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Assessment of Cherry Tomato Cultivars (*Solanum lycopersicum* var. *cerasiforme*) for Genetic Variability under Protected Environment

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A B S T R A C T

Fourteen genotypes of cherry tomato were evaluated under modified naturally ventilated polyhouse at the Experimental Farm, Department of Vegetable Science and Floriculture, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur during autumn winter season, 2017-2018 for marketable yield and its component traits to assess the morphological diversity among the genotypes. Based on the mean performance, genotypes *viz.* Solan Red Round, IC-383117 and EC-383109 were found superior for marketable fruit yield, number of marketable fruits per plant, number of fruits per cluster, number of nodes per plant and plant height among all the genotypes evaluated. Sufficient genetic variability was observed for almost all the traits studied. High PCV, GCV, heritability and genetic advance were observed for number of fruits per cluster and lycopene contents. Hence, it was inferred that there is better scope for improvement of these traits through direct selection.

Introduction

Presently, the demand for tomato is based on industrial requirement and ultimately the consumer preference. Therefore, breeding programme should focus on need-based research. As we know that, Cherry tomato (*Solanum lycopersicum* var. *cerasiforme*) is a botanical variety of the cultivated tomato or a smaller garden variety of tomato. It is marketed at a premium to ordinary tomatoes. Cherry tomatoes are generally considered to be similar but not identical to the wild relative of the domestic tomato. It has become more popular all over the world because of a good source of vitamin A and vitamin C, solids content, good taste and fruit set even at high temperature (Prema *et al.*, 2011). It has become a good alternative for many small farmers, for being rustic, productive, and marketable, besides tasting good. Cherry tomato is grown for its edible fruits and these are perfect for making processed products like sauce, soup, ketchup, puree, curries, paste, powder, rasam and sandwich. These also have good nutritional and antioxidant properties. Cherry tomatoes are widely used in salads, with dip as an appetizer or as garnishing. The size of cherry tomatoes ranges from thumb tip to the size of a golf ball and can range from being spherical to slightly oblong in shape. Protected cultivation of cherry tomatoes has been gaining importance for last about five-six years in Himachal Pradesh on account of

favourable growing conditions inside. In order to incorporate desirable characters to maximize marketable yield, the information on the nature and extent of genetic variability in a population of cherry tomato for desirable characters is the basic requirement. It is therefore, essential to assess the quantum of genetic variability with respect to different characters, which would help in planning a successful breeding programme to develop cultivars for protected cultivation. Therefore, present investigation was undertaken to study the performance and genetical studies of cherry tomato cultivars under the naturally ventilated polyhouse.

Materials and Methods

The present study was carried out in modified naturally ventilated polyhouse at the Research farm, Department of Vegetable Science and Floriculture. The experimental material used for the present study comprised of 14 diverse genotypes of cherry tomato. The experiment was conducted in Randomized Block Design (RBD) replicated thrice inside the modified naturally ventilated polyhouse of the size 25 m × 10 m. Ten plants of each genotype were planted at a spacing of 70 cm × 30 cm and trained on two stems. The seeds of all the genotypes were sown in soil-less media having a mixture of cocopeat: perlite: vermiculite in the ratio of 3:1:1, respectively. Five weeks old nursery was transplanted in the polyhouse. The intercultural operations *viz.*, hoeing, irrigation, weeding, cutting, pruning and staking were carried out in accordance with recommended package of practices to ensure a healthy crop growth and development. Fertigation was applied through drip system. The crop was trained on two stems through nylon twines. Five plants of each treatment were randomly marked and the observations were recorded for the different quantitative and qualitative characters. Varietal (fruit) Characters were also captured to study the visible differences among different genotypes (Fig. 1, 2, 3). The data were statistically analyzed as per the following methods given by Panse and Sukhatme (1984). The phenotypic and genotypic coefficients of variation were estimated as suggested by Burton and DeVane (1953). Heritability in broad sense (h^2_{bs}) was calculated as per the following formula given by Burton and DeVane (1953) and Johnson *et al.,* (1955). The expected genetic advance (GA) resulting from the selection of 5 per cent superior individuals was calculated as per Burton and DeVane (1953) and Johnson *et al.,* (1955). The statistical analysis was carried out for each observed character under study using MS-Excel and OPSTAT.

