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Studies on heritability and genetic advance for the quantitative traits in Bottle gourd [*Lagenaria siceraria* L. (Moll.) Standl.]

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Abstract
Bottle gourd [*Lagenaria siceraria* L. (Moll.) Standl.] is an important tropical species characterized by a wide range of diversity and a low yield, mainly due to number of selection for improved varieties. The present investigations were carried out at the Main Experiment Field, Vegetable Science, ANDUA&T, (Kumarganj), Ayodhya, during the season of *Zaid* 2019 and 2020. The experiment laid out in randomized complete block design (RBD) with three replications. High heritability coupled with high genetic advance as per cent of mean was observed for fruit length (cm), reducing sugar (%), total sugar (%), and days to first male flower anthesis (days), node number to first female flower appearance (days), primary branches per plant (days), total soluble solids (%) and non-reducing sugar (%). The results indicated that these characters had additive gene effect and therefore, these are more reliable for effective selection for their further improvement.

Keywords: Genetic advance and heritability in *Lagenaria siceraria* L.

Introduction
Bottle gourd [*Lagenaria siceraria* L. (Moll.) Standl.] is an important cucurbitaceous crop having range of uses and is largely cultivated in the tropics and subtropics for its edible fruits. Bottle gourd is one of the largest produced cucurbit vegetables in the world having chromosome number of 2n = 22. The genus *Lagenaria* is derived from the world *Lagena*, meaning bottle. It is also known as Calabash, Doodhi and Lauki in different parts of India (Deore *et al.*, 2009) [4]. Bottle gourd is a monoecious and cross pollinated crop in large amount of variation has been observed for many economically important characters. The fruits of bottle gourd are used are for making sweets, halva, kheer, petha, burfi and pickles. Kofta is a most popular preparation of bottle gourd. As a vegetable it is easily digestible therefore used even by patients. Fruit has cooling effect, cardiatonic and diuretic. The fruit is rich in pectin also, which showed good prospects for jelly preparation. A decoction made from the leaf is a very good medicine for jaundice. The fruit has cooling effect, it is a cardiotonic and diuretic, good for people suffering from biliousness, indigestion and convalescences *i.e.*, regain health after illness. The pulp is good for overcoming constipation, cough and night blindness and as an antidote against certain poisons. In addition, the seeds and seed oil are edible. The fruits contain 96.3 per cent moisture, 2.9 per cent carbohydrate, 0.2 per cent protein, 0.1 per cent fat, 0.5 per cent mineral matter and 11 mg of vitamin C (Ascorbic acid) per 100 g fresh weight (Thamburaj and Singh, 2005) [9]. Bottle gourd was one of the first plant species to be domesticated for human use, providing food, medicine and a wide variety of utensils and musical instruments made from the large hard shelled mature fruits. It travelled to India, where it has evolved into numerous local varieties and from India to China, Indonesia and New Zealand. At present time, the annual running or climbing monoecious vine crop is cultivated throughout the tropical and subtropical regions of the world for food and useful gourds (Whitaker and Davis, 1962) [2]. 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 finishing nets and musical instruments (Wikipedia, 2018) [12].
The genetic parameters such as heritability, genetic advance provide effective tools in hand of a breeder to select a genotype having the most desirable characters for yield. Many of the quantitative characters such as number of fruits per plant and yield per plant are highly influenced by environment conditions to use partitioning the overall heritable and non-heritable components which will be of the immense help in any planned breeding programme.

Thus, there exists scope for development of desirable F_1/segregates as per consumer's choice to meet out the ever increasing demand of bottle gourd in future.

Material and Methods

The present investigation was carried out at Main Experiment Station of the Department of Vegetable Science, Acharya Narendra Deva University of Agriculture and Technology, (Narendra Nagar), Kumarganj, Ayodhya (U.P.) India, during the seasons of *Zaid* 2019 and 2020. The observations were recorded on seventeen characters in quantitative and two qualitative parameters. Geographically, experimental site falls under humid, sub-tropical climate and is located in between 24.47^0 and 26.56^0 N latitude and 82.12^0 and 83.98^0 E longitude at an altitude of 113m above the mean sea level in the Gangetic Alluvial Plains of Eastern Uttar Pradesh. The soil type of experimental site was sandy loam with average fertility level and pH in the range of 7.5-8.5. This area falls under the humid subtropical zone and received average annual precipitation of about 1200 mm. The maximum rainfall received during the period between March to the end of July. However, occasional showers are also very common in the month of mid-July to September. The winter months are usually cool and dry. The summer is hot and dry, western hot winds, start from April and end at onset of monsoon. Twenty-seven genotypes of bottle gourd were evaluated for various yield and yield attributing traits. A factor experiment was laid out in randomized block design (RBD) with three replications of accession per plot. Plants from each genotype were direct sowing at random to each block at spacing of 1.0 m to 0.30 m between plants. Observations were recorded for 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, days to first fruit harvest, vine length (m), number of primary branches per plant, fruit length (cm), fruits circumference (cm), average fruit weight (kg), number of fruits per plant, total soluble solids (TSS) (%), reducing sugar (%), non-reducing sugar (%), total sugar (%), dry matter(g/100g) and fruit yield per plant (kg).The observations were also recorded for some ancillary traits as well. Heritability in narrow-sense was estimated as per the procedure presented by Amangoua (2018) [1]. The heritability percentage was categorized as low, moderate and high as suggested by Tiwari *et al.* (2002), (0-10%): Low, (10-30%): Moderate and (30% and above). The Genetic advance as per cent of mean was categorized as low, moderate and high by following Johnson *et al.* (1955) [5], (0-10%): Low, (10-20%): Moderate and (Above 20%) high respectably.

