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Evaluation of determinate tomato (*Solanum lycopersicum* L.) under Bhubaneswar conditions

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Abstract

Field experiment was conducted under AICRP on Vegetable Crops, OUAT, Bhubaneswar, during *Rabi* season of 2017-18 to identify the suitable determinate tomato genotype (s) under Bhubaneswar, Odisha, India condition. Eighteen determinate tomato genotypes were evaluated for twenty eight characters by adopting randomized block design replicated thrice. The overall performance on vegetative parameters of 18 diverse determinate tomato genotypes indicated superiority of 2016/TODVAR-12 and Pusa 120 as compared to other tested genotypes. 2016/TODVAR-12 was identified as best genotype under Bhubaneswar condition due to relatively better growth (77.77cm as plant height, 5.40 primary branches plant⁻¹ and 8.14cm of internodal length), fruit yield attributing parameters (79.82% of fruit set, 65 days to 1st fruit harvest, 84.25 g of average fruit weight and 0.64 cm pericarp thickness), fruit yield (marketable fruit yield plant⁻¹ of 1.06 kg, total fruit yield plant⁻¹ of 1.17 kg, marketable fruit yield of 393 qha⁻¹ and total fruit yield of 414.27 qha⁻¹). The next better performing genotypes identified were Pusa 120, Pusa Rohini. Hence based on the performance genotypes, 2016/TODVAR-12, Pusa Rohini, 2016/TODVAR-05, Pusa Gourav and Pusa 120 may be recommended for cultivation under Bhubaneswar conditions.

Keywords: Determinate tomato, mean performance and genotypes

Introduction

Tomato (*Solanum lycopersicum* L.) is a versatile vegetable having chromosome number 2n=24 belongs to family Solanaceae, is native to Peru Equador region. It is a day neutral plant with self-fertilizing behaviour. Tomato is so unique in nature, which can be used both as fresh vegetable as well as a variety of processed products such as juice, ketchup, sauce, canned fruits, puree, paste, etc. It has high nutritive value and antioxidant properties due to the presence of lycopene and flavonoids (Sepat *et al.*, 2013) [6]. High antioxidant capacity in both fresh and processed tomatoes associated with the higher capacity to eliminate reactive oxygen species (ROS) and helps in lowering the incidence of certain forms of human cancer (Capanoglu *et al.*, 2010) [3]. Lack of proper knowledge regarding the cultivars suitable for local condition, the potential of tomato is not fully exploited. Before recommendation of any cultivars suitable for the region, it is essential to evaluate the cultivars giving emphasis on the quality and yield. Due to the varied climatic conditions varietal performance of tomato varies from place to place. Considering all the above mentioned facts, this experiment was undertaken to evaluate the performance of 18 genotypes of determinate tomato under Bhubaneswar, Odisha conditions for commercial cultivation.

Materials and methods

The research work was carried out at All India Co-ordinated Research Project on Vegetable Crops, Odisha University of Agriculture and Technology, Bhubaneswar, Odisha, India during *Rabi*, season of 2017-18. The experimental material comprised of 12 advanced breeding lines, 3 state released varieties and 3 national varieties (Table 1). The experiment was laid out in Randomized Block Design with three replications. Seeds were sown in nursery bed on 29th November, 2017. One month old seedlings were transplanted in the main field with a spacing of 60 cm × 45 cm. All the Recommended cultural practices were adopted uniformly to raise the good crop stand. Five plants were selected at random from each plot to record observations on twenty eight qualitative and quantitative characters *viz.*, plant height (cm), primary branches plant⁻¹, internodal length (cm), days to 1st flowering, days to 50% flowering, flowers cluster⁻¹, % of fruit, days to fruit set, days to first fruit harvest, average fruit weight (g), fruit length (cm), fruit girth (cm), pericarp thickness (cm), number of locules, fruits plant⁻¹, marketable fruit yield plant⁻¹ (kg), total fruit yield plant⁻¹ (kg), marketable fruit yield plot⁻¹ (kg), unmarketable fruit yield plot⁻¹ (kg), total fruit yield plot⁻¹ (kg), marketable fruit yield ha⁻¹ (q), unmarketable fruit yield ha⁻¹ (q), total fruit yield ha⁻¹ (q), tss (° brix), ascorbic acid (mg100g⁻¹), total sugar (%), reducing sugar (%) and non-reducing sugar (%).

