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CORRELATION, PATH ANALYSIS AND GENETIC DIVERGENCE IN BRINJAL (*SOLANUM MELONGENA* L.)

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Abstract

The experiment was conducted at College of Horticulture and Research Institute, Dr. YSRHU, Venkataramannagudem, Andhra Pradesh to evaluate yield and its component characters of thirty one brinjal genotypes during Krarif season. Fruit yield per plant showed positive and significant association with number of leaves per plant, number of fruits per plant, average fruit weight and total number of harvests at phenotypic and genotypic correlation levels, and thus these characters were identified as component characters on which selection can be relied upon for genetic improvement of brinjal. The path analysis revealed that number of fruits per plant and average fruit weight had high direct effect on fruit yield per plant, while the remaining characters had high negligible to low indirect effect through other component characters. Therefore, number of fruits per plant and average fruit weight are the reliable characters for the improvement of brinjal. All the thirty one genotypes of brinjal were grouped in to six clusters using Ward's method by adopting Mahalanobis D^2 (1936) analysis concept. The maximum contribution towards total genetic divergence was from average fruit length. Intra cluster distance was maximum between cluster I and V. Intra cluster distance was maximum between III and V. Therefore, genotypes in I, IV, III and V with high *per se* performance could be utilized in different breeding programmes.

Key words : Brinjal (*Solanum melongena* L.), vegetable crop, path analysis, genetic divergence.

Introduction

Brinjal (*Solanum melongena* L.) is an important and popular vegetable crop of India. There is an increasing demand of its varieties for different culinary purposes. For any breeding programme improvement in yield is possible only through selection for the desired component characters and this crop exhibits rich genetic diversity for various horticultural traits and has great scope for its improvement. Thus, the knowledge of association between yield and its component characters as well as their direct and indirect contribution towards yield and also information regarding nature and magnitude of genetic distance among the genotypes is necessary in choosing diverse parental combinations for maximum heterosis. The multivariate analysis using Mahalanobis D^2-Statistics, which measures the forces of differentiation at Intra- cluster and Inter-cluster level, is a valuable tool in obtaining quantitative estimates of divergence. Therefore, the present investigation was carried out to study the correlation coefficient, path analysis and genetic divergence in 31genotypes of brinjal.

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Materials and Methods

The experiment was conducted at College of Horticulture and Research Institute, Venkataramannagudem, Andhra Pradesh Horticultural University, during the *Kharif* season of the year 2010 with thirty one brinjal genotypes. Experiment was laid out in randomized block design (RBD) with three replications. Seedlings were transplanted at a spacing of 75 cm between rows and 60 cm between the plants. All the recommended cultural practices were followed under irrigated condition. The observations were recorded on five randomly selected plants per replication for each genotype on fourteen important characters. The phenotypic and genotypic correlations coefficients between difference variables were calculated by using covariance technique (Al-Jibouri *et al*., 1958). The direct

Table 1 : Estimates of variability, heritability and genetic advance as per cent of mean for fourteen characters in 31 germplasm accessions of brinjal.

S. no.	Character	Mean ±S.E	Range		Variance		PCV (%)	GCV (%)	Heritability (%)	Genetic advance	Genetic advance as per cent of mean (%)
			Minimum	Maximum	Phenotypic	Genotypic					
1	Days to 1st flowering	49.78	39.73	56.93	22.05	21.44	9.43	9.30	97	9.41	18.90
2	Days to 1st Picking	69.49	57.00	76.93	24.82	23.98	7.17	7.05	97	9.91	14.27
3	Plant Height (cm)	98.96	80.44	118.15	110.71	56.68	10.63	7.61	51	11.10	11.21
4	Number of branches/ plant	14.58	8.40	17.20	4.35	3.53	14.31	12.88	81	3.48	23.88
5	Number of leaves/ plant	201.74	114.66	322.33	2535.74	2101.23	24.96	22.72	83	85.96	42.61
6	Leaf area index	5.02	3.14	7.39	2.10	2.05	28.85	28.49	98	2.91	57.95
7	Number of fruits/ plant	17.76	11.00	30.33	25.56	22.88	28.47	26.93	89	9.32	52.48
8	Average fruit length (cm)	9.03	5.80	13.83	4.43	4.39	23.32	23.19	99	4.29	47.50
9	Average fruit diameter (cm)	3.80	2.13	6.61	0.92	0.90	25.27	24.92	97	1.92	50.62
10	Average fruit weight (g)	56.62	44.63	70.19	76.72	18.58	15.47	7.61	24	4.37	7.72
11	Total number of harvests	13.25	10.06	15.93	2.59	2.49	12.14	11.91	96	3.19	24.07
12	Fruit yield/ plant (kg)	0.99	0.59	1.54	0.07	0.06	27.06	24.66	83	0.46	46.29
13	Fruit yield/ plot (kg)	15.89	9.46	24.69	18.51	15.37	27.07	24.67	83	7.36	46.31
14	Fruit yield/ ha (tones)	22.11	13.14	34.30	35.83	29.62	27.08	24.62	83	10.19	46.10

and indirect contributions of various characters to yield was calculated through path coefficient analysis as supported wright (1921) and elaborated by Dewey and Lu (1959). The data collected on different characters were analyzed using Mahalanobis D^2-Analysis (1936) to determine the genetic divergence among the genotypes.

