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Combining ability studies on bacterial wilt resistance in tomato for processing qualities and yield

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ABSTRACT

Combining ability for important processing characters besides yield was studied using line x tester analysis comprising of eight lines resistant to bacterial wilt and five testers with good horticultural qualities but susceptible to bacterial wilt, Analysis of variance revealed considerable amount of genetic variability among parents and their hybrids for all the characters except for pH indicating the influence of non additive gene action. Among resistant parents DMT-6, DMT-7 and L-15 and BFL-2, among susceptible parents were good general combiners for quality and yield. Among 40 hybrids studied eight were found suitable for processing. Out of eight crosses, DMT-6 x BFL-2 recorded an estimated highest yield of 1389.9 g followed by DMT-7 x DMT-D and L-14 x DMT-D. These hybrids in addition to high yield, exhibited high TSS, lycopene, pericarp thickness and pH were also resistant to bacterial wilt.

Key words : Bacterial wilt, General combining ability, Specific combining ability.

Tomato is an important and widely grown solanaceous vegetable crop around the world, both for fresh market and processing. Although tomato is a self pollinated crop, heterosis is being commercially exploited on large scale. With increasing popularity of F_1 hybrids the available dominant source of genetic resistance to bacterial wilt (Sathyanarayana and Anand, 1992) was exploited to obtain hybrids which had excellent processing qualities with high yields, A knowledge of general combining ability (gca) and specific combining ability (sca) help in choice of parents or hybrids and the nature of gene action acts as bases of choosing effective breeding methods. The present investigation was undertaken to identify parental combination that are likely to produce superior hybrids having excellent processing qualities in combination with resistance to bacterial wilt.

MATERIALS AND METHODS

Five diverse cultivars with good horticultural qualities (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 were carried out using the model of line x tester developed by Kempthrone (1957).

RESULTS AND DISCUSSION

All the 40 F_1s tested were resistant to bacterial wilt with 95 to 100 per cent survival. Eight of these hybrids were identified to be suitable for processing based on excellent processing qualities like high TSS (above 5%), high lycopene content (above 5 mg/100g), pericarp thickness (above 4 mm) and pH (below 4.5) required for processing.

The lines (resistant parents) differed significantly for characters like pH, lycopene content, pericarp thickness and locule per fruit and the hybrids showed significant variances for all the characters (Table 1). Difference for expression of quality parameters among parents were thus reflected the hybrids. The analysis of variance for combining ability reveled that the variances due to specific combining ability (sca) was greater than general combining ability (gca) for all the processing characters studied indicating predominant role of non additive gene action except in pH where additive gene effect was observed. This was similar to the findings of Kulkarni (1999) and Asawini (2005) and thus revealing the possibility of employing heterosis breeding to exploit specific quality traits.

Among lines DMT-6 exhibited significant gca effect for characters like lycopene content, pericarp thickness, yield and pH, locules per fruit in desirable direction (Table 2). This parent has the highest thickness (4.7 mm). The DMT-7 showed significant gca effects for lycopene content, pericarp thickness, shelf life and locules per fruit

Table 1: Analysis of variance for processing characters and yield

Sr. No.	Source	Mean sum or squares								
		Replication	Crosses	Lines	Testers	Line x Testers	Error	σ_{GCA}^2	σ_{SCA}^2	$\sigma_{GCA}^2/\sigma_{SCA}^2$
Degrees of freedom		1	39	7	4	28	39			
1.	Locule per fruit	1.8605**	1.5445**	6.2076**	0.4279	15.0702**	0.1143	0.027	0.21	0.126
2.	TSS	0.204	0.2343**	0.268	0.2787	6.1467	0.0893	0.000	0.07	0.006
3.	pH	0.0101	0.0978**	0.4468**	0.0468	0.499*	0.0111	0.002	0.00	0.618
4.	Lycopene	0.0118	2.0647**	4.5024*	0.2645	47.9475**	0.0085	0.009	0.85	0.011
5.	Pericarp thickness	0.3001	1.8412**	5.597**	1.2978	27.4368**	0.1006	0.023	0.44	0.052
6.	Yield	18126.23	192661.1**	294141.7	291470.6	4288908.5**	8804.301	1044.7	72185.5	0.014

