

Yield and Yield Contributing Performance of 75 Tomato Germplasm in Bangladesh

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Abstract

The study was conducted with 75 tomato germplasm/lines at the farm of Olericulture Division, Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute, Gazipur, Bangladesh during the winter season of 2020-21 to evaluate the WorldVeg tomato germplasm. The days to first harvest were varied from 106 to 116 days while twelve lines were harvested within 106 - 108 days. The number of fruits per plant varied from 11.7 to 71.3, while the range of single fruit weight was 16.4 - 186.6 g. Fruit yield per hectare was 15.7 - 150.4 t/ha where the highest fruit yield per hectare was obtained from the lines AVTO 1702 (150.40 t/ha), followed by AVTO 1409 (126.54 t/ha), AVTO 1010 (120.60 t/ha), AVTO 1712 (111.33 t/ha), AVTO 1711 (107.23 t/ha). The range of fruit length was observed 2.07 to 6.8 cm, while the fruit diameter was 1.9 to 7.4 cm. The range of pericarp thickness was 0.14 to 0.8 cm, while the range of number of locule was 2.0 to 8.2. The range of TSS level was 2.0% - 8.2%, while the shelf life of the tomato lines was recorded 5.2 to 10.3 days. Considering earliness, quantitative and qualitative characters, eleven WorldVeg Center tomato lines AVTO 1010, AVTO 1315, AVTO 1409, AVTO 1711, AVTO 1712, AVTO 1713, AVTO 1717, AVTO 1907, AVTO 1911, AVTO 1915 and AVTO 1921 were found promising. So, these eleven lines can be selected for further confirmation.

Keywords

Yield, Flower, Fruit Characters, Performance, Tomato Germplasm, Bangladesh

1. Introduction

Tomato (*Solanum lycopersicum*) is one of the most important vegetables of Bangladesh and the world wide, too. It is the second most important world consumable vegetable after potato, ranks first among the processing crops [1] and

belongs to Solanaceae family [2]. It is rich in a plethora of natural antioxidants and bioactive compounds. The regular ingestion of an adequate amount of fresh tomatoes or processed tomato products has been inversely correlated with the development of widespread human diseases [3] [4] [5] and with an increase in plasma lipid peroxidation levels [6] [7]. This protective effect has been mainly attributed to the carotenoid constituents of the fruits, particularly lycopene and β -carotene which act as antioxidants in detoxifying free radicals [4] [8] [9] [10]. [11] reported that both fresh and processing tomatoes constitute significant amounts within produced vegetable crops. In addition to the large production values, the tomato is an important source of antioxidant intake. The essential phytonutrients found in the tomato fruit are lycopene, β -carotene, α -tocopherol, polyphenols and ascorbic acid, and antioxidant activity depends on cultivar, environmental parameters, method of production and processing. The ripe tomatoes have important outside quality characteristics: uniform size, red colour and good aroma and texture but these external qualities are not reflecting perfectly the nutritional content.

However, Bangladesh Agricultural Research Institute (BARI) has released 21 open-pollinated (OP) and 11 hybrid tomato varieties so far. Several leading seed companies are also supplying some more tomato varieties and seeds which are being imported from different countries. Though the BARI released varieties are higher yielder, some varieties are prone to several pests and diseases. Beside this growers' demand is good quality summer hybrid varieties. So, growers are interested to get good quality pest and diseases resistant winter and summer tomato varieties having good shelf life. In this context, BARI needs to develop quality tomato varieties having good keeping quality along with higher yield. In 2020, The World Vegetable Centre has supplied 43 tomato advanced lines in two installments. Therefore, an experiment was under taken for assessing horticultural traits and yield potentiality along with local germplasm and varieties in Bangladesh condition to select suitable tomato lines for developing good quality pest and diseases resistant winter and summer tomato varieties having good shelf life.

