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Assessment of Genetic Divergence for Processing Traits in Tomato

Kulbir Singh*, Parmesher Kumar and Salesh Kumar Jindal
Department of Vegetable Science
Punjab Agricultural University, Ludhiana

The present investigation on genetic diversity for some physico-morphological and biochemical traits in tomato were conducted at the Vegetable Research Farm, Department of Vegetable Crops, Punjab Agricultural University, Ludhiana. The materials for investigation comprised 35 genotypes of tomato. The genotypes were grouped into six clusters. Genotypes of clusters IV were observed to be the most divergent from genotypes included in clusters III and VI; and clusters III and V. Ample genetic divergence has also been observed between the genotype comprised in cluster V and I, and cluster V and II. The genotypes in the cluster I and II were closely related to each other for most of the characters. Among the clusters with high genotypic values, genetic divergence was more between genotypes of clusters IV and genotypes of clusters III, VI. It may be worthful to initiate a hybridization programme by taking suitable parents from these divergent clusters and practicing selections in segregating generations to recover suitable superior recombinants.

Key words: Getetic divergence, Processing traits, Tomato

The knowledge of genetic diversity present in the germplasm and its quantitative assessment will help a plant breeder to choose desirable parents for breeding programme. Generally genotypic diversity has been considered as criterion to measure genetic diversity in crop plants, which may vary often fail to convey information about the genetic divergence. Therefore, it is worthwhile to use suitable tools like Mahalanobis statistics as described by Rao (1952). Information on genetic diversity of different genotypes in a population will hasten the process of crop improvement. High yield along with improved processing qualities have been the major objectives of tomato breeders and commercial growers. Since the information available on the above aspects is scanty, the present investigation was planned to evaluate thirty-five genotypes with the objectives of assessment of genetic diversity.

Materials and Methods

The present investigation on genetic diversity for some physico-morphological and biochemical traits in tomato were conducted at the Vegetable Research Farm, Department of Vegetable Science, Punjab Agricultural University, Ludhiana. The materials for investigation comprised 35 genotypes of tomato. Genotypes along with their sources are given in Table 1. The experimental material was sown in nursery beds during first and second year, respectively and 30 days old seedlings were transplanted in main field. The experiments were laid out in a randomized block design with three replications. Each entry consisted of a single row comprising of 10 plants with a row spacing of 120 cm and plant spacing, 30 cm. Cultural practices were followed as per package of practice for vegetable crops. In order to guard plants against the risk of frost injury, the crop was protected in the field by covering the plants with polythene sheets till middle of February. Plant protection measures on the crops were followed as per package of practices recommended by Punjab Agricultural University, Ludhiana. Field observations were recorded on five randomly marked competitive plants from each entry for fourteen characters. The data was subjected to analyses as per the method given by Rao (1952).

Results and Discussion

The materials were grouped in to 6 clusters indicating the presence of wide range of genetic diversity among the germplasm lines. Clustering of genotypes in to different groups/clusters is presented in Table 2. Cluster II was observed to be the largest with 17 genotypes closely followed by cluster I with7 genotypes. The cluster III and V consisted of 4 genotypes each. The cluster IV has only 2 genotypes. Cluster VI included only one genotype. Joshi and Kohli (2003) reported that 73 tomato (*Lycopersicon esculentum Mill.*) genotypes of diverse origin for different quantitative and qualitative traits. The grouping of the genotypes into 6 clusters indicated the presence of wide range of genetic diversity among the genotypes. The clustering pattern of tomato genotypes indicated

*Corresponding author email : kulbirpawar@gmail.com

Table 1. Names and sources of various tomato genotypes

Genotypes	Source
Azad T-3	KANPUR
Healani	USA
LO-6159	AVRDC
LO-1501	AVRDC
LO-125	AVRDC
LO-6158	AVRDC
BL-1199	AVRDC
BL-1200	AVRDC
LA-1310	USA
LA-1312	USA
LA-5911	USA
LA-1429	USA
LA-1316	USA
IPA-3	USA
I-181	LUDHIANA
P-4-5-2	USA
FT-5-2	SOLAN
FT-5-1	SOLAN
VTG-87	ALMORE
VTG-90	ALMORE
VTG-86	ALMORE
VRT-35	VARANASI
HADT-294	ALMORE
ATL-01-19 (ANAND)	GUJRAT
Pant-T-11	PANT NAGAR
Pant-T-10	PANT NAGAR
Angoor Lata	PANT NAGAR
PAU-2371	LUDHIANA
VR-415	VARANASI
KS-229	KALYANPUR
KS-7	KALYANPUR
DVRT-2	VARANASI
Malintaka	USA
Punjab Chhuhara (Check)	LUDHIANA
Punjab Upma (Check)	LUDHIANA

