₁, Y₂ and Pooled).

Traits Component of variation	Years	Df	Number of fruit per plant	Fruit yield per plant	Total soluble solids (%)	Reducing sugars(%)	Non-reducing sugar (%)	Total sugars (%)	Dry matter (g/100g)
Replications	Y ₁	2	0.12	1.20**	0.17**	0.01	0.00	10.43**	0.13*
	Y ₂	2	0.28**	0.55**	0.25**	0.01	0.00	0.00	0.04
	Pooled	2	0.06	1.67**	0.41**	0.02	0.00	5.27**	0.15**
Parents	Y ₁	11	0.71**	0.73**	0.03	0.12**	0.03**	0.06	0.47**
	Y ₂	11	0.82**	0.74**	0.02	0.13**	0.03**	0.05**	0.49**
	Pooled	11	1.52**	1.47**	0.04	0.25**	0.06**	0.031	0.96**
Parents (Line)	Y ₁	8	0.97**	0.73**	0.02	0.12**	0.04**	0.09	0.54**
	Y ₂	8	1.11**	0.75**	0.02	0.13**	0.04**	0.03**	0.57**
	Pooled	8	2.08**	1.48**	0.04	0.26**	0.08**	0.02	1.11**
Parents (Testers)	Y ₁	2	0.03	1.11**	0.07*	0.11**	0.00**	0.00	0.11*
	Y ₂	2	0.03	1.08**	0.01	0.13**	0.00**	0.11**	0.08
	Pooled	2	0.05	2.19**	0.06	0.24**	0.01**	0.07	0.18**
Lines vs Testers	Y ₁	1	0.00	0.00	0.02	0.08**	0.01**	0.00	0.70**
	Y ₂	1	0.05	0.01	0.02	0.10**	0.01**	0.06**	0.68**
	Pooled	1	0.04	0.00	0.04	0.17**	0.01**	0.02	1.38**
Parents vs Crosses	Y ₁	1	135.83**	78.39**	0.00	0.17**	0.01**	0.00	0.51**
	Y ₂	1	150.73**	52.93**	0.01	0.12**	0.01**	0.09**	0.53**
	Pooled	1	286.36**	130.072*	0.00	0.27**	0.01**	0.04	1.03**
Crosses	Y ₁	26	1.83**	2.53**	0.05**	0.12**	0.05**	0.14**	0.74**
	Y ₂	26	4.89**	3.24**	0.05*	0.12**	0.05**	0.03**	0.69**
	Pooled	26	5.13**	5.14**	0.09**	0.23**	0.09**	0.04*	1.43**
Error	Y ₁	76	0.29	0.19	0.02	0.01	0.00	0.05	0.03
	Y ₂	76	0.04	0.10	0.03	0.01	0.00	0.00	0.03
	Pooled	152	0.16	0.15	0.02	0.02	0.01	0.00	0.03

*, **Significant at 5 and 1% probability levels, respectively.

Table 2 : Estimates of variability parameters for growth, yield and quality traits in bottle gourd during two seasons 2019-20(Y_1), 2020-21 (Y_2) and Pooled.

Traits Component of variation	Years	Days to first male flower anthesis	Days to first female flower anthesis	Node number to first male flower appearance	Node number to first female flower appearance	Length of pedicel of male flower	Length of pedicel of female flower	Days to first harvest	Primary branches per plant
PCV (%)	Y_1	7.99	7.36	13.06	12.15	13.94	18.07	6.27	23.37
	Y_2	8.00	7.37	13.06	12.15	13.94	18.07	6.27	23.37
	Pooled	7.39	7.12	12.86	11.66	15.11	17.87	5.95	24.85
GCV (%)	Y_1	7.72	6.75	12.60	10.49	12.39	16.26	5.43	22.72
	Y_2	7.72	6.76	12.60	10.49	12.39	16.26	5.43	22.72
	Pooled	5.03	4.64	9.77	7.02	10.61	11.37	3.34	17.07
ECV (%)	Y_1	2.07	2.94	3.47	6.14	6.40	7.89	3.13	5.45
	Y_2	2.08	2.94	3.47	6.14	6.40	7.89	3.13	5.45
	Pooled	5.42	5.40	8.36	9.31	10.76	13.79	4.93	18.05
h^2 (broad sense) (%)	Y_1	92	84	93	75	79	81	75	95
	Y_2	93	84	93	75	79	81	75	95
	Pooled	46	43	58	36	49	40	31	47
Genetic advance (% of mean)	Y_1	3.12	3.47	0.58	0.72	1.29	0.78	3.14	6.54
	Y_2	4.35	3.61	0.69	1.47	1.38	0.93	2.96	6.76
	Pooled	3.53	3.49	0.65	0.71	1.49	0.93	2.97	6.76
General Mean	Y_1	47.11	49.85	13.38	17.95	16.98	9.64	57.43	20.92
	Y_2	50.17	55.52	14.94	19.77	17.12	10.09	63.01	22.19
	Pooled	48.61	52.62	14.12	18.82	17.09	9.83	60.18	21.19

