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Performance of Advanced Tomato (*Solanum lycopersicum* L.) Lines for Different Processing Quality Parameters of Fruits in Northern Dry Zone of Karnataka

N. Kavyashree, Revanappa, S. Gururaj, D. R. Jhanvi, B. M. Ranjitha

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Abstract Twenty tomato advanced lines, with a check variety (Megha), were evaluated during *kharif,* 2014 in the Northern Dry Zone (Zone 3) of Karnataka to study the yield performance of advanced tomato lines in Northern Dry Zone of Karnataka. The analysis of variance indicated significantly higher amount of variability among the genotypes for all the 17 characters studied. The advanced line DTR_{1-1} had shown maximum beta-carotene, where DTO-6 had shown maximum days of shelf life and the maximum calcium content was found in DTR-1. So these different lines can be used for processing purposes.

Keywords Processing quality parameters, Advanced lines, Tomato, Performance.

N. Kavyashree*, Revanappa, S. Gururaj, D. R. Jhanvi, B. M. Ranjitha
Assistant Horticulture Officer, Deputy Director of Horticulture Office, Department of Horticulture, Chikmagalore 577168, Karnataka, India
e-mail: kavyackm373@gmail.com
*Corresponding author

Introduction

Tomato (*Solanum lycopersicum* L.)is one of the most important, popular and extensively used vegetable as fresh fruit (Toor and Savage 2005) which belongs to the family Solanaceae. It is widely grown all over the world (mainly tropics and subtropics). Tomato is the world's largest grown vegetable crop after potato and onion. It is universally treated as protective food. Tomato forms an essential part of human diet. It is an important source of vitamin A and C as well as minerals and carotenoids. Among the carotenoids, lycopene is a powerful antioxidant which is synthesized in tomato. As reported by WH Foods (2013) lycopene has many human health benefits as it reduces the risks of nervous system problems, heart disease, cancer and obesity. It is reported by many researchers that lycopene has potential human health benefits. Lycopene prevents skin disease induced by UV-light (Aust et al. 2003). Lycopene protects from various cancers and cardiovascular disease (Teta et al. 2005) also. As reported by Giovannucci (2002), high tomato or lycopene consumption reduces the risk of prostate cancer. Tomato (*Solanum lycopersicum* L.) is one of the important crops used as a fresh vegetable as well as in a variety of processed products such as ketchup, sauce, juice, puree, pasta sauce, salsa, tomato-based powders, sun-dried tomatoes, curries and ready-to-eat products. On a global scale, more than 163 million tonnes (MT) of tomatoes were produced in 2014, or about 15% of total global vegetable production. In 2012, tomato production had a net value of US$59 billion, the eighth most valuable agricultural product worldwide. Global fresh tomatoes exports totaled US$8.4 billion in 2015. Global tomato production has increased by nearly 40% since 2002. FAO statistics show that the increase has been distributed evenly across the top 10 producing countries. While China is the leading producer with a share of 31%, India has consistently produced more tomatoes than third-ranked USA since 2008 with global share of 11% of production (Anonymous 2014). Thus, tomatoes are an important crop for both the farmer and the consumer in India. Amongst vegetable crops, tomato ranks third in priority after potato and onion in India as deflected in the tonnage produced. With an estimated production of 19.4 MT, India ranks second behind China in tomato production as well as in the area planted to the crop. Trends in tomato production in India show a strong expansion of production since 2010 largely due to an expansion in the area under cultivation in view of increasing market demand and a differential higher rate of return for farmers as compared with other crops. Karnataka is the second largest tomato producing state after Andhra Pradesh and accounts for 11.4% of total production. The State produced 2.07 MT of tomatoes from a cultivated area of about 61,000 ha. Karnataka's tomato productivity average is estimated at 34 tonnes/ha, the highest achieved amongst leading India tomato producing states. Kolar district produces some 28% of total state tomato production while Belgaum, Haveri and Mandya districts each have a share of between 8-10%. Irrigation remains a critical bottleneck for growers in several districts. Access to markets has also encouraged growers to cluster around the central and southern districts. Though quality of the fruit is important for consumption it is mainly influenced by different trents. The plants which shows good fruit characters viz., beta-carotene, shelf life and calcium content of fruits shows superior quality fruits. So this present investigation done to check performance of advanced tomato (*Solanum lycopersicum* L.) lines in Northern Dry Zone of Karnataka.

