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Production and evaluation of tomato hybrids using diallel genetic design

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ABSTRACT

Tomato is one of the most important vegetable crops and is known for its versatile uses. Thirty diverse tomato lines were evaluated out of which ten lines were selected on the basis of superior performance and crossed in a diallel fashion. The forty five F_1s along with ten parents were evaluated for various horticultural traits and compared to standard hybrid Naveen. On the basis of mean performance and heterosis over better parent, the cross FT-5 x UHF-659 gave the highest positive heterobeltiosis (43.67 per cent) over better parents. The cross AI-9 x UHF-612 was identified as early yielding cross. The heterobeltiotic effect for number of fruits per cluster ranged from -34.39 (EC-15998 x FT-5) to 33.0 percent (FT-5 x UHF-612). AI-9 yielded significantly higher (1347.16 g) than all other parents. The fruit yield among the crosses varied from 764.33 (EC-174023 x UHF-663) to 1808.23 g (AI-9 x Solan Vajr). The parent FT-5 (4.79°B) and the cross combination Solan Vajr x UHF-659 (4.70°B) showed highest total soluble solids content. Solan Vajr, having tallest plants maintained superiority over the parents for harvest duration. Significant heterobeltiotis was observed in desirable direction for all the traits except days to first picking and total soluble solids. The EC-15998 x AI-9, FT-5 x Solan Vajr, AI-9 x Solan Vajr and Solan Vajr x UHF-659 were identified as superior crosses on the basis of mean performance and heterosis.

Key words: Diallel analysis, genetic studies, evaluation, tomato.

INTRODUCTION

Tomato is a widely cultivated and consumed vegetable in the world and India. The hybrid cultivars in tomato have generated increased interest among the breeders due to possibility of combining a complex of valuable attributes in a genotype, *viz*. earliness, uniformity, high yield, resistance to diseases and strong adaptability to different environmental conditions. However in public sector there is still a dearth of F_1 hybrids that have a complex of these valuable attributes. The systematic approach for developing F_1 hybrids in any crop depends primarily on selection of desirable parents. The choice of parents in hybrid breeding programme largely depends upon target traits required in resultant F_1 hybrids. The diallel analysis evaluates parents for their breeding value and provides adequate information about their gene action.

Therefore, the present investigations were undertaken with a view to explore the possibility of developing high yielding tomato hybrids coupled with desirable traits like earliness, prolonged harvest duration and better fruit quality.

MATERIALS AND METHODS

The present investigations were carried out on the experimental farm of Department of Vegetable Crops, Dr Y.S. Parmar UHF Nauni, Solan, which falls under mid-hill zone of Himachal Pradesh. The experimental site represents an altitude of 1270 m above mean sea level with an average annual rainfall of 1,100-1,300 mm, most of which occurred during monsoon. In summer, 30 diverse tomato lines were evaluated for horticultural traits. On the basis of their mean performance presented in Table 1, ten lines, *viz*., EC-15998, AI-9, EC-174023, FT-5, Solan Vajr, UHF-656, UHF 553, UHF-659, UHF-612 and UHF-663 were selected and crossed in a diallel fashion, excluding reciprocals, to obtain forty five hybrid combinations. The F_1s were evaluated along with parents for various horticultural traits and were also compared with commercial hybrid Naveen. The experiment was laid out in a randomized block design with three replications. Eighteen plants of each line were transplanted in first week of June at a recommended spacing of 90 cm x 30 cm. The standard cultural practices to raise tomato crop in mid hills were followed as per the recommendations of the university. The observations pertaining to plant height (cm), days to first picking, number of fruits per cluster, fruit weight (g), yield (g), pericarp thickness (mm), total soluble solids (°Brix) and harvest duration (days) were recorded on ten randomly selected competitive plants from each treatment. Plant height of selected plants was measured from the ground level to the highest tip of the plant at the end of the crop season and mean was worked out. Data on the days to marketable picking was recorded from the date of

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Table 1. Mean performance of different tomato genotypes with respect to some important traits