2. Materials and Methods

2.1. Experimental Site

The experiment was conducted at the Olericulture Division of Horticulture Research Centre, Bangladesh Agricultural Research Institute (BARI) during 2020-21. The experimental field was at 23.9920°N Latitude and 90.4125°E Longitudes having an elevation of 8.2 m from sea level under agro-ecological zone (AEZ) 28. The average minimum and maximum temperature were 18.0°C and 29.0°C and the average relative humidity was 58.2%. The soil of the experimental field was sandy clay loam in texture having a pH range around 6.0.

Air temperatures and relative humidity of the experimental area

Average monthly minimum air temperatures, maximum air temperatures and

average relative humidity during the season are shown in **Table 1**.

2.2. Plant Materials

Seventy-five tomato germplasm/varieties (WorldVeg Center: 41 nos., BARI varieties: 10 nos., local germplasm 17 nos., exotic germplasm 7 nos.) were included in the study (**Table 2**). The seeds were sown on the seedbed on 01 October 2020. Thirty-two days old seedlings were transplanted in the main field on 01 November, 2020.

2.3. Experimental Design and Layout

The experiment was laid out in a RCB design with three replications. The plot

Table 1. Average monthly minimum temperature (°C), maximum temperature (°C) and relative humidity (%) recorded during winter season.

Parameter	Oct. 2020	Nov. 2020	Dec. 2020	Jan. 2021	Feb. 2021	Mar. 2021	Mean
Monthly minimum air temperature (°C)	24	19	14	16	15	20	18.0
Monthly maximum air temperature (°C)	31	29	26	28	28	32	29.0
Monthly mean relative humidity (%)	72	66	63	54	49	45	58.2

Table 2. Seventy-five tomato germplasm/varieties.

WorldVeg Center germplasm			BARI varieties	Local germplasm	Exotic germplasm
AVTO 0301	AVTO 1706	AVTO 1911	BARI Tomato-2	SLA 011	SLA 004
AVTO 1003	AVTO 1707	AVTO 1913	BARI Tomato-11	SLA 012	SLA 005
AVTO 1008	AVTO 1711	AVTO 1914	BARI Tomato-14	SLA 013	SLA 006
AVTO 1010	AVTO 1712	AVTO 1915	BARI Tomato-15	SLA 014	SLA 007
AVTO 1219	AVTO 1713	AVTO 1919	BARI Tomato-16	SLA 015-1	SLA 008
AVTO 1288	AVTO 1715	AVTO 1921	BARI Tomato-17	SLA 015-2	SLA 009
AVTO 1306	AVTO 1716	AVTO 1954	BARI Tomato-18	SLA 015-3	SLA 010
AVTO 1314	AVTO 1717		BARI Tomato-19	SLA 018	
AVTO 1315	AVTO 1718		BARI Tomato 20	SLA 025-1	
AVTO 1409	AVTO 1719		BARI Tomato 21	SLA 025-2	
AVTO 1424	AVTO 1720			SLA 025-3	
AVTO 1429	AVTO 1828			SLA 025-4	
AVTO 1464	AVTO 1829			SLA 025-5	
AVTO 1616	AVTO 1903			SLA 025-6	
AVTO 1619	AVTO 1907			SLA 025-7	
AVTO 1702	AVTO 1909			FOBHT8	
AVTO 1705	AVTO 1910			MOBHT8	
	41		10	17	7

size was 5.0×1.0 m where 20 plants were planted with space of 60×50 cm in two rows.

2.4. Land Fertilization

The experimental area was enriched with organic fertilizer, Nitrogen, Phosphorus, Potassium, Sulphur, Zinc and Boron @ 3,000, 250, 90, 125, 20, 3 and 2 kg/ha, correspondingly. One third of the organic fertilizer, 50% of Phosphorus and full of Sulphur, Zinc and Boron were incorporated for the period of last land-dwelling preparation. Rest of organic fertilizer and Phosphorus and 1/3 of Potassium were applied as basal in pit. Entire quantity of Nitrogen and rest of Potassium were applied in four equal portions beginning from 20 days after transplanting. Rest three portions were fertilized at 20, 40 and 60 days after transplanting.

