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Correlation and path analysis studies in tomato (*Solanum lycopersicum* L.)

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Abstract

Estimates of genetic parameters of twenty five tomato genotypes indicated a good amount of genetic variation in the germplasm collections. Correlation and path analysis of twenty five tomato genotypes were studied by evaluating them for yield, horticultural and quality traits in a randomized block design with three replications. The results showed that in general the correlation coefficients were high at genotypic than at phenotypic level. Results indicated that yield per plant was significantly and positively correlated with number of fruits per plant, average fruit weight, pericarp thickness and total soluble solids. Path coefficient analysis revealed that the number of fruits per plant had maximum positive and direct effect followed by average fruit weight.

Key words: Correlation, path analysis and tomato.

Introduction

Tomato (*Solanum lycopersicum* L.) is one of the most widely produced and consumed vegetables in the world, both for fresh market and for processed food industries. Tomato is commonly used as a model crop for diverse physiological, cellular, biochemical, molecular and genetic studies because it is easily grown, has a short life cycle and is easy to manipulate by grafting and cutting (Kinet and Peet, 1997). Tomato is most protective food as it contains various vitamins, minerals (Choudhary,1967) and lycopene, which is implicated in the prevention of various diseases including cancer, coronary heart diseases and cataract (Willett,1994). Medicinally, it acts as blood purifier, gastric juice promoter and intestinal antiseptic and anticancerous agent. The possibility of improvement in any crop is measured by the variability available in a crop. Correlation and path analysis are the important biometrical techniques to determine the yield components. Correlation coefficients indicate the nature of association among the traits, and path analysis splits the correlation coefficients into measure of direct and indirect effects, thus, providing an understanding on the direct and indirect contribution of each character towards yield.

Materials and Methods

The experiment was laid out at Vegetable Research Farm of the Department of Vegetable Science, Dr. Y.S. Parmar University of Horticulture and Forestry, Solan, which is located at an altitude of 1273 m above mean sea level, latitude of 35.5°N and longitude of 77.8°E. Mean temperature during the crop season varied from 15.7 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 of having dimensions of size 2.7 × 1.8 m with spacing of 90 × 30 cm. Observations on sixteen plant 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/0.503 cm^2), buck eye rot incidence (%), thousand seed weight (g), shelf life of fruits (days) and total soluble solids (^{0}B) were recorded from ten randomly selected plants, and the means were subjected to statistical analysis. Correlation coefficient and path analysis were also worked out.

Results and Discussion

The correlation coefficients among different characters were worked out in all possible combinations both at phenotypic and genotypic levels and are presented in Table 1. The phenotypic correlation coefficient among sixteen characters indicated that days to first picking had significant positive correlation with

Table 1. Phenotypic (rp) and genotypic (rg) correlation coefficients among various traits in tomato