Materials and Methods

A field experiment was conducted during *kharif,* 2014 at Regional Horticultural Research and Extension Center (RHREC), University of Horticultural Sciences, Bagalkot, situated in the Northern Dry Zone (Zone 3) of Karnataka. It is located at 75^0 42′ East longitude and 16^0 10′ North latitude at an altitude of 542 m above Mean Sea Level (MSL). The total rainfall of 249.5 mm was received in 17 rainy days during crop growth period from August to December 2014. Mean maximum and minimum relative humidity were 78.79 and 60.87%, respectively. The mean maximum temperature was 31.25^0 C and the mean minimum temperature was 19.75^0C. The soil of the experimental area was sandy

Table 1. Analysis of variance for different characters of advanced tomato lines. *Significant at 5% probability level, ** Significant at 1% probability level.

Sl. No.	Characters	Replication	Genotypes	Error	SEm ±	CD @1%	CD @ 5%
1	Plant height (cm)	5.94	190.55*	68.20	5.901	-	17.40
2	No. of primary branches	1.52	1.62**	0.46	0.50	1.93	1.41
3	Stem thickness (cm)	0.019	0.065**	0.011	0.074	0.323	0.232
4	Days to first flowering	50.38	25.83*	11.83	2.43	-	7.19
5	Days to 50% flowering	841.52	62.51**	14.32	2.67	10.56	7.89
6	No. of flowers per cluster	3.72	1.92**	0.32	0.404	1.62	1.187
7	No. of fruits per cluster	0.27	0.96**	0.059	0.16	0.694	0.507
8	Per cent fruit set	193.80	62.84**	16.45	2.86	11.54	8.46
9	No. of fruits per plant	197.16	276.05**	10.36	2.22	8.963	6.57
10	Average fruit weight (g)	80.95	184.06**	20.49	3.2	12.87	9.44
11	Shape index	0.004	0.023**	0.0009	0.067	0.086	0.068
12	Dry matter content (%)	9.81	29.37**	1.06	0.72	2.93	2.15
13	Pericarp thickness (mm)	0.002	0.014**	0.003	0.038	0.054	0.031
14	Fruit firmness (kg/cm^2)	0.184	0.237**	0.017	0.094	0.376	0.273
15	TSS (^{0}Brix)	0.073	0.251**	0.005	0.06	0.21	0.16
16	Shelf life	237.19	121.75**	1.26	0.268	3.19	2.347
17	Fruit yield per plant (g)	3010	5617**	5238	161.8	651.1	477.4

Table 2. Beta-carotene (mg/100g), shelf life (days), and calcium content (%) of different advanced tomato lines. *Significant at 5% probability level.

Sl. No.	Treatments	Beta-carotene (mg/100g)	Shelf life (days)	Calcium content (%)
1	DTR-1	4.24	17.15	0.392
2	DTR_{1-1}	4.79	34.35	0.240
3	DTR-3	2.36	23.75	0.200
4	DTR-4	2.57	15.5	0.228
5	DTR-5	2.20	18.25	0.168
6	DTR-6	4.17	32.45	0.212
7	DTR-7	2.62	10.65	0.328
8	DTR-8	2.64	26.85	0.104
9	DTO-1	2.06	28.15	0.104
10	DTO-2	3.11	24.35	0.156
11	DTO-3	2.22	15.55	0.144
12	DTO-4	3.33	30.75	0.108
13	DTO-5	2.67	28.5	0.184
14	DTO-6	2.43	35.25	0.156
15	DTO-7	2.13	29.45	0.116
16	DTO-8	1.63	29.65	0.140
17	DTO-9	2.15	13.85	0.164
18	DTO-10	2.38	24.15	0.156
19	DTO-11	2.76	33.35	0.152
20	DTO-12	2.36	10.55	0.176
21	Megha (L 15)	3.04	19.55	0.252
	F test	*	*	*
	SEm	0.06	0.268	0.9736
	CD (0.05)	0.06	0.787	0.004
	CV (%)	1.09	1.122	1.052

