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HETEROSIS FOR QUALITY TRAITS IN TOMATO

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Abstract: Quality improvement of bacterial wilt resistant / tolerant tomato accessions was attempted by crossing with selected processing varieties. The F1 hybrids which showed the highest *per se* performance were Sakthi x HW 208 (9.18%) for total solids, Sakthi x HW 208F for insoluble solids (0.91%) and consistency (0.31), LE 206 x St 64 (7.0%) for TSS and LE 206 x Ohio 8129 (11.66 mg $100g^{-1}$) for lycopene. Highest significant heterobeltiosis was expressed by the Fl hybrids Sakthi x TH 318 (for total solids), LE 206 x St 64 (for TSS, lycopene) and Sakthi x Fresh Market 9 (for consistency). The Fl hybrids, though showed improved fruit quality in terms of uniform ripening, high lycopene and total solids and resistance to cracking, were completely susceptible to bacterial wilt. Bacterial wilt resistant segregates with desirable fruit quality could be isolated from the F2 generation.

Key words: Bacterial wilt, heterobeltiosis, heterosis, quality traits, resistant.

INTRODUCTION

Resistance to bacterial wilt in tomato is commonly associated with poor fruit characteristics like green shoulder, softness and cracking. Anbu *et al.* (1976) suggested the exploitation of heterosis for combing desirable characters. The present study is an attempt for the improvement of bacterial wilt resistant / tolerant tomato accessions by crossing with selected processing varieties.

MATERIALS AND METHODS

Three tomato accessions (Sakthi, LE 214, LE 206) showing varying degrees of resistance / tolerance to bacterial wilt were crossed with selected processing varieties (HW 208F, St. 64, Ohio 8129, TH 318, Fresh Market 9) in a line x tester fashion. The 15 hybrids along with eight parents were raised in pots and evaluated in a completely randomized block design. Twelve pots were maintained for each entry. The crop was maintained as per the recommendations of the Kerala Agricultural University (KAU, 1986). Analysis of fruits for chemical composition was done as per AOAC methods (AOAC, 1980) except for lycopene content (Adsule and Dan, 1976) and consistency (Takada and Nelson, 1983). Bacterial wilt reaction of six selected F1s, their parents and six F2s was assessed by growing them in a wilt sick plot. Thirty plants for the seven parents and six Fl hybrids and 150 plants for the six F2 segregants were raised. Wilt incidence was assessed by the number of plants wilted confirmed by ooze test. Spot planting with susceptible Pusa Ruby was done to confirm resistance.

Heterosis over better parent (heterobeltiosis) and mid-parent (relative heterosis) were worked out as suggested by Briggle (1963) and Hayes *et al.* (1965).

RESULTS AND DISCUSSION

The mean performance of parents and hybrids and the estimates of heterobeltiosis and relative heterosis are presented in Tables 1 and 2. Maximum number of hybrids expressed significant heterobeltiosis and relative heterosis for total solids. Sakthi x HW 208F had the maximum total solids (9.18%) but the estimate of heterobeltiosis was not the highest (11.95%) due to the high *per se* performance of HW 208F. The maximum heterobeltiosis (28.49%) and relative heterosis (34.64%) were expressed by Sakthi x TH 318. All hybrids except LE 214 x Ohio 8129 exhibited significant relative heterosis.

All the Fl hybrids showed increased insoluble solids (0.66 to 0.91%) over female parents, which were relatively low in insoluble solids (0.45 to 0.62%). None of the hybrids exceeded the better parent (-43.65 to -11.54). Though four hybrids exhibited positive relative heterosis, only LE 214 x Fresh Market 9 expressed significant heterosis (12.20%).

LE 206 x St. 64 was the best hybrid for TSS content (7.00%). Heterobeltiosis (21.95%) and relative heterosis (32.22%) were significant and the highest for the hybrid. Sakthi x TH 318 and LE 214 x Fresh Market 9 also had significant positive relative heterosis (8.02% and 9.17%) respectively.

Table 1. Mean performance of parental lines and F_1 hybrids and extent of heterosis in tomato for total solids, insoluble solids and TSS