Results and Discussion

Phenotypic and genotypic correlation coefficient between yield and its component character and presented in the table 1. In general, genotypic correlation was higher than phenotypic correlation, indicating less environmental influence on the characters under study.

Fruit yield per plant was positively and significantly associated with number of leaves per plant, number of fruits per plant, average fruit weight and total number of harvests at both genotypic and phenotypic correlation levels. The results are in consonance with the findings of Bansal and Mehta (2008). Plant height showed positive and significant association with leaf area index and average fruit diameter. These findings are similar to earlier results of Gogoi and Gautam (2003) and Ajjappalavara *et al*. (2005).

Plant height showed negative and significant association with number of leaves per plant, number of fruits per plant, average fruit length, average fruit weight and fruit yield per plant. These results are similar with findings of Jansirani (2000). Number of branches per plant recorded positive and significant association with number of leaves per plant, number of fruits per plant and average fruit length and total number of harvests. The findings are similar with the earlier results by Sherly (2006) and Prabhu and Natarajan (2008).

Number of branches per plant recorded negative and significant association with leaf area index and average fruit diameter. As number of branches performs differently in a region and also with genotype to genotype which results in negative relation with leaf area index and average fruit diameter.

Number of leaves per plant showed positive and significant association with number of fruits per plant, total number of harvests and fruit yield per plant. As the number of leaves increases which results in more number of branches thereby more vegetative growth results in increased number of flowers per plant finally more number of fruits per plant thereby increased total number of harvests with final out put increased

Table 2 : Phenotypic (P) and genotypic (G) path coefficient analysis indicating direct and indirect effects of components characters on fruit yield in thirty one genotypes of brinjal.

Character		Days to 1st flowering	Days to 1st picking	Plant height (cm)	Number of branches/ plant	Number of leaves/ plant	Leaf area index	Number of fruits/ plant	Average fruit length (cm)	Average fruit diameter (cm)	Average fruit weight (g)	Total number of harvests
Days to 1st flowering	P	-0.2274	-0.2188	-0.0150	-0.0675	0.0239	-0.0166	0.0091	-0.0567	0.0595	0.0007	-0.0375
	G	0.2262	0.2195	0.0147	0.0748	-0.0234	0.0165	-0.0080	0.0581	-0.0618	-0.0012	0.0400
Days to 1st picking	P	0.2001	0.2079	0.0149	0.0671	-0.0107	0.0054	0.0073	0.0532	-0.0504	0.0171	0.0425
	G	-0.1982	-0.2043	-0.0180	-0.0723	0.0091	-0.0043	-0.0079	-0.0538	0.0522	-0.0346	-0.0438
Plant height (cm)	P	-0.0027	-0.0029	-0.0401	0.0057	0.0107	-0.0138	0.0054	0.0057	-0.0094	0.0038	0.0024
	G	0.0095	0.0130	0.1467	-0.0218	-0.0612	0.0679	-0.0298	-0.0306	0.0494	-0.0780	-0.0129
Number of branches/plant	P	-0.0052	-0.0057	0.0025	-0.0176	-0.0066	0.0058	-0.0032	-0.0044	0.0051	-0.0017	-0.0034
	G	-0.0700	-0.0749	0.0314	-0.2117	-0.1050	0.0791	-0.0464	-0.0598	0.0695	-0.0129	-0.0478
Number of leaves/plant	P	0.0008	0.0004	0.0020	-0.0028	-0.0075	0.0008	-0.0037	-0.0005	0.0004	-0.0004	-0.0026
	G	-0.0107	-0.0046	-0.0434	0.0516	0.1040	-0.0115	0.0586	0.0079	-0.0067	0.0145	0.0397
Leaf area index	P	0.0028	0.0010	0.0133	-0.0128	-0.0039	0.0387	0.0025	-0.0084	0.0046	-0.0091	0.0017
	G	-0.0073	-0.0021	-0.0464	0.0375	0.0111	-0.1002	-0.0073	0.0220	-0.0122	0.0533	-0.0050
Number of fruits/plant	P	-0.0298	0.0262	-0.1013	0.1344	0.3684	0.0487	0.7479	-0.0752	0.1149	-0.0088	0.4734
	G	-0.0341	0.0372	-0.1964	0.2119	0.5442	0.0705	0.9658	-0.1116	0.1600	0.1231	0.6410
Average fruit length (cm)	P	0.0157	0.0161	-0.0090	0.0157	0.0045	-0.0137	-0.0063	0.0630	-0.0365	0.0138	0.0019
	G	0.0081	0.0083	-0.0066	0.0089	0.0024	-0.0069	-0.0036	0.0315	-0.0186	0.0138	0.0009
Average fruit diameter (cm)	P	-0.0191	-0.0177	0.0171	-0.0212	-0.0042	0.0086	0.0112	-0.0423	0.0731	-0.0042	-0.0077
	G	0.0180	0.0169	-0.0222	0.0217	0.0042	-0.0081	-0.0109	0.0390	-0.0661	0.0109	0.0073
Average fruit weight (g)	P	-0.0012	0.0319	-0.0370	0.0372	0.0205	-0.0911	-0.0046	0.0850	-0.0225	0.3890	0.0170
	G	-0.0015	0.0467	-0.1467	0.0168	0.0384	-0.1467	0.0352	0.1210	-0.0454	0.2761	0.0303
Total number of harvests	P	0.0216	0.0268	-0.0077	0.0257	0.0448	0.0059	0.0830	0.0039	-0.0137	0.0057	0.1312
	G	0.0056	0.0068	-0.0028	0.0072	0.0121	0.0016	0.0211	0.0009	-0.0035	0.0035	0.0318
Fruit yield/ Plant (kg)	P	-0.0444	0.0652	-0.1604	0.1640	0.4400	-0.0212	0.8487	0.0233	0.1251	0.4059	0.6188
	G	-0.0542	0.0624	-0.2897	0.1244	0.5360	-0.0421	0.9667	0.0246	0.1168	0.3685	0.6815

