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Estimation of heterosis for bacterial wilt resistance in tomato

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ABSTRACT

In tomato, the extent of heterosis for bacterial wilt resistance, yield and associated characters was studied during *Rabi* 2008, in a set of 40 hybrids produced from a line x tester mating design involving eight lines and five testers of diverse nature maintained in pure form in the vegetable block, Division of Horticulture, UAS, Dharwad, India. Appreciable amount of heterobeltosis and standard heterosis was noticed for majority of the traits studied. Among the 40 hybrids studied, most of the hybrids were significantly superior over commercial check in desirable direction for bacterial wilt and yield. DMT-6 x DMT-D, DMT-2 x IMP-B and DMT-5 x DMT-D were found to be superior over the commercial check for bacterial wilt and significantly superior for higher fruit yield per plant, average fruit weight, number of fruits per plant over commercial check Ruchi.

Key words : Line, Tester, Commercial check, Heterosis, Heterobeltosis, Bacterial wilt

Tomato (*Solanum lycopersicum* Mill.) is an important and widely grown solanaceous vegetable crop around the world and belongs to the family solanaceae. It is native of Peru. It ranks second only after potato. In many countries it is considered as "poor man's orange" because of its attractive appearance and nutritive value. Breeding for disease resistance has been one of the most important objectives of vegetable breeders in the last few years. Often, breeding for disease resistance has assumed greater importance than improvement for yield or quality. Host plant resistance, the most important disease control strategy is environmentally sound with low running costs.Crop protection must then rely on genetic resistance or disease avoidance. Among the diseases, bacterial wilt is rising to an alarming proportion in India and becoming a limiting factor for tomato cultivation. In fact, early infection leads to loss up to 100 per cent thus tomato cultivation is almost precluded.

Now, cultivation of tomato has become increasingly popular, since mid nineteenth century. So far efforts of many vegetable breeders from both public and private sector have resulted in spectacular improvement in yield and quality characters. As a result of these efforts, hundreds of new cultivars have been developed since 50 years to meet the diverse needs and varied situations and climates under which tomato is grown.

MATERIALS AND METHODS

Five diverse cultivars with good horticultural traits (IMP-B, DMT-D, IMP-A, BFL-2, Arka Alok) but susceptible to bacterial wilt were crossed with eight parents (DMT-1, DMT-2, DMT-5, DMT-6, DMT-7, L-1, L-14 and L-15) having resistance to bacterial wilt. The resulting 40 hybrids along with 13 parents were evaluated in randomized block design with two replications during *Rabi* 2008. Observations like TSS, pH, number of locule, pericarp thickness and lycopene content were recorded. Lycopene was estimated by using the method developed by Sadasivam and Manickam (1992).TSS using Hand refractrometer (0-32^0) and pH was recorded using a pH meter. Statistical analysis was carried out using the model of line x tester.

RESULTS AND DISCUSSION

The analysis of variance for sixteen characters is presented in Table 1. It is clear from the table that all the entries comprising parents and hybrids showed significant differences for plant height, fruit cluster per plant, number of fruits per plant, average fruit weight,locules per fruit, fruit yield per plant, shelf life and bacterial wilt. Among the parents, testers exhibited significant differences for plant height, fruit cluster per plant, number of fruits per plant, average fruit weight, fruit yield per plant, shelf life and bacterial wilt while lines showed the significant differences for all characters exhibited in tester except for fruit cluster per plant.

Variance for parents vs. hybrids was significant for the characters *viz.*, plant height, cluster per plant, number of fruits per cluster, number of fruits per plant, average fruit weight, fruit yield per plant, shelf life and bacterial wilt. The contribution of lines and testers showed highly significant variation for plant height, number of clusters per plant, number of fruits per plant, average fruit weight, locules per fruit, fruit yield per plant, shelf life and bacterial

Table 1: Analysis of variance in respect of sixteen characters in line x tester study of tomato

