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Genetic Diversity Studies in Tomato (*Solanum lycopersicon* L.)

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A B S T R A C T

Fifty three genotypes of tomato were assessed for their genetic divergence using Mahalanobis D^2 statistics. Based on D^2 values of 24 traits genotypes were grouped into eight clusters. Maximum genotypes were grouped in cluster III (11) followed by cluster VI (10) the remaining 32 genotypes were distributed in six clusters, 9 in cluster V, 7 in cluster II, 6 in cluster IV, 4 in cluster I, 3 in cluster VI and 3 in cluster VIII. The mean intra and inter cluster distance (D) revealed that cluster VI highest intra cluster distance (50.975), While the inter cluster distance was maximum between cluster III and cluster VII (106.999) followed by cluster III and cluster VI (80.266). The characters like tritratable acidity, fruit pericarp thickness, pH contributed maximum to genetic divergence.

Introduction

Tomato (2n=24) is an important crop in the world belongs to the family Solanaceae which ranks next to potato in importance. Genetic variability is essential for first step of plant breeding for crop improvement which is immediately available from germplasm, its nature and degree of variability would be useful for selecting desirable parents from available germplasm for a successful breeding programme. Despite its wide cultivation and high yield potential the average yield is very low due to non-availability of improved varieties or hybrids in tomato. Development of promising hybrids depends largely on selection of desirable inbred lines. Diversity in parents is a pre-requisite in the development of variety or hybrid. Systematic study and evaluation of germplasm is of great importance for current and future genetic improvement of the crop. Furthermore, evaluation of germplasm is imperative, in order to understand the genetic background and breeding value of the available germplasm. Success of crop improvement programme depends on the extent of variability, choice of parents for hybridization and selection procedure. In plant breeding genetic diversity plays a very important role as it helps in selecting the suitable parents for hybridization programme resulting in superior hybrids and desirable recombinants (Rathi *et al.*, 2011). The present study is an attempt to

obtain information on the genetic diversity present in 53 genotypes of tomato and assessing their utility in developing heterotic combinations for commercial purpose.

Materials and Methods

The present investigation was carried out Vegetable Research Centre, GBPUAT, and Pantnagar. Experiment was laid down in Augmented Block Design II along with 50 genotypes and 3 clusters. During 2016-2017 and 2017-18 thirty days old seeding were transplanted in the field with spacing of 50cm between plant to plant and 50 cm between row to row. Necessary inter cultural operation was carried out during cropping period for proper growth and development of the plants. Various morphological traits (Primary branches per plant, Secondary branches per plant, Internodal length (cm), Fruit locules, Fruit length (cm), Fruit diameter (cm), Fruit pericarp thickness (mm), Days taken to first flowering, Days to first picking, Node number at first flowering, Plant height at first flowering (cm), Plant height at first picking (cm), Flower clusters per plant, Flowers per cluster, Fruit set (%), Leaf area (cm^2), Fruit weight (g), Fruit volume (cm^3), Specific gravity of fruit (g/cm^3), Fruits per plant, pH, Tritratable acidity (%),TSS (˚Brix), Fruit yield per plant (g).Average of 2 years mean data were subjected to D^2 analysis for analysis for genetic divergence (Mahalanobis 1936 and Rao 1952).

