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Evaluation of brinjal genotype under hot arid agro-climate

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ABSTRACT

The present investigation was carried out under hot arid agro-climatic conditions to study the genetic variability, heritability, expected genetic advance and character association for nine traits in brinjal. The experimental material comprised of 20 genotypes of brinjal. The genotypes V18, V14 and V3 were superior based on mean for fruit yield per plant. Wider variability was observed for plant height, number of primary branches per plant, leaf length, leaf width, fruit length, fruit width, number of fruits per plant, average fruit weight and fruit yield per plant. PCV was in general higher than the GCV and the highest genotypic coefficient of variation was recorded for fruit yield per plant followed by average fruit weight and number of fruits per plant. All these characters also recorded high heritability and genetic advance which indicates participation of additive genetic variance. Correlation coefficient analysis revealed that fruit length, fruit width, number of fruits per plant and average fruit weight had the significant positive correlation with fruit yield per plant. Hence selection will be effective for these traits.

Key words: *Solanum melongena*, correlation, multivariate analysis, genetic variability.

INTRODUCTION

Brinjal botanically known as *Solanum melongena* L. is one of the most popular and major vegetable crops grown in South Asia and other parts of the world. It is being grown extensively in India, Bangladesh, Pakistan, China, Philippines, France, Italy and USA. It is also termed as poor man's vegetable due to its highest production potential and availability of the produce to consumers (Kumar *et al.*, 2). It belongs to the family Solanaceae and has the chromosome number 2n=24. In India, brinjal is grown in an area of 0.72 million hectares with the production of 12.32 million metric tonnes and the productivity of 19.1 tonnes per hectare (NHB, 8). India has wide range of variability as it originated in India. Further, the crop exhibits rich genetic diversity and scope for improvement for various horticultural traits. Many of the round varieties of brinjal set fruits at slightly lower temperature, but are highly susceptible to frost. It is also considered to be the drought susceptible crop. Genotypic differences in tolerance to moisture stress have been noticed (Chen *et al.*, 1). The long-fruited varieties set fruit at higher temperature and show tolerance to frost. It can be successfully grown both in rainy and summer seasons. Local cultivars of brinjal have low average yields due to various biotic and especially abiotic stresses under hot arid condition. There is a need to evaluate new genotypes of brinjal to identify superior genotypes having high yield potential and tolerant to various biotic and abiotic stresses.

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Genetic variability and character association are pre-requisite for improvement of any crop for the selection of superior genotypes and improvement of any traits. It is very difficult to judge whether observed variability is heritable or due to environment alone. Knowledge of heritability is essential for selection based improvement as it indicates the extent of transmissibility of a character in future generations. Knowledge of correlation between yield and its contributing characters are basic and for most endeavor to find out guide lines for plant selection. Among the quantitative characters, yield is a complex character, which is dependent on a number of yield contributing characters. The knowledge of the association of yield components and their relative contribution shown by path analysis has practical significance in selection. The study of the association between pairs of characters and yield provides basis for further breeding programme (Verma *et al.*, 15) Assessment of variability present in the crop can help in developing suitable varieties for yield and stability Therefore, the present studies were aimed at to study the variability and correlation analysis among various genotypes of brinjal.

MATERIALS AND METHODS

A field experiment was conducted under hot arid agro -climatic conditions of ICAR-Central Institute for Arid Horticulture, Bikaner, Rajasthan situated at 28°north latitude and 73°18' E longitude at an altitude of 235 m above mean sea level. The agro-climate of location of study is characterized by low and erratic

rainfall (150-350 mm), extremes of temperatures (-4°C-48°C), high solar radiation, high wind spread (12-16 km/h) with several dusty days and also prolonged summer duration. Besides, the soil is sandy and having poor fertility and water holding capacity. Twenty germplasm were assessed in randomized block design during July, 2016 and 2017. Row to row and plant to plant distance was kept 75 cm and 60 cm, respectively along with three replications. The observations were recorded on five plants selected per replication for each genotype on nine quantitative characters. The recorded characters were plant height (cm), No. of primary branches, leaf length (cm), leaf width (cm), fruit length (cm), fruit width (cm), No. of fruits/ plant, fruit weight (g), average fruit yield/plant (g). The data of both the seasons were compiled, pooled and analyzed adopting standard statistical procedures using computer based SPAR-II (IASRI, New Delhi) package.

