



## **Per se performance of parents and hybrids in tomato for quantitative and qualitative characters**

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**Abstract:** Six lines and their hybrids generated through diallel fashion were evaluated for their *Per se* performances for 12 characters. The maximum yield per plant was recorded by the cross Shakthi x Accn. No. 368894. The crosses, which included Shakthi, Accn. No. 368894 and Accn. No. 378642 as parents have shown superior *Per se* performance for single plant yield, number of laterals per plant, number of fruits per plant, number of fruits per cluster, total soluble solids and flesh thickness.

**Key words :** *Tomato, Per se, Qualitative characters, Quantitative characters.*

### **Introduction**

*Per se* performance is still the most simple and effective way to get a first hand information on the genotypes. Parents with good *Per se* performance are expected to yield desirable recombinations in the segregating generations and the potentiality of such genotypes will also reflect in the performance of hybrids. The selected genotypes can be further used to exploit heterosis or recombination breeding. With this objective six tomato genotypes and their resultant hybrids were evaluated based on mean *Per se* performance.

### **Materials and Methods**

Six diverse tomato genotypes viz. CO 3 (P<sub>1</sub>), PKM 1 (P<sub>2</sub>), Shakthi (P<sub>3</sub>), Accn. No. 368893 (P<sub>4</sub>), Accn. No. 378642 (P<sub>5</sub>) and Accn. No. 368894 (P<sub>6</sub>) were crossed in a diallel fashion including reciprocals and the resultant 30 F<sub>1</sub> hybrids with their six parents were raised in a randomized block design with two replications at the orchard, Department of Horticulture, Agriculture College and Research Institute, Madurai during Rabi season (1999-2000). The recommended cultural practices were followed. Observations were recorded on five randomly selected plants from each entry in each replication for twelve quantitative and qualitative characters, viz. days to first flowering, plant height (cm), number of laterals per plant, number of fruits per plant, number of fruits per cluster, number of locules per fruit, flesh thickness (cm), total soluble solids (°Brix), acidity (per cent), ascorbic acid (mg/100g), mean fruit weight (g) and single plant yield (g). The data were analysed

for variances to assess the treatments difference for the various characters (Panse and Sukhatme, 1961).

### **Results and Discussion**

Analysis of variance details for twelve characters are furnished in Table 1. There existed significant variability among the parents and hybrids for all the characters. This is an essential pre requisite for further study of the genotypes. The mean performance of parents and hybrids is given in Table 2.

Early flowering is an important trait and an advantageous feature in tomato to have early maturity. In parents it ranged from 48.50 days (Accn. No. 368893) to 60.00 days (CO 3). Among the hybrids Accn. No. 378642 x CO 3 was the earliest (46.00 days) to commence flowering. The hybrids (51.36 days) commenced earlier flowering than their parents (53.75). Dwarf genotypes with determinate growth habit is an essential pre requisite for a successful hybrid. As many as 17 hybrids recorded significant decrease in the plant height over the hybrid mean (49.14 cm). The hybrid CO 3 x PKM 1 (38.65 cm) was the shortest. Information on variation in plant height is available from the studies of Dod *et al.* (1992) and Kumar *et al.* (1995). The number of laterals was found to be more in Accn. No. 368894 (15.75) and the hybrid Shakthi x Accn. No. 368894 (13.25).

Number of fruits per plant and number of fruits per cluster are the major yield contributing components in tomato. The parental value for

**Table 1.** Analysis of variances for twelve characters (Mean sum of squares)

Source	df	Days to first flowering	Plant height	Number of laterals per plant	Number of fruits per plant	Number of fruits per cluster	Number of locules per fruit
Replication	1	4.0138	3.234	0.0394	2.177	0.00000216	0.1801
Treatment	35	17.499**	62.094**	6.580**	727.115**	4.265**	5.080**
Error	35	4.585	2.109	0.326	1.849	0.00102	0.1937

*Table 1. Continued*

Source	df	Flesh thickness	Total soluble solids	Acidity	Ascorbic acid	Mean fruit weight	Single plant yield
Replication	1	0.00375	1.680	0.0011	0.00496	0.0477	28.327
Treatment	35	0.01593**	0.764**	0.0112**	4.5305**	660.205**	418070.51**
Error	35	0.00176	0.187	0.0001	0.00692	1.904	7.647

\* Significant at 5 per cent level.

