



Performance of Tomato (*Solanum lycopersicum* L.) Genotypes for Earliness and Yield Traits in Late Kharif and Summer Season under North Eastern Region of Uttar Pradesh, 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

Aims: This preliminary study's goal was to assess how well tomato genotypes performed in the north-eastern region of Uttar Pradesh in terms of earliness, yield, and quality traits in order to be used later in the production of hybrids with desirable characteristics.

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Study Design: Randomized Block Design.

Place and Duration of Study: The current study was carried out at the Vegetable Research Farm of the ICAR-Indian Institute of Vegetable Research (ICAR-IIVR), Varanasi, during the years 2015-16 in both the consecutive seasons (late Kharif & summer).

Methodology: The current study was carried out at the Vegetable Research Farm of the ICAR-Indian Institute of Vegetable Research (ICAR-IIVR), Varanasi 14 genotypes.. All the plant materials were grown on raised beds in the experimental plots of tomato breeding unit of ICAR-Indian Institute of Vegetable Research, Varanasi during late Kharif and summer season in the year 2015–2016. In both seasons, about 30 days old healthy seedlings grow in a nursery under net house and transplanted in a 4.50 x 1.20 m raised bed with a spacing of 60 x 45 cm in a Randomized Block Design with three replications in field. To grow a healthy harvest, a standard set of good agricultural practices of tomato was used. During the cropping season, no insecticides were used to protect the whitefly Population, allowing for maximal tomato leaf curl virus (ToLCV) spread and severe disease occurrence. Five plants from each plot were randomly tagged and observations recorded on days to first flowering, days to 50% flowering, number of leaves before truss, days to first ripening, number fruits/ plant, Average fruit weight, fruit yield/ plant, flesh thickness, TSS, texture and Lycopene content.. The data collected on different parameters during the course of investigation were subjected to statistical analysis as per method of analysis of variance (Panse and Sukhatme 1985).

Results: The genotype EC 538411 was showed earliness and take minimum days to first ripening than others and H-88-78-2 was late in all the traits related to earliness in both season. The highest yield per plot (kg.) was recorded in Punjab Barkha Bahar- 1 (49.73, 25.84) in the both season, respectively. The mean values of Genotypes for flesh thickness (mm.) ranged from 4.37 (H-88-78-2) to 6.27 (VRT-2103-1-8) and 4.07 (H-88-78-2) to 05.99 (VRT-2103-6-1 and D-2-2-3) for season I and season II, With respect to TSS⁰ Brix, The maximum TSS⁰ Brix was recorded Genotypes D-2-2-3 (7.47 and 7.53) during the both season respectively. The early maturity and high yield genotype was desirable character for a good variety. So that, those parent which exhibited early maturity and good yielder may be used for development of hybrids.

Conclusion: The genotypes EC 538411, EC 538411, and VRT-2103-1-4 are recommended as parents for earliness, Punjab Barkha Bahar-1 and D-2-2-3 for yield, and VRT-2103-6-1 and D-2-2-3 for yield and quality traits. These parents could be utilized to breed hybrids with desirable characteristics.

Keywords: Tomato; genotype; earliness; yield; quality.

1. INTRODUCTION

Tomatoes are one of the vegetables that are grown the most frequently around the world, coming in second only to potatoes. It has gained popularity over the past century and is now a leading crop for kitchen gardens, outdoor fields, greenhouses, and net houses in addition to being a significant food processing industry. In addition to being delicious, tomatoes are also quite nutrient-dense. Since tomatoes contain high amounts of vitamin A, C, and K as well as vitamin B6, foliate, niacin, and thiamine, tomatoes are sometimes referred to as "protective food." Tomatoes are a good source of potassium, magnesium, phosphorus, manganese, and copper. They also contain large amounts of lycopene a chemical known for its antioxidant effects [1].

Given the significance of this crop, there is a need for development of improved varieties that

are suited to various agro-ecological conditions with specific end uses. However, before creating any superior varieties with earliness, better yield and quality traits, it is necessary to periodically check the performance of existing germplasm in comparison to the best performing variety of that agro-climatic region. Reshuffling the genes through recombination is the principle way of developing improved genotypes in breeding programs. The objective of this preliminary study was to examine the earliness, yield and quality traits of tomato genotypes.

