Electronic Journal of Plant Breeding, 5(2): 300-304 (June 2014)
ISSN 0975-928X

Research Note

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

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(Received: 12 Apr 2014; Accepted:06 May 2014)

Abstract
Correlation analysis in tomato revealed that per cent fruit set, number of primary branches, number of fruits per plant, average fruit weight, total soluble solids, fruit length, fruit firmness, number of flower trusses per plant and pericarp thickness were positively and significantly associated with yield per plant. Path analysis revealed that average fruit weight had the high positive direct effect on yield per plant followed by number of fruits per plant. Traits viz., fruit diameter and fruit shape, fruit index had negative direct effect on fruit yield per plant. Most of the other traits had indirect effect via fruit weight, fruits per plant, fruit diameter and fruit shape index. Hence, these characters should be given more weightage in selection programme of high yielding genotypes in tomato.

Key words: Tomato, *Solanum lycopersicum*, Correlation, Path coefficient, fruit yield.

Tomato (*Solanum lycopersicum* L.) is one of the most economically important vegetable in India as well as the world. The fruit have manifold uses in human diet which canbe consumed raw, cooked and can also be processed in to various products. It is a good source of an antioxidant (lycopene),Vitamin C and Vitamin B;consumption of tomato and its products has been associated with lowerrisk of developing digestive tract and prostate cancers (Giovannucci *et al*., 2002).The correlation coefficient measures the mutual relationship between various characters and determines the componentcharacters on which selection could be made for genetic improvementfor yield and yield contributing traits.The path coefficient analysis provides an effective meanfor partitioning of direct and indirect cause of association. Hence, there is pre-requisite for preliminary investigations of characters in the genotypesfor the development of superior hybrids in tomato.

The study was conducted at college orchard, Department of Vegetable Crops, TNAU, Coimbatore, during 2012-13.The material for the present study comprised of 24 genotypes of tomato viz., EC-608406, EC-608395, EC-608456,EC-608431, EC-608401, IIHR-709, IIHR-2388, IIHR-2355,IIHR-2352,IIHR-2325,IIHR-2374,IIHR-2405,IIHR-2367,IIHR-2340,IIHR-2381, IIVR-L, CLN 2123A, BRML, Arka Ashish, Vybhav, Sankranthi, Arka Saurabh,Arka Ahuti and Punjab Chhuhara. Tomato seedlings of 30 days old were transplanted in the main field with spacing of 60 x 45 cm during Kharif, 2012. The experiment was laid out in a Randomized Block Design (RBD) with three replications. The recommended cultural practices were followed for raising good crop. Five randomly selected competitive plants from each row in each replication were tagged for the purpose of recording the observations on 16 characters *viz*. plant height (cm), number of primary branches, days to first flowering, number of flowers per truss, per cent fruit set, number of flower trusses per plant, fruit length (cm), fruit diameter (cm), fruit shape index, pericarp thickness (mm), number of locules, total soluble solids (%), average fruit weight (g), fruit firmness (kg/cm^2), number of fruits per plant and yield per plant (kg). Correlation and path analysis were carried out as per the standard procedure.

The correlation coefficient results of the present investigation on tomato germplasm revealed that the yield per plant was positively and significantly correlated with number of primary branches (0.768), per cent fruit set (0.856), number of flower trusses per plant (0.496), fruit length (0.617), pericarp thickness (0.398), TSS (0.625), average fruit weight (0.689), fruit firmness (0.556) and number of fruits per plant (0.774) at both genotypic and phenotypic level.So, the results suggest that selection of these would result in

increased yield in tomato. The results are in agreement with (Ara *et al*., 2009). Whereas the non-significant positive correlation was noticed for plant height (0.139), number of flowers per truss (0.321), fruit diameter (0.220) and fruit shape index (0.323) with yield per plant.Similarly the number of fruits per plant was also positively and significantly correlated with number of primary branches (0.453), per cent fruit set (0.985), number of flower trusses per plant (0.683) and TSS (0.590) which also had a positive association with yield per plant.But, here numbers of fruits per plant also were positively and significantly correlated with number of flowers per truss (0.585) and fruit shape index (0.643*).*

