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Per Se Performance of Tomato (*Solanum lycopersicum* L.) Genotypes for Growth, Yield and Quality Traits under North Eastern Dry Zone of Karnataka, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present investigation was conducted to study the twenty-five tomato genotypes for growth, yield and quality traits under north eastern dry zone of Karnataka during late-*kharif* season of 2022-23 and the experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The study revealed that, there was significant differences ($p < 0.05$) observed for

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all the traits studied. The highest plant height was recorded in the genotype EC-157568 (166.48 cm), internodal length in EC-164677 (8.85 cm) and number of branches per plant in IC-249514 (18.68). The genotype EC-631361 was found to be early among all the genotypes under study by recording minimum 50 per cent flowering (20.33). The maximum number of flowers per cluster (7.85) and clusters per plant (17.79) were observed in the genotype EC-631409 and EC-688516, respectively. Significantly highest fruit length (58.37 mm), fruit girth (58.57 mm), average fruit weight (136.43 g), fruits per cluster (5.41) and fruits per plant (30.76) were recorded in the genotypes Baari, Akshaya, Arka Meghali, EC-631409 and EC-688516, respectively. Genotype EC-688516 recorded maximum fruit yield per plant (2.49 kg) and fruit yield per hectare (71.58 t). Maximum pericarp thickness (6.58 mm), TSS (6.73 ^{0}Brix) and titrable acidity (0.73%) was observed in the genotypes Arka Meghali, Arka Meghali and EC-688516, respectively.

Keywords: Per se; tomato; genotypes and quality traits.

1. INTRODUCTION

Tomato, scientifically known as *Solanum lycopersicum*, belongs to family Solanaceae, with a chromosome number of 2n=2x=24, is one of the most economically significant and widely cultivated vegetable crops globally. Tomato is considered as the 2nd greatest significant vegetable crop grown in the world after potato [1]. Its popularity is attributed to its nutritional value, culinary versatility, and economic importance in the food industry such as preparation of salads, sauces, ketchups and soups [2]. As we all know food and nutritional security related concerns can only be solved with an increase in the yield of the vegetables [3]. Hence to meet the increasing demands for high-quality tomatoes, it is essential to evaluate different tomato genotypes to identify those with superior traits related to growth patterns, yield potential and quality attributes. The findings of this research can guide farmers in selecting appropriate cultivars for specific agro-climatic regions, enhance breeding programs by identifying valuable genetic resources, and can benefit both small-scale and large-scale farmers by increasing their yields and incomes. Furthermore, this evaluation process not only aids in the selection of suitable varieties for cultivation but also provides valuable insights into future breeding programs. In the subsequent sections of this paper, we will delve into the methodology, results, discussion, and conclusions derived from the systematic evaluation of tomato genotypes.

2. MATERIALS AND METHODS

The present investigation was conducted at Herbal Garden, College of Agriculture, UAS, Raichur during *late kharif* season, 2022-23. The experimental site is located at an altitude of 389.00 m above mean sea level (MSL) with latitude of 16.15^0 N', and longitude of 77.21^0 E' in the North Eastern Dry Zone of Karnataka (Zone-II). The experimental material comprises of twenty-four genotypes along with one check variety Arka Saurabh which were collected from NBPGR, New Delhi, Indian Institute of Horticultural Research (IIHR), Bengaluru, College of Horticulture (CoH), Bengaluru, College of Horticulture (CoH), Bagalkot and Kerala Agriculture University (KAU), Kerala.

Seedlings were raised in portrays under 50 % shade net by using coco-peat as growing media. Trays were irrigated daily once or twice depending up on the temperature. After fifteen days of sowing the trays were drenched with 19:19:19 (NPK) at the concentration of 1g/lit in order to get good rooting as well as growth. The prophylactic sprays were taken against pest and diseases.

Four weeks old seedlings were transplanted in the main field at a spacing of 60 cm between the rows and 45 cm between the plants and light irrigation was given at the time of planting. Subsequent irrigations were provided whenever it was required. The recommended dose of fertilizer for tomato (115:100:60 NPK kg/ha, package of practices, UHS, Bagalkot) was provided at 15 days intervals through fertigation in the form of water-soluble fertilizer. Regular weeding was carried out and staking was provided forty-five days after transplanting.

