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Studies on Genetic Variability, Heritability and Genetic Advance for Growth, Yield and Quality Traits in F_3 Population of Cherry Tomato (*Solanum lycopersicum* L. *var. ceraciformae*)

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ABSTRACT

The genetic parameters were studied to elucidate the genetic variability, heritability and genetic advance in cherry tomato (Solanum lycopersicum L. var. ceraciformae). Evaluation of thirty six genotypes of cherry tomato was done in randomised complete block design. The genotypes exhibited a wide range of variability for all the characters studied. Phenotypic coefficient of variation (PCV) was higher than genotypic coefficient of variation (GCV) for all the characters studied. In the present study, very high heritability (>90%) coupled with very high genetic advance as per cent over mean (>40%) was recorded for the characters viz., plant height at 30 DAT, pericarp thickness, average fruit weight, number of fruits per plant, number of seeds per fruit, thousand seed weight, lycopene content. High heritability with high genetic advance as per cent mean (GAM) was observed in number of primary branches at 60 and 90 DAT, polar diameter, equatorial diameter. Therefore, additive component is predominant here. Thus, there is ample scope for improving these characters through direct selection.

Key words: *Cherry tomato; GCV; PCV; heritability, genetic advance and GAM.*

INTRODUCTION

Tomato is one of the most economically important vegetables in the world with a production of 152.9 million tonnes with a value of $74.1 billion (FAOSTAT Database, 2014). In terms of human health, tomato fruit provide significant quantities of betacarotene, a provitamin-A carotenoid and ascorbic acid. Lycopene is the major carotenoid in tomato fruit, is a powerful anti-oxidant and is associated with reduced risk of certain cancers, heart diseases and age-related diseases [6]. Cherry tomatoes (*Solanum lycopersicum* var. *cerasiforme)* are generally considered to be similar but not identical to the wild relative of the domestic tomato. It is widely cultivated in Central America when the conquistadores arrived and is distributed in California, Korea, Germany, Mexico and Florida.

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Development of tomatoes for fresh market and for processing purpose need improvement of quality traits like colour, fruit pH, acidity, total soluble solids and viscosity which helps in value addition and prevention of post harvest losses. Therefore, there is a need for breeding cherry tomato to improve traits pertaining to fresh and processed forms with high nutritive value. The genotypic coefficient of variation estimates the heritable variability, whereas phenotypic component measures the role of environment on the genotype. High PCV and low GCV for a character indicated high influence of environment in its expression. The phenomenon of transmission of characters from parents to offspring is usually measured in terms of heritability. Therefore the estimates of heritability and genetic advance would help to formulate a sound breeding programme.

MATERIAL AND METHODS

The experiment was conducted at experimental plot of Biotechnology and Crop Improvement department of Kittur Rani Channamma College of Horticulture, Arabhavi, Belgaum (Dist.), Karnataka. 36 genotypes comprising of 8 parents collected from AVRDC Taiwan and 28 lines developed at Kittur Rani Channamma College of Horticulture, Arabhavi. The experiment was laid out in a Randomised Complete Block Design (RCBD) with 2 replications. Each treatment or varieties in each replication was represented by size of 5.4 Sq. meters and each line consisting of 20 plants. Each genotype is planted in a single row at spacing of 60cm between row-to-row and 45cm between plant-to-plant. Agronomical practices were followed as per the package of practices of UHS, Bagalkot [1].

