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Studies on heritability (Narrow Sense) and genetic advance analysis for growth, fruit yield and its component traits in bottle gourd [*Lagenaria siceraria* (Mol.) Standl.]

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Abstract

The present investigations entitled "Heterosis, combining ability and gene action for fruit yield and quality traits in bottle gourd [*Lagenaria siceraria* (Mol.) Standl.]" were conducted during the Zaid seasons of 2022-23 and 2023-24 at the Main Experiment Station (MES) of the Department of Vegetable Science, A.N.D. University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.), India. The experimental materials of the present investigation comprised of 43 genotypes including (30 F1's, 10 lines and 3 testers) and evaluated in Randomized Block Design (RBD) with three replications having each experimental unit with spacing of 3.0m × 0.50m with plot size of 3.0m ×3.0m. The observations were recorded for Twenty characters. Sowing was done on 24 February, 2022-23 and 22 February, 2023-24. Evaluation was done for different yield and quality traits. High heritability coupled with high genetic advance were observed for fruit length (cm), reducing sugar (%), non-reducing sugar (%) and dry matter content in fruit (g/100g) indicating that most likely that heritability is due to additive gene effects and selection may be effective.

Keywords: Randomized block design, heritability, genetic advance.

Introduction

Bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] is cucurbitaceous vegetable crop having chromosome number 2n=22. It is one of the important cucurbits in India, both as rainy and summer season vegetable. The fresh fruit has light green smooth skin and white flesh. The genus *Lagenaria* included six species that are distributed in Africa, Madagascar, Indo-Malaysia and the neotropics. There is only one cultivated species, *Lagenaria siceraria*, which is an annual and monoecious. The five other species are wild, perennial and dioecious, occurring in east Africa and Madagascar. Five wild species of *Lagenaria* exist in Africa: L. *breviflora* (Benth.), L. *abyssinica* (Hook f.), L. *rufa* (Gilg.) Jeffrey, L. *sphaerica* (Sonder) Naudin and L. *guineensis* (G. Don) Jeffrey. It was also observed that L. *siceraria* germplasm is more diverse than its wild relatives viz. L. *sphaerica*, L. *abyssinica* and L. *breviflora* for qualitative and quantitative traits. The variability for various characters was found wide in Europe, India and Japan (Badade *et al.*, 2001; Saito *et al*., 2008; Kumar *et al*., 2011; Schlumbaum and Vandorpe, 2012). Wild species produce small round fruits with strong bitter taste (Morimoto *et al.* 2005).

In India, the total area covered under bottle gourd is 0.223 million ha with production of 3.72 million tonnes and its productivity is 16.68 tonnes per ha. (Anonymous, 2023-24).

The bottle gourd has lot of variation for different morphological characters like fruit bearing capacity, fruit girth, fruit length, length of main shoot, number of branches per plant, number of seeds per fruit, seed weight, seed length, seed breadth, seed shape and seed colour (Decker-Walters *et al*., 2004; Morimoto *et al*., 2005; Clarke *et al*., 2006 and Yetisir *et al*., 2008) The principal component analysis of L. *siceraria* indicates that fruit size, seed size, fruit shape and seed shape are major components that explain most of the variation in the bottle gourd (Morimoto *et al*., 2006). Bottle gourd is predominately cross-pollinated crop due to its monoecious nature. The amount of cross pollination ranges from 60-80 %.

The genetic parameters i.e. heritability and genetic advance provide effective tools to a breeder to select a genotype having desirable traits for fruit yield. The expected improvement in the yield components primarily depends upon the nature and magnitude of heritable portion of total variation. The information on heritability alone may be misleading but when used in combination with genetic advance, the utility of heritability estimates increases.