Parents / F_1 hybrids	Total solids, %			Insoluble solids, %			TSS, %		
	Mean	HB, %	RH, %	Mean	HB, %	RH, %	Mean	HB, %	RH, %
Parents									
Sakthi	6.06	-	-	0.54	-	-	5.60	-	-
LE 206	6.56	-	-	0.62	-	-	5.74	-	-
LE 214	5.67	-	-	0.45	-	-	4.90	-	-
St 64	7.54	-	-	1.13	-	-	4.80	-	-
Ohio 8129	7.83	-	-	1.16	-	-	5.00	-	-
HW 208F	8.2	-	-	1.26	-	-	5.04	-	-
TH 318	6.67	-	-	0.84	-	-	4.62	-	-
Fresh Market 9	5.50	-	-	0.78	-	-	4.26	-	-
FI hybrids									
Sakthi x St 64	8.53	13.13**	25.44**	0.78	-30.97	-6.59	5.12	-8.57**	-1.54
Sakthi x Ohio 8121	8.24	5.24	18.65**	0.80	-31.03	-5.88	5.02	-10.36**	-5.28
Sakthi x HW 208F	9.18	11.95**	28.75**	0.91	-27.78	1.11	5.04	-10.10**	-5.26
Sakthi xTH 318	8.57	28.49**	34.64**	0.69	-17.86	-	5.52	-1.43	-8.02**
Sakthi x Fresh Markel 9	7.14	17.82**	23.53**	0.67	-14.10	1.52	5.06	-9.64**	2.64
LE 206 x St 64	8.91	18.17**	26.38**	0.84	-25.66	-4.00	7.00	21.95**	35.83**
LE 206 x Ohio 8129	8.82	12.64**	22.59**	0.88	-24.14	-1.12	5.12	-10.80**	-4.66
LE 206 x HW 208F	8.58	4.63	16.26**	0.71	-43.65	-24.47	5.14	-10.45**	-4.64
LE 206 x TH 318	7.47	11.99**	12.93**	0.67	-20.24	-8.22	5.42	-5.57	4.63
LE 206 x Fresh Market 9	6.84	4.27	13.43**	0.68	-12.82	-2.86	5.16	-10.10*	3.20
LE 214 x St 64	7.69	1.99	16.43**	0.73	-35.40	-7.59	5.06	3.27	4.33
LE 214 x Ohio 8129	6.98	-10.86	3.41	0.71	-38.79	-11.80	5.02	0.40	1.41
LE 214 x HW 208F	8.07	-1.59	16.37**	0.83	34.13	-2.92	5.02	-0.40	1.01
LE214xTH318	6.87	3.00	11.35**	0.66	21.43	2.33	4.96	1.22	4.20
LE 214 x Fresh Market 9	6.62	16.75**	18.53**	0.69	11.54	12.20*	5.00	2.04	9.17
SEm	0.20			0.026			0.12		
CD (0.05)	-	0.56	0.49	-	0.07	0.06	-	0.35	0.30
CD (0.01)	-	0.75	0.65	-	0.10	0.08	-	0.46	0.40

*Significant at 5 per cent level; **Significant at 1 per cent level

The female parents, which were soft fruited, had more acidity (0.51% to 0.58%) than firm fruited male parents (0.35% to 0.43%). All hybrids showed negative heterobeltiosis (-20.37% to -5.56%). Ten hybrids exceeded the mid-parent in acidity but the heterotic effect was not significant. The hybrids were intermediate between the parents in acidity as reported by Lukayanenko and Luckyanenko (1986). The hybrids were intermediate in the firmness of fruits.

All the hybrids had higher pulp consistency than the female parents, which were low in consistency (0.16 to 0.21). The hybrids Sakthi x Fresh Market 9, LE 206 x Fresh Market 9 and LE 214 x Fresh Market 9 expressed significant positive heterobeltiosis (19.05%, 14.29% and 9.52%) respectively. The relative heterosis ranged from 2.04% to 24.32% and nine out of 15 crosses exhibited significant relative heterosis.

The highest estimate of heterobeltiosis (-0.54% to 78.09%) and relative heterosis (2.56% to 107.29%) were observed for lycopene content. In four, out of six crosses involving St. 64 and Ohio 8129 as male parents significantly higher heterobeltiosis was observed. LE 206 x St. 64 (78.09%) and LE 206 x Ohio 8129 (107.29%) expressed maximum heterobeltiosis and relative heterosis respectively. These hybrids had

Table 2. Mean performance of parental lines and F_1 hybrids and extent of heterosis in tomato for acidity, consistency and lycopene