2. MATERIALS AND METHODS

The current study was carried out at the Vegetable Research Farm of the ICAR-Indian Institute of Vegetable Research (ICAR-IIVR), Varanasi. All the plant materials were grown on raised beds in the experimental plots of tomato breeding unit of ICAR-Indian Institute of

Vegetable Research, Varanasi during late Kharif and summer season in the year 2015–2016. The experimental field was ploughed with a cultivator, then leveled, harrowed, and planked to achieve a fine soil tilth. The weeds and trashes of various crops what so ever, were removed extensively to attain clean and leveled field and fine soil texture. A basal dose of 200 q ha⁻¹ of farmyard manure was supplied at the time of first ploughing in addition to application of fertilizers at the rate of 120 kg N, 80 kg P₂O₅ and 60 kg K₂O ha⁻¹ get optimum yield. An half amount of nitrogen, whole amount of phosphate and whole amount of P0tash were applied at the time of final ploughing in the form of chemical fertilizer. The remaining nitrogen in form of urea was applied in two split doses at 30 and 60 days after transplanting. The irrigations and other agricultural practices were done according to need of crops.

In both seasons, about 30 days old healthy seedlings produced in a nursery were transplanted in a 4.50 x 1.20 m raised bed with a spacing of 60 x 45 cm in a Randomized Block Design with three replications. To grow a healthy harvest, a standard set of good agricultural practices of tomato was used. During the cropping season, no insecticides were used to protect the whitefly Population, allowing for maximal tomato leaf curl virus (ToLCV) spread and severe disease occurrence.

Five plants from each plot were randomly tagged and observations recorded on days to first flowering, days to 50% flowering, number of leaves before truss, days to first ripening, number fruits/ plant, Average fruit weight, fruit yield/ plant, flesh thickness, TSS, texture and Lycopene content.. The data collected on different parameters during the course of investigation were subjected to statistical analysis as per method of analysis of variance [2]. The significance and non-significance of the

treatment effect were judged with the help of 'F' variance ratio test. Calculated 'F' value (variance ratio) was compared with the table value of 'F' at 5% level of significance. If calculated value exceeded the table value, the effect was considered to be significant.

3. RESULTS AND DISCUSSION

3.1 Traits Related to Earliness

There were significant differences among the genotypes for all the horticultural traits related to earliness viz., days to first flower, days to 50% flowering, Number of leaves before truss., and days to first ripening. The mean performance of both seasons for different quantitative traits related to earliness in Tomato for 14 lines along with their CD values is given in Table 1. The mean values of genotypes for days to first flower ranged from 28.00 (EC 538411) to 37.33 (H-88-78-2) and 24.67 (VRT-2103-1-4) to 42.00 (H-88-78-2) for season I and season II, respectively. With respect to days to 50% flowering, genotypes mean ranged from 33.67 (EC 538411) to 43.00 (H-88-78-2) during the first season whereas, in the second season genotypes mean ranged from 27.67 (VRT-2103-1-4) to 45.67 (H-88-78-2). The mean values of genotypes for number of leaves before truss ranged from 8.27 (EC 538411) to 13.13 (H-88-78-2) and 5.93 (Punjab Barkha Bahar- 2) to 11.80 (H-88-78-2) for season I and season II, respectively. For the days to first ripening, mean ranged from 78.0 (EC 538411) to 133.00 (H-88-78-2) days during the first season whereas in the second season genotypes mean ranged from 62 (EC 538411) to 84.67 (H-88-78-2). The genotype EC 538411 take minimum days to first flowering, fifty per cent flowering and first ripening where as the minimum leaves before truss showed in EC 538411 in late Kharif season (S1). Whereas, during the summer season the minimum days to

Table 1. List of tomato genotypes use in present investigation

S. No.	Name of genotypes	Silent features
1	VRT-2103-1-2	Advance breeding line
2	VRT-2103-1-4	Advance breeding line
3	VRT-2103-1-8	Advance breeding line
4	VRT-2103-3-6	Advance breeding line
5	VRT-2103-6-1	Advance breeding line
6	VRT-2102-13-3	Advance breeding line
7	EC 538411	Joint less flower
8	EC 538441	Joint less flower
9	Punjab Chhuhara	Leaf curl susceptible variety
10	Punjab Barkha Bahar- 1	TYLCV resistant variety at field condition
11	Punjab Barkha Bahar- 2	TYLCV resistant variety at field condition
12	D-2-2-3	Advance breeding line carrying
13	H-88-78-2	Tomato mutant carrying Ty-3 gene, with altered inflorescence and ripening
14	C-8-6-1	Advance breeding line carrying Ty-2 gene

Table 2. Mean performances of Genotypes for different quantitative and qualitative traits for yield in tomato

