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Research Note

Character association and path coefficient analysis for yield and quality traits in tomato (*Solanum lycopersicum* L.) under mid-hills of Himachal Pradesh

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Abstract
The present investigation was carried out to study the correlation and path coefficient between yield and quality traits at the experimental farm of Dr. Yaswant Singh Parmar University of Horticulture and Forestry, Solan during Kharif season, 2014. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. Positive association of yield components with average fruit weight, plant height, inter-nodal distance, pericarp thickness and harvest duration was observed. Significant direct effect towards yield was contributed by average fruit weight followed by number of fruits per plant, pericarp thickness and harvest duration, whereas number of fruits per cluster, number of locules per fruit, days to first picking, total soluble solids and inter-nodal distance showed negative direct effect. The indirect effect of number of fruits per cluster was of sufficient magnitude via number of fruits per plant. Pericarp thickness and locular wall thickness also exhibited high indirect effect via average fruit weight. Considering the direct and indirect effect of various components characters, it was ascertained that average fruit weight, number of fruits per plant, pericarp thickness and harvest duration are the characters to be emphasized in improving the yield.

Key words
Tomato, Component characters, Correlation, Path analysis, Yield

Tomato (*Solanum lycopersicum* L.) is one of the most important popular vegetable in the world because of its wider adaptability, high yielding potential and suitability for variety of uses in fresh as well as processed food industries. It is a self-pollinated crop belongs to the family Solanaceae and is native of Peru - Ecuador region. The approaches to make significant improvement in tomato require information regarding nature and magnitude of genetic variation in quantitative traits and their interrelationships in the available germplasm, which are important pre-requisites for a systematic breeding program. Selection for yield, based on multiple traits is always better than selection based on yield alone (Bello *et al*., 2010). Using these components, breeders would understand strength of correlated traits that would assists in decision making process to select for simultaneous improvement of more than one character. However, correlation alone does not provide information on the contribution of related characters, which need the study of cause and effect relationship of different characters among themselves (McGiffen *et al*., 1994). It has been observed that path coefficient analysis reveals the exact relationship of characters thereby providing more information than simple correlation analysis. Thus the present investigation was initiated to study both correlation and path coefficient analysis in different tomato germplasm, thereby; it is possible to recognize the relationship among various characters of tomato.

The experimental material consisting of 56 genotypes of tomato collected from various sources were evaluated during Kharif season, 2014 at an experimental farm in the Department of Vegetable Science, Dr. Y. S. Parmar University of Horticulture and Forestry, Nauni, Solan (HP). The experiment was laid out in a randomized complete block design with three replications at a spacing of 90×30 cm. Observations were recorded for 14 characters *viz.*, days to first flowering, number of fruits per cluster, number of fruits per plant, average fruit weight (g), fruit yield per plant (g), plant height (cm), inter-nodal distance (cm), thousand seed weight (g), number of locules per fruit, total soluble solids (^{0}B), locular wall thickness (mm), pericarp thickness (mm), lycopene content (mg/100g) and harvest duration (days) in five randomly selected plants from each genotype in each replication. Phenotypic and genotypic correlation coefficients were computed as suggested by Al-Jibouri *et al.* (1958). Path coefficient analysis for yield components was carried out according to the method given by Dewey and Lu (1959). The correlation and path coefficient analysis was carried out using SPAR-1 (Statistical Package for Agricultural Data Analysis) software of Indian Agricultural Statistical Research Institute, New Delhi.

In the present study, correlation coefficients among different characters were worked out in all possible combinations at phenotypic and genotypic levels

and presented in Table 1. The correlation was partitioned into direct and indirect effects by the path coefficient analysis (Table 2). In general, the genotypic correlations were higher in magnitude than phenotypic correlations suggesting a strong inherent relationship between different traits. The phenotypic expression of the correlation gets reduced under the influence of the environment.

Days to first picking showed significant positive correlation with pericarp thickness and locular wall thickness, while significant negative correlation was observed for the number of fruits per plant, number of fruits per cluster and harvest duration. Similar findings were also recorded by Kumar *et al.* (2014). Path analysis revealed negative direct effect towards yield which was also observed by Kumar (2014). Number of fruits per cluster showed significant positive correlation with number of fruits per plant, plant height, inter-nodal distance, thousand seed weight and harvest duration, while significant negative correlation was observed for the average fruit weight, locular wall thickness, and number of locules per fruit. Ara *et al.* (2009) recorded positive and significant association of number of fruits per cluster with number of fruits per plant and plant height. Negative significant associations of number of fruits per cluster with average fruit weight are in line with findings of Ara *et al.* (2009). Singh and Singh (1980) also noted significant negative correlation of number of fruits per cluster with number of locules per fruit. Correlation studies revealed that number of fruits per plant exhibited significant positive correlation with plant height, inter-nodal distance and harvest duration which is in accordance with Kumar (2010) for plant height and for harvest duration. Negative and significant correlation was found with average fruit weight, pericarp thickness, locular wall thickness and number of locules per fruit. Buckseth *et al.* (2012) also reported significant negative correlation of number of fruits per plant with average fruit weight. Sharma *et al*. (2010) reported significant negative correlation of number of fruits per plant with pericarp thickness. Parsanna *et al.* (2005) also observed significant negative correlation of number of fruits per plant with average fruit weight, number of locules per fruit and flesh thickness.