Table 1: Origin and source of collection of determinate tomato genotypes under study

S. No.	Genotype	Source
1	2016/TODVAR-01	IIVR, Varanasi (U.P)
2	2016/TODVAR-02	
3	2016/TODVAR-03	
4	2016/TODVAR-04	
5	2016/TODVAR-05	
6	2016/TODVAR-06	
7	2016/TODVAR-07	
8	2016/TODVAR-08	
9	2016/TODVAR-09	
10	2016/TODVAR-10	
11	2016/TODVAR-11	
12	2016/TODVAR-12	
13	PusaRohini	IARI, New Delhi
14	Pusa Gaurav	
15	Pusa 120	
16	UtkalPallavi	OUAT, Bhubaneswar, Odisha
17	UtkalDeepti	
18	UtkalPragyan	

Table 2: Performance of determinate tomato genotypes for vegetative and flowering parameters

Genotypes	Plant height (cm)	Primary branches plant ⁻¹	Internodal length (cm)	Days to 1 st flowering	Days to 50% flowering	Flowers cluster ⁻¹	% of fruit	Days to fruit set
2016/TODVAR-01	73.86	3.76	7.54	23.33	33.67	6.62	85.48	34.33
2016/TODVAR-02	57.68	3.50	6.76	17.67	26.67	5.58	82.98	30.67
2016/TODVAR-03	63.01	3.03	5.19	23.00	30.00	5.04	89.69	35.00
2016/TODVAR-04	58.38	3.85	5.37	28.33	32.33	5.92	84.80	33.00
2016/TODVAR-05	84.55	3.51	6.37	20.33	26.33	5.80	89.07	34.67
2016/TODVAR-06	61.51	3.85	7.34	17.33	24.00	8.75	66.38	31.33
2016/TODVAR-07	74.60	3.51	8.66	17.00	29.00	5.88	84.35	30.33
2016/TODVAR-08	76.49	5.07	6.78	21.67	30.00	6.22	82.36	32.67
2016/TODVAR-09	70.64	4.71	7.67	15.33	26.67	6.82	87.04	31.33
2016/TODVAR-10	65.37	3.50	7.69	21.00	29.67	6.09	75.30	35.00
2016/TODVAR-11	66.66	5.16	6.73	21.00	29.00	5.47	80.66	31.33
2016/TODVAR-12	77.77	5.40	8.14	20.67	29.00	5.65	79.82	33.00
Pusa 120	73.73	5.11	7.85	21.00	28.00	5.91	87.02	34.67
Pusa Gaurav	66.61	3.93	5.85	20.67	27.33	7.68	81.24	34.67
Pusa Rohini	72.48	4.07	6.63	19.33	28.67	5.64	82.08	32.33
Utkal Pallavi	47.20	3.98	4.13	19.00	26.67	7.71	79.43	28.33
Utkal Deepti	57.89	4.62	4.17	21.33	25.67	7.42	79.58	25.33
Utkal Pragyan	71.00	4.01	7.25	20.33	28.00	5.94	84.53	31.33
Mean	67.75	4.14	6.67	20.46	28.37	6.34	82.32	32.19
SE (±)	2.29	0.16	0.10	0.98	0.87	0.20	3.46	0.96
CD (5%)	6.59	0.45	0.29	2.82	2.51	0.57	9.96	2.75
CV	5.86	6.52	2.60	8.30	5.33	5.44	7.29	5.15

Flowering parameters

The genotype, 2016/TODVAR-09 showed earliness and 1st flower appeared 15.33 days after transplanting, whereas the genotype 2016/TODVAR-04 had taken maximum time (28.33) for appearance of 1st flower. With respect to days to 50% flowering, genotype 2016/TODVAR-06 (24 days) recorded earliest, closely followed by Utkal Deepti (25.67 days) and 2016/TODVAR-05 (26.33 days) while genotype 2016/TODVAR-01 (33.67 days) was found to be late in this respect. Significantly maximum flowers cluster⁻¹ was recorded in 2016/TODVAR-06 (8.75) closely followed by Utkal Deepti (7.42) and Pusa Gaurav (7.68) where *statistically parity* were observed. Similar reports on maximum flowers cluster⁻¹ in determinate tomato, Utkal Pallavi and Utkal Deepti was reported by Yende *et al.* (2018)