Sr. No.	Source	Mean sum of square							
		Replication	Parents	Lines	Tester	Line x tester	Hybrids	Parent Vs. hybrids	Error
	Degrees of freedom	1	12	7	4	1	39	1	52
1.	Plant height	0.0003	46.0418**	44.8677**	53.625**	23.9279**	64.9439**	41.0457**	9.6096
2.	Number of branches	0.5888	0.3757	0.5335	0.1915	0.0081	0.7456	3.3017	0.1197
3.	Fruit cluster per plant	3.751	2.6741**	1.1431	5.126**	3.5838*	2.6741	8.9138**	1.1238
4.	Fruits per cluster	0.2551	0.089	0.1149	0.0385	0.1101	0.2145	5.8593*	0.1737
5.	Number of fruits per plant	6.8978*	39.5782**	20.8656**	56.876**	101.3751**	67.2125**	526.8901**	12.808
6.	Average fruit weight	22.402**	8.0677**	6.3046**	11.836**	5.3368**	154.913**	212.988**	20.914
7.	Locules per fruit	1.7966	1.8038*	1.5535	1.2935	5.5978**	1.5445	1.5874	0.0989
8	Fruit yield per plant	13686.99**	22363.25**	30014.4**	6223.40**	33364.57**	192661.1**	542578.5**	9258.9
9.	Length of fruit	0.0782	0.9165	0.8228	1.218	0.3668	0.5885	2.1713	0.0966
10.	Width of fruit	0.0901	0.2129	0.1916	0.2759	0.1107	0.5443	0.1896	0.0721
11.	TSS	0.1236	0.3083	0.4163	0.1187	0.3105	0.2343	1.0337	0.0792
12.	pH of fruit juice	0.0319	0.0566	0.0106	0.1449	0.0259	0.0978	0.2208	0.0095
13.	Lycopene	0.0089	0.9477	0.6517	0.1803	6.0894	2.0647	0.0314	0.0064
14.	Pericarp thickness	0.2454	1.0635	1.2986	0.7885	0.5175	1.8412	0.5652	0.0911
15	Shelf life	0.1027	5.3154**	4.7596**	2.881*	18.9432**	4.4424*	11.9481**	0.7736
16.	Bacterial wilt	347.66**	325.78**	382.77**	332.18**	75.30**	156.84**	755.24**	17.53

* and ** indicate of significance of values at P = 0.05 and 0.01, respectively,

wilt.

The data regarding heterobeltosis and standard heterosis for bacterial wilt, yield, its related components and quality traits are presented in Table 2 and 3, respectively. The heterobeltosis for plant height was found to be in the range of-33.88 to 8.69 per cent with none of the crosses registered significant positive herterobeltosis. None of the hybrids registered the significant positive standard heterosis for plant height. Similar findings were recorded in tomato for plant height by Ashwini (2005) and Premlakshimi *et al.* (2006). For number of branches heterobeltosis and standard heteroisis varied from-24.14 to 44.74 per cent and -44.07 to 3.39 per cent, respectively with seven and one cross exhibiting positive significant heterobeltosis and standard hetorosis, respectively. Such results were also noticed by Dharmatti (1995), Mahendrakar (2004) and Ashwini (2005) in tomato.

For number of fruit cluster per plant, heterobeltosis and standard heterosis varied from -24.14 to 44.74 per cent and-31.56 to 14.07 per cent, respectively. However only one crosses DMT-1 x IMP-A (14.07%) was exhibited positive and significant heterosis over standard check Ruchi. Similar results for fruits per cluster were also noticed by Kulkarni (2003) and Ashwini (2005) in tomato. Further magnitude of heterobeltosis for average fruit weight was ranged from-30.83 to 27.45 per cent and -36.83 to 27.07 per cent standard heterosis significantly in positive direction. These results are in line with the findings of Prashant (2004), Mahendrakar (2004), Ashwini (2005) and Premlakshmi *et al.* (2006).

Out of 40 hybrids, the heterobeltosis and standard heterosis for number of locules per fruit was observed in the range of-56.14 to 8.45 per cent and -32.43 to 5.41 per cent, respectively. Less number of locules per fruit is a desirable character in tomato for industrial and fresh consumption point of view (negative heterosis is desirable) L-14 x IMP-B was only the promising cross, with -32.43 per cent over standard heterosis for this trait. In respect to TSS heterobeltosis was ranged from-22.38 to 3.51 per cent. The lowest was L-1 x BFL-2. For bacterial wilt resistance, heterobeltosis and standard heterosis were ranging from -100 to -5.82 and -100 to 87.00 per cent, respectively. Similar results were reported by Kulkarni (2003). Here, negative significant heterosis is desirable, but there is 23 cross showing negative heterosis, over standard check. For lycopene content, the heterobeltosis and standard heterosis varied from -44.13 to 41.38 per cent and-35.03 to 35.72 per cent, respectively with six and nineteen crosses exhibiting positive significant heterobeltosis and standard heterosis, respectively. For number of fruits per plant the heterobeltosis and standard heterosis was observed in the range of -28.35 to 41.84

Table 2 : heterobeltosis for bacterial wilt, yield and yield related components in tomato