Genotype	Days to first flowering		Days to 50% flowering		No. of leaf before truss		Days to first ripening		No of fruits/plant		Fruits weight (g)		Yield/plant (kg)		Yield/plot (kg)		Flesh thickness (mm)		TSS (° Brix)		Texture (N)		Lycopene (mg/100 g fw)	
	S-I	S-II	S-I	S-II	S-I	S-II	S-I	S-II	S-I	S-II	S-I	S-II	S-I	S-II	S-I	S-II	S-I	S-II	S-I	S-II	S-I	S-II	S-I	S-II
VRT-2103-1-2	34.00	27.67	37.33	30.67	29.13	11.27	96.33	67.67	29.13	11.27	79.1	93.8	2.30	1.05	5.27	4.92	6.13	7.53	5.27	4.92	1.40	1.51	5.57	5.56
VRT-2103-1-4	31.33	24.67	37.33	27.67	31.53	15.41	96.00	65.67	31.53	15.41	81.1	67.7	2.56	1.04	5.37	5.90	5.93	6.68	5.37	5.90	1.47	1.45	5.53	5.70
VRT-2103-3-6	31.33	30.00	36.00	33.00	27.60	9.38	108.33	74.67	27.60	9.38	76.2	78.3	2.10	0.73	6.27	5.18	7.03	5.83	6.27	5.18	2.93	2.71	3.67	4.00
VRT-2103-6-1	30.33	26.00	36.33	30.00	30.60	15.76	93.33	67.67	30.60	15.76	85.3	66.6	2.61	1.05	5.63	5.55	5.03	7.46	5.63	5.55	2.03	1.43	4.33	4.24
VRT-2103-1-8	28.67	29.00	36.33	34.33	26.13	9.76	103.00	68.67	26.13	9.76	96.5	78.1	2.53	0.76	6.07	5.99	5.37	6.84	6.07	5.99	1.17	1.15	5.40	5.54
VRT-2102-13-2	29.33	27.00	35.67	30.67	24.37	15.04	88.67	65.67	24.37	15.04	105.8	80.3	2.58	1.21	6.07	5.73	5.93	5.71	6.07	5.73	1.13	1.23	3.20	3.07
EC 538441	28.00	28.33	33.67	32.33	25.73	25.76	78.00	62.00	25.73	25.76	59.8	39.4	1.54	1.02	4.37	4.65	7.37	6.65	4.37	4.65	1.03	1.38	3.00	3.02
EC 538411	36.33	25.00	41.33	28.00	30.43	30.99	94.33	66.67	30.43	30.99	50.7	31.8	1.54	0.99	6.07	4.87	7.30	7.49	6.07	4.87	1.90	1.74	6.50	6.02
Pb, Chhuhara	30.33	31.33	38.33	36.00	17.60	2.89	98.00	68.33	17.60	2.89	49.4	50.6	0.88	0.15	6.27	5.27	7.47	6.15	6.27	5.27	1.20	1.18	6.43	6.58
Pb, Barkha Bahar- 1	34.67	32.00	40.67	37.00	31.73	19.25	90.33	69.67	31.73	19.25	87.6	66.1	2.77	1.27	4.93	4.51	6.37	6.12	4.93	4.51	0.67	0.97	5.57	5.28
Pb, Barkha Bahar- 2	34.00	28.67	38.00	33.00	28.60	20.91	97.67	67.33	28.60	20.91	80.7	66.5	2.30	1.39	4.50	4.07	7.07	6.09	4.50	4.07	0.98	1.07	2.33	2.36
D-2-2-3	31.67	25.33	37.33	30.00	34.53	16.05	92.33	69.33	34.53	16.05	70.4	63.1	2.43	1.01	6.27	5.99	7.47	7.53	6.27	5.99	2.63	2.61	6.50	6.58
H-88-78-2	37.33	42.00	43.00	45.67	8.13	2.67	113.00	84.67	8.13	2.67	184.2	106.3	1.50	0.28	4.37	4.07	5.03	5.71	4.37	4.07	1.07	1.47	2.33	2.36
C-8-6-1	33.67	31.00	39.00	35.33	24.70	12.P	93.67	65.00	24.70	12.P	94.8	76.8	2.34	0.93	5.50	5.13	6.42	6.60	5.50	5.13	1.51	1.53	4.64	4.64
Maximum	28.00	24.67	33.67	27.67	34.53	30.99	78.00	62.00	34.53	30.99	184.2	106.3	2.77	1.39	6.27	5.99	7.47	7.53	6.27	5.99	2.93	2.71	6.50	6.58
Minimum	37.33	42.00	43.00	45.67	8.13	2.67	113.00	84.67	8.13	2.67	49.4	31.8	0.88	0.15	4.37	4.07	5.03	5.71	4.37	4.07	0.67	0.97	2.33	2.36
Mean	32.27	29.67	37.94	33.56	25.84	15.06	95.87	69.35	25.84	15.06	89.7	69.0	2.10	0.90	5.47	5.12	6.40	6.60	5.47	5.12	1.54	1.57	4.62	4.62
SE±	0.76	1.18	0.66	1.23	1.80	2.10	2.27	1.44	1.80	2.10	8.8	5.3	0.15	0.09	0.21	0.19	0.26	0.20	0.21	0.19	0.21	0.P	0.44	0.43
C D at 5%	1.64	2.54	1.43	2.66	3.88	4.54	4.90	3.11	3.88	4.54	18.9	11.3	0.32	0.20	0.45	0.41	0.56	0.43	0.45	0.41	0.45	0.34	0.95	0.93