RESULTS AND DISCUSSION

The analysis of variance revealed significant differences between genotypes indicating presence of sufficient amount of variability in all the characters studied. These results are similar with the findings of Mishra (5), Patel *et al.* (9), Reshmika (11), Madhavi *et al.* (4) and Singh and Singh (12). The results of analysis of variance for nine characters are furnished in Table 1. Mean performance (Pooled data during 2016-17) of twenty genotypes of brinjal for various growth and yield parameters are presented in Table 2. Plant height ranged from 25.75 to 45.92 cm with a grand mean of 33.83cm. Maximum plant height was recorded in V20 (45.92 cm), whereas minimum plant height (25.75 cm) in V5 among all genotypes. Nine genotypes were significantly taller than the grand mean. The mean values for number of primary branches per plant ranged from 3.64 to 8.75 with a grand mean of 6.24. Among the genotypes, maximum number of primary branches was recorded in V14 (8.75), while minimum number was recorded in V7 (3.64). Eight genotypes exhibited significantly higher number of primary branches per plant compared to total mean. The character leaf length exhibited a range of 5.49 to 8.60 cm with a grand mean of 6.95 cm. Among the genotypes, V4 had the highest leaf length (8.60 cm) while the lowest was recorded in V7 (5.49 cm). Nine genotypes recorded significantly higher leaf length when compared to grand mean. The character leaf width exhibited a range of 3.50 to 5.33 cm with a grand mean of 4.16 cm. Among the genotypes, V13 had the highest leaf width (5.33 cm) while the lowest was recorded in V20 (3.50 cm). Seven genotypes recorded significantly higher leaf width when compared to grand mean. Number of fruits per plant ranged from 5.57 to 16.67 with a grand mean of 9.05. The maximum number of fruits per plant (16.67) was recorded in V5 and the minimum number of fruits per plant was recorded in V2 (5.57). Seven genotypes recorded significantly more number of fruits per plant compared to total mean. The mean weight of fruits ranged from 45.49 to 201.20 g with a total mean of 120.85 g. The genotype V18 recorded maximum fruits weight (201.20 g) and the minimum weight of fruits was recorded in V2 (45.49 g). Total ten genotypes recorded significantly higher fruits weight when compared to grand mean. Length of the fruits ranged from 11.73 to 25.55 cm with a grand mean of 16.67 cm. The maximum length of fruits (25.55 cm) was recorded in V5 while the minimum length of fruits was recorded in V11 (11.73 cm). Seven genotypes produced significantly lengthy fruits when compared to grand mean. The width of the fruits ranged from 3.91 to 9.11 cm with a total mean of 5.79 cm. The

Table 1. Analysis of variance for quantitative traits in twenty genotypes of brinjal

S. No.	Character	Mean sum of squares		
		Replications (df = 2)	Treatments (df = 19)	Error (df = 38)
1.	Plant height (cm)	0.9300	69.91**	1.48
2.	Number of primary branches per plant	0.0085	5.051**	0.063
3.	Leaf length (cm)	0.0050	2.131**	0.072
4.	Leaf width (cm)	0.0755	1.01**	0.019
5.	Fruit length (cm)	0.2130	52.64**	0.388
6.	Fruit width (cm)	0.0030	5.639**	0.042
7.	Number of fruits per plant	0.5980	32.251**	0.113
8.	Average fruit weight (g)	11.6140	8,337.95**	4.04
9.	Fruit yield per plant (g)	33689.360*	11,51,459.09**	63745.06

*, ** = significant at 5% and 1% levels of significance respectively

Table 2. Mean performance of twenty genotypes of brinjal for growth and yield parameters (Pooled data during 2016-17).

