

Genetic parameters study for yield and quality traits in tomato

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ABSTRACT

Genetic parameters studies for variability, correlation and path coefficients analysis of sixteen genotypes of tomato for twelve yield and quality traits revealed that the characters plant height, number of primary branches, number of fruits per plant, fruit diameter, fruit weight, pericarp thickness, number of locules per fruit, number of seeds per fruit, ascorbic acid and yield per plant showed high GCV and high heritability along with high genetic advance and these characters are controlled by additive gene. The study of path analysis indicated that the direct selection of days to first picking, fruit diameter, plant height, fruit weight, days to 75% flowering, ascorbic acid and number of primary branches could be used as selection criteria for improvement. Association analysis revealed that selection criteria based on plant height, fruit diameter, fruit weight, pericarp thickness, number of locules per fruit and ascorbic acid can provide better result for improvement of fruit yield and quality in tomato.

Key words : Genetic variability, Character association, Path coefficient, Tomato.

Tomato (*Solanum lycopersicon* Mill) occupies the prime position among different vegetables. It is high earning cash crop of the mid hills of Meghalaya. The present trend in crop improvement programmes is the development of hybrid cultivars to boost the productivity and profitability. To meet all the requirements of successful hybrids, it is necessary to be familiar with the detailed genetic structure of the selected material to be used for hybrid breeding. Genetic variability among the parents is a prerequisite to select better segregates for various economic characters. Knowledge of correlations is equally important in plant breeding for simultaneous and/or indirect improvement of characters that are difficult to quantify especially for those traits, which exhibit low heritability. Therefore, it is essential to make preliminary investigation of the characters of the lines to be used for the development of superior hybrids. In the light of the above, present investigation were undertaken to study the genetic variability, correlation among different quantitative and qualitative traits and path analysis in tomato genotypes to facilitate the selection of suitable superior genotypes for involvement in hybrids and standard cultivar breeding programmes.

MATERIALS AND METHODS

Sixteen diverse genotypes of tomato were transplanted in *rabi* season of 2005-06 at Horticultural Research Farm, ICAR Research Complex for NEH Region, Umiam (Meghalaya) in randomized block design with three replications at a spacing of 60 x 45 cm in plot size of 2.5 x 2.5 m consisting 23 plants in each plot. All the recommended cultivation practices were followed to

raise a good crop. The statistical analysis was done according to the methods of Ostle (1966) for the analysis of variance, Burton (1952) for genetic coefficients of variation, Allard (1960) for heritability in broad sense and Johnson *et al.* (1955) for genetic advance. Correlation coefficients were calculated by the method described by Al-jibouri *et al.* (1958) and path coefficients according to Wright (1921).

RESULTS AND DISCUSSION

Analysis of variance revealed that significant differences among the genotypes for all the traits under study. In general, phenotypic coefficients of variation were higher than genotypic coefficients of variation indicating that the genotypic influence is lessened under the influence of given environment (Table 1). A close correspondence between GCV and PCV varies in respect of all the characters indicated that environment has very little influence on the expression of the characters under study. The estimates of heritability (broad sense) for all the characters were high showing that the genotypes under study have a great scope for the selection based on these characters. High values of GCV and heritability estimates supplemented with greater gains also indicated additive gene effects regulating the inheritance such traits (Narayan *et al.*, 1996). The high GCV values for plant height, number of primary branches, number of fruits per plant, fruit diameter, fruit weight, number of seeds per fruit, number of locules per fruit, ascorbic acid and yield per plant were accompanied with high heritability indicating the scope for selection. Burton (1952) also suggested that genotypic coefficient of variation along

Table 1 : Genotypic and phenotypic coefficients of variations (GCV and PCV), heritability (h²) and genetic advance for yield and its component characters in tomato