Five plants from each replication and each plot were randomly tagged and selected for recording following observations on growth, yield and quality parameters and the average from these plants was worked out for the purpose of statistical computation (analysis) [4]. The details of observations recorded in each experiment and techniques adopted for the recording the observations were as follows.

Table 1. Details of tomato genotypes used in the experiment and their source of collection

Sl. No.	Original Code	Source of Collection
1	Anagha	KAU, Thrissur
2	Akshaya	KAU, Thrissur
3	S – 22	Local collection
4	14	COH, Bengaluru
5	15	COH, Bengaluru
6	16	COH, Bengaluru
7	IC-249514	NBPGR, New Delhi
8	EC-631409	NBPGR, New Delhi
9	EC-631361	NBPGR, New Delhi
10	EC-157568	NBPGR, New Delhi
11	EC-636877	NBPGR, New Delhi
12	EC-631368	NBPGR, New Delhi
13	EC-620427	NBPGR, New Delhi
14	EC-249508	NBPGR, New Delhi
15	EC-164677	NBPGR, New Delhi
16	EC-315489	NBPGR, New Delhi
17	EC-620361	NBPGR, New Delhi
18	EC-620366	NBPGR, New Delhi
19	Arka Meghali	IIHR, Bengaluru, Karnataka
20	EC-698849	NBPGR, New Delhi
21	EC-688516	NBPGR, New Delhi
22	Baari	COH, Bagalkot
23	RFT-S-1	COH, Bagalkot
24	Shalmala	COH, Bagalkot
25	Arka Saurabh	IIHR, Bengaluru, Karnataka

3. RESULTS AND DISCUSSION

Wide range of variation was observed for all the characters studied. Highly significant differences were shown for *per se* performance of all characters, suggesting that there is ample scope for selection of different traits for improvements of tomato. Mean performance of 25 genotypes for growth, yield and quality traits are presented in Tables 2 and 3.

The growth parameters like plant height significantly varied from 71.71 cm (Shalmala) to 166.48 cm (EC-157568). Genotype EC-157568 recorded the highest plant height (166.48 cm), which was at par with genotype EC-620427 (153.40 cm) and genotype EC-157568 recorded 51.53 per cent higher plant height than check cultivar Arka Saurabh (80.70 cm). The lowest plant height (71.71 cm) was observed in genotype Shalmala. Maximum internodal length was observed in genotype EC-164677 (8.85 cm), which is at par with the genotype EC-620361 (8.26 cm). Whereas, genotype EC-688516 recorded minimum internodal length of 3.52 cm.

In comparison to other tomato genotypes, genotype EC-157568 recorded statistically higher number of nodes per plant (28.78) and the least number of nodes per plant (14.66 & 14.67) was observed in genotypes RFT-S-1 and Shalmala respectively. Significantly the higher number of 18.68 branches per plant was recorded in genotype IC-249514, while the least number of 8.69 branches per plant was recorded in genotype Arka Meghali. The significant difference in growth parameters among the genotypes could be due to the genetic setup and inheritance of the character as well as differences in apical dominance, cell division and cell elongation, which are influenced by the production of endogenous plant hormones like auxins, gibberellins and cytokines at different levels in each of the genotype and which are directly controlled by the genetic constituent of the plant. The obtained results are in accordance with findings of [5-9] in tomato.

Minimum of 18.33 days to 1st flowering and 20.33 days to 50% flowering was observed in genotype EC-631361, whereas, the maximum of 24.67 days to 1st flowering and 28.33 days to 50 % flowering was observed in genotypes EC-636877 & RFT-S-1 and EC-688516, respectively. Check cultivar Arka Saurabh recorded 24.33 days for 1st flower and 27.33 days for 50% flower

Table 2. *Per se* performance of tomato genotypes for growth and flowering parameters