non-parallelism between geographic and genetic diversity. Genotypes belonging to cluster 5 and 6 were highly diverse from each other. The composition revealed that the clusters comprised of genotypes of heterogeneous geographic origin, indicating that the genotype were distributed among the different clusters randomly, irrespective of their geographic origin. For example of all, 8 genotypes having their origin in USA were grouped in to 4 different clusters. However, in some of the groups, varieties having same geographic origin fell in to same groups i.e. cluster I comprised 3 genotypes having USA as geographic origin. This suggests that genetic diversity may not necessarily be associated with geographic diversity. The reason for such pattern may be genetic drift, selection pressure and utility of product. There was also no relationship between genetic and geographical diversity of 50 tomato varieties studied by Bhattacharyya (1977). Mahesha *et al.* (2006) recorded genetic diversity among 30 genotypes of tomato. The genotypes were grouped into nine clusters, irrespective of geographic divergence, indicating no parallelism between genetic diversity and geographical divergence. Several other workers have also reported the absence of such relationship between genetic and geographical diversity of crops plants (Singh and Bains, 1968; Sidhu, 1988; Rai *et al* 1998 and Sharma and Verma, 2001). Therefore, it is not worthful to depend upon geographic distribution as a measure of genetic diversity. Kumar and Tewari (1999) assessed genetic divergence for different processing traits among 32 populations. They grouped these genotypes in to nine clusters depending on their genetic divergence. The inter and intra-cluster distances, D^2 and D values (in parenthesis) representing the index of genetic divergence among the clusters are given in Table 3. The maximum D value (228.98) was recorded between clusters IV and III, showing that the genotypes included in group IV were the most divergent from those of group III. The minimum D value was observed between clusters V and V (38.38) indicating close relationship among the members of same group. Considerable diversity of genotypes included in cluster VI with other genotypes included in other clusters i.e. with III (122.27) and IV(124.06) has also been observed. Comparatively, less genetic diversity of genotypes belonging to cluster III was observed with those of cluster IV**.** Ample genetic divergence has also been observed between the genotypes comprised in cluster V and I (53.44) and cluster V and II (69.51). Values for intra cluster distance varied from 0 (cluster VI) to 59.45 (cluster I**).** Sharma and Verma (2001) grouped 18 genotype divergence indicating no parallelism between genetic diversity and geographical divergence.

Table 2. Clustering pattern of 35 genotypes of tomato on the basis of genetic divergence

Cluster No.	Genotypes	Frequency
I	LA-1316, VTG-90, Healani, LA-1312, LO-125, LA-1429, Azad- T-3.	7
II	Punjab Upma , HADT-294, VR-415 , KS-229, Punjab Chhuhara, KS-7, I-181, IPA-3, LO-6159, LO-1501, PAU-2371, BL-1199, DVRT-2, Malintaka , BL-1200, LO-6158, P-4-5-2.	17
III	VTG-87, VTG-86, VRT-35, ATL-01-19	4
IV	LA-5911, FT-5-1.	2
V	FT-5-2, Angoor Lata, Pant -T-11, LA-1310.	4
VI	Pant-T-10.	1

Cluster means for various traits are given in Table 4, which showed showed appreciable difference for most of characters viz., number of fruits per plant, plant height, days to flower initiation, average fruit weight, lycopene content, acidity and pericarp thickness. Genotypes included in cluster I and II were observed to be close with respect to cluster means for many characters. Regarding yield and its components, the cultivars belonging to cluster VIexpressed the maximum values for number of fruits per plant (86.33). Maximum expression for yield was observed from cultivars comprising in cluster

Table 3. Average inter-intra cluster D^2 value and distance (D) value

Clusters	I	I	I	IV	V	VI
I	3533.85	4389.79	23090.69	9508.69	2856.46	3789.37
	59.45	66.26	151.96	97.51	53.44	61.56
II		3276.75	14951.05	15391.75	4831.56	9349.38
		57.24	122.27	124.06	69.51	96.69
III			2512.27	52429.61	26309.18	37951.10
IV			**50.12**	228.98	162.20	194.81
				1749.2	6238.98	2263.37
				41.82	78.99	47.57
V					1472.83	3699.78
					38.38	60.83
VI						**0.00**
						0.00

VI (2.2 kg) and cluster V (1.70 kg); for average fruit weight in cluster V (57.53 g) and for plant height in cluster IV(103.01 cm).

With respect to quality traits (Table 5) the cultivars showing maximum expression for dry matter (5.8) and acidity (0.583g/100 ml of juice) were observed in cluster IV. Maximum values for pericarp thickness (0.531 cm), lycopene content (2.55g/100g of fresh fruit) and ascorbic acid (23.29mg /100 of juice) were observed in cluster V. An examination of Table 4 and 5 also show that the genotypes included in cluster VI varied considerably for yield and quality traits from those of cluster III and IV. These observations lend support to information derived from inter-cluster distance values Table 3 indicated that the varieties in cluster VI might have possessed entirely different architecture from the varieties included in cluster III and IV, which may be quite rewarding, anticipating heterotic expression for both yield and quality attributes.

Table 4. Cluster means for yield and fruit traits in tomato

Clusters	Fruits yield / plant (kg)	Average fruit weight (g)	No. of fruits / plant	Days to flowers initiation	Days taken to marketable maturity	No. of branches /plant	Plant height at maturity (cm)	Pericarp thickness (cm)	Locule number
Cluster- I	1.625	31.235	52.440	101.405	157.262	6.286	60.762	0.547	3.631
Cluster –II	1.629	37.169	43.706	100.127	155.529	5.910	48.569	0.544	3.857
Cluster –III	1.528	29.448	51.958	101.542	149.708	7.458	90.917	0.489	3.129
Cluster- IV	1.288	19.759	65.250	100.917	159.167	6.907	103.083	0.540	2.652
Cluster –V	1.700	57.526	29.458	99.792	161.00	6.146	51.708	0.531	3.597
Cluster- VI	2.200	25.493	86.333	98.333	162.333	6.500	59.786	0.536	3.642

Table 5. Cluster means for processing traits in tomato

Clusters	Titrable acidity (g /100 ml juice)	Lycopene Content (mg/100g fresh fruit)	Dry matter (%)	Ascorbic acid (mg/100ml juice)	Total soluble solid (°Brix)
Cluster- I	0.541	2.192	4.787	19.117	4.564
Cluster –II	0.445	1.591	4.728	18.002	4.165
Cluster –III	0.494	1.892	4.956	23.144	4.613
Cluster- IV	0.583	2.295	5.883	18.373	4.575
Cluster –V	0.404	2.549	4.560	23.291	5.063
Cluster- VI	0.470	1.891	4.813	19.655	4.443

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