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Genetic variability, heritability and genetic advance of yield and related traits in F_3 and F_4 generations of Bottle gourd (*Lagenaria siceraria* (Mol.) Standl.)

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Abstract
The current study examined the nature of genetic variability, heritability, and genetic advance in 5 genotypes of bottle gourd in Table 1 and Table 2. For all of the traits studied, the results revealed highly significant differences between genotypes. This suggested that there was enough variance in all of the traits to allow for effective selection in the material under examination. GCV and PCV estimates were high for the length of vine, number of branches per vine, number of nodes per plant, number of female flowers per vine, number of fruits per vine, fruit yield per vine, fruit yield per plot and fruit yield per hectare. Most of the characters studied had higher heritability estimates, However, for characteristics such as length of vine, number of branches per vine, number of nodes per plant, number of female flowers per vine, number of fruits per vine, fruit yield per vine, fruit yield per plot and fruit yield per hectare, considerable genetic advance as a percentage of mean was seen. While the number of branches per vine, node at which first female flower occur, days required for occurrence of first female flower, number of female flowers per vine, number of fruits per vine, fruit yield per vine and fruit yield per plot were showed low genetic advance. Presented in the Table 1 and Table 2.
More variability exists in the content for all of the characters, which can be employed in the future by simple selection. According to the findings of this study, the number of female flowers per vine, number of fruits per vine and fruit yield per vine are the primary yield contributing features in bottle gourd. As a result, due to the importance of these features in developing the criterion in the selection process to evolve high yielding genotypes of bottle gourd.

Keywords: GCV, PCV, genetic variability, heritability, genetic advance

Introduction

Bottle gourd (*Lagenaria siceraria* (Mol.) Standl.) is one of the most popular vegetables of the family cucurbitaceae, with a chromosome number 2n=22. It is a highly cross pollinated crop due to its monoecious and andromonoecious nature. Bottle gourd is a modest source of nutrients. Fruits are used as sweets, pickles (especially on hills), kofta, petha, halwa, kopoorkand, paratha, rayata, kheer, pedha and burfi. The fruits contain vitamin C (11mg), thiamine (0.044mg), riboflavin (0.023mg), niacin (0.33mg), mineral matters (0.5%), carbohydrates (2.9%), fats (0.5%) protein (0.2%), and moisture (96.3%) and its different parts possess large number of medicinal properties. Dry hard shells of the fruits have been used for making a wide range of articles of common use, including bowls, bottles, containers, floats for fishing nets, pipes and musical instruments. In addition, the seeds and seed oil are also edible. Plant breeders are guided in their understanding of the pattern of inheritance of various plant features by the genetic influence of heritable traits. Genetic advancement, heritability, and variability are the three main determinants of crop improvement.

Materials and Methods

Five bottle gourd genotypes along with seeds of F_3 progenies of cross LTR-1 x LTR-5 (C1) provided from the previous M.Sc. research work carried out at Instructional-cum Research Farm, Department of Horticulture, College of Agriculture, Latur were grown in a Randomised block design in kharif 2022 and selfed to obtained F_4 generation. The F_3 and F_4 generation of cross LTR1 x LTR-5 were evaluated during summer 2023. The experimental plot size was 2 m x 10 m. and seed sown at 2 m x 1 m spacing between rows and plants randomized block design (RBD) for each cross. The recommended dose of fertilizer for bottle gourd is 20 t FYM + 100:50:50 kg NPK per ha was applied.

The dose of FYM 20 tons per hectare and the 50 *per cent* recommended dose of nitrogen (50 kg/ha) and full dose of phosphorus (50 kg/ha) and potassium (50 kg/ha) were incorporated in the soil at the time of preparation of field. The remaining dose of 50 *per cent* of nitrogen (50 kg/ha) was applied one month after sowing. The plant protection measures were applied as per recommendation. The gap filling and thinning was done. The vines were trailed on bower to give support.

Observations were made in F_4 generation on ten randomly chosen plants from each genotype, and the mean value was used for statistical analysis for eleven characters: length of vine (cm), number of branches per vine, number of nodes per plant, node at which first female flower occur, days required for occurrence of first female flower, number of female flowers per vine, days required for first harvest, number of fruits per vine, fruit yield per vine (kg), fruit yield per plot (kg) and fruit yield per hectare (q).

The formula of Panse and Sukhatme (1985) [8] will be used to calculate variation for all of the features under consideration. The mean squares from the variance table will be used to determine genotypic and phenotypic variances (Johnson *et al.*, 1955) [3]. The GCV and PCV will be determined using Burton (1952) [2] approach. Heritability (in the broad sense) will be calculated using the method proposed by Allard (1960) [1]. Johnson *et al.* (1955) [3] proposed a formula for calculating genetic advance.

Results and Discussion

Genotypic coefficient of variation was lower than the phenotypic coefficient of variation in all quantitative traits which indicate role of environment in the expression of traits. In F_3 and F_4 generations of cross LTR-1 x LTR-5 (C1: 1 x 5), high values of genotypic and phenotypic coefficient of variations were recorded for the length of vine, number of branches per vine, number of nodes per plant, number of female flowers per vine, number of fruits per vine, fruit yield per vine, fruit yield per plot and fruit yield per hectare. Genetic variability is a crucial part of any system in which selection occurs to evolve superior genotype. As a result, the more the genetic variety in these traits, the greater the potential for improvement through selection. To improve any crop, particularly its yield, it is vital to understand genetic variability and the production-related characteristics. Table 1 and Table 2 displays the data.