Sl. No.	Genotypes	Plant height (cm)	Internodal length (cm)	Number of nodes per plant	Number of branches per plant	Days to 1st flowering	Days to 50% flowering	Number of flowers per cluster	Number of clusters per plant
1	Anagha	78.89	6.34	16.66	11.43	21.67	24.67	6.00	14.22
2	Akshaya	98.58	6.40*	17.34	8.71	22.33	24.33	5.84	10.22
3	S – 22	102.30*	7.44*	18.67	9.69	23.33	24.67	4.50	12.09
4	14	84.40	5.64	17.34	9.00	24.00	27.00	5.50	14.23
5	15	77.53	5.37	15.66	11.40	24.33	25.33	6.20	13.28
6	16	73.71	6.02	17.34	9.27	23.67	25.67	5.84	14.31
7	IC-249514	149.03*	5.00	25.68*	18.68*	18.67	21.67	4.50	14.33
8	EC-631409	132.38*	6.30	25.74*	16.04*	21.67	24.67	7.85*	15.23*
9	EC-631361	124.79*	5.89	22.34*	12.36*	18.33	20.33	6.33	12.77
10	EC-157568	166.48*	7.03*	28.78*	14.70*	21.00	24.67	6.56	15.88*
11	EC-636877	118.80*	7.08*	17.33	8.63	24.67	25.67	6.33	10.35
12	EC-631368	115.60*	6.31	19.35*	10.23	19.67	20.67	6.20	11.17
13	EC-620427	153.40*	7.74*	23.01*	16.34*	20.33	24.33	5.50	13.52
14	EC-249508	102.58*	6.78*	17.68	9.30	24.00	25.00	4.50	17.37*
15	EC-164677	126.23*	8.85*	16.66	10.16	24.33	25.33	4.50	12.69
16	EC-315489	144.39*	7.83*	21.70*	15.03*	21.33	24.33	5.50	12.23
17	EC-620361	128.64*	8.26*	19.33*	12.43*	23.33	27.67	5.67	16.43*
18	EC-620366	142.03*	5.81	25.35*	16.24*	20.00	23.00	6.38	12.09
19	Arka Meghali	81.88	5.22	15.67	8.69	23.33	24.33	5.69	14.94*
20	EC-698849	148.59*	4.67	27.69*	18.35*	24.33	27.67	5.67	12.18
21	EC-688516	84.37	3.52	22.67*	10.67	24.33	28.33*	6.54	17.79*
22	Baari	97.74	5.03	21.70*	13.35*	24.33	25.00	6.83	15.78*
23	RFT-S-1	86.24	6.62	14.66	8.73	24.67	25.33	6.00	12.27
24	Shalmala	71.71	5.90	14.67	9.46	24.33	25.33	5.40	13.28
25	Arka Saurabh	80.70	5.01	16.33	10.39	24.33	27.33	6.43	13.34
	Mean	**110.84**	**6.24**	**19.98**	**11.97**	**22.65**	**24.89**	**5.85**	**13.68**
	S.Em. ±	**7.53**	**0.49**	**0.94**	**0.52**	**0.63**	**0.34**	**0.22**	**0.48**
	CD @ 5%	**21.42**	**1.39**	**2.67**	**1.48**	**1.80**	**0.96**	**0.62**	**1.36**

