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Evaluation of Various Genotypes of Tomato (*Solanum lycopersicum* L.) on Quality Traits under Temperate Conditions of Kashmir

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ABSTRACT

Background: Tomato is one of the most important vegetable crop grown in the world. Identification of better genotypes among the existing germplasm leads to the success of breeding programme. Elite genotypes should be known for our trait of interest.

Methods: 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 quality traits like lycopene content, titrable acidity, ascorbic acid content, total soluble solids and juice to pulp ratio.

Result: Analysis of variance revealed significant differences among the genotypes for all the traits under studied. Highest lycopene content was recorded in the genotypes 2015/TODHYB-1, Roma and VRT-19 Whereas highest TSS content was exhibited by Kashi Aman, Roma, Jawahar-99 and Shalimar Hybrid Tomato-1. Highest titrable acidity recorded in Marglobe followed by 2015/TODHYB-4 and Kashi Hemanth. Juice to pulp ratio was highest in the genotypes namely, 2016/TODVAR-5 and Kashi Vishesh. Hence, the best performed genotypes can be used as such in promotion of tomato production programme as elite germplasm lines/varieties or may be recommended for commercial cultivation after testing them over years and locations.

Key words: Genotypes, Juice to pulp ratio, Lycopene content, Titrable acidity, Tomato.

INTRODUCTION

India is the second largest producer of vegetables in the world after china. In horticulture production, vegetables having the share of about 59.3%. Tomato is the world's largest vegetable crop after potato and onion. In India, Madhya Pradesh leads in production followed by Karnataka, Andhra Pradesh, Tamil Nadu and Gujarat. During 2018-19, India produced 20.51 million metric tonnes of tomato in an area of about 0.81 million hectares (NHB, 1st Advance Estimates, 2018-19).

Tomato (*Soalanum lycopersicum* L.) is an important member of Solanaceae family having chromosome number of 2n=2x=24. It is the third most important vegetable crop in India, next to potato and onion. The probable ancestor of tomato is *Solanum lycopersicum var. cerasiforme* Bailey. It is originated in wild form in the Peru Equador region of Andes (South America). It is a day neutral plant and is mainly self pollinated, but a certain percentage of cross pollination also occurs (Depra *et al*., 2014). Tomato is a good source of minerals, vitamins, organic acids, lycopene, beta-carotne, phenols and flavonoids. Tomato fruit provides 3-4% total sugar, 4-7% total solids,15-30 mg/100 g ascorbic acid, 7.5-10 mg/100 ml titrable acidity, 6-8 mg/100 g lycopene and 0.5-2.5/100g beta carotene (Chada, 2019). Lycopene, which is a powerful anti-oxidant, is involved in reducing the risk of cardiovascular diseases and some types of cancer (Chada, 2019).

India is the source of various genotypes of tomato. Identification of superior genotypes among the existing germplasm becomes extremely important for future breeding programme.

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MATERIALS AND METHODS

The present investigation was carried out at Vegetable Experimental Farm of Division of Vegetable Science, SKUAST-Kashmir, Shalimar, Srinagar during summer 2018. The site is situated 34° N of latitude and 74.89° E of longitude. The climate is temperate characterized by mild summers. June and July are the hottest months while January and February are the coldest. The maximum rainfall is received during March to April. Twenty seven diverse genotypes of tomato were evaluated in a randomized complete block design (RCBD) with three replications, such

that there were 81 treatments in total (details of genotypes along with their source are given in the Table 1). The spacing followed for the row to row and plant to plant distance is 60 × 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 Panse and Sukhatme (1985).

Total soluble solids (%)

The total soluble solids (TSS) contents of the fruits were measured with the help of hand refractometer. Tomato juice was collected from red ripen fruits. A drop of juice was placed over the prism of digital refractometer and was noted in per cent.

Titrable acidity (%)

Acid content of the extracted juice was determined by titrating 5 ml of juice against N/10 NaOH using Phenolphthalein as an indicator. Acidity was expressed in term of anhydrous citric acid (A.O.A.C.1960) per 100 ml of tomato juice.