Genotype	Plant height (cm)	No. of fruits per cluster	No. of fruits per plant	Fruit weight (g)	Yield per plant (g)	Pericarp thickness (mm)	Total soluble solids (°B)
Magna	73.69	4.12	17.22	54.37	955.30	3.98	4.02
Cal-ace	110.03	3.16	15.00	68.46	1000.22	4.90	4.13
S-12	57.96	3.38	22.81	40.10	943.86	3.64	3.97
Sel-6	105.92	3.43	18.33	55.12	990.00	5.10	3.80
T-777	91.67	3.73	14.26	51.67	722.70	4.93	3.98
CL-1131	95.16	3.05	11.44	73.87	925.43	3.78	3.89
CRA-66	111.92	3.58	29.00	43.02	911.33	4.16	4.45
A-2	115.84	3.40	9.08	72.72	681.00	5.39	4.27
AC-402	67.67	3.95	14.56	60.80	860.51	4.69	3.98
Hawaii 7998	120.32	4.13	21.23	31.84	873.63	4.35	4.00
FT-1	111.33	3.22	17.40	48.65	850.00	3.70	3.73
FT-4	98.11	3.85	17.00	37.09	706.67	3.52	3.90
FT-5	135.57	3.00	16.33	73.22	1267.20	6.69	4.70
FT-6	101.65	3.54	11.74	61.29	743.33	5.50	3.97
FT-13	115.87	3.73	10.63	68.40	817.60	5.02	4.10
FT-100	108.74	4.00	13.50	62.52	871.00	5.42	3.79
EC-50311-1-1	106.39	3.13	14.19	64.60	910.81	3.44	4.05
EC-141887	149.93	3.31	18.45	46.40	780.62	4.74	4.48
EC-174031	130.00	4.45	27.12	30.77	721.73	4.76	4.44
EC-110264	133.85	3.39	21.05	42.59	815.33	4.00	4.69
EC-113809	132.86	3.62	19.99	45.40	755.00	3.91	4.71
EC-191538	107.51	4.03	19.10	40.89	776.80	5.41	4.64
EC-15998	115.00	3.65	20.00	57.00	1150.33	5.72	4.15
EC-174023	120.92	3.10	16.70	61.46	1000.43	5.23	3.98
AI-9	105.36	3.55	22.00	77.80	1278.19	6.44	3.95
Solan Vajr	162.39	3.78	17.00	70.51	1197.59	6.79	4.00
UHF-656	140.64	3.00	16.00	62.28	1050.55	4.62	3.45
UHF-553	86.53	3.35	18.00	55.00	1000.46	3.85	3.69
UHF-659	97.44	2.98	21.33	52.29	1134.77	5.41	3.30
UHF-612	70.13	3.40	16.55	56.44	960.16	4.44	3.22
UHF-663	85.57	4.10	19.00	53.98	920.25	6.53	3.96

transplanting to the date of first marketable harvest. Number of fruits in ten plants per cluster were counted and averaged. Average fruit weight (g) was calculated by dividing the total marketable yield in grams with total number of marketable fruits for each treatment. Pericarp thickness of ten randomly picked fruits were measured after cutting the fruits transversely. Measurement was done with digital Vernier callipers in millimetres and mean value was worked out. The pickings were made at half ripe stage for computing yield per plant (Thompson and Kelly, 8). Yield was recorded at every picking in grams and added up for all the pickings to arrive at the total yield per plant. For total soluble solids (°B) the ripe fruits were crushed and their juice passed through a double layer of fine mesh cheese cloth. A drop of juice was placed on the plate of hand refractometer (0-32 °B ERMA, Japan) and the reading was noted. A mean of ten readings was taken in every replication. Harvest duration was calculated by counting days from first picking to final picking of marketable fruit for each treatment. Mean values of each replication of parents and crosses

for all the traits were subjected to statistical analysis by using computer software package SPAR-I and significance of heterosis over the better parent was tested by using 't-test'.