In path coefficient analysis, this trait showed high positive direct effect on yield of tomato, which was in conformity with the results of Buckseth *et al.* (2012), Kumar *et al.* (2014) and Meena and Bahadur (2015). Correlation studies revealed that average fruit weight had positive significant correlation with pericarp thickness, locular wall thickness and yield per plant. Joshi *et al*. (2004) and Sharma *et al.* (2010) also reported significant positive association of average fruit weight with pericarp thickness. Significant positive association of average fruit weight with yield was also reported by Ara *et al.* (2009) and Meena and Bahadur (2015). In path coefficient analysis, this trait had positive direct effect on yield. Similar findings were reported by Ara *et al.*(2009), Buckseth *et al.* (2012) and Meena and Bahadur (2015). Plant height showed positive and significant correlation with inter-nodal distance, total soluble solids, harvest duration and yield per plant and negative significant correlation was also observed with number of locules per fruit. Singh *et al.* (2004) also found significant and positive correlation of plant height and total soluble solids. Ara *et al.* (2009) also reported the existence of significant positive correlation between plant height and yield. Kumar (2010) reported positive significant relationship of plant height with harvest duration. In path analysis, this trait showed positive direct effect on yield. Ara *et al*. (2009) reported similar results. Inter-nodal distance showed positive and significant correlation with total soluble solids, harvest duration and yield per plant. Kumar (2014) also reported the positive association of inter-nodal distance with yield per plant. Further, in path analysis this trait showed negative direct effect on yield.

The above all result suggests that yield cannot be improved directly by making selections for inter-nodal distance. Pericarp thickness showed positive and significant correlation with locular wall thickness and yield per plant. Similar results of pericarp thickness with yield were also obtained by Buckseth *et al.* (2012). Positive direct effect was shown by pericarp thickness on fruit yield per plant. Kumar *et al.* (2014) also reported similar results. Locular wall thickness showed positive and significant correlation with yield per plant, days to first picking, average fruit weight and pericarp thickness while, negative significant correlation of this trait was observed with number of fruits per plant and number of fruits per cluster. Number of locules per fruit showed negative and significant correlation with total soluble solids. Similar result was also reported by Kumar (2014). Negative direct effect was shown by number of locules per fruit on fruit yield per plant. Total soluble solids showed positive and significant correlation with harvest duration and positive but non-significant association with yield which is similar to the findings of Kumar (2014).

Path analysis revealed negative direct effect on fruit yield per plant and Correlation was found positive. In correlation studies harvest duration also showed positive and significant correlation with yield per plant. In path coefficient analysis, harvest duration showed positive direct effect on yield. Ara *et al.* (2009) and Kumar (2014) also reported positive direct effect of harvest duration on yield. Fruit yield per plant had positive and significant association with plant height, average

fruit weight, inter-nodal distance, pericarp thickness, locular wall thickness and harvest duration. Meena and Bahadur (2015) also reported positive significant correlation of yield per plant with average fruit weight. Similarly, Ara *et al.* (2009) reported positive significant association of yield with plant height. Buckseth *et al.* (2012) found significant association of yield with pericarp thickness. Joshi *et al.* (2004) found significant and positive correlation of yield per plant with pericarp thickness, harvest duration and average fruit weight.

A perusal of the results obtained from character association and path coefficient analysis, revealed that average fruit weight, number of fruits per plant, pericarp thickness and harvest duration were found to have significant influence on yield per plant and also have high positive direct and indirect effects through many other characters. Hence, simultaneous selection based on average fruit weight, number of fruits per plant, pericarp thickness and harvest duration seems to be more promising in improving the yield per plant in tomato. The residual effect of the genotypic and phenotypic path analysis was very less *i.e.* 0.08906. This indicates that the characters chosen for the present study is the main components of yield and that the variability in yield is accounted by the characters chosen for this investigation to a considerable extent.

References

Al-Jibouri, H.A., Miller, P.A. and Robinson, H.F. 1958. Genotypic and environmental variances and co-variances in an upland cotton cross of interspecific origin. *Agronomy J*., **50**: 633 - 636.