Fruit firmness was positively and significantly correlated with number of primary branches (0.478), per cent fruit set (0.569), fruit length (0.599), fruit diameter (0.519), pericarp thickness (0.735) and average fruit weight (0.735); hence, as revealed by these results, thicker the pericarp higher will be fruit firmness in tomato. The fruit firmness in tomato is an important trait which affects shelf life. The average fruit weight was also positively and significantly correlated with number of primary branches (0.609), per cent fruit set (0.973), fruit length (0.620), fruit diameter (0.791) and pericarp thickness (0.724). Fruit length and weight are the important traits which result in increasing average fruit weight in tomato. Similar results were also obtained by Mahapatra *et al*. (2013).

The total soluble solids ispositively and significantly correlated to number of primary branches (0.737), per cent fruit set (0.732), fruit length (0.393) and fruit shape index (0.624). Thenumber of locules showed positive and significantcorrelation with fruit diameter (0.772) that means more the diameter of fruit higher will have more number of locules in tomato.Similar resultswere reported by (Golani *et al*., 2007). Pericarp thickness is positively and significantly correlated with fruit length (0.689) and fruit diameter (0.621).Fruit shape index is positively and significantly correlated to plant height (0.411), number of flowers per truss (0.403), per cent fruit set (0.785), number of flower trusses per plant (0.375) and fruit length (0.504), which are in agreement with the findings of (Buckseth *et al*., 2012).

Fruit length was positively and significantly correlated with number of primary branches (0.612) and per cent fruit set (0.621) at genotypic level. Number of flower trusses per plant was positively and significantly correlated with number of flowers per truss (0.376) and per cent fruit set (0.895). Per cent fruit set was significant and positively correlated with number of primary branches (0.832) and number of flowers per truss (0.611). Whereas days to first flowering was positively and significantly correlated only with plant height (0.543).

The path coefficient analysis in Table 2 revealed that the high positive direct effect was noted for average fruit weight (0.8325), followed by number of fruits per plant (0.6646). It was also observed that the high negative direct effect was exerted by fruit diameter (-0.5389) and by fruit shape index (-0.3405). Similar results were reported by previous works for number of fruits per plant (Nandanpuri *et al*.,1977) and average fruit weight on yield (Dudhi and Kallo, 1982) in tomato. The indirect effect of most of the traits had medium to high via average fruit weight, fruit weight, fruit shape index, fruit diameter and number of fruits per plant.

The residual effect (0.0123) on yield per plant was negligible, which suggest that most of yield component was included in the present study. The highest positive direct effect was noted in average fruit weight, number of fruits per plant, number of flowers trusses per plant fruit length, number of primary branches, and fruit firmness which also had significant positive correlation with yield per plant. Hence, the plant with high number of primary branches, number of fruits per plant, average fruit weight, fruit length, fruit firmness and number of flower trusses per plant are to be considered in selection for increasing yield per plant in tomato. Overall all the characters revealed positive effect directly or indirectly on yield per plant, which is corroboration with finding of Kumar and Dudhi (2011) and Hidaytullah *et al*. (2008). In tomato, earlier studies made by Bodende (2002) and Hayder *et al*. (2007) also revealed that plant height, fruit weight and fruit length were directly responsible for the determination of fruit yield in tomato. Similar results were observed by Lakshmi and Mani (2004), Mehta and Asati (2008), Indu Rani *et al*., (2010).

Hence it could be concluded that in tomato yield per plant was positively and significantly correlated with number of primary branches followed by per cent fruit set, number of flower trusses per plant, fruit length, pericarp thickness, total soluble solids, average fruit weight, fruit firmness, and number of fruits per plant. In path coefficient analysis thehighest positive direct effect was noted in average fruit weight, followed by number of fruits per plant. So, the traits like; average fruit weight and number of fruits per plant showed positive correlation with yield as well as they have direct effect on yield. Hence these traits can be used as selection indices in tomato to bring about the improvement in yield.

Acknowledgement:
We are thankful to the Director, National Bureau of Plant Genetic Resources, New Delhi and Director, Indian Institute of Horticultural research for providing tomato genotypes for present study.

