

Correlation and path analysis studies for yield and quality traits in tomato (*Solanum lycopersicum* L.)

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Abstract: Correlation and path analysis were carried out in nineteen tomato genotypes for yield and quality characters. The association studies showed that fruit yield per plant was positively and significantly correlated with number of fruits per plant and fruit width. However, fruit yield per plant was negatively and significantly correlated with days to last fruit harvest and shelf life. Path analysis studies done to study the cause and effect relationship revealed that plant height, number of fruits per plant, fruit length, fruit width and ascorbic acid had high positive direct effects on fruit yield per plant. Hence, direct selection for these traits is done for improving fruit yield per plant.

Key words: Correlation and Path analysis, Tomato, Genotypes, Yield and quality

I. Introduction

Tomato (*Solanum lycopersicum* L.) is a member of the family solanaceae and significant vegetable crop of special economic importance in the horticultural industry worldwide (He *et al.*, 2003). It has a chromosome number of $2n=24$. Tomato is a native of Peru Equador region (Rick, 1969). It is the most important warm-season fruit vegetable grown throughout the world. Tomato is the most important vegetable crop next only to potato because of its wider adaptability, high yielding potential and multipurpose uses. Tomatoes are consumed as fresh and in processed form. In India, tomato occupies an area of 0.60 million hectares with a production of 11.15 million tonnes and productivity of 18.61 tonnes per hectare (FAO, 2009). Tomato is grown as a annual or short lived perennial herbaceous plants. It has taproot and growth habit of the plant is determinate, semideterminate and indeterminate.

Yield is a complex character and selection for yield and yield components deserves considerable attention. A crop breeding programme, aimed at increasing the plant productivity requires consideration not only of yield but also of its components that have direct or indirect bearing on yield. Correlation and path coefficient analysis give an insight into the genetic variability present in populations. Correlation coefficient analysis measures the mutual relationship between various plant characters and determines the component characters on which selection can be based for improvement in yield. Path analysis splits the correlation coefficients into direct and indirect effects of a set of dependent variables on the independent variable thereby aids in selection of elite genotype.

An improvement in yield and quality in self pollinated crop like tomato is normally achieved by selecting the genotypes with desirable character combinations existing in nature or by hybridization. Information on the nature and extent of variability present in genetic stocks, heritability, genetic advance and interrelationship among various characters is a prerequisite for framing any selection program.

II. Materials And Methods

Nineteen genotypes of tomato consisting of sixteen exotic collections and three varieties were evaluated in an augmented block design at National Bureau of Plant Genetic Resources (NBPGR) Regional Station, Hyderabad. The experiment laid out in eight blocks. In each block two genotypes of exotic collection and three varieties i.e., ArkaVikas, Marutham and Punjab Chhauhara which are used as checks are planted at a spacing of 60x50cm in a single row. Due to limited germplasm of each genotype the experiment is laid out of augmented block design. Observations were recorded for eighteen qualitative and quantitative characters *viz.*, Plant height (cm), number of primary branches, days to 50% flowering, number of clusters per plant, number of flowers per clusters, days to first fruit set, days to first fruit harvest, days to last fruit harvest, number of fruits per clusters, number of fruits per plant, fruit length (cm), fruit width (cm), fruit weight, fruit yield per plant (kg), ascorbic acid (mg/100g), acidity (%), TSS ($^{\circ}$ Brix) and shelf life (days).

III. Results And Discussion

Simple correlation studies were carried for all the characters studied. Number of fruits per plant and fruit width had significant positive correlation with fruit yield per plant. Days to last fruit harvest and shelf life had significant negative relationship with fruit yield per plant. The results are in accordance with Kumar *et al.* (2006), Dhankhar and Dhankar (2006) for number of fruits per plant, Singh *et al.*, (2007) and Singh (2009) for fruit width. Number of primary branches per plant and number of flowers per cluster had significantly positive correlation with plant height. Similar results are also observed by Prashanth *et al.* (2008). Number of fruits per cluster and ascorbic acid had significantly positive association with number of primary branches per plant and days to 50% flowering and days to last fruit harvest had negative association with number of primary branches per plant. Results are in accordance with Kumar and Dudi (2011).

Days to first fruit set, days to first fruit harvest and shelf life had positive association with days to 50% flowering. Number of clusters per plant had positive association with number of fruits per plant and TSS and negative association with days to first fruit harvest and shelf life. Results are in accordance with Kumar and Dudi (2011) for number of clusters per plant and number of fruits per cluster. Number of flowers per cluster had positive association with number of fruits per cluster. Days to first fruit set had positive association with days to first fruit harvest and shelf life. Days to first fruit harvest had positive association with shelf life. Days to last fruit harvest had negative association with TSS. Number of fruits per plant had negative correlation with acidity. Fruit length had highly significant positive correlation with fruit weight and TSS. Fruit width had highly significant positive correlation with fruit weight. Fruit weight had negative correlation with TSS. Ascorbic acid had negative association with TSS. Acidity had positive association with TSS. Results are in accordance with Kumar and Dudi (2011) for fruit weight, TSS, acidity.