Traits		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Days to first picking	P	1.000	-0.456*	0.090	-0.353	-0.302	0.476*	0.002	0.220	-0.052	0.388	0.239	0.561**	0.337	-0.127	0.087	-0.041
	G	1.000	-0.489*	0.113	-0.396*	-0.428*	0.582**	0.080	0.314	-0.151	0.439*	0.245	0.693**	0.365	-0.148	0.083	-0.051
Plant height (cm)	P		1.000	0.176	0.496*	0.278	-0.267	0.132	-0.125	-0.073	-0.002	-0.128	-0.486*	-0.088	0.270	-0.019	0.192
	G		1.000	0.178	0.519**	0.357	-0.283	0.150	-0.142	-0.107	-0.003	-0.133	-0.538**	-0.111	0.291	-0.035	0.223
Yield per plant (g)	P			1.000	0.482*	0.053	0.429*	0.002	0.044	0.231	0.428*	0.182	-0.098	-0.241	0.181	0.345	-0.063
	G			1.000	0.493*	0.061	0.478*	-0.008	0.008	0.254	0.444*	0.183	-0.131	-0.261	0.209	0.510**	-0.128
Number of fruits per plant	P				1.000	0.353	-0.541**	0.074	-0.217	0.106	-0.440*	-0.279	-0.500*	-0.514**	-0.212	-0.002	0.307
	G				1.000	0.480*	-0.647**	0.122	-0.288	0.113	-0.481*	-0.317	-0.592**	-0.587**	-0.285	-0.067	0.396*
Number of fruits per cluster	P					1.000	-0.281	0.001	-0.259	-0.076	-0.323	-0.404*	-0.208	-0.248	-0.110	-0.242	0.235
	G					1.000	-0.320	0.007	-0.411*	-0.081	-0.395	- 0.568**	-0.339	-0.093	-0.060	-0.338	0.504*
Average fruit weight (g)	P						1.000	-0.193	0.376	0.158	0.785**	0.429*	0.409*	0.361	0.369	0.304	-0.335
	G						1.000	-0.222	0.425*	0.162	0.868**	0.469*	0.536**	0.467*	0.437*	0.377	- 0.571**
Fruit shape index	P							1.000	0.000	-0.068	0.091	-0.006	0.136	-0.089	-0.189	-0.156	0.171
	G							1.000	-0.069	0.017	0.111	0.016	0.150	-0.119	-0.201	-0.219	0.243
Stem thickness (mm)	P								1.000	0.061	0.432*	0.433*	0.197	0.043	0.035	0.190	-0248
	G								1.000	0.074	0.490*	0.464*	0.292	0.055	0.075	0.302	-0.409*
No. of locules per fruit	P									1.000	0.105	-0.044	-0.020	-0.028	0.062	0.021	-0.032
	G									1.000	0.098	-0.055	-0.026	-0.165	0.081	0.033	-0.133
Pericarp thickness (mm)	P										1.000	0.574**	0.381	0.335	0.486*	0.334	-0.345
	G										1.000	0.597**	0.433*	0.384	0.537**	0.474*	-0.460*
Fruit firmness (kg/0.503 cm^2)	P											1.000	0.350	0.237	0.365	0.546**	-0.224
	G											1.000	0.442*	0.278	0.401*	0.690**	-0.291
Buckeye rot incidence (%)	P												1.000	0.538**	0.022	-0.122	-0.228
	G												1.000	0.776**	0.024	-0.151	-0.234
Thousand seed weight (g)	P													1.000	0.146	-0.236	-0.059
	G													1.000	0.151	-0.355	-0.205
Shelf life of fruits (days)	P														1.000	0.335	-0.145
	G														1.000	0.459*	-0.227
Total soluble solids (°B)	P															1.000	-0.176
	G															1.000	-0.279
Ascorbic acid content (mg/100 g)	P																1.000
	G																1.000

* Significant at 5 % level of significance, ** Significant at 1 % level of significance

average fruit weight (0.476) and buckeye rot incidence(0.561), whereas, significant negative correlation was observed with plant height (-0.456), which was significantly and positively correlated with number of fruits per plant (0.496) and significantly and negatively with buckeye rot incidence (-0.486). Yield per plant also showed significant positive correlation with number of fruits per plant (0.482), average fruit weight (0.429) and pericarp thickness (0.428). Number of fruits per plant was significantly and negatively correlated with average fruit weight (-0.541), pericarp thickness (-0.440), buckeye rot incidence (-0.500) and thousand seed weight (-0.514). Number of fruits per cluster was significantly and positively correlated with fruit firmness (-0.404). Average fruit weight showed significant positive correlation with pericarp thickness (0.785), fruit firmness (0.429) and buckeye rot incidence (0.409). Stem thickness showed significant positive correlation with pericarp thickness (0.432) and fruit firmness (0.433). Pericarp thickness showed significant positive correlation with fruit firmness (0.574) and shelf life of fruits (0.486). Fruit firmness had significant positive correlation with total soluble solids (0.546). Buckeye rot incidence had significant positive correlation with thousand seed weight (0.538). Days to first picking had significant positive correlation with average fruit weight (0.582), pericarp thickness (0.439), buckeye rot incidence (0.693) and significant negative correlation with plant height (-0.489), number of fruits per plant (-0.396) and number of fruits per cluster (-0.428). Correlation study revealed significant positive correlation of days to first picking with average fruit weight, pericarp thickness and buckeye rot incidence and significant negative correlation with plant height, number of fruits per plant and number of fruits per cluster. Similar are the findings of Bhardwaj (1999) for days to first picking with pericarp thickness. Similar findings of significant positive correlation of days to first flowering with average fruit weight and pericarp thickness and negative correlation with plant height and number of fruits per cluster were also reported by Cuong (2002). Plant height had significant positive correlation with number of fruits per plant (0.539) and significant negative correlation with buckeye rot incidence (-0.538). This trait showed significant positive correlation with number of fruits per plant and significant negative correlation with buckeye rot incidence. Similar results of significant positive correlation of plant height with number of fruits per plant were also reported by Bhardwaj (1999). Yield per plant had significant positive correlation with number of fruits per plant (0.493), average fruit weight (0.478), pericarp thickness (0.444) and total soluble solids (0.510). Correlation studies revealed that number of fruits per plant, average fruit weight and pericarp thickness had significant positive correlation with yield. Similar findings of positive significant correlation of average fruit weight with yield were also reported by Dev and Sharma (1996). Number of fruits per plant had significant positive correlation with number of fruits per cluster (0.480) and ascorbic acid content (0.396) and significant negative correlation with average fruit weight (-0.647), pericarp thickness (-0.481), buckeye rot incidence (-0.592) and thousand seed weight (-0.587). In the correlation studies, number of fruits per plant showed significant positive association with number of fruits per cluster and ascorbic acid content, and significant negative association with average fruit weight, pericarp thickness, buck eye rot incidence and thousand seed weight. Similar findings of positive correlation of number of fruits per plant with number of fruits per cluster were also reported by Cuong (2002) and Joshi *et al.* (2004). Path coefficient study showed positive direct effect of this trait on yield per plant which was in conformity with earlier findings of Singh *et al.* (2004), Joshi *et al.* (2004) and Kumar (2006). Number of fruits per cluster had significant positive correlation with ascorbic acid content (0.504) and significant negative correlation with stem thickness (-0.411) and fruit firmness (-0.568). This trait showed significant positive correlation with ascorbic acid content and significant negative correlation with stem thickness and fruit firmness. Average fruit weight had significant positive correlation with stem thickness (0.425), pericarp thickness (0.868), fruit firmness (0.469), buckeye rot incidence (0.536), thousand seed weight (0.467), shelf life of fruits (0.437) and significant negative correlation with ascorbic acid content (-0.571). Correlation studies revealed that average fruit weight had highly significant positive association with stem

