

Variability Pattern in Agro-morphological Characters among Tomato (*Solanum lycopersicum* L.) Germplasm

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ABSTRACT

The investigation was carried out at Vegetable Research Farm, Department of Horticulture, SHUATS, Allahabad during 2013-14. The experiment was laid out in Randomized Block Design with three replications having 30 germplasm. The results from the present investigation revealed that maximum plant height was observed in germplasm 2012/TODVAR-01; minimum days to 50% flowering were recorded in germplasm EC-620533 (45.20 days); the per cent fruit set was maximum in 2012/TODVAR-02 (55.24%). The maximum fruit yield per plant was observed in germplasm 2011/TODVAR-01 (2600.29g). TSS of fruit varied between 2.460B (EC-620533) to 6.160B (2012/TODVAR-04). The ascorbic acid content of the fruit varied between 17.67mg (EC-620533) to 43.04 mg (2012/TODVAR-04).

Key words : Agro-morphological characters and tomato, Growth, quality, yield.

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) belonging to family solanaceae is one of the most important vegetable, widely grown throughout the world for supplying in the fresh market as well as for processing. In India, it is grown in an area of 8.65 lakh hectares with annual production of 165.26 lakh tones (IHD, 2011). They are the secondmost consumed vegetable after potato (FAOSTAT, 2007). Although tomatoes are commonly consumed fresh, over 80% of tomato consumption comes from processed products such as tomato juice, paste, puree, ketchup and sauce (Takeoka *et al.*, 2001). It's indicated the potential health benefits of a diet rich in tomatoes and tomato products (Mayeaux *et al.*, 2006). Tomato as a source of carotenoids and polyphenols targeted to cancer prevention and red colour of fruit due to lycopene (Marti *et al.*, 2016; Boileau *et al.*, 2003; Rao *et al.*, 1998).

MATERIALS AND METHODS

The investigation was conducted at Vegetable Research Farm, Department of Horticulture, SHIATS, Allahabad during 2012-13. The experimental materials comprised of thirty indigenous germplasm of tomato collected from IIVR, Varanasi and VRS, JAU, Junagadh. The name of the germplasm are 2011/TODVAR-01, 2011/TODVAR-03, 2011/TODVAR-05, 2011/TODVAR-06, 2012/TODVAR-01, 2012/TODVAR-02, 2012/TODVAR-03, 2012/TODVAR-04, 2012/TODVAR-5, 2012/TODVAR-6, 2012/TODVAR-7, 2012/TODVAR-8, EC 620438, EC 620452, EC 620514, EC 620533, EC 620545, EC 620598, F 3-1, 2012/JTL-08-06, 2012/JTL-08-07, 2012/JTL-08-14, 2012/JTL-08-35, 2012/ATL-01-19, 2012/ATL-08-21, 2012/ATL-08-81, 2012/JT-03, 2012/AT-03, ArkaAlok (C₁), H-86 (C₂). The experiment was laid out in a randomized block design with three replications. Seeds were sown in the nursery beds on September, 30 and transplanting was done on 1st November, 2012. All the recommended agronomic package of practices was followed. The observation were recorded on five randomly selected plants per replication for each germplasm on fifteen quantitative characters:

(i) plant height (cm), (ii) no. of branches/plant, (iii) no. of leaves/plant, (iv) days to 50% flowering, (v) no. of flower clusters/plant, (vi) no. of flowers/plant, (vii) no. of fruits/plant, (viii) fruit set %, (ix) fruit weight (g), (x) radial diameter of fruit (mm), (xi) polar diameter of fruit (mm), (xii) fruit yield/plant (g), (xiii) leaf curl incidence %, (xiv) TSS^B and (xv) ascorbic acid (mg/100g).

RESULTS AND DISCUSSION

The mean performances of thirty germplasm, standard error of mean and critical difference for ten characters have been presented in Table 1. The results from the present investigation revealed that the plant height ranged from 54.92cm to 152.64cm with mean of 77.29cm. The maximum plant height was observed in germplasm 2012/TODVAR-01 (152.64cm) followed by 2012/ATL-08-21 (141.25cm), whereas the minimum plant height was observed in germplasm 2011/TODVAR-05 (54.92cm). Number of branches per plant ranged from 8.26 to 16.46 with mean of 11.25. Germplasm 2012/TODVAR-01 produced significantly high number of branches per plant (16.46) followed by 2012/ATL-08-21 (15.26), whereas the minimum branches per plant were recorded in germplasm 2011/TODVAR-05 (8.26). Among the germplasm, maximum leaves per plant were found in germplasm 2012/TODVAR-01 (204.26) followed by 2012/ATL-08-21 (195.53), whereas the minimum leaves per plant were found in germplasm 2011/TODVAR-03 (132.86). The results from the present investigation revealed that germplasm EC-620533 was the earliest to flowering which took 45.20 days to 50% flowering followed by 2011/TODVAR-05 (48.06 days), whereas maximum days to 50% flowering were recorded in germplasm 2012/JTL-08-14 (74.60 days). The wide variation in growth parameters of all the genotype might be due to their genetic makeup, which indirectly govern the morphology of the plant that have direct impact on formation of floral buds. Since all the genotype were grown under the same climatic condition. These results are in conformity with the finding of (Basar, 1999), (Kumar and Subramanian, 2007), (Swaroop and Suryanarayana, 2005) and (Ahmed *et al.*, 2007).