2.5. Data Recorded

Data on yield and yield attributing parameters with qualitative traits were recorded from 20 inner plants of each plot escaping border plants following WorldVeg guideline. Tomato fruits were started harvesting at breaker stage from 20 inner plant of each treatment. Four to six harvesting was done according to the different germplasm characters and data on days to first harvest, number of flower cluster per plant, number of fruit per cluster, number of fruit per plant, single fruit weight (g), fruit yield per plant (kg), fruit yield (t/ha), fruit length (cm), fruit diameter (cm), pericarp thickness (cm), TSS (%), shelf life, number of locule, number of leaflet, number of compound leaflet, leaf length (cm), leaf diameter (cm), plant height (cm), branches/plant, fruit size, fruit shape, plant growth nature, cluster nature of fruit, type of fruit.

2.6. Statistical Analysis

The recorded quantitative data were analyzed statistically and treatments means were compared by Least Significant Difference (LSD) test following R Software 3.1.2 [12].

3. Results and Discussion

The tomato germplasm/varieties differed significantly in all parameters studied and the results have been shown in **Table 3** and **Table 4**. The findings of different parameters revealed that days to first harvest was varied from 106 to 116 days which indicated the variation among the 75 tomato lines in the harvest days. Twelve lines viz., AVTO 1010, AVTO 1315, AVTO 1409, AVTO 1711, AVTO 1712, AVTO 1713, AVTO 1907, AVTO 1911, AVTO 1915, AVTO 1921, AVTO 1954, SLA 025-7 harvested within 106 - 108 days that indicated earliness of the lines. It may be due to the genetic variations among the lines. Number of flower clusters per plant was significantly varied from 11 - 21, while number of fruits per cluster counted 3.5 - 9.0. In respect of number of fruits per plant varied

Table 3. The harvest, flower and fruit characters of 75 tomato lines.

Line	Days to first harvest	No. of flower cluster per plant	No. of fruit per cluster	No. of fruit per plant	Single fruit weight (g)	Fruit yield per plant (kg)	Fruit yield (t/ha)	Fruit length (cm)	Fruit diameter (cm)	Pericarp thickness (cm)	No. of locule
AVTO 0301	112	19	4.2	30.0	60.0	1.79	59.15	4.5	4.4	0.4	4.4
AVTO 1003	110	15	5.7	23.3	65.0	1.51	49.76	5.5	4.0	0.6	2.6
AVTO 1008	113	16	7.2	35.7	75.2	2.68	88.43	5.1	4.5	0.5	3.0
AVTO 1010	106	15	7.0	41.7	88.0	3.65	120.60	5.7	5.9	0.6	3.0
AVTO 1219	112	15	4.3	26.7	62.3	1.67	55.22	6.3	4.6	0.7	4.8
AVTO 1288	112	14	6.0	14.7	96.6	1.41	46.56	6.2	5.3	0.6	5.5
AVTO 1306	110	13	8.6	24.0	74.3	1.78	58.69	4.8	3.6	0.8	5.5
AVTO 1314	114	14	6.4	24.3	80.0	1.92	63.46	4.9	5.2	0.3	4.7
AVTO 1315	108	20	4.1	34.8	74.0	2.57	84.70	4.9	4.2	0.6	2.2
AVTO 1409	108	17	5.1	44.0	87.3	3.83	126.54	5.3	5.0	0.4	3.4
AVTO 1424	110	14	7.0	33.7	63.7	2.14	70.48	5.1	4.6	0.6	3.0
AVTO 1429	111	14	4.9	23.0	105.0	2.41	79.41	4.7	6.8	0.5	4.4
AVTO 1464	113	18	5.4	21.3	102.0	2.18	71.85	5.1	5.4	0.6	6.1
AVTO 1616	113	17	5.1	15.3	82.6	1.26	41.67	5.0	4.9	0.6	3.3
AVTO 1619	111	11	5.4	25.3	81.6	2.07	68.34	6.0	5.2	0.5	2.4
AVTO 1702	111	16	7.6	27.3	186.6	4.56	150.40	5.6	5.4	0.8	2.4
AVTO 1705	113	15	5.0	24.3	74.7	1.82	59.95	4.5	4.3	0.4	3.0
AVTO 1706	114	14	4.2	21.0	24.6	0.51	16.89	4.9	4.5	0.6	3.0
AVTO 1707	112	14	6.8	19.7	74.4	1.46	48.09	5.2	4.9	0.6	3.0
AVTO 1711	107	17	4.7	34.7	93.7	3.25	107.23	6.2	6.7	0.6	4.8
AVTO 1712	107	21	5.9	43.3	78.7	3.37	111.33	5.6	5.6	0.6	6.4
AVTO 1713	108	13	8.0	30.7	87.0	2.65	87.40	6.7	5.8	0.5	4.9
AVTO 1715	109	15	6.2	24.0	93.0	2.23	73.64	5.6	6.5	0.6	6.8
AVTO 1716	112	12	5.2	34.7	70.7	2.45	80.79	4.2	5.7	0.5	2.0
AVTO 1717	109	16	5.3	36.0	83.7	3.00	98.91	5.7	6.3	0.6	5.5
AVTO 1718	111	13	5.5	32.7	80.0	2.61	86.16	5.2	5.3	0.6	4.7
AVTO 1719	113	14	5.8	26.3	86.4	2.27	75.06	5.2	6.6	0.6	5.2
AVTO 1720	111	16	3.5	24.7	85.0	2.09	69.10	5.2	6.4	0.7	5.1
AVTO 1828	112	18	6.4	54.7	22.0	1.21	39.92	4.5	4.2	0.3	3.3
AVTO 1829	111	14	6.2	55.2	25.0	1.38	45.39	4.8	3.8	0.4	3.0
AVTO 1903	114	15	5.7	31.0	74.4	2.30	76.01	5.3	5.5	0.6	3.4
AVTO 1907	108	16	7.0	36.7	80.7	2.95	97.38	5.1	5.4	0.7	3.3

