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Genetic divergence in tomato lines (*Solanum lycopersicum* L.)

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Abstract

Twenty genotypes of tomato were assessed for their genetic divergence using Mahalanobis D^2statistics. Based on D2 values of eleven yield related characters, genotypes were grouped in to five clusters. Maximum genotypes were grouped in cluster II (6) followed by cluster IV (5) the remaining 9 genotypes were distributed in three clusters, four in cluster III, three in cluster I and two genotypes in cluster V. Clustering pattern indicated that there was no association between geographical distribution of genotypes and genetic divergence. The mean intra and inter cluster distance (D) revealed that cluster I had highest intra cluster distance (0.979), while the inter cluster distance was maximum between cluster III and I (13.546) followed by III and V (11.218). The characters like plant height, fruit weight, fruits per plant contributed maximum to genetic divergence.

Keywords: Divergence, D^2 statistics, Tomato

Introduction

Genetic diversity is an important factor for heritable improvement in any crop and the knowledge of genetic diversity, its nature and degree of variability would be useful for selecting desirable parents from available germplasm for a successful breeding programme. Tomato (*Solanum lycopersicum* L.) is a popular vegetable crop grown in Bangladesh for its delicious fruits used in variety of different dishes. It has a wide range of variability which provides a tremendous scope for genetic improvement of economic traits (Khanna and Mishra, 1977 and Singh and Ramanujam, 1981). The present study is an attempt to obtain information on the genetic diversity present in 20 genotypes of tomato and assessing their utility in developing heterotic combinations for commercial purpose.

Materials and Methods

The present investigation was carried out Research and Development center, Energypac Agro Ltd., Gazipur. For diversity analysis there were used twenty genotypes. Experiment was laid down in randomized block design with three replications during Rabi season of 2012-13. Sowing was carried out in October in the nursery. Thirty days old seedlings were transplanted in the field in November with spacing of 40 cm between plant to plant and 60 cm between row to row. Necessary intercultural operation was carried out during cropping period for proper growth and development of the plants. Various morphological traits (days of 50% flowering, flower per cluster, fruits per cluster, fruits per plant, plant height, fruit weight, fruit length, fruit diameter, pericarp thickness, locule number per fruit and fruit yield per plant were recorded. The means of characteristics per accessions of three replicates were subjected to D^2 and canonical analyzes for genetic divergence (Mahalanobis 1936; Rao 1952).

Results and Discussion

On the basis of D^2 values, 20 genotypes were grouped in five clusters (Table 1). Cluster II had the highest number of six genotypes followed by 5 & 4 genotypes in cluster IV & III respectively. The remaining5 genotypes were distributed in two clusters, of which 3 in cluster I and two genotypes in cluster V. The grouping pattern of genotypes was observed to be random indicating that geographical diversity and genetic divergence were unrelated. Further, it was observed that genotypes belonging to the same origin not only appeared in the same cluster but many of them also distributed in different clusters, which may be due to preferential selection of Ideotype suitable for various vegetable purposes. Therefore, the selection of genotypes for hybridization should be based on genetic divergence rather than geographical diversity. Present results are also supported by the findings of Peter and Rai (1976), Rai *et al.,* (1998), Parthasarathy and Aswath (2002) and Joshi and Kohli (2003) in tomato.

Table 1. Grouping of 20 genotypes of tomato in clusters

Cluster	No. of Genotypes	Genotypes
I	3	TM 361, TM 403, TM 386
II	6	TM 368, TM 371, TM 384, TM 388, TM 360, TM 528
III	4	TM 390, TM 392, TM 419, TM 409
IV	5	TM 356, TM 382, TM 410, TM 422, TM 423
V	2	TM 377, TM 349

Inter and intra cluster D values among the five clusters are given in Table 2 and the nearest and farthest cluster from each cluster based on D^2 value is given in Table 3. Cluster I had maximum intra cluster distance (0.979) followed by cluster III (0.244).The intra cluster distances for cluster V was 00.00. Maximum inter cluster distance was between cluster III and I (13.546) followed by cluster V and III (11.218), cluster III and II (6.978). Inter cluster distance was observed maximum between cluster V and VI by Prasanth (2003). The cluster IV and II displayed the lowest degree of divergence (5.214) suggesting close genetic makeup of the strains included in the segroups. The clusters with single genotype indicated their independent identity and importance due to various unique characters possessed by them.