*, **Significant at 5 and 1% probability levels, respectively.

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Table 2 : Estimates of variability parameters for growth, yield and quality traits in bottle gourd during two seasons 2019-20 (Y_1), 2020-21 (Y_2) and Pooled.

Traits Component of variation	Years	Vine length	Number of node per vine	Internodal length	Picking duration	Peduncle length	Fruit length	Average fruit circumference	Average fruit weight
PCV (%)	Y_1	12.91	14.99	17.06	12.84	21.04	17.25	12.97	28.25
	Y_2	12.91	14.99	17.06	12.85	21.04	17.25	12.97	28.25
	Pooled	13.71	15.06	17.68	13.03	21.14	17.70	13.70	26.29
GCV (%)	Y_1	12.45	13.91	15.74	12.24	20.43	12.36	7.76	26.69
	Y_2	12.45	13.91	15.74	12.24	20.43	12.36	7.76	26.70
	Pooled	9.25	10.68	10.75	9.53	13.51	9.60	6.29	19.71
ECV (%)	Y_1	3.39	5.59	6.58	3.89	5.03	12.03	10.39	9.25
	Y_2	3.39	5.59	6.58	3.89	5.03	12.03	10.39	9.26
	Pooled	10.12	10.62	14.04	8.89	16.26	14.87	12.17	17.39
h^2 (broad sense) (%)	Y_1	93	86	85	91	94	51	36	89
	Y_2	93	86	85	91	94	51	36	89
	Pooled	46	50	37	53	41	29	21	56
Genetic advance (% of mean)	Y_1	55	100.5	147	160	141	118	166	70
	Y_2	92	104.9	122	154	144	173	162	17
	Pooled	69	106.8	137	164	145	163	145	30
General Mean	Y_1	8.16	87.59	10.9	40.37	15.53	39.28	23.49	1.1
	Y_2	10.13	92.04	9.2	42.34	15.42	40.3	22.73	1.07
	Pooled	9.13	89.83	10.07	41.21	15.48	39.79	23.14	1.08

*, **Significant at 5 and 1% probability levels, respectively.

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Table 2: Estimates of variability parameters for growth, yield and quality traits in bottle gourd during two seasons 2019-20 (Y_1), 2020-21 (Y_2) and Pooled.

Traits Component of variation	Years	Number of fruit per plant	Fruit yield per plant	Total soluble solids (%)	Reducing sugars(%)	Non- reducing sugar (%)	Total sugars(%)	Dry matter (g/100g)
PCV (%)	Y_1	38.65	28.41	7.58	11.89	14.51	4.28	14.17
	Y_2	38.65	28.41	7.58	11.89	14.51	4.28	14.17
	Pooled	36.59	28.43	7.41	11.65	14.46	8.57	14.31
GCV (%)	Y_1	38.32	27.30	2.76	10.71	14.36	4.22	13.24
	Y_2	38.32	27.30	2.76	10.72	14.36	4.22	13.24
	Pooled	29.90	22.15	2.54	5.02	6.23	3.69	9.33
ECV (%)	Y_1	5.01	7.86	7.06	5.16	2.08	0.69	5.03
	Y_2	5.01	7.86	7.06	5.16	2.08	0.69	5.03
	Pooled	21.08	17.83	6.96	10.51	13.05	7.74	10.84
h^2 (broad sense) (%)	Y_1	98	92	13	81	98	97	87
	Y_2	98	92	13	81	98	97	87
	Pooled	67	61	12	19	19	19	43
Genetic advance (% of mean)	Y_1	39	52	50	90	80	140	170
	Y_2	42	94	60	90	80	70	180
	Pooled	32	60	50	90	80	10	190
General Mean	Y_1	4	4.25	2.27	1.79	0.81	2.21	3.36
	Y_2	4.13	4.08	2.33	1.81	0.81	2.63	3.38
	Pooled	4.06	4.16	2.3	1.8	0.81	2.42	3.37