Character / Genotype	Plant height (cm)	No. of Primary branches	Leaf length (cm)	Leaf width (cm)	Fruit length (cm)	Fruit width (cm)	No. of fruits per plant	Average fruit weight (g)	Fruit yield per plant (g)
V1	35.40	6.18	6.74	3.68	17.64	4.48	13.28	88.98	1088.17
V2	31.27	4.87	7.11	3.54	16.10	5.13	5.57	45.49	255.32
V3	35.51	5.41	7.26	5.10	25.55	6.91	13.91	150.26	2094.50
V4	37.54	5.70	8.60	3.59	14.26	6.14	6.29	195.41	1176.89
V5	25.75	5.59	6.11	3.64	16.19	4.75	16.67	81.20	1324.86
V6	33.23	5.48	8.24	5.15	22.32	6.58	7.32	152.56	1108.30
V7	40.34	3.64	5.49	3.67	17.75	7.77	13.43	161.90	1489.91
V8	35.56	7.05	7.75	4.44	24.84	5.58	8.16	161.22	1297.43
V9	31.46	7.23	6.30	4.54	21.33	9.11	7.22	141.16	1000.44
V10	39.59	7.10	6.67	4.60	14.88	4.74	7.36	128.23	939.80
V11	37.59	7.20	6.57	3.91	11.73	3.91	8.32	61.11	491.79
V12	29.06	5.94	6.40	3.76	11.87	4.90	6.19	61.57	379.55
V13	31.47	5.62	7.67	5.33	12.22	5.26	9.06	63.70	555.81
V14	31.45	8.75	6.19	4.15	17.59	4.66	11.38	194.76	2188.14
V15	29.19	6.06	6.84	4.10	15.36	5.58	7.24	81.27	619.77
V16	34.81	7.29	7.15	4.34	19.28	5.22	8.43	109.80	899.12
V17	32.90	7.37	6.64	4.63	12.83	5.77	6.42	62.05	390.62
V18	27.33	4.38	5.65	3.56	13.51	8.59	12.67	201.20	2455.32
V19	31.11	5.56	8.10	3.96	15.56	5.39	5.91	189.34	1204.04
V20	45.92	8.47	7.45	3.50	13.63	5.38	6.21	85.86	526.51
Grand Mean	33.83	6.24	6.95	4.16	16.67	5.79	9.05	120.85	1074.31
SEm±	0.702	0.145	0.155	0.080	0.360	0.118	0.194	1.160	145.768
CV (%)	3.546	4.029	3.853	3.338	3.736	3.540	3.716	1.663	23.501
CD (P=0.05)	2.018	0.417	0.444	0.230	1.034	0.340	0.558	3.335	418.983

genotype V9 recorded maximum fruit width (2.08 cm) and the minimum fruit width was recorded in V11 (1.52 cm). Six genotypes recorded significantly more fruit width when compared to grand mean. The fruit yield per plant ranged from 255.32 to 2455.32 g with a grand mean of 1074.31 g. The genotype V18 recorded the maximum marketable fruit yield per plant (2455.32 g) and the minimum fruit yield was recorded in V2 (255.32 g). Ten genotypes recorded significantly more fruit yield per plant when compared to total mean.

Wide range of variability was observed for plant height, number of primary branches per plant, leaf length, leaf width, fruit length, fruit width, number of fruits per plant, fruit weight and fruit yield per plant indicating the scope for selection of suitable initial breeding material for further improvement. Out of twenty genotypes, V18 recorded the highest fruit yield per plant followed by V14 and V3 due to more number of fruits per plant. Other attributes like average fruit weight, fruit length and width were also higher in these genotypes. Hence, these can be selected for further improvement to release as a variety. The lowest fruit yield per plant was recorded in the genotype V2. Among the other genotypes, V5, V3 and V7 produced significantly more number of fruits per plant. V3 recorded significantly lengthy fruits, V9, V18 and V7 higher fruit width, V18, V4 and V14 higher number of fruits per plant and V18, V4 and V14 had higher average fruit weight. Hence, these genotypes can be used as donor parents for the respective characters. The existing variability can be used to further enhance the yield level of brinjal cultivars by following appropriate breeding strategies and diverse genotypes can be utilized for hybridization programme (Reshmika, 11).

