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Assessment of Agronomic and Quality Traits in Cherry Tomato Genotypes Grown under Open Field Condition

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Abstract

An experimental trial was conducted to evaluate the performance of eight cherry tomato genotypes for higher yield and better quality in open field during the Rabi season 2022-23 at the Research Area of Tomato Improvement Scheme under the Department of Horticulture, Mahatma Phule Krishi Vidyapeeth Rahuri, Maharashtra. The experiment was designed in a Randomized Block Design (RBD) with three replications and the plot size was 3.6 m x 3.3 m. The soil was amended using 20 t ha^{-1} of farmyard manure (FYM) and 200:100:100 kg NPK ha^{-1}. The results showed significant differences for qualitative and quantitative characters when evaluated among the eight tomato genotypes planted. The maximum plant height (184.25 cm) was recorded in the RHRCT-22-03 genotype. Genotype RHRCT-22-02 recorded the highest yield (49.99 t ha^{-1}), followed by RHRCT-22-04 (49.09 t ha^{-1}) and RHRCT-22-06 (49.09 t ha^{-1}). The promising genotypes also exhibited desirable qualitative traits including fruit size, shape, colour and total soluble solids (0Brix). Genotype RHRCT-22-03 had the highest T.S.S value (5.25 °Brix). The maximum polar diameter of the fruit was recorded by genotype RHRCT-22-06 (2.52 cm). The maximum equatorial diameter was recorded by genotype RHRCT-22-03 (2.40 cm). The study identified high-yielding and quality cherry tomato genotypes that can be used for commercial cultivation. The results of this study may be useful for breeders, farmers and industries involved in cherry tomato production.

Key words : Genotypes, Yield, Qualities and Cherry tomato.

Cherry tomato is botanically known as (Solanum lycopersicum L. var. cerasiforme (Dunal) A. Gray). It has a chromosome number of 2n=24. Tomato is one of the most important solanaceous vegetables grown extensively worldwide and is native to South America. It is a warm season crop that is heat and drought tolerant and grows in a variety of soil and climatic conditions (Anon., 2009a). Cherry tomato is a type of tomato species. It is characterized by having small fruits. It comes in various shapes and colours and is mainly used for fresh consumption. Due to its high quality and taste, it is in great demand in the global market. Therefore, its popularity is increasing among consumers worldwide. When taken as a salad dressing, it adds extra charm to the plate and looks very attractive. Cherry tomatoes are used for their edible fruits or as snacks after cooking and are used to make processed foods such as sauces, soups, ketchups, purees, curries, pastes, powders and sandwiches. The unripe green fruits are used to make pickles and chutneys. The size of the fruit's ranges from the tip of a thumb to the size of a golf ball. They can be round to slightly oblong in shape (Anon., 2009b). Cherry tomatoes are small in size, have a sweet taste and have several important nutritional benefits. It has been stated that cherry tomatoes have an intense colour and flavour. They are generally round in shape. Their fruits are used more as salads than as vegetables. Cherry tomatoes are often called 'salad tomatoes. Cherry tomatoes are also beneficial for human health. They are high in antioxidant and phytochemical compounds including lycopene, carotene, flavonoids, vitamin C and many essential nutrients. Cherry tomatoes are a