Ascorbic acid content (mg/100 g)

Ascorbic acid content was determine by 2,6-dichlorophenol indophenol titration method (A.O.A.C.1960) and expressed in mg/100 g of fruits.

Lycopene content (mg/100 g)

Total lycopene content of tomato was determined by the method of Lee (2001) with some modifications. With the help of moral and pestle 5 g of tomato pulp was crushed in acetone, till it became colourless. Then the extracted solution was poured into a separating funnel. Then added, petroleum ether and small amount of sodium sulphate and shaken rigorously for mixing well. Then the separating funnel was kept undisturbed to separate the lycopene pigment from the acetone to petroleum ether layer. After that, coloured solution was separate in a 500 ml volumetric flask and the volume will be adjusted with petroleum ether. Finally, the sample absorbance was measured at 503 nm in a spectrophotometer, using the petroleum as blank. The results were expressed as 100 g^{-1}FW (fresh weight) basis.

$$\text{Lycopene content (mg/100 g)} = \frac{3.1206 \times \text{Vol. made up} \times \text{Dilution}}{\text{Weight of sample}} \times 100$$

Juice to pulp ratio

A composite sample of 500 g of fruit was taken from the randomly selected plants from each replication and crushed thoroughly in an electrically operated juice extractor. The extract was filtered through dry muslin cloth and the filtrate was collected in the weighed beaker. The weight of juice along with the beaker was recorded and juice content was calculated as:

Juice content = (Juice + Beaker) weight-beaker weight

Pulp content was calculated as :

Pulp content = Fruit weight - Juice weight

RESULTS AND DISCUSSION

The data recorded on five qualitative traits were subjected to analysis of variance to test the significance of difference among the genotypes. Analysis of variance presented in Table 2, showed that the mean square due to genotypes were highly significant for all the traits. Mean performance of the various genotypes for the quality traits in tomato are presented in Table 3.

Total soluble solids (%)

Total soluble solid (%) ranged from 3.20% (2016/TODVAR-2) to 6.23% (2015/TODHYB-4) with the mean value of 4.46%. Top ranking genotypes as compared to mean are Kashi Aman (4.93%), Jawahar-99 (4.86%), Kashi Vishesh (4.80%), Sel.7 (4.73%), whereas the genotypes 2016/TODVAR-10 (3.93%), Kashi Hemanth (3.90%), VRT-01 and 2015/TODHYB-1 (3.80%) were showed significantly lower value. The results are in agreement with the findings of Neeraj Singh *et al.* (2015) and Pradeep Kumar *et al.* (2001).

Lycopene content (mg/100 g)

The lycopene content ranged from 6.80 mg/100 g (2016/TODVAR-12) to 18.50 mg/100 g (Kashi Aman) with the general mean of 12.13 mg/100 g. The genotypes namely

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

Genotype/variety	Source
Kashi Hemanth	IIVR (Varanasi)
Kashi Amrit	IIVR (Varanasi)
Kashi Sharad	IIVR (Varanasi)
Kashi Vishesh	IIVR (Varanasi)
Kashi Chayan	IIVR (Varanasi)
Kashi Aman	IIVR (Varanasi)
Kashi Anupam	IIVR (Varanasi)
TOLCV-16	IIVR (Varanasi)
TOLCV-28	IIVR (Varanasi)
TOLCV-32	IIVR (Varanasi)
VRT-01	IIVR (Varanasi)
VRT-19	IIVR (Varanasi)
VRT-13	IIVR (Varanasi)
Sel-7	IIVR (Varanasi)
Jawahar-99	IIVR (Varanasi)
2016/TOVDVAR-12	AICRP, IIVR (Varanasi)
2016/TODVAR-11	AICRP, IIVR (Varanasi)
2016/TODVAR-1	AICRP, IIVR (Varanasi)
2016/TODVAR-3	AICRP, IIVR (Varanasi)
2016/TODVAR-10	AICRP, IIVR (Varanasi)
2016/TODVAR-5	AICRP, IIVR (Varanasi)
2016/TODVAR-2	AICRP, IIVR (Varanasi)
2015/TODHYB-4	AICRP, IIVR (Varanasi)
2015/TODBYB-1	AICRP, IIVR (Varanasi)
Roma	SKUAST-K, Shalimar
Shalimar Hybrid Tomato-1	SKUAST-K, Shalimar
Marglobe	SKUAST-K, Shalimar

