



## Genetic variation and character interrelationship studies for identification of selection parameters in tomato (*Solanum lycopersicum*)

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### ABSTRACT

Forty nine genotypes of tomato (*Solanum lycopersicum* L.) collected from different sources and maintained in the Division of Vegetable Science and Floriculture, FOA, Chatha, SKUAST-Jammu, India, were evaluated for various quantitative and quality traits. The material showed wide range of variability for gross yield (116.67 – 5049.06 g/plant), marketable yield (41.67 – 4388.59 g/plant), average fruit weight (12.23 – 82.21g), number of marketable fruits/plant (1.67 – 177.00), pericarp thickness (0.15 – 1.05 cm) and total soluble solids (3.40 – 6.05%). The character association analysis indicated that total numbers of fruits/plant were significantly and positively correlated with gross yield (g/plant), marketable yield (g/plant), number of marketable fruits/plant, plant height (cm) and total soluble solids (%), whereas plant height was negatively and significantly correlated with fruit shape index. Fruit shape index was negatively and significantly correlated with number of locules/fruit. Gross yield (g/plant) was significantly and positively correlated with total number of fruits/plant, number of marketable fruits/plant and marketable yield (g/plant). Gross yield (g/plant) was significantly and positively correlated with total number of fruits/plant, number of marketable fruits/plant and marketable yield (g/plant). The estimates of direct and indirect effects showed that marketable yield (g/plant) gave highest positive direct effect on gross yield (0.904), followed by number of marketable fruits/plant (0.845) and total number of fruits/plant (0.796). Maximum indirect contribution towards gross yield (g/plant) was through marketable yield (0.819) via total number of fruits. The present studies revealed considerable scope for improvement in tomato as total number of fruits/plant, average fruit weight (g), number of marketable fruits and plant height (cm) showed a wide range of variability. The phenotypic coefficients of variability (PCV) were higher with smaller magnitude than genotypic coefficients of variability (GCV), indicating the apparent variation is not only due to genotypes but also due to influence of environmental factors. The characters like total number of fruits, gross yield (g/plant) and number of marketable fruits showed high genetic advance coupled with high heritability and genotypic coefficient of variability, indicating thereby that selections based on phenotypic performance could be effective for improvement of these characters.

**Key words:** Correlation, Genetic advance, Heritability, Path analysis, Tomato, Variability

Tomato (*Solanum lycopersicum* L.) is one of the most popular and widely grown vegetables in the world. It is grown extensively in tropical and subtropical areas and is also the most leading vegetable crop grown under protected structures. For bringing improvement in any crop, the knowledge of extent of genetic variability is of prime importance. Further the heritable and non-heritable components of the total variation enable the breeders to know the behaviour of the population under selection. Correlation studies further provide the characters essential for making the selection effective. Keeping these in mind the present investigation was carried out in tomato.

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### MATERIALS AND METHODS

The present investigation was undertaken in the experimental farm of the Division of Vegetable Science and Floriculture, FOA, Chatha, SKUAST of Jammu, India, during February – May 2008, situated at 33°55' North latitude and 74°58' East longitude at an elevation of 332 m above mean sea level. The place experiences cool winters and very hot summer with average rainfall. Agroclimatically, the location represents Zone IV of the state of Jammu & Kashmir, and is characterised by humid, sub-tropical climate.

The experimental material comprising forty nine genotypes of tomato was collected from different sources and maintained in the Division of Vegetable Science and Floriculture, SKUAST of Jammu. The genotypes were grown in Randomized Block Design with three replications during 2008. The seedlings were transplanted on 26 February 2008

and were spaced at 75 cm row to row and 45 cm plant to plant. There were 15 plants in each entry per replication. All the recommended cultural practices were followed to raise a healthy crop. Data was recorded on 7 randomly selected plants per entry per replication for various horticultural characters namely number of fruits/plant, average fruit weight (g), gross yield (g/plant), marketable yield (g/plant), number of marketable fruits/plant, plant height (cm) and 5 randomly selected fruits were taken per entry per replication for quality characters namely fruit shape index, pericarp thickness (mm), number of locules/fruit and total soluble solids (%). The data was analysed as per methods suggested by Panse and Sukhatme (1978), Burton and De Vane (1953) (Genotypic and phenotypic coefficient of variability), Hanson *et al.* (1956) and Johnson *et al.* (1955) (Heritability and genetic advance), Al-Jibouri *et al.* (1958) (correlation coefficients) and Dewey and Lu (1959) (path coefficient).

