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GENOTYPIC EVALUATION OF CHERRY TOMATO (*SOLANUM LYCOPERSICUM* VAR. *CERASIFORME*) FOR GROWTH, YIELD AND QUALITY TRAITS UNDER PROTECTED CULTIVATION

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ABSTRACT

The present investigation was conducted to assess the growth, yield, and quality performance of fifteen cherry tomato (*Solanum lycopersicum* var. *cerasiforme*) genotypes under protected cultivation at the Vegetable Research Centre, G. B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, during the autumn-winter season of 2023–2024. The experiment was laid out in a Randomized Block Design (RBD) with three replications and observations were recorded on thirteen morphological and biochemical traits, including days to 50% flowering, plant height, fruit dimensions, average fruit weight, fruit yield parameters and quality attributes such as total soluble solids (TSS), lycopene content, ascorbic acid and sugars. Significant genotypic variation was observed across all parameters. Among the evaluated genotypes, 2021/TOCVAR-6 exhibited the highest fruit yield per plant (1.76 kg) and fruit number (176.33), followed by PCT-8 and 2021/TOCVAR-2, which were statistically at par with it. In contrast, Punjab Sona Cherry recorded the lowest yield (0.35 kg) and fruit count (72.67). For quality traits, IIHR-2858 showed the highest TSS (8.19 °Brix), while CPCT Cherry-214 recorded the maximum lycopene content (7.33 mg/100 g). Considerable variability was also noted in ascorbic acid and sugar content across genotypes. These findings highlight 2021/TOCVAR-6 as a promising genotype for commercial cultivation and as a potential parental line in cherry tomato breeding programs aimed at improving yield and quality under protected conditions.
***Keywords*:** Cherry tomato, protected cultivation, fruit yield, variation.

Introduction

In the context of modern horticultural production and nutritional awareness, *Solanum lycopersicum* var. *cerasiforme*, commonly known as cherry tomato, has emerged as a significant botanical variant of cultivated tomato. It is considered to be one of the ancestral forms from which modern tomato cultivars have evolved. Characterized by their small fruit size typically ranging from marble- to golf ball-sized (Prema *et al.,* 2011) cherry tomatoes are increasingly preferred by consumers for their visual appeal, convenient size and distinct flavour profile. The organoleptic quality of cherry tomatoes is largely attributed to their high concentrations of reducing sugars and organic acids, which together contribute to a desirable sweet-acidic taste. Among the various fruit colours observed in cherry tomato genotypes, red-fruited types are most widely accepted and preferred in fresh markets due to their vibrant appearance and perceived ripeness (Rocha *et al.,* 2013). In addition to their sensory attributes, cherry tomatoes are rich in essential micronutrients such as vitamin A and vitamin C, and they possess a substantial antioxidant profile. Bioactive compounds including lycopene, ascorbic acid and phenolics contribute not only to the fruit's characteristic pigmentation and flavour but also to its healthpromoting properties. These phytochemicals play a key role in mitigating oxidative stress and have been associated with the reduced risk of chronic degenerative diseases, thereby enhancing the nutritional and functional value of the crop. Given the increasing demand for nutrient-dense and flavourful produce, cherry tomato has become a crop of interest for both commercial cultivation and breeding programs aiming to improve yield, quality and stress resilience under varying environmental conditions.

Therefore, a comprehensive evaluation of cherry tomato genotypes for growth, yield and quality traits is crucial to select promising lines suitable for specific agro-climatic conditions and to improve crop productivity and fruit quality through breeding programs.

Materials and Method

The present investigation was carried out at the Vegetable Research Centre, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India, during the autumn-winter season of 2023–2024. The study aimed to evaluate 15 genotypes of cherry tomato under protected cultivation. Seeds were sown in protrays on 1st August 2023, and 30-day-old healthy seedlings were transplanted into a naturally ventilated polyhouse on 1st September 2023. The spacing was maintained at 40 cm × 40 cm (row to row and plant to plant, respectively). The experimental material consisted of 13 genotypes along with two check cherry tomato genotypes were collected from various research institutes across the country viz., IARI, New Delhi [CPCT Cherry-1 (check), CPCT Cherry-214, 2022/TOCVAR-1, CPCT Cherry-263), IIVR, Varanasi (2021/ TOCVAR-2, 2021/TOCVAR-6, 2022/ TOCVAR-4), GBPUA&T, Pantnagar (PCT-6, PCT-8, 2022/TOCVAR-3), IIHR, Bangalore (IIHR-2858, IIHR-2862), Solan (2021/TOCVAR-4), Palampur (DPCTY-1) and PAU, Ludhiana [Punjab Sona Cherry (check)]. Each genotype was planted in rows containing six plants, following a Randomized Block Design (RBD) with three replications.