Sr. No.	Character	Range (%)	Number of desirable heterotic hybrids	Best hybrid combinations
1.	Plant height	-33.88 to 8.69	02	DMT-6 x IMP-B, DMT-6 x IMP-A
2.	Number of branches	-24.14 to 44.74	07	DMT-1 x DMT-D, DMT-2 x DMT-D and DMT-1 x IMP-B
3.	Fruit cluster per plant	-24.14 to 44.74	08	DMT-1 x IMP-A, DMT-7 x IMP-A and DMT-6 x IMP-A
4.	Number of fruits per cluster	-4.62 to 31.15	04	DMT-5 x Arka alok, DMT-2 x IMP-A and DMT-5 x DMT-D
5.	Number of fruits per plant	-28.35 to 41.84	13	DMT-7 x IMP-A, DMT-7 x IMP-B and DMT-1 x DMT-D
6.	Average fruit weight	-30.83 to 27.45	03	DMT-1 x BFL-2, DMT-2 x IMP-A, DMT-2 x IMP-A
7.	Yield per plant	-34.7 to 94.68	12	DMT-7 x IMP-A, DMT-6 x DMT-D and DMT-2 x IMP-B
8.	TSS	-22.38 to 3.51	01	L-1 x BFL-2
9.	Number of locules	-56.14 to 8.45	17	L-14 x IMP-B, L-14 x IMP-A and L-14 x Arka Alok
10.	Lycopene content	-44.13 to 41.38	06	L-15 x IMP-A, L-15 x DMT-D and L-15 x IMP-B
11.	pH	-19.33 to 12.4	17	DMT-2 x IMA-A, DMT-5 x IMA-P and DMT-6 x IMP-A
12.	Pericarp thickness	-39.05 to 40.43	08	DMT-6 x IMP-A, DMT-7 x IMP-A and DMT-6 x IMP-A
13.	Bacterial wilt resistance	-100 to -5.82	23	DMT-7 x IMP-A, DMT-6 x DMT-D and DMT-2 x IMP-B

Table 3: Standard heterosis for bacterial wilt, yield and yield related components in tomato

Sr. No.	Character	Range (%)	Number of desirable heterotic hybrids	Best hybrid combinations
1.	Plant height	-30.8 to 3.32	------	------
2.	Number of branches	-44.07 to 3.39	01	DMT-2 x DMT-D
3.	Fruit cluster per plant	-31.56 to 14.07	01	DMT-1 x IMP-A
4.	Fruits per cluster	-20.51to 12.82	02	DMT-7 x DMT-D
5.	Number of fruits per plant	-40.03 to 13.82	03	DMT-7 x IMP-A, DMT-6 x DMT-
6.	Average fruit weight	-36.83 to 27.07	02	DMT-1 x BFL-2, DMT-2 x BFL-2,
7.	Fruit yield per plant	-47.12 to 44.15	04	DMT-7 x IMP-A, DMT-6 x DMT-D and DMT-2 x IMP-B
8.	TSS	-25.95 to 7.38	33	L-1 x BFL-2
9.	Locules per fruit	-32.43 to 5.41	7	L-14 x IMP-B, L-14 x IMP-A and L-14 x Arka Alok
10.	Lycopene content	-35.03 to 35.72	19	L-15 x IMP-A, L-15 x DMT-D and L-15 x IMP-B
11.	pH	-8.5 to 15.39	05	DMT-2 x Arak alok, DMT-2 x IMP-B and DMT-2 x DMT-D
12.	Pericarp thickness	-13.51 to 90.54	26	DMT-6 x IMP-A, DMT-7 x IMP-A and DMT-6 x IMP-A
13.	Bacterial wilt resistance	-100 to 87.00	23	DMT-7 x IMP-A, DMT-6 x DMT-D and DMT-2 x IMP-B

per cent and -40.03 to 13.82 per cent, respectively. The crosses DMT-1 x BFL-2, DMT-2 x BFL-2, exhibited significant positive heterosis over commercial check Ruchi.

Fruit yield per plant, variation in heterobeltosis and standard heterosis was ranging from -34.7 to 94.68 per cent and-47.12 to 44.15 per cent, respectively of which four crosses DMT-7 x IMP-A, DMT-6 x DMT-D, DMT-2 x IMP-B and DMT-5 x DMT-D have shown significant positive heterosis. Theses results were also noticed by Mahendrakar (2004) and Ashwini (2005).

In conclusion, none of the crosses studied was observed to be consistent heterotic for all the characters. However, considerable amount of heterosis was observed in the desirable direction for majority of the crosses. Among the 40 hybrids studied, DMT-7 x IMP-A, DMT-

6 x DMT-D, DMT-2 x IMP-B and DMT-5 x DMT-D were found to be the best for Bacterial wilt resistance, higher fruit yield per plant, average fruit weight and number of fruits per plant. Further these hybrids need testing in replicated trials over locations for stability in performance prior to commercialization.

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