\*\* Significant at 1 per cent level.

number of fruits per plant ranged from 75.60 (Accn. No. 368894) to 21.00 (Accn. No. 368893). The cross Accn. No. 368894 x Accn. No. 378642 had maximum number of fruits per plant (88.37). In case of number of fruits per cluster the parental value ranged from 6.07 (Accn. No. 368894) to 1.73 (Accn. No. 368893). The hybrid Accn. No. 368894 x Accn. No. 378642 recorded the highest number of fruits per cluster. Pujari and Kale (1994) adjudged these were the important yield contributing characters.

The fruit quality suitability for long distance transport and processing qualities are determined by the presence of locules per fruit, total soluble solids, acidity and ascorbic acid content (Dod and Kale, 1992). Regarding locules per fruit the lowest number is considered favourable for processing. In the present study the parents Accn. No. 378642 and 368894 recorded the lowest number of locules (2.00). Around 24 hybrids registered lesser number of locules per fruit. In case of flesh thickness the values ranged from 0.70 (Accn. No. 368893) to 0.40 cm (CO 3 and PKM 1) in parents and 0.70 (Accn. No. 368894 x PKM 1) to 0.30 (PKM 1 to CO 3) for hybrids. The hybrid mean

(0.57) was found to be higher than the parental mean (0.52) inducing the heterotic nature of the synthesised hybrids.

The flavour of tomato products depends on the total soluble solids (TSS) of fruits (Stevens, 1972). The range of TSS in parents ranged from 5.25 °Brix (Accn. No. 368894) to 2.75 °Brix (CO 3) and the hybrids PKM 1 x CO 3, PKM 1 x Accn. No. 378642 and Accn. No. 378642 x Accn. No. 368893 recorded high TSS of 4.50 °Brix. For acidity the mean parental value ranged from 0.55 per cent (PKM 1) to 0.36 per cent (Accn. No. 368894) the hybrid (Accn. No. 378642 x PKM 1) recorded the highest acidity among all. The hybrid mean (0.46) was found to be higher than the parental mean (0.45) relevant that the hybrids were acidic in nature. The ascorbic acid content varied from 18.77 mg/100g (Accn. No. 368893) to 13.65 mg/100g (Accn. No. 378642) in parents and the hybrid PKM 1 x Accn. No. 368893 recorded the highest ascorbic acid content 19.61 mg/100 g.

The parents showed a wide variation for fruit weight, which ranged from 30.18 g (Accn.

Table 2. Mean performance of parents and hybrids in 6 x 6 diallel set of crosses for twelve characters.

