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GENETIC DIVERGENCE ANALYSIS IN EGGPLANT *(Solanum melongena* L.)

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Abstract

Genetic divergence among 19 eggplant genotypes was estimated using Mahalanobis's D^2 statistic. Altogether five clusters were formed. Cluster I contained the highest number of genotypes (7) and cluster IV and V contained the lowest (2). The pattern of distribution of genotypes from different geographical locations into five clusters was random, demonstrating that geographical isolation may not be the only factor causing genetic diversity. The highest intra-cluster distance was observed for cluster V (1.067) and the lowest for cluster III (0.916). The highest inter-cluster distance was observed between cluster IV and V (10.748). Cluster V recorded the highest mean for plant height at last harvest (cm), leaf blade length (cm), leaf blade diameter (cm), leaf pedicel length (cm), fruit pedicel length (cm), prickle on calyx. Whereas, number of branches per plant, fruit diametre (cm), individual fruit weight (g), fruit yield (t/ha) and prickle on fruit pedicel were in cluster II with the highest means. Therefore, more emphasis should be given on cluster V for selecting genotypes as parents for crossing with the genotypes of cluster II which may produce new recombinants with desired traits.

Key Words: Genetic diversity, eggplant *(Solanum melongena* L.) and cluster analysis.

Introduction

Information on genetic divergence among the available germplasm is vital to a plant breeder for an efficient choice of parents for hybridization. It is an established fact that genetically diverse parents are likely to contribute desirable segregants. It was also observed that the more diverse the parents, greater are the chances of obtaining high heterotic F_1s and broad spectrum of variability in the segregating generation (Arunachalam, 1981). Improvement in yield and quality is normally achieved by selecting genotypes with desirable character combinations existing in the nature or by hybridization. Selection of parents identified on the basis of divergence analysis would be more promising for a hybridization programme. Some related results have been reported in eggplant by Kumar *et al.* (2000), Singh and Gapalakrishnan (1999), Chaudhary and Pathania (1998) and Tambe *et al*. (1993). These studies did not cover any Bangladeshi cultivars/ genotypes and were carried out in a different agro climate. Masud *et al.* (1995)

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reported in pumpkin, Alam *et al.* (2006) reported in hull- less barley and Habib *et al.* (2007) reported in rice in Bangladesh condition, while these did not cover the eggplant oriented. Haque *et al.* (2002) reported with 32 eggplant genotypes in Bangladesh condition, while maximum genotypes were exotic. That is why, in Bangladesh context, information on the selection of local eggplant genotypes on the basis of diversity is inadequate. Therefore, the present investigation was undertaken to estimate the nature and magnitude of genetic diversity in some local eggplant genotypes in Bangladesh condition. This type of study would be useful for breeding eggplant varieties in the country.

Materials and Method

The experiment was conducted at the Olericulture Division of Horticulture Research Centre, Bangladesh Agricultural Research Institute (BARI) during the winter season of 2005-06 with 19 genotypes of eggplant representing samples from different locations. The seeds of these germplasm were sown on the seedbed on 25 September 2005. Thirty-five days old seedlings were transplanted in the main field on 30 October 2005. The experiment was laid out in a randomized complete block design with three replications. The unit plot size was 7.5x 0.70m and 10 plants were accommodated in a plot with a plant spacing of 75cm maintaining a row distance of 70cm. Data were recorded from five randomly selected plants from each plot for days to 50% flowering, days to harvest, plant height at last harvest (cm), number of branches per plant, fruit length (cm), fruit diametre (cm), number of fruits per plant, individual fruit weight (g), fruit yield (t/ha), infestation by eggplant fruit and shoot borer (EFSB) (%), leaf blade length (cm), leaf blade diametre (cm), leaf pedicel length (cm), fruit pedicel length (cm), prickle on fruit pedicel and prickle on calyx. Plot means over the replications were used for the statistical analysis. Genetic diversity was studied following Mahalanobis's (1936) generalized distance (D^2) extended by Rao (1952). Based on the D^2 values, the genotypes were grouped into clusters following the method suggested by Tocher (Rao, 1952). Intra and inter cluster distances were calculated by the methods of Singh and Chaudhury (1985). Statistical analyses were carried out using Genstat 5 software.