Ara, A., Narayan, R., Ahmed, N. and Khan, S.H. 2009. Genetic variability and selection parameters for yield and quality attributes in tomato. *Indian Journal of Horticulture,* **66**(1): 73 - 78.

Bello, O.B., Abdulmaliq, S.Y., Afolabi, M.S. andIge, S.A. 2010. Correlation and path coefficient analysis of yield and agronomic characters among open pollinated maize varieties and their F_1 hybrids in a diallel cross. *African Journal of Biotechnology,* **18**(9): 2633 - 2639.

Bukseth, T., Sharma, M.K. and Thakur, K.S. 2012. Genetic diversity and path analysis in tomato (*Solanum lycopersicum* L.). *Vegetable Science,* **39**(2): 221 - 223.

Dewey, D.R. and Lu, K.H. 1959. A correlation and path coefficients analysis of crested wheat grass seed production. *Agronomy Journal,* **51**: 515 - 518.

Joshi, A., Vikram, A. and Thakur, M.C. 2004. Studies on genetic variability, correlation and path analysis for yields and physio-chemical character in tomato (*Lycopersicum esculentum* Mill.). *Progressive Horticulture,* **36**(1): 51 - 58.

Kumar, N. 2014. Studies on genetic variability in tomato (*Solanum lycopersicum* L.) genotypes for different horticultural traits. M.Sc. Thesis. Department of vegetable science. Dr. Y. S. Parmar University of Horticulture and Forestry, Nauni, Solan.

Kumar, P., Singh, K., Jindal, S.K. and Khurana, D.S. 2014. Association studies for processing traits in tomato (*Solanum lycopersicum* L.). *Journal of Research, Punjab Agricultural University,* **51**(3-4): 250 - 254.

Kumar, S. 2010. Genetic variability and interrelationship of traits in F_3 progenies of tomato (*Lycopersicon esculentum* Mill.) under cold desert of Leh Ladakh. *Crop Improvement,* **37**(1): 66 - 72.

McGiffen, M.E., Pantone, D.J. and Masiunas, J.B. 1994. Path analysis of tomato yield components in relation to competition with black and eastern black nightshade. *Journal of American Society of Horticultural Science,* **119**: 6 - 11.

Meena, O.P. and Bahadur, V. 2015. Genetic Associations Analysis for fruit yield and its contributing traits of indeterminate tomato (*Solanum lycopersicum* L.) germplasm under open field condition. *Journal of Agricultural Science,* **7**(3): 148 - 163.

Prassana, H.C., Verma, A., Raj, M. and Singh, A.K. 2005. Genetic variability and association analysis in exotic cherry tomato. *Journal of Plant Genetic Resources,* **18**(1): 90 - 91.

Sharma, J.P., Singh, A.K. and Tiwari, P. 2010. Selection parameters for productive plant type in tomato (*Lycopersicon esculentum* Mill.). *Journal of Hill Agriculture,* **1**(1): 52 - 55.

Singh, J.K., Singh, J.P., Jain, S.K., Joshi, Aradhana and Joshi, A. 2004. Correlation and Path coefficient analysis in tomato. *Progressive Horticulture,* **36**(1): 82 - 86.

Singh, R.R. and Singh, H.N. 1980. Correlation studies in tomato. *Indian Journal of Agricultural Sciences,* **50**(8): 595 - 598.

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Table 1. Genotypic (G) and Phenotypic (P) coefficients of correlation of different characters in tomato genotypes

