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Assessment of the Genetic Diversity in Bottle Gourd [*Lagenaria siceraria* (Mol.) Standl.]

Rehan[1*], Manoj Kumar Singh[2], Mukesh Kumar[2], Vipin Kumar[2], Sunil Malik[2] and Atar Singh[3]

[1]Department of Horticulture, College of Agriculture, J.N.K.V.V., Jabalpur (M.P.), India
[2]Department of Horticulture, [3]Department of Genetics and Plant Breeding, College of Agriculture, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, U.P, India

**Corresponding author*

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A B S T R A C T

The present investigation was conducted to assess the genetic variability and genetic diversity of bottle gourd *Lagenaria seceraria* (Mol.) Standl.] Among 24 genotypes collected from different institute/SAUs during kharif season (2018-2019). Analysis of variance showed significant variation for all traits indicating wide range of variability in genotypes. The highest genotypic and phenotypic co-efficience of variation was observed in terms of fruit girth and fruit length, which indicates that high degree of variability in these character and suggested that possibility of yield improvement through selection of this traits. High heritability coupled with high genetic advance were recorded for fruit length, fruit girth, days to first fruit harvest, and for vine length, which indicates that above characters may be most potential for further improvement. Mahalanobis D2 analysis revealed that a considerable genetic diversity was found among genotypes. Total study twenty four genotypes of bottle gourd were grouped in five clusters. The I (19 genotypes) and III (2 genotypes) cluster had the maximum number of genotypes. The maximum inter cluster D2 value was recorded between Cluster V and Cluster I and the minimum inter cluster D2 value was recorded in cluster V and III. The maximum inter cluster D2 values indicates that genotypes of Cluster V and Cluster I not closely related, whereas the genotypes of cluster II, cluster III and cluster IV were found closely related due to minimum inter cluster D2 value. The maximum contribution percentage was found with fruit length among all the characters contributed.

Introduction

Bottlegourd [*Lagenaria siceraria* (Mol.) Standl.] is locally known as Lauki. It is an important member of cucurbitaceous fruit vegetable and having total number of chromosome i.e., 2n=22. It is a fast growing vine crop and originated from tropical Africa. It is well grown in both rainy and summer seasons around the world and its fruits are available in the market round year. Bottle gourd pulp is good for overcoming

constipation, cough, and night blindness and as an antidote against certain poison (Chauhan, 1972). According to Ayurveda and Unani, it is act as cardio tonic, laxative, cooling effect, diuretic, antebellum whole some to the focus, tonic to liver, anti-periodic, antipyretic (Kirtikar and Basu, 1991). The edible portion of fruit contains 96.3 per cent moisture, 2.9 per cent carbohydrates, 0.2 per cent protein, 0.1 per cent fat, 0.5 per cent mineral matter and 11 mg of vitamin C per 100 g fresh fruit pulp. It also contains various minerals like Ca (12 mg), P (37 mg), Na (1.7 mg), K (87 mg), Cr (0.05 mg), Fe (0.8 mg), per 100 gm of bottle gourd pulp (Thamburaj and Singh, 2005).

It is an annual, vigorous climbing species, monoecious and highly cross pollinated crop having wide range of genetic variability across the globe. The fruit yield of bottle gourd is the quantitative character which is dependent on many other attributes viz, vine length, node at which first female flower appeared, number of fruits per plant, fruit length, fruit weight etc. are inherited quantitatively and their expression is governed by polygenes which are highly influenced by environmental factors. Hence, selection based on yield components rather than yield itself is reliable and may be accomplished through the component approach of breeding. A specific difference in environment may have a great effect on some genotypes than others (Shaikh, *et al.,* 2012).

Genetic improvement of any crop is largely dependent on the magnitude of a number of genetic parameters *viz,* phenotypic and genotypic coefficient of variation (PCV and GCV), broad sense heritability in broad sense and genetic gain; on which the breeding methods are formulated for its further improvement. Analysis on genetic variability reveals its presence and is of utmost importance as it provides clear idea for effective selection. The yield potentiality of Bottle gourd needs to be improved through an effective breeding programme. Studies on the variations of yield and yield contributing characters are important for planning of breeding program. Genetic diversity analysis among elite germplasm is prerequisite for choosing shows potential genetic diverse lines for desirable traits and to reveal genetic distinctness among genotypes.