Continued

AVTO 1909	111	15	7.0	31.0	91.4	2.83	93.27	5.9	4.8	0.4	3.0
AVTO 1910	113	11	9.0	11.7	95.4	1.11	36.62	5.0	5.2	0.7	3.3
AVTO 1911	108	14	5.6	30.0	87.3	2.60	85.90	5.7	6.5	0.7	8.2
AVTO 1913	111	15	8.0	28.3	71.3	2.01	66.31	5.7	3.6	0.7	3.0
AVTO 1914	115	15	6.9	42.0	54.0	2.26	74.73	5.1	4.8	0.4	3.3
AVTO 1915	108	15	6.0	32.7	85.1	2.77	91.30	5.6	4.9	0.5	2.8
AVTO 1919	113	12	5.8	24.7	98.4	2.42	80.01	5.0	5.9	0.4	2.6
AVTO 1921	108	14	5.9	32.3	88.0	2.85	94.12	5.7	6.5	0.4	5.4
AVTO 1954	107	13	5.9	28.0	90.0	2.52	83.04	5.5	5.9	0.7	2.2
SLA 004	109	14	4.8	49.3	19.0	0.94	30.89	2.3	2.6	0.6	2.4
SLA 005	109	16	5.4	55.0	20.4	1.12	36.90	2.6	2.8	0.2	2.0
SLA 006	112	18	6.2	48.3	23.0	1.11	36.55	2.7	2.9	0.3	2.0
SLA 007	110	14	7.0	25.7	23.0	0.59	19.44	5.5	5.3	0.1	3.3
SLA 008	112	12	8.8	19.0	25.3	0.48	15.74	2.7	2.9	0.3	2.4
SLA 009	114	11	5.1	22.0	50.6	1.11	36.69	3.9	4.5	0.2	4.2
SLA 010	113	16	7.0	13.0	126.7	1.58	52.01	4.7	5.7	0.5	4.2
SLA 011	114	15	5.0	57.7	17.4	1.01	33.19	3.3	2.4	0.3	3.0
SLA 012	109	15	6.3	52.3	17.3	0.91	30.18	2.1	2.1	0.2	2.4
SLA 013	110	15	5.7	71.3	16.4	1.18	38.88	2.6	3.2	0.2	3.3
SLA 014	111	13	5.9	15.7	64.4	1.01	33.18	4.7	5.2	0.5	4.2
SLA 015-1	109	13	5.7	24.7	40.7	1.00	33.01	4.8	5.5	0.3	3.8
SLA 015-2	114	14	6.3	32.3	44.0	1.42	46.93	6.8	3.2	0.2	3.3
SLA 015-3	109	15	7.0	22.0	43.4	0.95	31.34	3.5	4.3	0.3	3.8
SLA 018	113	14	4.7	17.3	60.4	1.04	34.46	5.3	3.7	0.2	3.8
SLA 025-1	110	12	6.2	32.3	35.0	1.13	37.30	3.3	3.2	0.3	3.4
SLA 025-2	109	15	6.1	38.0	32.4	1.23	40.46	5.1	3.2	0.3	3.5
SLA 025-3	115	17	5.2	26.0	40.0	1.04	34.20	3.4	4.6	0.3	3.5
SLA 025-4	114	14	6.4	24.0	29.4	0.71	23.40	3.0	3.4	0.3	3.4
SLA 025-5	116	12	5.7	22.0	37.0	0.82	26.96	3.3	3.2	0.3	3.6
SLA 025-6	113	11	5.5	33.0	45.0	1.48	48.89	4.7	3.2	0.3	3.4
SLA 025-7	108	15	5.7	34.7	48.0	1.66	54.83	4.8	3.3	0.3	3.6
FOBHT8	111	12	5.8	34.3	62.4	2.14	70.66	5.3	5.1	0.4	3.1
MOBHT8	113	13	4.6	35.7	65.3	2.33	76.98	4.9	5.0	0.4	3.0
BARI Tomato-2	112	13	5.5	32.7	82.4	2.69	88.90	5.4	5.1	0.3	3.1
BARI Tomato-11	114	15	5.3	52.7	22.0	1.16	38.36	2.3	1.9	0.3	2.4