good source of total carbohydrates, sugars, protein, calcium and iron. They are a good source of vitamin C (13 mg 100^{-1} g), dietary fiber (2.0 g), vitamin A (25%) and vitamin K (Ramya *et al*., 2016). Generally, cherry tomatoes are often eaten raw. This is because it helps reduce the risk of cancer and the lycopene present in cherry tomatoes helps reduce blood cholesterol levels. This in turn reduces the risk of heart disease. The antioxidants in cherry tomatoes protect the skin from harmful UV rays. This increases the skin's radiance and reduces wrinkles. Cherry tomatoes are rich in vitamins, especially vitamins A and C. According to the USDA's nutritional information, 100 g of cherry tomato slices contain 500 IU of vitamin A and 9 g of vitamin C. The same size serving contains 4 g of carbs and 22 kilocalories. It has a little more protein per serving but is relatively low in carbs. It also has more sugar than regular tomatoes. Cherry tomatoes have determinate, semi-determinate and indeterminate growth habits with long racemes and produce multiple fruits weighing 10 to 30 g with intense colour and flavour (Prema *et al*., 2011). Cherry tomato fruits are consumed more as fruits than as vegetables (Omprasad *et al*., 2016). Due to its high bioflavonoid and carotene content, it is also used as a table crop which has anti-inflammatory effects and can be used to treat chronic diseases and as an analgesic (Omprasad *et al*., 2018). It is considered the ancestor of all cultivated tomatoes. It is widely cultivated in Central America and is distributed in California, Korea, Germany, Mexico and Florida. Cherry tomato production in India is about 20 million tonnes per year, accounting for 11% of the world's tomato production. Cherry tomato production across the country varies depending on the cultivation method, climate and variety. Cherry tomato production in India is generally 50 to 75 tons per hectare, while in greenhouses this production can increase to 120 tons. According to Volza's global export data, 8,916 shipments of cherry tomatoes were exported worldwide from March 2023 to February 2024 (TTM). These exports were made by 816 exporters to 1,067 buyers, representing a 22% increase over the previous twelve months. During this period, 589 cherry tomato export shipments were made worldwide in February 2024 alone. This represents a 0% year-on-year increase compared to February 2023 and a 0% sequential increase since January 2024. The majority of the world's cherry tomato exports go to Russia, the United States and Romania. The top three exporters of cherry tomatoes globally are Turkey, the Netherlands and Mexico. Turkey leads the world in cherry tomato exports with 8,133 shipments, followed by the Netherlands with 3,631 shipments and Mexico with 3,493 shipments. (These facts are based on Volza's global export data of cherry tomatoes.)

Quality parameters in cherry tomatoes emphasize on traits for fresh market and processing. Cherry tomatoes developed for fresh market and processing should possess specific quality traits (Kumar *et al.*, 2014). To meet the increasing demand for cherry tomatoes in fresh market and processing industry, it is necessary to develop high yielding and good quality varieties that are resistant to biotic and abiotic stresses and suitable for open field cultivation, suitable for different agro-climatic conditions as well as for increasing the profitability of marginal farmers in open field. Therefore, evaluation of tomato genotypes is very important for their suitability, growth and yield etc. traits, to identify potential genotypes. In view of the above facts, research has been planned on eight genotypes and one released variety for quality and important traits as well as for testing their production and related traits.

Materials and Methods

Experimental Site The experiment was

conducted during the *Rabi* season of 2022 on the experimental field of Tomato Improvement Scheme, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra. Geographically, the central area of Mahatma Phule Krishi Vidyapeeth, Rahuri is located between 73°15 0" to 76°22 12 North latitude and 15°46'48" to 22°3 0 East longitude. The site experiences hot, dry summers and humid monsoons and cold winter months, with maximum temperatures in summer (April to May) ranging from 38°-41° Celsius and minimum temperatures in winter ranging from 13° Celsius. The experimental field had medium black soil. The pH range was 6.5-7.5. University seeds were used for sowing to produce seedlings in the nursery. The experiment was designed in a randomized block design (RBD) with three replications. The treatment details included eight cherry tomato genotypes (RHRCT-22-01 to RHRCT-22-08) and one check variety (Phule Jayashree). Soil amendment was done using 20 t ha^{-1} of organic manure (FYM) and 200:100:100 kg NPK ha^{-1} in the main field. Each plot was 3.6 m x 3.3 m in size. The plants were planted in rows at a spacing of 90 cm x 30 cm. The plots were separated by one meter of lane to prevent cross-pollination. The crop was irrigated using drip irrigation system, with a total of 12 irrigations during the growing season. Irrigation management was based on soil moisture level and crop water requirements. Fruit yield and quality characters were recorded from five plants in each randomly selected replicate and tagged. Fruit firmness (Dhatt and Singh, 2004). The experimental plots were kept weed-free by frequent hand weeding. All the agronomic practices were followed as per the recommendations of the Department of Horticulture's Package of Practices. Plant height was measured in cm from the soil level to the tip of the plant. The days from the date of transplanting to the first flowering in 50% of the plant population in each replicate were recorded and averaged. Data were collected on various quantitative traits such as plant height, days to flowering, length of fruit bunch, number of fruits per bunch, average weight per bunch, yield per plant, yield per plot and yield per hectare as well as various qualitative traits such as polar diameter, equatorial diameter, number of locules, total soluble solids (°Brix), pericarp thickness, growth habit, colour and fruit size. Observations were recorded on each replicate for various growth, yield and quality traits to see the performance of five randomly selected tomato genotypes and eight cherry tomato genotypes from each genotype.