### RESULTS AND DISCUSSION

The analysis of variance revealed significant differences for the characters under study indicating wide diversity among the genotypes. The range, mean and other genetic parameters estimated are presented in Table 1. A wide range of variability was observed for marketable yield (41.67 – 4388.59 g/plant), number of marketable fruits/plant (1.67 – 177.00), average fruit weight (12.23 – 82.21 g), plant height (38.50 – 168.00 cm), pericarp thickness (0.15 – 1.05 cm) and total soluble solids (3.40 – 6.05%). The characters showing wide range of variability have ample scope of selections for the desirable types. Phenotypic coefficient of variation ranged from 15.45% for total soluble solids to 107.66% for number of marketable fruits/plant. High phenotypic coefficient of variation was observed for number of marketable fruits/plant (107.66%), number of fruits/plant (98.46%), marketable yield (87.45%) and gross yield (86.68%). Genotypic coefficient of variation ranged from 14.75% for total soluble solids to 101.84% in

number of marketable fruits/plant. High genotypic coefficient of variability was observed for number of marketable fruits/plant (101.84%) and number of fruits per plant (92.57%). The magnitude of phenotypic coefficient of variation was in general higher than corresponding genotypic coefficient of variation indicating the influence of environmental factors in their expression. Sharma *et al.* (2009) also reported similar results while studying 25 lines of tomato and Singh and Narayan (2004) had obtained similar results under cold arid environment of Ladakh. This shows more preponderance of environmental factors of yield contributing characters in tomato.

High heritability (broad sense) was observed for plant height (94.20%), fruit shape index (93.60%), total soluble solids (91.20%), number of marketable fruits/plant (89.50%), total number of fruits/plant (88.40%) and number of locules/fruit (80.70%), indicating the least influence of environment in their expression, thus suggesting that selection for these traits/characters based on phenotypic appearance would be reliable. High genetic advance as percentage of mean was observed for number of marketable fruits/plant (85.94%), gross yield (83.29%) and total number of fruits/plant (81.86%). High genetic advance coupled with high heritability could be considered for selection among the genotypes. The results are in accordance with the findings of Mohanty (2002) and Sharma *et al.* (2009).

The estimates of genotypic correlation coefficients in general were higher in magnitude than phenotypic correlation coefficients (Table 2), indicating the more preponderance of heritable components. Number of fruits/plant was positively and significantly correlated (genotypic and phenotypic) with gross yield (0.877; 0.879), marketable yield/plant (0.906; 0.898), number of marketable fruits/plant (0.991; 0.981) and plant height (0.398; 0.363). Total soluble solids were positively and significantly correlated with number of fruits per plant (genotypic). Gross yield showed positive and

Table 1 Estimates of coefficients of variability, heritability, genetic advance, genetic gain for different characters in tomato

Character	Mean	Range	Coefficient of variability (%)		Heritability (%)	Genetic advance	Genetic advance as % age of mean
			Genotypic	Phenotypic			
Number of fruits/plant	41.06	2.33 – 202.50	92.57	98.46	88.4	33.61	81.86
Average fruit weight (g)	41.79	12.23 – 82.21	31.82	37.18	73.3	23.45	56.11
Gross yield/plant (g)	1742.6	116.67 – 5049.06	76.94	86.68	78.8	1451.5	83.29
Marketable yield/plant (g)	1399.8	41.67 – 4388.59	77.64	87.45	78.8	987.6	70.55
Number of marketable fruits/plant	35.56	1.67 – 177.00	101.84	107.66	89.5	30.56	85.94
Plant height (cm)	84.83	38.50 – 168.00	37.54	38.67	94.2	63.68	75.07
Fruit shape index	0.95	0.68 – 1.63	19.3	19.95	93.6	0.36	37.89
Pericarp thickness (cm)	0.48	0.15 – 1.05	26.13	29.36	79.2	0.23	54.17
No. of locules/fruit	2.98	2.00 – 6.00	27.57	30.69	80.7	1.52	50.84
Total soluble solids (%)	4.48	3.40 – 6.05	14.75	15.45	91.2	1.3	29.01