Materials and Methods

An experiment was conducted at Horticulture Research Centre of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (UP) during the kharif season. The present study comprised of 24 diverse genotypes of Bottle gourd and replicated three times in a Randomized block design. The experimental field was prepared by employing one ploughing with disc harrow followed by three ploughing with cultivator and planking to make fine tilth of soil and then leveled. Fertilizers were incorporated. Before doing the layout of experimental plot, weed and other unwanted vegetation was removed from the field. Observations recorded were days to first flower initiation, days to 50% flowering, vine length (cm), number of leaves per plant, number of primary branches per plant, days to first fruit set, days to first fruit harvest, fruit length (cm), fruit girth (cm), number of fruit per plant, fruit weight (g), fruit yield per plant (kg) and duration of the crop. Heritability, genetic advance and genetic divergence were also analyzed.

Results and Discussion

The result revealed that the highest genotypic co-efficient of variation was observed (28.81) in times of fruit girth and fruit length (25.83). The moderate genotypic co-efficient of variation was observed for vine length

(13.93), fruit yield per plant (10.92). However, low genotypic co-efficient variation was observed number of fruit per plant (5.09), fruit weight (4.24), days to first fruit harvest (2.89), number of leaves (2.30), number of primary branches (2.08), days to 50% flowering (1.84), days to first flower initiation (1.69), days to first fruit set (0.57), and duration of crop (0.36) (Table 1–5).

The highest phenotypic coefficient of variation was observed for fruit girth (29.72) and fruit length (26.18). The moderate phenotypic co-efficient of variation was observed for vine length (17.24) and fruit yield per plant (10.96). How low phenotypic co-efficient of variation was observed for number of fruit per plant (7.90), number of leaves (7.22), fruit weight (7.12), number of primary branches (5.53), days to first fruit harvest (3.56), days to first flower initiation (2.68), days to 50% flowering (1.84), duration of crop (1.84), and days to first fruit set (1.49). Further, the present finding showed that estimates of PCV were generally higher than their corresponding GCV for all the characters studied.

These findings are similar in agreement with earlier reported by Chowdhury and Sharma (2002), Kumar and Syamal (2009), Husna *et al.,* (2011), Prasad *et al.,* (1993). The difference among the genotypic coefficient of variance and phenotypic coefficient of variance value for different characters indicated that PCV was higher than the GCV influence of environment in expressing the variability with traits. Less difference accounts for the fact that environment is much affecting the variable performance of the characters.

The data revealed that the broad sense heritability ranged from 3.90 % for duration of crop to 95.70 % for fruit length. High heritability in broad sense was obtained from fruit length (95.70%), fruit girth (91.00 %), days to first fruit harvest (66.10 %), and for vine length (65.40 %). The moderate heritability was observed for days to 50% flowering (47.80 %), number of fruit per plant (41.50 %), days to first flower initiation and fruit yield per plant (39.90 %), fruit weight (35.90 %). However low h2 value was exhibited by days to first fruit set (14.80 %), number of primary branches (14.20 %), number of leaves (10.10 %) and (3.90 %) for duration of crop. Similar result was also find earlier by Dora *et al.,* (2003), Rahman *et al.,* (1986), Randhawa *et al.,* (1975), Sharma *et al.,* (1966). The high heritability denotes high proportion of genetic effects in the determination of these characters and can be adopted for improving fruit yield. Fruit yield the character showing high heritability could be owing to greater contribution of additive genetic components in the inheritance of these attributes.

The data showed that the genetic advance expressed as percentage of mean was high for fruit girth (36.95) , fruit length (31.90) and for vine length (23.21).while low genetic advance was observed for fruit yield per plant (9.00), number of fruit per plant (6. 75), fruit weight (5.19), days to first fruit harvest (4.85), days to 50 % flowering (2.62), days to first flower initiation (2.20), number of primary branches (1.62), Number of leaves (1.51) days to first fruit set (0.45) and (0.15) for duration of crop. Some of these characters have been also reported by (Ram *et al.,* 2005, Rahman *et al.,* 1986).

