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INVESTIGATION OF HERITABILITY AND GENETIC ADVANCE FOR THE QUANTITATIVE, QUALITATIVE TRAITS IN BOTTLE GOURD (*LAGENARIA SICERARIA* MOL. STANDL.)

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ABSTRACT

An experiment was conducted to assess the genetic advance and heritability of yield and quality traits in bottle gourd. The study followed a completely randomized block design with three replications, involving 30 bottle gourd hybrids derived from the crossing of 10 lines with 3 testers, along with their 13 parental lines. The research was carried out at the Department of Vegetable Science, ANDUA&T, Kumarganj, Ayodhya, during the growing seasons of 2020–2021 and 2021–2022 on a horticulture research farm. The findings revealed that high heritability, combined with moderate genetic advance as a percentage of the mean, was observed for several traits, including days to first male flower anthesis, days to first female flower anthesis, node number at first male flower appearance, node number at first 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), fruit circumference (cm), average fruit weight (kg), number of fruits per plant, fruit yield per plant (kg), total soluble solids (%), ascorbic acid content (mg/100 g), reducing sugar, non-reducing sugar (%), total sugars (%) and dry matter content (g/100 g). These results suggest that these traits exhibit an additive gene effect, making them highly suitable for selection in future breeding programs aimed at genetic improvement.

Key words : Heritability (narrow sense), Genetic advance, Bottle gourd.

Introduction

Bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] is a widely cultivated cucurbit vegetable with a chromosome number of 2n = 2x = 22. It is an essential annual crop of the Cucurbitaceae family, grown extensively across the country. As a warm-season vegetable, it thrives in warm and humid climates. However, advancements in off-season cultivation have enabled its year-round production in the northern plains of India. The crop is primarily grown for its edible fruits and seeds, which serve as a valuable source of protein and oil. Commonly known as bottle squash, calabash gourd, white-flowered gourd, doodhi, and lauki, this versatile vegetable exhibits a highly cross-pollinated nature due to its monoecious and andromonoecious flowering behavior.

Among cucurbits, bottle gourd holds significant importance owing to its prolific fruiting ability, cost-effective cultivation, and nutritional value as a cooked vegetable. In northern India, it is primarily cultivated during the summer and rainy seasons. The juice of bottle gourd is known for its medicinal benefits, particularly in alleviating urinary disorders, excessive thirst, and insomnia. Additionally, it is a rich source of vitamin B, including thiamine, riboflavin, niacin and contains essential amino acids such as leucine, phenylalanine, cystine, valine, aspartic acid, and proline. Furthermore, it is abundant in

vital minerals like calcium, phosphorus, iron, potassium, sodium and iodine.

Heritability and genetic advance play crucial roles in predicting genetic gain through selection. These parameters aid plant breeders in identifying superior genotypes from diverse genetic backgrounds. Considering these aspects, the present study was conducted to estimate narrow-sense heritability and genetic advance across multiple seasons, aiming to determine effective breeding strategies for the genetic improvement of bottle gourd.

Materials and Methods

The research was conducted during the *Zaid* seasons of 2020–21 (Y1) and 2021–22 (Y2) to evaluate heritability and genetic advance using a line-tester mating design. The study took place at the Main Experiment Station (MES) of the Department of Vegetable Science, Acharya Narendra Deva University of Agriculture and Technology, Narendra Nagar, Kumarganj, Ayodhya (U.P.), India. Data were recorded for 24 different traits.

Table 1 : Different trait and their unit.

S. no.	Parameter	Unit
1	Days to first male flower anthesis	Days
2	Days to first female flower anthesis	Days
3	Node number at first male flower appearance	Number
4	Node number at first female flower appearance	Number
5	Pedicel length of male flowers	cm
6	Pedicel length of female flowers	cm
7	Days to first harvest	Days
8	Number of primary branches per plant	Number
9	Vine length	m
10	Number of nodes per vine	Number
11	Internodal length	cm
12	Picking duration	Days
13	Peduncle length	cm
14	Fruit length	cm
15	Average fruit circumference	cm
16	Average fruit weight	kg
17	Number of fruits per plant	Number
18	Fruit yield per plant	kg
19	Total soluble solids (TSS)	%
20	Ascorbic acid content	mg/100 g
21	Reducing sugar	%
22	Non-reducing sugar	%
23	Total sugars	%
24	Dry matter content	g/100 g