Continued

BARI Tomato-14	111	12	4.2	31.0	89.0	2.76	90.93	5.0	5.6	0.5	3.8
BARI Tomato-15	109	15	6.1	27.7	91.7	2.53	83.58	5.3	5.6	0.6	3.8
BARI Tomato-16	110	15	5.6	31.7	78.0	2.47	81.43	4.8	4.5	0.5	2.4
BARI Tomato-17	114	17	5.3	14.7	158.0	2.31	76.38	5.4	7.4	0.5	4.2
BARI Tomato-18	109	13	6.9	32.3	79.2	2.56	84.46	5.2	5.1	0.4	2.5
BARI Tomato-19	109	17	6.2	31.7	75.0	2.37	78.29	4.5	5.3	0.6	3.2
BARI Tomato 20	109	12	5.2	46.0	25.4	1.16	38.34	3.3	3.0	0.3	2.3
BARI Tomato 21	111	17	4.4	31.7	77.0	2.44	80.38	5.5	5.2	0.4	3.0
Range	106 - 116	11 - 21	3.5 - 9.0	11.7 - 71.3	16.4 - 186.6	0.47 - 4.6	15.7 - 150.4	2.07 - 6.8	1.85 - 7.4	0.14 - 0.8	2.0 - 8.2
Mean	111	15	5.9	31.6	67.2	1.9	63.7	4.8	4.7	0.5	3.6

Table 4. Leaf, plant height, branches, TSS and shelf life characters of 75 tomato lines.

