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Estimation of Heritability (Narrow sense) and Genetic Advance for Yield and Quality Traits in Bottle Gourd [*Lagenaria siceraria* (Mol.) Standl.]

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ABSTRACT: The current study was carried out in the summers of 2021 and 2022 at the Main Experiment Station, Department of Vegetable Science, College of Horticulture and Forestry, ANDUA&T, Kumarganj, Ayodhya (U.P.), India, to evaluate the heritability and genetic advancement. Days to first staminate flower anthesis, node number to first staminate flower appearance, node number to first pistillate flower appearance, vine length, number of primary branches plant^{-1}, fruit length, fruit circumference, average fruit weight, ascorbic acid, reducing sugars, total sugars, and fruit yield plant^{-1} were all noted to have high estimates of narrow-sense heritability in both the years and pooled data while, days to first pistillate flower anthesis, days to first fruit harvest in Y_1 and pooled whereas, number of fruits plant^{-1} in Y_2 and Pooled respectively. For the node number to first staminate flower appearance, node number to first pistillate flower appearance, vine length, number of primary branches plant^{-1}, fruit length, ascorbic acid, reducing sugars, non-reducing sugar, total sugars, dry matter content in fruit, and fruit yield plant^{-1}, high heritability as well as high genetic advance in percent of mean were recorded in Y_1 and Y_2, whereas in Y_2 only number of fruits plant^{-1}. In pooled dry matter content and reducing sugars showed high heritability as well as high genetic advance in percent of mean, indicating that simple selection based on phenotypic performance of these traits would be more effective as these traits were strongly influenced by additive gene action.

Keywords: Heritability, genetic advance, yield, line × tester, bottle gourd.

INTRODUCTION

Bottle gourd (*Lagenaria siceraria* (Mol) Standl) is one of the most important cucurbitaceous vegetable crop in India grown in both rainy and summer seasons. It belongs to the family cucurbitaceae having chromosome number 2n = 22. The bottle gourd is one of the most nutrient-rich vegetable crop for people and helps them tone up for energy and vigour since it contains a valuable source of carbohydrates, proteins, vitamins, and minerals. The edible 100 g fresh bottle gourd fruits contain 0.5 % fats, 0.2 % proteins, 2.9% carbohydrates, 11 mg of vitamin C, and 0.5 % minerals like calcium, iron, potassium, and phosphorus (Thamburaj and Singh 2013). Environmental influences have a significant impact on many quantitative traits, such as the number of fruits per plant and yield per plant, which helps any planned breeding programme by dividing the overall variability into heritable components. When predicting the genetic gain under selection, heritability and genetic advancement are important parameters. The breeder uses these estimates to pick genotypes from diverse genetic populations. It also suggests the direction of selection pressure to be applied for a trait during selection since it measures the relationship between parents and their offspring, which is frequently used to analyze the extent to which a character may be passed down from parents to offspring. High genetic advances in percent of mean and high heritability together offer excellent possibility for advance generations to continue improving. Assessing the suitability of a character for selection requires consideration of both heritability and an estimate of genetic advance.

MATERIALS AND METHODS

The current study was conducted at the Main Experiment Station of the Department of Vegetable Science, College of Horticulture and Forestry, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.) during the summers of 2021 and 2022 to evaluate the heritability and genetic advancement using a line x tester mating design with three replications. Ten lines of bottle gourd with three testers were used as the experimental materials for this study based on variability. In order to evaluate the performance of thirty F_1's and their thirteen parents (ten lines and three testers) for the study of heritability and genetic advancement for fruit yield and quality contributing traits, the current studies were carried out in a randomized block design with three replications. With a plant-to-plant spacing of 0.50 meters, this crop was sown in rows that were spaced 3 meters apart. To raise a good crop, all the recommended agronomic packages of cultural and protective measures were carried out. The observations comprised of quantitative traits such as days to first staminate flower anthesis, days to first pistillate flower anthesis, node number to first staminate flower appearance, node number to first pistillate flower appearance, days to first fruit harvest, vine length (m), number of primary branches plant^{-1}, fruit length (cm), fruit circumference (cm), average fruit weight (kg), number of fruits plant^{-1}and fruit yield plant^{-1} (kg) and quality traits included total soluble solids (%), ascorbic acid (mg/100 g fresh fruit), reducing sugars (%), non-reducing sugar (%), total sugars (%) and dry matter content in fruit (%). Kempthorne and Curnow (1961) classified the estimated heritability in the narrow sense (h^2ns) into three groups: high (>30%), medium (10%–30%), and low (10%). Following Johnson *et al.* (1955), the genetic advance as a percentage of the mean was divided into low (0–10%), moderate (10–20%), and high (>20%) categories.