Results and Discussion

The values of mean sum of squares of Analysis of Variance (ANOVA) showed highly significant difference among the tested genotypes for all the characters studied *viz.*, days to 50 per cent flowering, days to first picking, number of fruits per plant, number of fruits per cluster, fruit shape index, pericarp thickness (mm), internodal length (cm), number of nodes per plant, plant height (cm), marketable fruit yield per plant (kg), marketable yield per meter square area (kg/m²), total soluble solids (^{o}brix), ascorbic acid (mg/100g), titrable acidity (%), lycopene content and bacterial wilt incidence (plant survival percentage). The significant variation among the genotypes revealed the presence of adequate variability which can be exploited through selection. Our findings are acknowledged with the results reported by Kherwa *et al.,* (2018). Among all the lines, the genotypes *viz.,* EC-513703 (38.33), PSR-10693 (39.67 days) and EC-513521 (40.00 days) were found significantly earlier in flowering to the check (44.00 days). The genotypes EC-513521 (104.00 days), EC-513703 (105.33 days), Solan Red Round

(121.33 days), PSR-10693 (121.67 days) and EC-573703 (124.67 days) were significantly early in harvesting than the check (135.33 days). Among all the genotypes, Solan Red Round (115.56) and IC-383117 (109.05) were having significantly higher number of marketable fruits per plant than the check (102.50). The genotypes Solan Red Round (17.53) and IC-383117 (15.63) were having significantly higher number of fruits per cluster than the check (13.47) (Table 1).

The genotypes *viz.* IC-383172 (1.25), EC-514101 (1.24), IC-383117 (1.17), EC-513703 (1.14) and IC-383181 (0.97) were having significantly higher fruit shape index than the check (0.88). Among all the lines, the genotype Solan Red Round (2.41 mm) was having significantly thicker pericarp than the check (2.20 mm). Among all the lines, three genotypes i.e. Solan Red Round (9.16 cm), IC-383117 (10.37 cm) and EC-383109 (11.81 cm) were significantly having shorter internodal length than the check (12.62 cm) and considered superior to the check. The genotypes Solan Red Round (23.27) and IC-383117 (20.61) were having significantly higher number of nodes than the check (18.90). Among all lines, the genotypes Solan Red round (290.53 cm), IC-383117 (284.49 cm), EC-383109 (277.24 cm), IC-383181 (256.81 cm) and IC-436902 (246.42 cm) were found significantly taller than the check.

The genotypes Solan Red Round (0.98 kg), IC-383117 (0.89 kg) and EC-383109 (0.79 kg) were having significantly higher marketable yield per plant than the check (0.76 kg) (Table. 2). The genotypes Solan Red Round (9.16), EC-513521 (8.32), IC-383196 (8.16), EC-446616 (8.06), EC-383109 (8.03), IC-383172 (7.98), IC-383181 (7.96), EC-513703 (7.31), EC-573703 (7.14) and EC-514101 (7.06) were significantly having higher TSS than the check (6.84) among all the lines evaluated. The genotypes EC-513703 (29.75), PSR-10693 (27.89) and Solan Red Round (27.77) were having significantly higher ascorbic acid than the check (24.82) among all the lines evaluated (Table 2). The genotypes EC-513521 (0.80), EC-513703 (0.67) and IC-383196 (0.78) were having significantly higher acidity than the check (0.61). In the present study the all genotypes reported infection from 0.00% to 27.78% only; except EC-446616 and PSR-10693 (0.00%), which were completely resistant to the bacterial wilt disease.

High PCV existed for number of fruits per cluster (43.67) and Lycopene contents (35.91) (Table. 3). Moderate PCV was exhibited for ascorbic acid (27.24), yield per plant (26.27), titrable acidity (22.75), plant height (20.91) fruit shape index (20.85), number of fruits per plant (19.64), pericarp thickness (19.01), internodal length (17.20), number of nodes per plant (16.37) and total soluble solids (16.01), while days to 50% flowering (6.63) and days to first picking (10.71) had low PCV. High GCV was observed in case of number of fruits per cluster (43.51) and Lycopene contents (35.20). Moderate PCV was exhibited for ascorbic acid (26.69), titrable acidity (22.63), yield per plant (26.26), plant height (20.88) and fruit shape index (20.39), number of fruits per plant (19.54), pericarp thickness (18.91), internodal length (17.19), number of nodes per plant (16.21) and total soluble solids (15.99), while days to first picking (10.67) and days to 50% flowering (5.64) had low PCV. All the characters which recorded high heritability were fruit yield per plant (99.94), internodal length (99.87%), plant height (99.69%), TSS (99.64), days to first picking (99.27%), number of fruits per cluster (99.25%), number of fruits per plant (99.00%), pericarp thickness (98.99%), titrable acidity (98.94%), number of nodes per plant (98.07%), lycopene contents (96.13%), ascorbic acid (95.96%), fruit shape index (95.64%) and days to 50% flowering (72.17).