Residual effect =0.3041

Table 3 : Clustering of 31 brinjal genotypes by Ward's method.

Cluster	No. of genotypes	Genotypes
I	4	IC-090915, IC-374912, IC-127024, IC-111404
II	6	IC-298633, IC-354612, IC-090806, IC-136245, IC-13601,IC-111074
III	4	IC-427025, IC-090942, DBT-171, IC-354564
IV	7	IC-111443, IC-345309, AR/04-477, IC-136088,IC-111444, IC-90767, MR/04-02
V	3	IC-111439, IC-090093, IC-111431
VI	7	IC-089986, GULABI, IC-285140, IC-332508, IC-427007, EC-384565, IC-111387

Table 4 : The nearest and farthest clusters from each cluster based on D^2 values in brinjal germplasm

Cluster no	Nearest cluster with D^2 values	Farthest cluster with D^2 values
I	640.906	1599.517
II	342..626	694.564
III	342.626	959.265
IV	354.980	821.676
V	542.589	1599.517
VI	516.907	1594.974

Table 5 : The nearest and farthest clusters from each cluster based on D^2 values in brinjal germplasm.

Cluster	I	II	III	IV	V	VI
I	**333.276**	640.909	667.294	688.396	1599.517	1594.974
II		**197.547**	342.626	354.980	694.564	516.907
III			**240.268**	395.258	959.265	892.979
IV				**195.830**	542.589	821.676
V					**279.969**	558.127
VI						**304.041**

fruit yield per plant.

Leaf area index was negative and significant association with average fruit length and average fruit weight. Increased LAI increases the source to sink ratio, which increases the more number of fruits per plant with result of slightly less average fruit length and average fruit weight.

Days to first flowering showed positive and significant association with number of branches per plant and average fruit length. Similar results were reported earlier by Ananthalakshmi (2001) and Pathania *et al*. (2002).

Days to first picking showed positive and significant association with number of branches per plant, average fruit length and total number of harvests. As number of branches per plant increases, days to first flowering is early and also as average fruit length reaches to commercial harvest shape results positive and significant association of days to first picking.

Days to first picking showed negative and significant association with average fruit diameter. As fruit length increases results in decreased fruit diameter thereby the days to first picking recorded negative with average fruit diameter.

Number of fruits per plant showed positive and significant association with total number of harvests and fruit yield per plant. These results are in consonance with the findings of Patel and Sarnaik (2004), Sherly (2006) and Jadhao *et al*. (2009).

Average fruit length showed positive and significant association with average fruit weight. The result is similar with Jerard (1996). Average fruit weight recorded positive and significant association with fruit yield per plant. These results are in consonance with the findings of earlier workers (Dharwad *et al*., 2009 and Nalini *et al*., 2009). Therefore, selection for these characters can do favour in the selection of plants with high yield by putting pressure on these characters in selection procedure.

Average fruit length showed negative and significant association with average fruit diameter. The results are similar with Dipendra gogi and Gautham (2003) and Hari

Table 6 : Mean values of clusters for fourteen characters in 31 germplasm accessions of brinjal (Wards method).