loam having good physical and chemical properties. Tomato seeds were sown in pro-trays filled with cocopeat growing media. Recommended cultural practices and plant protection measures (drenching with Dithane M-45 2g/l two times) were carried out to raise healthy seedlings. Five plants were tagged at random in each replication and observations were recorded on growth parameters. Treatments of the experiment involved advanced lines (The pre-released genotypes have been developed by the plant breeder for use in modern scientific plant breeding and are under pipeline to release to farmers). Such 20 advanced lines of tomato viz., DTR-1, DTR_{1-1}, DTR-3, DTR-4, DTR-5, DTR-6, DTR-7, DTR-8, DTO-1, DTO-2, DTO-3, DTO-4, DTO-5, DTO-6, DTO-7, DTO-8, DTO-9, DTO-10, DTO-11, DTO-12 from Horticultural Research Station, Haveri (Devihossur) with Megha, a variety released by UAS, Dharwad as check constituted 21 treatments for the present investigation. Randomized complete block design was adopted with two replications with

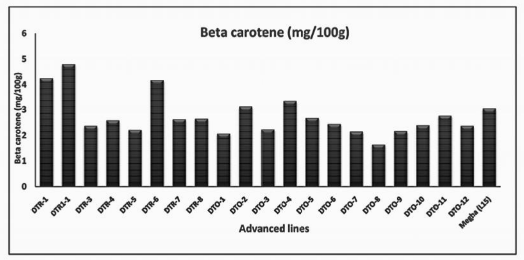

Fig. 1. Beta-carotene (mg/100g) of different advanced tomato lines.

20 plants in each replication. The experimental data collected were statistically analyzed using Fisher's method of Analysis of variance as outlined by Sundararaj (1972). β–carotene content of known weight of fruit sample was extracted using 80 per acetone and sodium sulfate crystals. Further, treated with petroleum other to obtain clear yellow color solution. The intensity of color (OD) was measured at 452 nm using UV-Visible spectrophotometer (AOAC, 2004) and β-carotene content was calculated using the standard formula. Fruits were harvested at breaker stage and packed in polythene cover having small pores and stored (kept) at room temperature and visually observed. The number of days taken for destruction of 50% of consumption quality of fruits was recorded as shelf life period. Pipette 5 ml seed digested sample in a 100 ml clean porcelain dish and dilute with 10 ml of distilled water, add 5 ml of sodium hydroxide solution and pinch of murexide indicator, tirate against EDTA (0.01N) till color changes from pink to violet and calcium content was calculated using the standard formula.

Results and Discussion

Result from analysis of variance showed highly significant difference among the genotypes ($p<0.0001$) for the characters evaluated (Table 1). Similar findings were reported by Pradeepkumar et al. (2001) and Fekadu et al. (2003) for the tomato characters studied. Among the genotypes, significant difference was observed with respect to beta-carotene content in fruit (Table 2 and Fig. 1). The beta-carotene content of Megha was 3.04 mg/100g. Only five advenced lines had significantly higher values but, fiteen lines had significantly lower beta-carotene content over check. The line with highest (4.79 mg/100g) beta-carotene content was in DTR $_{1-1}$ followed by DTR-1 (4.24 mg/100g), while the lowest was recorded in DTO-8 (1.63 mg/100g) similar results find with Audrius et al. (2009).Keeping quality of fruits i.e. shelf life was also studied for these 21 genotypes. Statistically, very wide significant differences within the genotypes (Table 2) were noticed. Shelf life of Megha was 19.55 days. Among 21 lines experimented, 13 lines were known to contain significantly higher and other 7 lines had significantly lower shelf life over Megha. However, the maximum shelf life was recorded in DTO-6 (35.25 days) followed by DTR$_{1-1}$ (34.35 days), and the minimum shelf life was in DTO-12 (10.55 days). The earlier findings of Jiregna Tasisa (2013) are in line with the present findings. The calcium content of seeds also varied significantly among different genotypes (Table 2). Megha had 0.252% of calcium. The highest calcium content in seeds was recorded in DTR-1 (0.392%) followed by DTR-7 (0.328%). Among 21, only these 2 lines were significantly richer than Megha. Among other lines, both, DTO-1and DTR-8 were found to have lowest (0.104%) calcium content. Similarly, DTO-2, DTO-6 and DTO-10 contained 0.156% calcium. The results of Abdel et al.(2011) are in agreement with the obtained results. So from all these we can conclude that the advanced line DTR$_{1-1}$ had shown maximum beta-carotene, where DTO-6 had shown maximum days of shelf life and the maximum calcium content was found in DTR-1. So these different lines can be used for processing purposes.

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