The selected parental lines used in the experiment included Kashi Kirti (L1), NDBG-63-1-1 (L2), HAU-22 (L3), Kashi Ganga (L4), Punjab Komal (L5), NDBG-17 (L6), NDBG-65-2-1 (L7), NDBG-83-1 (L8), FSC-5-1 (L9) and NDBG-517 (L10). These lines were crossed with three testers—Narendra Rashmi (T_1), Narendra Pooja (T_2) and Narendra Jyoti (T_3)—resulting in 30 F_1 hybrids. Additionally, the parental lines were either selfed or sibbed to obtain true-type seeds. The experiment followed a randomized block design (RBD) with three replications to assess the performance of the 30 F_1 hybrids and their 13 parents for heritability and genetic advance in relation to 24 yield- and quality-related traits. Narrow-sense heritability (h^2ns) was estimated using the method proposed by Amangoua (2018). According to the classification by Kempthorne and Curnow (2021), heritability in the narrow sense was categorized as high (>30%), medium (10–30%), and low (<10%). The genetic advance as a percentage of the mean was classified following the criteria of Johnson *et al*. (1995): low (0–10%), moderate (10–20%) and high (above 20%).

Results and Discussion

Heritability

In the first year (Y1), a moderate level of narrow-sense heritability was observed for several traits, including fruit length (cm), vine length (m), number of nodes per vine, fruit yield per plant (kg), picking duration, internodal length, pedicel length of male flowers (cm), ascorbic acid content (mg/100g), node number at first male flower appearance, days to first male flower anthesis, total soluble solids (%), days to first harvest, non-reducing sugars (%), days to first female flower anthesis, and the number of fruits per plant. However, dry matter content (g/100g) exhibited a low estimate of narrow-sense heritability, presented in Table 2 and Fig. 1.

In the second year (Y2), a moderate heritability estimate was recorded for pedicel length of male flowers (cm), vine length (m), node number at first male flower appearance, fruit length (cm), internodal length (cm), total sugars (%), number of nodes per vine, days to first male flower anthesis, total soluble solids (%), node number at first female flower appearance, number of fruits per plant, days to first female flower anthesis, days to first harvest, non-reducing sugars (%) and dry matter content (g/100g).

Table 2 : Estimates of heritability in narrow sense and genetic advance in per cent of mean for twenty four characters in bottle gourd over two years Y1 (2021), Y2 (2022) and pooled.

S. no.	Parameters	Heritability (h^2ns %)			Genetic advance in per cent of mean		
		Y_1	Y_2	Pooled	Y_1	Y_2	Pooled
1	Days to first male flower anthesis	17.73	16.06	39.93	3.15	4.90	3.02
2	Days to first female flower anthesis	12.69	13.49	12.40	8.86	7.87	6.47
3	Node number to first male flower appearance	20.00	25.28	30.64	18.23	13.86	11.67
4	Node number to first female flower appearance	34.97	14.86	20.75	17.98	22.42	11.11
5	Length of pedicel of male flower (cm)	22.42	29.53	30.18	21.44	22.20	11.35
6	Length of pedicel of female flower (cm)	39.00	32.75	39.60	31.22	29.09	11.93
7	Days to first harvest	16.50	11.49	16.14	7.85	10.75	6.65
8	Primary branches per plant	31.28	32.08	29.65	27.65	36.53	19.27
9	Vine length (m)	28.61	28.02	28.28	17.39	23.19	15.08
10	Number of node per vine	27.5	17.21	21.16	21.77	22.02	11.57
11	Internodal length (cm)	23.92	23.57	24.89	24.53	23.74	13.59
12	Picking duration	26.07	44.76	33.63	18.79	22.06	13.31
13	Peduncle length (cm)	56.02	71.75	67.82	23.19	24.90	5.62
14	Fruit length (cm)	29.54	25.39	28.10	10.81	18.59	5.05
15	Average fruit circumference (cm)	73.11	75.11	79.09	25.67	29.46	14.13
16	Average fruit weight (kg)	45.72	48.30	49.36	31.54	28.62	17.11
17	Number of fruit per plant	11.55	12.71	6.44	41.78	48.16	34.63
18	Fruit yield per plant (kg)	27.34	28.05	27.73	52.32	54.30	37.94
19	Total soluble solids (%)	17.70	15.77	17.49	24.99	24.85	12.10
20	Ascorbic acid (mg/100 gm)	21.86	33.26	29.09	11.11	14.58	7.42
21	Reducing sugars (%)	31.34	31.35	31.49	46.16	51.48	13.94
22	Non- reducing sugar (%)	13.52	14.11	14.15	36.29	35.74	8.51
23	Total sugars (%)	23.73	23.25	23.80	33.04	36.79	10.09
24	Dry matter (g/100g)	9.14	10.13	9.74	51.87	50.94	18.57