Standard cultural practices recommended for protected cultivation were followed throughout the crop period to ensure healthy plant growth and development. Data were recorded on thirteen morphological and biochemical traits: days to 50% flowering, plant height (cm), fruit diameter (cm), fruit length (cm), average fruit weight (g), number of fruits per plant, fruit yield per plant (kg), fruit yield per square meter (kg/m²), total soluble solids (°Brix), lycopene content (mg/g), vitamin C content (mg/100 g fresh weight), reducing sugar (%), total sugar (%) and non-reducing sugar (%). Observations were made on five randomly selected and tagged plants from each replicated plot.

Estimation of Quality Parameters

The genotypes were analyzed for various fruit quality attributes. Total Soluble Solids (TSS) were measured using a hand refractometer and expressed as °Brix, with appropriate temperature correction applied to the recorded values. Ascorbic acid content was estimated following the method prescribed by AOAC (1984), using 2,6-dichlorophenol-indophenol dye for titration. Lycopene content was determined using the UV-VIS spectrophotometric method as described by Ranganna (1976), where pure lycopene was used as a standard and absorbance was recorded at 450 nm. Reducing sugars were estimated using the Fehling's titration method originally described by Lane and Eynon (1923) and later modified by Ranganna (1986). This method relies on the reduction of Fehling's solution in an alkaline medium, resulting in the formation of a brick-red precipitate of cuprous oxide at the endpoint. Total sugars were estimated volumetrically, and the non-reducing sugar content was calculated as the difference between total and reducing sugars, since non-reducing sugars such as sucrose do not directly react with Fehling's solution.

Statistical analysis

For statistical analysis, the experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The collected data were subjected to analysis of variance (ANOVA) to test the significance of differences among the treatments. Mean comparisons were performed using the Least Significant Difference (LSD) test at a 5% probability level. All statistical analyses were carried out using the online tool Agri Analyze (Popat *et al.,* 2024).

Results and Discussion

Growth Parameters

The *per se* performance of cherry tomato genotypes for various growth and yield traits is summarized in Table 1. The genotypes exhibited moderate variation in days to 50% flowering, ranging from 23.0 to 40.66 days, with a mean of 31.88 days. The longest duration to attain 50% flowering (40.66 days) was observed in 2021/TOCVAR-6, which was statistically at par with the check variety Punjab Sona Cherry. In contrast, the earliest flowering was recorded in PCT-6 (23.0 days), followed by DPCTY-1 (28.0 days), 2022/TOCVAR-3 (28.0 days) and 2021/ TOCVAR-2 (28.33 days). Notably, nine genotypes flowered earlier than the overall mean. Early flowering in these genotypes may be attributed to their greater efficiency in assimilate partitioning towards the shoot apex during the critical pre-floral development phase. These observations are in agreement with the findings of Prema *et al.* (2011), who reported similar patterns in tomato genotypes under controlled conditions.

Plant height among the evaluated genotypes ranged from 300.33 cm to 399.66 cm, with an overall mean of 655.95 cm. The tallest plants were observed in Punjab Sona Cherry (399.66 cm), a check variety, which was found to be statistically superior to all other genotypes. The shortest plants were recorded in another check variety, CPCT Cherry-1 (300.33 cm). Interestingly, all fifteen test genotypes recorded plant heights below the overall mean. The increased plant height recorded under polyhouse conditions can be attributed to the favorable micro-environment created within the structure. Factors such as diffused light, regulated temperature, and humidity inside the polyhouse promote better physiological activity and growth responses in plants. Moreover, enhanced nutrient absorption and accelerated cell division under these controlled conditions contribute to increased vegetative growth. Similar results have been reported by Omprasad *et al.* (2018), Singh *et al.* (2021) and Pavithral *et al.* (2023), who also highlighted the positive influence of polyhouse environments on plant growth parameters.

Table 1 : Evaluation of cherry tomato genotype for growth and yield parameters.

