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Performance of Advanced Tomato (*Solanum lycopersicum* L.) Lines for Different Yield Attributed Characters in Northern Dry Zone of Karnataka

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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-3 had shown highest percent of fruit set, highest number of fruits per plant and maximum yield when compare to other lines. When come to the fresh weight, the line DTO-5 is superior where DTO-8 is superior for dry weight and dry matter content.

Keywords Yield attributed characters, Advanced lines, Tomato, Performance.

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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 lyco-persicum* L.)

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**	0.0003	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 (^{o}Brix)	0.073	0.251**	0.005	0.06	0.21	0.16
16	Shelf life	237.19	121.75**	1.25	0.268	3.19	2.347
17	Fruit yield per plant (g)	3010	5617**	5238	161.8	651.1	477.4

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. India has consistently produced more tomato 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 cropd, tomato ranks third in prority after potato and onion in India as reflected 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 Indian 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.

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^o 42´ East longitude and 16^o 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^{o}C and the mean minimum temperature was 19.75^{o}C. The soil of the experimental area was sandy loam having good physical and chemical properties. Tomato seeds were sown in peo-trays filled with cocopeat growing media. Recommended cultural practices and plant protection measures (drenching with

Table 2. Average fruit weight, polar diameter, transverse diameter and shape index of different advanced tomato lines. *Significant at 5% probability level.

Sl. No.	Treatments	Per cent fruit set	Number of fruits	Yield (g)	Fresh weight (g)	Dry weight (g)	Dry matter content (%)
1	DTR-1	49.58	41.70	2500	410.0	71.8	17.55
2	DTR_{1-1}	56.86	48.43	3584	408.9	72.8	17.80
3	DTR-3	63.75	82.13	4125	407.4	76.6	18.73
4	DTR-4	55.44	62.58	3730	409.8	79.8	19.51
5	DTR-5	42.73	45.83	2677	407.5	77.8	19.02
6	DTR-6	49.26	65.89	3992	386.0	85.0	22.02
7	DTR-7	50.62	57.70	3012	409.0	72.3	17.67
8	DTR-8	50.68	43.29	2459	390.0	88.0	22.56
9	DTO-1	58.71	45.34	3428	410.4	75.8	18.53
10	DTO-2	56.91	38.83	2711	406.6	75.7	18.51
11	DTO-3	51.53	43.84	3025	408.8	73.9	18.08
12	DTO-4	41.80	28.75	2341	347.9	90.6	26.04
13	DTO-5	50.64	57.16	3636	411.2	103.6	25.32
14	DTO-6	53.84	60.86	3860	382.4	94.5	24.71
15	DTO-7	58.39	53.01	3096	411.0	97.4	23.81
16	DTO-8	51.21	40.11	3057	406.4	127.8	31.25
17	DTO-9	52.90	42.95	3342	406.0	70.5	17.36
18	DTO-10	43.67	37.65	2869	409.0	81.6	19.25
19	DTO-11	59.20	50.60	2697	342.9	88.1	25.69
20	DTO-12	49.67	48.29	2627	264.0	60.3	22.84
21	Megha (L 15)	49.52	54.74	3055	396.0	99.8	25.20
	F test	*	*	*	*	*	*
	SEm	2.86	2.22	161.8	19.81	2.58	0.72
	CD (0.05)	8.46	6.57	477.4	58.46	7.63	2.15
	CV (%)	7.76	6.30	7.30	7.156	4.35	4.80

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 replication with 20 plants in each replication. The experimental data collected were statistically analyzed using Fisher's method of Analysis of variance as outlined by Sundararaj et al. (1972). The per cent fruit set was calculated by finding ratio of number of flowers per cluster to the number of fruits per cluster. By adding the number of marketable fruits harvested per plant from all the pickings, number of fruits per plant was calculated. After final harvesting, tagged plants were uprooted and washed with water and third fresh weight was recorded and expressed in grams. After recording fresh weight, the plants were kept in hot air oven at 60 to 70°C for 48 h and later dry weight was recorded in grams. The ratio of fresh weight of plants to the dry weight of the plant was converted in to percentage and recorded as the dry matter content of plants.