Data were recorded on five randomly selected plants in each entry in each replications for the traits Plant height (cm), Plant spread from east to west (cm), Plant spread from north to south (cm), Number of primary branches per plant, Number of secondary branches per plant, Stem girth (cm), Days to first flowering, Days to fifty per cent flowering, Polar diameter of the fruit (cm), Equatorial diameter of the fruit (cm), Number of locules per fruit, Pericarp thickness (mm), Number of fruits per plant, Average fruit weight (g), Total soluble solids (^{0} Brix), Ascorbic acid content (mg/100 g), Lycopene content (mg/100 g), ß-carotene content (mg/100 g), Number of seeds per fruit, 1000 seed weight (g), Fruit borer infestation (%),Tomato leaf curl virus (ToLCV) incidence except yield which recorded in kg/plant converted into kg/ha. The data subjected to INDOSTAT software to estimate Genetic coefficient of variation (%), phenotypic coefficient of variation (%), Heritability (%) (broad sense), Genetic Advance and Genetic Advance as per cent of mean. The estimates for variability treated as per the categorization proposed by [2], heritability and genetic advance as percent of mean estimates according to criteria proposed by [7].

RESULTS AND DISCUSSION

The mean performance of all the 36 genotypes of the tomato were presented in Table 1. In the present study analysis of variance revealed the existence of significant differences among genotypes for all traits studied except Stem girth at 60 and 90 DAT and number of locules per fruit (Treatment MSS) (Table 2). Estimates of different statistical and genetic parameters like mean, genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV), heritability, genetic advance as percent mean are presented Table 3.

PCV and GCV were higher (>20) for plant height 30 DAT, Plant height 60 DAT, number of secondary branches at 60 DAT, yield per plant, yield per plot, yield per hectare, number of seeds per fruit, thousand seed weight, lycopene content, beta carotene content, and ascorbic acid content number of fruits per plant and average fruit weight which suggested greater phenotypic and genotypic variability among the accessions and sensitiveness of the attributes for making further improvement by selection. Moderate GCV and PCV (10 - 20 %) were observed for number of primary branches at 60 and 90 DAT, number of secondary branches at 90

DAT, plant spread from east to west at 60 DAT, plant spread from north to south 60 DAT, Days to first flowering, Days to 50 per cent flowering, Polar diameter, Equatorial diameter, indicating moderate amount of variability. The PCV was higher than the respective GCV for all the traits denoting environmental factors influencing their expression to some degree or other. Narrow difference between PCV and GCV for all the characters suggested their relative resistance to environmental alteration. The heritability in broad sense ranged from 3.05 for Number of locules to 99.56 for Number of seeds per fruit. Genetic advance as percent mean (GAM) *i.e*., genetic gain ranged from 1.43 to 135.59.

Table 1: Mean performance of F_3 population of Cherry tomato for growth, earliness, yield and quality parameters