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

Table 2 : Estimation of general combining ability of parents

Sr. No.	Characters	LPF	TSS	PH	LYP	PTS	YLD	BW
		0.72**	-0.17	0.01	-0.07*	-0.06	-114.5**	8.56
2.	DMT-2	1.5**	-0.01	-0.32**	-0.71**	-0.89**	269.39**	-6.99
3.	DMT-5	-0.56**	-0.14	-0.21**	-0.83**	0.46**	182.36**	-6.99
4.	DMT-6	-0.37**	0.03	-0.1**	0.3**	1.3**	106.05**	2.48
5.	DMT-7	-0.64**	0.17	0.36**	0.28**	0.56*	8.8	1.04
6.	L -1	0.4**	0.3**	0.14**	-0.62**	-0.85**	-160.29**	3.58
7.	L-14	-0.63**	-0.08	0.01	0.94**	-0.42**	-85.2	5.31
8.	L-15	-0.4**	-0.11	0.1**	0.71**	-0.09**	-206.63**	-6.99
9.	IMP-B	-0.26**	-0.18*	0.06*	-0.09**	0.42**	13.48	4.88
10.	DMT-D	-0.03	-0.07	-0.04	-0.08**	0.12	107.53**	-0.52
11.	IMP-A	0.09	0.08	0.04	0.11**	-0.15	4.59	-7.0
12.	BFL-2	0.17*	0.16*	0.01	0.17**	-0.07	100.31**	3.12
13.	A.ALOK	0.03	0.01	-0.07**	-0.11**	-0.32**	-225.92**	-0.48
S.E. ±		0.220	0.20	0.06	0.05	0.21	68.04	2.96
C.D. (P=0.05)		0.620	0.56	0.19	0.15	0.59	190.52	4.18
C.D. (P=0.01)		0.820	0.74	0.26	0.21	0.79	253.06	8.39

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

Table 3 : Estimation of specific combining ability of characters in line x tester study of tomato (selected superior hybrids)

Hybrids	Characters						
	LPF	YLD	TSS	PH	LYP	PTS	SL
DMT-1 × BFL-2	-0.78**	-200.39**	-0.17	0.09	0.78**	1.45**	-1.3
DMT-6 × BFL-2	-0.79**	191.8**	0.03	-0.03	0.53**	-0.65**	0.23
DMT-6 × A.Alok	-0.2	-63.92	0.18	0.07	1.31**	0.39	-0.86
DMT-7 × DMT-D	-0.37	-152.67*	0.18	0.21**	0.81**	-0.36	1.71*
L-14 × IMP-B	-0.5*	-213.77**	0.35	-0.07	0.15*	0.27	0.34
L-14 × DMT-D	0.42	-181.02**	0.3	-0.07	0.15*	-0.43	-1
L.NO.15 × IMP-B	0.62*	7.86	0.19	-0.03	0.19**	-0.82**	0.59
L.NO.15 × IMP-A	-0.88**	23.55	0.2	-0.05	0.55**	0.06	-0.66

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

in desirable direction. Among the testers BFL-2 exhibited highly significant gca effects for yield, TSS, and lycopene content. These parents were found to be good general combiners for various processing characters (Table 2).

The hybrid DMT-6 x BFL-2 (5.37) and L-15 x DMT-D (5.68) showed significant positive sca effects for lycopene content. The hybrid DMT-6 x BFL-2 exhibited 25.61 per cent heterosis for lycopene content over mid parent 13.29 per cent heterosis over the best parent; the L-15 x DMT-D also exhibited significant 52.89 per cent heterosis over the mid parent 39.9 per cent heterosis over the better parent. Findings are similar as reported by

Chishti *et al.* (2008)

The hybrid DMT-6 x BFL-2 recorded significant sca effects for yield. Estimated yields of eight processing hybrids were ranged from 760.5 to 1389.90 g/plant. The best among them was again DMT-6 x BFL-2 with an estimated yield potential of 1389.9 g/plant, besides having resistance to bacterial wilt. This hybrid recorded highest heterosis for yield of about 73.28 per cent over mid parent, 68.06 per cent heterosis over the best parent. The results are in close conformity with the findings of Sharma *et al*. (2006) Pandey *et al*. (2006).

Thus the present investigation reveled that IMP-B, DMT-D, IMP-A BFL-2, Arka Alok 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 and were also good general combiners for processing qualities and yield with dominant sources of resistance to bacterial wilt available, the selected parents can be successfully utilized for heterosis breeding programme to evolve bacterial wilt resistant hybrids in tomato. The hybrids DMT-6 x FL-2, DMT-7 x DMT-D and L-14 x DMD-D were promising for yield besides quality apart from bacterial wilt. Transferring the dominant resistance gene in to several processing lines with adequate genetic diversity for various processing characters, further enhancement of desired quality parameters can be activated in hybrids.

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