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HETEROSIS FOR GROWTH, YIELD AND QUALITY TRAITS IN CHERRY TOMATO (*SOLANUM LYCOPERSICUM* VAR. *CERASIFORME*)

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Abstract

Seven diverse genotypes of cherry tomatoes (*Solanum lycopersicum* var. *cerasiforme*) were crossed in a half diallel fashion during *kharif* 2011. The resulting twenty-one hybrids along with 7 parents were tested during *rabi* 2012 for their mean performance and heterosis.

The study revealed that on the basis of mean performance the parents IIHR-2754, IIHR-2864 and IIHR-2863 were superior for all characters of total inflorescences (48), number of fruits per kg (96.67), number of fruits per plant (498.67), acidity (0.459mg/ 100g), average fruit weight (31.05 g), yield per plot (53.33 kg), ascorbic acid (38.67 mg/100g), total carotenoids (15.024 mg/ 100g) and Lycopene (6.97 mg/100g). However, the conclusion of result is crosses IIHR-2754 × IIHR-2866 and IIHR-2754 × IIHR-2860 were the best heterotic hybrids with respect to yield and yield related characters.

Key words : Heterosis, cherry tomato, half diallel.

Introduction

Tomato (*Solanum lycopersicum* L.) is one of the most important, popular and extensively used vegetable crop (Toor and Savage, 2005). Tomato ranks second among vegetables next to potato in area and production. It occupies an area of 6.34 lakh hectares with an annual production of 124.33 lakh metric tonnes accounting to an average productivity of 15.9 t/ha (Anonymous, 2011).

Cherry tomato *Solanum lycopersicum* var. *cerasiforme* is a botanical variety of the cultivated tomato. Cherry tomato is a warm season crop and grows under wide range of soil and climatic conditions. Cherry tomato is grown for its edible fruits, which can be consumed either fresh as a salad or after cooking as snacks. They are perfect for making processed products (Anonymous, 2009). Cherry tomato is considered as an important source of dietary antioxidants (Lenucci *et al*., 2006).

Although, cherry tomatoes have more nutritional values as compare to normal tomatoes there is a less work has been done with respect to quality improvement in cherry tomatoes. There was hardly any breeding programme targeted towards nutritive values in India. Therefore, in the recent past exploitation of hybrid vigour and selection of parents on the basis of gene action have been important breeding approaches in the crop improvement programme (Choudury and Khanna, 1972). Emphasized the extensive utilization of heterosis to step up tomato production. The present study was undertaken to estimate the magnitude of genetic variability and heterosis for yield and its component traits in crosses using seven diverse cherry tomato genotypes in half diallel combinations. A judicious choice of parents promotes an improvement process leading to a well planed hybridization in cherry tomato.

Materials and Methods

Twenty one cherry tomato lines were evaluated to study genetic diversity for important morphological and yield parameters during 2011. Based on the results of preliminary study, seven lines *viz*, IIHR-2754(P1), IIHR-2858(P2), IIHR-2860(P3), IIHR-2863(P4), IIHR-2864(P5), IIHR-2865(P6) and IIHR-2866(P7) were crossed in a half diallel fashion during 2012. The parents and resultant twenty-one F_1 hybrids were evaluated in a 7 × 7 half diallel analysis during *rabi* 2012 at Indian Institute of Horticultural Research, Hesaraghatta,

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Banglore-560089 and Karnataka. Four weeks old seedlings were transplanted in plots having four rows for each plot. Row to row spacing of 1 m and plant to plant spacing of 0.6 m, respectively so as to accommodate 40 plants in each plot per replication. Standard crop production technology as needed for crop was used in the experiment.