Genotypes	1			2		3		4		5		6		7		8	9	10	11	12
	30 DAT	60 DAT	90 DAT	60 DAT	90 DAT	60 DAT	90 DAT	60 DAT	90 DAT	60 DAT	90 DAT	60 DAT	90 DAT	60 DAT	90 DAT					
KCT 1	49	53	115.5	2	4.05	7.75	10.03	38.8	60.4	36.5	73.3	38.45	69	1.01	1.3	28.75	43.5	27.92	28.55	4.4
KCT 2	68	118.13	130	2.8	3.25	6	9.68	33.5	60.4	47	66.3	41	73	0.7	1.2	33.75	39.85	20.3	21.47	3.7
KCT 3	71	132.5	139.61	3.68	3.25	7.13	10.6	41.25	57.2	41.5	72.3	38.4	67.25	0.91	1.32	36.63	49.85	34.63	23.05	2
KCT 4	85.75	156.88	163.3	3	4.05	6.25	10.7	33.5	61.2	35.5	69.4	35.5	66.75	0.8	1.06	39.25	49.95	23.5	26.5	1.35
KCT 5	66.5	116.38	123	2.8	4.45	6.75	10.4	36	65.9	33	66.3	36.25	68.25	0.8	1.07	29.5	46.58	25.08	22.5	1.7
KCT 6	91.63	119.5	126.5	2.73	3.18	7.25	11.35	33.5	60.9	30.5	65.5	36.25	65	0.92	1.04	33.88	51.2	21.4	22	1.8
KCT 7	66.63	109	59	3.43	3.58	6	10.55	39.7	60.7	38.5	70.8	42.3	74.75	0.78	0.87	36.88	47.2	22.88	22.36	5.25
KCT 8	68.63	121.88	128.33	2.33	2.88	5.25	8.93	35	57.9	32.5	64.15	37	63.5	0.69	0.9	34.25	44.45	28.8	28.5	7.8
KCT 9	74	116.5	124	3.18	3.25	8.75	7.6	26	50.9	43.5	67.8	34	61.5	0.8	0.94	37.75	53.58	26.39	23	3.15
KCT 10	71	120.13	127.3	2.3	3.03	4.88	8.68	26.5	55.85	32.25	66.5	30.75	62.25	0.84	1.11	35.25	46.95	25.5	24.24	1.3
KCT 11	61	111.88	118	2.68	2.58	5.58	7.18	34.25	58.8	32.6	64	33.25	63	0.78	1.01	32.88	43.45	25.73	22.94	2.15
KCT 12	74.75	108.75	116.5	2.8	3.08	5.03	7.4	30.5	74.4	42.1	70.65	36	66.75	0.75	1.01	29	42.45	28.39	30.55	2.45
KCT 13	68.38	130.25	136.5	2.93	3.25	4.88	9.68	25.6	57.9	33	71.15	30.8	66	0.6	0.88	30.13	43.83	22.57	18.65	4.05
KCT 14	61.38	94.5	102.5	2.4	2.93	4.88	7.78	28.2	66	33.9	63.65	30.55	65	0.76	0.93	25.5	43.58	37	26.92	1.3
KCT 15	80.75	114.25	123	2.05	4.3	9.5	8.93	28.15	61.4	35.7	62.3	30.4	64	1.3	1.02	33.75	45.95	23.15	23.4	1.75
KCT 16	68.13	128.5	131	2.68	3.18	3.8	8.03	28.1	63.2	31.75	81.3	30.55	65.25	0.76	1.04	35.88	52.08	26.86	26.92	1.4
KCT 17	58.75	115.5	123.71	3.1	3.2	6.4	8.55	23.8	66.15	31.25	67.65	28.9	66.25	0.79	0.83	37.88	50.83	35.96	31.5	4.8
KCT 18	59.88	94.63	103.78	3.18	3.5	7.33	7.68	24.5	64.7	26.75	68.3	28.55	68.25	0.85	1.17	38	51.83	25.5	23.24	5.4
KCT 19	73.13	123.38	130.23	3.18	3.58	7.15	10.8	28	64.4	30.75	68.3	31.75	68.5	1.1	1.19	36.75	52.83	21.74	22.36	1.65
KCT 20	76	111.75	116.5	3.8	4.25	8.13	9.15	29.75	52.9	37.5	68.8	33.75	63	0.88	0.96	33.38	49.33	31.68	25.46	1.3
