

Original Research Article

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Correlation and Path Coefficient Analysis in Tomato (*Solanum lycopersicum* L.)

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ABSTRACT

Keywords

Tomato, *Solanum lycopersicum*, Correlation, Path coefficient, Fruit yield

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Correlation and path analysis were carried out in twenty three tomato genotypes for yield characters. The correlation coefficient studies showed that positive association of fruit yield per plant with plant height, number of primary branches per plant, number of fruits per plant, days to last harvest, fruit length, fruit width, average fruit weight, ascorbic acid, total soluble solids and lycopene content. Path coefficient showed that number of fruits per plant, average fruit weight, fruit width, ascorbic acid, total soluble solids and lycopene content had high positive direct effects on fruit yield per plant. Hence, these characters should be given more helpful in selection programme of high yielding genotypes in tomato.

Introduction

Tomato is a self-pollinated crop with chromosome number of $2n=24$ and belongs to the family Solanaceae. The cultivated tomato originated in a wild form in the Peru-Ecuador-Bolivia area of the Andes (South American) (Vavilov, 1951). Tomato is a rich source of vitamins (A and C), minerals (Ca, P and Fe), consumption of tomato and processed products has been associated with

lower risk of developing digestive tract and prostate cancer (Giovannucci *et al.*, 2002). Correlation studies between fruit weight and its components and their relative contribution to yield are of value in planning a breeding program. Path analysis facilitates the partitioning of the correlation coefficient into direct and indirect effects on yield and any other attributes (Islam *et al.*, 2010). Hence, keeping the above in view the present investigation was carried out to

study correlation and path coefficient analysis.

Materials and Methods

The present study was carried out at the PG Research Block, Department of Vegetable Science, College of Horticulture, Rajendranagar, Sri Konda Laxman Telangana State Horticultural University, Hyderabad, which comes under sub-tropical zone and farm is situated at a latitude of 17.19° N, longitude of 79.23° E and a altitude of 542.3 m above mean sea level. The seeds of twenty three genotypes were raised in protrays in College of Horticulture, Rajendranagar during second week of July, 2018. Twenty five days old seedlings were transplanted in the second week of August, 2018 in the main field. The experiment was laid out with twenty three genotypes of tomato in Randomized Block Design (RBD) with three replications (Table 1). Each germplasm line was grown in a plot of 1.8 m × 3.15 m (5.67 Sq. meters) accommodating 21 plants per plot per replication, three rows with 7 plants per row with spacing of 60×45 cm. All the recommended cultural practices were followed. Five randomly selected equally competitive plants from each row in each replication were tagged for the purpose of recording the observations on 15 characters viz. plant height (cm), number of primary branches per plant, days to first flowering, days to 50% flowering, days to first fruit harvest, days to last fruit harvest, number of fruits per plant, fruit length (cm), fruit width (cm), average fruit weight (g), fruit yield per plant (kg), ascorbic acid (mg/100g), total soluble solids (°Brix), lycopene content (mg/100g) and beta-carotene (mg/100g).

Results and Discussion

The correlation coefficient results on the present investigation on tomato germplasm revealed that the fruit yield per plant

recorded positive and significant correlations with plant height (0.3282P, 0.3584G), number of primary branches per plant (0.5203P, 0.5710G), days to last fruit harvest (0.4839P, 0.5490G), number of fruits per plant (0.4737P, 0.4971G), fruit length (0.3425P, 0.3934G), fruit width (0.4074P, 0.4617G), average fruit weight (0.4297P, 0.4608G), ascorbic acid (0.3712P, 0.3954G), total soluble solids (0.3041P, 0.3010G) and lycopene content (0.0208P, 0.0301G). It also registered negative and significant correlations with days to first fruit harvest (-0.3180P, -0.3977G) and beta-carotene (-0.3309P, -0.3520G). Plant yield is a very complex character dependent on a number of components. Therefore knowledge of magnitude of correlation of yield with its attributes is of immense practical utility and has profound significance in the field of crop improvement. Without bringing an improvement in the yield component characters, the genetic improvement in fruit yield is not possible. The results on character association indicated significant positive association yield with plant height, number of primary branches per plant, number of fruits per plant, days to last harvest, fruit length, fruit width, average fruit weight, ascorbic acid, total soluble solids and lycopene content which indicated that the adequate knowledge of interrelationship between fruit yield per plant and its component themselves is useful for selection and simultaneous improvement in these characters. All the possible genotypic and phenotypic correlation coefficient between fruit yield and quality components is given in Table 2. The present study discloses that in general, genotypic correlation coefficient were higher than their phenotypic ones. Similar finding were observed by Nagariya *et al.*, (2015) Sudesh and Anita (2016) and Singh *et al.*, (2018).

