E-ISSN: 2663-1067
P-ISSN: 2663-1075
https://www.hortijournal.com
IJHFS 2022; 4(1): 157-164
Received: 08-01-2022
Accepted: 09-02-2022

Basavarajaiah MP
Department of Vegetable Science, College of Horticulture, Bagalkot, Karnataka, India

Raveendra S Jawadagi
Department of Vegetable Science, College of Horticulture, Bagalkot, Karnataka, India

Shivanad Hongal
Department of Vegetable Science, College of Horticulture, Sirsi, Karnataka, India

Raghavendra K Mesta
Professor and Special officer (PPMC), University of Horticultural Sciences, Bagalkot, Karnataka, India

Dadapeer A Peerajade
Department of Biotechnology and Crop improvement, College of Horticulture, Bagalkot, Karnataka, India

Corresponding Author:
Basavarajaiah MP
Department of Vegetable Science, College of Horticulture, Bagalkot, Karnataka, India

Genetic analysis of quantitative and qualitative traits in f_2 population of cherry tomato (*Solanum lycopersicum* var. *cerasiforme*)

Basavarajaiah MP, Raveendra S Jawadagi, Shivanad Hongal, Raghavendra K Mesta and Dadapeer A Peerajade

DOI: https://doi.org/10.33545/26631067.2022.v4.i1c.135

Abstract
The genetic parameters were studied to elucidate the genetic variability, heritability, genetic advance and genetic advance as per cent over mean in cherry tomato (*Solanum lycopersicum* var. *cerasiforme*). Two hybrids 'Cheramy' and 'Sheeja' were evaluated at the experimental block of the Department of Vegetable Science, College of Horticulture, Sirsi. Uttara Kannada, Karnataka (India)-581 401 during *Rabi* 2020-21. The results of present investigation revealed that phenotypic coefficient of variation (PCV) values are higher than genotypic coefficient of variation (GCV) for almost all traits which indicates there is a greater influence of the environment on the plants of the F_2 population performance. Highest GCV and PCV was observed for number of primary branches per plant, fruit length, fruit width, fruit shape index, pericarp thickness, lycopene content, average fruit weight, fruit yield per plant and fruit yield per m^2 in the both segregating population. High heritability coupled with high genetic advance were observed for plant height, number of primary branches per plant, fruit length, fruit shape index, pericarp thickness, number of locules per fruit, TSS, ascorbic acid content, lycopene content, shelf life, number of flowers per cluster, number of fruits per cluster, number of fruits per plant, average fruit weight, fruit yield per plant and fruit yield per m^2 in both the population. Correlation study revealed that fruit yield per plant had highly positive significant correlation with average fruit weight, number of fruits per plant. Path analysis studies revealed that average fruit weight, number of fruits per plant, number of fruits per cluster, fruit set per cent, number of locules per fruit, plant height and days to first flowering had direct positive effect with fruit yield per plant indicating the possibility of increasing the fruit yield by selecting these traits in both the segregating populations.

Keywords: Genetic variability, heritability, genetic advance as per cent over mean, GCV, PCV, correlation and path analysis

1. Introduction
Cherry tomato (*Solanum lycopersicum* var. *cerasiforme*) is a type of smaller botanical variety of the cultivated tomato and is considered as the grandmother of all tomatoes (*S. lycopersicum*) grown today. It is native to Peru-Equador region (Rick, 1969) [42] then travelled to North through Central America. It is a warm season crop, fairly tolerant to hotter temperature and drought conditions and a great choice for growing under wide range of soil and climatic conditions (Anonymous, 2009) [3].

Cherry tomato had adequate nutritional status its fruits are highly tastier and pleasant to consume and valued for their attractive colour and flavor. Cherry tomatoes are highly preferred and are ideal for preparation of processed products like tomato juice, sauce, paste, ketchup, soup, puree, curries, powder, rasam, sandwich and tomato beverages. Chutney and pickles are prepared from unripe green fruits (Raju *et al.*, 2014) [36]. It is a highly priced and is commonly grown in protected conditions for its impressively nutritious fruits. It is a rich source of vitamin C (13 mg/100 g), dietary fiber (2 g/100 g), vitamin A, vitamin K, vitamin E (a-Tocopherol), niacin, thiamin, vitamin B_6, folate, phosphorus, and micronutrients such as manganese, copper and potassium (Naik *et al.*, 2021) [33].

Among the vegetables tomato ranks second in both area and production in India after potato and also India is the second leading tomato-producing country in the world, with an annual production of 19.75 million tonnes with an area of 0.789 million hectares with an average productivity of 25.03 tonnes per hectare.

Though cherry tomato has gained popularity among greenhouse growers due to a surge in demand, especially in urban markets, information on area and production is not available (Anonymous, 2019) [4].

