Diversity Pattern, Elucidating Choice of Parents for Hybridization from Exotic Tomato (*Lycopersicon esculentum* Mill) Genepool

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An evaluation trial of 75 lines of exotic germplasm of tomato was conducted to identify suitable parents for high yield, biotic and abiotic stresses at Central Horticultural Experiment Station, Ranchi in the year 1999-2000. The analysis of variance showed high and significant differences for all the characters studied. Data were subjected through Mahalanobis D^2 multivariate analysis and subsequently genotypes were grouped into 10 clusters. The heat tolerant tomato lines EC-238508 and EC-238308 from cluster V and VII were selected for utilization in the breeding program. The exotic line EC-238308 not only possessed heat tolerance but also resistance to early blight. The bacterial wilt resistant lines EC-326142, EC-180188, EC-164672, EC-241147, EC-251677-1 and EC-368785 were identified from clusters II, IV, VI and VII. The tomato lines possessing high TSS, high fruit firmness belonged to cluster I (EC-2511579) and cluster II (EC-241147, EC-320571 and EC-321425-C). The tomato lines possessing marker characters like potato leaf marker (EC-164665, EC-165665, EC-164336 and EC-326142-B) belonged to cluster IV, VI and VII. Similarly, lines with stem pigmentation and hairiness appeared in cluster III and VI. Tomato lines possessing long-styled flowers for natural cross pollination studies (EC-251518 and EC-164336) belonged to VII.

Key words: Diversity, Exotic, Genepool, *Lycopersicon esculentum*, Tomato, Transgressive

A wide genetic base, with high level of productivity and combining ability to yield superior segregants is an essential requisite for selection of parents in any hybridization programme. However, in the absence of information on the relationship between different lines with similar performance, there is a possibility of related lines being chosen in a hybridization programme. This results in limited or no advance under selection to known material. In the past National Bureau of Plant Genetic Resources (NBPGR) New Delhi, has procured several exotic tomato germplasm which have been utilized in development of present day tomato varieties. Thus exotic tomato germplasm was obtained from NBPGR and work initiated with an objective to develop high yielding, bacterial wilt and early blight resistant varieties/hybrids suitable to eastern part of India. All the germplasm lines were evaluated, characterized and descriptors were prepared and lines were maintained through regular seed production for the use of breeders. In order to identify suitable parents for high yield, disease resistance, lines suitable for natural cross-pollination and lines with marker-aided characters, an evaluation trial was conducted and results are presented in this paper.

Materials and Methods

Seventy-five exotic tomato lines were obtained from NBPGR New Delhi, and evaluated in a randomized block design with two replications at Plandu farm of Central Horticultural Experiment Station (CHES), Ranchi during the rainy *(Kharif)* season1999-2000. In each line, the plants were raised in 2 rows, 3m long with inter- and intra-row spacing of 60 x 50 cm. Observations were recorded on five randomly selected plants for plot yield, plant height, fruit weight, fruit length, fruit firmness, total soluble solids (TSS) number of locules and pulp thickness. The mean data were analyzed for analysis of variance . A total of 2,415 D^2 values corresponding to all the 75 possible pairs of entries were computed. Divergence between any two populations was obtained as sum of squares of difference in the transformed values of the corresponding varieties (Mahalanobis, 1936). Co-variance between character pairs were computed as per the method described by Rao (1952). For generalized distance, correlated linear functions of the original value were obtained by transforming the original correlated un-standardized character means by the method of Pivotal condensation, a criterion suggested by cannonical approach described by Rao (1952). For determining group constellations, a relatively simple criterion suggested by Tocher (Rao, 1952) was adopted.