Results and Discussion

Mahalanobis D^2 statistics helped in grouping of 53 genotypes of tomato into eight clusters (Table 1) cluster I had four genotypes, cluster II has seven genotypes, cluster III had eleven genotypes, cluster IV had six genotypes, cluster V had nine genotypes, Cluster VI had three genotypes, cluster VII had ten genotypes and cluster VII had three genotypes. Cluster VI had maximum intra cluster distance (50.975), followed by cluster IV (40.876), and cluster I (40.115). Cluster VII had minimum intra cluster distance (0.000). Maximum inter cluster distance was between cluster III and cluster VII (106.999) followed by cluster III and VI (80.266) and cluster V and cluster VII average inter and intra cluster distances revealed that in general, inter cluster distances were much higher than those of intracluster distances, suggesting homogeneous and heterogeneous nature of the genotypes within and between the clusters, respectively (Table 2). These results are in accordance with the finding of Mahalanobis *et al.,* (2006), Sekhar *et al.,* (2008) and Reddy *et al.,* (2013) in tomato. The per cent contribution of 24 characters for genetic divergence Table 3 showed that tritratable acidity (33.74%) was maximum and followed by fruit pericarp thickness (18.87%) and pH (12.12%). De *et al.,* (1988) reported that traits contributing maximum towards the D^2 value needed to be given more emphasis for deciding the clusters to be taken for the purpose of choice of parents for hybridization. The cluster mean analysis (Table 4) results had been interpreted for all the 24 characters. In case primary branches per plant, Cluster I had maximum number of primary branches per plant (7.546) whereas, highest number of secondary branches per plant was grouped in cluster V (35.665). Maximum internodal length (8.628 cm) was observed in cluster VI and maximum number of fruit locules (5.984) was grouped in cluster VII. Cluster VIII had maximum fruits length (8.210 cm), fruit diameter (16.024 cm), node number of first flowering (5.859), flower cluster per plant (13.320), fruit set perc ent (70.841%), leaf area (24.426 cm^2) and tritratable acidity (5.161%). Maximum fruit pericarp thickness (5.98 mm) and pH (4.984) were classified in cluster V whereas, minimum days taken to first flowering (27.996) and first picking (46.812) was grouped in cluster VIII.

Table.1 Clustering pattern of 53 genotypes of tomato on the basis of genetic divergence

Clusters	Number of genotypes in cluster	Genotypes included
I	4	EC519769, EC519793, EC519261, EC519823
II	7	EC 519713, EC 519770, EC519821, EC519972, PT-42, HYB-1, HYB-4
III	11	Pant bahar, EC 519818, PT-2009-08, PT-2009-10, PT-19, PT-11, Shirozi, Sweet-72 , Pant-T-3, Arka Vikas, Roma
IV	6	EC-519778, PT-8, Pant Selection-3, Selection-03-05, EC-519712, Pant-Selection-1
V	9	EC-519811, S-108, ARTH-3, Big oval -2009, Pant Selection-4, S-816-3, Selection-06-01, S-816, CLN-1154R
VI	3	S-186, CLN-2237A, CLN-2070R
VII	10	EC-519748, EC-519789, EC-519772, EC-519758, EC-519814, EC-519802, PT-7, PT-41, CLN-2127B, CLN-2123E
VIII	3	H-86, H-816, AC-05-06

Table.2 The average inter and intra cluster D2 values for eight clusters in 53 genotypes of tomato (Tocher's method)

	Cluster I	Cluster II	Cluster III	Cluster IV	Cluster V	Cluster VI	Cluster VII	Cluster VIII
Cluster I	**40.115**	39.534	59.241	56.638	57.159	56.746	59.800	52.516
Cluster II		**26.684**	36.184	39.343	51.571	56.555	64.866	40.805
Cluster III			**0.000**	46.680	53.873	80.266	106.999	47.181
Cluster IV				**40.876**	52.812	64.792	67.995	47.103
Cluster V					**26.304**	40.470	66.457	40.245
Cluster VI						**50.975**	36.550	34.839
Cluster VII							**0.000**	46.415
Cluster VIII								**28.410**

Table.3 The percent contribution of 24 characters for genetic divergence in tomato

Source	Contribution	Times Ranked 1st
Primary branches per plant	0.01	0.000
Secondary branches per plant	0.01	0.000
Internodal length (cm)	0.01	0.000
Fruit locules	0.01	0.000
Fruit length (cm)	0.01	0.000
Fruit diameter (cm)	0.01	0.000
Fruit pericarp thickness (mm)	18.87	260.000
Days taken to first flowering	1.67	23.000
Days to first picking	0.36	5.000
Node number at first flowering	0.01	0.000
Plant height at 1st flowering (cm)	0.01	0.000
Plant height at 1st picking (cm)	0.58	8.000
Flower clusters per plant	0.22	3.000
Flowers per cluster	1.23	17.000
Fruit set (%)	1.38	19.000
Leaf area (cm^2)	1.09	15.000
Fruit weight (g)	3.19	44.000
Fruit volume (cm^3)	4.79	66.000
Specific gravity of fruit (g/cm^3)	2.61	36.000
Fruits per plant	0.29	4.000
pH	6.75	93.000
Tritratable acidity (%)	12.12	167.000
TSS (˚Brix)	33.74	465.000
Fruit yield per plant (g)	11.10	153.000