Genetic improvement of any crop needs creation and utilization of variability using suitable breeding programmes. Hence, it is essential to examine the nature of association among the various plant characters and evaluate variability and splitting the whole variability into non-heritable and heritable components in such a way that helps to know whether the superiority of genetic advance could be expected after selection (Robinson *et al.*, 1956) [19].

Selection based on multiple characters is always better than a selection based on yield alone. Yield is controlled by polygenes because it is a quantitative trait. Ample knowledge on the magnitude and type of association of yield along with its attributing traits is of great significance to breeders, so that they can simply understand the solidity of the correlated traits when they are selected for simultaneous improvement of more than one character.

The variability occurred in any population could be due to interaction between environmental and genetic factors. Exploiting the genetic variability of specific traits in segregating population of cherry tomato has greater importance for genetic improvement of the crop therefore, evaluation of genetic variability is very essential. Hence, the present investigation was conducted to study the genetic variability, heritability, genetic advance for quantitative and qualitative traits and to identify segregates for higher yield with good quality over the parents in F_2 segregating population of cherry tomato.

2. Materials and Methods

2.1 Experimental location and climate

The present investigation was carried out in a naturally ventilated polyhouse at the experimental block of the Department of Vegetable Science, College of Horticulture, Sirsi. Uttara Kannada, Karnataka (India)-581 401 during *Rabi* 2020-21. It was an ideal polyhouse with essential features like double door, side and top ventilation and drip irrigation system. The experimental site was located at 14.32° N latitude and 74.83° E longitude in the Hill Zone of Karnataka at an altitude of 611 meters above mean sea level (MSL). It has a geographical area of 10,292 square kilometer with an average rainfall of 2500-3000 mm per annum. During the cropping period, the mean air temperature of the greenhouse ranged between 24 °C to 36 °C and relative humidity ranged from 64 to 75%.

2.2 Experimental material

Two hybrids 'Cheramy' (Rijk Zwaan India Seeds Pvt. Ltd., Bengaluru, India) and 'Sheeja' (Known–You Seed Co., Ltd., Kaohsiung, Taiwan) were selected in order to develop the experimental material required for the variability studies in F_2 generation. These were selected due to their high preference in the Indian market: 'Cheramy' bears red, round fruits, and 'Sheeja' bears orange grape-type cylindrical fruits. The base material for this experiment comprised of two population and each population consists of two hundred fifty F_2 segregating cherry tomato plants.

2.3 Intercultural operations

Cherry tomato seeds were sown in plastic protrays with cocopeat as the growing media. The seeds were treated with capton at 0.1 per cent before sowing to avoid fungal diseases as a precautionary measure. Protrays were kept in the net house to take care of seedlings against damping off, white fly and other biotic and abiotic parameters. Under naturally ventilated polyhouse, beds were prepared with 1m width, 20 cm height with convenient length. Between two beds 50 cm space was left for intercultural operation. Fumigation is done with 4% formaldehyde and polythene sheet was covered for a week, after that the polythene sheet was removed and beds were irrigated for removing all the residues of formaldehyde. Farm yard manure, basal dose of fertilizers and vermicompost were applied on the beds before transplanting of seedlings. Seedlings were transplanted at a spacing of 60 cm x 45 cm.

The edaphic characteristics of the planting medium in the greenhouse were lateritic clay with pH 6.5, electrical conductivity 0.9 ds/m and organic carbon 1.1%. The available N-P-K content of the soil was 315-20-280 kg /ha, with 1.25 g/cm^3 soil bulk density and 49% water holding capacity. At the time of land preparation vermicompost and decomposed farmyard manure at 10 t/ ha each was mixed with the top soil 15 days before the transplanting of the seedlings. During the crop cycle, commercial-grade water-soluble fertilizers were applied once a week through fertigation at the following rates (kg/ week for 500 m^2 area): calcium nitrate 0.813 kg, potassium nitrate 0.760 kg, mono-potassium phosphate 0.365 kg, potassium sulphate 0.163 kg, magnesium sulphate 0.450 kg and micronutrients mix 0.032 kg.

The main branch was trained by twining on the jute threads hanging from an overhead GI wire trellis support system, clips are used at the base of the plant to tie the jute to avoid the breakage of branches due to the weight of fruits and foliage. The lower leaves that are shaded by new growth and touching the ground was removed periodically which avoids the incidence of soil borne diseases and also reduces the pest attack, this operation started from 35-40 days after transplanting of seedlings. From the ground level, leaves were removed up to 50 cm. To reduce the competition between the weeds and main crop and also maintain the cleanness in the plot weeding is done by hand at 15 days interval. To provide the proper ventilation to the plant light hoeing was done by loosening the soil.

