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Genetic variability in bottle gourd

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Abstract
The present investigation was carried out at Main Experiment Station of Department of Vegetable Science, Narendra Deva University of Agriculture & Technology, Narendra Nagar, (Kumarganj) Ayodhya (U.P.), India during summer season of 2013 in a Randomized Block Design with three replications. Observations were recorded for twelve quantitative characters *viz*., node to first staminate flower anthesis**,** node to first pistillate flower anthesis, days to first staminate flower anthesis, days to first pistillate flower anthesis, days to first picking, number of fruits/ plant, fruit weight (kg), fruit length (cm), fruit circumference (cm), vine length at the time of last harvest (m), number of branches/plant, fruit yield (kg/plant). The analysis of variance showed highly significant differences for all the characters studied indicating considerable variability among the genotypes. The highest GCV (63.07%) and PCV (63.75%) were observed for fruit yield (kg/plant). In general PCV was marginally higher than the corresponding GCV indicated the less influence of environment in the expression of the characters under study. The broad sense heritability was high for all characters expected genetic advance as percent of mean was also moderate to high for all the economic traits. Thus, most of the economic characters studied in the present investigation were expected to exhibit satisfactory response through selection.

Keywords: Bottle gourd, genetic variability, heritability and correlation

Introduction
Cucurbitaceous vegetables are the largest family consisting of maximum number of edible species in vegetable kingdom. Bottlegourd (*Lagenaria siceraria* (Molina) Standley) is an important vegetable crop of the family cucurbitaceae, grown extensively all over India. Bottle gourd is gaining popularity as a health food because of its easy digestibility, diuretic and cardiatonic effects [1]. Bottle gourd is a cross pollinated crop with large amount of variation for many economically important traits. A programme of breeding for high yield requires information of the nature magnitude of variation in the available genotypes, association of characters with yield among themselves. Knowledge of existent variability, with respect to yield and yield attributing traits in the germplasm of a crop is the basic requirement in order to select the desirable types. The coefficients of genotypic variability and phenotypic variability are used as an aid in the plant breeding work. However, the proportion of heritable variance of a character is of much importance. Heritability estimate which provides the assessment of transmissible genetic variability to total variability happens to be the most important basic factor in determining the genetic improvement and response to selection. The parameter genetic advance in per cent of mean (GA) is more reliable index for understanding the effectiveness of selection to improve the traits because its estimate is derived by involvement of heritability, phenotypic standard deviation and intensity of selection. Thus heritability and genetic advance in per cent of mean in combination provides clear picture regarding the effectiveness of selection for improving the plant characters.

Materials and Methods
The experimental material consisted of twenty four genotypes were laid out in a Randomized Block Design (RBD) with three replications at at Main Experiment Station of Department of Vegetable Science, Narendra Deva University of Agriculture & Technology, Narendra Nagar, (Kumarganj), Ayodhya during spring summer season of 2013. Each genotype was represented by a double row plot of 3 m length with 6 plants sown at a distance of 3 m between rows and 0.5 m between plants. Observations were recorded for twelve quantitative characters *viz*., node to first staminate flower anthesis, node to first pistillate flower anthesis, days to first staminate

flower anthesis, days to first pistillate flower anthesis, days to first picking, number of fruits/ plant, fruit weight (kg), fruit length (cm), fruit circumference (cm), vine length at the time of last harvest (m), number of branches/plant, fruit yield (kg/plant). For statistical analysis, Analysis of variance was done based on RBD as suggested by Panse and Sukhatme [2] for each of the characters separately. Genetic parameters, genotypic, environmental and phenotypic coefficients of variation (expressed in percentage) were calculated by using the formula given by Burton [3]. Heritability in broad sense was determined according to the methodology given by Allard [4]. The estimate of the expected genetic advance (GA) expressed as a percentage of the mean was computed by the formula given by Johnson *et al.* [5].

Results and Discussion

The analyses of variance for twelve characters of twenty four genotypes of bottle gourd are presented in table-1. The mean sums of squares due to genotypes were highly significant for all the characters subjected to analysis of variance. This indicated the presence of considerable amount of variation among the genotypes to carry out further genetic analysis. Joydip *et al*. [6] and Damor *et al*. [7] also reported similar results. The phenotypic variance (σ2p) and phenotypic coefficient of variation (PCV) were slightly higher than corresponding genotypic variance (σ2g) and genotypic coefficient of variation (GCV) for most of the characters indicated the presence of less environmental effect upon the concerned characters. The genetic parameters *viz*., genotypic and phenotypic coefficients of variation, heritability in broad sense and genetic advance along with mean and range of different characters are presented in table-2. High magnitude of GCV as well as PCV were recorded for traits *viz*., fruit yield (63.07 and 63.75), number of fruits per plant (59.31 and 60.25), node to first staminate flower anthesis (39.49 and 39.78), node to first staminate flower anthesis (38.93 and 39.28), fruit length (32.45 and 32.68), fruit circumference (28.89 and 29.08). Moderate GCV and PCV were recorded for fruit weight (19.63 and 21.90), vine length (18.98 and 20.42), number of branches/plant (15.53 and 17.58), days to first picking (12.82 and 12.99), days to first pistillate flower anthesis (12.44 and 12.62), and days to first staminate flower anthesis (10.97 and 11.13), suggested existence of considerable variability in the population. Selection for these traits may also be given the importance for improvement programme. Similar findings were also reported earlier in bottle gourd by Munshi and Acharyya [8], Gayen and Hossain [9], Pandit *et al.* [10], Bhardwaj *et al.* [11], Sharma and Sengupta [12], Mangala *et al.* [13] and Rambabu *et al.* [14].