RESULTS AND DISCUSSION

Significant differences among parents and hybrids suggested the presence of sufficient genetic diversity for the trait under study (Table 2). The mean performance of parents and crosses are presented in Table 3, while heterobeltiotic effects are presented in Table 4. The tomato hybrids having indeterminate growth habit are preferred because of their longer harvest duration and lower incidence of buckeye rot which is caused by *Phytophthora nicotianae* var. *parasitica*. Plant height among parents varied from 73.13 cm (UHF-612) to 164.37cm (Solan Vajr). A perusal of data presented in Table 4 reveal that the heterobeltiotic effects for plant height ranged from 34.44 (EC-174023 x UHF-612) to 43.67 percent (FT-5x UHF-659). Positive heterosis over better parent for plant height has also been reported by Joshi and Thakur (5).

Early picking is one of the major objective in the selection of tomato cultivars. Among the parents, UHF-612 was the earliest to mature which took 62.00 days to first picking while UHF-656 took the longest duration (80.00 days) for first picking. The cross AI-9 x UHF-612 was identified as early yielding cross. Only five crosses produced fruits earlier than their respective early parent. Six cross combinations showed significantly early picking than hybrid Naveen. Early picking in F_1 as compared to parent has also been reported by Mishra (6). Mean number of fruits per cluster among the parents, ranged from 2.86 (UHF-659) to 4.07 (UHF-663). Among the F_1s, the cross FT-5 x UHF-612 exhibited maximum (4.50) number of fruits per cluster, which was at par with four other crosses. The heterobeltiotic effects ranged from -34.39 (EC-15998 x FT-5) to 33.30 percent (FT-5 x UHF-612). Only two crosses FT-5 x UHF-612 and EC-15998 x AI-9 showed positive significant increase of 11.03 and 9.71 percent, respectively over check Naveen (4.05) as presented in Table 4.

Fruit weight directly contribute towards the total yield of the plant. Among the parents, FT-5 was found to have highest fruit weight followed by AI-9 and Solan Vajr. FT-5 x Solan Vajr, AI-9 x Solan Vajr and EC-15998 x Solan Vajr were the three best crosses. The maximum positive heterobeltiotic effect among the crosses was observed in EC-5998 x UHF-612. A total of 15 crosses showed significant and positive heterosis over their respective parents. There was a significant degree of variation among patents and hybrids for fruit yield per plant. Among parents, AI-9 yielded significantly higher (1347.16 g) than all other parents. The fruit yield among crosses varied from 764.33 g (EC-174023 x UHF-663) to 1808.23 g (AI-9 x Solan Vajr). A total of 16 crosses were found to have positive and significant heterobeltiotic effect. Heterobeltiotic effect for this trait was also observed by Sudhakar and Puroshotham (7). However, only four crosses had significantly higher yield over check Naveen. Similar results were also reported by Kumar (1), and Sharma and Sharma (2).

Paricarp thickness is directly related to whole fruit firmness and shelf-life of tomatoes. The pericarp thickness among parents ranged from 3.84 (UHF-553.) to 7.46 mm (Solan Vajr). Among F_1s, the maximum pericarp thickness was observed in EC-15998 x AI-9 (7.45 mm). Only five crosses registered significant positive heterobeltiotic effects, whereas 12 crosses were at par with their respective parents. Total soluble

Table 2. Analysis of variance for different horticultural traits in tomato.

Source of variation	d.f.	Mean sum of squares							
		Plant height (cm)	Days to first picking (days)	No. of fruits per cluster	Av. fruit weight (g)	Fruit yield per plant (g)	Pericarp thickness (mm)	Total soluble solids (°B)	Harvest duration (days)
Replication	2	137.99	147.33	0.11	1.62	96215.52	0.056	0.04	119.71
Treatments	54	3969.48*	53.61*	0.72*	235.53*	231258.28*	2.70*	0.42*	86.41*
Parents (P)	9	2550.56*	77.59*	0.45*	205.76*	58845.67*	4.51*	0.83*	73.04*
Crosses (C)	44	3858.59*	49.54*	0.77*	229.54*	255558.34*	2.37*	0.35*	83.15*
Parents v/s Crosses (P × C)	1	21619.38*	16.44	0.44*	767.53*	713769.01*	0.85*	0.19*	349.61*
Error	108	70.78	6.00	0.04	3.82	5520.75	0.02	0.004	4.21

*Significant at 5% level

Table 3. Mean performance of parents and crosses for different horticultural traits in tomato.