Result and Discussion

In this study high estimates of heritability (> 30) in narrow-sense was estimated for days to first male flower anthesis, fruit length, reducing sugar, total sugar were found in both the years and pooled, whereas days to first female flower anthesis, node number to first male flower appearance, average fruit weight and non-reducing sugar in y_1, days to first fruit harvest in pooled, moderate heritability (10-30) was found for primary branches per plant in both the years and pooled, whereas non-reducing sugar y_2 and pooled and days to first harvest, node number to first male flower appearance in y_2, node number to first female flower appearance in y_1 and pooled and dry matter in both the years and pooled, fruit circumference in y_2 and pooled, average fruit weight and days to first female flower anthesis in y_2, days to first harvest in y_1, rest of the character show low heritability (<10) in y_1 and pooled (Table-4.8). Similar finding for high estimate of narrow sense heritability for different bottle gourd traits have been also reported by Robinson *et al.*, (1949) [7], Singh *et al.* (2005), Deepthi *et al.* (2016) [3], Damor *et al.* (2016) [2], Tiwari *et al.* (2018) [10] and Kumar *et al.* (2018) [6].

High estimate of genetic advance in per cent of mean (>20%) was observed for node number to first female flower appearance, primary branches per plant, total soluble solids and non-reducing sugar in both the years whereas node number to first female flower appearance and vine length in y_1. Moderate estimate of genetic advance in per cent of mean was observed for fruit length in both the years and pooled, days to first male flower anthesis, days to first female flower anthesis, number of fruits per plant, dry matter and fruit yield per plant in both the years while total sugar and average fruit weight in y_1 and node number to first male flower anthesis in y_2 and pooled, while days to first harvest, vine length, fruit circumference in y_2 and non-reducing sugar, total soluble solids and primary branches per plant in pooled. Similar results had also been reported by earlier workers, Deepthi *et al.* (2016) [3], Damor *et al.* (2016) [2], Saha *et al.* (2018) [8] and Kumar *et al.* (2018) [6].

Table 1: Heritability (h^2ns %) and genetic advance in per cent of mean for seventeen characters in bottle gourd.

S. 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 male flower anthesis	45.86	37.44	46.32	11.68	11.83	7.39
2	Days to first female flower anthesis `	45.56	3.90	23.35	17.35	13.31	7.09
3	Node number to first male flower appearance	30.92	27.11	-20.22	21.63	16.79	12.91
4	Node number to first female flower appearance	22.72	-21.14	16.02	24.37	21.51	7.86
5	Days to first harvest	7.09	10.04	42.63	17.02	15.38	9.24
6	Vine length (m)	-22.51	-20.73	11.95	20.08	19.73	8.02
7	Primary branches per plant	14.01	15.37	14.80	30.61	29.37	16.30
8	Fruit length (cm)	52.12	52.12	54.81	18.55	17.78	10.32
9	Fruit circumference (cm)	10.76	6.09	8.97	9.99	11.61	4.84
10	Average fruit weight (kg)	30.04	9.97	-5.11	13.81	9.70	6.99
11	Number of fruits per plant	-32.47	-35.16	-36.39	14.06	11.64	5.03
12	Total soluble solids (%)	0.86	0.40	0.65	20.65	20.54	11.55
13	Reducing sugar (%)	54.31	55.34	79.02	6.27	6.15	5.52
14	Non-Reducing sugar (%)	52.16	12.73	29.61	31.33	25.77	11.14
15	Total sugars (%)	53.35	53.24	79.31	6.95	7.09	6.84
16	Dry matter (g/100g)	3.67	4.51	4.24	16.03	15.97	2.18
17	Fruit yield/ plant (kg)	-32.71	-34.99	-34.83	19.15	12.73	6.87

Conclusion

Estimate of high heritability in narrow-sense was recorded by reducing sugar and total sugar in both years. Estimate of high genetic advance in per cent of mean (>20%) was observed for node number to first female flower appearance followed by primary branches per plant, total soluble solids and non-reducing sugar in both the years whereas node number to first female flower appearance and vine length in y_1. High heritability (narrow scene) coupled with high genetic advance (as per cent of mean) was observed for non-reducing sugar (52.16 and 31.33%), node number to first female flower appearance (30.92 and 21.63%) inY_1, and moderate range recorded for node number to first male flower appearance (27.11 and 16.79%), days to first harvest (10.04 and 15.38%), in Y_2 and primary branches per plant (14.80 and 16.30%) in pooled content indicating the preponderance of additive gene action. Rest of the character show low heritability (<10) in y_1 and pooled. Similar finding for high estimate of narrow sense heritability for different bottle gourd traits have been also reported by Deepthi *et al.* (2016) [3], Damor *et al.* (2016) [2], Tiwari *et al.* (2018) [10], Kumar *et al.* (2018) [6] and Saha *et al.* (2018) [8].

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