Website : www.asthafoundation.in
Frontiers in Crop Improvement
Vol 10 (2) : 107-111 (July-2022) Print ISSN : 2393-8234 Online ISSN : 2454-6011
Astha Foundation, Meerut (U.P.) India

Assessment of Tomato (*Solanum lycopersicum* L.) Genotypes for Growth and Yield Traits under Temperate Conditions of Kashmir

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Abstract

A field experiment was carried out at Vegetable Experimental Field, SKUAST-K, Shalimar, Srinagar during *Kharif*-2018 in which twenty seven genotypes of tomato (*Solanum lycopersicum* L.) were evaluated to estimate the performance of genotypes on various growth and yield traits like plant height, plant spread, days to fruit set, days to red ripen fruit stage, average fruit weight, number of locules fruit^{-1}, pericarp thickness, 1000 seed weight and fruit yield (q/ha). Randomized complete block design is followed and the genotypes are replicated thrice. Analysis of Variance revealed significant differences among the genotypes for all the traits under studied. The genotypes namely, Kashi Amrit, VRT-19, Selection-07 exhibit higher plant height whereas VRT-13, Jawahar-99 and VRT-01 were early in days to fruit set and days to red ripen fruit stage. Minimum numbers of days are required for the genotypes VRT-13, Jawahar-99 and VRT-01 to reach the first fruit set and red ripen fruit stage. High pericarp thickness is shown by the genotypes namely, 2016/TODVAR-11, 2015/TODHYB-4, 2016/TODVAR-1 and KashiAmrit. Highest fruit weight is shown by 2016/TODVAR-3, 2016/TODVAR-11 and 2015/TODHYB-1. Maximum number of locules fruit^{-1} was recorded for the genotype Kashi Anupam. Higher fruit yield (q/ha) was shown by the genotypes namely, Kashi Sharad, Sel.7 and 2016/TODVAR-10.Identification of better genotypes among the existing germplasm leads to the success of breeding programme. Elite genotypes should be known for trait of interest.

Key words *: Growth and yield traits, performance, tomato, genotypes and evaluation.*

Introduction

Tomato (*Solanum lycopersicum* L.) is one of the most important Solanaceous vegetable crops grown widely all over the world. Tomatoes are important source of lycopene (an antioxidant), ascorbic acid and ß-carotene and valued for their colour and flavor. It is a very versatile vegetable for culinary purposes. Ripe fresh tomato fruit is consumed fresh as salads and consumed after cooking and utilized in the preparation of range of processed products such as puree, paste, powder, ketchup, sauce, soup and canned whole fruits. Unripe green fruits are used for preparation of pickles and chutney. Tomato is a self pollinated crop, but cross-pollination also occurs up to some extent. It is a warm season vegetable crop reasonably tolerant to heat and drought.

India ranks second in area and production of tomato after china. In India, Madhya Pradesh leads in production followed by Karnataka, Andhra Pradesh, Tamil Nadu and Gujarat. During 2019-20, India produced 20.57 million metric tonnes of tomato in an area of about 0.81 million hectares (1).

India is the source of large amount of tomato germplasm. The genotypes selected on the basis of *per se* performance of fruit yield, yield contributing traits can be used in tomato improvement programme as elite germplasm lines or may be recommended as such for commercial cultivation after testing them for several years and on different locations.

Materials and Methods

The present investigation was carried out at Vegetable Experimental Farm of Division of Vegetable Science, SKUAST-Kashmir, Shalimar, Srinagar during *Kharif*-2018.Twenty seven diverse genotypes of tomato were evaluated to estimate the performance of various growth and yield traits *viz*., plant height, plant spread, days to fruit set, days to red ripen fruit stage, average fruit weight, number of locules fruit^{-1}, pericarp thickness, 1000 seed weight and fruit yield (q/ha). The experiment is laid in a Randomized Complete Block Design (RCBD) with three replications (Details of genotypes along with their source are given in the Table-1). The spacing followed was 60 x 35 cm. The experimental field was well prepared and standard cultural and plant protection measures were followed to raise a healthy crop. Analysis of variance was carried out as per the procedure given by (2), which is presented in table-2. The significance of varietal differences was tested by F-test.