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

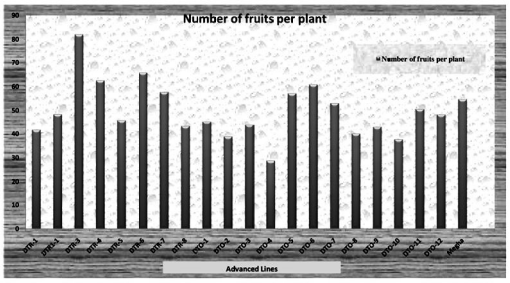

Fig. 1. Number of fruits per plant of different advanced tomato lines.

Fekadu et al. (2003) for the tomato characters studied. Genotypes differed significantly within themselves for per cent fruit set (Table 2). The significantly highest fruit set was recorded in four lines DTR-3 (63.75%), DTO-11 (59.20%), DTO-1 (58.71%) and DTO-7 (58.39%) over the check variety Megha (49.52). The lowest per cent fruit set was seen in DTO-4 (41.80%) and other three advanced lines compared to Megha. Similar results also found by Regassa et al. (2012). The number of fruits per plant also varied significantly among different genotypes (Table 2 and Fig. 1). Three lines performed significantly superior than check, and of which DTR-3 recorded the highest number of fruits (82.13) followed by DTR-6 (65.89) and DTR-4 (62.58) per plant. The minimum number of fruits per plant was recorded in DTO-4 (28.75). Compared to Megha, 11 lines had superior performance and 9 lines had inferior performance. Ahmed et al. (2009) also found same results. The differences among the genotypes with regard to fresh weight of the plants were found to be significant (Table 2). The highest fresh weight of plant was recorded in DTO-5 (411.2 g) followed by DTO-7 (411 g), DTO-1 (410.4 g) and DTR-1 (410 g). Megha registerd a fresh weight of 396 g per plant. All the lines were found on par with Megha except DTO-12 (264 g) which recorded the significantly lowest fresh weight these results also found by Ghasemi (2015). Significant differences among the genotypes were noticed even with respect to dry weight of plants (Table 2). Megha recorded 99.8 g. Only DTO-8 had recorded significantly the highest dry weight (127.8 g). However, DTO-5, Megha, DTO-7, DTO-6 and DTO-4 were on par with each other. Among the 21 genotypes studied, sixteen lines had recorded significantly lower dry weight, and was the lowest in DTO-12 (60.3 g). Ahmed et al. (2007) also in the same line in their experiments. The dry matter content varied significantly among the genotypes (Table 2). The dry matter content of Megha was 25.2 g per plant. Although, 4 lines recorded better dry matter content than Megha it was only DTO-8 which had significantly the highest dry matter content (31.25%). Many of the lines had significantly lower dry matter content compared to check and significantly lowest was in DTO-9 (17.36%). Similar results also obtained by Eshteshabul et al. (2010). The data on fruit yield per plant is presented in Table 2. The check variety, Megha had recorded per plant yield of 3055 g. Compared to Megha, 10 advanced lines of Devihossur had exhibited higher yields and other 10 lines had lower yields. Among these 10 lines, 6 lines were found significantly superior. The line to record significantly highest yield per plant was DTR-3 (4125 g) followed by DTR-6 (3992 g) and DTO-6 (3860 g). Four slightly high yielding and seven slightly low yielding advanced lines were on par with Megha. Only two lines which yielded significantly lower than Megha were DTO-4 (2341 g)and DTR-8 (2459 g).

Totally seven pickings were made in all the genotypes. The picking wise per plant yield is presented in Appendix II a. Yield of first two pickings was added and taken as early yield and similarly yield of last two pickings was added and taken as late yield. The yield of 3rd, 4th and 5th picking was added and taken as middle yield. To the highest yield of DTR-3 (4125 g) early, middle and late yields have contributed to the tune of 938 g (22.7%), 1920 g (46.5%) and 1267 g (30.7%), respectively. In DTR-6, the contribution of early yield (first two pickings) was considerably more (1437 g i.e. 36%) than the late yields (928 g i.e. 23.2%) i.e. yield of last two pickings to its total yield (3992 g) per plant. The scenario was reverse with DTO-3. In DTO-3, late yields (yield of last two pickings) had maximum contribution (1754 g i.e. 58%) to its total yield (3025 g/pt) while contribution of early yields (yield of first two pickings) was less (584 g i.e. 19.3%). These results help in grouping the genotypes as early and late yielders, which gives options to farmers to exploit early or late market demands.

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