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Studies on stability of processing-type genotypes of tomato (*Solanum lycopersicum* L.)

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ABSTRACT

To study stability of genotypes under three diverse environments, ten genotypes along with two checks of processing-type tomato were evaluated in Randomized Block Design (RBD) with three replications. Environment included three seasons, viz., *kharif* (2007), *rabi* (2007-08) and summer (2008) to identify the most stable varieties. Overall performance of PTR-1, PTR-4, PTR-6 and 'Arka Ashish' was found stable for yield per plant, number of branches per plant, % fruit set, % acidity and lycopene content. PTR-4 and PTR-6 were stable for high yield and for good processing traits.

Key words: Tomato, stability, Genotype x Environment interaction

INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is one of the most popular and extensively consumed vegetable crops. It tops the list of processed vegetables, as, several items like puree, paste, sauce, ketchup, soup, juice and peeled tomatoes are prepared on a large scale. This multi-million dollar industry thrives on cultivation of processing varieties of tomato the world over. Thus, processed tomatoes possessing specific characteristics have acquired special significance in the tomato industry in many advanced countries. Processing in tomato has not gained much importance in India though there is a considerable scope for processing for earning foreign exchange. India, in particular Karnataka, has favorable weather conditions for growing tomato all year round and produce can be continuously supplied to processing factories. Already, some industries have started processing tomato in and around major cities of this state. Hence, the demand is rising for identifying a suitable variety for processing. The present study is aimed at evaluating potential genotypes for the purpose on the basis of stability parameters for important yield and quality attributes.

MATERIAL AND METHODS

The experimental material consisted of ten tomato genotypes, along with two check varieties. The genotypes were tested during *kharif* and *rabi* seasons of year 2007 and summer of 2008, at Regional Agricultural Research Station, Division of Horticulture, Raichur. These three seasons were treated as three environments in stability analysis. The experiments were carried out in Randomized Block Design, with three replications. Spacing between rows and plants was 75 and 60cm, respectively. Data were recorded on five randomly selected plants for plant height (cm), number of primary branches per plant, % fruit set per cluster, yield per plant (kg), acidity (% citric acid) (as per Ranganna, 1977), lycopene content (mg/100g fruit juice) as per Adsule and Ambadan (1976), Total Soluble Solids (TSS) (^{0}Brix) and pH. The data were subjected to Analysis of Variance to test the significance of Genotype x Environment interactions. Stability parameters, regression (bi) and deviation from regression (S^2di) were worked out by the method of Eberhart and Russel (1966). Co-efficient of variation (CV) was calculated as one of the characters, where G x E interaction was non-significant, as per Berry *et al* (1988).

RESULTS AND DISCUSSION

Pooled analysis of variance for various characters is presented in Table 1. Genotype and Environment effects were significant for all the characters studied. Similar results were earlier reported in tomato by Pandey (1983), Poysa *et al* (1986) and Patil (1996). Differences seen between genotypes promise a scope for selection, while, significant differences between environments indicate validity of the experiment.

Table 1. Pooled analysis of variance (mean squares) for various traits in tomato

Source	Genotype	Environment	Gen. x Env. (G x E)	Total	Env. + (Gen. x Env.)	Environment (Linear)	Genotype x Environment (Linear)	Pooled deviation	Pooled error
Degree/s of freedom	11	2	22	35	24	1	11	12	66
Plant height (cm)	38.11**	235.80**	16.03**		34.34	471.63**	15.88	14.82**	6.80
Number of branches per plant	2.034**	30.921**	1.262**		3.734	61.842**	1.373	1.056**	0.092
% Fruit set per cluster	363.85**	455.81**	21.26**		57.47	911.56**‘	31.36*	10.24**	6.807
Yield per plant (kg)	0.122*	3.027**	0.149**		0.3895	6.054**	0.0545	0.224**	0.0061
Total Soluble Solids (TSS)	0.4409**	2.9257**	0.0974		0.3331	5.8513**	0.15532**	0.036	0.01167
Acidity (% citric acid)	0.0033**	0.0528**	0.00537**		0.00933	0.1056**	0.0107**	0.00014	0.00047
pH	0.05168**	0.0769**	0.00919		0.0148	0.1538**	0.0161**	0.00208	0.00537
Lycopene content (mg/100 g juice)	2.031**	2.352**	0.6018**		0.7477	4.706**	0.2909**	0.8366	0.0764