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Table 1.Genotypic (G) and phenotypic (P) coefficient of correlation among different character in tomato genotypes

Characters		NPB	DFF	NFT	PFS	NFTP	FL	FD	FSI	PT	NOL	TSS	AFW	FF	NFP	YPP
PH	G	0.087	0.543**	0.267	0.182	0.027	0.101	-0.303	0.411*	-0.318	-0.233	0.270	-0.173	-0.307	0.362*	0.139
	P	0.135	0.155	0.180	0.024	0.041	0.058	-0.231	0.295	-0.242	-0.191	0.230	-0.139	-0.251	0.338	0.138
NPB	G		-0.114	0.144	0.832**	0.184	0.612**	0.157	0.314	0.326	-0.189	0.737**	0.609**	0.478**	0.453*	0.768**
	P		-0.068	0.056	0.182	0.067	0.371	0.141	0.138	0.204	-0.138	0.453*	0.410*	0.361*	0.338	0.529*
DFF	G			0.056	-0.539**	-0.054	-0.243	-0.452**	0.208	-0.573**	-0.118	0.095	-0.561**	-0.638**	0.024	-0.360*
	P			0.023	-0.167	-0.024	-0.094	-0.236	0.159	-0.341	-0.099	0.023	-0.242	-0.379*	-0.016	-0.184
NFT	G				0.611**	0.376*	-0.066	-0.552**	0.403*	-0.409*	-0.627**	0.220	-0.264	0.046	0.585**	0.321
	P				0.120	0.253	-0.033	-0.478**	0.374*	-0.325	-0.366	0.192	-0.223	0.013	0.506	0.256
PFS	G					0.895**	0.621**	0.097	0.785**	0.286	-0.339	0.732**	0.973**	0.569**	0.985**	0.856**
	P					0.280	0.300	0.010	0.248	0.188	-0.098	0.315	0.273	0.126	0.323	0.409*
NFTP	G						0.082	-0.318	0.375*	-0.157	-0.278	0.409	-0.031	-0.079	0.683**	0.496**
	P						0.032	-0.252	0.260	-0.179	-0.152	0.275	-0.069	-0.090	0.579**	0.385*
FL	G							0.342	0.504**	0.689**	-0.277	0.393*	0.620**	0.599**	0.325	0.617**
	P							0.355*	0.502**	0.643**	-0.174	0.357*	0.570**	0.494**	0.295	0.566**
FD	G								-0.624**	0.621**	0.772**	-0.340	0.791**	0.519**	-0.367*	0.220
	P								-0.613**	0.532**	0.481**	-0.236	0.683**	0.448*	-0.308	0.212
FSI	G									0.008	-0.866**	0.624**	-0.207	-0.030	0.643**	0.323
	P									0.050	-0.550**	0.516**	-0.158	-0.054	0.569**	0.288
PT	G										0.132	-0.004	0.724**	0.735**	-0.032	0.398*
	P										0.079	0.047	0.585**	0.595**	-0.035	0.323
NOL	G											-0.479**	0.372*	-0.114	-0.370*	-0.082
	P											-0.333	0.230	0.041	-0.232	-0.022
TSS	G												0.277	0.089	0.590**	0.625**
	P												0.209	0.087	0.524**	0.527**
AFW	G													0.751**	0.088	0.684**
	P													0.611**	0.063	0.689**
FF	G														0.061	0.556**
	P														0.054	0.475**
NFP	G															0.774**
	P															0.741**

***Significant at 5% level and **Significant at 1% level**

PH: Plant height (cm), NPB: Number of primary branches, DFF: Days to first flowering, NFT: Number of flowers per truss, PFS: Per cent fruit set, NFTP: Number of flower trusses per plant, FL: Fruit length (cm), FD: Fruit diameter (cm), FSI: Fruit shape index, PT: Pericarp thickness (mm), NOL: Number of locules, TSS: Total soluble solids (%), AFW: Average fruit weight (g), FF: Fruit firmness (kg/cm^2), NFP: Number of fruits per plant, YPP: Yield per plant (kg).