Parents/ Hybrids	Days to first flowering	Plant height (cm)	Number of laterals per plant	Number of fruits per plant	Number of fruits per cluster	Number of locules per fruit
CO-3 (P <sub>1</sub> )	60.00	45.50	11.50	44.50	2.76	4.30
PKM-1 (P <sub>2</sub> )	54.00	45.30	11.00	38.60	3.09	8.00
Shakthi (P <sub>3</sub> )	54.00	53.00	10.50	57.00	4.32	4.00
Accn. No. 368893 (P <sub>4</sub> )	48.50	48.75	8.50	21.00	1.73	7.10
Accn. No. 378642 (P <sub>5</sub> )	53.00	45.10	10.25	62.80	5.94	2.00
Accn. No. 368894 (P <sub>6</sub> )	53.00	63.50	15.75	75.60	6.07	2.00
(P <sub>1</sub> ) x (P <sub>2</sub> )	58.00	38.65	8.25	42.60	4.04	5.00
(P <sub>1</sub> ) x (P <sub>3</sub> )	55.50	46.65	7.65	47.59	3.92	3.50
(P <sub>1</sub> ) x (P <sub>4</sub> )	52.50	47.50	9.15	38.23	2.32	4.00
(P <sub>1</sub> ) x (P <sub>5</sub> )	51.00	45.25	9.35	51.61	6.93	3.00
(P <sub>1</sub> ) x (P <sub>6</sub> )	54.50	54.50	10.50	58.23	4.31	3.00
(P <sub>2</sub> ) x (P <sub>1</sub> )	53.50	47.50	10.00	40.73	4.63	7.00
(P <sub>2</sub> ) x (P <sub>3</sub> )	50.50	58.50	10.00	43.21	3.79	4.00
(P <sub>2</sub> ) x (P <sub>4</sub> )	52.00	50.00	8.35	28.27	2.70	8.00
(P <sub>2</sub> ) x (P <sub>5</sub> )	51.00	47.00	11.85	48.37	4.97	7.00
(P <sub>2</sub> ) x (P <sub>6</sub> )	48.00	47.15	8.10	52.70	5.22	3.00
(P <sub>3</sub> ) x (P <sub>1</sub> )	49.50	54.50	10.05	76.21	5.08	4.00
(P <sub>3</sub> ) x (P <sub>2</sub> )	49.50	55.00	9.00	72.63	3.12	5.00
(P <sub>3</sub> ) x (P <sub>4</sub> )	49.50	56.50	12.20	68.79	3.74	6.10
(P <sub>3</sub> ) x (P <sub>5</sub> )	52.00	51.00	9.15	80.83	4.27	3.00
(P <sub>3</sub> ) x (P <sub>6</sub> )	51.00	50.50	13.25	85.92	5.73	3.00
(P <sub>4</sub> ) x (P <sub>1</sub> )	54.50	51.30	10.15	24.32	2.27	4.00
(P <sub>4</sub> ) x (P <sub>2</sub> )	52.00	48.10	9.85	22.73	5.32	4.00
(P <sub>4</sub> ) x (P <sub>3</sub> )	50.50	53.15	11.50	28.33	2.93	5.00
(P <sub>4</sub> ) x (P <sub>5</sub> )	53.00	49.00	9.75	31.75	3.93	4.00
(P <sub>4</sub> ) x (P <sub>6</sub> )	46.50	52.20	9.65	37.59	4.92	3.00
(P <sub>5</sub> ) x (P <sub>1</sub> )	46.00	44.00	12.35	60.98	7.01	3.00
(P <sub>5</sub> ) x (P <sub>2</sub> )	50.50	40.65	8.15	57.29	4.98	4.00
(P <sub>5</sub> ) x (P <sub>3</sub> )	50.50	43.75	10.00	65.37	5.43	3.00
(P <sub>5</sub> ) x (P <sub>4</sub> )	51.50	45.60	11.50	50.77	3.17	3.00
(P <sub>5</sub> ) x (P <sub>6</sub> )	47.00	49.50	13.00	73.93	7.31	3.00
(P <sub>6</sub> ) x (P <sub>1</sub> )	56.00	46.15	13.10	75.37	4.49	3.00
(P <sub>6</sub> ) x (P <sub>2</sub> )	51.00	46.00	10.90	68.82	5.13	4.00
(P <sub>6</sub> ) x (P <sub>3</sub> )	52.00	47.15	13.60	80.94	5.17	3.00
(P <sub>6</sub> ) x (P <sub>4</sub> )	51.50	43.70	11.00	62.72	3.12	3.00
(P <sub>6</sub> ) x (P <sub>5</sub> )	50.50	63.75	9.40	88.37	7.49	3.00
Mean of parents	53.75	50.19	11.25	49.08	3.99	4.56
Mean of hybrids	51.36	49.14	10.36	55.52	4.58	4.02
Grand mean	51.76	49.32	10.51	54.44	4.48	4.11
SE	0.214	0.145	0.571	1.360	0.317	0.440
CD at 5%	0.434	0.294	1.159	2.768	0.643	0.893
CD at 1%	0.5829	0.3949	1.555	3.704	0.863	1.198

Table 2. Continued...