Estimates of variability, heritability and genetic advance are presented in Table 3. Among the characters studied, high PCV and GCV were observed for characters like number of primary branches per plant, fruit length, fruit width, number of fruits per plant, fruit weight and fruit yield per plant indicating high variability available in the germplasm for these characters for further improvement. Close relationship between GCV and PCV was found in all the characters and PCV values that were slightly greater than GCV and revealed a very little influence of environment for their expression. This was in confirmation with the results reported by Mishra (5), Patel *et al.* (9). Moderate GCV was observed for plant height, leaf length and leaf width whereas, none of the character recorded low GCV.

High heritability was observed for all the characters indicated that these characters were least influenced by the environmental effects and these characters are suitable for selection. High genetic advance as per cent of mean was observed for all the characters. High heritability coupled with high genetic advance as per cent of mean was observed for all the characters indicated that these characters were least influenced by the environmental effects and these characters are suitable for selection. Hence, simple selection based on phenotypic characters will be rewarding for improvement of such traits Tripathi *et al.* (14), Reshmika, (11), Madhavi *et al.* (4) and Singh and Singh (12).

Hence, based on the foregoing discussion, it may be concluded that genotypes V18, V14, V3 and V7 are superior based on mean for fruit yield per plant. Wider variability was observed for number of primary branches per plant, fruit length, fruit width, number of fruits per plant, fruit weight and fruit yield per plant. All these characters also recorded high heritability and genetic advance. Hence selection will be effective for these traits.

Yield, being a complex character is governed by a large number of factors. The influence of each character on yield could be known through correlation studies with a view to determine the extent and nature of relationships prevailing among yield and yield attributing characters. The present investigation was carried out to study the association of different characters on yield and yield attributing traits in brinjal (Table 4).

Plant height recorded non-significant positive correlation with number of branches per plant, leaf length, fruit length and average fruit weight, whereas non-significant negative correlation with leaf width, fruit width, number of fruits per plant and fruit yield per plant. Number of branches per plant showed negative significant correlation with fruit width and number of fruits per plant. Leaf length recorded negative significant correlation with number of fruits per plant, whereas positive significant correlation with leaf width.

Leaf width had positive significant association with fruit length. Other attributes like fruit length had significant positive association with fruit width, average fruit weight and fruit yield per plant. Fruit width was found to be positively associated with average fruit weight and fruit yield per plant. Similar result has been reported by Mishra (5). Number of fruits per plant showed positive significant correlation with fruit yield per plant. Similar observation was obtained by Nalini *et al.* (7), Muniappan *et al.* (6) and Shinde *et al.* (13). Average fruit weight recorded positive significant correlation with fruit yield per plant. Marketable fruit yield per plant exhibited highly significant positive association with fruit length, fruit width, number of

Table 3. Estimates of variability, heritability and genetic advance as per cent of mean for nine characters in 20 genotypes of brinjal.

S. No.	Characters	Mean	Variance		PCV (%)	GCV (%)	h^2 (%)	GA as per cent of mean
			Phenotypic	Genotypic				
1.	Plant height (cm)	33.825	24.2883	22.8083	14.5701	14.1192	93.9065	28.1854
2.	Number of primary branches per plant	6.2436	1.7257	1.6627	21.0399	20.8523	96.3492	41.7598
3.	Leaf length cm	6.946	0.7583	0.6863	12.5370	11.9270	90.5055	23.3742
4.	Leaf width cm	4.1595	0.3493	0.3303	14.2095	13.8177	94.5611	27.6795
5.	Fruit length cm	16.6733	17.8063	17.4183	25.3085	25.0312	97.8210	50.9994
6.	Fruit width cm	5.7923	1.9077	1.8657	23.8452	23.5812	97.7984	48.0396
7.	Number of fruits per plant	9.05133	10.8257	10.7127	36.3509	36.1607	98.9562	74.1012
8.	Fruit weight (g)	120.8531	2782.0110	2777.9710	43.6437	43.5120	99.8548	89.7755
9.	Fruit yield per plant (g)	1074.314	426316.402	362571.3427	60.7764	56.0487	85.0475	106.4789

Table 4. Correlation analysis in brinjal.