The cluster mean for fourteen character under study has been presented in table 2 and revealed that the days to 50% flowering and vine length were observed highest mean value for cluster V i.e., (48.33) and (490.98) and lowest mean value for same character observed in cluster II and cluster IV (45.00) and (361.90), respectively. The days to first

flower initiation showed highest mean value i.e. (44.48) and lowest mean value (41.77) found in cluster V and cluster II respectively. The another character like days to first fruit set showed highest mean value in cluster III and lowest mean value in cluster IV i.e. (48.00) and (45.55) respectively. Days to first fruit harvest showed highest mean value in cluster V and lowest in cluster III (60.11) and (52.72) respectively. The fruit length was showed highest mean value i.e. (42.14) and lowest mean value (17.96) found in cluster I and cluster V. The another character like fruit girth was observed that highest mean value (12.29) and lowest mean value (5.77) was found in cluster V and cluster IV. In case of number of fruit per plant highest mean value (9.50) and (7.99) found cluster V and cluster IV respectively.

The yield and yield attributing character like fruit weight showed highest mean value (955.00) and lowest mean (773.50) was found in cluster IV and cluster III. Another character like fruit yield per plant highest mean value (6.37) and lowest (4.88) was found in cluster IV and cluster I. in other character like duration of crop highest mean value (113.44) and lowest (109.88) was found in cluster V and cluster III respectively.

The genetic divergence analysis was done by using Mahalanobis D2 statistics and the twenty four genotypes were grouped into five different genetic clusters on the basis of genetic affinity or diversity by Tocher's methods.

Cluster I comprised of 19 genotype named, NDBG-4, VRBG-15-1, VRBG-61, VRBG-15-2, VRBG-71, IC-594545, Mahima Hybrid, Pant Hybrid-4, Hazari -4000, BG- Kaveri, Ketan, warad, VRBG-16-13, NDBG-613-4, Kashi Ganga, Narendra Rashmi, Pusa Samridhi.

Cluster II comprised of 1 genotype named, Rajendra chamatkar.

Cluster III comprised of 2 genotype named, IC-594544, Pusa Naveen.

Cluster IV comprised of 1 genotype named, Narendra Dharidar-1.

Cluster V comprised of 1 genotype named, Pusa Santushti.

It was concluded that in general, there was parallelism between genetic and geographical diversity. The view point has been supported by the work of (Ghai *et al.,* 2005, Mathew *et al.,* (2001), Banik (2003), Islam (2004), Kabir (2007), Devi *et al.,* (2013).

The mean inter and intra-cluster D2values are presented in table 4. The maximum inter cluster D2 value (16.09) was recorded between Cluster V and Cluster I and the minimum inter cluster D2 value (12.12) was recorded in cluster V and III. The intra cluster distance were found in cluster III (3.883) followed by cluster I (3.850), cluster II (3.786), cluster V (3.783), cluster IV (3.146). The maximum inter cluster D2 values indicates that genotypes of Cluster V and Cluster not closely related, whereas the genotypes of cluster II, cluster III and cluster IV were found closely related due to minimum inter cluster I D2 values.

It is apparent therefore, the genotypes of cluster do not differ significantly with regards to their relative genetic distance as indicated from low variation of D2 values. It is apparent therefore, the genotypes of cluster do not differ significantly with regards to their relative genetic distance as indicated from low variation of D2 values (Khatun *et al.,* 2010, Visen *et al.,* 2015, Kabir, 2007, Choudhary *et al.,* 2011, Devi *et al.,* 2013).

Table.1 Estimates of variability

Characters	General mean	Range	PCV %	GCV %	Heritability %	GA	GA as %
Vine length	410.54	158.64-510.10	17.24	13.93	65.40	95.28	23.21
No. of leaves	28.27	24.22 - 32.22		2.30	10.10	0.43	1.51
No. of primary branches	11.96	11.00 - 13.11	5.53	2.08	14.20	0.19	1.62
Days first flower initiation	43.50	41.77- 45.55	2.68	1.69	39.90	0.96	2.20
Days to 50% flowering	47.24	45 - 49.33	2.66	1.84	47.80	1.24	2.62
Days to first fruit set	47.14	45.55 - 48.67	1.49	0.57	14.80	0.21	0.45
Days to first fruit harvest	57.45	52.11 - 60.11	3.56	2.89	66.10	2.78	4.85
Fruit length	39.60	17.96 - 43.95	26.18	25.83	95.70	12.63	31.90
Fruit girth	6.57	5.67- 12.29	29.72	28.81	91.00	2.43	36.95
No. of fruit/plant	8.36	7.33 - 10.22	7.90	5.09	41.50	0.57	6.75
Fruit weight	868.29	749.22- 973.33	7.12	4.24	35.40	45.04	5.19
Fruit yield/plant	5.02	4.23 - 6.37	10.96	10.92	39.90	0.45	9.00
Duration of the crop	112.80	107.78 -116.11	1.83	0.36	3.90	0.17	0.15