KCT 21	73.13	121.25	128.8	2.25	3.13	5.75	7.93	30.3	58.4	33.6	65.3	32.35	64	0.66	1.13	34.5	45.45	23.28	24.53	2
KCT 22	74.5	119.5	127	2.53	2.88	5.15	7.4	32.5	60.9	35.5	70.8	35.95	68	0.8	0.85	31.25	45.45	26.79	24.02	6.65
KCT 23	72.88	89	97	2.45	3.13	6.25	9.55	31.8	59.9	38.5	73.65	36.15	67.25	0.86	0.99	37.5	48.7	28.15	18.55	6.85
KCT 24	72.5	125.13	136.8	3.68	3.13	6.75	8.88	30.7	55.4	42.25	74.15	35.85	65.75	0.77	1.13	35.38	52.58	27.65	26.12	3
KCT 25	67.63	114	120.65	3.05	3.25	6.25	9.8	29.8	61.9	44	69.3	33.4	67.75	0.7	1.12	34.75	54.58	24.52	23.78	**7.6**
KCT 26	80	97.13	103.3	3.18	3.5	8.05	9.2	30.8	60.9	37.75	65.8	32.55	65.5	0.91	1.25	35.75	51.7	28.02	29.1	1.5
KCT 27	50.38	102.5	109.42	2.18	3.13	4.93	10.18	30.8	51.2	34	67.3	33.65	62	0.44	0.93	37.75	47.95	27.5	27.02	1.35
KCT 28	58.38	100.5	106.5	2.68	3	5.88	9.88	31.5	59.9	32.55	65.3	32.5	64.75	0.85	1.12	36.63	52.1	26	22.45	1.6
KCT 29	42	67	72.57	3.05	2.88	7.5	9.18	32.65	47.7	34.2	63.3	34.1	59.25	0.99	0.82	45.25	57.45	24.57	26.6	1.6
KCT 30	30	73.38	80	2.5	3.18	7.65	11.05	37.2	66.4	30.35	73.65	34.45	70.5	0.87	1.05	32.63	48.95	34.48	19.84	1.25
KCT 31	44	85.63	92.08	2.3	2.93	6.5	9.85	31.7	60.9	35.5	71.65	35.2	68	0.63	0.84	38	50.95	17	21.45	2.8
KCT 32	34.5	94.13	100	1.8	3	8.75	9.48	31.5	64.7	38.75	62.3	35.05	65	0.86	1.04	41.88	57.75	24.5	23	3.45
KCT 33	51.5	101.5	107	2.8	3.5	8.25	8.8	30.9	63.2	35.25	64.65	34.35	63.75	0.65	0.88	42.88	55.95	25.03	29.9	1.4
KCT 34	47.5	79.88	84	3.05	3.25	9.25	9.18	36.25	56.9	34.9	67.8	34.9	64.5	0.9	0.81	40	55.08	27.08	32.05	1.3
KCT 35	26	74.75	82.4	3.2	2.83	7.5	8.65	30.5	63.9	37.75	69.4	33.95	68.25	0.94	0.81	45.38	59.95	26.48	29.6	1.8
KCT 36	21.5	64.5	69	1.8	3.1	8.15	8.45	35	63.9	32.75	74.3	37.65	71.25	0.85	0.88	41.88	61.33	27.5	23.5	2.45
Mean	62.24	105.75	112.63	2.76	3.29	6.7	9.2	31.63	60.48	35.66	68.53	34.35	66.19	0.82	1.01	35.84	49.86	26.49	24.9	2.93
S.Em±	3.57	4.79	4.48	0.23	0.18	0.39	0.57	2.23	2.53	1.01	1.34	1.8	1.45	0.12	0.11	0.51	0.95	1.34	1.12	0.17
C.D. (5%)	10.24	13.74	12.85	0.66	0.52	1.13	1.64	6.39	7.27	2.89	3.84	5.16	4.16	0.34	0.31	1.47	2.73	3.86	3.23	0.48
C.D. (1%)	13.74	18.43	17.23	0.88	0.7	1.51	2.2	8.58	9.74	3.87	5.15	6.92	5.57	0.46	0.41	1.97	3.66	5.17	4.33	0.64
CV (%)	8.11	6.4	5.62	11.79	7.82	8.29	8.81	9.95	5.92	3.99	2.76	7.4	3.09	20.62	15.05	2.02	2.7	7.18	6.39	8.11