2.4 Recording of observations

Individual F_2 plants along with their parents were labeled and used for recording growth and yield-related attributes observations like plant height, Number of primary branches per plant, days to first flowering and days to fifty per cent flowering. All fruit parameters were recorded at the ripe stage of cherry tomato *viz.*, fruit length, fruit width, fruit shape index, pericarp thickness, number of locules per fruit. All observations related to yield and yield attributing traits were recorded *viz.*, number of flowers per cluster, number of fruits per cluster, fruit set per cent, number of fruits per plant, average fruit weight. The fruit yield and number of fruits per plant were obtained by adding the fruit weight and fruit number from each harvest. The results were expressed as fruit yield per plant and yield per square meter.

Fruit quality analysis was carried out on freshly harvested ripe fruits of each tagged plants. The length and diameter of the fruits and the thickness of the pericarp were measured using digital vernier calipers. Digital handheld refractometer

(Atago Pal-1) was used to determine total soluble solids (TSS) content of fruit juice. The ascorbic acid content in fruit juice was estimated titrimetrically with 2, 6, dichlorophenol indophenol dye. pH of the fruit juice was estimated by using Siemen pH meter. The fruit lycopene content was estimated as per the procedure suggested Sadashivam and Manickam. An average number of days taken by the fruits from harvested to show first visible shrinkage on the fruit surface are recorded as shelf life.

2.5 Statistical analysis

The genotypic and phenotypic coefficients of variation were calculated using the formulae of Burton and De Vane (1953) [9]. Heritability was calculated according to Weber and Moorty (1952) [56] and genetic advance as per cent of mean was estimated using the method of Johanson *et al.* (1955). Genotypic and phenotypic correlations were calculated as per Al-Jibouri *et al.* (1958) [5]. The direct and indirect paths were obtained according to the method of Dewey and Lu (1959) [11].

3. Result and Discussion

3.1 Variability studies

Variability is an essential requirement for cherry tomato crop improvement. To begin breeding activities breeder should have a large number of variable populations. In the process of improvement, desirable plants are continuously selected from a genetically variable population. Fruit yield is the most important economic character in any crop. Other supporting characters influencing the fruit yield and yield itself are governed by polygenes and are quantitatively inherited (Hayes *et al.*, 1955) [15]. Since the selection is based on phenotypic observations, their reflection on genotypic value may not hold good unless observation on quantitative traits are subjected and interpreted according to statistical procedures as fruit yield in cherry tomato is much influenced by environmental factors. Therefore, parameters like mean, range, phenotypic and genotypic variation for different characters in cherry tomato have been computed to draw some valid inferences from the F_2 generation studied in the present investigation.

The range of the values for the particular trait represents the amount of phenotypic variability present in that trait and which is not conclusive, since it includes environmental, genotypic and genotypic x environment interaction components. Further, the phenotype of the crop is influenced by dominance (non-heritable), additive gene effect (heritable) and epistasis (non-allelic interaction), therefore it is important to partition the total variability into heritable and non-heritable components like phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV) which ultimately indicates the extent of variability existing for various characters. However, even this does not give a clear picture about the extent of inheritance of a particular character. Therefore, the heritability of a character can be relied upon, as it enables the plant breeder to decide the extent of selection procedure to be applied under a particular environment which separates out the environmental influence from the total variability. Nevertheless, its use would be limited because it is prone to the change in the environment, material *etc*. The estimation of heritability has a greater role to play in determining the effectiveness of selection of a character provided if it is combined with the predicted genetic advance as suggested by Johnson *et al.* (1955) [18].

The results of present investigation revealed that PCV values are higher than GCV for almost all traits which indicates there is a greater influence of the environment on the plants of the F_2 population performance and presented in Table 1 to 4.

In the present investigation high (>20%) genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were observed for the traits *viz.*, number of primary branches per plant, fruit length, fruit width, fruit shape index, pericarp thickness, lycopene content, average fruit weight, fruit yield per plant and fruit yield per m^2 in the both segregating population of Cheramy RZ-F_1 and Sheeja derived F_2 population. These results are in accordance with Hazim *et al.* (2017) [16], Mamatha *et al.* (2017) [27], Rakesh *et al.* (2018) [37], Reddy *et al.* (2019) [41] and Anuradha *et al.* (2020) [5]. It indicates existence of broad genetic base, which would be amenable for further selection.

Moderate (10-20 %) GCV and PCV was observed in the traits such as plant height, number of locules per fruits, TSS, ascorbic acid content, shelf life, number of flowers per cluster, number of fruits per cluster, number of fruits per plant in the populations of Cheramy RZ-F_1, similar results was noticed in the traits such as plant height, fruit length, fruit width, number of locules per fruits, TSS, ascorbic acid content, shelf life, fruit set per cent, number of fruits per plants in the populations of Sheeja derived F_2 population. These results are in the line with findings of Meena *et al.* (2015) [30], Mamatha *et al.* (2017) [27], Reddy *et al.* (2019) [41], Anuradha *et al.* (2020) [5] and Eppakayala *et al*. (2021) [12]. Which indicates that there is moderate amount of variability was found in these traits.