Path coefficient is the ratio of standard deviation of the effect due to a given cause (independent variable) to the total standard

deviation of the effect (dependant variable). This technique, which aims to improve a dependent character like yield when the independent characters have a significant relation in desirable direction and positive direct or indirect effect through other component traits on the dependent characters, it is used in plant breeding programs. Plant height showed negligible direct positive effect on fruit yield per plant at phenotypic level (0.003P) and low negative direct effect at genotypic level (-0.1041G), number of primary branches per plant showed

negligible direct positive effect on fruit yield per plant at genotypic level (0.083G) and low negative direct effect at phenotypic level (-0.1211P), days to first flowering recorded negligible and low positive direct effect on fruit yield per plant at phenotypic level and genotypic level (0.0350P, 0.1309G), days to 50% flowering showed negligible positive direct effect at genotypic level on fruit yield per plant at genotypic level (0.029G) and negligible negative direct effect at phenotypic level (-0.0184P).

Table.1 List of genotypes and their sources

S.No.	Genotypes	Source
1.	EC-615055	NBPGR, Hyderabad
2.	EC-620463	NBPGR, Hyderabad
3.	EC-620428	NBPGR, Hyderabad
4.	AVTO-1219	WVC, Taiwan, China
5.	EC-620378	NBPGR, Hyderabad
6.	EC-620382	NBPGR, Hyderabad
7.	EC-620389	NBPGR, Hyderabad
8.	EC-620395	NBPGR, Hyderabad
9.	EC-620406	NBPGR, Hyderabad
10.	EC-620427	NBPGR, Hyderabad
11.	EC-620394	NBPGR, Hyderabad
12.	EC-620422	NBPGR, Hyderabad
13.	EC-631369	NBPGR, Hyderabad
14.	EC-631379	NBPGR, Hyderabad
15.	EC-620503	NBPGR, Hyderabad
16.	AVTO-9803	WVC, Taiwan, China
17.	AVTO-9804	WVC, Taiwan, China
18.	AVTO-1002	WVC, Taiwan, China
19.	AVTO-0101	WVC, Taiwan, China
20.	Pusa Ruby	IARI, New Delhi
21.	PKM-1	Periyakulam, TNAU
22.	Pant bahar	GBPUAT, Uttarakhand
23.	Arkavikas	IIHR, Bengaluru

Table.2 Phenotypic (P) and genotypic (G) correlation coefficients among yield and yield attributes in twenty three genotypes of tomato