Data were collected from each plot on individual plant basis as mean values of five plants of each genotype selected at random for all the 14 characters. The data were subjected to statistical analysis according to Griffing (1956) using 'Indostat' software. Mid-parent heterosis (MPH) was calculated in terms of percent increase (+) or decrease (-) of the F_1 hybrids against its mid-parent value as suggested by Fehr (1987).

$$\text{MPH}(\%) = [F_1 - \text{MP/MP}]*100$$

Similarly, heterobeltiosis or better parent heterosis (BPH) was also estimated in terms of percent increase or decrease of the F_1 hybrid over its better parent.

$$\text{BPH}(\%) = [F_1 - \text{BP/BP}]*100$$

Significance of mid and better parent heterosis was determined following the "t" test.

$$\text{MP}(t) = F_1 - \text{MP}/\sqrt{(3/2r)}\text{EMS}$$

$$\text{BP}(t) = F_1 - \text{BP}/\sqrt{(2/r)}\text{EMS}$$

Where, F_1 = mean of the hybrid for a specific trait, MP = mid parent value for the cross, BP = mean of better parent in the cross and EMS = error mean square.

Results and Discussion

The analysis of variance for all the traits under study showed significant differences among parents and crosses revealing the presence of considerable variability among the genotypes. The average heterosis and heterobeltiotic effects were presented in table 1.

In the present studies seven hybrids showed positive heterosis for plant height and two hybrids showed positive heterobeltiosis (table 1), the magnitude of heterosis varied from 19.41 (P4×P6) to 32.05 (P2×P7), these were in close conformity with those of Joshi and Thakur (2003). For the character number of primary branches the highest magnitude of heterosis observed was 15.79 (P3×P6), heterosis for number of secondary branches the magnitude of heterosis varied from -41.94 (P5×P6) to 19.30 (P1×P5) and heterobeltiotic effect varied from -52.63 (P5×P6) to -12.12 (P1×P7). Heterobeltiosis for total number of inflorescence was found to be highest in P2×P3 (63.19) and minimum was observed in P2×P7 (-20.83). Heterobeltiosis for average fruit weight varies from -23.75 (P3×P5) to 33.90 (P1×P4). For the character fruits per kg the magnitude of heterosis varies from -36.51 (P1×P3) to 25.08 (P5×P6), heterobeltiosis values varied between -8.45 (P2×P3) to 45.86 (P1×P3). Heterosis and heterobeltiosis for number of fruits per truss was found to be highest in P2×P3 (62.70, 52.27). The hybrid P3×P5 (-35.71) showed maximum heterosis and heterobeltiotic effect for number of fruits per plant. A similar effect for this trait was also reported by Deepa and Thakur (2007**)**. The average heterosis for yield per plant ranged between 9.64 (P2×P7) to 93.94 (P1×P3) and heterobeltiosis values varied between 9.89 (P1×P7) to 93.94 (P1×P3), the similar results were also reported by Deepa and Thakur (2007), Sharma *et al*. (2006). For the trait yield per plot all the hybrids showed positive heterosis over mid-parent, highest heterosis over mid-parent recorded was 111.34 (P1×P7) fallowed by 82.79 (P4×P7) and least was 7.17 (P1×P3) and over better parent the values ranged between 8.13 (P5×P6) to 81.13 (P1×P7). The heterotic effect for yield per hectar ranged from 7.17 (P1×P3) to 111.34 (P1×P7) and heterobeltiotic values ranged between 9.09 (P2×P6) to 81.25 (P1×P7).

The heterobeltiotic effect for number of locules per fruit ranged between 20 (P1×P6, P3×P6) to 80.88 (P1×P4) and remaining hybrids showed non-significant heterobeltiosis. The heterosis over better parent for pericarp thickness ranged between 9.68 (P4×P5) to 74.29 (P1×P4) and negative heterobeltiotic effect varied between -22.31 (P1×P7) to -12.30 (P5×P7), these findings were in accordance with Venktram and Thuramani (2013).