Results and Discussion

Mean performance of genotypes in respect of various traits have been presented in Table-3a and 3b.

Growth attributes : The plant height ranged from 47.66

Received : April-2022; Revised : May-2022; Accepted : May-2022

Table-1 : List of genotypes of tomato (*Solanum lycopersicum* L.) used in the experiment.

S. No.	Genotype/variety	Source
1.	Kashi Hemanth	IIVR (Varanasi)
2.	Kashi Amrit	IIVR (Varanasi)
3.	Kashi Sharad	IIVR (Varanasi)
4.	Kashi Vishesh	IIVR (Varanasi)
5.	Kashi Chayan	IIVR (Varanasi)
6.	Kashi Aman	IIVR (Varanasi)
7.	Kashi Anupam	IIVR (Varanasi)
8.	TOLCV-16	IIVR (Varanasi)
9.	TOLCV-28	IIVR (Varanasi)
10.	TOLCV-32	IIVR (Varanasi)
11.	VRT-01	IIVR (Varanasi)
12.	VRT-19	IIVR (Varanasi)
13.	VRT-13	IIVR (Varanasi)
14.	Sel-7	IIVR (Varanasi)
15.	Jawahar-99	IIVR (Varanasi)
16.	2016/TOVDVAR-12	AICRP, IIVR (Varanasi)
17.	2016/TODVAR-11	AICRP, IIVR (Varanasi)
18.	2016/TODVAR-1	AICRP, IIVR (Varanasi)
19.	2016/TODVAR-3	AICRP, IIVR (Varanasi)
20.	2016/TODVAR-10	AICRP, IIVR (Varanasi)
21.	2016/TODVAR-5	AICRP, IIVR (Varanasi)
22.	2016/TODVAR-2	AICRP, IIVR (Varanasi)
23.	2015/TODHYB-4	AICRP, IIVR (Varanasi)
24.	2015/TODBYB-1	AICRP, IIVR (Varanasi)
25.	Roma	SKUAST-K, Shalimar
26.	Shalimar Hybrid Tomato-1	SKUAST-K, Shalimar
27.	Marglobe	SKUAST-K, Shalimar

cm (VRT-01) to 90.90 cm (Kashi Amrit) comprising mean value was 72.95 cm. The genotypes VRT-19 (87.13 cm), Selection-07 (81.76 cm), Kashi Chayan (78.93 cm) TOLCV-16 (75.90 cm), Kashi Aman (74.96 cm), Kashi Anupam (74.40 cm), had significantly higher plant height as compared to general mean. The genotypes namely VRT-01 (47.66 cm), TOLCV-32 (58.33 cm), 2015/TODHYB-1 (59.86 cm), 2016/TODVAR-11 (64.26 cm) had significantly lower plant height as compared to the general mean. The plant spread ranged from 49.66 cm (VRT-01) to 102.66 cm (Kashi Amrit) with the mean value of 81.22 cm. The genotypes TOLCV-16 (96.50 cm), Kashi Sharad (88.83 cm), Kashi Hemanth (88.16 cm), KashiChayan (87.56 cm), 2016/TODVAR-3 (87.06 cm), are having significantly higher plant spread as compared to general mean, whereas, VRT-01 (49.66 cm), TOLCV-32 (67.40 cm), 2015/TODHYB-1 (69.00 cm), 2016/TODVAR-12 (76.23 cm) are having significantly lower plant spread as compared to general mean. The results are in agreement with the findings of (3,4,5).