Unlike Y1, no traits exhibited low heritability estimates in Y2. For the pooled data, a moderate estimate of narrow-sense heritability was found for primary branches per plant, ascorbic acid content (mg/100g), vine length (cm), fruit length (cm), fruit yield per plant (kg), total sugars (%), number of nodes per vine, node number at first female flower appearance, total soluble solids (%), days to first harvest, non-reducing sugars (%), and days to first female flower anthesis. However, dry matter content (g/100g) and the number of fruits per plant exhibited low narrow-sense heritability (Deepthi *et al*. (2016) Singh *et al*. (2021), presented Table 2 and Fig. 1.

Genetic Advance Estimates

In Y1, a low estimate of genetic advance as a percentage of the mean (<10%) was observed for days to first male flower anthesis, days to first female flower anthesis and days to first harvest. A moderate estimate (10–20%) was recorded for fruit length (cm), ascorbic acid content (mg/100g), picking duration, node number at first male flower appearance, node number at first female flower appearance, and vine length (cm). In Y2, genetic advance estimates followed a similar pattern, with a low genetic advance (<10%) for days to first male flower anthesis and days to first female flower anthesis. A moderate estimate (10–20%) was found for fruit length (cm), node number at first male flower appearance, and days to first harvest. For the pooled data, a low genetic advance as a percentage of the mean (<10%) was observed for days to first male flower anthesis, fruit length (cm), peduncle length (cm), days to first female flower anthesis, ascorbic acid content (mg/100g), and non-reducing sugars (%). Meanwhile, a moderate genetic advance (10–20%) was recorded for total sugars (%), pedicel length of female flowers (cm), days to first male flower appearance, number of nodes per vine, pedicel length of male flowers (cm), days to first female flower appearance, total soluble solids (%), internodal length (cm), picking duration, vine length (cm), average fruit weight (g), and primary branches per plant (Singh *et al*.,

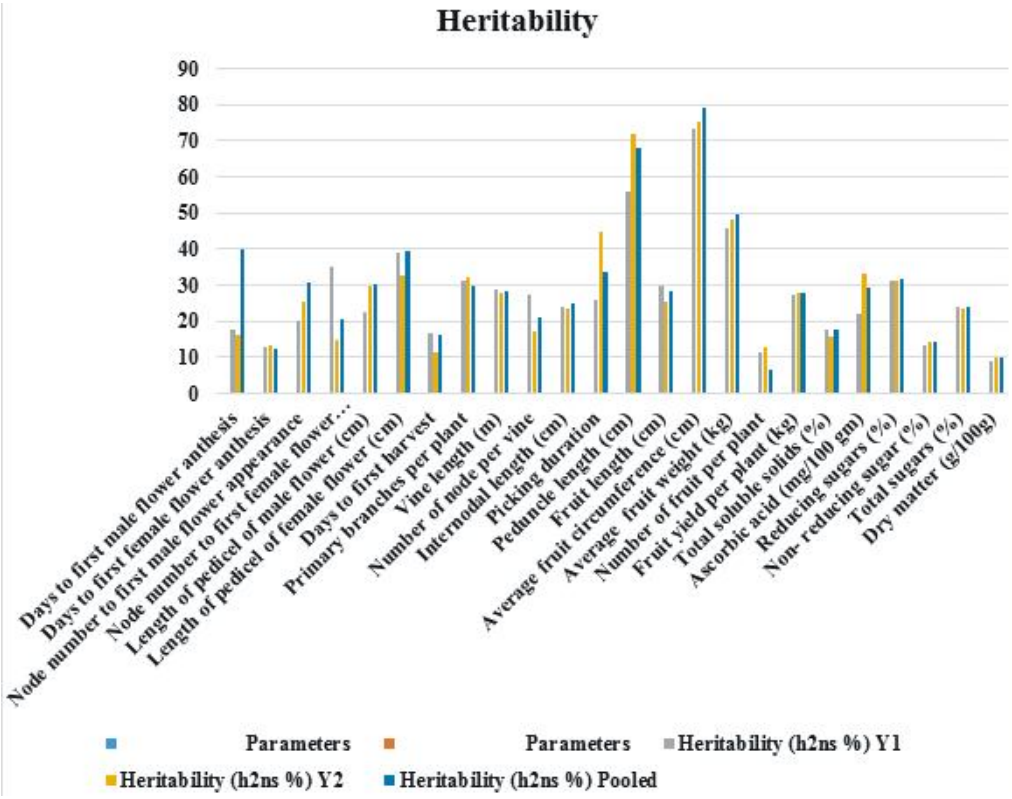

Fig. 1 : Analysis of Heritability for different traits in bottle gourd.