Table 1 ctd..

Genotypes	13	14	15	16	17	18	19	20	21	22	23	24
KCT 1	2.5	6.07	390	2.05	38.5	70.3	5.24	4.23	12.6	44.31	83.8	1.68
KCT 2	2.5	7.22	196	1.65	31	57.41	4.97	6.18	13.75	39.77	71.6	1.92
KCT 3	3	12.86	168	1.35	21	38.89	4.8	5.29	23.6	44.31	32.1	3.72
KCT 4	2.5	4.35	479.5	2.55	31.5	58.33	5.26	6.29	15.1	45.44	76	3.97
KCT 5	2.5	8.95	177.5	1.55	23.25	43.06	5.01	4.38	14.6	43.17	53.6	3.57
KCT 6	2.5	16.86	131	1.45	25.25	46.76	5.02	5.67	10.6	46.58	118	3.45
KCT 7	3	10.61	136	1	19.5	36.11	4.5	5.75	15.9	48.85	63	3.3
KCT 8	2	6.11	209	1.65	24.75	45.83	5.15	3.89	20.25	23.86	93.4	3.75
KCT 9	2.5	16.41	66	1.05	17.25	31.94	4.98	3.29	24.25	30.67	152.2	4.1
KCT 10	3.5	13.26	142	1.55	21.5	39.81	5.19	5.96	24.4	24.99	84.9	3.17
KCT 11	3	19.96	73	1.1	16.5	30.56	5.25	4.85	15.6	30.67	67.6	2.82
KCT 12	2.5	19.71	92	1.1	16.5	30.56	5.88	5.33	12.55	34.08	154	4.4
KCT 13	3	7.06	233	2.2	30	55.56	5.21	4.07	15.6	31.81	62.7	2.2
KCT 14	3.5	20.78	83	1.05	13.5	25	4.6	5.38	18.35	29.54	94	1.4
KCT 15	3.5	14.46	263	2.7	38.75	71.76	5.12	5.78	15.25	24.99	114	4.7
KCT 16	2	6.26	194.5	1.55	23.25	43.06	5.04	7.6	21.4	24.99	94.1	4.5
KCT 17	2	23.86	46	1.15	14.25	26.39	5.06	8.41	24.1	21.58	153.6	3.15
KCT 18	2.5	14.73	123.5	1.3	19.5	36.11	5.01	7.94	18.6	28.4	74.1	3.75
KCT 19	2.5	11.97	77	1.2	18	33.33	6.02	9.24	10.6	32.94	59.4	2.55
KCT 20	3	14.16	157	1.6	24	44.44	5.92	9.03	13.6	29.54	92.9	1.37
KCT 21	2.5	9.36	239.5	2.05	30.75	56.94	6.06	8.65	25.9	27.26	96.4	2.8
KCT 22	3	17.61	112	1.6	24.5	45.37	5.24	8.25	10.8	23.86	47.2	1.25
KCT 23	3.5	6.15	475	2.3	30	55.56	7.77	6.86	13.35	38.62	27	1.5
KCT 24	3	17.39	240.5	2	30	55.56	7.44	6.51	9.2	44.3	116	3.1
KCT 25	3	10.71	242	2.2	30	55.56	7.13	6.64	13.35	34.08	89.8	3.5
KCT 26	3	13.5	167	1.7	26.75	49.54	8.11	7.71	23.25	36.35	81	1.85
KCT 27	3.5	7.45	130.5	1.7	25.5	47.22	8.08	7.77	9.3	36.35	54	4.15
KCT 28	3	4.3	162	1.55	23.25	43.06	5.53	9.25	15.6	33.26	87.2	3.85
KCT 29	3	12.3	103	1.3	19.5	36.11	6.15	3.63	10.5	28.4	78.2	4.45
KCT 30	3	17.25	88	1.55	24.5	45.37	7.77	5.79	22.9	19.27	113.7	4.15
KCT 31	3.5	19.21	233	2.3	34.5	63.89	6.89	3.32	13.05	32.94	90.8	2.1
KCT 32	3	5.96	275	1.8	27	50	4.2	6.84	15.2	24.99	54.8	1.35
KCT 33	3.5	6.25	397	2.25	34.25	63.43	5.03	6.97	13.65	24.99	29.3	2.33
KCT 34	2	6.41	167	1.55	23.25	43.06	5.56	8.15	17.25	34.08	116.5	2.78
KCT 35	2.5	4.85	142	1.3	19.5	36.11	6.7	6.64	19	43.93	75	2.88
KCT 36	3	28.8	31.5	1.1	16.5	30.56	3.75	5.91	23.25	23.86	62.5	4.13
Mean	2.83	12.31	184.5	1.64	24.69	45.82	5.68	6.32	16.56	32.97	83.73	3.04
S.Em±	0.45	0.54	20.68	0.24	2.65	6.65	0.1	0.21	1.37	1.9	1.49	0.19
C.D. (5%)	1.29	1.56	59.36	0.69	7.6	19.09	0.29	0.61	3.93	5.46	4.27	0.54
C.D. (1%)	1.73	2.1	79.64	0.92	10.19	25.69	0.39	0.81	5.27	7.32	5.73	0.72
CV (%)	22.41	6.26	15.85	20.31	15.15	19.83	2.52	4.73	11.68	8.15	2.51	8.73