Low (>10%) GCV and PCV was observed for the traits such as days to first flowering, days to 50 per cent flowering, pH of the juice, fruit set per cent in the population of Cheramy RZ-F_1 and the similar results were obtained in the traits such as days to first flowering, days to 50 per cent flowering and pH of the fruit juice in Sheeja population also. These results are in accordance with Tiwari and Upadhyay (2011) [54], Hazim *et al.* (2014), Reddy *et al.* (2019) [41] Anuradha *et al.* (2020) [5] and Eppakayala *et al*. (2021) [12]. This indicated the narrow genetic base and variability has to be generated for these characters either through introduction or through hybridizing divergent genotypes to recover transgressive segregants or by mutation breeding.

High estimates of heritability (>60%) coupled with high values of GAM (>20%) were observed for the characters *viz.*, plant height, number of primary branches per plant, fruit length, fruit shape index, pericarp thickness, number of locules per fruit, TSS, ascorbic acid content, lycopene content, shelf life, number of flowers per cluster, number of fruits per cluster, number of fruits per plant, average fruit weight, fruit yield per plant and fruit yield per m^2 in both the population. The results are in line with Singh *et al.* (2000), Aradhana and Singh (2003) [7], Singh and Singh (2019) and Eppakayala *et al*. (2021) [12]. This indicates predominance of additive components for these traits and hence direct selection would be more effective in improving these traits.

High heritability (> 60 %) coupled with moderate GAM (10-20 %) were observed for the traits *viz.*, days to first flowering, pH of the fruit juice, fruit set per cent in the population of Cheramy RZ F_1. whereas, in population of Sheeja high estimates of heritability and moderate GAM were observed in the traits such as days to first flowering,

pH of the fruit juice and fruit width. The similar findings also observed by Vinodkumar *et al.* (2012) [55], Cholin and Raghavendra (2021) [10] and Eppakayala *et al*. (2021) [12]. Which indicated that prevalence of non-additive components and there can be little response to selection and these traits can be exploited through heterosis breeding.

High heritability (> 60 %) coupled with low GAM (<10 %) were observed for the trait days to 50 per cent flowering in both the hybrids. Similar findings are also reported by Tiwari and Upadhyay (2011) [54], Hazim *et al.* (2014), Reddy *et al.* (2019) [41] Anuradha *et al.* (2020) [5] and Eppakayala *et al*. (2020) [12]. These findings elucidate prevalence of non-additive components and higher influence of environment on these traits and hence, selection will be quite difficult or ineffective.

3.2 Correlation Coefficient Analysis

For the improvement of these segregating population, one should know the correlation and path analysis of different trait/s with yield, which helps in improvement of different traits along with the yield character. Correlation or character association is a measure of the degree of association between two traits. Variability studies provide information on the extent of improvement possible in different traits, but they do not provide the information about extent and nature of relationship existing between yield and various yield attributing traits. Further, many of these yield contributing traits are associated in undesirable and desirable direction. Hence, the information regarding the association of various traits among themselves and with economic traits is necessary for making indirect and direct selection for improvement of economic traits.

Grafius (1959) [14] studied that there might not be any gene for yield but operates only through its components. Hence, the study of trait association through correlation will help in selecting the yield and yield attributing traits.

Correlation studies in F_2 generations of the population Cheramy RZ-F_1 for fruit yield per plant revealed highly positive correlation with average fruit weight, number of fruits per plant. Days to 50 per cent flowering, fruit width, number for fruits per cluster, fruit set per cent and average fruit weight showed positive association with other traits (Table 5). These findings are corroborated with the earlier findings of Lakshmi *et al.* (2017) [24], Kumar *et al*. (2015), Sharma *et al.* (2009) [48], for average fruit weight. Reddy *et al*. (2013) [40] and Golani *et al.* (2007) [13] for fruit width. Livia *et al.* (2012) [26], Rani *et al.* (2010) [38], Golani *et al.* (2007) [13] and Singh and Cheema (2006) [50] for average fruit weight. Monamadi *et al.* (2013) [32], Anjum *et al.* (2009) [2], Lakshmikanth and Mani (2004) [25] and Mayavel *et al.* (2005) [59] for plant height.

In Sheeja F_2 population showed positive association with the traits like average fruit weight, number of fruits per plant, days to 50 per cent flowering. Number of flowers per cluster, number of fruits per cluster, fruit width, plant height and days to first flowering and number of primary branches per plant had association with other traits (Table 6). These findings are in accordance with the findings of of Younis *et al.* (2000) [58], Lakshmikant and Mani (2004) [25], Raut *et al.* (2005) [39], Mayavel (2005) [59], Sharma *et al.* (2009) [48], Livia *et al.* (2012) [26], Kumar *et al*. (2015), Lakshmi *et al*. (2017) [24], Mishra *et al.* (2019) [31], Reddy *et al*. (2019) [41] and Sangamesh (2019) [46]. Thus, suggesting the possibility of simultaneous selection for these traits for improving yield in the respective segregating populations.