Results and discussion**Vegetative growth parameters**

The mean performances of 18 genotypes of determinate tomato for vegetative parameters are presented in Table 2. Plant height range was observed maximum for 2016/TODVAR-05 (84.55cm) and was minimum for Utkal Pallavi (47.20cm). Significantly maximum primary branches plant⁻¹ (5.40) was recorded in 2016/TODVAR-12 followed by 2016/TODVAR-11 (5.16). The data on internodal length indicated wide variations among tested genotypes ranging from 4.13 cm (Utkal Pallavi) to 8.66cm (2016/TODVAR-07) with a mean value of 6.67 cm. The overall performance on vegetative parameters of 18 diverse determinate tomato genotypes indicated superiority of 2016/TODVAR- 12 and Pusa120 as compared to other genotypes. Similar results have been reported for Pusa 120 with respect to plant height by Basavraj *et al.* (2015) [2] and minimum plant height for Utkal Pallavi by Mohanty and Prusty (2001) [5] and Yende *et al.* (2018) [9].

[9].% of fruit set, significant variations were observed which varied significantly from 66.38% (2016/TODVAR-06) to 89.69% (2016/TODVAR-03) with mean value of 82.32%. Utkal Deepti (25.33 days) was the earliest variety to set fruits while 2016/TODVAR-10 and 2016/TODVAR-03 (35.00 days) took maximum days for fruit set but the genotype 2016/TODVAR-02, Pusa Rohini and Utkal Pallavi recorded early harvesting (60.33 days).

Fruit yield attributing parameters

Highest number of fruits plant⁻¹ was observed in Pusa Gaurav (21.40) and that of lowest in 2016/TODVAR-04 (10.68). Heaviest fruit of 84.25 g was recorded in 2016/TODVAR-12 and lightest fruit was recorded in Utkal Deepti (47.63 g). These findings are in conformity with the reports of Ara *et al.*

(2009) ^[1], Basavraj *et al.* (2015) ^[2], Singh *et al.* (2015) ^[7] and Spaldon *et al.* (2017) in tomato under different agro-climatic conditions of India. Fruit length was found to be maximum for 2016/TODVAR-07 (8.85 cm) whereas it was minimum for Utkal Deepti (13 cm). Data recorded on fruit girth showed maximum for Pusa 120 (18.35 cm) while that of lowest in Utkal Deepti (12.31 cm). The present investigation indicated that the genotype, Utkal Deepti recorded significantly lowest fruit weight, fruit length and fruit girth than rest of the genotypes. Similar trend with respect to fruit length in tomato was also reported by Singh *et al.* (2015) ^[7]. Pericarp thickness result revealed significant variations ranging from 0.49 cm (2016/TODVAR-5, 2016/TODVAR-07 and 2016/TODVAR-08) to 0.69 cm (2016/TODVAR-04) with an average pericarp thickness of 0.57cm. The range for number of locules was varied from 2.00 (Utkal Pallavi, Utkal Deepti, Utkal Pragyana) to 6.13 (2016/TODVAR-11) with a mean value of 3.03.

Fruit yield

Significantly highest marketable fruit yield (plant⁻¹, plot⁻¹ and ha⁻¹) was recorded in genotype 2016/TODVAR-12 (1.06 kg, 23.58 kg and 393q). The second maximum marketable fruit yield (qha⁻¹) was obtained in 2016/TODVAR-05 (316.21) which was *statistically at par* with the genotype, Pusa Rohini (298.17). Significant lowest unmarketable fruit yield (plot⁻¹ and ha⁻¹) was found in the genotype Utkal Pragyana (0.77 kg and 12.83q) whereas highest unmarketable fruit yield (plot⁻¹ and ha⁻¹) was recorded for the genotype Pusa Rohini (2.65 kg and 44.11 q). Utkal Pallavi and Utkal Deepti were found *statistically at par* with Utkal Pragyana for both the traits. The genotype, 2016/TODVAR-12 recorded significantly maximum total fruit yield (plant⁻¹ plot⁻¹ and ha⁻¹) *i.e.* 1.17 kg, 24.85 kg and 414.27 q on the other hand genotype 2016/TODVAR-06 gave minimum total fruit yield (plant⁻¹, plot⁻¹ and ha⁻¹) 0.53 kg, 6.06 kg and 101.02 q. The results are in agreement with that of Basavraj *et al.* (2015) ^[2] for Pusa

Gaurav, Pusa 120 and Pusa Rohini. Singh *et al.* (2015) ^[7] also reported such observations with respect to fruit yield plant⁻¹ (0.43 kg to 1.44 kg) in tomato.