Results and Discussion

High and significant variation was found among the 75 tomato exotic lines (Table 1) for all the attributes studied. The D^2 values (2,415) obtained between 75 tomato lines showed considerable range indicating the existence of appreciable genetic divergence in the genotypes tested. All the lines were grouped into 10 clusters. Composition of different clusters are presented

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in Table 2. Among these, cluster-IV (14), cluster-V (14), cluster-VI (14) consist of maximum number of genotypes followed by cluster-VII (11), cluster-III (8), cluster-VIII (7), cluster-II (3) and cluster-IX (2), whereas, cluster-I and X had one exotic line each. The material under study included all exotic tomato collections from different countries and clustering pattern of lines indicates that geographical isolation has not contributed much to the genetic divergence. The observed genetic divergence, therefore, seems to be possible due to differences in genotypes. In situations where the role of the geographic isolation is negligible, genetic drift and selection in different environment could lead to greater diversity. In the present study the clustering pattern revealed that high yielding, bacterial wilt resistance lines i.e., EC-241147, EC-326142, EC-180138, EC-164672, EC-251672 and EC-368785 belonged cluster-II, IV, VI and VII respectively. Similarly, high temperature tolerant lines i.e., EC-320578 (hairiness) and EC-251518 (hairiness and long style) were in Cluster-VII. On the other hand, lines with potato leaf marker i.e., EC-164165, EC-164336, and EC-326142 were in cluster-VI, VII and II respectively.

Table 3 gives the inter- and- intra-cluster distances for all the ten clusters. The inter-cluster distance was maximum between cluster-I and X (D=21.56) comprising 2 genotypes *i.e.*, EC-251579 and EC-368863 followed by cluster-II and X (D = 20.86) and cluster-III and X (D=19.52). The selection of parents on large phenotypic differences may be useful but there are several instances, where a single gene can provide large scale differences in height, maturity, and disease resistance. Therefore, measures based on genetic criteria quantifying diversity have become important in classifying the material for use by the breeders. Among them, assessment of divergence for a set of characters utilizing multivariate analysis like distance analysis, cannonical analysis, factor analysis and cluster analysis has been attempted and effectively utilized in a number of crop plants including vegetable crops with diverse breeding system (Murthy, 1979).

Table 1. Analysis of variance for 9 traits in 75 exotic tomato germplasm lines

Source	DF	Plot yield	Plant height	Fruit weight	Fruit length	Fruit breadth	Fruit firmness	TSS	No. of locules	Pulp thickness
Replication	1	4.16	1142.87	31.15	0.00	0.23	0.73	0.41	0.56	0.00
Treatment	74	1491.24	244810.10	112918.5	75.86	167.93	100.59	47.26	271.26	1.58
Error	74	273.18	70101.13	6693.46	4.41	13.48	25.35	15.58	57.36	0.17

Table 2. Distribution of 75 exotic tomato germplasm in various clusters

Cluster number	No. of genotypes in each cluster	Genotypes
I	1	EC-251579
II	3	EC-241147, EC-320571, and EC-321425-C
III	8	EC-168283, EC-310303, EC-277691, EC-315476, EC-320578, EC-321425-A, EC-357841-A, EC-321425
IV	14	EC-241148, EC-246028, EC-163606, EC-320581, EC-257751, EC-272496, EC-326142-B, EC-272982, EC-326145, EC-326142-A, EC-321425-D, EC-321425-B, EC-326144 and EC-339062
V	14	EC-162520, EC-168290, EC-1264653, EC-2585, EC-238508, EC-338725, EC-251578, EC-320583, EC-373966, EC-31761, EC-257751-A, EC-357841, EC-326142, and EC-362959
VI	14	EC-180188, EC-164665, EC-241446, EC-164660, EC-164672, EC-320565, EC-339059, EC-362940, EC-368757, EC-368785, EC-357846, EC-368832-1, EC-368833, and EC-368890
VII	11	EC-238308, EC-164336, EC-164336-B, EC-211672-1, EC-251566, EC-2920, EC-339060, EC-339060-1, EC-362949, EC-357840, and EC-368800
VIII	7	EC-164336, EC-339061, EC-251518, EC-320576, EC-339074, EC-361671, and EC-368707
IX	2	EC-361671 and EC-357846-1
X	1	EC-368863

The characters contributing towards genetic divergence are presented in Table 4, which shows that maximum genetic divergence was observed in fruit weight (21.59%) followed by fruit length (18.41%) and fruit firmness (15.10%). The least contribution towards divergence was observed in TSS (2.55%) and pulp thickness.