Result and Discussion

The results of the field experimental trial on cherry tomato genotypes and the data on quantitative and qualitative characters of cherry tomato genotypes are presented in Tables 1 and 2. Significant differences were observed in the results among the genotypes for all the characters studied. Analysis of diversity showed significant differences among 08 genotypes. Plant height (cm), days to first flowering, length of fruit bunch, number of fruits per bunch, average weight in bunch, number of locules, weight of individual fruits (g), yield per plant (kg), yield tons per hectare, T.S.S (°Brix) and pericarp thickness (cm) were found to be significant for all treatments. This is because all the genotypes were genetically distinct from each other.

Plant height : Plant height is an indicator of plant health. It is robust and determines the number of branches and leaves. Good plant height provides good sunlight access to the plant canopy and good biomass accumulation and translocation. Plant height of different cherry tomato genotypes varied significantly. The RHRCT-22-03 genotype had the tallest plants with an average height of (184.25) cm. This was followed by the RHRCT-22-04 genotype with an average height of (172.15 cm). While

RHRCT-22-05 had the shortest plants (102.52 cm). These results were consistent with previous findings in cherry tomato by Nitsche *et al*., (2003), Kumar *et al*., (2014) and Renuka *et al*., (2014). These indeterminate growth habits are mainly preferred due to their harvest period Prema *et al*., (2011a). These results were also consistent with previous findings by Nitsche *et al*., (2003), Kumar *et al*., (2014) and Renuka *et al*., (2014).

Days to 50% flowering : The genotype RHRCT-22-04 took the longest time to reach 50% flowering on average (31.00) days. This was followed by genotypes RHRCT-22-03 and RHRCT-22-06 which took an average of (30.00) days. RHRCT-22-02, RHRCT-22-07 and RHRCT-22-08 took the shortest time (28.00) days. In cherry tomato, Yimchungar *et al*., (2018) and Gawali *et al.*, (2023) obtained similar results of significant variation. Omprasad *et al*., (2016a) and Prema *et al*., (2011) reported similar variation.

Fruit cluster length and number of fruits per cluster: The length of fruit clusters of different cherry tomato genotypes varied significantly. The genotype RHRCT-22-07 had the longest fruit cluster with an average length of (9.20 cm). This was followed by RHRCT-22-01 with an average length of (9.10 cm). Also, the number of fruits in each cluster of different cherry tomato genotypes varied significantly. The genotype RHRCT-22-04 had the highest average number of fruits per cluster (8.35), followed by RHRCT-22-06 with an average of (8.21) fruits. On the contrary, the genotypes RHRCT-22-01, RHRCT-22-05, RHRCT-22-08 respectively, recorded the lowest number of fruits which was (7.58). This variation is likely due to several factors, including the number of fruits per plant, temperature, and genotype genetic potential in response to favourable weather conditions. Similar findings have been reported in cherry tomato by Yimchunger *et al*., (2018), Malvika *et al*., (2017) and Sabindas *et al.*, (2021).