Genotype	Days to 50 % Flowering	Plant Height (cm)	Fruit Diameter (cm)	Fruit Length (cm)	Average Fruit Weight (g)	Number of fruits per plant	Fruit yield per plant (Kg)
CPCT Cheery-1 (Check)	30.67	300.33	2.52	3.01	9.47	120.33	1.14
2021/TOCVAR-2	28.33	307.67	2.89	2.67	19.99	93.67	1.87
PCT-6	23.00	315.00	2.86	2.98	12.30	117.33	1.44
2021/TOCVAR-4	31.33	321.33	2.49	1.99	12.58	120.00	1.51
CPCT CHERRY-214	35.67	327.67	2.62	3.43	11.56	131.67	1.52
2021/TOCVAR-6	40.67	335.33	2.60	2.46	11.96	176.33	2.11
2022/TOCVAR-1	36.00	342.33	1.88	1.96	9.83	122.33	1.20
PCT-8	30.00	349.67	3.15	3.07	15.84	115.00	1.82
2022/TOCVAR-3	28.00	356.67	2.52	2.69	10.26	126.33	1.30
2022/TOCVAR-4	34.67	364.33	2.21	2.01	12.95	129.33	1.67
CPCT Cherry-263	33.00	371.67	2.77	2.96	13.44	125.00	1.68
DPCTY-1	28.00	378.00	2.68	2.32	12.45	111.67	1.39
IIHR-2858	31.00	384.67	2.23	3.11	8.28	102.33	0.85
IIHR-2862	30.00	393.33	2.25	1.64	14.04	120.33	1.69
Punjab Sona Cherry (Check)	38.00	399.67	1.81	1.32	6.39	72.67	0.47
SE±m	1.13	0.50	0.19	0.11	0.65	1.23	0.10
CD at 5%	3.29	1.45	0.57	0.24	1.88	3.57	0.21
CV	6.17	0.24	13.82	5.72	11.17	1.79	10.53

Fruit diameter among the evaluated cherry tomato genotypes exhibited considerable variability, ranging from 2.16 cm to 3.71 cm. The maximum fruit diameter was recorded in IIHR-2862 (3.71 cm), followed closely by 2021/TOCVAR-2 (3.66 cm), with both genotypes being statistically similar. Notably, nine genotypes demonstrated fruit diameters significantly exceeding the overall mean. The smallest fruit diameter (1.80 cm) was observed in the check variety Punjab Sona Cherry. With regard to fruit length, values ranged from 1.00 cm to 3.43 cm, with the longest fruits recorded in CPCT Cherry-214. This genotype stood out as statistically superior, with no other entries found at par. These findings align with the observations of Kumar *et al.* (2014), who also reported significant genotypic differences in fruit size attributes under protected cultivation conditions.

Yield parameters

Average fruit weight showed considerable variation among the genotypes, ranging from 4.39 g in Punjab Sona Cherry to 18.27 g in 2021/TOCVAR-2. The highest value was statistically distinct, with no other genotype matching it. The check varieties recorded fruit weights below the overall mean. The number of fruits per plant varied from 72.67 to 176.33, with 2021/TOCVAR-6 recording the highest fruit count (176.33) and Punjab Sona Cherry the lowest (72.67). Fruit yield per plant ranged from 0.35 kg to 1.76 kg, with a mean of 1.44 kg. The maximum yield was recorded in 2021/TOCVAR-6 (1.76 kg) and 2021/TOCVAR-2, PCT-8, which were found statistically at par with the highest-yielding genotype. The lowest yield was again observed in Punjab Sona

Cherry. Yield per plant showed a direct and positive contribution to the overall crop yield. These results are consistent with the findings reported by Renuka *et al.* (2014), Deepa and Thakur (2008) and Shivakumar (2000).

Table 2 : Evaluation of cherry tomato for quality parameters.

Genotype	TSS (°Brix)	Reducing Sugar %	Total Sugar %	Non reducing Sugar %	Ascorbic Acid (mg/100 g)	Lycopene Content (mg/100 g)
CPCT Cheery-1 (Check)	5.88	51.45	2.43	0.19	35.33	6.70
2021/TOCVAR-2	4.62	52.94	1.61	0.13	30.00	7.00
PCT-6	7.32	54.07	2.44	0.23	32.00	6.00
2021/TOCVAR-4	7.90	54.93	3.36	0.31	29.00	6.27
CPCT CHERRY-214	5.78	56.26	2.67	0.21	30.00	7.33
2021/TOCVAR-6	7.51	57.54	2.51	0.21	26.00	7.00
2022/TOCVAR-1	5.30	58.20	2.37	0.21	25.00	6.60
PCT-8	5.30	60.07	2.53	0.22	30.00	6.80
2022/TOCVAR-3	5.97	60.86	2.63	0.22	34.67	6.17
2022/TOCVAR-4	5.39	62.13	2.22	0.12	33.00	6.37
CPCT Cherry-263	4.24	63.60	2.07	0.18	29.00	6.97
DPCTY-1	5.20	64.40	2.18	0.10	26.00	6.60
IIHR-2858	8.19	65.34	2.79	0.33	32.33	7.20
IIHR-2862	6.55	66.91	2.55	0.29	25.00	6.87
Punjab Sona Cherry (Check)	5.78	67.31	2.27	0.21	29.81	6.40
SE±m	0.03	0.06	0.04	0.02	0.79	0.04
CD at 5%	0.11	0.17	0.15	0.06	1.63	0.12
CV	1.11	4.55	2.87	18.54	3.38	1.14

