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Short Note

Studies on genetic variation and heritability of yield and its components in tomato (*Solanum lycopersicum* L.)

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Abstract

Twenty five genotypes of tomato were evaluated in a randomized block design to study genetic variability of sixteen economic traits. The analysis of variance revealed considerable genetic diversity among the genotypes for aggregate effect of all the characters. The results on the genetic variability, heritability and genetic advance showed that a large portion of phenotypic variability was genetic and highly heritable in most cases. Association of high heritability with high genetic advance for number of fruits per plant, average fruit weight, pericarp thickness and fruit firmness suggested that these characters were under the control of additive genes which holds a good chance of improvement through selection.

Key words: Tomato, variability, heritability, genetic gain.

Tomato is one of the most important solanaceous vegetable crops grown for its delicious fruits. It is a versatile vegetable used for various culinary purposes. They are processed into puree, paste, ketchup, sauce, soup etc. Tomatoes are commonly used as a model crop for diverse physiological, cellular, biochemical, molecular and genetic studies because they are easily grown, have a short life cycle and are easy to manipulate by grafting and cutting (Kinet and Peet, 1997). Tomatoes are important source of lycopene (an antioxidant), ascorbic acid and ß-carotene and valued for their colour and flavour. Lycopene is implicated in the prevention of various diseases including cancer, coronary heart diseases and cataract (Willett, 1994). The possibility of improvement in any crop is measured by the variability available in a crop. Wider the genetic variability, greater are the chances of improvement with respect to different desirable traits through selection. The genotypic variability in a population is due to genotypic difference among individuals for a particular character. On the other hand, phenotypic variation is the observed differences present in individuals and includes both genotypic and environmental components. Hence, an attempt was made to assess the available genetic variability in tomato by partitioning of overall variability into its heritable and non heritable components as genetic parameters like genotypic coefficient of variation (CV), heritability and expected genetic advance help in developing superior genotypes. Keeping in view the importance of this crop, there is a need to identify better performing lines in respect of higher yield and better horticultural and quality traits. The extent of variability, heritability, genetic advance and genetic gain was also estimated in diverse tomato genotypes to identify the most promising ones.

The experiment was laid out at the Vegetable Research Farm of the Department of Vegetable Science, Dr Y. S. Parmar University of Horticulture and Forestry, Nauni, Solan in the

year 2007-2008. The farm is located at an altitude of 1273 m above mean sea level having latitude of 35.5°N and longitude of 77.8°E. The Climate of the area is generally sub- temperate and semi-humid characterized by cold winters. The mean annual rainfall is 1100-1300 mm. Mean temperature during the crop season varied from 15.7°C to 25.8°C, while the relative humidity ranged from 40 to 77 per cent. The experiment was conducted with 25 tomato genotypes grown in a randomized block design with 3 replications. Each cultivar was planted in a plot having dimensions of 2.7 × 1.8 m with spacing of 90 × 30 cm. The observations on sixteen characters such as days to first picking, plant height (cm), yield per plant (g), number of fruits per plant, number of fruits per cluster, average fruit weight (g), fruit shape index, stem thickness (mm), number of locules per fruit, pericarp thickness (mm), fruit firmness (kg/0.503cm^2), buck eye rot incidence (%), thousand seed weight (g), shelf life of fruits (days), total soluble solids (^{0} B) and ascorbic acid content (mg/100g) were recorded from ten randomly selected plants and the means were subjected to statistical analysis. Phenotypic and genetic coefficients of variation, heritability and genetic advance were also worked out by following method suggested by Burton and De Vane (1953) and Allard (1960). In the present investigation, twenty five diverse genotypes were evaluated for some morphological, fruit and quality characters. The mean values for each character is given in Table 1. The parameters of variability viz. coefficients of variability, heritability and genetic gain were also worked out to select the desirable genotypes for different traits. The data presented (Table 2) indicated that phenotypic coefficient of variability was higher in magnitude than genotypic ones for all the characters. High genotypic and phenotypic coefficients of variability were recorded for average fruit weight (42.04% and 46.23%), number of fruits per plant (37.61% and 39.75%) and buck eye rot incidence (29.11% and 32.78%). Moderate coefficients of variability were observed for plant height (22.51% and 22.69%), yield per plant (20.51% and 21.73 %), fruit shape index (15.33% and 17.80%), stem thickness (16.00% and 18.75%), number of locules per fruit (17.87% and 21.11%), pericarp thickness (25.61% and 26.52%), fruit firmness (26.63% and 27.13%) and shelf life of fruits (18.96% and 20.33%). Characters like days to first picking (5.14% and 5.45%), number of fruits per cluster (11.36% and 15.31%), thousand seed weight (8.05% and 9.47%), total soluble which depicts the improvement in performances of selected lines over the original population and is used to predict the effect of selection. The genetic gain (genetic advance expressed as percentage of population mean) was low to high in nature and ranged from 10.00- 78.76 per cent. High genetic gain was recorded for average fruit weight (78.76%), number of fruits per plant (73.31%), fruit firmness (53.93%), buck eye rot incidence (53.22%) and pericarp thickness (51.10%), while it was moderate for plant height (46.01%), yield per plant (39.87%), shelf life of fruits (36.53%), number of locules per fruit (31.17%), stem thickness (28.15%) and fruit shape index (26.88%). However, low genetic gain was noticed for ascorbic acid content (20.75%), number of