Table.1 Mean performance of cherry tomato genotypes for yield and its attributing traits

Genotypes	Days to 50% flowering	Days to first picking	Number of fruits per plant	Number of fruits per cluster	Fruit shape index	Pericarp thickness (mm)	Internodal length (cm)	Number of nodes per plant
EC-513703	38.33	105.33	83.36	8.89	1.14	0.98	14.97	16.51
EC-514101	44.00	136.33	64.75	3.12	1.24	1.93	16.97	13.96
EC-513521	40.00	104.00	68.23	5.81	0.83	1.40	16.66	14.34
EC-573703	44.67	124.67	66.18	4.55	0.81	2.13	16.85	14.13
EC-446616	47.00	151.33	76.03	8.75	0.95	1.94	15.07	15.59
EC-383109	47.67	137.67	102.36	13.54	0.83	1.87	11.81	19.56
IC-383172	43.67	136.67	85.39	9.07	1.25	2.06	14.27	16.72
IC-436902	44.67	137.33	91.78	9.13	0.63	2.11	13.89	17.56
IC-383181	43.67	140.00	96.86	10.44	0.97	2.12	13.22	18.33
IC-383117	42.67	138.00	109.05	15.63	1.17	1.81	10.37	20.61
IC-383196	43.33	146.33	71.28	6.95	0.74	1.85	15.98	14.71
PSR-10693	39.67	121.67	74.60	7.27	0.86	2.25	15.59	15.07
Solan Red Round	42.67	121.33	115.56	17.53	0.82	2.41	9.16	23.27
Nagmoti (Check)	44.00	135.33	102.50	13.47	0.88	2.20	12.62	18.90
S.E. (m)±	0.88	0.69	0.98	0.21	0.02	0.02	0.05	0.22
S.E. (d)±	1.24	0.98	1.38	0.30	0.03	0.03	0.07	0.32
C.V.	3.50	0.91	1.96	3.78	4.29	1.92	0.63	2.27
C.D. (5%)	2.56	2.02	2.86	0.61	0.07	0.06	0.15	0.66
Range	38.33-47.67	104.00-151.33	64.75-115.56	3.12-17.53	0.63-1.25	0.98-2.41	9.16-16.97	13.96-23.27
Grand mean	43.29	131.14	86.28	9.58	0.94	1.93	14.10	17.09

Table.2 Mean performance of cherry tomato genotypes for yield and its attributing traits

Genotypes	Plant height (cm)	Fruit Yield per plant (kg)	Fruit yield per meter square area (kg/m²)	Total soluble solids (°brix)	Ascorbic acid (mg/100g)	Titrable acidity (%)	Lycopene contents
EC-513703	224.00	0.57	3.43	7.31	29.75	0.67	8.85
EC-514101	131.20	0.36	2.16	7.06	22.98	0.58	4.50
EC-513521	186.65	0.51	3.08	8.32	23.01	0.80	3.53
EC-573703	156.52	0.49	2.96	7.14	8.73	0.56	4.23
EC-446616	212.26	0.56	3.35	8.06	26.01	0.43	4.89
EC-383109	277.24	0.79	4.77	8.03	24.80	0.47	2.92
IC-383172	227.97	0.58	3.50	7.98	26.01	0.55	8.13
IC-436902	246.42	0.62	3.73	5.25	19.04	0.29	8.21
IC-383181	256.81	0.69	4.17	7.96	24.39	0.50	6.97
IC-383117	284.49	0.89	5.32	4.97	10.71	0.61	3.91
IC-383196	198.80	0.55	3.28	8.16	23.74	0.78	5.40
PSR-10693	204.65	0.55	3.29	6.44	27.89	0.62	7.18
Solan Red Round	290.53	0.98	5.88	9.16	27.77	0.58	4.50
Nagmoti (Check)	224.80	0.76	4.53	6.84	24.82	0.61	4.04
S.E. (m)±	1.50	0.002	0.008	0.04	0.722	0.008	0.225
S.E. (d)±	2.13	0.003	0.01	0.06	1.02	0.01	0.32
C.V.	1.17	0.65	0.34	0.96	5.48	2.35	7.06
C.D. (5%)	4.39	0.007	0.022	0.12	2.11	0.02	0.66
Range	131.20-290.53	0.36-0.98	2.16-5.88	4.97-9.16	8.73-29.75	0.29-0.80	2.92-8.85
Grand mean	223.03	0.64	3.819	7.34	22.83	0.58	5.52