Characters	Mean	Range	GCV (%)	PCV (%)	Heritability (%)	Genetic advance as % of mean
Plant height (cm)	56.15	35.32 – 99.07	25.07	26.29	90.90	58.52
No of primary branches	6.21	4.36 – 8.34	15.38	18.08	72.40	31.08
Days to 75% flowering	65.19	55.11-75.68	9.67	10.50	84.70	16.86
Days to first picking	91.17	80.32 – 106.23	7.04	7.99	77.60	11.88
No of fruits/ plant	22.92	13.34 – 46.33	31.92	33.58	90.30	73.91
Fruit diameter (cm)	4.47	2.98 – 5.81	12.18	14.74	68.30	23.49
Fruit weight (g)	44.52	14.01 – 67.17	23.58	26.53	79.00	51.10
No of seeds/fruit	75.04	28.35 – 118.17	34.43	38.06	81.80	74.45
No of locules/fruit	3.87	2.34 – 6.97	38.52	39.36	95.80	64.08
Pericarp thickness (cm)	0.42	0.21 – 0.62	19.64	23.83	67.90	38.10
Ascorbic acid (mg/100g)	27.62	22.99 – 43.09	20.71	21.45	93.20	36.50
Yield per plant (kg)	0.81	0.51 – 1.1	25.00	26.53	88.80	69.14

with heritability gives clear picture of gain to be expected from selection.

Estimates of heritability and genetic advance provide information about the heritable portion and genetic gain expected in the next generation, hence it is desirable to consider these estimates. High heritability with high genetic advance was observed for plant height, number of primary branches, number of fruits per plant, fruit diameter, fruit weight, pericarp thickness, number of locules per fruit,

number of seeds per fruit, ascorbic acid and yield per plant indicating that most likely the heritability is due to additive gene effects and selection may be effective. Johnson *et al.* (1955) has also suggested that characters with high heritability coupled with high genetic advance would respond to selection better than those with high heritability and low genetic advance. These findings are in accordance with the reports of Joshi and Singh (2003) and Singh and Narayan (2004) in tomato. High values of

Table 2 : Genotypic (G) and phenotypic (P) correlation for fruit yield and its component characters of tomato

Sr. No.	Characters	Correlation	2	3	4	5	6	7	8	9	10	11	Fruit yield/plant
1.	Plant height	P	0.170	0.060	0.018	0.513*	-0.571*	-0.515*	-0.092	0.050	-0.391	0.595**	-0.311
		G	0.261	0.030	0.070	0.546*	-0.714**	-0.581**	-0.073	0.028	-0.455*	0.691**	-0.557*
2.	No of primary branches	P		-0.073	-0.052	0.248	-0.156	-0.098	0.198	-0.040	0.087	-0.015	-0.215
		G		-0.061	-0.051	0.297	-0.216	-0.083	0.154	-0.078	-0.021	0.016	-0.084
3.	Days to 75% flowering	P			0.754**	-0.389	0.033	0.043	-0.038	-0.012	0.091	-0.058	-0.167
		G			0.861**	-0.430	0.107	0.053	-0.054	-0.017	0.159	-0.070	-0.255
4.	Days to first picking	P				-0.139	-0.006	-0.057	-0.284	-0.325	0.181	-0.138	-0.074
		G				-0.163	-0.028	-0.049	-0.320	-0.344	0.195	-0.149	-0.049
5.	No of fruits/ plant	P					-0.369	-0.669**	0.085	-0.393	-0.173	0.259	0.020
		G					-0.520*	-0.750**	0.116	-0.444*	-0.260	0.297	0.001
6.	Fruit diameter	P						0.483*	0.264	0.182	0.488*	-0.335	0.274
		G						0.678**	0.285	0.230	0.634**	-0.404	0.420*
7.	Fruit weight	P							-0.045	0.054	0.420	-0.189	0.471*
		G							0.012	0.079	0.609**	-0.200	0.520*
8.	No of seeds/fruit	P								0.320	0.047	0.070	-0.100
		G								0.326	0.039	0.080	-0.062
9.	No of locules/fruit	P									-0.320	0.063	-0.391
		G									-0.396	0.063	-0.522*
10.	Pericarp thickness	P										-0.228	0.172
		G										-0.283	0.480*
11.	Ascorbic acid	P											-0.355
		G											-0.451*

* and ** indicates significance of values at P=0.05 and P=0.01, respectively

Table 3 : Genotypic path coefficient analysis (direct and indirect) of different characters on fruit yield in tomato