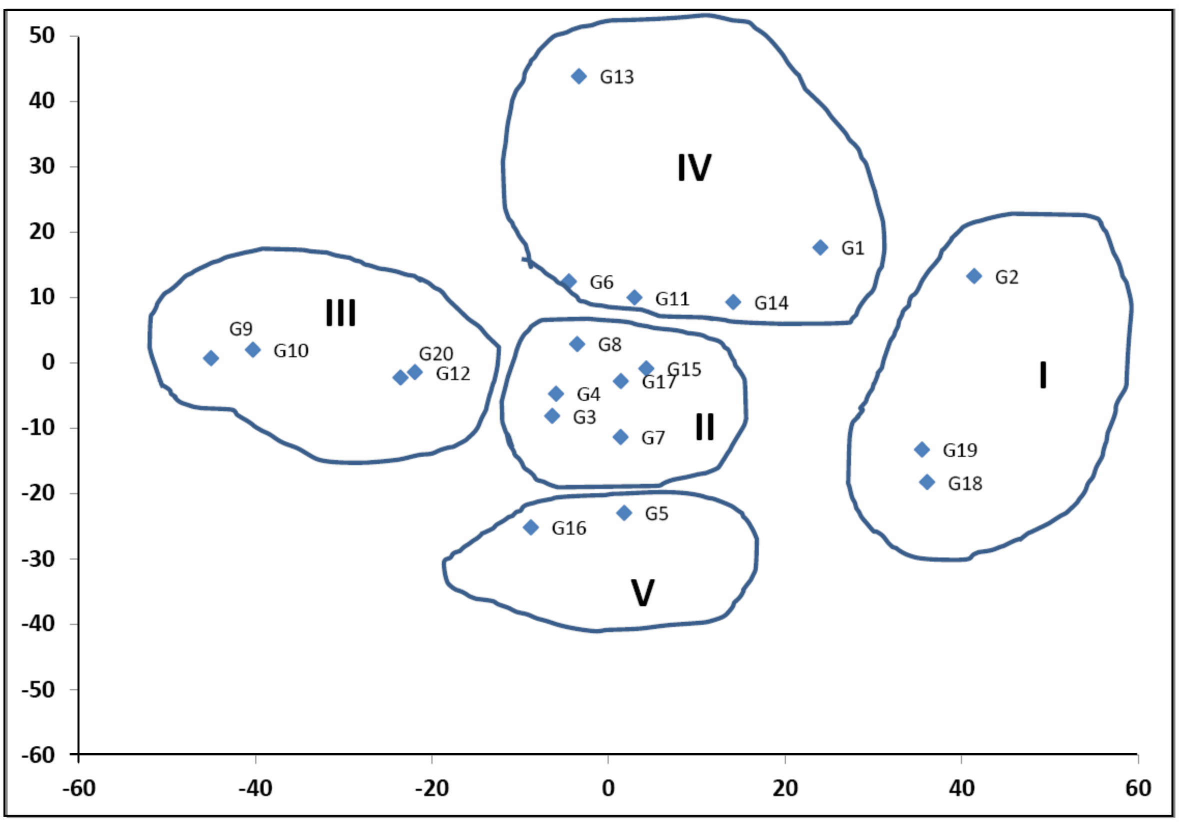

Fig 1. Cluster diagram of 20 genotypes of tomato by differentiating of five clusters

Table 2. Intra (bold) and inter cluster distance (D) values in 20 genotypes of tomato

Cluster	I	II	III	IV	V
I	**0.979**				
II	7.473	**0.089**			
III	13.546	6.978	**0.244**		
IV	8.045	5.214	9.605	**0.147**	
V	7.291	6.346	11.218	9.676	**0.000**

Table 3. the nearest and farthest clusters from each cluster between D^2 values in mustard

Cluster	Nearest Cluster with D^2 values	Farthest Cluster with D^2 values
I	V (7.291)	III (13.546)
II	IV (5.214)	I (7.473)
III	II (6.978)	I (13.546)
IV	II (5.214)	V (9.676)
V	II (6.346)	III (11.218)