Line	Number of leaflets	Number of compound leaflet	Leaf length (cm)	Leaf diameter (cm)	Plant height at last harvest (cm)	Branches/plant	TSS (%)	Shelf life
AVTO 0301	5.0	4.0	22.9	15.2	132	7.4	3.2	5.2
AVTO 1003	7.0	2.5	24.9	24.9	177	5.5	3.0	8.2
AVTO 1008	4.3	5.9	27.3	26.9	177	8.2	2.8	9.2
AVTO 1010	6.1	6.5	15.9	28.9	167	5.6	3.4	8.2
AVTO 1219	6.5	4.9	7.3	4.4	132	7.5	4.0	5.2
AVTO 1288	8.5	5.8	12.2	12.6	118	9.8	5.4	6.2
AVTO 1306	13.5	4.5	11.9	7.9	102	7.6	4.3	6.2
AVTO 1314	6.6	3.8	12.7	6.4	151	6.8	4.5	6.2
AVTO 1315	10.5	6.0	12.2	10.6	159	7.0	4.6	8.2
AVTO 1409	8.6	4.9	12.4	8.9	148	8.8	3.5	8.2
AVTO 1424	4.6	7.0	29.9	26.4	15	5.6	2.2	5.3
AVTO 1429	8.0	4.4	11.2	7.2	258	7.9	5.4	6.0
AVTO 1464	4.5	4.0	9.7	8.2	177	12.0	5.0	6.3
AVTO 1616	4.9	6.4	24.9	16.0	130	9.7	3.4	5.3
AVTO 1619	4.6	6.6	27.8	26.4	132	6.8	3.0	8.3
AVTO 1702	9.5	4.0	8.1	6.7	150	10.0	4.7	7.0
AVTO 1705	4.3	6.4	26.7	26.9	132	7.1	2.8	6.2
AVTO 1706	8.0	4.3	9.4	7.2	116	8.9	4.4	6.0
AVTO 1707	7.0	6.0	26.6	24.4	140	8.8	5.3	5.3
AVTO 1711	8.7	4.0	10.2	7.4	120	9.0	0.6	8.0

Continued

AVTO 1712	9.5	4.0	10.2	7.4	121	10.2	4.4	8.3
AVTO 1713	6.0	7.0	28.7	26.9	155	6.6	2.2	7.3
AVTO 1715	4.3	5.8	29.5	31.4	146	6.8	2.0	8.2
AVTO 1716	3.0	6.8	25.3	22.3	150	9.1	3.0	7.3
AVTO 1717	10.1	4.0	12.9	10.9	135	8.3	3.0	9.2
AVTO 1718	4.6	10.0	13.9	10.4	131	6.0	4.4	8.0
AVTO 1719	4.3	6.2	23.6	22.3	132	6.8	2.4	8.2
AVTO 1720	3.6	6.8	26.9	21.5	128	6.8	4.3	7.3
AVTO 1828	4.0	5.8	26.5	25.3	238	17.6	3.8	7.3
AVTO 1829	4.3	6.5	24.3	22.3	140	8.3	4.4	6.2
AVTO 1903	4.0	6.8	29.3	25.3	151	8.3	3.6	9.2
AVTO 1907	10.4	5.0	33.4	27.9	127	8.8	2.5	8.2
AVTO 1909	9.0	4.0	26.9	22.2	114	7.6	2.7	9.2
AVTO 1910	5.1	6.8	24.3	18.4	116	6.6	2.5	6.2
AVTO 1911	5.9	4.0	23.9	15.3	407	9.8	4.0	8.2
AVTO 1913	6.6	4.1	24.8	24.9	238	9.5	4.4	6.2
AVTO 1914	7.5	9.5	7.4	8.9	121	10.9	3.5	6.3
AVTO 1915	3.6	5.0	17.4	20.9	155	6.2	4.0	10.3
AVTO 1919	5.6	7.0	28.3	25.3	128	6.8	3.0	7.2
AVTO 1921	8.2	3.0	10.2	7.4	135	5.4	2.5	7.2
AVTO 1954	4.3	6.4	29.5	26.9	149	6.9	3.0	7.2
SLA 004	4.0	6.3	32.4	24.6	134	8.7	4.2	6.2
SLA 005	4.3	6.6	25.9	25.3	233	6.7	5.2	5.2
SLA 006	9.1	3.9	10.2	7.4	244	7.1	4.6	5.2
SLA 007	5.6	7.0	29.6	23.9	134	9.7	2.9	7.2
SLA 008	4.0	6.3	26.8	28.3	229	7.8	4.7	6.2
SLA 009	3.3	6.8	27.9	21.5	67	15.0	2.2	7.2
SLA 010	5.3	5.3	23.6	15.2	170	10.2	3.4	6.2
SLA 011	7.0	4.3	27.3	24.9	261	6.7	5.2	7.2
SLA 012	4.3	6.5	25.9	21.2	106	7.1	5.0	6.2
SLA 013	4.3	6.5	29.5	31.4	176	9.6	3.8	7.2
SLA 014	3.0	6.6	26.3	22.3	186	7.3	3.5	6.2
SLA 015-1	5.4	4.0	21.9	14.9	181	5.5	2.8	5.2
SLA 015-2	4.0	3.3	24.6	15.3	169	5.2	2.9	10.2
SLA 015-3	4.8	4.0	21.6	18.0	174	6.2	2.7	5.2