Table 1. Estimates of mean values for various traits in tomato

Genotypes	Days to first picking	Plant height (cm)	Yield per plant (g)	Number of fruits per plant	Number of fruits per cluster	Average fruit weight (g)	Fruit shape index	Stem thickness (mm)	Number of locules per fruit	Pericarp thickness (mm)	Fruit firmness (kg/0.50 3cm^2)	Buckeye rot incidence (%)	Thousand seed weight (g)	Shelf life of fruits (days)	T.S.S. (°B)	Ascorbic acid (mg/100g)
EC-521079	72.33	154.73	1533.67	68.67	4.03	22.60	0.82	7.60	3.90	1.91	0.83	10.45	2.50	4.80	3.32	30.35
EC-5863	69.67	172.12	1413.50	74.20	4.00	20.40	0.92	8.53	5.40	3.43	1.52	11.93	2.57	7.87	3.69	29.69
EC-9046	68.33	135.30	1340.17	32.67	4.27	54.93	0.78	8.89	4.73	3.96	1.46	13.67	2.74	7.93	4.06	23.36
EC-3526	72.00	144.09	928.17	33.80	3.07	39.00	0.85	11.05	3.66	3.46	1.62	13.67	2.52	8.00	3.67	19.61
EC-251581	71.67	141.17	871.67	31.87	2.97	23.70	0.93	9.56	3.73	3.02	1.64	14.77	2.86	7.33	3.53	28.97
EC-531802	70.33	131.49	968.33	28.73	3.77	20.40	0.95	8.52	3.10	3.03	1.63	14.33	2.72	6.93	3.60	28.83
EC-521074	77.33	164.35	1365.17	29.20	2.97	48.00	0.93	8.45	4.00	4.98	1.75	12.07	2.65	8.07	4.38	26.00
EC-13904	74.00	173.65	1151.83	62.40	4.50	18.03	0.92	9.47	2.46	2.88	1.51	15.50	2.67	7.27	3.60	31.06
EC-521052	70.33	79.27	806.67	31.33	3.63	20.30	0.90	8.25	5.20	2.24	1.78	22.83	2.67	6.47	3.67	27.41
EC-25265	70.00	141.83	1450.00	49.47	3.53	22.06	0.92	8.78	3.73	3.41	1.73	20.10	2.70	7.13	3.74	21.44
EC-15127	71.33	133.37	1040.33	28.67	3.33	36.56	0.79	10.25	3.86	3.72	1.71	18.23	3.20	7.53	3.50	22.58
EC-12692	72.33	153.37	1373.33	53.40	3.23	30.26	0.86	11.02	5.70	3.63	1.42	16.97	2.64	8.13	3.59	26.11
EC-108283	73.33	132.82	1566.70	52.67	3.13	40.00	0.88	11.77	3.40	4.33	2.86	15.00	2.37	8.80	4.94	23.22
EC-535151	75.67	119.48	1279.33	45.33	3.30	28.73	1.24	12.87	4.10	4.21	1.47	20.00	2.54	4.40	3.67	23.20
EC-129604	80.00	84.15	1548.00	34.13	3.13	51.30	0.83	7.58	4.46	3.82	1.49	23.63	2.72	8.53	4.03	22.91
EC-6192	73.67	150.52	1273.50	45.73	3.53	31.00	1.50	8.05	4.70	3.88	1.74	20.80	2.69	7.00	3.44	27.21
EC-6829	74.33	89.63	1340.67	30.87	3.13	44.53	0.90	8.45	3.60	4.41	1.68	18.63	2.66	7.67	3.58	23.9
EC-521076	74.33	144.48	650.00	27.33	3.37	25.00	0.92	9.04	3.46	3.12	1.48	23.17	3.01	8.47	3.48	26.36
Gold Nugget	79.00	97.08	1008.67	51.33	3.83	19.00	0.90	7.91	4.00	2.14	0.86	15.67	2.66	4.00	3.41	28.37
Oregon Cherry	74.67	112.05	1065.00	28.87	4.00	32.30	1.03	10.02	3.36	3.32	0.94	19.20	2.49	7.60	3.53	30.41
VLT-32	78.00	103.10	1118.67	22.87	3.20	61.66	0.78	12.45	4.63	4.41	1.69	24.33	2.88	6.27	3.60	18.91
Siletz	81.33	85.50	1321.33	23.73	3.03	58.33	0.86	13.28	4.86	4.61	2.38	23.03	2.75	7.40	4.08	29.16
Oregon2	78.33	88.34	905.00	39.73	2.83	21.26	0.93	9.24	3.26	2.35	1.93	25.10	2.80	4.07	3.72	26.94
Solan Gola	80.00	107.65	1183.33	20.80	3.77	56.96	0.90	10.56	3.80	4.61	1.91	29.67	3.07	7.87	3.61	20.97
Solan Vajr	81.67	132.05	1386.67	22.60	3.27	68.40	0.99	10.12	3.56	5.76	2.37	34.60	3.42	7.93	3.60	27.41
Overall Mean	74.56	126.86	1195.60	38.82	3.47	35.79	0.93	9.66	4.03	3.62	1.65	19.09	2.74	7.09	3.72	25.77
CD (P=0.05)	2.145	5.75	137.37	7.98	0.57	11.01	0.13	1.51	0.72	0.40	0.14	4.60	0.22	0.83	0.38	3.89