1. Plant height (cm)
2. Number of primary branches
3. Number of secondary branches
4. Plant spread from east to west (cm)
5. Plant spread from north to south (cm)
6. Plant canopy (cm2)
7. Stem girth (cm)
8. Days to first flowering
9. Days to 50 per cent flowering
10. Polar diameter of the fruit (mm)
11. Equatorial diameter of fruit (mm)
12. Pericarp thickness (mm)
13. Number of locules
14. Average fruit weight (g)
15. Number of fruits per plant
16. Yield per plant (kg)
17. Yield per plot (kg)
18. Yield per hectare (t/ha)
19. Total soluble solids (^{0} Brix)
20. Lycopene content (mg / 100 g)
21. Beta carotene (mg / 100 g)
22. Ascorbic acid (mg / 100 g)
23. Number of seeds per fruit
24. Thousand seed weight (g)

In the present study, very high heritability (>90%) coupled with very high genetic advance as per cent over mean (>40%) was recorded for the characters *viz.*, plant height 30 DAT, pericarp thickness, average fruit weight, number of fruits per plant, number of seeds per fruit, thousand seed weight, lycopene content. Very high heritability along with high GAM (20-40%) was observed in plant height 60 and 90 DAT, days to first flowering, days to 50 per cent flowering, total soluble solids. High heritability with high GAM was observed in number of primary branches at 60 and 90 DAT, polar diameter, equatorial diameter which might be assigned to additive gene effect governing their inheritance and phenotypic selection for their improvement could be achieved by simple method like pure line or mass selection or bulk or SSD method following hybridization and selection in early generations.

Moderate heritability (30-60%) with high GAM was observed for yield per plant. The results are in accordance with the [9,10,14] for plant height,[9,10,11] for number of primary branches at 60 and 90 DAT, [5] for number of secondary branches per plant at 90 DAT, plant spread from east to west and north to south at 60 and 90 DAT, [13] for days to 50% flowering and pericarp thickness of the fruit, [4] and [3] for polar and Equatorial diameter of the fruit[8,11], [14] for number of fruits per plant, yield per plant and fruit yield per plot. [12] for lycopene content and total soluble solids and [11] for ascorbic acid content.

Table 2: Analysis of variance for growth, earliness, yield and quality parameters in F_3 population of Cherry tomato

