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GENETIC VARIABILITY, CORRELATION AND PATH COEFFICIENT STUDIES IN TOMATO

I.J.Golani, D.R. Mehta, V.L. Purohit, H.M. Pandya and M.V. Kanzariya

Vegetable Research Station,
Junagadh Agricultural University, Junagadh - 362 001, India

ABSTRACT

Evaluation of 20 genotypes of tomato elucidated high heritability with high GCV and genetic gain for-10 fruits weight, number of locules/fruit and fruit yield which could be improved by simple selection. The phenotypic and genotypic associations of fruit yield were significant and positive with 10-fruits weight, fruit girth, TSS (only at genotypic level) and number locules/fruit but significant and negative with plant height. Ten-fruit weight had significant and positive correlation with fruit length, fruit girth and number of locules/fruit at both levels. Path analysis confirmed that 10 fruits weight had highest positive direct effect followed by number of locules/fruit. Hence due weightage should be given to both characters while imposing selection for amelioration of fruit yield in tomato.

INTRODUCTION

The efficiency of selection depends on the nature and extent of genetic variability and degree of transmissibility of desirable characters. Since the quantitative characters are markedly influenced by the environment, a study under different locations and years is likely to bring out the genotype-environment interaction for precise estimation of genetic parameters and predicting the progress of selection. Moreover, a knowledge about association of various characters and their relative contribution to yield is helpful for multiple trait selection. The present investigation was conducted to generate these information in a collection of some indigeneous genotypes of tomato (*Lycopersicon esculantum* Mill) in order to formulate a sound breeding plan for its improvement.

MATERIAL AND METHODS

The experiment was laid out in a randomized block design with three replication at Vegetable Research Station, Junagadh Argil. University, Junagadh during late *kharif*, 2003-04. Twenty genotypes of tomato including two check varieties were tested. Thirty days old healthy seedlings of each entry were transplanted during third week of August at a spacing of 75 cm x 45 cm in a plot of 4.5 m x 3.00 m. Recommended agronomic package of practices and plant protection measures were adopted timely to raise the crop successfully. Five plants were selected at random in each plot to recorded the observations on plant height (cm), plant spread (cm), number of branches/plant, 10-fruits weight (g), fruit length (cm), fruit girth (cm), TSS (%), number of locules/fruit. The fruit yield (q/ha) was taken on plot basis. The means were analyzed to compute the variance components and coefficients of variation according to Burton (1952). The heritability in broad sense and expected genetic advance were determined as per Johnson *et al.* (1955). The correlation coefficients were worked out following Al-Jibouri *et al.* (1958) and the path coefficient were calculated as suggested by Dewey and Lu (1959).

RESULTS AND DISCUSSION

The analysis of variance revealed significant mean square estimates for all the characters indicating sufficient diversity among the genotypes. The variation was maximum for 10-fruits weight (267.33 to 836.33 g) followed by fruit yield (190.49 to 442.90 q/ha), plant height (69.89 to 122.11 cm) and number of locules/fruit (2.33 to 6.44) and minimum for fruit length (3.27 to 4.94 cm). The characters showing wide range of variation provide ample scope for selecting the desirable

Table 1. Range, mean, coefficient of variation (GCV and PCV), heritability, genetic advance for various characters in tomato

Characters	Range		Mean±S.E.	GCV (%)	PCV (%)	Heritability (%)	Genetic advance (GA)	GA as % of mean
	Min.	Max.						
Plant height (cm)	69.89	122.11	94.31±6.40	18.27	21.72	70.8	29.85	31.65
Plant spread (cm)	41.45	64.89	52.53±2.19	9.71	12.10	64.4	8.43	16.05
No. of branches/plant	3.47	6.27	4.86±0.36	13.04	18.40	50.2	0.93	19.14
10-fruits weight (g)	267.33	836.33	520.90±29.02	29.35	30.89	90.2	299.18	57.44
Fruit length (cm)	3.27	4.94	4.05±0.12	12.83	13.89	85.3	0.99	24.44
Fruit girth (cm)	3.81	5.82	4.74±0.21	11.52	13.76	70.1	0.94	19.83
Fruit yield (q/ha)	190.49	442.90	307.81±18.82	22.38	24.76	81.7	128.25	41.66
TSS (%)	3.76	5.10	4.26±0.24	6.62	11.90	31.0	0.32	7.51
No. of locules/fruit	2.33	6.44	4.04±0.30	29.64	32.37	83.8	2.26	55.94

types (Table 1).

The phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were high for number of locules/fruit (32.37, 29.64 %), 10-fruits weight (30.89, 29.35 %), fruit yield (24.76, 22.28 %) and plant height (21.72, 18.27 %) which suggested greater phenotypic and genotypic variability among the accessions and sensitiveness of the attributes for making further improvement by selection. Wide difference between PCV and GCV for branches/plant and TSS implied its susceptibility to environmental fluctuation, whereas narrow difference between PCV and GCV for other traits suggested their relative resistance to environmental alteration. The PCV was higher than the respective GCV for all the characters denoting environmental factors influencing their expression to some degree or other.

