Heritability Analysis for Horticultural Traits in Tomato under Low Cost Polyhouse Conditions of Jammu Subtropics

Abstract

Biometrical assessment of genetic parameters for horticultural traits in tomato under Low Cost Polyhouse Conditions of Jammu Subtropics divulged minute differences among GCV and PCV, indicating less environmental influences on the traits under consideration. High heritability & genetic gain were noticed for important yield and yield contributing traits *viz.,* yield per plant (99.91 % & 75.28 %), fruit weight (99.42 % & 74.91 %), fruit equatorial diameter (99.15 % & 50.08 %), no. of fruits per plant (98.61 % & 66.70 %), no. of flowers per cluster (98.27 % & 55.48 %), plant height (93.27 % & 46.86 %), number of fruits per truss (96.17 % & 44.66 %), number of branches per plant (96.43 % & 37.98 %), fruit polar diameter (83.06 % & 38.40 %) and quality traits *viz.,* lycopene content (98.69 % & 98.97 %), TSS (97.37 % & 39.82 %) and fruit pericarp thickness (83.20 % & 35.21 %). High heritability combined with high genetic gain suggests a significant role for additive gene action in regulating these traits and suggests using simple selection as a breeding method to improve these traits.

Key Words : Indeterminate , Low cost polyhouse, Gene action, Tomato

Introduction

Tomato (*Solanum lycopersicum* L.) is the most important crop in Solanaceae family. It is cultivated in open fields and protected conditions in practically every country on the earth. Its production has increased owing to its wide variety of applications, which include raw salad, cooking as a vegetable, and processing into soup, sauces, ketchups, preserves, paste, and puree (Tiwari and Choudhury 1986). A wide range of environmental stresses can adversely influence the crop's performance when grown in open fields. Thus, protected cultivation is one of the major alternatives to overcome the situation wherein microclimate surrounding the plant is partially or completely regulated, based on the needs of the crop growing during their growth phase (Mishra *et al*., 2010). Wani *et al.,* 2011 reported that extensive cultivation of tomato under protected structure had distinct advantages in terms of earliness, higher productivity and quality produce which is free from pesticide residue and also higher returns to farmer.

Yield being a quantitative trait is largely affected by biotic and abiotic factors which lead to ineffective selection with reference to observed phenotypic variability. The nature and magnitude of the heritable variation, on the other hand, have a significant impact on the expected improvement. Highly heritable characters are more effective in selection than those that are less heritable. In order to plan a breeding programme, it is necessary to have a fundamental understanding of genetic variability and the components of genetic variability.

Materials and Methods

The experimental trial was conducted at the Division of Vegetable Science Floriculture experimental farm, SKUAST Jammu, during the year 2018-19 with twenty one tomato genotypes namely Pusa Ruby, Punjab Barkha Bahar, Marglobe, CLN-2123-A1-Red, Hawaii-7998, PKM-1, EC 160885, Palam Pink, EC 249515, IIHR 2042, Punjab Rakthak, EC 163383, EC 163611, IIVR BT-10, EC 163605, Roma, Kashi Chayan, Arka Abha, EC 521038, Punjab Sartaj and DVRT-2 and three checks, namely Arka Rakshak, Palam Tomato Hybrid-1, and BSS-488. The experiment was set up in an augmented block design with three replications of checks. The field was divided into five blocks with five varieties and three checks in each block. Seeds were sown on 7^{th} September of 2018 in lines 3-4 cm apart and 1 cm deep on raised nursery beds of size 3 m x 1m x 0.15 m under the polyhouse at the experimental farm of the division. The transplanting was done in October, 2018. Each genotype was transplanted in a single 2.75 m long row with spacing of 60 x 40 cm^2. Plant height, number of branches per plant, days to fifty per cent flowering, no. of flowers per truss, no. of fruits per truss, fruit set percentage, truss per plant, fruit weight, polar diameter, equatorial diameter, shape index, number of fruits per plant, and yield per plant were recorded on three plants. The INDOSTAT software application is used for the statistical analysis. Various genetic parameters of variability were calculated using methods by Weber and Moorthy (1952); Burton and Devane (1953).

Results and Discussion

The results of various genetic parameters are given in Table 1. Low to high range of coefficients of variation indicated high diversity in the experimental materials. In general, estimates of phenotypic coefficients of variation (PCV) were greater than estimates of genotypic coefficients of variation (GCV) for all the characters assessed, with minute differences for most of the traits suggest less effect of environment on heritability of these traits. For determining the magnitude of variation, PCV and GCV were calculated for all the characters studied. High PCV and GCV were observed for lycopene content (66.39 % & 65.95 %), average fruit weight (36.58 % & 36.47 %), fruit yield per plant (36.58 % & 36.56 %), no. of fruits per plant (32.84 % & 32.61 %), no. of flowers per cluster (27.40 % & 27.17 %), fruit equatorial diameter (24.52 % & 24.42 %), plant height (24.39% & 23.56 %), number of fruits per truss (22.55 % & 22.11 %) and fruit polar diameter (22.44 % & 20.45%), fruit set per cent (21.19 % & 20.89 %) which indicates more phenotypic and genotypic heterogeneity among the accessions, as well as the sensitivity of the traits to further improvement by selection. Similar trend for GCV and PCV in tomato was found by Patel *et al.* (2015); Bhandari *et al.* (2017) and Lekshmi and Celine (2017). Moderate PCV and GCV were observed for fruit pericarp thickness (20.66 and 18.85 %), TSS (19.86 % and 19.59 %), number of branches per plant (19.12 % and 18.78 %), number of truss per plant (18.09% and 17.81%). However, low values of PCV and GCV was observed for fruit shape index (7.61 % and 7.31 %), days to 50 % flowering (5.99 % and 5.44 %). Similar results were reported by Sharmin and Farhana (2022); Ullah *et al.* (2015); Mohamed *et al.* (2012); Kaushik *et al.* (2011) and Dar and Sharma (2011).