Continued

SLA 018	4.3	6.0	21.9	14.3	181	5.5	4.7	6.2
SLA 025-1	3.8	6.2	24.3	16.3	169	5.2	3.2	5.2
SLA 025-2	4.3	6.2	21.9	14.9	181	5.5	4.5	9.2
SLA 025-3	4.0	6.2	22.6	15.3	169	5.2	3.5	7.2
SLA 025-4	4.3	6.3	20.9	16.3	174	6.2	3.9	7.3
SLA 025-5	4.0	6.2	19.9	14.9	179	6.0	3.9	7.3
SLA 025-6	4.3	6.2	24.9	22.4	149	7.2	4.7	8.2
SLA 025-7	4.0	6.2	23.6	21.5	149	7.5	4.5	9.2
FOBHT8	4.6	4.1	24.3	14.6	154	8.3	3.0	6.3
MOBHT8	6.3	4.9	27.2	24.0	164	7.5	3.0	7.3
BARI Tomato-2	4.3	6.3	28.2	26.9	145	9.6	3.8	9.2
BARI Tomato-11	4.0	6.5	31.3	31.4	190	8.6	4.9	5.2
BARI Tomato-14	3.3	7.0	27.7	23.7	186	15.0	3.0	9.2
BARI Tomato-15	5.0	5.1	23.6	14.5	155	9.1	3.0	9.3
BARI Tomato-16	6.6	3.4	27.3	24.0	163	7.1	2.7	10.2
BARI Tomato-17	4.0	6.4	25.9	23.4	131	6.8	2.9	6.3
BARI Tomato-18	4.3	6.4	32.3	25.3	151	9.0	2.7	9.3
BARI Tomato-19	4.0	6.4	26.8	31.4	148	7.4	3.2	8.2
BARI Tomato 20	3.7	6.7	26.9	22.9	231	5.5	5.3	6.2
BARI Tomato 21	5.0	4.6	24.3	14.5	153	6.7	3.0	9.3
Range	3.01 - 13.5	2.51 - 10	7.31 - 33.4	4.41 - 31.4	67 - 407	5.21 - 17.6	0.61 - 5.4	5.2 - 10.3
Mean	5.6	5.6	22.4	19.1	161.1	7.9	3.6	7.2

from 11.7 to 71.3, while the highest number of fruit (71.3) was counted from the lines SLA 013 followed by SLA 011 (57.7), SLA 005 (55.0), BARI Tomato-11 (52.7), SLA 012 (52.3), SLA 004 (49.3), SLA 006 (48.3), BARI Tomato 20 (46.0). This high number of fruit bearing is due to smaller sized of fruits. In case of single fruit weight, the range was 16.4 - 186.6 g, while the largest fruit was harvested from the line AVTO 1702 (186.6 g) followed by BARI Tomato-17(158.0 g), SLA 010 (126.7 g), AVTO 1429 (105.0 g), AVTO 1464 (102.0 g), AVTO 1919 (98.4 g), AVTO 1288 (96.6 g), AVTO 1910 (95.4g), AVTO 1711 (93.7 g), AVTO 1715 (93.0 g), where the line SLA 013 produced the lowest average fruit weight having 16.4 g. The fruit yield per plant also indicated statistically significant difference which was varied from 0.47 to 4.56 kg, while the line AVTO 1702 exhibited the highest per plant yield (4.56 kg) followed by AVTO 1702 (4.56 kg), AVTO 1409 (3.83 kg), AVTO 1010 (3.65 kg), AVTO 1712 (3.37 kg). It was observed that the lines having larger fruit contained were higher yield. Fruit yield per hectare was also varied significantly from 15.7 - 150.4 t/ha. The highest fruit yield per hectare