Parents / F_1 hybrids	Acidity, %			Consistency, PPT			Lycopene (mg100g^{-1})		
	Mean	HB, %	RH, %	Mean	HB, %	RH, %	Mean	HB, %	RH, %
Parents									
Sakthi	0.58	-	-	0.21	-	-	2.94	-	-
LE 206	0.54	-	-	0.18	-	-	4.70	-	-
LE 214	0.51	-	-	0.16	-	-	3.05	-	-
St 64	0.40	-	-	0.28	-	-	6.39	-	-
Ohio 8 129	0.36	-	-	0.32	-	-	6.55	-	-
HW 208F	0.40	-	-	0.33	-	-	5.55	-	-
TH 318	0.43	-	-	0.28	-	-	3.91	-	-
Fresh Market 9	0.35	-	-	0.21	-	-	3.79	-	-
F_1 hybrids									
Sakthi x St 64	0.50	-13.79	2.04	0.27	-3.57	10.20**	7.63	19.41**	63.56**
Sakthi x Ohio 8 121	0.49	-15.52	4.26	0.28	-12.5	5.66	8.36	27.63**	76.19**
Sakthi x HW 208F	0.49	-15.52	-	0.31	-6.06	14.81**	5.22	-5.95	22.97*
Sakthi x TH 318	0.52	-10.34	2.97	0.25	-10.71	2.04	4.25	8.70	24.09*
Sakthi x Fresh Market 9	0.47	-18.97	1.08	0.25	19.05**	19.05**	4.16	9.76	23.63*
LE 206 x St 64	0.49	9.26	4.26	0.27	-3.57	17.39**	11.38	78.09**	105.23**
LE 206 x Ohio 8 129	0.43	-20.37	-4.44	0.29	-9.38	16.00**	11.66	78.02**	107.29**
LE 206 x HW 208F	0.46	-14.81	-2.13	0.30	-9.09	17.65**	6.15	10.81	20.00**
LE 206 x TH 318	0.51	-5.56	5.15	0.25	-10.71	8.70	5.12	8.94	18.93*
LE 206 x Fresh Market 9	0.46	-14.81	3.37	0.24	14.29*	13.08**	4.88	3.83	14.96*
LE 214 x St 64	0.44	-13.73	-3.30	0.25	-10.71	13.64**	6.54	2.35	38.56**
LE 214 x Ohio 8129	0.46	-9.80	-	0.26	-18.75	8.33	6.07	-7.33	26.46**
LE 214 x HW 208F	0.48	-5.88	5.49	0.26	-21.21	6.12	4.41	-20.54**	2.56
LE 214 x TH 318	0.51	-	8.51	0.24	-14.29	9.09	4.24	8.44	21.84*
LE 2 14 x Fresh Market 9	0.44	-13.73	2.33	0.23	9.52*	24.32**	4.16	97.6	21.64*
SEm	0.015			0.008			0.28		
CD (0.05)		0.04	0.04		0.02	0.02		0.81	0.70
CD (0.01) j		0.06	0.06		0.03	0.03		1.08	0.93

*Significant at 5 per cent level; **Significant at 1 per cent level

tively. These hybrids had 11.38 mg 100g^{-1} and 11.66 mg 100 g^{-1} lycopene respectively.

The female parents Sakthi and LE 214 showed 27.32% and 8.71% fruit cracking respectively whereas LE 206 was devoid of fruit cracking. Among the male parents, Fresh Market 9 alone showed fruit cracking (4.14%). Irrespective of the female and male parents involved in the crosses, the F1 hybrids were completely devoid of fruit cracking.

The data on bacterial wilt incidence and inheritance of resistance are presented in Tables 3 and 4. The female parents Sakthi and LE 206 recorded 23% and 42% wilt incidence respectively. The male parents and Fl hybrids were highly susceptible and none of the plants survived beyond 60 days after panting. The F2s in crosses with Sakthi segregated in a 3:1 ratio (P = 0.7 to 0.5) indicating that resistance to bacterial wilt in Sakthi is inherited monographically and is controlled by a single recessive gene. In crosses with LE 206, F2s segregated in a 13.3 ratio (P = 0.9 to 0.8) indicating that the gene system operating in LE 206 is digenic with supplementary gene interactions. From the F2 segregants, resistant plants with desirable fruit attributes like uniform ripening, good red colour, oval shape and resistance to cracking could be selected for further improvement.

Table 3. Inheritance of resistance to bacterial wilt in Sakthi

Generations	No. of plant			Expected no. considering expressivity		Expected* genetic ratio	χ^2	Probability
	Total	Resistant	Susceptible	R	S	R:S		
Sakthi	30	23	7	-	-	-	-	-
Ohio 8129	30	-	30	-	-	-	-	-
F1	30	-	30	-	-	-	-	-
F2	150	24	126	29	121	0.77:3.23	0.226	0.7-0.5
HW 208F	30	-	30	-	-		-	-
Fl	30	-	30	-	-		-	-
F2	150	22	128	29	121	0.77:3.23	0.235	0.7-0.5
TH 318	30	-	30	-	-	-	-	-
Fl	30	-	30	-	-	-	-	-
F2	150	28	122	29	121	0.77:3.23	0.206	0.7-0.5
Fresh Market 9								
Fl	30	-	30	-	-	-	-	-
F2	150	31	119	29	121	0.77:3.23	0.193	0.7-0.5

The expected ratio is derived from classical ratios considering expressivity

Table 4. Inheritance of resistance to bacterial wilt in LE 206

Generations	No. of plant			Expected considering expressivity, No		Expected* genetic ratio	χ^2	Probability
	Total	Resistant	Susceptible	R	S	R:S		
LE 206	30	17	13	-	-	-	-	-
St 64	30	-	30	-	-	-	-	-
Fl	30	-	30	-	-	-	-	-
F2	150	14	136	24	126	2.57:13.43	0.023	0.90-0.80
Ohio 8129	30	-	30	-	-		-	-
Fl	30	-	30	-	-		-	-
F2	150	12	138	24	126	2.57:13.43	0.022	0.90-0.80

The expected ratio is derived from classical ratios considering expressivity

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