Fruit quality parameters

The mean value of genotypes indicated highest TSS (⁰brix) in 2016/TODVAR-03 (5.8) closely followed by Utkal Deepti (5.67), Pusa Rohini (5.60) and 2016/TODVAR-05 (5.10) and the lowest TSS value was recorded in 2016/TODVAR-12 (4.1). Similar findings with respect to TSS in tomato have been reported by Basavraj *et al.* (2015) ^[2], Singh *et al.* (2015) ^[7] and Spaldon *et al.* (2017). The ascorbic acid content (mg100g⁻¹) found highest in 2016/TODVAR-05 (48.34) and lowest in Pusa Gaurav (14.35). Such wide variations in ascorbic acid content were also reported by Kumar *et al.* (2017). Total sugar content ranged from 2.24 (2016/TODVAR-10) to 4.81 (2016/TODVAR-06) with a mean value of 3.29. Significantly highest amount of total sugar was also reported in genotypes 2016/TODVAR-01 and 2016/TODVAR-02. Highest reducing sugar was found in Utkal Pallavi (2.73%) and was *statistically at par* with 2016/TODVAR-12 (2.59%), 2016/TODVAR-08 (2.54%), Pusa Gaurav (2.52%), Utkal Deepti (2.45%), Utkal Pragyana (2.40%) and 2016/TODVAR-04 (2.31%) whereas, lowest value was observed 1.74% for 2016/TODVAR-03. Significantly wide variations of non-reducing sugar content from 0.24% (2016/TODVAR-10) to 2.41% (2016/TODVAR-06) with a mean value of 1.05% were recorded.

Conclusion

It may be concluded from the present investigation that genotype, 2016/TODVAR-12 has best performing ability followed by Pusa 120, Pusa Rohini, 2016/TODVAR-05 and Utkal Deepti under Bhubaneswar, Odisha condition and may be recommended for commercial cultivation.

Table 3: Performance of determinate tomato genotypes for yield attributing parameters

Genotypes	Days to first fruit harvest	Average fruit weight (g)	Fruit length (cm)	Fruit girth (cm)	Pericarp thickness (cm)	Number of locules	Fruits plant ⁻¹
2016/TODVAR-01	62.33	64.20	8.45	15.73	0.57	2.47	12.09
2016/TODVAR-02	60.33	69.50	7.71	15.55	0.57	3.07	12.63
2016/TODVAR-03	64.33	58.40	7.88	15.63	0.58	3.67	17.62
2016/TODVAR-04	64.33	66.70	8.13	14.69	0.69	2.13	10.68
2016/TODVAR-05	63.33	82.50	7.69	15.35	0.49	2.87	15.33
2016/TODVAR-06	62.33	80.30	6.57	13.48	0.64	2.20	12.00
2016/TODVAR-07	69.00	68.20	8.85	18.33	0.49	5.00	13.71
2016/TODVAR-08	62.33	74.80	7.94	16.14	0.49	2.07	14.30
2016/TODVAR-09	62.67	66.50	6.86	13.85	0.66	2.40	18.18
2016/TODVAR-10	62.67	74.20	7.20	14.91	0.51	3.13	12.15
2016/TODVAR-11	65.00	72.00	8.13	17.91	0.66	6.13	12.64
2016/TODVAR-12	65.00	84.25	7.29	15.18	0.64	3.60	13.98
Pusa 120	62.00	55.71	8.39	18.35	0.55	4.87	17.26
Pusa Gaurav	61.33	60.08	7.40	13.53	0.58	2.27	21.40
Pusa Rohini	60.33	65.60	8.37	17.14	0.65	2.67	15.25
Utkal Pallavi	60.33	48.76	8.19	12.90	0.50	2.00	17.55
Utkal Deepti	63.00	47.63	6.13	12.31	0.53	2.00	17.82
Utkal Pragyana	62.67	48.23	6.18	12.69	0.51	2.00	19.05
Mean	62.96	65.98	7.63	15.20	0.57	3.03	15.20
SE (±)	2.09	2.38	0.21	0.47	0.03	0.18	0.88
CD (5%)	4.09	6.85	0.59	1.35	0.08	0.51	2.54
CV	4.06	6.25	4.66	5.37	7.93	10.14	10.08