Materials and methods

The experimental plant material comprised of 30 F1 hybrids and their 13 parents (10 lines and 3 testers) of bottle gourd. These lines were evaluated in a Randomized Block Design (RBD) with three replications during Zaid seasons of 2022-23 (Y1) and 2023-24 (Y2). The crop was sown in rows spaced at 3.0m × 0.50m with plot size of 3.0m × 3.0m. Sowing was done on 24 February, 2022-23 and 22 February, 2023-24. All the recommended agronomic package of practices and protection measures were followed to raise good crops by Main Experiment Station (MES) of Department of Vegetable Science, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.) India. The data were collected for Twenty characters viz., 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 nodes per main vine, Internodal length (cm), Number of primary branches per plant, Fruit length (cm), Fruit circumference (cm), Average fruit weight (kg), Number of fruits per plant, Total soluble solids (^{0}B), Ascorbic acid (mg/100g), Reducing sugars (%), Non-reducing sugar (%), Total sugars (%), Dry matter content in fruit (g/100g), Fruit yield per plant (kg).

Results and discussion

The estimates of heritability in narrow-sense and genetic advance in per cent of mean had given in table-1. The estimates of heritability in narrow-sense (h2ns) have been classified by Kempthorne and Curnow (1961) classified heritability in narrow sense (h2ns) 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 (51.71%, 44.27% and 52.74%), node number to first staminate flower appearance (38.12%, 36.95% and 38.92%), node number to first pistillate flower appearance (44.69%, 38.26% and 42.97%), Number of nodes per main vine (47.54%, 43.45% and 57.69%), fruit length (56.47%, 61.69% and 60.91%), number of fruits per plant (39.46%, 49.33% and 49.92%), ascorbic acid (47.32%, 36.13% and 48.35%), reducing sugars (40.64%, 41.71% and 41.84%), non-reducing sugars (35.23%, 71.56% and 62.46%), dry matter (40.54%, 37.21% and 40.89%) in both the years and pooled while, days to first pistillate flower anthesis (30.85%) in Y1. days to first fruit harvest (34.19%) in pooled. Vine length (30.18%) in pooled and average fruit weight (30.45 and 31.71) in Y2 and pooled. Total soluble solids (31.78%) in Y2 and total sugar (40.62%) in Y1 and fruit yield per plant (30.28%) in Pooled. Similar findings for the high estimate of heritability for different traits in bottle gourd have been also reported by Dubey *et al.* (2022) for fruit yield per plant, average fruit weight, number of fruits per plant, node number to first

pistillate flower, node number to first staminate flowers and vine length; 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.

The moderate estimates of heritability in narrow-sense were recorded for days to first pistillate flower anthesis (28.55%) in pooled and days to first fruit harvest (27.33% and 29.42) in Y1 and Y2. Vine length (25.09% and 21.15) in Y1 and Y2. In internodal length (25.48%, 17.39 and 25.98) in both the year and pooled and number of primary branches per plant (18.15% and 12.66%) in Y1 and pooled. Fruit circumference (14.49% and 13.35) in Y2 and pooled. Average fruit weight (21.05) in Y1 and total soluble solids (14.10% and 22.09%) in Y1 and pooled. Total sugar (11.23% and 26.79%) in Y2 and pooled and fruit yield per plant (25.42% and 29.41%) in Y1 and Y2.

The estimates of heritability were recorded low for days to first pistillate flower anthesis (9.67%) in Y2 and number of primary branches per plant (0.68%) also in fruit circumference (9.90%) in Y1.

Genetic advance in percent of mean was recorded high for number of primary branches per plant (29.81% and 21.97) in Y1 and pooled and fruit length (24.42%, 24.88 and 26.21%), average fruit weight (20.89%, 23.92% and 23.92%), total soluble solids (21.51%, 22.31% and 21.65%), reducing sugar (30.16%, 28.69% and 29.12%), non-reducing sugar (21.58%, 26.99% and 22.15%), total sugar (30.05%, 20.26% and 23.60%), dry matter (31.79%, 32.61% and 31.44%) and fruit yield per plant (22.63%, 28.23% and 26.86%) in both the year and pooled.