RESULTS AND DISCUSSION

Kempthorne (1957) classified heheritability estimates in the narrow sense (h^2ns) into three categories *viz.*, high (>30%), medium (10-30%), and low (<10%). The high estimates of heritability in narrow-sense (Table 1) were recorded for days to first staminate flower anthesis (42.71%, 33.01% and 56.90%), node number to first staminate flower appearance (86.96%, 46.74% and 51.62%), node number to first pistillate flower appearance (77.02%, 53.45% and 52.59%), vine length (79.59%, 60.19% and 77.35%), number of primary branches plant^{-1} (85.54%, 58.10% and 74.20%), fruit length (87.13%, 91.62% and 95.89%), fruit circumference (64.26%, 86.87% and 137.06%), average fruit weight (62.09%, 62.02% and 64.28%), ascorbic acid (30.86%, 37.89% and 34.10%), reducing sugars (56.05%, 52.85% and 52.03%), total sugars (47.54%, 46.53% and 44.50%), and fruit yield plant^{-1}. (35.11%, 53.75% and 33.55%) in both the years and pooled while, days to first pistillate flower anthesis (39.59% and 45.98%), days to first fruit harvest (37.92% and 45.08%) in Y_1 and pooled whereas, number of fruits plant^{-1} (54.97% and 36.91%) in Y_2 and Pooled respectively. Similar findings by Ahmad *et al.* (2022) recorded high heritability in average fruit weight and fruit yield; Gautam and Yadav (2018) observed higher values of heritability only for fruit length and fruit circumference during both the seasons and pooled; Yadav and Kumar (2012a) for fruit yield per plant and fruit diameter.

The moderate estimates of heritability in narrow-sense were recorded for total soluble solids (22.18%, 20.71% and 21.52%) in both the years and pooled while, number of fruits plant^{-1} (27.28%) and non-reducing sugars (14.64%) in Y_1 and days to first pistillate flower anthesis (26.58%), days to first fruit harvest (24.62%), dry matter content in fruit (29.47%) in Y_2. The estimates of heritability were recorded low for non-reducing sugars (7.10% and 7.92%) in Y_2 and pooled respectively.

High Genetic advance in percent of mean was recorded for reducing sugars (56.54%, 59.05% and 36.03%) and total sugars (43.76%, 45.61% and 27.11%) in both the years and pooled while, node number to first staminate flower appearance (36.28% and 33.17%), node number to first pistillate flower appearance (29.78% and 25.32%), vine length (24.27% and 26.25%), number of primary branches plant^{-1} (24.56% and 22.88%), fruit length (39.39% and 42.80%), number of fruits plant^{-1} (23.98% and 25.06%), total soluble solids (38.57% and 39.86%), ascorbic acid (25.03% and 24.30%),non-reducing sugar (31.78% and 26.84%), dry matter content in fruit (43.40% and 43.83%) and fruit yield plant^{-1} (28.10% and 31.84%) in Y_1 and Y_2 respectively. Ahmad *et al.* (2022) for fruit yield and fruit length.

Genetic advance in percent of mean were recorded moderate for fruit circumference (15.44% and 14.47%) and average fruit weight (14.51% and 13.62%) in Y_1 and Y_2 respectively while, node number to first staminate flower appearance (18.43%), node number to first pistillate flower appearance (15.16%), vine length (15.06%), number of primary branches plant^{-1} (13.02%), fruit length (18.19%), number of fruits plant^{-1} (15.59%), total soluble solids (15.35%), ascorbic acid (13.84%), reducing sugars (%), non-reducing sugar (14.94%), dry matter content in fruit (17.23%) and fruit yield plant^{-1} (19.85%) in pooled.

