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Genetic diversity studies in tomato (*Solanum lycopersicum* L.)

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Abstract: *A study was conducted using nineteen exotic collections of tomato. Genetic divergence analysis following Mahalanobis D^2 statistics revealed considerable genetic diversity among 19 genotypes of tomato (Solanum lycopersicum L.) for all the eighteen quantitative characters which was pertaining to the growth, earliness, yield and quality. Fruit weight, plant height and number of fruits per plant contributed 92.40% to the total divergence. Appreciable diversity within and between the clusters was observed. The characters fruit weight, number of fruits per plant and plant height were the potent factors in differentiating the germplasm of tomato under study. Five clusters were fanned from the D^2 analysis using Tocher's method. Cluster II topped with maximum number of genotypes among cluster fanned, while maximum inter-cluster distance was observed between cluster III and IV followed by cluster IV and V.*

Keywords: *Solanum lycopersicum L., clusters, D^2 analysis, Solanaceae, germplasm, diversity*

I. Introduction

Tomato (2n=24) belonging to the family Solanaceae is an important vegetable crop of the world, which ranks next to potato in importance. Systematic study and evaluation of germplasm is of great importance for current and future agronomic and genetic improvement of the crop. Furthermore, if an improvement program is to be carried out, evaluation of germplasm is imperative, in order to understand the genetic background and breeding value of the available germplasm (Singh *et al.,* 2002). Landraces are often heterogeneous and composed of different genotypes which are mostly homozygous and usually exhibit considerable genetic variation for quantitative and qualitative characteristics (Frankel *et al*., 1995).

Tomato crop has wider adaptability, high yielding potential and multipurpose uses in fresh as well as processed food industries. An improvement in yield and quality in self pollinated crops like tomato is normally achieved by selecting the genotypes with desirable character combinations existing in nature or by hybridization. Hence, present study was undertaken to assess the extent of genetic diversity in tomato.

II. Materials And Methods

Nineteen genotypes of tomato consisting of sixteen exotic collections and three varieties were evaluated in an augmented block design at National Bureau of Plant Genetic Resources (NBPGR) Regional Station, Hyderabad. The experiment laid out in eight blocks. In each block two genotypes of exotic collection and three varieties *i.e*., ArkaVikas, Marutham and Punjab Chhauhara which are used as checks are planted at a spacing of 60x50cm in a single row. Due to limited germplasm of each genotype the experiment is laid out of augmented block design. Observations recorded for eighteen characters viz., Plant height (cm), number of primary branches, days to 50% flowering, number of clusters per plant, number of flowers per clusters, days to first fruit set, days to first fruit harvest, days to last fruit harvest, number of fruits per clusters, number of fruits per plant, fruit length (cm), fruit width (cm), fruit weight, fruit yield per plant (kg), ascorbic acid (mg/100g), acidity (%), TSS (ºBrix) and shelf life (days). Mahalanobis (1936) generalized distance (D^2) was used to determine the degree of divergence and the genotype were grouped into clusters following Tocher's method (Rao, 1952).

III. Results And Discussion

Mahalanobis D^2 statistics helped in grouping of 19 genotypes of tomato into five clusters (Table I). Cluster I had three genotypes, cluster II had seven genotypes, cluster III had four genotypes, cluster IV had four genotypes and cluster V is solitary consisting of only one genotype. The inter and intra cluster distances (Table II) indicated that maximum inter cluster distance of 5689.99 was observed between the cluster III and IV followed by 5139.32 between cluster IV and V while the minimum cluster distance of 1917.70 was observed between clusters I and V followed by 2796.65 between cluster II and V. The maximum intra cluster distance of

2661.48 was observed in cluster IV followed by 2010.36 in cluster III, while the minimum intra-cluster distance of zero was observed in the cluster V as it is solitary.

The percent contribution of eighteen characters for genetic divergence (Table III) showed that fruit weight contributed maximum (39.77%) towards genetic divergence followed by plant height (30.99%) and number of fruits per plant (21.64%). Mohanty and Prusti (2001) also observed such maximum contribution of fruit weight and number of fruits per plant to total divergence of tomato germplasm. De *et al*. (1988) opined that traits contributing maximum towards the D^2 values needed to be given more emphasis for deciding the clusters to be taken for the purpose of choice of parents for hybridization.

The results of Mahalanobis D^2 statistics revealed substantial and desirable genetic diversity among 19 germplasm lines included in the present study for all the eighteen characters under consideration collectively.

Several authors also reported profound diversity in the germplasm of tomato by assessing genetic divergence on the basis of quantitative traits following Mahalanobis D^2 statistics (Basavaraj *et al.,* 2010 and Evgenidis *et al.*, 2011). Average inter and intracluster distances revealed that, in general, intercluster distances were much higher than those of intracluster distances, suggesting homogeneous and heterogeneous nature of the germplasm lines within and between the clusters, respectively. These results are in accordance with the findings of Mahesha *et al.* (2006), Sekhar *et al.* (2008) in tomato.

The cluster mean analysis (Table IV) results had been interpreted for all the eighteen characters. In case of plant height, cluster IV had maximum plant height (131.33) followed by cluster II (92.74). In case of cluster mean values for number of primary branches per plant cluster IV had the highest number (22.56) followed by cluster III (16.19). Days to 50% flowering was minimum (38.33 days) in cluster V followed by cluster II (38.71 days). In case of number of clusters per plant cluster V had maximum clusters per plant (27.32) followed by cluster II (18.26).