Broad sense heritability varied from 82.54 % to 99.91 %. Most of the traits like yield per plant (99.91 %), fruit weight (99.42%), fruit equatorial diameter (99.15 %), lycopene content (98.69 %), number of fruits per plant (98.61 %), number of flowers per cluster (98.27 %), TSS (97.37%), fruit set per cent (97.27%), number of truss per plant (97.01 %), no. of branches per plant (96.43 %), no. of fruits per truss (96.17 %), fruit shape index (93.69 %), plant height (93.27 %), fruit pericarp thickness (83.20 %), fruit polar diameter (83.06 %), fruit yield per plant (92.48 %), and days to fifty per cent flowering (82.54 %) estimated high heritability.

Genetic advance as per cent of population mean ranged from 10.19 % to 98.97 % (Table 1). Genetic gain was noticed high for lycopene content (98.97 %) followed by fruit yield per plant (75.28 %), number of fruits per plant (66.70 %), number of flowers per cluster (55.48 %), fruit equatorial diameter (50.08 %), plant height (46.86 %), number of fruits per truss (44.66 %), fruit set per cent (42.45 %), TSS (39.82 %), fruit polar diameter (38.40 %), number of branches per plant (37.98 %), number of truss per plant (36.14 %), fruit pericarp thickness (35.41 %), fruit polar diameter (34.80 %). Moderate genetic gain was observed for fruit shape index (14.69 %) and days to fifty per cent flowering (10.19 %).

The combination of high heritability and significant genetic advance is required to make efficient selection in advanced generations. Although independent, genetic advance is an important selection parameter that represents the expected genetic advance under selection. Thus, the traits with high heritability and high genetic advance as a percentage of mean indicate that simple selection or pure line selection followed by hybridization with selection in earlier generations may be effective in improving these traits in tomato. High heritability and high genetic gain were observed for lycopene content (98.69 % & 98.97 %), fruit yield per plant (99.91 % & 75.28 %), fruit weight (99.42 % & 74.91 %), fruit equatorial diameter (99.15 % & 50.08 %), number of fruits per plant (98.61 % & 66.70 %), number of flowers per cluster (98.27 % & 55.48 %), TSS (97.37 % & 39.82 %), plant height (93.27 % & 46.86 %), number of fruits per truss (96.17 % & 44.66 %), number of branches per plant (96.43 % & 37.98 %), fruit pericarp thickness (83.20 % & 35.21 %) and fruit polar diameter (83.06 % & 38.40 %). High heritability and moderate genetic gain was observed in fruit shape index (93.69 % & 14.69 %) and days to fifty per cent flowering (82.54 % & 10.19 %). These results are supported by Nagariya *et al.* (2015); Lekshmi and Celine (2017); Bhandari *et al.* (2017); Kumar *et al.* (2018); Meena *et al.* (2018b) and Khuntia *et al*. (2019) in tomato.

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Table 1. : Genetic parameters of variability in tomato for yield and yield contributing traits

Sl.No.	Genetic parameters	Mean	Coefficient of variation (%)		Heritability h^2 (Broad Sense)	Genetic Advance	Genetic gain (%)
			GCV	PCV			
1.	Days to fifty per cent flowering	49.09	5.44	5.99	82.54	5.00	10.19
2.	Plant height (cm)	169.82	23.56	24.39	93.27	73.85	46.86
3.	Number of branches per plant	6.23	18.78	19.12	96.43	2.29	37.98
4.	Number of flowers per cluster	8.08	27.17	27.40	98.27	4.53	55.48
5.	Number of fruits per truss	4.73	22.11	22.55	96.17	2.11	44.66
6.	Fruit set per cent	61.09	20.89	21.19	97.27	25.69	42.45
7.	Number of truss per plant	19.72	17.81	18.09	97.01	7.05	36.14
8.	Number of fruits per plant	44.63	32.61	32.84	98.61	29.21	66.7
9.	Average fruit weight (g)	43.31	36.47	36.58	99.42	32.55	74.91
10.	Fruit polar diameter (cm)	4.17	20.45	22.44	83.06	1.60	38.40
11.	Fruit equatorial diameter (cm)	4.08	24.42	24.52	99.15	2.04	50.08
12.	Fruit shape index	1.03	7.37	7.61	93.69	0.15	14.69
13.	Fruit yield per plant (kg)	1.79	36.56	36.58	99.91	1.31	75.28
14.	Fruit pericarp thickness (mm)	3.99	18.85	20.66	83.20	1.40	35.41
15.	Total soluble solids (ºB)	4.14	19.59	19.86	97.37	1.63	39.82
16.	Lycopene content (mg/100g)	1.43	65.95	66.39	98.69	1.71	98.97