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Variability, Heritability and Genetic Advance in Brinjal (*Solanum melongena* L.)

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A B S T R A C T

Thirty five accessions of brinjal were assessed for variability for nineteen characters. Highly significant differences were observed among the accessions. High phenotypic and genotypic coefficient of variation was observed for number of fruits per cluster, number of fruits per plant, fruit length, fruit width, average fruit weight, fruit yield per plant, ascorbic acid content, total phenol content, shoot and fruit borer infestation indicating the existence of wider genetic variability for these traits in the germplasm. High heritability accompanied with high genetic advance was noticed for days to 50% flowering, number of flower clusters per plant, number of flowers per cluster, number of fruits per cluster, number of fruits per plant, days to last harvest, fruit length, fruit width, average fruit weight, fruit yield per plant, total phenol content, shoot and fruit borer infestation suggesting that they can be improved through direct selection due to predominant additive variation.

Introduction

Brinjal (*Solanum melongena* L.) is an important and popular vegetable crop of family Solanaceae, grown throughout the year all over the country. Eggplant contains the alkaloid solanine in roots and leaves, and there are medicinal uses for eggplant. Fruits are rich in Ca, Mg, and P and contain fatty acids (Dhankhar and Singh, 1984). Being primary centre of origin, India has accumulated a wide range of variability in this crop. Genetic improvement of any crop mainly depends on the amount of genetic variability present in the population and the germplasm serves as a valuable source of base population and provide scope for wide variability (Gavade and Ghadage, 2015). Further, the crop exhibits rich genetic diversity and scope for improvement for

various horticultural traits. Heritability is the heritable portion of phenotypic variance. The estimates of heritability help the plant breeder in selection of elite genotypes from diverse genetic populations. Heritability indicates only the effectiveness with which selection of a genotype can be based on phenotypic performance but it fails to indicate the expected genetic progress in one cycle of selection. Heritable variation can be effectively used with greater degree of accuracy when heritability is studied in conjunction with genetic advance (Johnson *et al.,* 1955). Genetic advance denotes the improvement in the mean genotypic values of selected families over base population and thus helps the breeder to select the progenies in the earlier generation itself. An improvement in yield and quality of brinjal is normally achieved by selecting the genotypes with desirable character combination existing in nature or by hybridization. With this objective, the present investigation was carried out with brinjal germplasm.

Materials and Methods

Thirty-five brinjal germplasm lines were evaluated in Randomized Block Design with three replications. The experiment was carried out at Vegetable Research Block, SKLTSHU, Rajendra nagar, Hyderabad during rabi seasons of 2015–16. Thirty days old seedlings from the nursery beds were transplanted on ridges adopting a spacing of 50 cm × 50 cm. twenty plants of each genotype were maintained in a plot in each replication. Recommended cultural practices were followed. Observations were recorded from five randomly selected plants of each genotype in each replication. The data were analyzed by the methods of Cochran and Cox (1957) using mean values of random plants in each replication from all genotypes to determine significance of genotypic effects. Genotypic and phenotypic coefficients of variation were calculated using the formulae of Burton (1952). Broad sense heritability was calculated as per Lush (1940) and genetic advance estimated by the method of Johnson *et al.,* (1955a). Categorization of genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV) and genetic advance (GA) were done as per Sivasubramanian and Menon (1973) and heritability categorized as by Johnson *et al.,* (1955).

Results and Discussion

The mean sum of squares for nineteen characters in genotypes of brinjal is presented in table 1. Analysis of variance revealed highly significant differences among genotypes for all nineteen characters. The results pertaining to mean, range, phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability in broad sense (h2) and expected genetic advance as per cent of mean (GAM) for all the nineteen characters are furnished in table 2.

Variability refers to the presence of differences among the individuals of a population. Variability is essential for wide adaptability and resistance to biotic and a biotic factors and hence, an insight into the magnitude of genetic variability present in a population is of paramount important to a plant breeder for starting a judicious breeding programme. The phenotypic and genotypic variances measure the magnitude of variation arising out of difference in phenotypic and genotypic values. The absolute values of phenotypic and genotypic variances cannot be used for comparing the magnitude of variability for different characters, since the mean and units of measurement of the characters may be different. Hence, the coefficients of variation expressed at phenotypic and genotypic levels have been used.