Table.4 Cluster mean for different characters a many 53 genotypes of tomato

Characters	Clusters							
	I	II	III	IV	V	VI	VII	VIII
Primary branches per plant	7.546	6.089	7.070	6.385	7.074	6.755	6.757	6.963
Secondary branches per plant	35.663	31.812	34.065	31.253	35.665	31.116	32.794	34.274
Internodal length (cm)	6.982	6.812	7.228	6.684	5.898	8.628	6.743	7.531
Fruit locules	5.245	4.669	4.650	5.236	5.190	5.190	5.984	5.298
Fruit length (cm)	5.342	6.509	7.267	6.424	5.552	5.931	6.345	8.210
Fruit diameter (cm)	12.127	13.482	14.691	13.554	11.624	13.313	13.472	16.024
Fruit pericarp thickness (mm)	5.130	5.528	4.296	4.686	5.980	5.568	5.437	5.498
Days taken to first flowering	32.855	33.860	29.350	32.571	34.908	33.613	33.260	27.996
Days to first picking	53.589	52.172	48.739	51.420	55.501	52.133	52.762	46.872
Node number at first flowering	5.812	5.778	5.259	5.679	5.731	4.586	5.853	5.859
Plant height at first flowering (cm)	15.846	16.222	17.108	16.539	16.105	16.747	16.704	16.754
Plant height at first picking (cm)	38.849	38.139	39.293	38.492	37.524	39.322	39.277	37.938
Flower clusters per plant	10.552	11.917	12.242	11.718	10.176	10.236	11.417	13.320
Flowers per cluster	5.364	6.967	6.513	7.025	5.134	5.961	6.525	6.484
Fruit set (%)	43.598	59.919	63.162	65.586	45.798	52.152	59.195	70.481
Leaf area (cm^2)	19.803	22.266	22.036	23.294	18.951	17.319	21.686	24.426
Fruit weight (g)	64.880	66.495	78.864	70.633	65.056	72.175	71.881	76.490
Fruit volume (cm^3)	45.957	51.741	69.582	56.894	49.293	62.873	58.070	68.274
Specific gravity of fruit (g/cm^3)	1.185	1.239	1.318	1.390	1.233	1.115	1.299	1.281
Fruits per plant	70.646	71.575	66.173	66.793	70.103	73.582	71.082	64.826
pH	4.893	4.536	4.059	4.544	4.984	4.769	4.946	4.233
Tritratable acidity (%)	3.578	4.763	4.855	4.700	3.960	4.689	4.009	5.161
TSS (˚Brix)	8.589	8.953	8.143	7.803	8.559	9.009	8.192	8.974
Fruit yield per plant (g)	4636.529	4852.960	5099.112	4893.351	4581.685	5253.470	5096.451	4836.384

Maximum plant height at first flowering (17.108) and at first picking (39.322) was grouped in cluster III and cluster VII respectively. Maximum flower per cluster (7.025) and specific gravity of fruit (1.390 g/cm^3) were placed in cluster IV. Maximum fruit weight (70.864 g) and fruit value (69.582 cm^3) were classified in cluster III. Maximum number of fruits per plant (73.582) and fruit yield per plant (5253.470g) placed in cluster VI whereas highest TSS (9.009˚B) was in cluster VI. To improve for earliness and fruit weight hybridization between cluster VIII and cluster III is better in which genotypes with earliness are included. The highest inter cluster D^2 values were estimated between clusters indicating that there is enough scope for the improvement of tomato crop by hybridization and selection (Dar *et al.*, 2015).

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