Table.2 Cluster mean

Traits / Clusters	Days to first flower initiation	Days to 50% flowering	Days to first fruit set	Vine length	No. of leaf	No. of primary branches	Days to first fruit harvest	Fruit length	Fruit girth	No. of fruit/ plant	Fruit weight	Fruit yield/plant	Duration of the crop
Cluster-I	43.65	47.46	47.21	405.83	28.31	12.03	57.85	42.14	6.32	8.22	872.42	4.88	113.29
Cluster-II	41.77	45.00	46.55	405.13	30.22	11.66	54.33	36.26	6.76	8.22	845.55	5.42	109.89
Cluster-III	43.14	46.50	48.00	442.33	28.66	11.11	52.72	27.22	6.39	9.50	773.50	5.21	109.28
Cluster-IV	41.78	45.67	45.55	361.90	24.22	12.77	59.66	41.08	5.77	7.99	955.00	6.37	112.89
Cluster-V	44.88	48.33	46.22	490.48	28.78	11.66	60.11	17.96	12.29	9.33	915.55	5.40	113.44

Table.3 Clustering pattern

Clusters numbers	Number of genotypes	Genotypes name
Cluster I	19	NDBG-4, VRBG-15-1, VRBG-61, VRBG-15-2, VRBG-71, IC-594545, Mahima Hybrid, Pant Hybrid-4, Hazari -4000, BG-Kaveri, Ketan,Warad, VRBG-16-13, NDBG-613-4, Kashi Ganga, Narendra Rashmi, Pusa Samridhi.
Cluster II	1	Rajendra Chamatkar
Cluster III	2	IC-594544 and Pusa Naveen
Cluster IV	1	Narendra Dharidar-1
Cluster V	1	Pusa Santushti

Table.4 Inter and Intra cluster distance

Clusters	Cluster I	Cluster-II	Cluster-III	Cluster-IV	Cluster-V
Cluster I	**3.850**	5.491	9.642	5.960	16.09
Cluster-II		**3.786**	5.782	5.061	13.39
Cluster-III			**3.883**	8.552	12.12
Cluster-IV				**3.146**	14.86
Cluster-V					**3.783**

Table.5 Contribution of traits towards the divergence

S.No.	Traits	Contribution
1	Vine length	9.42
2	No. of leaf	1.09
3	No. of primary branches	1.81
4	Days first flower initiation	3.99
5	Days to 50% flowering	5.07
6	Days to first fruit set	1.09
7	Days to first fruit harvest	1.81
8	Fruit length	36.59
9	Fruit girth	5.07
10	No. of fruit/plant	1.45
11	Fruit weight	10.51
12	Fruit yield/plant	17.39
13	Duration of the crop	4.71

Contributions of various characters toward total genetic divergence are presented in table 5. Ranking character wise D2 value and adding the rank for each character for all the entries the variables, this contributed towards the genetic divergence. The maximum contribution percentage (36.59 %) was found with fruit length among all the characters contributed followed by fruit yield per plant (17.39 %), fruit weight (10.51 %), vine length (9.42 %), days to 50% flowering and fruit girth (5.07 %), duration of crop (4.71 %), days to first flower initiation (3.99 %), number of primary branches and days to first fruit harvest (1.81 %), number of fruit per plant (1.45 %), number of leaves and days to first fruit set (1.09 %).

Based on genetic diversity and superiority with respect to any of traits the genotype may be identified and may be involve in crossing for obtaining high heterotic population, segregates and also may be exploited for development of hybrid in bottle gourd.

In conclusion the high heritability denotes high proportion of genetic effects in the determination of these characters and can be adopted for improving fruit yield. Fruit yield the character showing high heritability, could be owing to greater contribution of additive genetic components in the inheritance of these attributes and hence may prove useful for effective selection. Genotypes from the geographical region fall into different clusters and vice versa. This suggested that the selection of the parent for hybridization should be on genetic diversity rather than on the geographical area.

Divergence study suggested that crosses between the genetically diverse genotypes of cluster V and III. Based on genetic diversity and superiority with respect to any of traits the genotype may be identified and may be involve in crossing for obtaining desired segregates from breeding point of view in bottle gourd.

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