Table.3 Estimates of PCV, GCV, heritability and genetic advance for fruit yield and its traits in cherry tomato genotypes

Characters	PCV (%)	GCV (%)	Heritability (%) (h^2_{bs})	Genetic Advance (% of mean) (GA)
Days to 50% flowering	6.63 (L)	5.64 (L)	72.17 (H)	9.86 (L)
Days to first picking	10.71 (L)	10.67 (L)	99.27 (H)	21.90 (L)
Number of fruits/ plant	19.64 (M)	19.54 (M)	99.00 (H)	40.06 (M)
Number of fruits/ cluster	43.67 (H)	43.51 (H)	99.25 (H)	89.29 (H)
Fruit shape index	20.85 (M)	20.39 (M)	95.64 (H)	41.07 (M)
Pericarp thickness (mm)	19.01 (M)	18.91 (M)	98.99 (H)	38.76 (M)
Internodal length (cm)	17.20 (M)	17.19 (M)	99.87 (H)	35.38 (M)
Number of nodes/ plant	16.37 (M)	16.21 (M)	98.07 (H)	33.06 (M)
Plant height (cm)	20.91 (M)	20.88 (M)	99.69 (H)	42.94 (M)
Yield/ plant (kg)	26.27 (M)	26.26 (M)	99.94 (H)	54.09 (H)
Total soluble solids (˚brix)	16.01 (M)	15.99 (M)	99.64 (H)	32.87 (M)
Ascorbic acid (mg/100g)	27.24 (M)	26.69 (M)	95.96 (H)	53.86 (H)
Titrable acidity (%)	22.75 (M)	22.63 (M)	98.94 (H)	46.36 (M)
Lycopene contents	35.91 (H)	35.20 (H)	96.13 (H)	71.10 (H)

PCV = Phenotypic coefficient of variation {Low (L): <15%, Moderate (M): 15-30%, High (H): >30%} GCV = Genotypic coefficient of variation {Low (L): <15%, Moderate (M): 15-30%, High (H): >30%} h2bs = Heritability (broad sense) {Low (L): <40%, Moderate (M): 40-60%, High (H): >60%} GA = Genetic advance {Low (L): <30%, Moderate (M): 30-50%, High (H): >50%}

Fig.1 Variability in fruit characters

Cherry Nagmoti

Solan Red Round

EC-514101

IC-383181

IC-383117

EC-383109

Fig.2 Variability in fruit characters

IC-383172

IC-383196

PSR-10693

IC-436902

EC-513703

EC-446616

Fig.3 Variability in fruit characters

EC-573703

EC-513521

In the present study, high genetic advance (expressed as per cent of mean) was observed for number of fruits per cluster (89.29%), lycopene contents (71.10%), yield per plant (54.09%) and ascorbic acid (53.86%) (Table 3). Moderate genetic advance was recorded for titrable acidity (46.36%), plant height (42.54%), fruit shape index (41.07%), number of fruits per plant (40.06%), pericarp thickness (38.76%), internodal length (35.38%), number of nodes per plant (33.06%) and total soluble solids (32.87%), while low genetic advance was noticed in days to first picking (21.90%) and days to 50% flowering (9.86). Present findings are acknowledged by the results reported by Shankar *et al.,* (2013), Mehboob *et al.,* (2016) and Rai *et al.,* (2016) for lycopene content. Similar to our research, high genetic advance was advocated by Reddy *et al.,* (2013b) for ascorbic acid.

Among various parameters of variability, both PCV and GCV estimates were found high for number of fruits per cluster and Lycopene contents. Moderate PCV and GCV was exhibited for number of fruits per plant, pericarp thickness, internodal length, number of nodes per plant, total soluble solids, ascorbic acid, yield per plant, titrable acidity, plant height and fruit shape index, while days to first picking and days to 50% flowering had low PCV and GCV. In the present study, high heritability estimates were obtained for all the characters. High heritability along with high genetic advance was observed for the traits studied *viz.*, fruit yield per plant, number of fruits per cluster, lycopene contents and ascorbic acid. High heritability with moderate genetic advance was recorded for titrable acidity, plant height, fruit shape index, number of fruits per plant, pericarp thickness, internodal length, number of nodes per plant and total soluble solids. High to moderate heritability coupled with high to moderate genetic advance indicated preponderance of additive gene action which implied that these traits could be improved upon by pure line selection. However high heritability along with low genetic advance was observed for days to 50% flowering and days to first picking, which indicates that this character is governed by non-additive gene action and selection based on phenotypic appearance is not effective and could exploited by heterosis breeding.

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