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Table-1: - Mean performance of tomato genotypes for different characters:

S.N.	Characters Genotypes	Plant Height (cm) at 120 DAT	No. of Branches/ Plant at 120 DAT	No. of Leaves/ Plant at 120 DAT	Days to 50% flowering	No. of flower Clusters/ Plant	No. of Flowers/ Plant	Average No. of Fruits/Plant	Fruit Set (%)
1.	2011/TODVAR-01	68.36	11.73	173.66	55.46	15.86	76.13	40.80	53.58
2.	2011/TODVAR-03	58.49	9.33	132.86	56.26	17.20	86.53	28.80	33.28
3.	2011/TODVAR-05	54.92	8.26	163.66	48.06	16.26	85.06	29.13	34.24
4.	2011/TODVAR-06	97.21	10.13	178.53	50.73	17.53	84.93	31.00	36.50
5.	2012/TODVAR-01	152.64	16.46	204.26	58.33	16.53	69.86	35.13	50.28
6.	2012/TODVAR-02	56.40	8.46	151.40	61.13	13.20	73.60	40.66	55.24
7.	2012/TODVAR-03	76.58	11.46	157.73	52.20	19.13	105.46	26.33	24.96
8.	2012/TODVAR-04	63.01	13.33	155.06	60.53	16.86	71.33	34.80	48.78
9.	2012/TODVAR-05	62.72	10.60	159.93	69.13	16.53	81.46	37.53	46.06
10.	2012/TODVAR-06	59.30	9.46	156.26	59.13	18.06	103.13	54.46	52.80
11.	2012/TODVAR-07	63.66	9.06	141.40	66.06	16.80	79.26	37.33	47.09
12.	2012/TODVAR-08	64.89	13.53	150.66	62.60	17.93	72.73	35.93	49.40
13.	EC- 620438	67.92	10.33	139.46	65.13	12.33	69.93	34.40	49.18
14.	EC- 620452	79.38	10.73	155.13	59.20	12.13	72.66	36.20	49.81
15.	EC- 620514	91.33	11.53	162.73	71.33	15.80	74.33	34.86	46.90
16.	EC- 620533	64.24	9.80	151.46	45.20	13.06	74.13	30.13	40.64
17.	EC- 620545	107.78	14.13	185.93	48.20	14.86	84.40	30.60	36.25
18.	EC- 620598	88.42	13.26	172.53	70.80	14.66	81.26	29.60	36.42
19.	F- 3-1	84.28	9.80	180.46	68.33	12.60	72.00	35.33	49.08
20.	2012/JTL- 08-06	69.02	12.13	177.26	73.26	17.80	70.20	34.40	48.99
21.	2012/JTL- 08-07	64.78	10.26	170.93	72.66	16.73	81.06	41.00	50.57
22.	2012/JTL- 08-14	66.29	10.93	157.20	74.60	17.06	102.33	27.33	26.70
23.	2012/JTL- 08-35	60.38	9.86	162.66	71.46	14.46	82.26	41.46	50.37
24.	2012/ATL- 01-19	97.06	13.06	183.66	65.73	13.86	80.80	30.46	37.70
25.	2012/ATL- 08-21	141.25	15.26	195.53	57.46	12.06	72.06	35.80	49.67
26.	2012/ATL- 08-81	91.70	12.80	180.66	64.53	13.60	75.06	36.06	48.04
27.	2012/JT-03	59.49	8.93	137.33	66.40	16.73	78.93	38.46	48.73
28.	2012/AT-03	62.56	10.13	138.60	51.33	15.33	74.93	31.66	42.25
29.	ArkaAlok (C1)	64.52	10.06	145.26	58.46	16.00	77.06	31.73	41.17
30.	H-86 (C2)	80.18	12.73	158.26	61.60	15.00	75.33	32.53	43.18
	Grand Mean	77.29	11.25	162.68	61.51	15.53	79.61	34.80	44.26
	F-test	S	S	S	S	S	S	S	S
	S.E. (+)	0.43	0.23	0.26	0.25	0.32	0.33	0.38	0.52
	C.D. at 5%	1.22	0.66	0.76	0.73	0.91	0.95	1.09	1.49
	Range Minimum	54.92	8.26	132.86	45.20	12.06	69.86	26.33	24.96
	Range Maximum	152.64	16.46	204.26	74.60	19.13	105.46	54.46	55.2433