Average cluster weight and yield per plant : The average cluster weight of different cherry tomato genotypes varied significantly. The genotype RHRCT-22-03 had the highest average weight, averaging (71.25 g) followed by RHRCT-22-06, averaging (64.25 g). There was also significant variation in yield per plant of cherry tomato genotypes. The genotype RHRCT-22-02 had the highest yield per plant,

Table 1. Quantitative characters of promising genotypes of cherry tomato

Genotypes	Plant height (cm)	Days for 50% flowe-ring	Length of fruit cluster (cm)	No. of fruits cluster^{-1}	Av. wt. of cluster (g)	Yield plant^{-1} (kg)	Yield plot (kg)	Yield (t ha^{-1})
RHRCT-22-01	142.25	29.00	9.10	7.58	60.25	1.52	54.72	46.06
RHRCT-22-02	158.62	28.00	8.16	8.16	58.2	1.65	59.4	49.99
RHRCT-22-03	184.25	30.00	8.40	7.82	71.25	1.55	55.8	46.96
RHRCT-22-04	172.15	31.00	7.58	8.35	57.25	1.62	58.32	49.09
RHRCT-22-05	102.52	29.00	8.20	7.58	60.35	1.45	52.2	43.93
RHRCT-22-06	104.62	30.00	7.58	8.21	64.25	1.62	58.32	49.09
RHRCT-22-07	111.65	28.00	9.20	7.95	58.20	1.52	54.72	46.06
RHRCT-22-08	132.40	28.00	8.25	7.58	58.17	1.55	55.8	46.96
Phule Jayashree (C)	144.53	30.00	8.69	8.02	56.38	1.42	51.12	43.03
S.E.±	2.58	1.25	2.92	2.42	3.85	0.58	1.35	2.12
C.D. at 5%	7.72	3.71	8.70	7.20	11.50	1.74	4.05	6.30
CV %	6.42	3.20	3.45	5.20	5.68	7.75	7.56	7.56

averaging (1.65 kg) followed by RHRCT-22-04 and RHRCT-22-06, averaging (1.62 kg) each. The yield per plant ranged from (1.42 kg) Phule Jayashree to (1.65 kg) RHRCT-22-02. The yield per plot ranged from (51.12 kg) Phule Jayashree to (59.4 kg) RHRCT-22-02. These results are similar to those obtained by Alamet *et al*., (2005), Islam *et al*., (2014) and Jamdhade *et al*., (2016).

Yield per hectare : The yield per hectare of different cherry tomato genotypes varied significantly. The genotype RHRCT-22-02 was reported to have the highest yield per hectare. The average yield was (49.99 tonnes/hectare) followed by the genotypes RHRCT-22-04 and RHRCT-22-06. The average yield was (49.09 tonnes hectare^{-1}). Similar results were reported in cherry tomato by scientists Prema *et al*., (2011), Islam *et al*., (2012) and Razzak *et al*., (2013). The yield hectare^{-1} ranged from (43.03 tonnes hectare^{-1}) Phule Jayashree to (49.99 tonnes hectare^{-1}) RHRCT-22-02. These results are more or less similar to those obtained by Tkacheva (1984), Alamet *et al*., (2005) and Jamdhade (2016).

Polar diameter : The polar diameter of different cherry tomato genotypes varied significantly. The genotype RHRCT-22-06 had the highest polar diameter of (2.52 cm). It was followed by the genotypes RHRCT-22-08, RHRCT-22-03 with polar diameters of (2.14 cm) and (2.12 cm) respectively. While the genotypes RHRCT-22-01 and RHRCT-22-04 had the lowest polar diameter of (1.98 cm).

Equatorial diameter : The equatorial diameter of different cherry tomato genotypes varied significantly. The equatorial diameter of the genotype RHRCT-22-03 was the highest at (2.40 cm). It was followed by the equatorial diameter of the genotypes RHRCT-22-07 and RHRCT-22-04 with polar diameters of (2.21 cm) and (2.13 cm) respectively. The lowest equatorial diameter of (1.25 cm) was found in the genotype RHRCT-22-06.

Number of Locules : Tomatoes with fewer loculi are preferred for fruit processing industries as they give better firmness and indirectly better storage properties. Cherry tomatoes having a limited number of loculi in 2-3 fruits are preferred over fruits having more loculi. Cherry tomatoes are generally preferred as table fruit vegetables. The data related to the number of loculi per fruit showed significant variation among different genotypes of cherry tomatoes.