was obtained from the lines AVTO 1702 (150.40 t/ha), followed by AVTO 1409 (126.54 t/ha), AVTO 1010 (120.60 t/ha), AVTO 1712 (111.33 t/ha), AVTO 1711 (107.23 t/ha), while the lowest yield (15.74 t/ha) was obtained from the line SLA 008. The low yield was due to less number of fruits as well smaller sizes of fruit.

The fruit length and fruit diameter of different lines varied significantly. The range of fruit length was observed 2.07 to 6.8 cm, while highest fruit length was produced from the line SLA 015-2 (6.8 cm), followed by AVTO 1713 (6.7 cm), AVTO 1288 (6.2 cm), AVTO 1619 (6.0 cm), AVTO 1909 (5.9 cm) and the lowest was produced from SLA 012 (2.07 cm). The range of fruit diameter was 1.9 to 7.4 cm, while highest fruit diameter was produced from the line BARI Tomato-17 (7.4 cm), followed by AVTO 1429 (6.8 cm), AVTO 1711 (6.7 cm), AVTO 1719 (6.6 cm), AVTO 1715 (6.5 cm), AVTO 1911 (6.5 cm), AVTO 1921 (6.5 cm), AVTO 1720 (6.4 cm), AVTO 1717 (6.3 cm), and the lowest diameter was produced from BARI Tomato-11 (1.9 cm). The pericarp thickness is another important criterion for selecting a good variety. The range of pericarp thickness was 0.14 to 0.8 cm, while the range of number of locule was 2.0 to 8.2.

Different characters of leaf were studied and observed significant variation among those characters viz., number of leaflets, number of compound leaflet, leaf length, leaf diameter. The range of number of leaflets and number of compound leaflet were counted 3.01 to 13.5 and 2.51 to 10.0, respectively, while leaf length and leaf diameter were 7.31 to 33.4 cm and 4.41 to 31.4 cm, respectively. The range of plant height at last harvest significantly varied and it was ranged from 67 to 407 cm. It indicated the variability of growth among the lines, while the range of branches per plant varied from 5.2 to 17.6. Sometime higher TSS (%) is preferred by some consumers, so it should be categories in different TSS level. The range of TSS level was 2.0% - 8.2%. The tomato lines were kept under ambient condition (Temp. 26°C - 27°C), and the shelf life of the tomato lines was recorded 5.2 to 10.3 days.

4. Conclusions

The days to first harvest were varied from 106 to 116 days while twelve lines were harvested within 106 - 108 days. The number of fruits per plant varied from 11.7 to 71.3, while the range of single fruit weight was 16.4 - 186.6 g. Fruit yield per hectare was 15.7 - 150.4 t/ha where the highest fruit yield per hectare was obtained from the lines AVTO 1702 (150.40 t/ha), followed by AVTO 1409 (126.54 t/ha), AVTO 1010 (120.60 t/ha), AVTO 1712 (111.33 t/ha), AVTO 1711 (107.23 t/ha). The range of fruit length was observed 2.07 to 6.8 cm, while the fruit diameter was 1.9 to 7.4 cm. The range of pericarp thickness was 0.14 to 0.8 cm, while the range of number of locule was 2.0 to 8.2. The range of TSS level was 2.0% - 8.2%, while the shelf life of the tomato lines was recorded 5.2 to 10.3 days.

Considering earliness, quantitative and qualitative characters, eleven WorldVeg Center tomato lines AVTO 1010, AVTO 1315, AVTO 1409, AVTO 1711, AVTO

1712, AVTO 1713, AVTO 1717, AVTO 1907, AVTO 1911, AVTO 1915 and AVTO 1921 were found promising. So, these eleven lines can be selected for further confirmation.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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