In the present investigation high magnitude of heritability was recorded for all the characters studied. The highest heritability was recorded for node to first pistillate flower anthesis (99.0%), fruit length (99.0%) and fruit circumference (99.0%) followed by node to first staminate flower anthesis (98.0%), fruit yield (98.0%), days to first staminate flower anthesis (97.0%), days to first pistillate flower anthesis (97.0%), days to first picking (97.0%), number of fruits/ plant (97.0%), vine length (86.0%), fruit weight (80.0%), and number of branches/plant (78.0%). Similar high heritability for all the traits was also reported by Munshi and Acharyya [9], Bhardwaj *et al.* [11] and Rambabu *et al.* [14].

Genetic advance as percent of mean was observed high for fruit yield **(**128.56%), number of fruits/ plant **(**120.25%), node to first pistillate flower anthesis **(**80.73%), node to first staminate flower anthesis **(**79.47%), fruit length **(**66.35%), fruit circumference **(**59.11%) while moderate genetic advance as percent of mean was recorded for vine length (36.36%), fruit weight (36.22%), number of branches per plant (28.28%), days to first picking (26.06%), days to first pistillate flower anthesis (25.28%), and days to first staminate flower anthesis (22.25%).

Heritability estimates along with genetic advance are more useful than the heritability value alone for selecting the best individual. High heritability coupled with high genetic advance over mean was observed for fruit length, fruit circumference, node to first pistillate flower anthesis, fruit yield, and node to first staminate flower anthesis. The individual bottle gourd genotypes, which should desirable mean values in characters like fruit length, fruit circumference, node to first pistillate flower anthesis, fruit yield, and node to first staminate flower anthesis, should be selected, because these characters with high genotypic coefficients of variation, high heritability and high genetic advance are controlled by additive gene action and hence direct selection is effective. Aruah *et al*. [15], Kumer *et al*. [16], Joydip *et al*. [6] and Sultana *et al*. [17] support the present findings. Days to first staminate flower anthesis, days to first pistillate flower anthesis and days to first picking registered low genotypic coefficient of variation, high heritability and low genetic advance which indicated the preponderance of non additive gene action and influence of environment.

Table 1: Analysis of variance for twelve economic characters of 24 bottle gourd genotypes

Sources of variation	Degree of freedom	Characters											
		Node to first staminate flower anthesis	Node to first pistillate flower anthesis	Days to first staminate flower anthesis	Days to first pistillate flower anthesis	Days to first picking	Number of fruits/ plant	Fruit weight (g)	Fruit length (cm)	Fruit circum-ference (cm)	Vine length (m)	Number of branches/plant	Fruit yield (kg/plant)
Replications	2	0.3	0.5	0.4	1.1	1.6	0.1	0.0	2.3	0.1	0.1	0.3	0.1
Genotypes	23	97.9**	168.4**	80.0**	109.2**	166.5**	9.1**	0.1**	296.7**	182.3**	5.6**	19.5**	8.9**
Error	46	0.6	0.8	0.8	1.0	1.5	0.1	0.0	1.4	0.8	0.3	1.7	0.1

**Significant at 1% level of probability

Table 2: Estimates of variability, heritability, genetic advance and expected genetic advance as per cent of mean for twelve economic characters

S. No.	Characters	Range		Mean	Components of variance		Coefficient of variability		Heritability (%)	Genetic advance	Genetic advance as per cent of mean
		Min.	Max.		σ_p^2	σ_g^2	P.C.V. (%)	G.C.V. (%)			
1.	Node to first staminate flower anthesis	8.67	28.39	14.63	33.03	32.44	39.28	38.93	98	11.63	79.47
2.	Node to first pistillate flower anthesis	10.33	36.33	18.93	56.68	55.84	39.78	39.49	99	15.28	80.73
3.	Days to first staminate flower anthesis	40.33	57.33	46.86	27.22	26.41	11.13	10.97	97	10.43	22.25
4.	Days to first pistillate flower anthesis	41.33	62.33	48.26	37.10	36.07	12.62	12.44	97	12.20	25.28
5.	Days to first picking	49.33	78.67	57.86	56.49	55.02	12.99	12.82	97	15.08	26.06
6.	Number of fruits/ plant	0.17	5.39	2.92	3.10	3.00	60.25	59.31	97	3.51	120.25
7.	Fruit weight (kg)	366.67	1081.11	863.40	0.04	0.03	21.90	19.63	80	0.32	36.22
8.	Fruit length (cm)	14.17	45.00	30.58	99.86	98.42	32.68	32.45	99	20.29	66.35
9.	Fruit circumference (cm)	13.60	42.93	26.92	61.30	60.48	29.08	28.89	99	15.91	59.11
10.	Vine length (m)	5.69	10.31	7.00	2.04	1.77	20.42	18.98	86	2.55	36.36
11.	Number of branches/plant	11.44	19.51	15.70	7.62	5.95	17.58	15.53	78	4.44	28.28
12.	Fruit yield (kg/plant)	0.06	5.21	2.71	2.99	2.93	63.75	63.07	98	3.49	128.56

Conclusion

The present investigation revealed that the association of any qualitative character with desirable traits or yield components serves as a phenotypic marker in the selection process. On the basis of this study, it can be concluded that selection would be rewarding for fruit length, fruit circumference, node to first pistillate flower anthesis, fruit yield, and node to first staminate flower anthesis in bringing out the improvement in the bottle gourd because they appeared with high value of GCV, PCV, heritability and genetic advance.

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