* and ** Indicate significance at 0.05 and 0.01 levels of probability, respectively
Gen. = Genotype; Env. = Environment

Significant genotype x environment interaction (G x E) for all characters except TSS and pH indicates that genotypes responded to changing environment. Non-significant G x E for TSS and pH shows that these characters are largely non-responsive to changing environment. Kalloo and Pandey (1979) reported significant differences among genotypes, between environments and G x E interaction in tomato fruit yield, suggesting that prediction of genotype performance across changing environments would be highly effective for these characters.

G x E (linear) effects were significant for per cent fruit-set per cluster, % acidity, lycopene content, TSS and pH. This indicates that a major component for difference in stability was due to linear as well as non-linear components, and that, performance can be predicted over environments for these characters. These results are in conformity with findings of Ortiz and Izqeierdo (1994).

To assess the stability of a genotype, linear regression can be regarded as a major response of that particular genotype, and deviation from regression should be considered as a better measure of stability (Jatasra and Paroda, 1979 and Beeker, 1981). Hence, mean performance of the genotype, together with regression co-efficient (bi) and deviation from regression (S^2di) are discussed here.

Genotypes PTR-1, PTR-4, PTR-6 and 'Arka Ashish' were identified as stable for fruit yield, with 'bi' value closer to unity, mean value above population-mean and deviation from regression closer to zero (Table 2). Maximum yield was observed in PTR-1 (1.9kg plant^{-1}), followed by PTR-4 (1.89kg plant^{-1}), PTR-6 (1.84kg plant^{-1}), and 'Arka Ashish' (1.73kg plant^{-1}). Genotype PTR-7 showed average stability.

Genotypes identified as stable for other traits were: PTR-4, PTR-6 and 'Arka Ashish' for number of branches per plant; PTR-1, PTR-4, PTR-6, PTR-8, PTR-10, 'Arka Ahuti' and 'Arka Ashish' for per cent fruit set per cluster; all and genotypes except PTR-7, PTR-8, PTR-9 and 'Arka Ahuti' for per cent acidity; and PTR-1, PTR-4, PTR-5, PTR-6, PTR-9, PTR-10 and 'Arka Ashish' for lycopene content.

Genotypes identified as stable for TSS were: PTR-1, PTR-4, PTR-5, PTR-6, PTR-8, PTR-9, PTR-10 and 'Arka Ahuti' (as indicated by lower CV) and for pH, PTR-2, PTR-3, PTR-4, PTR-7 and 'Arka Ashish' (Table 3).

As for overall performance, PTR-1, PTR-4, PTR-6 and 'Arka Ashish' were found to be stable for yield per plant and for other characters, i.e. number of branches per plant, fruit set, % acidity and lycopene content. PTR-4 and PTR-6 were stable, with high yield and good processing traits.

Table 2. Performance of various tomato genotypes (mean of three seasons), regression coefficient (bi) and deviation from regression (S^2di)