Characters		Plant height (cm)	No. of primary branches per plant	Days to first flowering	Days to 50 % flowering	Days to first fruit harvest	Days to last fruit harvest	No. of fruits per plant	Fruit length	Plant height (cm)	No. of primary branches per plant	Days to first flowering	Days to 50 % flowering	Days to first fruit harvest	Days to last fruit harvest	No. of fruits per plant
Plant height (cm)	P	1.0000	0.7078 * *	-0.0967	0.0605	0.0104	0.3366 **	0.6517 * *	-0.2031	-0.1577	--0.3265 * *	0.2192	0.5101 **	0.2461*	-0.2380 *	0.3282*
	G	1.0000	0.7562* *	-0.1068	0.1240	0.0034	0.3975**	0.6908* *	-0.2201	-0.1729	-0.3493* *	0.2386	0.5506**	0.2291*	-0.2503*	0.3584*
No. of primary branches per plant	P		1.0000	-0.2892 *	- 0.1242	-0.2098	0.6673 * *	0.7343 * *	-0.0831	-0.0802	-0.1760	0.3996 * *	0.5451 * *	0.1296	-0.0271	0.5203* *
	G		1.0000	-0.3491*	-0.1908	-0.2379	0.7356* *	0.7598* *	-0.0966	-0.0724	-0.2004	0.4228* *	0.5841* *	0.1288	-0.0487	0.5710* *
Days to first flowering	P			1.0000	0.6009 * *	0.5154 **	-0.4514**	-0.4194 * *	0.3650 **	0.2475 *	0.2990*	0.2709 *	-0.1314	-0.4307**	-0.0627	-0.0565
	G			1.0000	0.8356* *	0.7363* *	-0.5751* *	-0.5094* *	0.4403**	0.3377*	0.3836*	0.3029*	-0.1617	-0.5335**	-0.1269	-0.0750
Days to 50 % flowering	P				1.0000	0.3834 * *	-0.4029 **	-0.2555 *	0.3641 **	0.1530	0.3167 * *	0.0767	0.0182	-0.2867 *	- 0.1023	0.0529
	G				1.0000	0.7305* *	-0.6066**	-0.3539*	0.4163**	0.2462	0.4256* *	0.1666	0.0402	-0.4111	-0.1279	0.0920
Days to first fruit harvest	P					1.0000	-0.3044 *	- 0.2902 *	- 0.0185	- 0.0562	- 0.1017	0.1567	- 0.0271	- 0.2485*	0.0095	-0.3180*
	G					1.0000	-0.4056	-0.3427	-0.0555	-0.0128	-0.0880	0.1135	-0.0067	-0.3016*	0.0162	-0.3977*
Days to last fruit harvest	P						1.0000	0.6657 * *	- 0.2545*	- 0.0954	-0.2254	0.1616	0.3226 * *	0.2461 *	- 0.2478 *	0.4839* *
	G						1.0000	0.7502* *	-0.2912*	-0.0841	-0.2581	0.1694	0.3518* *	0.2844*	-0.3059*	0.5490* **
No of fruits per plant	P							1.0000	0.4545 * *	0.4027 * *	-0.5187 * *	0.2824*	0.4904**	0.4143 **	0.3452**	0.4737* *
	G							1.0000	-0.4880**	-0.4535* *	-0.5484* *	0.2954*	0.5012**	0.4283* *	0.3615**	0.4971* *
Fruit length (cm)	P								1.0000	0.7084* *	0.7615* *	0.2276	0.0844	-0.3723 * *	0.1304	0.3425*
	G								1.0000	0.7927* *	0.8879* *	0.2430	-0.0756	-0.4090* *	0.1417	0.3934*
Fruit width (cm)	P									1.0000	0.7324 * *	0.0805	-0.1527	-0.2816*	- 0.0341	0.4074* *
	G									1.0000	0.8571* *	0.1015	-0.1908	-0.3157*	-0.0242	0.4617* *
Average fruit weight	P										1.0000	0.0433	-0.1971	-0.4212* *	0.1315	0.4297* *
	G										1.0000	0.0626	-0.2173	-0.4574* *	0.1408	0.4608* *
Ascorbic acid content (mg/100g)	P											1.0000	0.1145	-0.4182* *	-0.0573	0.3712* *
	G											1.0000	0.1185	-0.4482* *	-0.0729	0.3954* *
TSS (^o Brix)	P												1.0000	0.4243 * *	0.1713	0.3041*
	G												1.0000	0.4481* *	0.1739	0.3010*
Lycopene content (mg/100g)	P													1.0000	-0.0684	0.0208
	G													1.0000	-0.802	0.0301
Beta-carotene mg/100g)	P														1.0000	-0.3309* *
	G														1.0000	-0.3520* *
Fruit yield per plant(Kg)	P															1.0000
	G															1.0000

Table.3 Phenotypic (P) and genotypic (G) path coefficients indicating direct and indirect effects of components characters on fruit yield in twenty three genotypes of tomato