Low estimates of genetic advance in percent of mean were recorded for days to first staminate flower anthesis (4.68%, 5.18% and 3.67%), days to first pistillate flower anthesis (5.88%, 5.73% and 4.56%) and days to first fruit harvest (5.59%, 5.94% and 4.39%) in Y_1, Y_2 and pooled respectively while, fruit circumference (7.05%) and average fruit weight (4.47%) in pooled.

In Y_1 and Y_2 high heritability along with high genetic advance in percent of mean (Table 1) were recorded for node number to first staminate flower appearance, node number to first pistillate flower appearance, vine length, number of primary branches plant^{-1}, fruit length, ascorbic acid, reducing sugars, non-reducing sugar, total sugars, dry matter content in fruit and fruit yield plant^{-1} respectively while, number of fruits plant^{-1} in Y_2 only. Dry matter content and reducing sugars in pooled showed high heritability as well as high genetic advance in percent of mean, indicating that simple selection based on phenotypic performance of these traits would be more effective as these traits were strongly influenced by additive gene action. Singh *et al.* (2021) for vine length, number of primary branches, fruit length, number of fruits per plant and yield q/ha; Vaidya *et al.* (2020) for number of primary branches per vine, number of fruits per vine, yield per vine. Rehan *et al.* (2020) for fruit length and for vine length.

Table 1: Estimates of heritability in narrow sense (h^2ns) and genetic advance in per cent of mean for eighteen characters in bottle gourd over two years and over season pooled.

Sr. No.	Parameters / Characters	Heritability (h^2ns %)			Genetic advance in per cent of mean		
		Y_1	Y_2	Pooled	Y_1	Y_2	Pooled
1.	Days to first staminate flower anthesis	42.71	33.01	56.90	4.68	5.18	3.67
2.	Days to first pistillate flower anthesis	39.59	26.58	45.98	5.88	5.73	4.56
3.	Node number to first staminate flower appearance	86.96	46.74	51.62	36.28	33.17	18.43
4.	Node number to first pistillate flower appearance	77.02	53.45	52.59	29.78	25.32	15.16
5.	Days to first fruit harvest	37.92	24.62	45.08	5.59	5.94	4.39
6.	Vine length	79.59	60.19	77.35	24.27	26.25	15.06
7.	Number of primary branches plant^{-1}	85.54	58.10	74.20	24.56	22.88	13.02
8.	Fruit length	87.13	91.62	95.89	39.39	42.80	18.19
9.	Fruit circumference	64.26	86.87	137.06	15.44	14.47	7.05
10.	Average fruit weight	62.09	62.02	64.28	14.51	13.62	4.47
11.	Number of fruits plant^{-1}	27.28	54.97	36.91	23.98	25.06	15.59
12.	Total soluble solids	22.18	20.71	21.52	38.57	39.86	15.35
13.	Ascorbic acid	30.86	37.89	34.10	25.03	24.30	13.84
14.	Reducing sugars	56.05	52.85	52.03	56.54	59.05	36.03
15.	Non-reducing sugar	14.64	7.10	7.92	31.78	26.84	14.94
16.	Total sugars	47.54	46.53	44.50	43.76	45.61	27.11
17.	Dry matter content in fruit	32.46	29.47	30.25	43.40	43.83	17.23
18.	Fruit yield plant^{-1}	35.11	53.75	33.55	28.10	31.84	19.85

CONCLUSIONS

Days to first staminate flower anthesis, node number to first staminate flower appearance, node number to first pistillate flower appearance, vine length, number of primary branches plant^{-1}, fruit length, fruit circumference, average fruit weight, ascorbic acid, reducing sugars, total sugars, and fruit yield plant^{-1} in both the years and pooled recorded high heritability estimates in narrow sense. In pooled high heritability along with high genetic advance in percent of mean were recorded for reducing sugars and dry matter content in fruit indicated simple selection based on phenotypic performance of these traits would be more efficient as these traits were strongly influenced by additive gene action.

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Conflict of Interest. None.

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