Parents/ Hybrids	Flesh thickness (cm)	Total soluble solids (°Brix)	Acidity (%)	Ascorbic acid (mg/100g)	Mean fruit weight (g)	Single plant yield (g)
CO-3 (P <sub>1</sub> )	0.40	2.75	0.46	14.68	38.61	1689.25
PKM-1 (P <sub>2</sub> )	0.40	4.00	0.55	17.69	33.86	1345.30
Shakthi (P <sub>3</sub> )	0.50	3.50	0.48	15.43	39.18	2126.25
Accn. No. 368893 (P <sub>4</sub> )	0.70	4.00	0.50	18.77	80.32	1008.29
Accn. No. 378642 (P <sub>5</sub> )	0.60	4.00	0.37	13.65	30.18	18.23.25
Accn. No. 368894 (P <sub>6</sub> )	0.50	5.25	0.36	15.51	38.30	1959.50
(P <sub>1</sub> ) x (P <sub>2</sub> )	0.40	3.00	0.55	18.34	31.32	1450.37
(P <sub>1</sub> ) x (P <sub>3</sub> )	0.50	3.50	0.47	15.33	40.17	2011.20
(P <sub>1</sub> ) x (P <sub>4</sub> )	0.50	3.00	0.58	18.85	48.73	1370.37
(P <sub>1</sub> ) x (P <sub>5</sub> )	0.40	4.25	0.43	14.93	35.32	1825.71
(P <sub>1</sub> ) x (P <sub>6</sub> )	0.50	3.00	0.43	15.69	38.91	1921.32
(P <sub>2</sub> ) x (P <sub>1</sub> )	0.30	4.50	0.45	16.44	37.09	1450.93
(P <sub>2</sub> ) x (P <sub>3</sub> )	0.50	3.00	0.58	16.90	40.37	1921.30
(P <sub>2</sub> ) x (P <sub>4</sub> )	0.60	3.00	0.58	19.61	43.72	1375.29
(P <sub>2</sub> ) x (P <sub>5</sub> )	0.40	4.50	0.44	16.94	26.21	1725.78
(P <sub>2</sub> ) x (P <sub>6</sub> )	0.50	3.75	0.41	16.80	32.00	1825.23
(P <sub>3</sub> ) x (P <sub>1</sub> )	0.40	3.00	0.43	16.25	47.82	2340.50
(P <sub>3</sub> ) x (P <sub>2</sub> )	0.40	4.00	0.59	18.62	33.46	2750.21
(P <sub>3</sub> ) x (P <sub>4</sub> )	0.50	4.00	0.49	17.94	50.92	1950.73
(P <sub>3</sub> ) x (P <sub>5</sub> )	0.60	3.75	0.39	16.26	38.73	2987.97
(P <sub>3</sub> ) x (P <sub>6</sub> )	0.50	3.25	0.37	17.25	42.63	3125.87
(P <sub>4</sub> ) x (P <sub>1</sub> )	0.60	3.75	0.47	17.89	85.34	1325.36
(P <sub>4</sub> ) x (P <sub>2</sub> )	0.40	3.25	0.50	19.26	73.46	1265.50
(P <sub>4</sub> ) x (P <sub>3</sub> )	0.50	3.25	0.51	16.27	97.62	1750.15
(P <sub>4</sub> ) x (P <sub>5</sub> )	0.60	3.75	0.41	14.94	77.49	1450.27
(P <sub>4</sub> ) x (P <sub>6</sub> )	0.40	3.00	0.51	17.26	80.72	1625.32
(P <sub>5</sub> ) x (P <sub>1</sub> )	0.50	4.25	0.48	14.94	38.19	1790.35
(P <sub>5</sub> ) x (P <sub>2</sub> )	0.60	4.00	0.62	16.25	29.00	1619.90
(P <sub>5</sub> ) x (P <sub>3</sub> )	0.40	3.50	0.43	14.21	42.31	2350.87
(P <sub>5</sub> ) x (P <sub>4</sub> )	0.50	4.50	0.36	15.25	53.79	1750.39
(P <sub>5</sub> ) x (P <sub>6</sub> )	0.50	3.25	0.39	16.25	32.10	2150.87
(P <sub>6</sub> ) x (P <sub>1</sub> )	0.50	3.00	0.39	15.75	35.14	1922.32
(P <sub>6</sub> ) x (P <sub>2</sub> )	0.70	3.50	0.43	16.26	29.00	1792.32
(P <sub>6</sub> ) x (P <sub>3</sub> )	0.50	3.75	0.49	15.75	42.13	2230.23
(P <sub>6</sub> ) x (P <sub>4</sub> )	0.50	3.00	0.34	17.26	50.00	1692.35
(P <sub>6</sub> ) x (P <sub>5</sub> )	0.50	2.25	0.37	14.34	30.90	1923.35
Mean of parents	0.52	3.92	0.45	15.95	43.40	1658.64
Mean of hybrids	0.57	3.51	0.46	16.59	46.15	1888.77
Grand mean	0.49	3.58	0.46	16.49	45.69	1850.42
SE	0.420	0.433	0.363	0.828	1.379	2.765
CD at 5%	0.852	0.878	0.736	1.680	2.799	5.612
CD at 1%	1.144	1.179	0.988	2.255	3.756	6.287

No. 378642) to 80.32 g (Accn. No. 368893). The hybrid Accn. No. 368893 x Shakthi (97.62 g) recorded the highest mean fruit weight among the cross combinations studied. The high yield potential is considered to be the most important character for any variety or hybrid, the parents recorded a range of 2126.25 g (Shakthi) to 1008.29 g/plant (Accn. No. 368893). The hybrid Shakthi x Accn. No. 368894 registered the highest yield of 3125.87 g/plant among the cross combinations studied. The hybrid mean (1888.77) was also found to be higher than the parental mean (1658.64).

The common parent occurring in a number of hybrids with superior *per se* performance can be considered as a successful donar for the particular trait. In the present study, the parents Shakthi and Accn. No. 368894 were identified as the best donars. The hybrids Shakthi x Accn. No. 368894 and Accn. No. 378642 x Accn. No. 368894 excelled in its *per se* performance for many traits.

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