Table 4: Performance of determinate tomato genotypes for fruit yield parameters

Genotypes	Marketable fruit yield plant ⁻¹ (kg)	Total fruit yield plant ⁻¹ (kg)	Marketable fruit yield plot ⁻¹ (kg)	Unmarketable fruit yield plot ⁻¹ (kg)	Total fruit yield plot ⁻¹ (kg)	Marketable fruit yield ha ⁻¹ (q)	Unmarketable fruit yield ha ⁻¹ (q)	Total fruit yield ha ⁻¹ (q)
2016/TODVAR-01	0.61	0.83	10.75	1.29	12.04	179.18	21.50	200.68
2016/TODVAR-02	0.63	0.73	13.90	1.74	15.64	231.64	29.00	260.64
2016/TODVAR-03	0.48	0.61	5.84	0.94	6.78	97.32	15.61	112.93
2016/TODVAR-04	0.52	0.79	10.67	1.15	11.82	177.84	19.11	196.95
2016/TODVAR-05	0.96	1.16	18.97	1.43	20.40	316.21	23.83	340.05
2016/TODVAR-06	0.44	0.53	4.82	1.24	6.06	80.29	20.72	111.02
2016/TODVAR-07	0.57	0.79	6.54	1.75	8.29	108.98	29.11	138.09
2016/TODVAR-08	0.54	0.64	7.48	1.47	8.95	124.62	24.50	149.12
2016/TODVAR-09	0.50	0.56	8.48	0.83	9.31	141.32	13.83	155.15
2016/TODVAR-10	0.59	0.67	9.64	1.04	10.68	160.75	17.33	178.08
2016/TODVAR-11	0.84	1.03	17.27	1.24	18.51	287.79	20.72	308.52
2016/TODVAR-12	1.06	1.17	23.58	1.28	24.85	393.00	21.28	414.27
Pusa 120	0.88	1.05	16.52	1.71	18.23	275.29	28.56	303.85
Pusa Gaurav	0.79	1.14	16.86	2.30	19.16	281.03	38.39	319.42
Pusa Rohini	0.73	1.07	17.89	2.65	20.54	298.17	44.11	342.28
Utkal Pallavi	0.73	1.00	17.00	0.93	17.93	283.27	15.50	298.76
Utkal Deepti	0.69	0.99	16.93	0.88	17.81	282.13	14.72	296.85
Utkal Pragyan	0.66	0.80	17.22	0.77	17.99	287.01	12.83	299.85
Mean	0.68	0.86	13.35	1.37	14.72	222.55	22.81	245.36
SE (±)	0.07	0.06	0.59	0.10	0.67	9.85	1.74	11.11
CD (5%)	0.21	0.12	1.70	0.20	1.92	28.30	3.41	31.94
CV	18.25	8.80	7.66	9.32	7.84	7.66	9.33	7.84

Table 5: Performance of determinate tomato genotypes for fruit quality parameters

Genotypes	TSS (^o Brix)	Ascorbic acid (mg100g ⁻¹)	Total Sugar (%)	Reducing sugar (%)	Non-reducing sugar (%)
2016/TODVAR-01	4.20	15.62	4.31	1.78	2.40
2016/TODVAR-02	4.63	22.49	4.23	1.76	2.35
2016/TODVAR-03	5.80	17.93	2.72	1.74	0.93
2016/TODVAR-04	5.03	14.95	2.64	2.31	0.32
2016/TODVAR-05	5.10	48.34	3.50	1.89	1.53
2016/TODVAR-06	4.93	17.47	4.81	2.27	2.41
2016/TODVAR-07	5.00	22.41	2.65	2.18	0.44
2016/TODVAR-08	5.00	19.66	3.32	2.54	0.74
2016/TODVAR-09	4.13	24.21	3.22	2.15	1.02
2016/TODVAR-10	4.20	45.08	2.24	1.99	0.24
2016/TODVAR-11	5.00	19.39	2.77	2.17	0.57
2016/TODVAR-12	4.10	22.62	3.18	2.59	0.56
Pusa 120	4.33	25.83	2.60	2.12	0.46
Pusa Gaurav	4.67	14.35	3.55	2.52	0.98
Pusa Rohini	5.60	32.14	3.45	1.82	1.55
Utkal Pallavi	4.73	19.25	3.39	2.73	0.63
Utkal Deepti	5.67	24.17	3.37	2.45	0.88
Utkal Pragyan	4.33	22.58	3.31	2.40	0.86
Mean	4.80	23.80	3.29	2.19	1.05
SE (±)	0.25	1.17	0.17	0.15	0.07
CD (5%)	0.72	3.36	0.48	0.44	0.14
CV	9.07	8.52	8.80	12.14	8.09

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