On analyzing cluster means for different characters (Table 4), it was observed that cluster III, which included genotypes (TM 390, TM 392, TM 419 and TM 409) recorded the highest mean value for fruit weight (107.33 g), fruit length (5.94 cm), fruit diameter (5.94 cm) and fruit yield (3.44 Kg per plant) and the lowest days to 50% flowering (57.92). In contrast, cluster V, which consisted of genotypes (TM 377 and TM 349) recorded minimum mean value for plant height (64.5 cm), locule number per fruit (2.16) and fruit yield (2.62 Kg per plant). Cluster IV recorded maximum plant height (107.33 cm) and locule number per fruit (3.73). On the other hand cluster I recorded the maximum mean value for number of fruits per plant (55.67) and days to 50% flowering (61.56), minimum fruit weight (47.42 g), fruit diameter (4.33 cm), pericarp thickness (6.64 mm) while cluster II recorded early flowering with maximum fruit per cluster. Inter crossing the genotypes from these clusters may result in wide array of variability for exercising effective selection for these traits (Singh and Singh 1976).

Percent character contribution towards total divergence among the tomato genotypes was maximum from days to 50% flowering (33.15), followed by flower per cluster (20.66), fruit per cluster (12.4), fruit per plant (11.13) (Table 4).These results were almost in accordance with the studies of Khanna and Misra (1977), Bhattacharya (1979), Singh and Singh (1980) and Prasanth (2003).De *et al.* (1988) proposed that traits contributing maximum towards the D^2 values need to be given great emphasis for deciding onthe cluster to be chosen for the purpose of further selection and choice of parents for hybridization.

Table 4. Cluster means of yield contributing characters towards divergence in 20 genotypes of tomato

Cluster	Characters										
	Days to 50% flowering	Flower per cluster	Fruit per cluster	Fruit per plant	Plant height (cm)	Fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Pericarp thickness (mm)	Locule number per fruit	Fruit yield per plant (Kg)
I	61.56	6.13	4.41	55.67	99.22	47.42	5.28	4.33	6.64	2.22	2.83
II	59.5	6.52	5	41.78	83.44	80.63	5.42	5.68	7.61	3.22	3.43
III	57.92	5.57	4.56	31.08	73	108.36	5.94	5.94	7.03	3.67	3.44
IV	60.73	5.52	3.96	36.4	107.33	82.03	5.12	5.93	6.97	3.73	3.04
V	61.17	5.73	4.24	36.33	64.5	71.62	5.52	5.16	8.45	2.16	2.62
Percent contribution towards divergence	33.15	20.66	12.4	11.13	7.7	5.96	4.11	3.23	1.17	0.47	0.02

Contribution of characters towards the divergence obtained from canonical variates analysis is presented in Table 5. In vector (Z_1), the important characters responsible for genetic divergence in the axis of differentiation were fruit yield per plant (3.083), fruit per cluster (2.608), locule number per fruit (2.205), fruit length (1.183) and fruit weight 90.082).

Table 5. Relative contributions of the twelve characters of 20 genotypes to the total divergence

Principal Component	Characters										
	Days to 50% flowering	Flower per cluster	Fruit per cluster	Fruit per plant	Plant height (cm)	Fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Pericarp thickness (mm)	Locule number per fruit	Fruit yield per plant (Kg)
Vector-1	-0.252	-1.133	2.608	-0.324	0.002	0.082	1.183	-4.408	-0.269	2.205	3.083
Vector-2	0.222	4.295	-4.034	0.604	0.084	0.27	-0.304	7.503	-1.654	-1.444	-7.935

Intra cluster distance being much lesser than inter cluster ones, suggested homogenous and heterogeneous nature of the strain within and between the clusters, respectively.

In vector 2 (Z_2), the second axis of differentiation fruit diameter (7.503), flower per cluster (4.295), fruit per plant (0.604), fruit weight (0.27) and days to 50% flowering (0.222)were important because all these characters had positive signs. Plant height and fruit weight had positive signs in both the vectors, which indicated they were the important component characters having higher contribution to the genetic divergence among the materials studied.

Genotype belonging to same place were distributed among different clusters, thus ruling put the association between geographical distribution and genetic divergence. Since crosses among divergent parents are likely to yield desirable recombinants, a breeding programme would be worthwhile to be initiated between the selected genotypes belonging to clusters III and I, III and II, III and IV and III and V.

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