3.3 Path Coefficient Analysis

The correlation analysis indicates the association of components characters with yield. They simply represent the overall influence of a particular character on yield rather than providing cause and effect relationship. The technique of path coefficient analysis developed by Wright (1921) [57] and demonstrated by Dewey and Lu (1959) [11] facilitates the partitioning of correlation coefficients into indirect and direct contribution of various characters towards yield. As such, it measures the direct influence of one variable upon other. Such information would be of great value in enabling the breeder to specifically identify the important component characters of yield and utilize the genetic stock for improvement in a planned way.

In the present investigation in Cheramy RZ-F_1, path analysis revealed that average fruit weight had highest positive direct effect on fruit yield per plant followed by number of fruits per plant, plant height, number of fruits per cluster, days to first flowering, fruit length, number of primary branches per plant, fruit width, fruit set per cent and number of locules per fruit. Whereas, number of flowers per cluster and days to 50 per cent flowering showed negative direct effect followed by pericarp thickness (Table 7). These results are in conformity with the findings of Kumar *et al.* (2003), Asati *et al.* (2008) [8], Kumar and Thakur (2007) [20], Srivastava *et al.* (2013) [53], Khapte and Janasiri (2014) [19], Premalakshmi *et al.* (2014) [35], Prajapati *et al.* (2015) [34], Jogi *et al.* (2018) [17], Singh *et al.* (2018), Sangamesh (2019) [46], Sharma *et al.* (2019) [47] and Kumari and Dogra (2021) [23] in tomato.

In Sheeja, average fruit weight had positive direct effect on fruit yield per plant followed by number of fruits per plant, number of fruits per cluster, number of flowers per cluster, fruit length, fruit set per cent, plant height, days to first flowering, days to 50 per cent flowering, number of primary branches per plant and pericarp thickness. Whereas, fruit width and number of locules per fruit showed negative direct effect on fruit yield per plant (Table 8). These results are in accordance with the findings of Kumar *et al.* (2003), Asati *et al.* (2008) [8], Ara *et al.* (2009), Manna and Paul (2012) [28], Saleem *et al.* (2013) [45], Srivastava *et al.* (2013) [53], Khapte and Janasiri (2014) [19], Premalakshmi *et al.* (2014) [35], Prajapati *et al.* (2015) [34], Jogi *et al.* (2018) [17], Singh *et al.* (2018), Sharma *et al.* (2019) [47], Sangamesh (2019) [46] and Kumari and Dogra (2021) [23] in tomato.

Table 1: Estimates of mean, range, components of variance, heritability and genetic advance for growth and earliness parameters in F_2 population of cherry tomato

Sl. No.	Characters	F_2 population	Mean	Range	GV	PV	GCV (%)	PCV (%)	h^2 (%)	GA	GAM (%)
Growth characters											
1	Plant height (cm)	Cheramy	90.45	60-135	231.42	235.70	16.82	16.98	98.19	31.05	34.33
		Sheeja	92.20	56-135	222.38	227.70	16.19	16.38	97.66	30.36	32.95
2	Number of primary branches per plant	Cheramy	3.87	2-5	0.71	0.74	21.93	22.37	96.11	1.71	44.29

		Sheeja	3.49	2-5	1.13	1.14	30.70	30.80	99.40	2.18	63.08
Earliness parameters											
1	Days to first flowering	Cheramy	27.54	24-31	2.67	2.81	5.94	6.08	95.48	3.29	11.96
		Sheeja	26.82	24-32	1.95	1.97	5.21	5.24	98.99	2.86	10.67
2	Days to 50 percent flowering	Cheramy	34.10	30-38	2.52	2.70	4.65	4.81	93.49	3.16	9.26
		Sheeja	33.10	29-38	2.29	2.45	4.56	4.73	93.20	3.00	9.07

Table 2: Estimates of mean, range, components of variance, heritability and genetic advance for fruit parameters in F_2 population of cherry tomato

Sl. No.	Character	F_2 population	Mean	Range	GV	PV	GCV (%)	PCV (%)	h^2 (%)	GA	GAM (%)
Fruit parameters											
1	Fruit length (cm)	Cheramy	3.62	1.73-6.5	0.70	0.73	23.16	23.63	96.06	1.69	46.76
		Sheeja	2.56	1.4-3.56	0.10	0.10	11.60	12.20	91.50	0.58	22.96
2	Fruit width (cm)	Cheramy	2.25	1.01-4.6	0.42	0.45	28.70	29.77	92.94	1.29	57.10
		Sheeja	2.60	1.68-3.4	0.07	0.08	10.22	11.35	81.08	0.50	18.96
3	Fruit shape index	Cheramy	1.70	0.78-3.63	0.25	0.26	29.60	29.73	99.17	1.03	60.73
		Sheeja	1.00	0.78-1.77	0.40	0.20	64.23	45.42	79.63	1.84	40.62
4	Pericarp thickness (mm)	Cheramy	2.69	1.11-4.19	0.34	0.41	21.66	23.65	83.93	1.10	40.89
		Sheeja	3.17	1.07-4.86	0.46	0.49	21.59	21.93	96.88	1.39	43.77
5	Number of locules per fruit	Cheramy	2.46	2-3	0.14	0.15	15.04	15.66	92.26	0.73	29.76
		Sheeja	2.55	2-3	0.11	0.12	13.03	13.20	97.40	0.68	26.49