Sl. No	Genotype	Plant height (cm)			Number of branches / plant			Per cent fruit set / cluster			Yield (kg plant^{-1})			Acidity (% citric acid)			Lycopene content (mg/ 100g juice)		
		Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di
1.	PTR-1	55.70	0.15**	1.17	7.83	1.55	0.04	60.33	1.47	1.49	1.90	0.56	-0.02	0.37	0.58	0.00	5.26	0.30	0.01
2.	PTR-2	54.50	0.31**	2.26	6.25	1.19**	0.10	69.33	0.41**	2.23	1.53	0.51**	0.00	0.58	2.27	0.00	4.40	2.80	5.55^{CC}
3.	PTR-3	64.65	1.72	18.57^{CC}	7.46	0.91	2.22^{CC}	49.11	2.80	10.72^{CC}	1.58	1.30	0.68^{CC}	0.41	0.63	0.00	3.73	2.22	1.03
4.	PTR-4	55.35	0.77	5.95	8.72	0.88	0.07	66.35	0.91	2.17	1.89	0.89	-0.02	0.40	2.00	0.00	5.64	1.30	0.02
5.	PTR-5	62.73	1.19	18.2^{CC}	8.37	0.28	0.75^{CC}	73.11	0.42**	0.56	1.39	1.40**	0.02	0.37	0.27	0.00	4.66	1.04	0.12
6.	PTR-6	56.26	0.16	2.27	8.68	1.07	0.07	69.43	0.77	1.27	1.82	0.94	-0.02	0.41	0.35	0.00	5.30	0.57	0.01
7.	PTR-7	58.25	2.24	2.43	8.03	1.20	2.64^{CC}	36.21	0.63**	1.14	1.59	91.60	0.28^{CC}	0.36	2.58**	0.00	3.07	1.64	2.09
8.	PTR-8	62.58	1.14	21.81^{CC}	6.67	0.81	0.03	60.11	0.74	2.27	1.48	0.72	0.02	0.32	0.29	0.00	3.20	1.23	0.21
9.	PTR-9	61.32	1.30	67.42^{CC}	7.12	2.10	3.08^{CC}	44.58	0.73	2.27	1.34	0.93	1.54^{CC}	0.34	1.43	0.00	4.66	1.03	0.11
10.	PTR-10	61.43	1.39	12.71^{CC}	7.18	0.13**	0.10	60.58	0.94	0.92	1.49	0.99	-0.02	0.38	0.42	0.00	4.80	0.70	0.33
11.	Arka Ahuti	62.13	0.99**	0.99	6.62	0.98**	0.20^{CC}	64.57	0.96	0.23	1.34	0.95**	-0.01	0.31	0.22	0.00	5.16	0.20**	0.00
12.	Arka Ashish	56.90	0.63	0.32	7.95	0.92	0.08	62.01	1.20	2.20	1.73	1.22	-0.02	0.41	2.50	0.00	4.78	1.04	0.32
	Mean	59.3	1.00		7.52	1.00		59.6	1.00		1.59	1.00		0.37	1.00		4.55	1.00	
	S.Em±	2.72	0.61		0.72	0.45		2.26	0.36		0.33	0.66		0.002	0.041		0.646	1.46	

, * Regression coefficient significantly different from unity at 0.05 and 0.01 levels of probability.

$^{C, CC}$ Deviations from regression significantly different from zero at 0.05 and 0.01 levels of probability, respectively

Table 3. Performance of various tomato genotypes (CV values)

Sl.No.	Genotype	TSS (°Brix)		pH	
		Mean	CV	Mean	CV
1.	PTR-1	4.30	5.70	3.55	2.43
2.	PTR-2	4.46	11.02	3.52	0.98
3.	PTR-3	4.68	10.56	3.46	1.08
4.	PTR-4	5.67	9.70	3.35	1.35
5.	PTR-5	4.69	9.31	3.65	2.37
6.	PTR-6	4.71	2.32	3.42	4.65
7.	PTR-7	4.65	14.17	3.46	0.52
8.	PTR-8	4.52	4.20	3.42	3.48
9.	PTR-9	4.62	9.91	3.56	1.14
10.	PTR-10	4.44	4.79	3.61	6.19
11.	Arka Ahuti	5.19	5.98	3.85	1.39
12.	Arka Ashish	5.06	18.61	3.56	0.36
	Mean	4.75		3.53	

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