Yield attributes : Days to fruit set ranged from 26.86 days (VRT-13) to 35.26 days (2016/TODVAR-12) with the mean value of 31.11. The genotypes namely Jawahar-99 (28.20), VRT-01 (29.80), Sel.07 (30.23), VRT-19 (30.56) were significantly earlier in number of days in order or merit as compared to general mean, whereas the genotypes namely, 2015/TODHYB-1 (33.80), 2016/TODVAR-10 (33.73), 2016/TODVAR-1 (33.53), 2015/TODHYB-4 (33.40), 2016/TODVAR-2 (33.46), 2016/TODVAR-3 (33.20) took significantly more number of days for fruit set. The analyzed data for these traits revealed that days to red ripen fruit stage ranged from 63.50 days (Jawahar-99) to 84.36 days (2015/TODVAR-1) with the mean value of 72.98. The genotypes viz., Kashi Vishesh (64.13), VRT-13 (64.26), TOLCV-16 (67.46), Kashi Hemanth and KashiAnupam (71.40) were significantly earlier in number of days in order or merit as compared to general mean, whereas the genotypes, VRT-19 (74.06), Kashi Sharad (74.80), 2015/TODHYB-4 (75.53), 2016/TODVAR-12 (78.13) and 2016/TODVAR-3 (83.73) took significantly more number of days to red ripen fruit stage. The results in present investigation are in agreement with the findings of (6,7).

The range of average fruit weight varies from 50.33 g (Jawahar-99) to 72.66 g (2016/TODVAR-3) with the average mean value of 61.01 g. The highest fruit weight as compared to general mean was observed in the genotypes, 2016/TODVAR-11 (72.00 g), 2015/TODHYB-1 (69.33 g), 2016/TODVAR-5 (67.66 g), Kashi Hemanth (64.66 g), Kashi Anupam (63.33 g), The lowest fruit weight as compared to the general mean was observed in Kashi Chayan (59.00 g), TOLCV-32, Kashi Sharad (58.00 g), 2015/TODHYB-4 (55.00 g), Kashi Amrit, VRT-01 (54.33 g) genotypes respectively. The maximum number of locules fruit^{-1} was recorded for the genotype Kashi Anupam (5.70) which was significantly higher as compared to the general mean (3.71). Minimum number of locules fruit^{-1} was observed in the genotype Roma. The results are in agreement with the findings obtained by (4).

The variation for the pericarp thickness is ranged from 0.36 cm (2016/TODVAR-5) to 0.72 cm (2016/TODVAR-11) with the general mean of 0.51 cm. The genotypes namely, 2015/TODHYB-4 (0.65 cm), 2016/TODVAR-1 (0.62 cm), Kashi Amrit (0.57 cm), Kashi Vishesh (0.55cm), TOLCV-32 (0.54 cm), were showing significantly higher pericarp thickness as compared to general mean, whereas the genotypes viz., Kashi Hemanth (0.41 cm), TOLCV-16, 2016/TODVAR-10 (0.44 cm), Jawahar-99 (0.45 cm), 2015/TODHYB-1(0.47 cm) were showed significantly lower pericarp thickness. From the Table it is obvious that, the range of 1000 seed weight varies between 2.43 g (Kashi Chayan) to 3.76 g (Kashi Anupam). The general mean was obtained as 3.00g. The genotypes namely TOLCV-28 (3.63 g), Kashi Vishesh (3.66g), 2016/TODVAR-13 (3.13 g), Sel.07 (3.30 g) are

Table-2 : Analysis of variance for different traits in tomato (*Solanum lycopersicum* L.).