A relatively high estimate of genotypic and phenotypic coefficient of variation (GCV of more than 20%) occurred for number of fruits per cluster, number of fruits per plant, fruit length, fruit width, average fruit weight, fruit yield per plant, ascorbic acid content, total phenol content, shoot and fruit borer infestation were high indicating the presence of high variability in the germplasm for selection. It could be inferred that the selection for improvement of these characters would be effective.

The results are in consonance with Kumar *et al.,* (2011), Kumar *et al.,* (2012), Lokesh *et al.,* (2013), Arunkumar *et al.,* (2013), Ramesh Kumar and Arumugam (2013), Gavade and Ghadage (2015). Moderate phenotypic and genotypic coefficients of variation (10–19%) were observed for number of branches per plant, days to first flowering and days to 50% flowering. The parameters like number of flower clusters per plant and number of flowers per cluster exhibited moderate coefficient of variation at genotypic level. There is the opportunity for improving these characters in the desirable direction through selection. This agrees with findings of Ramesh Kumar and Arumugam (2013), Lokesh *et al.,* (2013), Gavade and Ghadage (2015). Low estimates of phenotypic and genotypic coefficient of variation were observed for plant height, days to first fruit harvest and days to last fruit harvest. Similar results were reported by Kumar *et al.,* (2012), Gavade and Ghadage (2015).

Table.1 Mean squares of the nineteen characters studied in brinjal

S. No.	Character	Replications (df =2)	Treatments (df=34)	Error (df = 68)	S.E.	C.V. (%)	C.D. 5%
1	Plant height (cm)	65.13	193.19**	1.37	0.67	1.23	1.91
2	No. of branches per plant	19.04	6.35**	0.54	0.42	5.41	1.20
3	Days to first flowering	38.37	117.25**	0.69	0.48	1.95	1.36
4	Days to 50 % flowering	17.86	111.87**	0.52	0.41	1.49	1.18
5	No. of flower clusters per plant	35.87	32.76**	0.64	0.46	4.56	1.30
6	No. of flowers per cluster	2.96	1.04**	0.15	0.22	13.64	0.64
7	No. of fruits per cluster	2.98	0.69**	0.07	0.15	14.82	0.44
8	No. of fruits per plant	29.54	104.37**	0.45	0.38	3.12	1.10
9	Days to first harvest	32.86	110.76**	0.77	0.51	1.39	1.44
10	Days to last harvest	43.53	277.38**	0.50	0.41	0.47	1.15
11	Fruit length (cm)	1.36	35.33**	0.27	0.30	4.39	0.85
12	Fruit width (cm)	0.01	5.29**	0.02	0.08	2.92	0.24
13	Average fruit weight (kg)	0.04	0.004**	0.00	0.00	1.84	0.00
14	Fruit yield per plant (kg)	0.26	4.17**	0.02	0.05	4.51	0.14
15	Ascorbic acid content (mg/100g)	0.10	6.12**	17.68	0.08	2.37	0.24
16	Total phenol content (mg/100g)	17.65	570.67**	2.65	2.42	8.97	6.86
17	Shoot and fruit borer infestation (%)	33.32	140.48**	0.008	0.94	9.91	2.65
18	Cumulative wilt incidence (%)	0.00	0.00	0.00	0.00	0.00	0.00
19	Little leaf incidence (%)	0.00	0.00	0.00	0.00	0.00	0.00

Table.2 Estimates of variability, heritability and genetic advance as Percent of mean for nineteen characters