The heritability in broad sense ranged from 31.0 % for TSS to 90.2 for 10-fruits weight. Such high values of heritability for 10-fruits weight, fruit length, number of locules/fruit and fruit yield clarified that they were least affected by environmental modification and selection based on phenotypic performance would be reliable. The genetic advance as per cent of mean (genetic gain) varied from 7.51 % to 57.44 %. High estimates of genetic gain were obtained for 10-fruits weight (57.44 %), number of locules/fruit (55.94 %) and fruit yield (41.66 %). These characters also exhibited high values of GCV which portrayed that these are controlled by additive gene and phenotypic selection for their improvement could be achieved by simple selection. High estimates of heritability coupled with low GCV and genetic gain were observed for fruit length which might be attributed to non-additive gene action controlling its expression and simple selection would not be rewarding. Nevertheless this could be improved by development of hybrid varieties or utilization of trangressive segregants in heterosis breeding programme. The present results endured Prasad and Rai (1999); Natarajan (1991); Padmini and Vadival (1997); Das *et al.* (1998); Singh *et al.* (2002) and Mohanty (2003) in tomato.

The estimates of phenotypic and genotypic correlation coefficients (Table 2) described that the genotypic correlations were higher in magnitude than the corresponding phenotypic ones for most of the characters combinations establishing predominant role of heritable factors. The phenotypic and genotypic associations of fruit yield was significant and positive with 10-fruits weight, fruit girth, TSS and number of locules/fruit but significant and negative with plant height. The interrelationship among 10-fruits weight had significant and positive correlations with fruit

Table 2. Estimates of genotypic (r_g) and phenotypic (r_p) correlation coefficient between various pairs of characters in tomato

Characters		Plant spread (cm)	No. of branches/ plant	10-fruits weight	Fruit length (cm)	Fruit girth (cm)	TSS (%)	No. of locules/ fruits	Fruit yield (q/ha)
Plant height (cm)	r_g	0.536**	0.118	-0.527**	0.100	-0.520**	-0.475**	-0.645**	-0.949**
	r_p	0.420**	0.040	-0.400*	0.106	-0.427**	-0.217	-0.554**	-0.675**
Plant spread (cm)	r_g		0.692**	-0.051	-0.081	0.049	0.096	-0.014	-0.264
	r_p		0.423**	0.001	-0.063	0.077	0.023	-0.010	-0.237
No. of branches/plant	r_g			0.243	-0.094	0.434**	0.043	0.071	-0.168
	r_p			0.162	-0.080	0.175	0.097	0.078	-0.055
10-fruits weight (g)	r_g				0.365*	0.987**	0.004	0.625**	0.531**
	r_p				0.389*	0.886**	-0.017	0.567**	0.441**
Fruit length (cm)	r_g					0.144	-0.862**	-0.341*	-0.088
	r_p					0.199	-0.521**	-0.319*	-0.059
Fruit girth (cm)	r_g						0.186	0.785**	0.581**
	r_p						0.052	0.697**	0.420**
TSS (%)	r_g							0.661 **	0.370*
	r_p							0.429**	0.205
No. of locules/fruit	r_g								0.643**
	r_p								0.559**

*, ** Significant at P=0.05 and P=0.01 levels, respectively.

length, fruit girth, and number of locules/fruit. Likewise, number of locules had also significant and positive associations with fruit girth and TSS at both levels. On the other hand, fruit length expressed significant and negative relationship with TSS and number of locules/ fruit at both levels. Similarly, plant height had significant and negative correlations with 10-fruits weight, fruit girth, TSS and number of locules/fruit. The findings were in consonance with Dudi and Kalloo (1982); Das *et al.* (1998) and Prasad and Rai (1999).

Due to non-significant correlation coefficient of fruit yield with plant spread, number of branches/plant and fruit length, these three traits were omitted for path coefficient analysis. The path coefficient studies (Table 3) revealed that 10 fruits weight (1.226) had the maximum positive direct effect on fruit yield followed by number of locules/fruit (0.817). The direct effect of fruit girth and TSS on fruit yield was negative but fruit girth had positive indirect effects via 10 fruits weight and number of locules/fruit as well as TSS had positive indirect effect through number of locules/fruit which resulted into strong positive correlation with fruit yield. Plant height manifested significant and negative relationship with fruit yield and its direct effect was negative but its indirect effect via fruit girth was high and positive. Therefore, 10 fruits weight and number of locules/fruit were important contributing traits to circumvent the fruit yield in tomato. The trend of this result was in accordance with Dudi and Kalloo (1982) and Mohanty (2003) who reported high positive direct effect of average fruit weight on yield of tomato but contradict to Prasad and Rai (1999). The unexplained variation in genotypic path was 0.1591 which predicted that 84.09 per cent variation in fruit yield had been determined. It further imparted the occurrence of some more factors, not considered here, contributed to fruit yield of tomato.

Table 3. Direct (diagonal and bold) and indirect effects of various characters on fruit yield in tomato

Characters	Plant height (cm)	10-fruits weight (g)	Fruit girth (cm)	TSS (%)	No. of locules/ fruit	Genotypic correlation with fruit yield (q/ha)
Plant height (cm)	**-0.712**	-0.646	0.832	0.103	-0.527	-0.949**
10-fruits weight (g)	0.375	**1.226**	-1.581	-0.001	0.511	0.531**
Fruit girth (cm)	0.370	1.211	**-1.601**	-0.040	0.642	0.581
TSS (%)	0.338	0.005	-0.297	**-0.218**	0.541	0.370*
No. of locules/fruit	0.459	0.767	-1.257	-0.144	**0.817**	0.643**

*, ** significant at P=0.05 and P=0.01 levels, respectively;
Residual effect = 0.1591.

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