S. No.	Character	Mean sum of squares		
		Replication	Treatment	Error
	d.f	2	26	52
1.	Plant height (cm)	0.8492	342.5798**	2.3381
2.	Plant spread (cm)	5.9393	552.5597**	8.3681
3.	Days to fruit set	0.0538	14.5454**	0.1353
4.	Days to red ripen fruit stage	0.3482	76.3705**	0.2416
5.	Average fruit weight (g)	0.3456	128.1661**	2.4226
6.	No. of locules/fruit	8.0171	2.4190**	0.0854
7.	Pericarp thickness (cm)	0.0028	0.0202**	0.0007
8.	1000-seed weight (g)	0.0237	0.6623**	0.0480
9.	Fruit yield (q/ha)	4.8625	10466.3775**	11.7693

** Significant at 1%.

Table-3a : Mean performance of various genotypes for the different traits in tomato (*Solanum lycopersicum* L.).

S. No.	Genotypes	Plant height (cm)	Plant spread (cm)	Days to fruit set	Days to red ripen fruit stage	Average fruit weight (g)
1.	Kashi Hemanth	69.00	88.16	46.60	71.40	6.66
2.	Kashi Aman	74.96	78.80	47.66	70.30	61.33
3.	Kashi Amrit	90.90	102.63	48.86	72.60	54.33
4.	Kashi Vishesh	58.60	62.66	47.90	64.13	64.00
5.	Kashi Anupam	74.40	75.00	46.40	71.40	63.33
6.	Kashi Chayan	78.93	87.56	46.73	75.66	59.00
7.	Kashi Sharad	69.00	88.83	50.60	74.80	58.00
8.	VRT-01	47.66	49.66	46.40	72.46	54.33
9.	VRT-13	88.66	82.00	46.60	64.26	52.33
10.	VRT-01	47.66	49.66	46.40	72.46	54.33
11.	Tolcv-16	75.90	96.50	49.53	67.46	54.00
12.	Tolcv-28	71.50	79.16	49.06	72.70	55.33
13.	Tolcv-32	58.33	67.40	48.20	72.13	58.00
14.	Sel-7	81.76	90.66	54.80	71.70	57.66
15.	Jawahar-99	80.06	101.00	48.00	63.50	50.33
16.	2016/TODVAR-1	83.40	85.80	54.33	84.36	67.66
17.	2016/TODVAR-2	57.33	87.00	49.73	73.96	66.00
18.	2016/TODVAR-3	70.60	87.06	55.00	83.73	72.66
19.	2016/TODVAR-5	75.00	77.40	49.26	77.73	67.66
20.	2016/TODVAR-10	75.56	58.00	50.20	76.13	64.00
21.	2016/TODVAR-11	64.26	83.66	46.60	74.13	72.00
22.	2016/TODVAR-12	67.83	76.23	46.53	78.13	69.00
23.	2015/TODHYB-1	59.86	69.00	46.60	74.26	69.33
24.	2015/TODHYB-4	83.50	80.00	49.20	75.53	55.00
25.	Shalimar Hybrid Tomato-1	70.03	59.66	46.40	66.36	51.66
26.	Roma	85.50	83.50	48.83	74.40	66.33
27.	Marglobe	70.16	92.86	50.33	73.26	63.00
	Mean	72.95	81.22	48.80	72.98	61.01
	CV	2.09	3.56	0.71	0.67	2.55
	C.D. 5%	2.50	4.73	0.57	0.80	2.55
	C.D. 1%	3.33	6.31	0.76	1.07	3.39

Table-3b : Mean performance of various genotypes for the different traits in tomato (*Solanum lycopersicum* L.).