Conclusion

Heterosis in hybrid plants has often been exploited as an efficient tool for increasing yields. Among other vegetables, heterotic hybrids have been commercially used in tomatoes. Inspite of the several possible genetic explanations for the phenomenon of heterosis, it is clear that its manifestation depends on genetic divergence of the two parental varieties. If heterosis manifested from the two parental varieties is relatively large, it is concluded that these varieties are genetically more diverse than two other varieties that manifested little or no heterosis in their crosses. Therefore, the present study was carried out, to find out genetic variability and the extent of heterosis for yield and yield related attributes in tomato. The promising hybrids IIHR-2754 × IIHR-2866 ($P_1 \times P_7$) and IIHR-2754 × IIHR-2860 ($P_1 \times P_3$) were selected for exploitation in subsequent tomato breeding programmes. Three of the parents, IIHR-2866, IIHR-2864 and IIHR-2865 were also considered for re-evaluated for their higher yield potential. In conclusion, the present

Table 1 : Heterosis for Heterosis for growth, yield and quality traits in cherry tomato.

S. no.	F_1 Hybrids	Plant hight (cm)		No. of Pri branches		No. of sec. branches		Total infloresence		Average fruit weight		Fruits per kg		Fruits per cluster	
		Average heterosis	Heterobe ltiosis	Average heterosis	Heterobe ltiosis	Average heterosis	Heterobel tiosis	Average heterosis	Heterobel tiosis	Average heterosis	Heterobe ltiosis	Average heterosis	Heterobe ltiosis	Average heterosis	Heterobe ltiosis
1	$P_1 \times P_2$	2.62	-10.2	10	0	-6.67	-15.15 *	2.31	-7.64	4.85	-9.1	-6.96 **	-19.31 **	-6.67	-9.68 *
2	$P_1 \times P_3$	17.46	10.71	10	0	1.64	-6.06	7.63	-6.94	53.12 **	30.65 **	-36.57 **	-45.86 **	-18.64 **	-22.58 **
3	$P_1 \times P_4$	28.51 **	17.86	10	0	-11.86*	-21.21**	34.13 **	17.36 **	46.23 **	33.90 **	-32.20 **	-37.93 **	-22.81 **	-29.03 **
4	$P_1 \times P_5$	7.01	6.87	-9.09	-9.09	19.30**	3.03	-11.97 *	-20.83 **	-23.22 **	-48.80 **	-2.33	-34.83 **	-23.08 **	-35.48 **
5	$P_1 \times P_6$	22.41 **	18.33 *	-4.76	-9.09	-21.13**	-26.32**	-1.93	-11.81 *	37.53 **	20.47 **	-28.74 **	-37.59 **	-10.71 *	-19.35 **