S1-Late Kharif Season; S1-Summer Season

first and 50 percent flowering was exhibited by VRT-2103-1-4. The genotype Pb. Barkha Bahar-2 blooms on minimum number of leaves before truss. The minimum days to first ripening exhibited in EC 538411. Thus genotype EC 538411 was showed earliness than others and H-88-78-2 was late in all the traits related to earliness in both season. The result is conformity of the findings of Kumar et al., (2012), Raju et al., [3]; and Kumar et al., [4].

3.2 Traits Related to Yield

The mean performance of both seasons for yield and yield related traits in Tomato for 14 lines with their CD values is given in Tables 1 & 2. In the first season the mean values of genotypes for number of fruits per plant ranged from 8.13 (H-88-78-2) to 34.53 (D-2-2-3) In respect to ten fruit weight (g), mean ranged from 493.61 (Punjab Chhuhara) to 1842.0 (H-88-78-2). Whereas, in the second season genotypes mean ranged from 318.0 (P8) to 1063.17 (H-88-78-2) In the first season for yield per plant (kg), the genotypes mean differed from 0.88 (Punjab Chhuhara) to 2.77 (Punjab Barkha Bahar- 1) In the second season, genotypes mean ranged from 0.15 (Punjab Chhuhara) to 1.39 (Pb. Barkha Bahar-2). The minimum genotypes mean for yield per plot (kg) was recorded in Punjab Chhuhara (16.60, 2.84) whereas, the maximum was recorded in Punjab Barkha Bahar- 1 (49.73, 25.84) in the both season, respectively Cheema et al., [5]; Meena et al., [6]; Prajapati et al., (2015) and Kumar et al., [7] had also found the related trend of results.

3.3 Traits Related to Quality

The mean performance of both seasons for qualitative characters like flesh thickness (mm), TSS⁰ Brix, Texture and Lycopene (mg/100 g fw) in Tomato for 11 lines and 3 testers with their CD values is given in Table 2 respectively. The mean values of Genotypes for flesh thickness (mm) ranged from 4.37 (H-88-78-2) to 6.27 (VRT-2103-1-8) and 4.07 (H-88-78-2) to 05.99 (VRT-2103-6-1 and D-2-2-3) for season I and season II, respectively. With respect to TSS⁰ Brix, Genotypes mean ranged from 5.03 (H-88-78-2) to 7.47 (Punjab Chhuhara and D-2-2-3) during the first season whereas, in the second season it ranged from 5.71 (H-88-78-2) to 7.53 (D-2-2-3). For the fruit texture (N), the mean differed from 0.67 (Punjab Barkha Bahar- 1) to 2.93 (D-2-2-3) during the first season whereas in the second season genotypic mean ranged from 0.97

(Punjab Barkha Bahar- 2) to 2.71 (VRT-2103-1-8). The minimum mean for Lycopene (mg/100 g fw) was recorded in H-88-78-2 (2.33, 2.36) whereas, the maximum mean was recorded in D-2-2-3 (6.50, 6.58) in the both season, respectively. These results are in accordance with the findings of Raju et al., [3] Kumar et al., (2012). Bhattarai et al., [8] and Singh et al., [9-11].

4. CONCLUSION

The objective of this preliminary study was to examine the earliness, yield and quality traits of tomato genotypes. The minimum days to first ripening exhibited in EC 538411. Thus genotype EC 538411 was showed earliness than others and H-88-78-2 was late in all the traits related to earliness in both season. The highest yield per plot (kg.) was recorded in Punjab Barkha Bahar-1 (49.73, 25.84) in the both season, respectively. The mean values of Genotypes for flesh thickness (mm.) ranged from 4.37 (H-88-78-2) to 6.27 (VRT-2103-1-8) and 4.07 (H-88-78-2) to 05.99 (VRT-2103-6-1 and D-2-2-3) for season I and season II, With respect to TSS⁰ Brix, The maximum TSS⁰ Brix was recorded Genotypes D-2-2-3 (7.47 and 7.53) during the both season respectively. Thus, these genotypes may used for crossing program to develop hybrids in desirable traits.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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