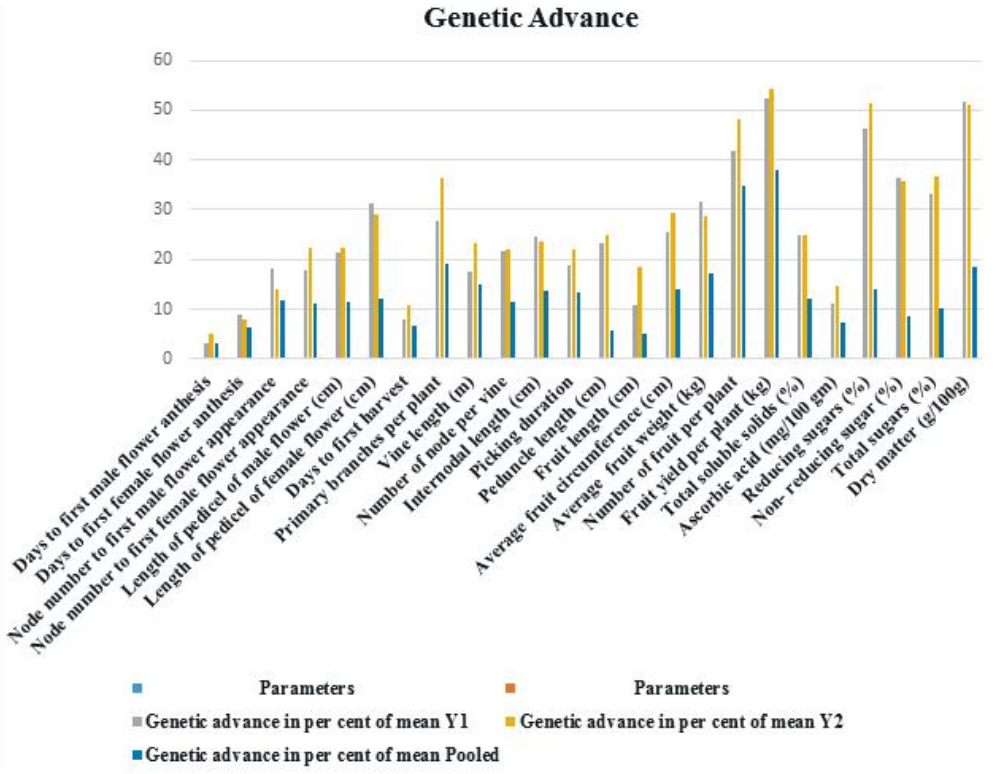

Fig. 2 : Analysis of genetic advance for different traits in bottle gourd.

2021 and Lal *et al*., 2021) presented Table 2 and Fig. 2.

An examination of Table 2 and Fig. 2 reveals that in the first year (Y1), high narrow-sense heritability (>30%) was recorded for several traits, including average fruit circumference (cm), peduncle length (cm), average fruit weight (kg), pedicel length of female flowers (cm), node number at first female flower appearance, reducing sugars (%) and primary branches per plant. In the second

year (Y2), high heritability was observed for fruit circumference (cm), peduncle length (cm), average fruit weight (kg), picking duration, ascorbic acid content (mg/100g), pedicel length of female flowers (cm), primary branches per plant, and reducing sugars (%). For the pooled data, traits with high narrow-sense heritability included fruit circumference (cm), peduncle length (cm), average fruit weight (kg), days to first male flower anthesis, pedicel length of female flowers, picking duration, reducing sugars, node number at first male flower appearance, and pedicel length of male flowers. These findings align with previous reports of high narrow-sense heritability for various bottle gourd traits as documented by Deepthi *et al*. (2016), Rashid *et al*. (2020), Singh *et al*. (2021) and Lal *et al*. (2021).

Conclusion

Estimates of high heritability reported on average fruit circumference and Peduncle length (cm) and in case of genetic advance fruit yield per plant (kg) and number of fruit per plant. The characterises days to 1st male flower anthesis, peduncle length (cm) with high heritability and low genetic advance indicated the character is inflicted by environmental effect and selection may not useful.

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