Table 3: Estimates of mean, range, components of variance, heritability and genetic advance for yield and yield attributing traits in F_2 population of cherry tomato

Sl. No.	Character	F_2 population	Mean	Range	GV	PV	GCV (%)	PCV (%)	h^2 (%)	GA	GAM (%)
Yield parameters											
1	Number of flowers per cluster	Cheramy	10.25	5-15	2.72	3.13	16.15	17.31	87.03	3.18	31.03
		Sheeja	8.20	5-16	5.39	5.41	22.83	22.85	99.84	4.78	46.98
2	Number of fruits per cluster	Cheramy	8.18	4-12	1.47	1.82	14.83	16.50	80.78	2.24	27.46
		Sheeja	7.15	4-15	2.94	2.96	23.88	23.94	99.47	3.52	49.06
3	Fruit set per cent (%)	Cheramy	80.00	60-100	50.76	56.84	8.90	9.42	89.30	13.86	17.32
		Sheeja	71.04	53.85-100	101.86	102.78	14.17	14.24	99.11	20.69	29.06
4	Number of fruits per plant	Cheramy	202	160-248	485.11	496.04	10.88	11.00	97.80	44.86	22.17
		Sheeja	193	142-230	661.63	662.20	13.32	13.33	99.19	52.96	27.43
5	Average fruit weight (g)	Cheramy	9.13	4.76-17.41	5.45	5.67	25.57	26.08	96.14	4.71	51.64
		Sheeja	10.90	3.37-18.34	11.55	11.59	31.21	31.26	99.67	6.99	64.18
6	Fruit yield per plant (kg)	Cheramy	1.86	0.84-3.89	0.30	0.31	29.60	30.16	96.32	1.11	59.84
		Sheeja	2.10	0.54-4.04	0.50	0.51	33.82	33.87	99.71	1.46	69.56
7	Fruit yield per m^2 (kg)	Cheramy	6.89	3.12-14.38	4.14	4.29	29.63	30.16	96.47	4.12	59.94
		Sheeja	7.78	2.01-14.94	6.90	6.93	33.82	33.87	99.72	5.41	69.60

Table 4: Estimates of mean, range, components of variance, heritability and genetic advance for fruit quality parameters in two F_2 population of cherry tomato

Sl. No.	Character	F_2 population	Mean	Range	GV	PV	GCV (%)	PCV (%)	h^2 (%)	GA	GAM (%)
Quality parameters											
1	Total soluble solids (°B)	Cheramy	7.34	5-9.4	0.86	0.87	12.65	12.71	99.12	1.90	25.95
		Sheeja	7.35	5.1-8.9	0.80	0.81	12.24	12.28	99.38	1.85	25.13
2	Ascorbic acid content (mg/100g)	Cheramy	21.68	15.24-30	11.52	11.58	15.66	15.70	99.51	6.98	32.19
		Sheeja	20.75	15.04-28.29	9.23	9.31	14.67	14.70	99.53	6.26	30.14
3	pH of fruit juice	Cheramy	4.21	3.69-4.98	0.04	0.05	5.10	5.20	97.50	0.44	10.36
		Sheeja	4.33	3.88-4.96	0.08	0.09	6.33	6.58	92.70	0.54	12.56
4	Lycopene content (mg/100g)	Cheramy	5.58	2.99-8.30	1.27	1.44	20.23	21.54	88.20	2.18	39.14
		Sheeja	5.69	2.89-8.54	1.75	1.76	23.30	23.33	99.76	2.73	47.94
5	Shelf life (days)	Cheramy	16.82	13-28	3.10	3.20	10.41	10.72	94.29	3.50	20.82
		Sheeja	17.63	12-25	7.45	7.55	15.50	15.62	98.56	5.58	25.00

Table 5: Estimation of correlation coefficients in segregation population of Cheramy RZ- F_1 hybrid of cherry tomato