The highest value of genetic advance in per cent of mean was shown by Dubey *et al.* (2022) for number of fruits per plant, fruit yield per plant, node number to first pistillate flower, vine length, node number to first staminate flowers; Ahmad *et al.* (2022) for fruit yield and fruit length.

Moderate estimates of genetic advance in percent of mean were recorded for node number to first staminate flower appearance (18.79%, 16.41 and 19.24), node number to first pistillate flower appearance (15.24%, 15.66% and 17.46), vine length (12.96%, 14.15% and 15.15%), internodal length (14.93%, 13.84% and 16.68%), fruit circumference (18.40%, 16.85% and19.12%), number of fruits per plant (18.84%, 15.76% and 19.39), ascorbic acid (12.22%, 11.34% and 12.29%) in both the year and pooled while, number of primary branches per plant (16.87%) in Y2.

Table- 1: Estimates of heritability in narrow sense (h^2ns) and genetic advance in per cent of mean for twenty characters in bottle gourd over two years (Y_1= 2023, Y_2=2024) and pooled.

S. No.	Parameters / Characters	Heritability(h2ns%)			Genetic advance in percent of mean		
		Y1	Y2	Pooled	Y1	Y2	Pooled
1.	Days to first staminate flower anthesis	51.71	44.27	52.74	1.71	1.72	2.78
2.	Days to first pistillate flower anthesis	30.85	9.67	28 .55	1.98	1.74	3.63
3.	Node number to first staminate flower appearance	38.12	36.95	38.92	18.79	16.41	19.24
4.	Node number to first pistillate flower appearance	44.69	38.26	42.97	15.24	15.66	17.46
5.	Days to first fruit harvest	27.33	29.42	34.19	2.23	2.79	3.89
6.	Vine length (m)	25.09	21.15	30.18	12.96	14.15	15.15
7.	Number of nodes per main vine	47.54	43.45	57.69	3.04	2.96	5.83
8.	Internodal length (cm)	25.48	17.39	25.98	14.93	13.84	16.68
9.	Number of primary branches per plant	18.15	0.68	12.66	29.81	16.87	21.97
10.	Fruit length (cm)	56.47	61.69	60.91	24.42	24.88	26.21
11.	Fruit circumference (cm)	9.90	14.49	13.35	18.40	16.85	19.12
12.	Average fruit weight (kg)	29.05	30.45	31.71	20.89	23.92	23.92
13.	Number of fruits per plant	39.46	49.33	49.92	18.84	15.76	19.39
14.	Total soluble solids (^{0}B)	14.10	31.78	22.09	21.51	22.31	21.65
15.	Ascorbic acid (mg/100g)	47.32	36.13	48.35	12.22	11.34	12.29
16.	Reducing sugars (%)	40.64	41.71	41.84	30.16	28.69	29.12
17.	Non-reducing sugar (%)	35.23	71.56	62.46	21.58	26.99	22.15
18.	Total sugars (%)	40.62	11.23	26.79	30.05	20.26	23.60
19.	Dry matter content in fruit (g/100g)	40.54	37.21	40.89	31.79	32.61	31.44
20.	Fruit yield per plant (kg)	25.42	29.41	30.28	22.63	28.23	26.86

Low estimates of genetic advance in percent of mean were recorded for days to first staminate flower anthesis (1.71%, 1.72% and 2.78%), days to first pistillate flower anthesis (1.98%, 1.74% and 3.63%) and days to first fruit harvest (2.23%, 2.79% and 3.89%) and Node per vine main vine (3.04%, 2.96% and 5.83) in Y1, Y2 and pooled.

In Y1, Y2 and pooled high heritability along with high genetic advance in percent of mean were recorded for fruit length, average fruit weight, reducing sugar, no-reducing sugar and dry matter and total soluble solids in Y2 while, total sugar in Y1 and fruit yield per plant in pooled. Lal *et al.* (2021) observed high heritability coupled with high genetic advance as per cent of mean for fruit length, reducing sugar, total sugar, node number to first female flower appearance, primary branches per plant; 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.

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