Sl. No.	Source of variation/ Characters	Replication	Treatments (Genotypes)	Error	S. Em ±	CD (5%)
	Degrees of freedom	1	35	35		
1.	Plant height (cm) (30 DAT)	128.66	556.46**	25.45	3.57	10.24
2.	Plant height (cm) (60 DAT)	312.5	959.66**	45.81	4.79	13.74
3.	Plant height (cm) (90 DAT)	223.27	998.55**	40.05	4.48	12.85
4.	No. primary branches (60 DAT)	0.1701	0.518**	0.1	0.23	0.66
5.	No. primary branches (90 DAT)	0.061	0.38**	0.066	0.18	0.52
6.	No. secondary branches (60 DAT)	0.0058	3.954**	0.308	0.39	1.13
7.	No. secondary branches (90 DAT)	0.0058	2.519**	0.656	0.57	1.64
8.	Plant spread from E to W (cm) (60 DAT)	4.702	33.85**	9.901	2.23	6.39
9.	Plant spread from E to W (cm) (90 DAT)	8.542	51.700**	12.81	2.53	7.27
10.	Plant spread from N to S (cm) (60 DAT)	48.511	39.228**	2.024	1.01	2.89
11.	Plant spread from N to S (cm) (90 DAT)	1.56	33.685**	3.58	1.34	3.84
12.	Plant canopy (cm^2) (60 DAT)	57.066	19.057**	6.455	1.8	5.16
13.	Plant canopy (cm^2) (90 DAT)	10.503	20.502**	4.189	1.45	4.16
14.	Stem girth (cm) (60 DAT)	0.0179	0.04479 NS	0.028	0.12	0.34
15.	Stem girth (cm) (90 DAT)	0.049	0.040 NS	0.023	0.11	0.31
16.	Days to first flowering	0.021	39.952**	0.523	0.51	1.47
17.	Days to 50% flowering	0.568	52.58**	1.81	0.95	2.73
18.	Polar diameter of the fruit (cm)	32.72	36.074**	3.615	1.34	3.86
19.	Equatorial diameter of the fruit(cm)	14.88	24.19**	2.527	1.12	3.23
20.	Pericarp thickness (mm)	0.08	7.580**	0.056	0.17	0.48
21.	Number of locules per fruit	0.5	0.407 NS	0.414	0.46	1.31
22.	Number of fruits per plant	4232	24372**	854.9	20.68	59.3
23.	Average fruit weight(g)	0.286	75.417**	0.592	0.54	1.56
24.	Fruit yield per plant (kg)	1.306	0.414**	0.115	0.24	0.69
25.	Fruit yield per plot (kg)	200	88.107 **	14	2.65	7.6
26.	Fruit yield per hectare (t)	685.87	302.15**	48.01	4.9	14.0
27.	Total soluble solids (^{0} Brix)	0.0008	2.4752**	0.02	0.1	0.29
28.	Ascorbic acid (mg/100g)	45.712	131.55**	7.22	1.9	5.46
29.	Lycopene (mg/100g)	0.004566	5.833**	0.089	0.21	0.61
30.	β-carotene (mg/100g)	24.616	48.29**	3.743	1.37	3.93
31.	Number of seeds per fruit	6.722	2037.81**	4.43	1.49	4.27
32.	1000 seed weight (g)	0.004	2.183**	2.183	0.19	0.54

Table 3: Estimates of mean, range, components of variance heritability and genetic advance for growth, earliness, yield and quality parameters in F_3 population