*, **Significant at 5 and 1% probability levels, respectively.

environmental factors on trait expression. The highest values (>20%) of PCV and GCV were recorded for number of fruits per plant and average fruit weight, suggesting greater variability and scope for selection. In contrast, reducing and non-reducing sugars exhibited high PCV but comparatively lower GCV, indicating a stronger environmental influence.

Moderate estimates of PCV and GCV were observed for traits such as node number to first male flower anthesis, node number to first female flower anthesis, number of primary branches per plant, internodal length, average fruit weight, dry matter content, total soluble solids, and total sugars across seasons. However, the remaining traits exhibited low variability. This showed that moderate level of variability (10-20%) was there for these traits. The environmental coefficient of variation was generally low for most traits, except vine length, reducing sugars and non-reducing sugars, which showed very little environmental influence for these characters.

Heritability in the broad sense is a crucial parameter for plant breeders as it indicates the extent to which a trait is genetically controlled/transmitted from one generation to another one and can be effectively improved through selection. High heritability alone, however, does not guarantee selection efficiency unless accompanied by substantial genetic advance. The combination of high heritability and high genetic advance as a percentage of the mean suggests the predominance of additive gene action along with high variability and provides better prospects for improvement through selection. It is because additive genetic variance is fixable and heritable.

The results of heritability and genetic advance (Table 2) revealed that important yield-contributing traits, particularly number of fruits per plant and fruit yield per plant, exhibited high heritability coupled with high genetic advance across both seasons and pooled analysis. This showed that these two characters are most important for higher yield of bottle gourd. Similarly, traits including days to first male and female flower anthesis, node number to first flowering, days to first fruit harvest, number of primary branches, fruit circumference, internodal length, dry matter content, total soluble solids, and reducing sugars also exhibited high heritability, indicating the effectiveness of phenotypic selection for their improvement. Thus, these traits were also governed by additive gene action which on selection will be highly heritable and resemble the similar phenotype in proceeding generations. These findings are in agreement with earlier reports of Tinkie *et al.* (2023), Hegde *et al.* (2024), Patel (2025) and Harika *et al.* (2025).

In pooled analysis, moderate heritability estimates were observed for days to first flowering, node number to first flowering, days to first fruit harvest, number of primary branches per plant, and fruit circumference. Furthermore, certain traits exhibited high heritability coupled with low genetic advance, suggesting the predominance of additive gene action along with low variability and as a result limited scope for direct selection. No trait exhibited low heritability across seasons and pooled conditions.

The results of the present investigation indicate that traits governed predominantly by additive gene effects can be effectively improved through direct selection due to the higher predictability of their inheritance. In contrast, traits influenced by non-additive gene action may respond less efficiently to simple selection and may require alternative breeding approaches such as hybridization followed by selection and heterosis breeding. These findings are consistent with reports of earlier workers like Verma *et al.* (2025), Adeyemi and Okonkwo (2025), Yadav *et al.* (2023), Anuj *et al.* (2025) and Rehan *et al.* (2023).

Conclusion

The present investigation revealed that several economically important traits in bottle gourd exhibited high heritability coupled with substantial genetic advance, indicating the predominance of additive gene action. This suggests that these traits can be effectively improved through direct selection. Notably, yield and its contributing attributes demonstrated significant potential for genetic enhancement, highlighting the efficiency of selection strategies within the available genotypes. Therefore, the existing genetic variability in bottle gourd germplasm can be strategically exploited to develop high-yielding and superior cultivar/hybrids, ensuring sustainable productivity under salt affected soil in future.

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