Character	PH	NBB	LL	LW	FL	FW	NFPP	AFW	PYPP
PH	1.000								
NBB	0.294	1.000							
LL	0.225	0.089	1.000						
LW	-0.046	0.132	0.314	1.000					
FL	0.122	-0.114	0.176	0.401	1.000				
FW	-0.089	-0.398	-0.212	0.117	0.410	1.000			
NFPP	-0.197	-0.313	-0.521*	-0.078	0.237	0.130	1.000		
AFW	0.044	-0.130	0.111	0.011	0.393	0.501*	0.181	1.000	
PYPP	-0.159	-0.199	-0.249	0.009	0.392	0.443*	0.656**	0.807**	1.000

*Significant at 0.05% and **significant at 0.01% level of significance, if correlation r = >0.443 and 0.561, respectively

fruits per plant and average fruit weight. These results are in consonance with the findings of Patel *et al.* (9), Praneetha (10) and Kushwah and Bandhyopadhya (3). On the basis of association analysis studies, it can be concluded that the selection criteria based on fruit length, fruit width, fruit yield per plant, number of fruits per plantand average fruit weight can provide better result for improvement of fruit yield in brinjal (Mishra, 5).

Path coefficient splits the interrelationship between two characters into direct and indirect effects (Table 5). Among all the traits under study, number of fruits per plant and average fruit weight exhibited high positive direct effect on fruit yield per plant. Present results indicate the importance of these traits in selection for marketable fruit yield per plant. Fruit width exhibited high positive indirect effect on fruit yield through average fruit weight. Direct selection based on these traits would result in simultaneous improvement of aforesaid traits and yield in brinjal. Thus, the number of fruits per plant and average fruit weight seems to have predominant effect on marketable fruit yield per plant. Negligible to low direct negative effect on fruit yield per plant was found with plant, leaf length and fruit length. Similar results were also noted by Praneetha (10) and Muniappan *et al.* (6) for plant height and Kumar *et al.* (2) for fruit length. Therefore, indirect selection practiced on these characters will result in the improvement of respective characters and ultimately fruit yield.

CONCLUSION

Hence, based on the findings of present study, it may be concluded that genotypes V18, V14 and V3 are superior based on mean performance for fruit yield per plant under hot arid conditions. There is a need to evaluate these high yielding genotypes in large plots and over locations under hot arid conditions of western Rajasthan for their commercial utilization. The characters which recorded high heritability coupled with high genetic advance as per cent of mean indicated that these characters were least influenced by the environmental effects and these characters are suitable for selection. Hence, simple selection based on phenotypic characters

Table 5. Direct and indirect effects of various yield and yield attributes in brinjal.

Character	PH	NBB	LL	LW	FL	FW	NFPP	AFW
PH	**-0.100**	0.026	-0.014	-0.002	-0.006	-0.001	-0.098	0.032
NBB	-0.029	**0.088**	-0.006	0.006	0.001	-0.008	-0.156	-0.095
LL	-0.023	0.008	**-0.063**	0.014	-0.001	-0.004	-0.261	0.081
LW	0.005	0.012	-0.020	**0.044**	-0.002	0.002	-0.039	0.008
FL	-0.012	-0.010	-0.011	0.017	**-0.006**	0.007	0.118	0.287
FW	0.009	-0.035	0.013	0.005	-0.002	**0.019**	0.065	0.367
NFPP	0.020	-0.028	0.033	-0.003	-0.001	0.003	**0.500**	0.132
AFW	-0.004	-0.012	-0.007	0.000	-0.002	0.010	0.091	**0.731**

Residual effect = 0.061; Diagonal (under lined) values indicate direct effects
PH = Plant height (cm), NBB = No. of Primary branches, LL = Leaf length (cm), LW = Leaf width (cm), FL = Fruit length (cm), FW = Fruit width (cm), NFPP = No. of fruits per plant, AFW = Average fruit weight (g) and FYPP = Fruit yield per plant (g)

will be rewarding for improvement of such traits. From the correlation and path coefficient analysis, it can be concluded that fruit width, number of fruits per plant and average fruit weight had the significant positive correlation with fruit yield per plant as well as high positive direct effect on fruit yield per plant suggested that the direct selection for these traits would be effective for the yield improvement in brinjal and emphasis must be given on such traits while exercising selection. These were identified as superior yield components and the genotypes which exhibited better performance for these characters can be used in further improvement of brinjal.

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