Parent/ Cross	Plant height (cm)	Days to first picking (days)	No. of fruits per cluster	Fruit weight (g)	Yield/ plant (g)	Pericarp thickness (mm)	Total soluble solids (°B)	Harvest duration (days)
Parent								
EC-15998	115.36	70.00	3.59	56.19	1160.33	5.92	4.17	32.00
AI-9	98.49	72.00	3.53	71.04	1347.16	6.38	3.93	30.67
EC-174023	120.36	76.00	3.08	60.44	1013.48	5.24	3.97	28.33
FT-5	139.57	74.00	2.98	76.12	1279.35	7.23	4.79	37.00
Solan Vajr	164.37	75.33	3.77	69.51	1215.59	7.46	4.12	40.00
UHF-656	137.71	80.00	3.01	63.29	1056.96	4.67	3.44	39.00
UHF-553	89.14	67.00	3.31	55.43	1034.45	3.84	3.65	27.00
UHF-659	93.43	71.00	2.86	52.29	1172.59	5.63	3.33	38.00
UHF-612	72.13	62.00	3.37	56.31	963.92	4.43	3.22	31.00
UHF-663	84.25	69.00	4.07	53.30	922.19	6.72	3.98	28.00
Cross								
EC-15998 × AI-9	164.87	69.33	4.44	72.94	1743.48	7.64	4.32	42.00
EC-15998 × EC-174023	145.74	70.00	3.64	63.48	1047.70	4.94	3.60	41.00
EC-15998 × FT-5	168.73	69.00	2.35	59.91	1080.66	5.64	4.44	33.67
EC-15998 × Solan Vajr	175.82	71.00	3.38	82.41	1181.91	5.71	3.94	38.00
EC-15998 × UHF-656	163.98	73.00	2.82	71.53	823.42	5.41	4.03	42.00
EC-15998 × UHF-553	86.52	70.00	2.71	51.32	861.55	4.76	3.77	30.00
EC-15998 × UHF-659	143.67	73.00	3.63	61.71	1211.88	5.70	3.39	38.00
EC-15998 × UHF-612	98.67	71.00	3.69	69.55	1397.03	4.64	3.64	29.33
EC-15998 × UHF-663	96.00	70.00	3.28	68.59	1112.35	6.64	3.68	33.00
AI-9 × EC-174023	149.31	68.00	4.00	66.26	1340.60	4.65	3.92	35.00
AI-9 × FT-5	169.30	69.00	3.98	69.89	1601.67	7.11	4.02	36.67
AI-9 × Solan Vajr	168.04	71.00	4.16	82.59	1808.23	7.00	4.13	39.00
AI-9 × UHF-656	145.82	73.00	3.15	74.16	1060.83	5.00	3.44	37.00
AI-9 × UHF-553	118.04	68.00	3.02	68.71	1543.16	4.40	3.97	27.67
AI-9 × UHF-659	95.29	67.33	3.72	62.15	1585.25	6.18	4.03	29.67
AI-9 × UHF-612	102.69	63.67	3.26	74.13	1086.91	5.64	4.17	28.00
AI-9 × UHF-663	92.94	71.00	2.95	63.48	1165.76	6.57	3.94	31.67
EC-174023 × FT-5	151.65	73.00	3.23	73.37	1465.24	4.42	4.11	27.00
EC-174023 × Solan Vajr	153.66	79.00	3.28	80.22	1430.94	4.37	3.79	40.00
EC-174023 × UHF-656	162.43	82.33	3.50	65.48	1061.12	4.04	4.02	42.67
EC-174023 × UHF-553	118.15	75.33	3.59	57.29	858.12	5.06	3.20	30.67
EC-174023 × UHF-659	167.84	75.00	3.23	53.42	1204.07	4.17	3.52	40.00
EC-174023 × UHF-612	78.91	73.00	2.52	50.02	984.93	5.23	3.46	26.00
EC-174023 × UHF-663	133.62	70.00	2.53	70.02	764.43	5.60	3.87	35.00
FT-5 × Solan Vajr	221.84	67.33	4.35	83.00	1800.56	7.25	4.46	38.67
FT-5 × UHF-656	193.28	73.00	3.73	69.99	1200.06	7.45	4.39	38.00

Contd...