**Significant at p = 0.05*

Table 3. *Per se* performance of tomato genotypes for yield parameters

Sl. No.	Genotypes	Fruit length (mm)	Fruit girth (mm)	Average fruit weight (g)	Number of fruits per cluster	Number of fruits per plant	Fruit yield per plant (kg)	Fruit yield per hectare (t)	Pericarp thickness (mm)	Number of locules per fruit	TSS (^{0}Brix)	Titrable Acidity (%)
1	Anagha	35.74	44.37	52.73	4.60	27.11	1.43	50.83	4.43	4.00*	6.10*	0.53*
2	Akshaya	42.60	58.57	87.63*	4.22	25.25	1.68	59.86	4.83	5.00*	5.81*	0.49*
3	S – 22	37.10	54.85	84.64*	3.62	24.71	1.58	56.26	5.16	4.00*	6.18*	0.18
4	14	40.42	49.55	62.29	4.20	23.46	1.52	54.13	4.67	4.00*	5.85	0.35
5	15	34.32	52.07	70.28	4.60	25.60	1.66	58.94	4.55	6.00*	5.18	0.48*
6	16	37.00	51.88	71.08	4.40	26.63	1.72*	61.07*	4.09	5.00*	5.44	0.15
7	IC-249514	38.15	46.52	55.46	3.80	23.26	1.29	45.86	3.85	7.00*	5.20	0.28
8	EC-631409	56.07	46.22	62.04	5.41*	28.72*	2.03*	72.13*	6.32	2.00	5.16	0.42
9	EC-631361	36.51	49.08	59.83	4.00	24.18	1.39	49.30	3.74	4.00*	4.56	0.25
10	EC-157568	36.56	52.11	51.57	4.60	23.11	1.19	42.37	5.50	5.00*	5.36	0.27
11	EC-636877	53.27	51.12	82.66*	5.41*	25.30	1.76*	62.55*	4.94	4.00*	4.49	0.54*
12	EC-631368	42.56	48.53	60.36	5.35*	24.90	1.38	49.12	4.64	5.00*	5.13	0.59*
13	EC-620427	45.86	46.13	56.24	3.40	24.52	1.44	51.03	6.02	3.00	5.74*	0.40
14	EC-249508	40.04	49.52	74.10	3.80	23.83	1.47	52.16	5.98	4.00*	4.91	0.33
15	EC-164677	42.46	47.60	44.98	3.60	25.65	1.24	44.22	5.07	5.00*	5.79*	0.54*
16	EC-315489	41.78	46.07	48.17	5.41*	22.35	1.27	45.12	5.82	4.00*	5.45	0.35
17	EC-620361	45.65	50.76	65.38	3.80	24.25	1.58	56.35	4.45	4.00*	5.98*	0.48*
18	EC-620366	31.07	43.48	34.85	4.60	26.45	1.27	45.19	4.56	7.00*	6.61*	0.47*
19	Arka Meghali	55.60	55.64	136.43*	3.40	22.11	2.20*	78.27*	6.58	4.00*	6.73*	0.34
20	EC-698849	43.45	51.91	86.76*	4.40	21.74	1.45	51.52	4.79	3.00	6.22*	0.40
21	EC-688516	53.25	50.58	93.26*	5.28*	30.76*	2.49*	88.51*	6.49	3.00	5.44	0.73*
22	Baari	58.37*	47.98	77.74*	5.21*	28.59*	2.32*	82.57*	6.40	2.00	4.62	0.51*
23	RFT-S-1	37.67	39.71	65.25	4.80	23.95	1.49	53.02	4.72	5.00*	6.37*	0.26
24	Shalmala	43.23	50.55	69.79	4.50	22.32	1.35	47.96	4.72	3.00	4.89	0.49*
25	Arka Saurabh	56.03	51.87	65.55	4.60	24.71	1.55	55.22	6.32	3.00	5.10	0.41
	Mean	**43.39**	**49.47**	**68.76**	**4.44**	**24.94**	**1.59**	**56.54**	**5.14**	**4.20**	**5.53**	**0.41**
	S.Em. ±	**1.40**	**2.20**	**3.44**	**0.18**	**0.89**	**0.08**	**1.74**	**0.24**	**0.17**	**0.23**	**0.02**
	CD @ 5%	**3.98**	**6.27**	**9.79**	**0.52**	**2.53**	**0.22**	**4.96**	**0.68**	**0.48**	**0.66**	**0.04**

**Significant at p = 0.05*

emergence. The variation in days to flowering in different tomato genotypes might be due to variation in the level of gibberellins in the plant. The higher level of gibberellins has been expressed to promote early flowering in crop plants. The differences in days to flowering was also reported by [5,10-12] in tomato.

Number of flowers per cluster ranged from 4.50 to 7.85 and clusters per plant ranged from 10.22 to 17.79. The maximum of 7.85 flowers per cluster and 17.79 clusters per plant was observed in genotype EC-631409 and EC-688516, respectively. whereas minimum of 4.50 flowers per cluster was observed in genotypes S – 22, IC-249514, EC-249508 and EC-164677 and minimum of 10.22 clusters per plant were observed in genotype Akshaya. The findings are in agreement with [13].