2015/TODHYB-1 (16.80 mg/100 g), VRT-19 (15.06 mg/100 g), TOLCV-28 (14.56 mg/100 g), VRT-13 (14.36 mg/100 g) and Kashi Anupam (13.60 mg/100 g), have exhibited significantly highest lycopene content as compared to general mean, whereas the genotypes *viz*., 2016/TODVAR-5 (10.63 mg/100 g), Kashi Hemanth (10.23 mg/100 g), Kashi Amrit (9.36 mg/100 g), Kashi Chayan, Jawahar-99 (8.70 mg/100 g) and 2016/TODVAR-3 (7.90 mg/100 g) had lowest lycopene content as compared to general mean. The results are in agreement with the earlier findings of Gonalez-Cebrino *et al.* (2011).

Ascorbic acid content (mg/100 g)

The ascorbic acid content ranges from 18.73 mg/100 g (Marglobe) to 29.30 mg/100 g (Kashi Chayan) with the mean value of 22.91 mg/100 g. The genotypes Kashi Hemanth

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

Character	Mean sum of squares		
	Replication	Treatments	Error
d.f	2	26	52
Total soluble solids (%)	0.0509	1.3094**	0.0270
Lycopene content (mg/100g)	0.0075	29.8218**	0.0400
Ascorbic acid content (mg/100g)	0.0208	35.6402**	0.0365
Titrable acidity (%)	0.0001	0.0140**	0.0003
Juice to pulp ratio	0.0004	0.0387**	0.0003

** Significant at 1 per cent level.

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

Genotypes	Total soluble solids (%)	Lycopene content (mg/100 g)	Ascorbic acid (mg/100 g)	Titrable acidity (%)	Juice to pulp ratio
Kashi Hemanth	3.90	10.23	26.26	0.35	0.50
Kashi Aman	4.93	18.50	19.30	0.32	0.64
Kashi Amrit	5.53	9.36	20.10	0.16	0.44
Kashi Vishesh	4.80	13.30	20.60	0.26	0.66
Kashi Anupam	3.86	13.60	22.60	0.17	0.62
Kashi Chayan	5.20	8.70	29.30	0.25	0.47
Kashi Sharad	4.20	11.26	28.80	0.32	0.48
VRT-01	3.80	15.43	19.53	0.23	0.41
VRT-13	4.96	14.36	21.33	0.17	0.37
VRT-01	3.80	15.43	19.53	0.23	0.41
Tolcv-16	4.70	10.90	23.93	0.22	0.47
Tolcv-28	4.36	14.56	25.13	0.32	0.45
Tolcv-32	4.40	8.23	21.36	0.37	0.59
Sel-7	4.73	11.23	24.73	0.25	0.32
Jawahar-99	4.86	8.70	24.86	0.31	0.37
2016/TODVAR-1	4.10	8.33	25.63	0.32	0.51
2016/TODVAR-2	3.20	16.96	21.63	0.36	0.56
2016/TODVAR-3	4.03	7.90	20.30	0.25	0.65
2016/TODVAR-5	4.06	10.63	24.90	0.33	0.71
2016/TODVAR-10	3.93	10.33	23.93	0.32	0.39
2016/TODVAR-11	3.90	9.56	25.10	0.32	0.46
2016/TODVAR-12	3.76	6.80	20.80	0.26	0.56
2015/TODHYB-1	3.80	16.89	20.73	0.23	0.64
2015/TODHYB-4	6.23	16.43	19.30	0.37	0.53
Shalimar Hybrid Tomato-1	4.83	8.36	21.70	0.26	0.56
Roma	4.93	16.33	19.66	0.28	0.27
Marglobe	4.23	15.73	18.73	0.46	0.42
Mean	4.46	12.13	22.91	0.28	0.50
CV	3.68	1.57	0.87	6.66	3.65
C.D. 5%	0.26	0.31	0.32	0.03	0.02
C.D. 1%	0.35	0.41	0.43	0.04	0.03

