



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
NAAS Rating (2026): 5.20
www.agronomyjournals.com
2026; 9(7): 93-95
Received: 12-04-2026
Accepted: 15-05-2026

Akhilesh Pal
M.Sc. Student, Department of Vegetable
Science, Acharya Narendra Deva
University of Agriculture and Technology
(ANDUA&T), Uttar Pradesh, India

RB Singh
Professor, Department of Vegetable
Science, Acharya Narendra Deva
University of Agriculture and Technology
(ANDUA&T), Uttar Pradesh, India

Aastik Jha
Associate Professor, Department of
Vegetable Science, Acharya Narendra Deva
University of Agriculture and Technology
(ANDUA&T), Uttar Pradesh, India

Akash Singh
M.Sc. Student, Department of Vegetable
Science, Acharya Narendra Deva
University of Agriculture and Technology
(ANDUA&T), Uttar Pradesh, India

Ankit Kumar Verma
M.Sc. Student, Department of Vegetable
Science, Acharya Narendra Deva
University of Agriculture and Technology
(ANDUA&T), Uttar Pradesh, India

Aditya Singh
M.Sc. Student, Department of Vegetable
Science, Acharya Narendra Deva
University of Agriculture and Technology
(ANDUA&T), Uttar Pradesh, India

Rahul Yadav
M.Sc. Student, Department of Vegetable
Science, Acharya Narendra Deva
University of Agriculture and Technology
(ANDUA&T), Uttar Pradesh, India

Manoj Kumar Singh
Assistant Professor, Department of
Vegetable Science, Acharya Narendra Deva
University of Agriculture and Technology
(ANDUA&T), Uttar Pradesh, India

Vaibhav Singh
Research Scholar, Department of Vegetable
Science, Acharya Narendra Deva
University of Agriculture and Technology
(ANDUA&T), Uttar Pradesh, India

Corresponding Author:
Aastik Jha*
Associate Professor, Department of
Vegetable Science, Acharya Narendra Deva
University of Agriculture and Technology
(ANDUA&T), Uttar Pradesh, India

Assessment of genetic variability, heratibility and genetic advance for yield and quality traits in cherry tomato (*Solanum lycopersicum* var. *cerasiforme* L.)

Akhilesh Pal, RB Singh, Aastik Jha, Akash Singh, Ankit Kumar Verma, Aditya Singh, Rahul Yadav, Manoj Kumar Singh and Vaibhav Singh

DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i7b.5898>

Abstract

The present experiment was conducted to study the genetic variability, heritability and genetic advance for seventeen yield and quality traits in thirty-one cherry tomato (*Solanum lycopersicum* var. *cerasiforme* L.) genotypes. The experiment was laid out in Completely Randomized Block Design (CRBD) with three replications at Main Experimental Station, Department of Vegetable Science, A.N.D.U.A.&T., Kumarganj, Ayodhya (U.P.). Analysis of variance revealed highly significant differences among the genotypes for all the characters studied. High estimates of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were recorded for lycopene content (31.36% and 31.53%), average fruit weight (30.34% and 31.37%) and pericarp thickness (29.82% and 30.62%). The heritability in broad sense varied from 38.08% (days to first fruit harvest) to 98.96% (lycopene content). High heritability coupled with high genetic advance as per cent of mean was observed for lycopene content (98.96%; 64.27%), average fruit weight (93.53%; 60.45%) and pericarp thickness (94.86%; 59.83%) indicating predominance of additive gene action.

Keywords: Genetic variability, Heritability, Genetic advance, Cherry tomato

Introduction

Cherry tomato (*Solanum lycopersicum* var. *cerasiforme* L.) of the family Solanaceae ($2n=2x=24$) is considered as the progenitor of modern cultivated tomatoes, which originated from the Peru-Ecuador-Bolivian region and is now widely cultivated in Central America, Spain, Japan, Europe, Mexico and Florida (Gharezi *et al.*, 2012; Renuka *et al.*, 2017) ^[5, 11]. It is a nutrient-dense crop that provides a significant amount of vitamin A, vitamin C, folic acid, potassium, dietary fiber, and antioxidants such as lycopene (Babu *et al.*, 2024) ^[2]. The fruits are eaten fresh and processed into sauce, ketchup, puree, paste and powder. The crop has considerable industrial value in tomolive and tomatine production. (Venkadeswaran *et al.*, 2018) ^[12]. Cherry tomato is a warm season, day neutral and mainly self-pollinated crop, moderately tolerant to heat and drought, considered as highly promising under protected cultivation. Its germplasm is characterized by high variability for important horticultural traits like fruit size, shape, colour, growth habit and yield (Vidyadhar *et al.*, 2014; Prema *et al.*, 2011) ^[13, 10]. The genetic variability is the basic requirement of any successful crop improvement programme, which determines the scope of selection possible in a population. The genetic parameters such as GCV, PCV, broad sense heritability and genetic advance as percentage of mean is an essential for effective breeding strategies. High heritability coupled with high genetic advance suggests the predominance of additive gene action and predicts the expected response to phenotypic selection (Johnson *et al.*, 1955).