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1.0000	0.7526**	-0.0377	-0.0957	-0.0600	0.0367	-0.0363	-0.0141	0.1029	0.1069	0.0526	0.0056	-0.1023	-0.0911
2		1.0000	-0.0521	-0.0328	-0.0353	0.0120	-0.0888	-0.0013	0.0207	0.0642	0.0511	-0.0604	-0.0977	-0.0998
3			1.0000	-0.1111	-0.0248	-0.0245	-0.0457	0.0877	0.1107	0.0648	-0.1225*	0.0258	-0.0903	0.0700
4				1.0000	-0.0628	-0.0696	0.0120	-0.0568	0.0446	0.0216	-0.0304	0.0310	-0.0737	-0.0513
5					1.0000	0.4192**	0.0463	0.1194	0.0384	0.0031	-0.0505	-0.0138	0.0495	0.0421

6						1.0000	0.0331	0.0340	0.0530	0.0149	-0.0776	-0.0387	-0.0777	-0.0808
7							1.0000	0.0592	0.0780	0.0524	-0.0607	0.1180	-0.0121	0.0287
8								1.0000	-0.0564	-0.0301	0.0397	0.0238	0.0632	0.0657
9									1.0000	0.8577**	-0.3521**	-0.0092	-0.1169	-0.1020
10										1.0000	0.1370*	0.0130	-0.1122	-0.0983
11											1.0000	0.0558	0.0457	0.0195
12												1.0000	0.1491**	0.4840**
13													1.0000	0.9330**
14														1.000

*significant at p=0.05 **significant at p=0.01

1- Days to 50 per cent flowering 2- Days to first flowering 3- Plant height 4- Number of primary branches per plant
5- Fruit length 6- Fruit width 7- Pericarp thickness 8- Number of locules per fruit
9- Number of flowers per cluster 10- Number of fruits per cluster 11- Fruit set per cent 12- Number of fruits per plant
13- Average fruit weight 14- Fruit yield per plant

Table 6: Estimation of correlation coefficients in segregation population of Sheeja hybrid of cherry tomato

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
1	1.0000	0.7648**	0.1913**	0.0854	-0.0278	0.0413	-0.0149	-0.0002	0.0703	0.1037	0.0915	0.0952	0.0891	0.1265*
2		1.0000	0.0384	0.0494	-0.0087	0.0746	0.0131	0.0410	-0.0625	-0.0667	0.0225	0.0575	-0.0168	0.0161
3			1.0000	0.0951	0.0063	0.0148	0.0602	0.0365	0.1720**	0.0785	-0.1509**	0.0375	-0.0068	0.0036
4				1.0000	0.0220	0.0539	0.1839**	0.0158	0.0904	0.0158	-0.1282*	0.0555	-0.0771	-0.0511
5					1.0000	0.7842**	0.0732	0.0529	0.0889	0.0308	-0.1012	-0.0118	-0.0287	-0.0239
6						1.0000	0.0943	0.0688	0.0999	0.0961	-0.0056	0.0275	0.0194	0.0301
7							1.0000	0.0710	0.0128	0.0111	-0.0105	-0.0307	-0.0096	-0.0217
8								1.0000	0.0164	-0.0381	-0.0996	0.0172	-0.1165	-0.1026
9									1.0000	0.8384**	-0.2696**	0.0452	0.0743	0.0848
10										1.0000	0.2786**	0.0018	0.0831	0.0779
11											1.0000	-0.0629	0.0238	0.0227
12												1.0000	-0.0280	0.3674**
13													1.0000	0.9111**
14														1.000

*significant at p=0.05 **significant at p=0.01

1- Days to 50 per cent flowering 2- Days to first flowering 3- Plant height 4- Number of primary branches per plant
5- Fruit length 6- Fruit width 7- Pericarp thickness 8- Number of locules per fruit 9- Number of flowers per cluster 10- Number of fruits per cluster 11- Fruit set per cent 12- Number of fruits per plant 13- Average fruit weight 14- Fruit yield per plant

Table 7: Estimation of path coefficients in segregating population of Cheramy RZ-F_1 hybrid of cherry tomato