Significantly highest fruit length of 58.37 mm and fruit girth of 58.57 mm was noticed in genotype Baari and Akshaya, respectively. The lowest fruit length of 31.07 mm and fruit girth of 39.71 mm was noticed in genotype EC-620366 and RFT-S-1, respectively. Average fruit weight significantly varied from 34.85 g to 136.43 g. Genotype Arka Meghali recorded highest average fruit weight of 136.43 g and it was found to be significantly superior over all genotypes studied and genotype Arka Meghali produced 52.07 per cent greater average fruit weight as compared to check cultivar Arka Saurabh (65.55 g). Whereas, the least average fruit weight was recorded in genotype EC-620366 (34.85 g). Variation in fruit characteristics may be due to differences in the level of endogenous hormones like GA3 and NAA, which induces cell elongation and leads to more growth of tomato fruits, which are directly controlled by the genetic makeup and inherent character of genotypes. These results are in close conformity with the earlier findings of [14,6,15] in tomato.

The maximum of 5.41 fruits per cluster and 30.76 fruits per plant was noticed in genotypes EC-631409, EC-315489 & EC-636877 and EC-688516, respectively. The minimum of 3.40 fruits per cluster and 21.74 fruits per plant was noticed in genotypes EC-620427 & Arka Meghali and EC-698849, respectively. whereas, check cultivar Arka Saurabh recorded average of 4.60 fruits per cluster and 24.71 fruits per plant.

Fruit yield per plant differed from 1.19 kg to 2.49 kg fruits per plant and fruit yield per hectare differed from 88.51 to 42.37 tonnes per hectare. Genotype EC-688516 produced significantly highest fruit yield per plant (2.49 kg) and fruit yield per hectare (88.51 t) when compared to all other genotypes it was at par with the genotype Baari (2.32 kg and 82.57 t, respectively). The lowest fruit yield per plant (1.19 kg) and fruit yield per hectare (42.37 t) was produced in genotype EC-157568. 1.55 kg yield per plant and 55.22 tonne yield per hectare was produced by check cultivar Arka Saurabh. Increase in the yield parameters like number of clusters per plant, number of fruits per cluster, number of fruits per plant, average fruit weight, as increased fruit yield per plant, which in turn increases fruit yield per hectare and also might be due to genetic makeup of the genotype. The above results with respect to fruit yield per hectare are in conformity with the results of [5,16,13,12,17] in tomato crop.

The quality parameters like pericarp thickness varied from 6.58 mm to 3.74 mm. Significantly maximum pericarp thickness of 6.58 mm was observed in genotype Arka Meghali and minimum pericarp thickness of 3.74 mm was observed in genotype EC-631361. The highest of 7.00 locules per fruit was recorded in genotypes IC-249514 and EC-620366. Genotype EC-631409 and Baari recorded lowest of 2.00 locules per fruit and 2.00 locules per fruit in check cultivar Arka Saurabh. Total soluble solids varied from 4.49 ^{0}Brix to 6.73 ^{0}Brix and titrable acidity varied from 0.73% to 0.15%. The maximum TSS (6.73 ^{0}Brix) and titrable acidity (0.73%) was recorded in the genotype Arka Meghali and EC-688516, respectively. The minimum TSS of 4.49 ^{0}Brix and titrable acidity of 0.15% was recorded in genotype EC-636877 and 16, respectively. The variation in quality parameters might be due to the genetic makeup and inherent character of the genotypes. Similar results with respect to quality parameters were reported by [18,19,16,17,20].

4. CONCLUSION

On the basis of overall findings of present investigation, wide range of variation was observed by all the tomato genotypes for all the characters studied. EC-688516 (2.49 kg) recorded significantly highest fruit yield per plant and found superior to all other genotypes, which was at par with the genotypes Baari (2.32 kg), Arka Meghali (2.20 kg) and EC-631409 (2.03 kg), these genotypes will helpful for farmers for getting higher yields per hectare. Arka Meghali and EC-688516 produced maximum TSS (6.73 ^{0}Brix) and titrable acidity (0.73%), respectively

and these genotypes can be used for processing purpose. Hence, these genotypes can be used in future breeding programme for breeding varieties with high yielding potential.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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