Characters		Plant height (cm)	No. of primary branches per plant	Days to first flowering	Days to 50 % flowering	Days to first fruit harvest	Days to last fruit harvest	No. of fruits per plant	Fruit length (cm)	Fruit width (cm)	Average fruit weight(g)	Ascorbic acid content (mg/100g)	TSS (^o Brix)	Lycopene content (mg/100g)	Beta -carotene (mg/100g)	Correlation coefficient
Plant height (cm)	P	<u>0.0033</u>	0.0023	-0.0003	0.0002	0.0000	0.0011	0.0021	-0.0007	-0.0005	-0.0011	0.0007	0.0017	0.0008	-0.0008	0.0011
	G	-0.1041	-0.0787	0.0111	-0.0129	-0.0004	-0.0414	-0.0719	0.0229	0.0180	0.0364	-0.0248	-0.0573	-0.0239	0.0261	-0.0373
No. of primary branches per plant	P	-0.0857	<u>-0.1211</u>	0.0350	0.0150	0.0254	-0.0808	-0.0889	0.0101	0.0097	0.0217	-0.0484	-0.0660	-0.0157	0.0033	-0.0630
	G	0.0629	0.0832	-0.0290	-0.0159	-0.0198	0.0612	0.0632	-0.0080	-0.0060	-0.0167	0.0352	0.0486	0.0107	-0.0041	0.0475
Days to first flowering	P	-0.0034	-0.0101	<u>0.0350</u>	0.0210	0.0180	-0.0158	-0.0147		0.0087	0.0105	0.0095	-0.0046	-0.0151	-0.0022	-0.0020
	G	-0.0140	-0.0457	0.1309	0.1094	0.0964	-0.0753	-0.0667	0.0576	0.0442	0.0502	0.0397	-0.0212	--0.0698	--0.0166	-0.0098
Days to 50 % flowering	P	-0.0011	0.0023	-0.0110	-0.0184	-0.0070	0.0074	0.0047	-0.0067	-0.0028	-0.0058	-0.0014	-0.0003	0.0053	0.0019	-0.0010
	G	0.0066	-0.0101	0.0442	0.0529	0.0387	-0.0321	-0.0187	0.0220	0.0130	0.0225	0.0088	0.0021	-0.0218	-0.0068	0.0049
Days to first fruit harvest	P	0.0003	-0.0054	0.0132	0.0098	<u>0.0257</u>	-0.0078	-0.0075	-0.0005	-0.0014	-0.0026	0.0040	-0.0007	-0.0064	0.0002	-0.0082
	G	-0.0002	0.0136	-0.0420	-0.0416	-0.0570	0.0231	0.0195	0.0032	0.0007	0.0050	-0.0065	0.0004	0.0172	-0.0009	0.0227
Days to last fruit harvest	P	0.0463	0.0918	-0.0621	-0.0554	-0.0419	<u>0.1375</u>	0.0915	-0.0350	-0.0131	-0.0310	0.0222	0.0444	0.0338	-0.0341	0.0665
	G	0.0144	0.0267	-0.0209	0.0220	-0.0147	0.0363	0.0272	-0.0106	-0.0031	-0.0094	0.0062	0.0128	0.0103	-0.0111	0.0199
No of fruits per plant	P	0.5608	0.6319	-0.3609	-0.2199	-0.2498	0.5728	<u>0.8606</u>	-0.3912	-0.3466	-0.4464	0.2430	0.4220	0.3565	-0.2970	0.4076
	G	0.6313	0.6944	-0.4656	-0.3235	-0.3132	0.6856	0.9139	-0.4460	-0.4144	-0.5012	0.2699	0.4581	0.3914	-0.3304	0.4543
Fruit length (cm)	P	-0.0206	-0.0084	0.0370	0.0369	-0.0019	-0.0258	-0.0461	<u>0.1014</u>	0.0719	0.0772	0.0231	-0.0086	-0.0378	0.0132	0.0347
	G	0.0516	0.0226	-0.1032	-0.0976	0.0130	0.0682	0.1144	-0.2343	-0.1858	-0.2081	-0.0570	0.0177	0.0958	-0.0332	-0.0922
Fruit width (cm)	P	-0.0242	-0.0123	0.0380	0.0235	-0.0086	-0.0147	-0.0619	0.1088	<u>0.1536</u>	0.1125	0.0124	-0.0235	-0.0433	-0.0052	0.0626
	G	-0.0215	-0.0090	0.0419	0.0306	-0.0016	-0.0104	-0.0563	0.0984	0.1242	0.1064	0.0126	-0.0237	-0.0392	-0.0030	0.0573
Average fruit weight	P	-0.2420	-0.1327	0.2216	0.2347	-0.0754	-0.1670	-0.3844	0.5643	0.5428	<u>0.7411</u>	0.0321	-0.1461	-0.3122	0.0975	0.3184
	G	-0.3743	-0.2147	0.4111	0.4561	-0.0943	-0.2766	-0.5878	0.9516	0.9186	1.0717	0.0671	-0.2329	-0.4902	0.1509	0.4938
Ascorbic acid content (mg/100g)	P	0.0173	0.0315	0.0214	0.0060	0.0124	0.0127	0.0223	0.0179	0.0063	0.0034	<u>0.0788</u>	0.0090	-0.0330	-0.0045	0.0293
	G	0.0283	0.0502	0.0360	0.0198	0.0135	0.0201	0.0351	0.0289	0.0120	0.0074	0.1188	0.0141	-0.0532	-0.0087	0.0470
TSS (^o Brix)	P	0.0387	0.0413	-0.0100	0.0014	-0.0021	0.0245	0.0372	-0.0064	-0.0116	-0.0149	0.0087	<u>0.0758</u>	0.0322	0.0130	0.0231
	G	0.0089	0.0095	-0.0026	0.0007	-0.0001	0.0057	0.0081	-0.0012	-0.0031	-0.0035	0.0019	0.0162	0.0073	0.0028	0.0049
Lycopene content (mg/100g)	P	0.0118	0.0062	-0.0206	-0.0137	-0.0119	0.0118	0.0198	-0.0178	-0.0135	-0.0201	-0.0200	0.0203	<u>0.0478</u>	-0.0033	0.0010
	G	0.0429	0.0241	0.0999	0.0770	0.0585	0.0533	0.0802	0.0766	0.0591	0.0857	0.0839	0.0839	0.1873	0.0150	0.0056
Beta-carotene mg/100g)	P	0.0269	0.0031	0.0071	0.0115	-0.0011	0.0280	0.0390	-0.0147	0.0039	-0.0148	0.0065	-0.0193	0.0077	-0.1129	0.0373
	G	0.0255	0.0050	0.0130	0.0131	-0.0017	0.0312	0.0369	-0.0145	0.0025	-0.0144	0.0074	-0.0177	0.0082	-0.1021	0.0359