Table 2. Path coefficient showing direct (diagonal) and indirect effect (off diagonal) of different characters on fruit yield in tomato

Characters	PH	NPB	DFF	NFT	PFS	NFTP	FL	FD	FSI	PT	NOL	TSS	AFW	FF	NFP	GCY
PH	**0.0462**	0.0173	-0.0427	-0.0211	-0.0012	0.0017	0.0291	0.1633	-0.1401	0.0492	0.0100	-0.0687	-0.1443	-0.0003	0.2407	0.1390
NPB	0.0040	**0.1981**	0.0090	-0.0114	-0.0055	0.0115	0.1755	-0.0850	-0.1070	-0.0504	0.0081	-0.1877	0.5075	0.0005	0.3013	0.7685**
DFF	0.0251	-0.0228	**-0.0786**	-0.0044	0.0035	-0.0034	-0.0699	0.2438	-0.0711	0.0886	0.0050	-0.0242	-0.4673	-0.0007	0.0164	-0.3600*
NFT	0.0123	0.0287	-0.0044	**-0.0789**	-0.0040	0.0235	-0.0191	0.2980	-0.1375	0.0634	0.0268	-0.0561	-0.2198	0.0001	0.3889	0.3217
PFS	0.0084	0.1249	0.0424	-0.0482	**-0.0066**	0.0507	0.2021	-0.0526	-0.2675	-0.0443	0.0145	-0.2985	0.6002	0.0006	0.6550	0.9811**
NFTP	0.0013	0.0366	0.0042	-0.0297	-0.0059	**0.0622**	0.0236	0.1719	-0.1277	0.0244	0.0119	-0.1041	-0.0264	-0.0001	0.4545	0.4967**
FL	0.0047	0.1213	0.0192	0.0053	-0.0067	0.0051	**0.2865**	-0.1848	-0.1717	-0.1066	0.0118	-0.1001	0.5164	0.0006	0.2162	0.6172**
FD	-0.0140	0.0313	0.0355	0.0436	-0.0006	-0.0199	0.0983	**-0.5389**	0.2125	-0.0961	-0.0329	0.0867	0.6586	0.0006	-0.2441	0.2206
FSI	0.0190	0.0623	-0.0164	-0.0319	-0.0052	0.0233	0.1445	0.3363	**-0.3405**	-0.0014	0.0370	-0.1589	-0.1724	0.0000	0.4277	0.3234
PT	-0.0147	0.0646	0.0450	0.0323	-0.0019	-0.0098	0.1976	-0.3350	-0.0030	**-0.1545**	-0.0056	0.0011	0.6034	0.0008	-0.0215	0.3988*
NOL	-0.0108	-0.0376	0.0093	0.0495	0.0022	-0.0173	-0.0796	-0.4161	0.2951	-0.0204	**-0.0427**	0.1221	0.3097	-0.0001	-0.2462	-0.0829
TSS	0.0125	0.1461	-0.0075	-0.0174	-0.0077	0.0255	0.1127	0.1836	-0.2126	0.0007	0.0205	**-0.2546**	0.2308	0.0001	0.3926	0.6252**
AFW	-0.0080	0.1208	0.0441	0.0208	-0.0064	-0.0020	0.1777	-0.4263	0.0705	-0.1120	-0.0159	-0.0706	**0.8325**	0.0008	0.0585	0.6846**
FF	-0.0142	0.0948	0.0502	-0.0037	-0.0037	-0.0049	0.1718	-0.2797	0.0105	-0.1137	0.0049	-0.0227	0.6256	**0.0011**	0.0406	0.5568**
NFP	0.0167	0.0898	-0.0019	-0.0462	-0.0065	0.0426	0.0932	0.1979	-0.2191	0.0050	0.0158	-0.1504	0.0733	0.0001	**0.6646**	0.7749**

***Significant at 5% level and **Significant at 1% level [Residual effect: 0.0123]**

PH: Plant height (cm), NPB: Number of primary branches, DFF: Days to first flowering, NFT: Number of flowers per truss, PFS: Per cent fruit set, NFTP: Number of flower trusses per plant, FL: Fruit length (cm), FD: Fruit diameter (cm), FSI: Fruit shape index, PT: Pericarp thickness (mm), NOL: Number of locules, TSS: Total soluble solids (%), AFW: Average fruit weight (g), FF: Fruit firmness (kg/cm^2), NFP: Number of fruits per plant, YPP: Yield per plant (kg), GCY: Genotypic correlation with yield.