Cluster	Days to 1st flowering	Days to 1st picking	Plant height (cm)	Number of branches /plant	Number of leaves/ plant	Leaf area index	Number of fruits/ plant	Average fruit length (cm)	Average fruit diameter (cm)	Average fruit weight (g)	Total number of harvests	Fruit yield/ plant (kg)	Fruit yield/ plot (kg)	Fruit Yield/ ha (tones)
1	41.63	60.46	100.16	12.00	177.91	5.30	16.51	6.57	4.98	53.41	12.35	0.91	14.66	20.36
2	49.27	69.33	100.07	15.51	208.16	4.16	16.533	8.97	4.13	56.56	12.62	0.92	14.71	20.61
3	50.83	70.16	92.10	15.90	233.25	4.26	21.06	6.75	3.77	56.35	14.15	1.10	17.60	24.45
4	51.78	72.20	105.12	13.79	196.42	6.66	18.52	8.23	4.21	57.03	13.68	1.04	16.74	23.25
5	52.48	70.84	100.99	15.28	195.33	6.82	21.55	11.30	2.91	50.40	14.24	1.07	17.26	23.98
6	51.11	71.11	94.18	15.00	199.90	3.61	15.23	11.61	2.81	60.92	12.92	0.94	15.18	21.09

et al. (2005).

The correlation and path coefficients in combination can give a better insight into cause and effect relationship between different pairs of characters and are presented in the table 2.

Total number of harvests showed positive and significant association with fruit yield per plant. The results are similar with findings of Daliya and Wilson (2002) and Kushwah and Bandhyopadhya (2005). The character number of fruits per plant registered high positive and direct effect on fruit yield per plant. This result is similar with the findings of Bansal and Mehta (2008) and Singh *et al*. (2010).

Average fruit weight exhibited high positive and direct effect on fruit yield per plant. These results are in consonance with the findings of Patel and Sarnaik (2004), Nair *et al*. (2007) and Bansal and Mehta (2008).

The high direct effect of these traits appeared to be the main factor for their strong association with fruit yield per plant. Hence, direct selection for these traits would be effective in greatly improving the fruit yield per plant.

Total number of harvests exerted high positive and direct effect on fruit yield per plant. As total number of harvests increases obviously increases the number of fruits per plant thereby high positive direct effect on yield. Days to first picking recorded moderate positive and direct effect on fruit yield per plant. The result is similar with the finding of Jadhao *et al*. (2009).

Days to first flowering recorded moderate negative and direct effect on fruit yield per plant. The result is similar with the finding of Ajjappalavara *et al*. (2005). Days to first flowering resulted positive and direct effect on earliness of the fruit production but had negative and direct on the fruit yield. Hence these characters may be given due weightage while practising the selection for high yield in brinjal.

Plant height, number of branches per plant and number of leaves per plant had negligible and negative direct effect on fruit yield per plant and negligible and indirect effect through other characters.

Leaf area index, average fruit length and average fruit diameter had negligible positive and direct effect on fruit yield per plant and negligible indirect effect through other characters on fruit yield per plant. Hence, it would be little rewarding to select these characters for improvement of yield in brinjal.

D^2 statistic has been found as an important tool in estimating the genetic divergence in plant breeding experiments and is presented in the tables 3, 4, 5 and 6. Highest contribution to diversity was from average fruit length, followed by leaf area index, days to first flowering, average fruit diameter and total number of harvests.

The maximum intra cluster distance was observed between cluster I and IV and also the inter cluster distance was maximum between cluster III and V indicating the wider genetic diversity and also this might be due to limited gene exchange or selection practices among the genotypes for diverse characters. Selection of parents from clusters I, III, IV and V for hybridization programme would help in achieving

novel recombinants.

The intra cluster distance was minimum between cluster I and VI, cluster II and IV, cluster III and V and also the inter cluster distance was minimum between cluster II, III and IV; indicating the close relationship and similarity for most of the characters of the genotypes. Days to first flowering recorded minimum mean value in cluster I, followed by days to first picking, number of branches per plant, number of leaves per plant, average fruit length, total number of harvests, fruit yield per plant, fruit yield per plot and yield per hectare. Days to first flowering recorded maximum mean value in cluster V, followed by leaf area index, number of fruits per plant and total number of harvests. Cluster IV recorded maximum mean value for days to first picking and plant height. Cluster III recorded maximum mean value for number of branches per plant followed by number of leaves per plant, fruit yield per plant, fruit yield per plot and yield per hectare. Cluster III recorded minimum mean value for plant height.

Cluster VI recorded maximum mean value for average fruit length and average fruit weight. Cluster VI recorded minimum mean value for average fruit diameter and average fruit weight.

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