Contd...

Parent/ Cross	Plant height (cm)	Days to first picking (days)	No. of fruits per cluster	Fruit weight (g)	Yield/ plant (g)	Pericarp thickness (mm)	Total soluble solids (°B)	Harvest duration (days)
FT-5 × UHF-553	112.50	68.00	3.72	68.33	1198.15	5.68	3.72	35.00
FT-5 × UHF-659	200.52	66.00	3.35	63.25	1620.68	7.02	3.79	48.00
FT-5 × UHF-612	99.57	72.00	4.50	59.68	1190.74	6.48	3.49	38.00
FT-5 × UHF-663	106.52	70.00	3.65	63.62	1272.38	6.03	3.83	37.00
Solan Vajr × UHF-656	192.53	81.00	3.46	63.96	1092.26	4.73	4.36	37.00
Solan Vajr x UHF-553	117.32	78.00	3.52	58.41	1474.78	6.35	4.00	34.00
Solan Vajr x UHF-659	197.40	72.00	3.46	60.92	1627.12	6.44	4.70	43.67
Solan Vajr x UHF-612	166.72	73.00	3.63	59.54	920.67	5.48	3.73	35.00
Solan Vajr x UHF-663	133.35	70.00	3.32	61.58	1190.00	5.71	3.89	34.33
UHF-656 x UHF-553	92.50	66.00	3.32	68.02	1270.15	4.77	3.83	30.00
UHF-656 x UHF-659	140.65	71.00	3.75	60.85	1176.25	5.48	3.27	36.00
UHF-656 x UHF-612	115.42	70.00	3.56	55.08	1217.10	5.80	3.23	37.33
UHF-656 x UHF-663	125.52	69.00	3.65	60.52	1089.13	6.91	3.80	35.00
UHF-553 x UHF-659	94.63	68.00	3.76	57.54	1208.60	6.02	3.55	30.67
UHF-553 x UHF-612	97.99	65.67	4.05	68.37	1213.92	5.16	3.91	37.00
UHF-553 x UHF-663	83.39	66.67	4.20	60.64	1231.28	6.18	4.00	32.00
UHF-659 x UHF-612	116.20	69.00	4.02	66.23	1273.63	4.14	3.10	36.00
UHF-659 x UHF-663	82.13	64.00	3.13	64.58	1157.63	5.08	3.60	33.00
UHF-612 x UHF-663	78.54	69.00	2.90	59.16	876.24	6.37	3.25	29.67
Naveen (Check)	175.80	71.00	4.05	75.30	1610.33	6.97	4.30	39.67
Population Mean	135.76	70.96	3.47	65.97	1270.13	5.92	3.86	36.18
$CD_{0.05}$	13.60	3.96	0.32	3.16	60.67	0.23	0.06	3.32

*Significant at 5% level

solids content above 3°brix mostly preferred for fresh market tomatoes. In the present studies, the parent FT-5 and the cross combination Solan Vajr x UHF-659 showed highest total soluble solids content. Highest heterobeltiotic was shown by the cross Solan Vajr x UHF-659. These results are in accordance with those of and Dod and Kale (3). Solan Vajr, having tallest plants maintained superiority over other parents for harvest duration. Among the crosses FT-5 x UHF-659 had the maximum harvest duration, whereas, EC-15998 x AI-9 was found to have maximum positive heterobeltiosis. These results are in line with those of Fageria (4). It can be concluded from these studies that the hybrids, *viz*., FT-5 x Solan Vajr, AI-9 x Solan Vajr, EC-15998 x AI-9 and Solan Vajr x UHF-659 excelled for fruit yield per plant, also performed well for most of the traits. These crosses could be further evaluated and tested for their feasibility for commercial cultivation.