Materials and Methods

The present investigation was conducted in the Department of Vegetable Science A.N.D.U.&T. Kumargang, Ayodhya (U.P.) College of Horticulture and Forestry during 2024-2025. The experimental material was semi-indeterminate, indeterminate and determinate types of genotypes. Thirty-one genotypes including a check variety were grown in open field conditions. The

experiment was conducted in Completely Randomized Block Design with each genotype having three replications. The seeds were initially sown in the nursery bed. The seedlings were transplanted to the main field at a spacing of 60 x 60 cm. The plot size was 3.0 x 1.2m² with 10 plants per plot. All the recommended cultural practices were followed for the good crop stand and growth of the plants. Seventeen quantitative and qualitative characters like days to 50% flowering, days to first fruit harvest, plant height (cm), number of primary branches per plant, number of fruits per plant, average fruit weight (g), fruit length (cm), fruit width (cm), number of locules per fruit, pericarp thickness (mm), total soluble solids (°Brix), titratable acidity (%), ascorbic acid content (mg/100g), lycopene content (mg/100g), fruit yield per plot (kg), fruit yield per plant (kg) and fruit yield per hectare (q) were recorded. Observations were recorded from five representative plants tagged in each plot. The quality parameters were studied by standard biochemical methods. The analysis of variance (ANOVA) was done according to the method of Panse and Sukhatme (2000) [8]. Genotypic and phenotypic coefficients of variation were calculated according to Burton and De Vane (1953) [3]. Heritability in broad sense and genetic advance were estimated as per the formulae given by Allard (1960) [1] and Hanson *et al.* (1956) [6]. Correlation coefficient (Pearson, 1909). Path analysis (Dewey and Lu, 1959) [4] respectively. Genetic divergence was estimated using Mahalanobis D² statistics, 1936) [7].

Results and Discussion

Analysis of variance (ANOVA) of Thirty-one cherry tomato genotypes revealed highly significant differences among the genotypes for all the seventeen characters studied (Table 1). The mean sum of squares due to genotypes were highly significant for all the characters. The genotypes effects were highly significant indicating the presence of considerable genetic variability among the genotypes for all the traits under study. The wide variability available permits effective selection and use of superior genotypes in cherry tomato improvement programs. The estimates of genotypic and phenotypic coefficients of

variation for seventeen characters of cherry tomato among thirty-one genotypes are presented in Table 2. The maximum (>20%) phenotypic coefficient of variation (PCV) as well as genotypic coefficient of variation (GCV) were recorded for lycopene content (31.53% and 31.36%) followed by average fruit weight (31.37% and 30.34%), pericarp thickness (30.62% and 29.82%), number of fruits per plant (26.42% and 25.40%), fruit yield per plot (24.43% and 23.59%), fruit yield per hectare (24.40% and 23.68%), fruit yield per plant (24.16% and 23.45%), number of locules per fruit (22.96% and 21.77%) and titratable acidity (20.48% and 20.17%). These results showed high variability among the genotypes for these traits. Moderate (10-20%) estimates of PCV and GCV were observed for plant height (20.17 and 18.88%), number of primary branches per plant (17.43 and 15.88%), ascorbic acid (14.96 and 14.54%), total soluble solids (14.17 and 13.79%), fruit length (15.79 and 13.46%), fruit width (15.49 and 13.15%) and days to 50% flowering (13.48 and 12.46%). The magnitude of variation of these traits was moderate, suggesting adequate scope for improvement by selection. Low (<10%) estimates of PCV and GCV were recorded for days to first fruit harvest (7.15 and 4.41%). The low estimates suggested comparatively lower variability and greater environmental effects in the expression of this trait. The heritability in broad sense among 31 genotype varied widely, ranged from 38.08 for days to first fruit harvest to 98.96 lycopene content. High heritability (>60%) were recorded for lycopene content (98.96%), titratable acidity (97.00%), total soluble solids (94.72%), ascorbic acid (94.54%), pericarp thickness (94.86%), fruit yield per plant (94.20%), fruit yield per hectare (94.15%), fruit yield per plot (93.18%), average fruit weight (93.53%), number of fruits per plant (92.39%), number of locules per fruit (89.92%), plant height (87.61%), days to 50% flowering (85.49%), number of primary branches per plant (83.03%), fruit length (72.71%) and fruit width (72.07%), while moderate heritability (30% and <60%) was recorded for days to first fruit harvest (38.08%). These results suggested that most of the yield and quality traits were less influenced by environmental factors and selection based on phenotypic performance would be effective.