Table 2 Genotypic (G) and phenotypic (P) correlation coefficients among different characters in tomato

Characters		Number of fruits/plant	Average fruit weight	Gross yield	Marketable yield	Number of marketable fruits/plant	Plant height	Fruit shape index	Pericarp thickness	Number of locules/fruit	Total soluble solids
Number of fruits/plant	G	-0.143	0.877**	0.906**	0.991**	0.398*	-0.154	-0.215	0.117	0.413*	
	P	0.101	0.879**	0.898**	0.981**	0.363*	-0.135	-0.174	0.076	0.353	
Average fruit weight	G		0.240	0.156	-0.194	-0.305	0.319	0.076	-0.048	-0.325	
Gross yield/plant	P		0.241	0.184	-0.149	-0.227	0.250	0.013	-0.006	0.216	
Marketable yield/plant	G			0.979**	0.844**	0.198	-0.046	-0.179	0.091	0.159	
	P			0.975**	0.832**	0.173	-0.037	-0.141	0.056	0.301	
Number of marketable fruits/plant	G				0.893**	0.237	-0.074	-0.231	0.093	0.233	
	P				0.875**	0.205	-0.067	-0.194	0.059	0.466**	
Plant height	G					0.404*	-0.181	-0.216	0.118	0.399*	
	P					0.361	-0.166	-0.194	0.084	0.250	
Fruit shape index	G						-0.445*	-0.214	0.051	0.240	
	P						-0.407*	-0.184	0.035	0.062	
Pericarp thickness	G							0.327	-0.471**	0.083	
	P							0.284	-0.428*	-0.164	
Number of locules/fruit	G								-0.190	-0.166	
	P								-0.167	-0.127	
Total soluble solids	G									-0.144	
	P										

\* Significant at P = 0.05, \*\*significant at P = 0.01

significant correlation (genotypic and phenotypic) with marketable yield/plant (0.979; 0.975) and number of marketable fruits/plant (0.844; 0.832). Marketable yield/plant showed positive and significant correlation with number of marketable fruits/plant (0.893; 0.875). Plant height with fruit shape index (-0.445; -0.407) and fruit shape index with number of locules/fruit (-0.471; -0.428) were negatively and significantly correlated. These findings are in accordance with Sharma *et al.* (2009), Lakshmi and Mani (2004) and Singh and Narayan (2004).

The characters showing significant correlation were subjected to estimation of direct and indirect effects (Table 3). Data depicted that number of fruits/plant (0.796), marketable

yield/plant (0.904) and number of marketable fruits/plant (0.845), exerted high positive direct effects on gross yield. The direct effects of remaining characters irrespective of their positive or negative contribution were poor in magnitude. Number of fruits/plant (0.819) showed maximum indirect effect on gross yield via number of marketable fruits/plant. These findings are in agreement with those of Sharma *et al.* (2009).

From the present studies it can be concluded that characters like number of fruits per plant, number of marketable fruits/plant, marketable yield and plant height, showing higher values of genotypic coefficient of variability, heritability (broad sense) and genetic advance, can be

Table 3 Estimates of direct and indirect effects and genotypic correlation coefficients between various characters and gross yield in tomato

Characters	Number of fruits	Average fruit weight	Marketable yield	Number of marketable fruits	Plant height	Genotypic correlation with gross yield
Number of fruits/plant	0.796	-0.010	0.819	-0.837	-0.012	0.877
Average fruit weight	-0.256	0.067	0.141	0.164	0.009	0.240
Marketable yield/plant	0.628	0.010	0.904	-0.754	-0.007	0.979
Number of marketable fruits/plant	0.779	-0.013	0.807	0.845	-0.012	0.844
Plant height	0.715	-0.020	0.214	-0.341	-0.030	0.198

Residual value: 0.0014

improved by selection. Further correlation and path analyses revealed that number of fruits/plant and marketable yield/plant are good indicator of gross yield in tomato and are thus effective selection parameters for development of productive genotypes in tomato.

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