S. No.	Genotypes	No. of locules fruit^{-1}	Pericarp thickness (cm)	1000 seed weight (g)	Fruit yield (q/ha)
1.	Kashi Hemanth	3.73	0.41	2.73	186.86
2.	Kashi Aman	4.70	0.57	2.70	195.13
3.	Kashi Amrit	4.73	0.46	2.70	194.86
4.	Kashi Vishesh	3.73	0.55	3.66	192.46
5.	Kashi Anupam	5.70	0.41	3.76	200.13
6.	Kashi Chayan	2.73	0.46	2.43	156.13
7.	Kashi Sharad	2.73	0.43	2.63	362.66
8.	VRT-01	3.73	0.54	3.43	290.70
9.	VRT-13	3.70	0.45	3.40	196.60
10.	VRT-01	3.73	0.54	3.43	290.70
11.	Tolcv-16	3.96	0.47	3.73	198.00
12.	Tolcv-28	3.70	0.54	3.63	292.93
13.	Tolcv-32	3.73	0.54	2.66	205.50
14.	Sel-7	2.73	0.53	3.30	326.23
15.	Jawahar-99	3.73	0.45	2.53	192.13
16.	2016/TODVAR-1	2.76	0.62	2.60	195.00
17.	2016/TODVAR-2	2.70	0.47	3.13	153.33
18.	2016/TODVAR-3	3.76	0.55	2.50	188.00
19.	2016/TODVAR-5	5.63	0.36	2.60	145.00
20.	2016/TODVAR-10	4.16	0.44	2.60	294.00
21.	2016/TODVAR-11	2.70	0.72	2.70	133.66
22.	2016/TODVAR-12	4.10	0.57	2.70	124.66
23.	2015/TODHYB-1	3.70	0.47	3.46	194.33
24.	2015/TODHYB-4	3.76	0.65	3.33	190.00
25.	Shalimar Hybrid Tomato-1	3.73	0.53	3.66	289.20
26.	Roma	1.73	0.63	2.53	207.63
27.	Marglobe	3.40	0.52	2.53	214.33
	Mean	3.71	0.51	3.00	211.86
	CV	7.87	5.33	7.29	1.61
	C.D. 5%	0.47	0.04	0.35	5.62
	C.D. 1%	0.63	0.06	0.47	7.48

showing significantly higher value as compared to general mean. Kashi Aman, Kashi Amrit (2.70g), TOLCV-32 (2.66 g), 2016/TODVAR-5, 2016/TODVAR-10, 2016/ TODVAR-1 (2.60) genotypes were showing significantly lower value. The results in present investigation are in agreement with the findings of (6,7).

Fruit yield (q/ha) ranged from 124.66 q (2016/TODVAR-12) to 362.66 q (Kashi Sharad) with the general mean of 211.86 q. The genotypes namely, Sel.7 (326.23 q), 2016/TODVAR-10 (294.00 q), TOLCV-28 (292.93 q), VRT-01 (290.70 q), were showing significantly higher fruit yield as compared to the general mean, whereas, Kashi Aman (195.13 q), 2015/TODHYB-1 (194.33 q), Jawahar-99 (192.13 q), Kashi Hemanth (186.86 q), Kashi Chayan (156.13 q),, 2016/TODVAR-11 (133.66 q) genotypes were showing significantly lower fruit yield per hectare. The results are in agreement with the findings of (3,4,8).

Analysis of Variance revealed significant differences among the genotypes for all the traits under studied. The genotypes namely, Kashi Amrit, VRT-19 and Selection-07 exhibited higher plant height as well as plant spread. Minimum number of days are required for the genotypes VRT-13, Jawahar-99 and VRT-01 to reach the first fruit set and red ripen fruit stage. Highest fruit weight is shown by 2016/TODVAR-3, 2016/TODVAR-11 and 2015/ TODHYB-1. High pericarp thickness is shown by the genotypes namely, 2016/TODVAR-11, 2015/TODHYB-4, 2016/TODVAR-1 and Kashi Amrit. Maximum fruit yield (q/ha) was shown by the genotypes namely, Kashi Sharad, Sel.7 and 2016/TODVAR-10. The genotypes/ varieties which showed best *per se* performance for the

traits can be used as such in promotion of tomato production programme as elite germplasm lines/varieties.

Acknowledgement

I am highly thankful to the Division of Vegetable science, Division of Plant Breeding and Genetics, Sher-e-Kashmir University of Agricultural Sciences and Technology, Shalimar, Srinagar for providing the facilities for conducting the research.

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