Among the germplasm, number of flower clusters per plant ranged from 12.06 to 19.13 with mean of 15.53. The maximum flower clusters per plant were observed in germplasm 2012/TODVAR-03 (19.13) followed by 2012/TODVAR-06 (18.06), whereas the minimum flower clusters per plant were observed in germplasm 2012/ATL-08-21 (12.06). Number of flowers per plant ranged from 69.86 to 105.46 with mean of 79.61. The maximum flowers per plant were recorded in germplasm 2012/TODVAR-03 (105.46) followed by 2012/TODVAR-06 (103.13), whereas the minimum flowers per plant were recorded in germplasm 2012/TODVAR-01 (69.86). Like other yield and growth parameters significant variations were observed in the number of fruits per plant among the tomato germplasm (Table 1). The number of fruits per plant ranged from

26.33 to 54.46 with mean of 34.80 and maximum fruits per plant were observed in germplasm 2012/TODVAR-06 (54.46) followed by 2012/JTL-08-35 (41.46), whereas the minimum fruits per plant were observed in germplasm 2012/TODVAR-03 (26.33). The maximum fruit set per cent was recorded in germplasm 2012/TODVAR-02 (55.24%) followed by 2011/TODVAR-01 (53.58%), whereas the minimum fruit set per cent was recorded in germplasm 2012/TODVAR-03 (24.96%).

The results from the present investigation revealed that fruit weight (g) ranged from 32.70g to 66.30g with mean of 50.51g and maximum fruit weight was recorded in variety H-86(C₂) (66.30g) followed by EC-620598 (64.20g), whereas the minimum fruit weight was recorded in genotype 2012/JTL-08-06 (32.70g). Radial

diameter of fruit (mm) ranged from 42.63mm to 64.47mm with mean of 49.19mm. The maximum radial diameter of fruit was recorded in germplasm H-86(C₂) (64.47mm) followed by 2012/TODVAR-03 (58.51mm), whereas the minimum radial diameter of fruit was recorded in germplasm F-3-1 (42.63mm).

Polar diameter of fruit (mm) ranged from 36.95mm to 60.97mm with mean of 45.97mm. The maximum polar diameter of fruit was recorded in germplasm 2012/TODVAR-07 (60.97mm) followed by 2011/TODVAR-01 (59.38mm), whereas the minimum polar diameter of fruit was recorded in germplasm 2012/ATL-08-21 (36.95mm). Fruit yield per plant data in the *Table 1* indicate significant variations among the germplasm. In this study, fruit yield per plant (g) ranged from 1124.48g to 2600.29g with mean of 1734.58g. The maximum fruit yield per plant were observed in germplasm 2011/TODVAR-01 (2600.29g) followed by germplasm H-86(C₂) (2156.92g) which is attributed to comparatively higher average fruit weight, whereas the minimum fruit yield per plant were

recorded in germplasm 2012/JTL-08-06 (1124.48g) which is attributed to comparatively lesser average fruit weight. Leaf curl incidence per cent ranged from 11.79% to 55.18% with mean of 34.91%. The minimum leaf curl incidence per cent were observed in germplasm EC-620514 (11.79%) followed by 2011/TODVAR-01 (13.12%), whereas the maximum leaf curl incidence per cent were observed in germplasm 2012/TODVAR-01 (55.18%). The higher yield might be due to corresponding response to increased yield attributing characters attained previously under this genotype. These results are in conformity with the finding of (Swaroop and Suryanarayana, 2005), (Ahmed *et al.*, 2007), (Doreswamy *et al.*, 2011), (Dar and Sharma, 2011) and (Narolia *et al.*, 2012).