Sr. No.	Characters	1	2	3	4	5	6	7	8	9	10	11	r
1.	Plant height	<u>0.402</u>	-0.124	-0.027	0.047	0.158	-0.338	-0.211	-0.019	-0.003	0.092	-0.506	-0.557*
2.	No of primary branches	0.105	<u>-0.474</u>	0.054	-0.034	0.086	-0.102	-0.030	0.039	0.008	0.004	-0.012	-0.084
3.	Days to 75% flowering	0.012	0.029	<u>-0.885</u>	0.578	-0.124	0.051	0.019	-0.014	0.002	-0.032	0.052	-0.255
4.	Days to first picking	0.028	0.024	-0.762	<u>0.672</u>	-0.047	-0.013	-0.018	-0.082	0.037	-0.039	0.110	-0.049
5.	No of fruits/ plant	0.220	-0.141	.381	-0.110	<u>0.288</u>	-0.247	-0.273	0.030	0.048	0.052	-0.218	0.001
6.	Fruit diameter	-0.287	0.102	-0.094	-0.019	-0.150	<u>0.474</u>	0.246	0.073	-0.025	-0.128	0.297	0.420
7.	Fruit weight	-0.234	0.040	-0.047	-0.033	-0.216	<u>0.321</u>	<u>0.363</u>	0.003	-0.009	-0.123	0.147	0.520*
8.	No of seeds/fruit	-0.029	-0.073	0.048	-0.215	0.033	0.135	0.004	<u>0.257</u>	-0.035	-0.008	-0.059	-0.062
9.	No of locules/fruit	0.011	0.037	0.015	-0.231	-0.128	0.109	0.029	0.084	<u>-0.108</u>	0.080	-0.047	-0.522*
10.	Pericarp thickness	-0.183	0.010	-0.140	0.131	-0.075	0.300	0.221	0.010	0.043	<u>-0.202</u>	0.207	0.480*
11.	Ascorbic acid	0.278	-0.008	0.062	-0.100	0.086	-0.192	-0.073	0.021	-0.007	0.057	<u>-0.733</u>	-0.451*

* indicates significance of value at P=0.05

GCV accompanied with heritability and genetic advance were noticed for plant height, number of primary branches, number of fruits per plant, fruit diameter, fruit weight, pericarp thickness, number of locules per fruit, number of seeds per fruit, ascorbic acid and yield per plant. The high GCV couples with high heritability and genetic advance offers the most effective condition for selection. Thus direct selection for these characters could be effective for improvement of tomato.

Coefficients of correlation were worked out at phenotypic and genotypic level for twelve characters (Table 2). The genotypic correlation was higher than the phenotypic correlation coefficients indicating the strong association between two characters genetically, but the phenotypic correlation value is lessened by the significant interaction of environment. Fruit yield per plant expressed a highly significant positive correlation with fruit diameter and pericarp thickness, while significant negative correlation with plant height, number of locules per fruit and ascorbic acid at genotypic level. Only one trait fruit weight showed significant positive association with fruit yield at phenotypic and genotypic level. Similar finding was also reported by Mohanty (2002). Pericarp thickness showed significant positive correlation with fruit diameter and fruit weight, which is in agreement with the findings of Ghosh and Syamal (1994). Significant positive correlation was shown by fruit weight with fruit diameter, whereas, significant negative correlation was exhibited with plant height and number of fruits per plant by this character (fruit weight) at phenotypic and genotypic level. These results are in accordance with the findings of Joshi *et al.* (2004) in tomato. Days to first picking had significant positive correlation with days to 75% flowering in present study. On the basis of association analysis studies, it can be concluded that the selection criteria based on plant height, fruit diameter, fruit weight, pericarp thickness,

number of locules per fruit and ascorbic acid can provide better result for improvement of fruit yield and quality in tomato.

Path coefficient analysis of different characters (Table 3) contributing towards fruit yield per plant revealed that days to first picking expressed a highest positive direct effect on fruit yield per plant followed by fruit diameter, plant height and fruit weight, whereas, lowest positive direct effect on fruit yield per plant was observed for number of seeds per fruit. Among the negative direct effects, days to 75% flowering showed highest negative direct effect on fruit yield per plant followed by ascorbic acid and number of primary branches, whereas lowest negative direct effect on fruit yield per plant was observed for number of locules/fruit. Positive direct effects of various characters on fruit yield per plant were observed in the present study are according to the findings of Joshi *et al.* (2004) in tomato. The study of path analysis indicated that the direct selection of days to first picking, fruit diameter, plant height, days to 75% flowering, fruit weight, ascorbic acid and number of primary branches could be used as selection criteria for improvement in tomato.

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