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Table 4. Heterobeltiotic effects and economic heterosis for different horticultural traits in tomato

Cross	Plant height (cm)		Days to first picking (days)		No. of fruits per cluster		Fruit weight (g)		Yield/plant (g)		Pericarp thickness (mm)		Total soluble solids (°B)		Harvest duration (days)	
	Better parent	Check	Better parent	Check	Better parent	Check	Better parent	Check	Better parent	Check	Better parent	Check	Better parent	Check	Better parent	Check
EC-15998 x Al-9	42.92*	-6.22	-0.95	-2.35	23.88*	9.71*	2.67	-3.13	29.42*	8.27*	19.75*	9.60*	3.59*	0.47	31.25*	5.87
EC-15998 x EC-174023	21.09*	-17.10*	0.00	-1.41	1.49	-10.12*	5.02	-15.70*	-9.71*	-34.94*	16.60*	-29.12*	-13.66*	-16.20*	28.12*	3.35
EC-15998 x FT-5	20.90*	-4.02	-1.43	-2.82	-34.39*	-41.89*	-21.30*	-20.74*	-15.53*	-32.89*	-22.04*	-19.31*	-7.38*	3.18*	-9.00*	-16.36*
EC-15998 x Solan Vajr	6.96	0.01	1.43	0.00	-10.34*	-16.54*	18.55*	9.44*	-2.77	-26.60*	-24.04*	-18.08*	-5.44*	-8.29*	-5.00	-4.21
EC-15998 x UHF-656	19.08*	-6.72	4.29	2.82	-21.47*	-30.45*	13.01*	-5.01*	-29.04*	-48.87*	-8.61*	-22.33*	-3.28*	-6.20*	7.69	5.87
EC-15998 x UHF-553	-25.00*	-50.78*	4.48	-1.41	-24.44*	-33.09*	8.66*	-31.85*	-25.75*	-46.50*	-19.64*	-31.71*	-9.59*	-12.33*	-6.25	-24.37*
EC-15998 x UHF-659	24.54*	-18.28*	4.29	2.82	1.12	-10.45*	9.83*	-18.05*	3.35	-24.74*	-3.71	-18.22*	-18.78*	-21.24*	0.00	-4.21
EC-15998 x UHF-612	-14.46*	-43.87*	14.52*	0.00	2.88	-8.89*	23.52*	-7.64*	20.39*	-13.24*	-21.72*	-33.48*	-12.70*	-15.34*	-8.34	-26.06*
EC-15998 x UHF-663	-16.78*	-45.39*	1.45	-1.41	-19.49*	-19.09*	22.08*	-8.91*	-4.14	-30.92*	-1.19	-4.73*	-11.83*	-14.50*	3.12	-16.81*
Al-9 x EC-174023	24.05*	-15.07*	-5.56*	-4.23	13.31*	-1.23	-6.72*	-12.00*	-0.48	-16.74*	-27.10*	-33.24*	-1.26*	-8.76*	14.13*	-11.77*
Al-9 x FT-5	21.30*	-3.70	-4.16	-2.80	12.74*	-1.72	-8.18*	-7.18*	18.89*	-0.54	-1.71	1.96	-16.14*	-6.39*	-0.89	-7.61
Al-9 x Solan Vajr	2.23	-4.41	-1.39	0.00	10.34*	2.71	16.25*	9.68*	34.22*	12.28*	-6.17*	0.43	0.24	-3.95*	-2.50	-1.69
Al-9 x UHF-656	5.89	-17.05*	1.39	2.82	-10.94*	-22.30*	4.39	-1.51	-21.25*	-34.12*	-21.72*	-28.31*	-12.31*	-19.92*	-5.13	-6.73
Al-9 x UHF-553	19.84*	-32.85*	1.49	-4.23	-14.62*	-25.51*	-3.27	-8.75*	14.54*	-4.17*	-31.02*	-36.82*	1.19	-7.60*	-9.78	-30.26*