Characters		DFP	NFPC	NFPP	AFW	PH	ID	PT	LWT	NLPF	TSS	TSW	LC	HD
1. Days to first picking	G	-0.266*	-0.398**	0.106	-0.208	-0.181	0.400**	0.498**	0.009	-0.043	0.175	0.215	-0.366**	-0.220
	P	-0.199	-0.314*	0.085	-0.189	-0.149	0.286*	0.334*	0.037	-0.043	0.137	0.159	-0.312*	-0.174
2. Number of fruits per cluster	G		0.713**	-0.296*	0.538**	0.325*	-0.145	-0.314*	-0.655**	0.001	0.309*	-0.069	0.264*	0.155
	P		0.632**	-0.266*	0.486**	0.284*	-0.109	-0.245	-0.496**	-0.031	0.212	-0.054	0.219	0.137
3. Number of fruits per plant	G			-0.413**	0.433**	0.280*	-0.448**	-0.415**	-0.270*	0.032	0.050	-0.093	0.312*	0.233
	P			-0.409**	0.372**	0.212	-0.381**	-0.373**	-0.228	0.032	0.045	-0.090	0.256	0.244
4. Average fruit weight (g)	G				0.134	0.253	0.584**	0.571**	0.233	0.102	0.068	-0.012	0.213	0.723**
	P				0.123	0.195	0.501**	0.510**	0.198	0.085	0.061	-0.015	0.173	0.717**
5. Plant height (cm)	G					0.831**	-0.131	-0.052	-0.316*	0.298*	0.241	0.024	0.679**	0.390**
	P					0.661**	-0.082	-0.061	-0.265*	0.225	0.183	0.013	0.520**	0.345**
6. Internodal distance (cm)	G						0.112	0.105	-0.253	0.398**	0.034	0.185	0.598**	0.426**
	P						0.044	0.040	-0.182	0.270*	0.011	0.110	0.406**	0.328*
7. Pericarp thickness (mm)	G							0.739**	-0.248	0.207	0.082	0.123	-0.181	0.339**
	P							0.679**	-0.215	0.110	0.056	0.119	-0.144	0.286*
8. Locular wall thickness (mm)	G								-0.087	0.245	-0.007	-0.047	-0.109	0.281*
	P								-0.106	0.158	-0.030	-0.014	-0.107	0.244
9. Number of locules per fruit	G									-0.310*	-0.196	0.073	-0.148	0.008
	P									-0.212	-0.170	0.004	-0.140	0.009
10. Total soluble solids (^{0}B)	G										-0.141	0.146	0.315*	0.110
	P										-0.065	0.122	0.176	0.098
11. Thousand seed weight (g)	G											-0.020	0.095	0.123
	P											-0.008	0.115	0.111
12. Lycopene content (mg/100g)	G												-0.150	-0.068
	P												-0.106	-0.073
13. Harvest duration	G													0.485**
	P													0.400**
14. Yield per plant (g)	G													
	P													

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Table 2. Estimation of direct and indirect effects of different traits on yield per plant in tomato

Traits	DFP	NFPC	NFPP	AFW	PH	ID	PT	LWT	NLPF	TSS	TSW	LC	HD	Gen. Corr. Yield
DFP	**-0.120**	0.070	-0.299	0.093	-0.008	0.019	0.102	-0.032	-0.001	0.005	0.007	0.013	-0.070	-0.220
NFPC	0.032	**-0.262**	0.535	-0.259	0.020	-0.035	-0.037	0.020	0.082	0.000	0.013	-0.004	0.050	0.155
NFPP	0.048	-0.187	**0.750**	-0.362	0.016	-0.030	-0.114	0.027	0.034	-0.004	0.002	-0.006	0.060	0.233
AFW	-0.013	0.078	-0.310	**0.877**	0.005	-0.027	0.148	-0.037	-0.029	-0.012	0.003	-0.001	0.041	0.723
PH	0.025	-0.141	0.325	0.117	**0.037**	-0.089	-0.033	0.003	0.040	-0.034	0.010	0.001	0.129	0.390
ID	0.022	-0.085	0.210	0.222	0.031	**-0.107**	0.029	-0.007	0.032	-0.046	0.001	0.011	0.114	0.426
PT	-0.048	0.038	-0.336	0.512	-0.005	-0.012	**0.254**	-0.048	0.031	-0.024	0.004	0.007	-0.034	0.339
LWT	-0.060	0.083	-0.311	0.501	-0.002	-0.011	0.188	**-0.064**	0.011	-0.028	0.000	-0.003	-0.021	0.281
NLPF	-0.001	0.172	-0.203	0.204	-0.012	0.027	-0.063	0.006	**-0.126**	0.036	-0.008	0.004	-0.028	0.008
TSS	0.005	0.000	0.024	0.090	0.011	-0.043	0.053	-0.016	0.039	**-0.116**	-0.006	0.009	0.060	0.110
TSW	-0.021	-0.081	0.038	0.060	0.009	-0.004	0.021	0.000	0.025	0.016	**0.043**	-0.001	0.018	0.123
LC	-0.026	0.018	-0.070	-0.011	0.001	-0.020	0.031	0.003	-0.009	-0.017	-0.001	**0.061**	-0.029	-0.068
HD	0.044	-0.069	0.234	0.186	0.025	-0.064	-0.046	0.007	0.019	-0.036	0.004	-0.009	**0.191**	0.485

Residual effect: **0.089** Diagonal figures represent direct effects

DFP = Days to first picking, NFPC = Number of fruits per cluster, NFPP = Number of fruits per plant, AFW = Average Fruit Weight, PH = Plant height, ID = Inter-nodal distance, PT= Pericarp thickness, LWT = Locular wall thickness, NLPF = Number of locules per fruit, TSS = Total soluble solid, TSW = Thousand seed weight, LC = Lycopene content, HD = Harvest duration, Gen. Corr. Yield = Genotypic correlation coefficient with yield per plant.