6	$P_1 \times P_7$	7.87	6.63	-14.29*	-18.18*	-6.45	-12.12*	8.53	-2.78	17.62 **	4.23	-16.34 **	-25.86 **	-10.71 *	-19.35 **
7	$P_2 \times P_3$	8.27	0	0	0	1.82	0	71.95 **	63.79 **	7.1	5.09	-6.70 *	-8.45 **	-5.26	-6.90 ns
8	$P_2 \times P_4$	-14.01	-18.35	0	0	-5.66	-7.41	3.57	0	17.16 **	10.30 *	-14.98 **	-19.92 **	-9.09 *	-13.79 **
9	$P_2 \times P_5$	30.42 **	13.99	0	-9.09	-9.8	-14.81*	4.76	4.31	-11.34 **	-35.52 **	-3.23	-29.58 **	-24.00 **	-34.48 **
10	$P_2 \times P_6$	21.29 *	3.1	-5.26	-10	-23.08 **	-34.21**	16.02 **	15.52 *	19.64 **	18.21**	-16.47 **	-17.43 **	-7.41	-13.79 **
11	$P_2 \times P_7$	32.05 **	16.71	-5.26	-10	-14.29 *	-17.24*	11.30 *	10.34	31.52 **	28.25**	-24.03 **	-25.89 **	-7.41	-13.79 **
12	$P_3 \times P_4$	-6.53	-9.22	0	0	3.7	0	20.19 **	18.52 **	36.03 **	25.81	-26.91 **	-32.37 **	-7.41	-10.71 *
13	$P_3 \times P_5$	14.86	8.14	10	0	-11.54	-17.86*	0.91	-3.48	3.6	-23.75**	-15.89 **	-38.05 **	-26.53 **	-35.71 **
14	$P_3 \times P_6$	11.34	1.67	15.79 *	10	0	-13.16*	7.27	2.61	26.47 **	22.65**	-21.04 **	-23.39 **	-16.98 **	-21.43 **
15	$P_3 \times P_7$	24.93 **	19.06	-5.26	-10	-8.77	-10.34	4.11	0	9.16 *	4.5	-8.62 **	-12.50 **	-20.75 **	-25.00 **
16	$P_4 \times P_4$	30.00 **	19.08 *	-10	-18.18 *	16.00 *	11.54	35.43 **	31.30 **	-9.16 **	-36.36**	-10.06 **	-36.93 **	-19.15 **	-26.92 **
17	$P_4 \times P_6$	19.41 *	6.19	-5.26	-10	-28.13 **	-39.47**	21.08 **	17.39 **	27.18 **	21.10**	-21.57 **	-25.31 **	-5.88	-7.69
18	$P_4 \times P_7$	21.69 *	12.79	-5.26	-10	-27.27 **	-31.03**	18.92 **	15.79 *	27.04 **	22.52 **	-21.29 **	-24.07 **	-1.96	-3.85
19	$P_5 \times P_6$	-5.78	-8.81	-14.29 *	-18.18 *	-41.94 **	-52.63**	5.22	5.22	-31.98 **	-50.91 **	25.08 **	-9.63 **	-13.04 *	-20.00 **
20	$P_5 \times P_7$	1.8	0.51	-14.29 *	-18.18 *	-16.98 **	-24.14**	10.92	10.43	-18.59 **	-41.72 **	3.43	-25.89 **	0	-8
21	$P_6 \times P_7$	4.86	0.24	-10	-10	-10.45 *	-21.05**	0.44	0	8.84 *	7.41	-8.14 **	-9.38 **	0	0
	SE ±	10.91	12.6	0.238	0.2749	0.56	0.65	2.1	2.43	0.59	0.68	1.81	2.09	0.39	0.46
	CD @ 5%	21.39	24.69	0.466	0.537	1.1	1.28	2.15	4.77	1.15	1.33	3.56	4.11	0.78	0.9
	CD @ 1 %	28.04	32.38	0.611	0.704	1.45	1.67	5.42	6.26	1.51	1.74	4.66	5.39	1.02	1.18