Al-9 x UHF-659	-3.25	-45.80*	-5.16	-5.16	5.28	-8.15*	-12.51*	-17.46*	17.67*	-1.55	-3.13	-11.33*	2.55*	-6.36*	-21.93*	-25.22*
Al-9 x UHF-612	4.26	-41.58*	2.69	-10.32*	-8.11	-19.84*	3.09	-1.55	-19.32*	-32.50*	-11.59*	-19.03*	6.20*	-3.02*	-9.68	-29.42*
Al-9 x UHF-663	-5.63	-47.13*	2.90	0.00	-27.52*	-27.16*	-10.65*	-15.70*	-13.47*	-27.61*	-2.23	-5.73*	-1.01	8.37*	3.26	-20.17*
EC-174023 x FT-5	8.66	-13.74*	-1.35	2.82	4.88	-20.33*	-3.61	-2.56	14.53*	-9.01*	-38.82*	-36.54*	-14.20*	-4.42*	-27.03*	-31.94*
EC-174023 x Solan Vajr	-6.51	-12.59	4.87*	11.27*	-12.91*	-18.93*	15.40*	6.53	17.72*	-11.04*	-41.82*	-37.25*	-8.01*	-11.86*	0.00	0.83
EC-174023 x UHF-656	17.95*	-7.61	8.33*	15.96*	13.76*	-13.58*	3.46	-13.04*	0.39	-34.11*	-22.95*	-42.04*	1.25*	6.59*	9.41*	7.56
EC-174023 x UHF-553	-1.84	-32.49*	12.44*	6.10*	8.56	-11.28*	-5.21	-23.91*	-17.05*	-46.71*	-3.56	-27.45*	-19.39*	-25.58*	8.25	-22.68*
EC-174023 x UHF-659	39.45*	-4.53	5.63*	5.63*	5.09	-20.16*	-11.63*	-29.06*	2.68	-25.23*	-25.95*	-40.22*	-11.33*	-18.06*	5.26	0.83
EC-174023 x UHF-612	-34.44*	-55.11*	17.75*	2.82	-25.30*	-37.78*	-17.24*	-33.57*	-2.82	-38.84*	-0.19	-24.92*	-12.48*	-19.53*	-16.12*	-34.45*
EC-174023 x UHF-663	11.02	-23.99*	1.45	-1.41	-17.77*	-37.53*	15.84*	-7.01*	-3.66	-39.36*	-16.63*	-19.66*	-2.76*	-10.00*	23.53*	-11.77*
FT-5 x Solan Vajr	34.96*	26.19*	-9.01*	-5.17*	15.38*	7.41	12.97*	10.22*	40.74*	11.81*	-2.81	4.01*	-6.88*	3.72*	-3.32	-2.52
FT-5 x UHF-656	38.48*	9.94*	-1.35*	2.82	23.67*	-7.98	-8.05*	-7.05*	-6.19*	-25.47*	3.04*	6.88*	-8.35*	2.09*	-2.56	-4.21
FT-5 x UHF-553	-19.39*	-36.01*	1.49	-4.23	12.29*	-8.23*	-10.23*	-9.25*	-6.34*	-25.59*	-21.44*	-18.51*	-22.41*	-13.57*	-5.41*	-11.77*
FT-5 x UHF-659	43.67*	14.06*	-7.04*	-7.04*	12.53*	-17.20*	-16.90*	-16.00*	26.67*	0.64	-2.90	0.71	-20.88*	-11.86*	26.32*	21.00*
FT-5 x UHF-612	-28.65*	-43.36*	16.13*	1.41	33.30*	11.03*	-21.60*	-20.74*	-6.93*	-26.06*	-10.42*	-7.08*	-27.14*	-18.84*	2.70	-4.20
FT-5 x UHF-663	-23.67*	-39.40*	1.45	-1.41	-10.24*	-9.79*	-16.42*	-15.51*	-0.54	-20.98*	-16.64*	-13.53*	-20.11*	-11.01*	0.00	-6.73
Solan Vajr x UHF-656	17.13*	9.52*	7.52*	14.08*	-8.22	-15.56*	-7.99*	-15.06*	-10.15*	-32.17*	-37.07*	-32.14*	5.91*	1.40*	-7.50	-6.73
Solan Vajr x UHF-553	-28.62*	-33.27*	16.42*	9.86*	-6.72	-13.17*	-15.97*	-22.46*	21.32*	-8.42*	-15.57*	-8.94*	-2.91*	-7.05*	-15.00*	10.07*