The character fruit yield per vine have greater values of GCV and PCV, indicating that there is a significant degree of genetic variability and that the environment has less influence, making them appropriate for selection. Kumar *et al.* (2018) found similar results. All the revealed moderate values of GCV and PCV, indicating a medium range of variability and the effect of environment, which might be misleading at times. Similar findings have been found by Vinithashri *et al.* (2019) [11]. The trait node at which first female flower occur estimates lower GCV and PCV, indicating low variability and substantial environmental influence, making selection undesirable. GCV and PCV have a significant trait difference, indicating that these traits are heavily influenced by environmental influences. And the lower difference between GCV and PCV showing environmental influence on trait expression and revealed that most of the features are mostly under genetic control.

The magnitude of PCV values was greater than GCV for all traits, showing that all characters played a dominant role and that the environment had an influence on these traits. Variability is a requirement for any breeding effort aimed at increasing yield and other yield contributing characteristics.

All eleven traits demonstrated high heritability as a percentage of mean. This suggests that heritability is caused by additive gene effects and that selection may be effective. Similar results were achieved by Korat *et al.* (2009) [5]. There is opportunity for enhancement of these traits through selection, as seen by the low heritability and genetic advance as a percentage of mean for the trait number of branches per plant and 100 kernel weight. This suggests additive gene action. John *et al.* discovered comparable outcomes (2005) [4].

According to the findings of the current study, there is more variability in the material for all of the traits, which can be seen in the future through easy selection.

Table 1: Mean, range, GCV, PCV, heritability, genetic advance and *per cent* mean of genetic advance of two parents and F_3 population of cross LTR-1 x LTR-5 (C1: 1 x 5)

Sr. No.	Name of the Character	Range	Mean	GCV	PCV	Heritability (%)	Genetic Advance	GAM (%)
1.	Length of Vine (cm)	244.00-671.00	407.00	30.72	30.75	67.50	257.77	63.29
2.	Number of branches per vine	2.00-6.00	3.00	32.23	32.69	79.31	2.32	66.40
3.	Number of nodes per plant	21.00-48.00	35.00	29.69	31.27	62.29	21.51	61.17
4.	Node at which first female flower occurs	9.00-12.00	10.00	7.97	8.25	79.42	1.64	16.44
5.	Days required for first female flower	44.00-55.00	51.00	6.46	7.22	68.28	6.77	13.31
6.	No. of female flowers per vine	4.00-8.00	5.00	28.87	29.11	66.80	3.22	59.49
7.	Days required for first harvest	55.00-66.00	62.00	5.27	5.41	94.76	6.77	10.85
8.	No. of fruits per vine	3.00-8.00	5.00	36.72	37.02	75.85	3.66	75.66
9.	Fruit yield per vine (kg)	2.01-2.95	2.20	45.66	48.34	99.90	3.19	59.84
10.	Fruit yield per plot (kg)	10.68-14.88	12.85	46.21	48.34	99.25	0.63	60.43
11.	Fruit yield per hectare (q)	160-308.66	255.04	23.41	49.65	99.98	43.17	85.09

GCV - Genotypic coefficient of variation, PCV - phenotypic coefficient of variation, ECV - environmental coefficient of variation, GAM - Genetic advance as % mean

Table 2: Mean, range, GCV, PCV, heritability, genetic advance and *per cent* mean of genetic advance of two parents and F_4 population of cross LTR-1 x LTR-5 (C1: 1 x 5)

Sr. No.	Name of the Character	Range	Mean	GCV	PCV	Heritability (%)	Genetic advance	GAM (%)
1.	Length of Vine (cm)	244.00- 979.00	603.00	35.07	35.65	73.65	45.69	72.25
2.	Number of branches per vine	2.00 - 7.00	5.00	28.65	29.12	89.36	2.75	59.03
3.	Number of nodes per plant	21.00 - 57.00	40.00	27.14	27.29	79.38	22.22	55.91
4.	Node at which first female flower occurs	11.00 - 13.00	12.00	5.74	5.93	69.00	1.24	11.83
5.	Days required for first female flower	49.00 - 55.00	52.00	4.18	4.69	68.93	4.43	8.59
6.	No. of female flowers per vine	4.00 - 10.00	6.00	34.36	34.91	66.38	4.01	70.75
7.	Days required for first harvest	60.00 - 66.00	63.00	3.41	3.95	71.20	4.43	7.02
8.	No. of fruits per vine	3.00 - 7.00	4.00	27.15	27.69	98.99	2.61	55.94
9.	Fruit yield per vine (kg)	1.89-2.45	2.10	43.66	26.31	99.30	2.56	53.84
10.	Fruit yield per plot (kg)	11.85-17.26	15.07	17.09	11.06	99.65	4.06	29.88
11.	Fruit yield per hectare (q)	165.00-355.33	259.67	25.66	27.45	100.00	47.32	45.62

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