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**rG**
1	-0.0121	-0.0091	0.0005	0.0012	0.0007	-0.0004	0.0004	0.0002	-0.0012	-0.0023	0.0006	0.0009	0.0012	-0.0911
2	0.0121	0.0161	-0.0098	-0.00015	-0.0006	0.0018	-0.0014	-0.0017	0.0003	0.0010	0.0008	-0.0019	-0.0016	-0.0998
3	0.0017	0.0011	0.0600	0.0042	-0.0148	-0.0128	-0.0020	0.0045	0.0050	0.0005	0.0006	0.0203	0.0007	0.0700
4	-0.0005	-0.0007	0.0035	0.0025	-0.0002	-0.0002	0.0010	-0.0008	0.0009	0.0007	-0.0024	0.0001	-0.0017	-0.0513
5	-0.0006	-0.0005	-0.0059	-0.0018	0.0034	0.0014	0.0002	0.0004	0.0008	0.0003	-0.0053	-0.0018	0.0002	0.0421
6	-0.0005	-0.0006	-0.0043	0.0008	0.0001	0.0018	0.0008	-0.0011	0.0019	-0.0038	-0.0048	-0.0037	0.0005	-0.0808
7	0.0001	0.0002	0.0007	0.0006	-0.0001	-0.0001	-0.0020	-0.0006	-0.0008	-0.0019	0.0001	-0.0046	0.0008	0.0287
8	-0.0006	-0.0006	0.0006	-0.0019	0.0002	0.0060	0.0001	0.0013	-0.0024	0.0007	0.0001	-0.0018	0.0007	0.0657
9	-0.0029	0.0006	-0.0052	-0.0015	-0.0011	-0.0015	-0.0022	0.0016	-0.0286	-0.0246	0.0101	0.0008	0.0033	-0.1020
10	0.0035	0.0021	0.0054	0.0007	0.0001	0.0025	0.0017	-0.0015	0.0274	0.0324	0.0044	-0.0007	-0.0036	-0.0983
11	0.0009	-0.0009	0.0074	0.0005	0.0009	0.0013	0.0010	-0.0007	0.0060	0.0023	0.0017	0.0019	-0.0018	0.0195
12	-0.0020	-0.0213	0.0091	0.0109	-0.0049	-0.0136	0.0417	0.0084	-0.0083	-0.0046	-0.0198	0.3529	0.0526	0.4840
13	-0.0902	-0.0862	0.008	-0.0660	0.0436	-0.0670	-0.0106	0.0557	-0.1030	-0.0990	0.0334	0.1202	0.8817	0.9330

rG = dependent character Bolded values indicates direct effect on yield

1- Days to 50 per cent flowering 2- Days to first flowering 3- Plant height 4- Number of primary branches per plant
5- Fruit length 6- Fruit width 7- Pericarp thickness 8- Number of locules per fruit 9- Number of flowers per cluster 10- Number of fruits per cluster 11- Fruit set per cent 12- Number of fruits per plant 13- Average fruit weight

Table 8: Estimation of path coefficients in segregating population of Sheeja hybrid of cherry tomato

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**rG**
1	0.0048	0.0037	0.0009	0.0004	-0.0001	0.0002	-0.0001	0.0005	0.0003	0.0005	0.0004	0.0005	0.0004	0.1265
2	0.0059	0.0077	0.0003	0.0004	-0.0001	0.0006	0.0001	0.0003	-0.0010	-0.0045	0.0002	0.0004	-0.0043	0.0161
3	-0.0024	-0.0005	0.0127	0.0012	-0.0001	-0.0005	-0.0008	-0.0006	-0.0022	-0.0590	0.0019	0.0005	0.0001	0.0030
4	-0.0004	0.0007	0.0019	0.0008	0.0004	0.0006	-0.0002	-0.0005	-0.0009	0.0026	0.0007	0.0004	0.0001	-0.0511
5	-0.0008	-0.0004	0.0005	0.0006	0.0186	0.0146	0.0014	0.0010	0.0017	-0.0023	-0.0022	-0.0002	-0.0022	-0.0239
6	-0.0006	-0.0005	-0.0039	-0.0018	-0.0108	-0.0138	-0.0013	-0.0009	-0.0024	-0.0013	-0.0061	-0.0004	-0.0023	0.0301
7	0.0002	-0.0008	-0.0028	-0.0013	-0.0002	0.0002	0.0001	0.0002	-0.0014	-0.0030	-0.0048	-0.0083	0.0004	-0.0217
8	0.0003	-0.0004	-0.0037	-0.0020	-0.0003	-0.0006	-0.0001	-0.0016	-0.0025	0.0021	0.0002	-0.0008	0.0002	-0.1026
9	-0.0022	0.0020	-0.0053	-0.0028	-0.0028	-0.0031	-0.0004	-0.0008	0.0211	0.0260	0.0056	-0.0024	-0.0033	0.0848

10	0.0034	-0.0022	0.0021	0.0005	0.0010	0.0031	0.0004	-0.0012	0.0214	0.0327	0.0061	0.0032	0.0027	0.0779
11	-0.0014	-0.0004	0.0024	0.0020	0.0016	0.0001	0.0002	0.0016	0.0043	0.0044	0.0158	0.0044	0.0004	-0.0001
12	0.0375	0.0227	0.0048	0.0219	-0.0046	0.0108	-0.0121	0.0068	0.0178	0.0031	0.0048	0.3929	0.0110	0.3674
13	0.0822	-0.0155	-0.0063	-0.0711	-0.0265	0.0179	-0.0089	-0.1074	0.0286	0.0766	0.0051	-0.0228	0.9079	0.9111

rG = dependent character bolded values indicates direct effect on yield

1- Days to 50 per cent flowering 2- Days to first flowering 3- Plant height 4- Number of primary branches per plant
5- Fruit length 6- Fruit width 7- Pericarp thickness 8- Number of locules per fruit 9- Number of flowers per cluster
10- Number of fruits per cluster 11- Fruit set per cent 12- Number of fruits per plant 13- Average fruit weight

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