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Cross	Plant height (cm)		Days to first picking (days)		No. of fruits per cluster		Fruit weight (g)		Yield/plant (g)		Pericarp thickness (mm)		Total soluble solids (°B)		Harvest duration (days)	
	Better parent	Check	Better parent	Check	Better parent	Check	Better parent	Check	Better parent	Check	Better parent	Check	Better parent	Check	Better parent	Check
Solan Vajr x UHF-659	20.09*	12.39*	1.41	1.41	-8.49	-14.81*	-12.36*	-19.10*	33.85*	1.04	-14.32*	-7.60*	14.07*	9.31*	9.17*	0.83
Solan Vajr x UHF-612	1.43	-5.16	17.74*	2.82	-3.80	-10.45*	-14.35*	-20.93*	-24.26*	-42.83*	-27.05*	-21.33*	-9.39*	-13.26*	-12.50*	-11.77*
Solan Vajr x UHF-663	-18.87*	-24.15*	1.45	-1.41	-18.43*	-18.02*	-11.40*	-18.22*	-2.10	-26.10*	-23.99*	-18.03*	-5.59*	-9.61*	-14.17*	-13.45*
UHF-656 x UHF-553	-32.83*	-47.38*	-1.49	-7.04*	0.32	-18.02*	7.46*	-9.66*	20.17*	-21.12*	2.21	-31.52*	4.93*	-11.01*	-23.08*	-24.38*
UHF-656 x UHF-659	2.13	19.99*	0.00	0.00	24.56*	-7.33	-3.87	-19.19*	0.31	-26.96*	-2.66	-26.54*	-4.94*	-23.95*	-7.69	-9.25*
UHF-656 x UHF-612	-16.19*	-34.35*	12.90*	-1.41	5.43	-12.18	-12.97*	-26.85*	15.15*	-24.42*	24.20*	-16.79*	-6.10*	-24.88*	-4.27	-5.89
UHF-656 x UHF-663	-8.85	-28.60*	0.00	-2.82	-10.24*	-9.79*	-4.38	-19.62*	3.04	-32.37*	2.82	-0.86*	-4.52*	-11.63*	-10.26*	-11.77*
UHF-553 x UHF-659	1.28	-46.17*	1.49	-4.23	13.49*	-7.24	3.81	-23.58*	3.07	-24.95*	6.93*	-13.68*	-2.83*	-17.44*	-19.30*	-22.70*
UHF-553 x UHF-612	9.93	-44.26*	5.91	-7.51*	20.17*	0.00	21.42*	-9.20*	17.34*	-28.36*	16.55*	-25.92*	6.93*	-9.15*	19.35*	-6.73
UHF-553 x UHF-663	-6.45	-52.57*	-0.50	-6.10*	3.28	3.79	9.41*	-19.46*	19.03*	-23.54*	-8.03*	-11.38*	0.59	-6.90*	14.29*	-19.33*
UHF-659 x UHF-612	24.37*	-33.90*	11.25	-2.82	19.07*	-0.82	17.63*	-12.04*	8.62*	-20.91*	-26.36*	-40.55*	-6.90*	-27.83*	-5.26	-9.25*
UHF-659 x UHF-663	-12.09	-53.28*	-7.25*	-9.86*	-23.18*	-22.80*	21.16*	-14.24*	-1.28	-28.11*	-24.37*	-27.12*	-9.46*	-16.20*	-13.16*	-16.81*
UHF-612 x UHF-663	-6.78	-55.32*	10.44*	-2.82	-28.75*	-28.40*	5.06	-21.43*	-9.10*	-45.59*	-5.11*	-8.56*	-18.34*	-24.41*	-4.29	-25.20*

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