Results and Discussion

The analysis of variance showed significant differences among the 19 genotypes for all the 16 characters under study indicating the presence of notable genetic variability among the genotypes. The principal component analysis (PCA) showed that the two components (vector Z_1 and vector Z_2) accounted for 89.94% of the total variation.

Nineteen genotypes were grouped into 5 clusters on the basis of cluster analysis. Maximum 7 entries were grouped into cluster I, followed by 4 in cluster II and III. Cluster IV and V composed of only 2 of each (Table 1).

Table 1. Distribution of 19 genotypes of eggplant in different clusters.

Clusters	Number of genotypes	Genotypes	Fruit characteristics	Place of collection
I	7	BLO4-0l (1)	Long fruit with deep purple colour	Jessore (Bangladesh)
		BLO9S (2)	Long fruit with green, mottle colour	Jessore (Bangladesh)
		BLIO2 (4)	Long fruit with purple colour	Jessore (Bangladesh)
		BLS3 (9)	Oval fruit with purple colour	India
		Bombai 02 (15)	Long fruit with purple colour	Comilla (Bangladesh)
		BL Comilla (16)	Long fruit with purple colour	Comilla (Bangladesh)
		Mixture (17)	Long fruit with light green colour	Gazipur (Bangladesh)
II	4	BLI 53(V) (6)	Round fruit with deep purple colour	India
		BLIS3(W) (7)	Round fruit with very light green colour	India
		BLSI 8 (11)	Oval fruit with purple colour	India
		Islampuri (BADC) (19)	Oval fruit with purple green colour	Mymensingh (Bangladesh)
III	4	8L097 (3)	Long fruit with green, mottle colour	Jessore (Bangladesh)
		BLI 13 (5)	Long fruit with purple green, mottle colour	Joydebpur (Bangladesh)
		EG195 (8)	Oval fruit with light green colour	Tiwan
		BLS4 (10)	Long fruit with black purple colour	India
IV	2	Tha 01(12)	Long fruit with deep green, mottle colour	Thakurgaon (Bangladesh)
		Tha 02 (13)	Oval fruit with deep green, mottle colour	Thakurgaon (Bangladesh)
V	2	Bombai 01(14)	Long fruit with light purple colour	Comilla (Bangladesh)
		New Selection (18)	Long fruit with black purple colour	India

The maximum inter-cluster distances were recorded between the cluster IV and V (10.748) followed by the distance between I and II (10.378) (Table 2). As the genetic variation is very distinct among the groups, genotypes from these four clusters if used in hybridization, may produce a wide spectrum of segregating population. The lowest inter cluster distance was observed between cluster I and III (5.531) followed by I and V (5.757) suggesting a close relationship among these three clusters. However, the intra-cluster divergence varied from 0.916 to 1.067, maximum being from cluster V that comprised of two genotypes of diverse origin, while the minimum distance was observed in cluster III that comprised of four genotypes.

Table 2. Mean intra- (bold) and inter- cluster distances (D^2) for the 19 eggplant genotypes obtained on the basis of the 16 morphological characters.

Clusters	I	II	III	IV	V
I	0.934	10.378	5.531	9.342	5.757
II		0.977	8.144	6.935	10.362
III			0.916	8.069	7.650
IV				0.979	10.748
V					1.067

Differences were observed in cluster means for almost all the 16 characters in the 19 genotypes studied (Table 3). Cluster I composed of seven genotypes and showed maximum mean value for fruit length (19.86cm) and the second highest mean values for days to 50% flowering (89.14), plant height at last harvest (69.86cm), number of fruits per plant (19.71), infestation by EFSB (12.24 %) and leaf pedicel length (4.2 cm).

Cluster II constituted of four genotypes and produced highest mean for number of branches per plant (7.25), fruit diametre (7.15cm), individual fruit weight (170g), fruit yield (35.74 t/ha) and prickle on fruit pedicel (1.55).

Cluster III also had four genotype and this cluster scored highest mean for number of fruits per plant (26.00) and infestation by EFSB (13.13 %) and produced the lowest means for days to 50% flowering (78.00) and days to 1st harvest (117.00) which are desirable traits for earliness.