Characters	Mean	Range	Coefficient of variation (%)		Heritability (%)	Genetic advance	Genetic gain (%)
			GCV (%)	PCV (%)			
Days to first Picking	74.56	68.33-81.67	5.14	5.45	89.10	7.46	10.00
Plant height (cm)	126.86	79.27-173.65	22.51	22.69	98.40	58.37	46.01
Yield per plant (g)	1195.6	650.00-1566.70	20.51	21.73	89.10	476.70	39.87
Numbers of fruits per plant	38.82	20.80-74.20	37.61	39.75	89.60	28.46	73.31
Number of fruits per cluster	3.47	2.83-4.50	11.36	15.31	55.00	0.60	17.29
Average fruit weight (g)	35.79	18.03-68.40	42.04	46.23	82.70	28.18	78.76
Fruit shape index	0.93	0.77-1.50	15.33	17.80	74.20	0.25	26.88
Stem thickness (mm)	9.66	7.58-13.28	16.00	18.75	72.80	2.72	28.15
Number of locules per fruit	4.03	2.46-5.70	17.87	21.11	71.68	1.25	31.17
Pericarp thickness (mm)	3.62	1.91-5.76	25.61	26.52	93.20	1.85	51.10
Fruit firmness (Kg/0.503cm^2)	1.65	0.83-2.86	26.63	27.13	96.40	0.89	53.93
Buckeye rot incidence (%)	19.09	10.45-34.6	29.11	32.78	78.90	10.16	53.22
Thousand seed weight (g)	2.74	2.37-3.42	8.05	9.47	72.19	0.38	14.09
Shelf life of fruits (Days)	7.09	4.0-8.80	18.96	20.33	87.00	2.59	36.53
Total soluble solids (^{0}B)	3.72	3.32-4.94	8.54	10.71	63.48	0.52	14.01
Ascorbic acid content (mg/100g)	25.77	18.91-31.06	12.59	15.74	63.98	5.34	20.75

fruits per cluster (17.29%), thousand seed weight 14.09%), total soluble solids (14.01%) and days to first picking (10.00%). High heritability along with high estimates of genetic gain was observed for number of fruits per plant (89.10 % and 73.31%)

Nandpuri *et al.* (1977), average fruit weight (82.70% and 78.76%) Mohanty (2002), pericarp thickness (93.20% and 51.10%) Mittal *et al.* (1996) and fruit firmness (96.40% and 53.93%) Vikram and Kohli (1998). Association of high heritability with high genetic advance for these traits suggested that these characters are under the control of additive genes which holds a good chance of improvement through selection. Significant varietal differences were recorded for all the characters studied. Mean values for all the characters are presented in Table 1. Genotype EC- 108283 recorded maximum values for yield per plant (1566.70 g) followed by EC- 129604 with a yield of 1548.00 grams. High coefficients of variability were found for number of fruits per plant, average fruit weight and buckeye rot incidence. The results on the genetic variability, heritability and genetic advance showed that a large portion of phenotypic variability was genetic and highly heritable in most cases. The apparent variation is not due to genotypes but also due to environmental influences since phenotypic coefficients of variation is greater than genotypic coefficients of variation. The difference between phenotypic and genotypic coefficients of variation is less for days to first picking, plant height and pericarp thickness suggesting thereby that these characters were less influenced by the environment. Hence, selection based on phenotypic basis will hold good for these characters. High estimates of heritability and genetic gain were recorded for number of fruits per plant, average fruit weight, pericarp thickness and fruit firmness. Therefore, selection for these traits will bring worthwhile improvement.

VIR SOFTECH

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