(26.26 mg/100 g), 2016/TODVAR-1 (25.63 mg/100 g), Jawahar-99 (24.86 mg/100 g), Sel.7 (24.73 mg/100 g) and TOLCCV-16 (23.93 mg/100 g) were showed significantly highest ascorbic acid as compared to general mean. The genotypes *viz.*, Kashi Aman (19.30 mg/100 g), 2015/TODHYB-4 (19.30 mg/100 g), VRT-01(19.53 mg/100 g), Kashi Anupam (22.60 mg/100 g), 2016/TODVAR-12 (22.80 mg/100 g) had lowest ascorbic acid content. These results are in agreement with the earlier findings of George *et al.* (2004) and Kaur *et al.* (2002).

Titrable acidity (%)

The highest and lowest titrable acidity was observed in Marglobe (0.46%) and Kashi Amrit (0.16%). The general mean for this trait was 0.28%. The genotypes namely, 2015/TODHYB-4 (0.37%), Kashi Hemanth (0.35%), TOLCV-28 (0.32%), 2016/TODVAR-11 (0.32%), Jawahar-99 (0.31%), were showed significantly highest titrable acidity as compared to general mean, whereas the genotypes *viz.*, VRT-13, Kashi Anupam (0.17%), VRT-19, 2016/TODVAR-3 (0.25%), 2015/TODHYB-1 (0.43%) were showed significantly lowest titrable acidity. The results are in agreement with the findings of Toor *et al.* (2006) and Pradeep Kumar *et al.* (2001).

Juice to pulp ratio

The highest and lowest values for the trait juice to pulp ratio was recorded as 2016/TODVAR-5 (0.71) and Roma (0.27). The general mean for this trait was 0.50. The genotypes *viz.*, Kashi Vishesh (0.66), 2016/TODVAR-3 (0.65), 2015/TODHYB-1 (0.64), TOLCV-32 (0.59), 2016/TODVAR-12 (0.56) were showed significantly highest values for the trait as compared to general mean. The genotypes, TOLCV-16 (0.47), 2016/TODVAR-11 (0.46), Kashi Amrit (0.44), VRT-01 (0.41), Kashi Chayan (0.37), were showed significantly lowest value.

Per se performance of tomato genotypes/varieties for all the quality traits revealed that Kashi Vishesh, Kashi chayan, Roma and Sel-7 were the best, hence these genotypes/varieties can be used as such in promotion of tomato production programme as elite germplasm lines/varieties or may be recommended for commercial cultivation after testing them over years and locations.

CONCLUSION

Analysis of variance in the present investigation indicated that the genotypes evaluated differed significantly among all the treatment for all the traits. Among the quality traits, highest TSS content was exhibited by Kashi Aman, Roma, Jawahar-99, Shalimar Hybrid Tomato-1, Kashi Vishesh and Sel-7 whereas highest lycopene content was recorded in 2015/TODHYB-1, Roma, VRT-19, Marglobe and TOLCV-28. Highest ascorbic acid was recorded in Kashi Chayan, Kashi Hemanth, 2016/TODVAR-1, Jawahar-99 and Sel-7. Highest titrable acidity recorded in Marglobe followed by 2015/TODHYB-4, Kashi Hemanth, TOLCV-28 and Jawahar-99. Maximum Juice to pulp ratio was recorded in 2016/TODVAR-5 followed by Kashi Vishesh, 2016/TODVAR-3, 2015/TODHYB-1 and TOLCV-32. The genotypes namely Kashi Vishesh, Kashi chayan, Roma and Sel-7 were performed best for the quality traits under studied. Best performed genotypes on various quality traits, could be used as a source of germplasm for future breeding programmes.

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