Cluster IV composed of only two genotypes and this cluster had highest mean values for days to 50% flowering (91.50), days to 1st harvest (127.00) and second highest mean values for fruit diametre (5.65cm), individual fruit weight (160g), Yield (29.87 t/ha), leaf blade length (16.00cm), leaf blade diametre (10cm), fruit pedicel length (6.50cm), prickle on fruit pedicel (1.50) and prickle on calyx (2.00).

Cluster V constituted of two genotypes and produced highest mean for plant height at last harvest (84.50cm), leaf blade length (17.00cm), leaf blade diametre (11.00cm), leaf pedicel length (5.50cm), fruit pedicel length (6.55cm) and prickle on calyx *(2.05)* and second highest mean values for days to 1st harvest (124.50), number of branches per plant (7.00) and fruit length (18.00cm). However, this cluster produced the lowest means for infestation by EFSB (7.95%), which is a desirable horticultural trait.

Table 3. Class mean values of 16 characters in 19 genotypes of eggplant.

Characters	Clusters				
	I	II	III	IV	V
Days to 50% flowering	89.14	82.25	78.00	91.50	87.50
Days to harvest	123.57	122.00	117.00	127.00	124.50
Plant height at last harvest (cm)	69.86	67.75	60.00	56.00	84.50
Number of branches per plant	6.29	7.25	5.50	5.00	7.00
Fruit length (cm)	19.86	9.00	13.75	15.50	18.00
Fruit diametre (cm)	2.59	7.15	3.40	5.65	3.65
Number of fruits per plant	19.71	16.25	26.00	14.00	18.50
Individual fruit weight (g)	60	170	70	160	90
Fruit yield (t/ha)	16.11	35.74	23.96	29.87	22.40
Infestation by EFSB (%)	12.24	9.00	13.13	11.05	7.95
Leaf blade length (cm)	14.14	13.75	13.25	16.00	17.00
Leaf blade diametre (cm)	9.00	8.50	8.75	10.00	11.00
Leaf pedicel length (cm)	4.29	4.25	3.25	4.00	5.50
Fruit pedicel length (cm)	6.29	6.00	5.50	6.50	6.55
Prickle on fruit pedicel	1.29	1.55	1.25	1.50	1.00
Prickle on calyx	1.71	1.75	1.95	2.00	2.05

Based on principal component axes I and II, a two-dimensional scattered plotting diagram (Z_1 and Z_2) reflecting the position of genotypes are presented in Fig. 1. It was revealed that from the diagram, there were mainly five clusters. Most distantly located genotypes in cluster were IV (Tha 01, Tha 02) and V (Bombai 01 and New Selection). Distribution pattern of genotypes in the scattered diagram also revealed that considerable variability exist in the germplasm studied.

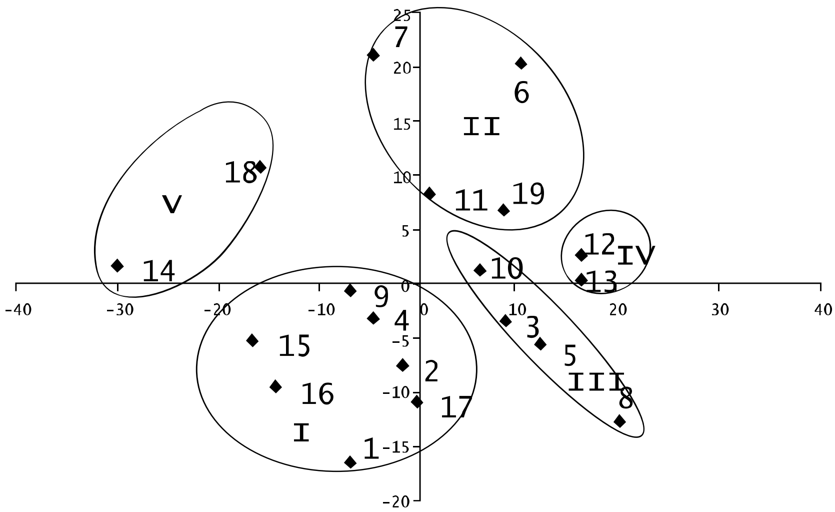

Fig. 1. Scatter distribution of 19 eggplant genotypes on principal component score superimposed with clustering.