Quality parameters in tomato emphasizes on attributes for fresh market and processing. The tomatoes developed for fresh market and processing should have distinct quality characteristics. For processing and fresh market consumption, fruits should be firm, well coloured with acceptable flavour. For shipment, fruits should

Fruit Weight (g)	Radial Diameter of fruit (mm)	Polar Diameter of Fruit (mm)	Fruit Yield/Plant (g)	Leaf Curl Incidence (%)	TSS (° Brix)	Ascorbic Acid (mg/100g)
63.73	48.47	59.38	2600.29	13.12	5.16	37.89
60.53	54.40	47.60	1743.29	24.78	4.63	28.98
51.60	52.46	52.82	1503.02	33.68	2.73	18.54
53.96	48.93	49.82	1672.89	28.19	5.63	41.95
34.43	51.58	38.56	1209.81	55.18	3.26	29.85
37.80	42.94	41.00	1537.43	18.97	5.43	38.03
58.03	58.51	49.41	1528.21	23.11	3.16	21.44
37.36	47.68	39.38	1300.24	51.20	6.16	43.04
50.40	46.70	44.20	1891.43	30.25	2.83	19.41
33.03	45.95	43.14	1799.18	39.24	4.86	34.19
52.23	44.23	60.97	1950.08	22.57	2.63	17.89
53.06	52.30	50.67	1906.76	32.03	3.13	24.99
51.96	48.06	42.01	1787.62	38.23	5.13	37.17
54.93	49.73	54.07	1988.62	46.87	4.83	26.44
60.50	49.17	57.26	2109.56	11.79	4.73	33.40
54.20	50.01	49.51	1633.12	39.87	2.46	17.67
50.60	45.66	46.56	1548.06	49.19	3.76	28.54
64.20	46.89	44.57	1900.53	46.01	3.16	22.60
54.86	42.63	44.53	1938.57	26.22	4.73	22.16
32.70	42.86	46.28	1124.48	42.45	4.33	31.95
39.90	46.98	40.03	1635.72	25.30	3.36	27.53
58.20	55.88	41.27	1590.76	50.46	4.66	24.12
49.90	46.62	39.28	2069.13	18.23	3.56	29.85
51.13	50.26	43.46	1557.53	27.43	5.46	39.20
42.46	47.00	36.95	1520.22	53.95	5.53	40.71
49.63	42.93	42.92	1790.10	37.48	3.03	20.79
53.80	55.72	37.97	2069.56	29.70	5.03	36.44
42.63	46.89	44.72	1349.66	37.46	4.90	35.43
51.20	49.87	39.99	1624.58	48.64	3.83	29.77
66.30	64.47	50.81	2156.92	45.65	3.46	30.07
50.51	49.19	45.97	1734.58	34.91	4.19	29.67
S	S	S	S	S	S	S
0.32	0.29	0.30	19.04	0.16	0.07	0.20
0.90	0.83	0.86	53.92	0.47	0.21	0.59
32.70	42.63	36.95	1124.48	11.79	2.46	17.67
66.30	64.47	60.97	2600.29	55.18	6.16	43.04

be smooth and firm enough to withstand transportation. High total soluble solids (TSS) and low acidity are the major factors considered for manufacture of processed products. One per cent increase in TSS content of fruits results in 20 per cent increase in recovery of processed product (Berry *et al.*, 1988). Lower acidity is the most deciding factor for processing of tomatoes as it reduces heating time required for processing. From the present investigation TSS °Brix ranged from 2.46°B to 6.16°B with mean of 4.19°B. The maximum TSS °Brix was observed in germplasm 2012/TODVAR-04 (6.16°B) followed by 2011/TODVAR-06 (5.63°B), whereas the minimum TSS °Brix was observed in germplasm EC-620533 (2.46°B). Earlier, (Sharma *et al.*, 1996) reported the TSS (°B) range of 4.0 to 6.0 °B, respectively. In the present study, TSS ranged from 2.46°B to 6.16°B. High value of TSS is desirable for fresh market and also for processing because it is related to the yield of processed products. In this study, ascorbic acid (mg/100g) ranged from 17.67mg to 43.04mg with mean of 29.67mg. The maximum ascorbic acid was observed in germplasm 2012/TODVAR-04 (43.04mg) followed by 2011/TODVAR-06 (41.95mg), whereas the minimum ascorbic acid was observed in germplasm EC-620533 (17.67mg). The difference among the genotypes in regard to vitamin C and total soluble solids content of fruits might be due to the genetic constitution of the genotypes. These results are in conformity with the finding of (Swaroop and Suryanarayana, 2005) and (Ahmed *et al.*, 2007), (Shashikanth *et al.*, 2010) and (Manna & Paul, 2012).

CONCLUSION

Overall analysis of yield and quality parameters revealed that genotype 2011/TODVAR-01 was suitable for higher yield whereas, 2012/TODVAR-04 and 2011/TODVAR-06 were suitable for processing.

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