S.No	Characters	Range		Mean	Variance		PCV (%)	GCV (%)	h^2_{bs} (%)	Genetic Advance	GA as per cent of mean
		Mini mum	Maxi mum		Pheno - typic	Geno- typic					
1	Plant height (cm)	81.24	106.02	94.83	65.31	63.94	8.522	8.43	97.90	16.29	17.18
2	No. of branches per plant	11.10	16.66	13.58	2.48	1.94	11.59	10.25	78.17	2.53	18.67
3	Days to first flowering	32.55	54.33	42.7	39.55	38.85	14.72	14.59	98.23	12.72	29.80
4	Days to 50% flowering	36.33	60.33	48.39	37.64	37.12	12.67	12.59	98.60	12.46	25.75
5	No. of flower clusters per plant	10.99	26.22	17.53	11.35	10.71	19.21	18.66	94.34	6.54	37.33
6	No. of flowers per cluster	1.66	4.11	2.88	0.45	0.30	23.28	18.87	65.66	0.90	31.50
7	No. of fruits per cluster	1.00	2.88	1.85	0.28	0.21	28.60	24.46	73.15	0.79	43.10
8	No. of fruits per plant	11.22	34.22	20.35	35.10	34.64	27.48	27.30	98.70	12.04	55.87
9	Days to first harvest	52.33	74.66	63.18	37.44	36.66	9.63	9.51	97.57	12.24	19.37
10	Days to last harvest	132	165.66	150.57	92.80	92.29	6.39	6.38	99.42	19.73	13.10
11	Fruit length (cm)	5.02	18.42	11.93	11.96	11.69	28.98	28.65	97.69	6.96	58.33
12	Fruit width (cm)	2.77	7.73	5.12	1.78	1.76	26.06	25.90	98.73	2.71	53.02
13	Average fruit weight (kg)	0.04	0.16	0.10	0.35	0.30	36.74	36.69	99.75	0.07	75.49
14	Fruit yield per plant (kg)	0.71	2.94	2.00	1.40	1.39	49.66	49.49	99.31	2.12	101.61
15	Ascorbic acid content (mg/100g)	3.27	9.52	6.29	2.06	2.03	22.79	22.66	98.91	2.92	46.44
16	Total phenol content (mg/100g)	22.36	72.58	46.84	202.02	184.33	30.34	28.98	91.24	26.71	57.03
17	Shoot and fruit borer infestation (%)	7.88	36.56	16.41	48.60	45.95	42.46	41.28	94.54	13.57	82.70
18	Cumulative wilt incidence (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	Little leaf incidence (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

In general, the values of PCV were higher than the values of GCV indicating that the apparent variation is not only due to genotypes but also due to influence of environment. Hence selection for the improvement of such characters will not be rewarding but the differences between PCV and GCV values were minimum, indicating that the traits under study were less influenced by environment.

The values of heritability in broad sense for the characters studied were high (>60%), indicating that though the characters were least influenced by the environmental effects, the selection for the improvement of such characters may not be effective. The results agree with the findings of Lokesh *et al.*, (2013). But heritability coupled with genetic advance as per cent of mean were more useful than heritability alone in predicting the resultant effect for selecting the best individual as explained by Johnson *et al.*, (1955). In the present investigation, high heritability coupled with high genetic advance occurred for days to 50% flowering,

number of flower clusters per plant, number of flowers per cluster, number of fruits per cluster, number of fruits per plant, days to last harvest, fruit length, fruit width, average fruit weight, fruit yield per plant, total phenol content, shoot and fruit borer infestation indicating that these characters are governed by additive genes and selection will be rewarding for the improvement of such traits. This result agrees with the findings of Shekar *et al.,* (2012), Kumar *et al.,* (2012), Arunkumar *et al.,* (2013), Lokesh *et al.,* (2013), Ramesh Kumar and Arumugam (2013), Gavade and Ghadage (2015).

High heritability accompanied with low genetic advance was noticed for ascorbic acid content indicating the role of non-additive gene action and selection for such traits may not be rewarding.

Burton (1952) stated that GCV together with high heritability and genetic advance would give the best picture on the extent of advance expected from selection. The genetic architecture of fruit yield is based on the balance, or overall net effect, produced by the interaction of yield components.

High estimates of PCV and GCV and high estimates of heritability coupled with high estimates of genetic advance for days to 50% flowering, number of flower clusters per plant, number of flowers per cluster, number of fruits per cluster, number of fruits per plant, days to last harvest, fruit length, fruit width, average fruit weight, fruit yield per plant, total phenol content, shoot and fruit borer infestation indicated that the variability available for these traits in the germplasm was high and selection for these traits may be effective. The promising accessions identified in this study could be used for prebreeding and other brinjal crop improvement programmes.

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