***-significant at 5 % , **- significant at 1%**

Table 1 continued...

S. no.	F_1 Hybrids	Fruits per plant		Yield per plant		Yield per plot		Yield per ha		No. of locules/fruit		Fruit firmness		Pericarp thickness	
		Average heterosis	Heterobeltiosis	Average heterosis	Heterobeltiosis	Average heterosis	Heterobeltiosis	Average heterosis	Heterobeltiosis	Average heterosis	Heterobeltiosis	Average heterosis	Heterobeltiosis	Average heterosis	Heterobeltiosis
1	P_1 x P_2	-4.54	-16.44 **	36.17 **	28.00 **	68.47 **	57.14 **	68.47 **	57.14 **	0	-11.11	-2.13	-8.00 *	3.6	-1.37
2	P_1 x P_3	-13.37 *	-28.34 **	93.94 **	93.94 **	7.17 **	-5.22	7.17 **	-5.22 ns	14.29	14.29	-22.48 **	-24.24 **	2.2	-19.83 **
3	P_1 x P_4	2.22	-16.84 **	13.29 **	5.19	55.67 **	53.40 **	55.67 **	53.40 **	-20	-25	83.58 **	80.88 **	35.25 **	28.77 **
4	P_1 x P_5	-34.03 **	-49.20 **	21.05 **	6.98	61.98 **	33.13 **	61.98 **	33.13 **	14.29	14.29	20.69 **	-2.78	14.29 **	-16.67 **
5	P_1 x P_6	-13.83 *	-29.41 **	60.81 **	45.12 **	58.54 **	36.36 **	58.54 **	36.36 **	-11.11	-27.27 *	27.66 **	20.00 **	44.36 **	43.28 **
6	P_1 x P_7	-3.85	-21.46 **	27.39 **	9.89 *	111.34 **	81.25 **	111.34 **	81.25 **	0	0	-1.86	-3.65	0.53	-22.31 **
7	P_2 x P_3	62.70 **	52.27 **	39.01 **	30.67 **	23.32 **	16.42 **	23.32 **	16.42 **	-25	-33.33 *	8.70 *	0	0.53	-18.10 **
8	P_2 x P_4	-5.87	-13.62	-1.32	-2.6	57.08 **	44.54 **	57.08 **	44.54 **	-17.65	-22.22	9.09 **	4	64.38 **	64.38 **
9	P_2 x P_5	-20.46 *	-31.61 **	25.47 **	17.44 **	34.77 **	17.50 **	34.77 **	17.50 **	-25	-33.33 *	18.03 **	0	65.90 **	25.00 **
10	P_2 x P_6	7.12	-0.89	-0.64	-4.88	19.08 **	9.09 **	19.08 **	9.09 **	-30.00 **	-36.36 **	36.00 **	36.00 **	74.29 **	67.12 **
11	P_2 x P_7	3.52	-4.54	9.64 *	0	63.50 **	49.31 **	63.50 **	49.31 **	-12.5	-22.22	49.83 **	43.33 **	29.90 **	4.13
12	P_3 x P_8	11.22	8.89	7.69	0	47.01 **	28.36 **	47.01 **	28.36 **	-6.67	-12.5	66.41 **	60.29 **	-0.53	-18.97 **
13	P_3 x P_5	-25.46 **	-31.97 **	19.74 **	5.81	39.46 **	28.13 **	39.46 **	28.13 **	0	0	67.25 **	32.41 **	15.38 **	4.17
14	P_3 x P_6	-10.65	-11.75	33.78 **	20.73 **	51.62 **	46.85 **	51.62 **	46.85 **	-11.11	-27.27 *	30.43 **	20.00 **	4.92	-17.24 **
15	P_3 x P_7	-16.97 *	-18.28	12.10 **	-3.3	25.18 **	20.83 **	25.18 **	20.83 **	0	0	77.95 **	70.80 **	3.8	1.65
16	P_4 x P_5	9.51	1.92	15.34 **	9.30 *	37.69 **	11.88 **	37.69 **	11.88 **	-20	-25	4.55	-14.81 **	9.68 *	-17.36 **
17	P_4 x P_6	14.1	13.09	20.75 **	17.07 **	45.68 **	23.78 **	45.68 **	23.78 **	-15.79	-27.27 *	0.7	-4	37.14 **	31.51 **
18	P_4 x P_7	16.44	15.82	7.14	-1.1	82.79 **	54.86 **	82.79 **	54.86 **	-6.67	-12.5	75.09 **	74.45 **	21.65 **	-2.48 ns
19	P_5 x P_6	-8.68	-15.71	21.43 **	18.60 **	21.45 **	15.00 **	21.45 **	15.00 **	0	-18.18	-2.19	-17.13 **	15.64 **	-15.28 **
20	P_5 x P_7	11.16	2.95	3.95	1.1	13.82 **	8.13 **	13.82 **	8.13 **	14.29	14.29	5.38 *	-13.89 **	-4.91	-12.50 **
21	P_6 x P_7	0.68	0.31	0.58	-4.4	31.71 **	31.25 **	31.71 **	31.25 **	11.11	-9.09	67.25 **	60.00 **	2.13	-20.66 **
	SE ±	26.36	30.43	0.1	0.12	1.06	1.23	0.67	0.76	0.36	0.41	0.15	0.17	0.14	0.16
	CD @ 5%	51.66	59.64	0.2	0.23	2.08	2.41	1.31	1.48	0.7	0.81	0.303	0.35	0.28	0.32
	CD @ 1 %	67.48	77.9	0.26	0.31	2.73	3.16	1.71	1.94	0.92	1.06	0.398	0.46	0.37	0.43

study suggests that hybrid breeding can be used efficiently to improves, yield together with its yield components in cherry tomato.

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