Sl. No.	Character	Mean ± S. Em	Range	GV	PV	GCV (%)	PCV (%)	h^2	GA	GAM
1	Plant height 30 DAT (cm)	62.24 ± 3.57	21.50- 91.63	265.5	290.9	26.18	27.4	91.25	32.06	51.51
2	Plant height 60 DAT (cm)	105.75 ± 4.79	53.00- 156.8	456.9	502.7	20.21	21.2	90.88	41.97	39.69
3	Plant height 90 DAT (cm)	112.63 ± 4.48	59.00-163.3	479.2	519.3	19.43	20.23	92.28	43.32	38.46
4	No. primary branches (60 DAT)	2.76 ± 0.23	1.80 - 3.80	0.206	0.312	16.44	20.23	66.02	0.76	27.51
5	No. primary branches (90 DAT)	3.29 ± 0.18	2.58 - 4.45	0.159	0.225	12.11	14.42	70.59	0.69	20.97
6	No. secondary branches (60 DAT)	6.70 ± 0.39	3.80 - 9.50	1.823	2.13	20.15	21.79	85.53	2.57	38.4
7	No. secondary branches (90 DAT)	9.20 ± 0.57	7.18 - 11.35	0.931	1.58	10.49	13.7	58.66	1.52	16.55
8	Plant spread (E-W) 60 DAT (cm)	31.63 ± 2.23	23.80- 41.25	11.97	21.87	10.94	14.79	54.73	5.27	16.67
9	Plant spread (E-W) 90 DAT (cm)	60.48 ± 2.53	47.70- 74.40	19.44	32.25	7.29	9.39	60.27	7.05	11.66
10	Plant spread (N-S) 60 DAT (cm)	35.66 ± 1.01	26.75- 47.00	18.6	20.62	12.09	12.73	90.18	8.43	23.65
11	Plant spread (N-S) 90 DAT (cm)	68.53 ± 1.34	62.30- 81.30	15.05	18.63	5.66	6.29	80.78	7.18	10.48
12	Plant canopy 60 DAT (cm^2)	34.35 ± 1.80	28.55- 42.30	6.3	12.75	7.3	10.39	49.39	3.63	10.58
13	Plant canopy 90 DAT (cm^2)	66.19 ± 1.45	59.25- 74.75	8.15	12.34	4.31	5.3	66.32	4.78	7.22
14	Stem girth (cm) (60 DAT)	0.82 ± 0.06	0.44 - 1.30	0.008	0.04	10.99	23.36	22.14	0.087	10.65
15	Stem girth (cm) (90 DAT)	1.01 ± 0.11	0.81 - 1.32	0.008	0.03	9.16	17.62	27.03	0.099	9.81
16	Days to first flowering	35.84 ± 0.51	25.50- 45.38	19.71	20.23	12.38	12.56	97.41	9.02	25.18
17	Days to 50 per cent flowering	49.86 ± 0.95	39.83- 61.33	25.38	27.2	10.1	10.45	93.33	10.02	20.11
18	Polar diameter (mm)	26.49 ± 1.34	17.00- 37.00	16.22	19.84	15.2	16.81	81.78	7.5	28.33
19	Equatorial diameter (mm)	24.90 ± 1.12	18.70- 32.05	10.83	13.36	13.22	14.68	81.07	6.1	24.52
20	Pericarp thickness (mm)	2.93 ± 0.17	1.25 - 7.80	3.76	3.81	66.31	66.8	98.52	3.96	135.59
21	Number of locules	2.81 ± 0.46	2.00 - 3.50	0.012	0.41	3.96	22.76	3.05	0.04	1.43
22	Average fruit weight (g)	12.31 ± 0.54	4.30 - 28.80	37.41	38	49.69	50.08	98.43	12.5	101.56
23	Number of fruits per plant	184.50 ± 20.68	31.5 - 479.5	11758	12613	58.77	60.87	93.22	215.6	116.89
24	Yield per plant (kg)	1.64 ± 0.24	1.00 - 2.70	0.14	0.26	23.57	31.38	56.45	0.59	36.49
25	Yield per plot (kg)	24.69 ± 2.65	13.50– 38.7	37.05	51.05	24.65	28.93	72.58	10.68	43.26
26	Yield per hectare	45.73 ± 4.90	25.00– 71.7	127.07	175.0	24.65	28.93	72.58	19.78	43.26
27	Number of seeds per fruit	83.73 ± 1.49	27.00- 154.0	1016	1021	38.07	38.16	99.56	65.54	78.27
28	Thousand seed weight (g)	3.04 ± 0.19	1.25 - 4.70	1.05	1.12	33.75	34.86	93.73	2.04	67.32
29	Total soluble solids (^{0}Brix)	5.68 ± 0.10	3.75 - 8.11	1.22	1.24	19.48	20.35	98.35	2.26	39.81
30	Lycopene content (mg / 100 g)	6.32 ± 0.21	3.29 - 9.25	2.87	2.96	26.82	27.24	96.98	3.43	54.42
31	Beta carotene (mg / 100 g)	16.56 ± 1.37	9.20 - 25.90	22.27	26.01	28.49	30.79	85.61	8.99	54.31
32	Ascorbic acid (mg / 100 g)	32.97 ± 1.90	19.27- 48.85	62.16	69.38	23.91	25.26	89.59	15.3	46.62

****-Significant at 1% *-Significant at 5%**
NS-Non significant DAT-Days after transplanting

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