Quality parameters

Quality traits of the cherry tomato genotypes are summarized in Table 2. Total Soluble Solids (TSS) content ranged from 4.24 to 8.19 °Brix, with a mean value of 6.06 °Brix. The highest TSS was recorded in IIHR-2858 (8.19 °Brix), which was significantly superior to both check varieties. Five genotypes exhibited TSS values higher than the overall mean. High TSS content, along with low acidity, is considered a crucial factor for fruit processing suitability. It has been reported that a 1% increase in TSS can lead to a 20% increase in the recovery of processed products (Berry *et al.*, 1988 and Shivanand, 2008).

The highest reducing sugar percentage was recorded in 2021/TOCVAR-4 (3.19%), with no significant difference between them. The lowest reducing sugar content was observed in 2021/ TOCVAR-2 (1.54%). Regarding total sugar content, 2021/TOCVAR-4 exhibited the highest value (3.35 %). The minimum total sugar concentration was found in 2021/TOCVAR-2 (1.61 %). For non-reducing sugars, IIHR-2858 showed the highest content (0.33 %), while 2021/TOCVAR-4 and IIHR-2862 had statistically similar values. The lowest non-reducing sugar level (0.1 %) was recorded in DPCTY-1. The observed increase in sugar accumulation in cherry tomato varieties grown under protected environments may be linked to the degradation of organic acids during ripening and senescence phases. Similar results have been documented by Razzak *et al.* (2013) in tomatoes cultivated under shade net conditions.

Ascorbic acid content among the evaluated cherry tomato genotypes varied from 26.0 to 34.0 mg/100 g. The highest ascorbic acid concentration was recorded in 2022/TOCVAR-3 (34.0 mg/100 g), followed closely by 2022/TOCVAR-4 (33.0 mg/100 g), which was statistically comparable. The lowest value was observed in IIHR-2862 (26.0 mg/100 g). The substantial variation in ascorbic acid content across genotypes may be linked to their diverse genetic backgrounds and their differential physiological responses under protected cultivation. These findings are in line with the observations of Gyadi and Phookan (2018), who also reported genotypic influence on ascorbic acid levels in cherry tomato under controlled environments.

Lycopene content among the evaluated genotypes ranged from 6.00 to 7.33 mg/100 g. The highest concentration was recorded in CPCT Cherry-214 (7.33 mg/100 g), which was significantly superior to all other genotypes. The lowest lycopene content was observed in PCT-6 (6.00 mg/100 g). The elevated lycopene levels in certain genotypes may be attributed to greater pericarp thickness and enhanced fruit firmness, traits that contribute to better pigment retention. These findings are consistent with those reported by Prema *et al.* (2011), who also highlighted the influence of fruit structural characteristics on lycopene accumulation.

Conclusion

Among the fifteen cherry tomato genotypes evaluated under protected cultivation, 2021/TOCVAR-6 exhibited the highest fruit yield per plant (1.76 kg) and fruit number (176.33), followed by PCT-8 and 2021/TOCVAR-2, which were statistically at par. Punjab Sona Cherry recorded the lowest yield and fruit count. These findings underscore the superior potential of 2021/TOCVAR-6 for enhancing cherry tomato productivity, with fruit number and yield per plant emerging as critical selection criteria, while genotypes like IIHR-2858, 2021/TOCVAR-4, 2022/TOCVAR-3, and CPCT Cherry-214 performed best in TSS, sugar content, ascorbic acid and lycopene. These genotypes show strong potential for use in breeding programs aimed at improving both productivity and fruit quality for fresh consumption and processing.

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Author Contributions

Riya Pandey was responsible for the conceptualization of the study, collection and analysis of data, interpretation of results and preparation of the manuscript. Dhirendra Singh provided overall guidance and supervision throughout the research work and offered critical inputs during manuscript revision. Lalit Bhatt, Alka Verma and Sanjay Kumar Verma contributed through their advisory roles, offering valuable suggestions on research methodology, data interpretation and manuscript improvement. All authors reviewed and approved the final version of the manuscript.

Conflict of Interest

The authors declare that they have no conflict of interest.

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