Table 1: Analysis of variance (mean squares) for seventeen quantitative and qualitative characters in cherry tomato germplasm

S. No.	Characters	Source of variation		
		Replication	Genotypes	Error
	Degree of freedom	2	30	60
1	Days to 50% flowering	0.09	44.60**	2.39
2	Days to first fruit harvest	29.54	42.89**	15.08
3	Plant height (cm)	47.66	1979.05**	89.12
4	Number of primary branches per plant	0.04	2.11**	0.13
5	Number of fruits per plant	30.11	5327.30**	142.29
6	Average fruit weight (g)	0.026	5.185**	0.117
7	Fruit length (cm)	0.044	0.415**	0.046
8	Fruit width (cm)	0.028	0.290**	0.033
9	Number of locules per fruit	0.009	0.787**	0.028
10	Pericarp thickness (mm)	0.026	0.672**	0.012
11	TSS (°Brix)	0.104	1.852**	0.034
12	Titratable acidity (%)	0.001	0.033**	0.000
13	Ascorbic acid (mg/100g)	2.34	59.19**	1.12
14	Lycopene content (mg/100g)	0.045	5.431**	0.019
15	Fruit yield per plot (kg)	0.54	16.64**	0.40
16	Fruit yield per plant (kg)	0.001	0.165**	0.003
17	Fruit yield per hectare (q)	32.89	10487.31**	212.90

* and ** indicate significance at 5% and 1% significance levels, respectively

The genetic advance as percent of mean ranged from 5.61% for days to first fruit harvest to 64.27% for lycopene content. High estimates of genetic advance as percent mean were recorded for

lycopene content (64.27%), average fruit weight (60.45%), pericarp thickness (59.83%), number of fruits per plant (50.29%), fruit yield per hectare (47.32%), fruit yield per plot (46.90%), fruit

yield per plant (46.87%), number of locules per fruit (42.52%), titrable acidity (40.92%), plant height (36.41%), number of primary branches per plant (29.81%), ascorbic acid (29.13%), total soluble solids (27.64%), days to 50% flowering (23.74%), fruit length (23.65%) and fruit width (22.99%), where as low genetic advance as per cent of mean was observed for days to first fruit harvest (5.61%).

High heritability combined with high genetic advance as per cent of mean was observed for lycopene content (98.96% and

64.27%), average fruit weight (93.53% and 60.45%), pericarp thickness (94.86% and 59.83%), number of fruits per plant (92.39% and 50.29%), fruit yield per hectare (94.15% and 47.32%), fruit yield per plot (93.18% and 46.90%), fruit yield per plant (94.20% and 46.87%), number of locules per fruit (89.92% and 42.52%), titrable acidity (97.00% and 40.92%) and plant height (87.61% and 36.41%), which indicated the predominance of additive gene action and efficiency of simple selection for improvement of these traits.

Table 2: Range, grand mean, GCV, PCV, heritability, genetic advance (GA), and GA as percent of mean for seventeen characters in cherry tomato germplasm

Characters	Mean	Min	Max	GCV (%)	PCV (%)	Heritability (%)	GA	GA% of Mean
Days to 50% flowering	30.09	22.63	36.49	12.46	13.48	85.49	7.14	23.74
Days to first fruit harvest	68.99	59.12	72.93	4.41	7.15	38.08	3.87	5.61
Plant height (cm)	132.94	82.37	209.07	18.88	20.17	87.61	48.39	36.41
No. of primary branches/plant	5.11	3.34	6.63	15.88	17.43	83.03	1.52	29.81
No. of fruits per plant	163.69	97.00	278.00	25.40	26.42	92.39	82.32	50.29
Average fruit weight (g)	4.28	2.20	7.22	30.34	31.37	93.53	2.59	60.45
Fruit length (cm)	2.61	1.58	3.42	13.46	15.79	72.71	0.62	23.65
Fruit width (cm)	2.23	1.51	3.04	13.15	15.49	72.07	0.51	22.99
No. of locules per fruit	2.31	2.00	3.63	21.77	22.96	89.92	0.98	42.52
Pericarp thickness (mm)	1.57	0.66	3.01	29.82	30.62	94.86	0.94	59.83
TSS (°Brix)	5.65	4.18	7.01	13.79	14.17	94.72	1.56	27.64
Titrable acidity (%)	0.52	0.33	0.66	20.17	20.48	97.00	0.21	40.92
Ascorbic acid (mg/100g)	30.25	22.42	38.78	14.54	14.96	94.54	8.81	29.13
Lycopene content (mg/100g)	4.28	2.22	7.50	31.36	31.53	98.96	2.75	64.27
Fruit yield per plot (kg)	9.87	5.62	12.86	23.59	24.43	93.18	4.63	46.90
Fruit yield per plant (kg)	0.99	0.56	1.29	23.45	24.16	94.20	0.46	46.87
Fruit yield per hectare (q)	247.18	139.07	322.78	23.68	24.40	94.15	116.97	47.32

GCV: Genotypic Coefficient of Variation; **PCV:** Phenotypic Coefficient of Variation; **GA:** Genetic Advance

Conclusion

This study revealed significant genetic variability among the 31 cherry tomato genotypes for all the traits under investigation, indicating ample scope for genetic improvement. High estimates of GCV, PCV, heritability, and genetic advance as percent of mean for traits such as lycopene content, average fruit weight, pericarp thickness, number of fruits per plant, and fruit yield traits suggested the predominance of additive gene effect. Hence, these traits may be considered as important selection criteria for the development of high-yielding and quality cherry tomato genotypes through effective selection.

Acknowledgements

The author gratefully acknowledges ICAR-AICRP on Vegetable Crops, Department of Vegetable Science, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh for providing the valuable germplasms, essential infrastructure, research facilities and institutional support.

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