thickness, pericarp thickness, fruit firmness, buckeye rot incidence, thousand seed weight and shelf life of fruits. Similar findings of significant positive association of average fruit weight , stem thickness, pericarp thickness, fruit firmness and shelf life were also reported by Vikram and Kohli (1998) and Joshi *et al.* (2004). Stem thickness had significant positive correlation with pericarp thickness (0.490) and fruit firmness and significant negative correlation with ascorbic acid content (-0.409). Pericarp thickness had significant positive correlation with fruit firmness (0.597), buckeye rot incidence (0.433), shelf life (0.401) and total soluble solids (0.690). In correlation studies, the pericarp thickness had significant positive correlation with fruit firmness, buckeye rot incidence, shelf life of fruits and total soluble solids and significant negative correlation with ascorbic acid content. Similar finding of significant positive correlation of this trait with fruit firmness and shelf life of fruits was also reported by Kumar (2000) and Joshi (2002). In path coefficient analysis, the pericarp thickness had positive direct effect on yield. Similar are the findings of Kumar (2000) and Kumar (2006). Buckeye rot incidence had significant positive correlation with thousand seed weight (0.776). Shelf life had significant positive correlation with total soluble solids (0.459). The results showed that in general, the correlation coefficients were high at genotypic than at phenotypic level. Results indicated that yield per plant was significantly and positively correlated with number of fruits per plant, average fruit weight pericarp thickness and total soluble solids.

In order to understand the factors contributing significantly towards yield per plant, the estimates of direct and indirect effects were computed through path coefficient analysis. Path coefficient analysis helps in partitioning the genotypic correlation coefficients into direct and indirect effects of component characters in yield. The results obtained are presented in Table 2. Analysis revealed that out of all the characters studied, significant positive direct effect towards yield was contributed by number of fruits per plant (1.031), followed by average fruit weight (0.960), total soluble solids (0.215) and pericarp thickness (0.005). Similar are the findings of Singh *et al.* (2004), Joshi *et al.* (2004) and Kumar (2006). Path coefficient analysis revealed that number of fruits per plant had maximum positive and direct effect followed by average fruit weight.

Table 2. Estimates of direct and indirect effects of significant traits on yield per plant in tomato

Traits	Number of fruits per plant	Average fruit weight (g)	Pericarp thickness (mm)	Total soluble solids (^{0}B)	Genotypic correlation coefficient with yield per plant
Number of fruits per plant	1.031	-0.521	-0.003	-0.014	0.493
Average fruit weight (g)	-0.567	0.960	0.005	0.081	0.478
Pericarp thickness (mm)	-0.496	0.833	0.005	0.102	0.444
Total soluble solids (^{0}B)	-0.069	0.362	0.003	0.215	0.510

Residual effects = 0.1199, Underline values indicate direct effects

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