For number of per cluster, cluster IV had maximum value (6.97) followed cluster II (6.34). Days to first fruit set was maximum in cluster V (40.92 days) followed by cluster II (43.63 days). Minimum days to first fruit harvest was observed in cluster II (82.69 days) followed by cluster V (82.83). In case of days to last fruit harvest, cluster I had maximum value (139.89 days) followed by cluster II (134.24 days), maximum number of fruits per cluster were observed in IV (40.20) followed by cluster II (4.60). In case of number of fruits per plant cluster III had the maximum value (66.23) followed by cluster II (50.90). Fruit length was maximum in cluster V (5.94cm) followed by cluster III (5.61cm). Fruit width was maximum in cluster III (3.99cm) followed by cluster IV (3.68cm). Maximum fruit weight was observed in cluster III (83.25gm) followed by cluster I (77.67g). In case of fruit yield per plant, cluster V had maximum value (2.09 kg $plant^{-1}$) followed by cluster III (1.51 kg/plant). For ascorbic acid, cluster V recorded maximum value (34.47mg/100g) followed by cluster IV (26.42mg.g). Acidity was maximum in cluster IV (0.44%) followed by cluster I (0.38%). Total soluble solids (TSS) was maximum in cluster IV (6.75 ^{o}Brix) followed by cluster II (5.97 ^{0}Brix). In case of self life, cluster I had the maximum shelf life (31.17 days) followed by cluster III (27.42 days)

IV. Conclusion

To improve for earliness, hybridization between cluster V and II is better in which genotypes with earliness are included. For fruit weight hybridization between cluster III and I would be better in which genotypes with more fruit weight were included. To improve number of fruits per plant, hybridization between cluster III and Cluster II would be better in which genotypes with more number of fruits per plant were included.

Source	Times Ranked 1st	Contribution %
1 Plant Height cm	53	30.99
2 Primary Branches	0	0.00
3 Days to 50% Flowering	0	0.00
4 Clusters/ Plant	2	1.17
5 Flowers/ Cluster	0	0.00
6 1st Fruit Set	0	0.00
7 1st Fruit Harvest	4	2.34
8 Last Fruit Harvest	2	1.17
9 Fruits/ Cluster	0	0.00
10 Fruits/ Plant	37	21.64
11 Fruit Length (cm)	0	0.00
12 Fruit Width (cm)	0	0.00
13 Fruit Weight (gm)	68	39.77
14 Fruit Yield (kg/ Plant)	0	0.00
15 Asccorbic Acid	2	1.17
16 Acidity	0	0.00
17 TSS	0	0.00
18 Shelf Life	3	1.75

Table I. Percent contribution of quantitative traits towards divergence in 19 genotypes of tomato

Table II. Average intra (bold) and inter cluster D^2 values for five clusters in 19 genotypes of tomato (Tocher's method)

	1 Cluster	2 Cluster	3 Cluster	4 Cluster	5 Cluster
I Cluster	**867.19**	3769.29	3034.80	4598.59	1917.70
II Cluster		**1716.78**	4044.14	4624.96	2796.35
III Cluster			**2010.36**	5689.90	3059.19
IV Cluster				**2661.48**	5139.32
V Cluster					**0.000**

Table III. Grouping of germplasm into clusters

Cluster	Number of germless	Genotypes
I cluster	3	EC671592, EC671599, EC676816
II cluster	7	EC677058, EC671593, EC677079, EC677051, Marutham, Punjab Chhauhara, Arka Vikas
III cluster	4	EC677040, EC677206, EC671598, EC677063
IVcluster	4	EC676793, EC677203, EC677202, EC677204
V cluster	1	EC676790

Table IV. Mean values of clusters for eighteen quantitative traits in 19 genotypes

Cluster No	Plant Height cm	Primary Branches	Days to 50% Flowering	Clusters/ Plant	Flowers/ Cluster	1st Fruit Set	1st Fruit Harvest	Last Fruit Harvest	Fruits/ Cluster
I	78.181	12.701	42.111	5.743	5.713	47.25	92.944	139.889	3.662
II	92.744	15.432	38.714	18.264	6.341	43.631	82.69	134.238	4.472
III	84.542	16.188	44.417	11.646	5.829	51.5	96.833	131.583	4.604
IV	131.333	22.563	40.417	6.846	6.971	44.917	92.167	130.583	4.896
V	74.625	13.813	38.333	27.321	5.512	40.917	82.833	129	3.196

Table IV. Conti….

Fruits $Plant^{-1}$	Fruit Length (cm)	Fruit Width (cm)	Fruit Weight (g)	Fruit Yield/ Plant	Ascorbic Acid	Acidity	TSS	Shelf Life
24.410	4.860	3.669	77.667	0.554	23.044	0.379	5.699	31.167
50.902	3.947	2.977	39.952	1.183	23.381	0.308	5.968	22.262
66.229	5.613	3.992	83.250	1.513	22.567	0.296	5.421	27.417
30.812	4.729	3.675	66.333	1.246	26.417	0.438	6.746	20.833
35.854	5.938	3.458	72.000	2.088	34.467	0.313	4.921	7.167

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