The cluster means (Table 5) for plot yield was maximum in case of cluster-VIII (9.76 kg) followed by cluster-II (9.64 kg) which had lines for high temperature tolerance, early blight resistance, bacterial wilt resistance and the lines possessing long-styled flowers. Further, it is interesting to note that the germplasm lines possessing resistant genes fell in different clusters. It is generally believed that genetically divergent parents tend to give rise to heterotic hybrids on crossing. The divergent parent

Table 3. Average inter- and intra-cluster distances among 10 clusters

	I	II	III	IV	V	VI	VII	VIII	IX	X
I	0.00	30.31	35.53	54.67	76.53	97.02	107.97	177.96	237.24	464.90
	(0.00)	(5.50)	(5.79)	(7.39)	(8.74)	(9.85)	(10.39)	(13.34)	(15.40)	(21.56)
II		30.64	22.47	34.53	56.84	75.16	78.54	140.89	189.87	435.54
		(5.53)	(4.74)	(5.87)	(7.53)	(8.67)	(.8.86)	(11.87)	(13.77)	(20.86)
III			20.71	29.12	109.48	58.02	362.21	112.98	169.18	381.20
			(4.55)	(5.39)	(10.46)	(7.61)	(19.04)	(10.62)	(13.00)	(19.52)
IV				61.86	37.31	73.28	80.09	93.91	128.30	373.64
				(7.86)	(6.10)	(8.56)	(8.94)	(9.61)	(11.32)	(19.32)
V					30.32	38.02	48.59	68.74	100.51	324.05
					(5.50)	(6.16)	(6.97)	(8.29)	(10.02)	(18.490)
VI						51.25	35.75	119.04	88.10	30.909
						(7.15)	(5.97)	(10.91)	(9.38)	(17.58)
VII							28.99	49.87	77.91	277.52
							(5.38)	(7.06)	(8.82)	(16.65)
VIII								56.20	51.33	230.14
								(7.49)	(7.16)	(15.17)
IX									21.57	233.48
									(4.64)	(15.28)
X										0.00
										0.00)

Table 4. Contribution of different attributes towards genetic divergence

Character	Number of times appearing in first rank	Percent contribution towards divegence
Plot yield	194	6.99
Plant height	197	7.10
Fruit weight	599	21.59
Fruit length	511	18.41
Fruit breadth	242	8.72
Fruit firmness	419	15.10
TSS	79	2.85
No of locules	353	12.72
Pulp thickness	181	6.52

Table 5. Cluster means for 9 traits of exotic tomato germplasm lines

Cluster number	Plot yield	Plant height	Fruit weight	Fruit length	Fruit breadth	Fruit firmness	TSS	No. of locules	Pulp thickness
1	3.67	145.75	12.5	2.13	2.79	3.50	4.00	3.30	0.30
2	3.96	153.08	9.83	2.61	2.58	2.18	4.08	2.10	0.25
3	4.75	139.71	18.62	2.72	3.12	2.02	3.56	3.08	0.29
4	5.56	128.32	27.22	3.26	3.57	2.26	3.62	2.98	0.35
5	8.58	125.32	27.22	3.62	4.55	2.75	3.69	3.70	0.44
6	7.93	90.82	52.78	3.81	4.99	2.98	3.21	4.28	0.44
7	9.64	104.65	59.31	3.85	5.06	2.51	3.54	4.19	0.46
8	9.76	91.6	88.71	4.49	5.76	3.11	3.14	4.90	0.52
9	6.91	97.5	110.0	5.29	5.98	4.5	3.12	4.90	0.57
10	4.47	81	162.5	4.02	7.75	1.88	3.00	10.25	0.55
General Mean	7.42	116.32	47.59	3.60	4.47	2.65	3.50	3.80	0.41
SD	1.92	30.77	9.51	0.24	0.42	0.58	0.45	0.88	0.04
CV	25.87	26.45	19.98	6.78	9.52	22.08	13.10	23.12	11.65

possessing high yield potential, with high degree of resistance may be selected as parents for formulating a sound breeding programme in order to develop hybrids resistant to bacterial wilt and alternaria disease. The lines possessing long-styled flowers will be utilized to find out the extent of cross-pollination for production of hybrids without emasculation (natural cross pollination).

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