Contribution of characters towards divergence of the genotypes is presented in Table 4. The results of the PCA revealed that in vector Z_1, the important characters responsible for genetic divergence in the major axis of differentiations were number of fruits per plant (0.3367), infestation by EFSB (0.2631), prickle on pedicel (0.0375) and prickle on calyx (0.07 18). In vector Z_2, plant height at last harvest (0.0219), number of branches (0.3101), fruit diametre (0.4518), individual fruit weight (0.3890), fruit yield (0.4443) and leaf pedicel length (0.0636) played a major role, while rest of the characters in this second axis of differentiations might not have played any major role. The role of fruit yield in both the vectors was found to be more important towards genetic divergence. Updhya and Murty (1970) stated that genetic difference and natural selection in different environments can cause high diversity among the races than geographic location alone. While Haque *et al.* (2002) stated that no relationship was observed between genetic divergence and geographic distribution of the genotypes. Alam *et al.* (2006) reported that days to heading, 1000-grain weight, yield per plant were the major contributors towards divergence in hull-less barley. Masud *et al.* (1995) found that number of fruits per plant and yield per plant was one of the important contributors to genetic divergence in pumpkin. Moreover Habib *et al.* (2007) in rice reported same result for grains per panicle, grain length and harvest index. Hence, these characters could offer a scope for genetic improvement and deserve to be included as selection criteria in eggplant.

Table 4. Latent vectors for 16 principal component characters of 19 genotypes in eggplant.

Characters	Vector (Z_1)	Vector (Z_2)
Days to 50% flowering	-0.3200	-0.1655
Days to 1 harvest	-0.2857	-0.0642
Plant height at last harvest (cm)	-0.2866	0.0219
Number of branches per plant	-0.1099	0.3101
Fruit length (cm)	-0.1891	-0.3822
Fruit diametre (cm)	-0.0131	0.45 18
Number of fruits/plant	0.3367	-0.0835
Individual fruit weight (kg)	-0.1113	0.3 890
Fruit yield (t/ha)	0.0282	0.4443
Infestation by EFSB (%)	0.2631	-0.1825
Leaf blade length (cm)	-0.3447	-0.0657
Leaf blade diametre (cm)	-0.2965	-0.0298
Leaf pedicel length (cm)	-0.3224	0.0636
Fruit pedicel length (cm)	-0.2454	-0.1664
Prickle on fruit pedicel	0.0375	-0.03 17
Prickle on calyx	0.0718	-0.1204

The clustering pattern of the genotypes revealed that the genotypes collected from the same places did not form a single cluster. On the other hand, genotypes originating from different geographical locations formed a single cluster indicating there was no clear relationship between the clustering pattern of the genotypes and their geographic sources. This findings fully agree with those of Murty and Arunachalam (1966), Sangha (1973), Dasgupta and Das *(*1985), Nadaf *et al*. (1986), Ramana and Singh (1987) and Golakia and Makne (1992). Lack of true relationship between geographic and genetic diversity was explained by Murty and Arunachalam (1966) and Updhyya and Murty (1970) who pointed out that genetic drift and natural selection in different environments can cause high diversity among the races than geographic isolation. It must be noted that in breeding programmes, geographic diversity alone should not be considered as an index of genetic diversity for selection of parents.

Generally crosses involving parents belonging to most divergent clusters are expected to give maximum heterosis and create wide variability in genetic architecture. However, for a practical plant breeder, the objective is not only obtaining high heterosis but also to achieve high level of production with the shortest possible time. In the present study, the maximum distances existed between cluster VI and cluster V. Considering group distance and other agronomic performance, the inter-genotypic crosses between the members of cluster V with that of cluster II would exhibit high heterosis and is also likely to produce new recombinants with desired traits. Therefore, more emphasis should be given on cluster II and V in selecting inbreds for crossing in eggplant hybridization programmes.

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