Table 2. Qualitative characters of promising genotypes of cherry tomato

Genotypes	Polar diameter (cm)	Eq. diameter (cm)	No. of locules	T.S. S (°Brix)	Pericarp thickness (cm)	Growth habit	Fruit colour	Fruit shape
RHRCT-22-01	1.98	2.10	2.00	4.58	0.22	Indt.	Red	Round
RHRCT-22-02	2.05	1.87	2.00	5.10	0.19	Indt.	Dark red	Oval
RHRCT-22-03	2.12	2.40	2.00	5.25	0.18	Indt.	Dark red	Round
RHRCT-22-04	1.98	2.13	2.00	5.15	0.22	Indt.	Dark red	Round
RHRCT-22-05	2.05	1.85	2.00	4.85	0.15	Indt.	Red	Oval
RHRCT-22-06	2.52	1.25	2.00	5.20	0.21	Indt.	Orange	Strawberry shape
RHRCT-22-07	2.10	2.21	2.00	5.15	0.18	Indt.	Red	Round
RHRCT-22-08	2.14	1.90	2.00	5.00	0.17	Indt.	Red	Oval
Phule Jayashree (C)	2.12	2.15	2.00	5.52	0.18	Indt.	Red	Round
S.E.±	2.25	2.15	2.10	1.12	0.9	-	-	-
C.D. at 5%	6.75	6.45	6.63	3.36	0.25	-	-	-
CV %	6.12	4.25	6.42	3.20	3.78	-	-	-

The average of 2.00 loculi was found in all genotypes. This result was consistent with the findings of Kamimura *et al.*, (1985), Dundee and Mandalageri (1991), Renuka *et al.*, (2014) and Renuka *et al.*, (2017) in cherry tomatoes.

Total Soluble Solids (°Brix) : A major factor to be considered for the production of processed products is high Total Soluble Solids (°Brix). A one percent increase in T.S.S content in the fruit indicates a 20 percent increase in the recovery of the processed product. (Berry *et al.*, 1988 and Sivananda, 2008). The data related to total soluble solids (°Brix) showed significant variation among different genotypes of cherry tomato. The Phule Jayashree (Check) genotype had the highest mean (5.52 °Brix) T.S.S. The genotype RHRCT-22-01 had the lowest T.S.S value (4.58 0Brix). This was followed by RHRCT-22-03, which had a mean of (5.25 0Brix). Similar results were also observed by Jasmin and Ramdas (1994), Saimbhi *et al.*, (1995), Sharma *et al.*, (1996), Rathod *et al.*, (1997), Shivkumar *et al.*, (2000) and Sheferao *et al.*, (2001). T.S.S of cherry tomatoes is an important factor in determining their taste and quality. Genotypes with higher T.S.S have a sweeter and more savoury taste.

Pericarp thickness : The pericarp thickness ranged from (0.15 cm) for RHRCT-22-05 to (0.22 cm) for RHRCT-22-01 and RHRCT-22-04. The pericarp thickness of different cherry tomato genotypes varied significantly. The genotype RHRCT-22-01 and RHRCT-22-04 was found to have the highest pericarp thickness of (0.22 cm). This was followed by genotypes RHRCT-22-06, RHRCT-22-02, RHRCT-22-03, RHRCT-22-07, Phule Jayashree, RHRCT-22-08 and RHRCT-22-05. These results are in close agreement with Dar *et al.*, (2012), Spaldon and Hussain (2017) and Kumara *et al.*, (2017). Growth habit was indeterminate for all genotypes.

Fruit colour and shape : Fruit colour of different cherry tomato genotypes varied significantly. The genotype RHRCT-22-06 had orange-coloured fruits. While the other genotypes had red or dark red-coloured fruits. A range of fruit shapes was observed across genotypes, including round, oval and strawberry shaped. Effects of the fruit shape of cherry tomatoes is an important factor in determining their appearance and marketability. Different consumers or markets may prefer different fruit shapes. The results of this study suggest that the genotypes exhibit a range of fruit shapes, which may be useful for different purposes or markets. The genotype RHRCT-22-06 had strawberry shaped fruits. Except for genotype RHRCT-22-06, other genotypes had round or oval shaped fruits.

In this study, RHRCT-22-02, RHRCT-22-04 and RHRCT-22-06 were identified as promising genotypes for high yield and good quality in cherry tomato. These genotypes can be used for commercial cultivation and further breeding programs.

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