Phenotypic Residual effect =0.304; Genotypic Residual effect= 0.233; Diagonal (under lined) values indicate direct effect

Days to first fruit harvest showed negligible positive direct effect on fruit yield per plant was exhibited by this trait at phenotypic level (0.0257P) and negligible negative direct effect at genotypic level (-0.057G). Days to last fruit harvest showed low and negligible positive direct effect on fruit yield per plant at phenotypic level and genotypic level (0.1375P, 0.0363G), number of fruits per plant showed at both phenotypic and genotypic level, fruit yield per plant showed high positive direct effect (0.8606P, 0.9139G) on fruit yield per plant respectively. Fruit length (cm) showed low positive on fruit yield per plant (0.1014P) at phenotypic level and negligible negative direct effects at genotypic level (-0.2343G). Fruit width showed low positive direct effect on fruit yield per plant both at phenotypic and genotypic (0.1536P, 0.1242G) levels, Average fruit weight showed moderate and high positive direct effect on fruit yield per plant both at phenotypic and genotypic (0.7411P, 1.0717G) levels (Table 3).

Ascorbic acid content (mg/100g) showed negligible and low positive direct effect on fruit yield per plant both at phenotypic and genotypic (0.0788P, 0.1188G) levels. Total soluble solids (^oBrix) showed negligible positive direct effect on fruit yield per plant both at phenotypic and genotypic (0.0758P, 0.0162G) levels. Lycopene content recorded negligible direct effect on fruit yield per plant both at phenotypic (0.0478P) and low genotypic (0.1873G) levels. Beta-carotene recorded negligible negative direct effects on fruit yield per plant at genotypic level (-0.1129P) and phenotypic level (-0.1021G) respectively. The traits like number of fruits per plant and average fruit weight exhibited positive direct effects on fruit yield and these traits also recorded positive correlation with yield. This suggested that direct selection based on these traits will be rewarding for crop yield improvement. Similar results were

also reported in tomato by Asati *et al.*, (2008), Tiwari *et al.*, (2013), Meitei *et al.*, (2014) and Rakesh *et al.*, (2014). In this study, it can be concluded that days to last fruit harvest, number of fruits per plant, fruit width, average fruit weight, ascorbic acid, total soluble solids, lycopene content and beta-carotene showed positive correlation and positive direct effect on fruit yield per plant. These are identified as superior yield components. Hence, the genotypes which exhibited better performance for these characters can be used in further improvement of tomato.

The residual factor determines how best the causal factors account for the variability of the dependent factor, the fruit yield per plant in this case. The residual effects were 0.304 and 0.233, which were of low magnitude at genotypic and phenotypic levels.

Hence, it could be concluded that in tomato yield per plant was positively and significantly correlated with plant height, number of primary branches per plant, number of fruits per plant, days to last harvest, fruit length, fruit width, average fruit weight, ascorbic acid, total soluble solids and lycopene content. In path coefficient analysis the highest 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 for selection in tomato to bring about the improvement in yield.

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