The path coefficient studies (Table 2) revealed that plant height, number of fruits per plant, fruit length, fruit width and ascorbic acid had high positive direct effects on fruit yield per plant, shelf life had moderate direct positive effects on fruit yield per plant. High negative direct effects on fruit yield per plant had been observed for number of primary branches per plant, days to 50% flowering, number of clusters per plant, number of flowers per cluster, days to first fruit set, days to first fruit harvest and fruit weight. The results are in accordance with the findings of Asati *et al.* (2008) for plant height, number of primary branches per plant, days to 50% flowering and fruit weight, Kumar and Thakur (2007) for number of fruits per plant, fruit length and fruit width, Mayavel *et al.* (2005) for number of primary branches per plant.

IV. Conclusion

The association and cause effect studies showed that fruit yield per plant was positively and significantly correlated with number of fruits per plant and fruit width. High direct effects are also observe for these traits. So, by improving these traits yield can be significantly increased.

Table 1: Correlation coefficients between different quantitative and qualitative characters of tomato

	1	2	3	4	5	6	7	8	9
1	1.0000	0.7185***	-0.1782	0.2982	0.5137*	-0.268	0.0921	-0.3679	0.3001
2		1.0000	0.4670*	0.1074	0.3906	-0.3727	0.0909	0.5342*	0.5140*
3			1.0000	0.3918	-0.235	0.9063***	0.5730*	0.2997	-0.2192
4				1.0000	0.1962	-0.3525	0.5848**	-0.1254	0.3036
5					1.0000	-0.3099	-0.1322	-0.4498	0.4725*
6						1.0000	0.6254**	0.3302	-0.0673
7							1.0000	0.0486	-0.0262
8								1.0000	-0.3621
9									1.0000
10									
11									
12									
13									
14									
15									
16									
17									
18									

Table 1. Conti....

	10	11	12	13	14	15	16	17	18
1	-0.2427	-0.1422	-0.06	-0.1271	0.0549	0.3872	0.3443	-0.155	0.0598
2	0.0576	-0.036	0.0278	-0.0818	0.4642*	0.1134	0.2159	-0.3619	0.2319
3	0.0216	0.1504	0.2437	0.3266	-0.2395	0.1355	0.2122	0.6122**	-0.264
4	0.4799*	-0.2313	-0.0271	-0.2244	0.1379	-0.1773	-0.146	-0.5241*	0.3642
5	0.1589	-0.0036	0.2671	0.2206	0.2746	0.0751	0.0679	-0.342	0.388
6	0.0895	0.098	0.149	0.1913	-0.1533	0.1426	0.2693	0.6613**	-0.3952
7	-0.1321	0.332	0.301	0.3471	0.0726	0.1536	0.1905	0.4884*	-0.0934
8	-0.4193	-0.0525	-0.1175	-0.0972	-0.4214	0.1705	-0.1445	0.4207	-0.5357*
9	0.3727	-0.0357	0.0535	-0.0564	0.1355	-0.2476	0.0366	-0.0745	0.0127
10	1.0000	0.049	0.1844	0.0885	0.0601	-0.4589*	-0.1827	-0.0784	0.5324*
11		1.0000	0.37	0.7113***	-0.0148	-0.3795	0.6206**	0.0305	0.3052
12			1.0000	0.8683***	-0.1059	-0.0828	-0.3552	-0.2263	0.4807*
13				1.0000	-0.0735	-0.1639	-0.4697*	-0.0587	0.3936
14					1.0000	0.0567	0.3484	-0.3353	0.2262
15						1.0000	0.6416**	0.0663	-0.34
16							1.0000	0.1589	-0.4098
17								1.0000	-0.5336*
18									1.0000

Table 2: Direct and indirect effects of different qualitative and quantitative characters on yield in tomato

	1	2	3	4	5	6	7	8	9
1	1.2223	0.8782	-0.2178	-0.3645	0.6279	-0.3276	0.1126	-0.4496	0.3668
2	-1.1059	-1.5391	0.7188	0.1653	-0.6012	0.5737	-0.1399	0.8221	-0.7911
3	0.0502	0.1315	-0.2816	0.1103	0.0662	-0.2553	-0.1614	-0.0844	0.0617
4	0.1213	0.0437	0.1593	-0.4067	-0.0798	0.1434	0.2378	0.051	-0.1235
5	-0.1793	-0.1364	0.082	-0.0685	-0.3491	0.1082	0.0461	0.157	-0.1649
6	0.1918	0.2667	-0.6486	0.2523	0.2218	-0.7157	-0.4476	-0.2363	0.0482
7	-0.0146	-0.0144	-0.0905	0.0924	0.0209	-0.0988	-0.1579	-0.0077	0.0041
8	-0.0201	-0.0291	0.0164	-0.0068	-0.0245	0.018	0.0027	0.0546	-0.0198
9	-0.0046	-0.0078	0.0033	-0.0046	-0.0072	0.001	0.0004	0.0055	-0.0152
10	-0.2345	0.0556	0.0209	0.4637	0.1535	0.0865	-0.1277	-0.4052	0.3602
11	-0.1565	-0.0397	0.1656	-0.2547	-0.0039	0.1079	0.3656	-0.0578	-0.0393
12	-0.1324	0.0614	0.5377	-0.0597	0.5891	0.3287	0.6641	-0.2592	0.1181
13	0.2502	0.1609	-0.6428	0.4415	-0.4341	-0.3764	-0.6831	0.1913	0.111
14	0.0539	0.4557	-0.2351	0.1353	0.2696	-0.1505	0.0713	-0.4136	0.133
15	0.0355	0.0104	0.0124	-0.0162	0.0069	0.0131	0.0141	0.0156	-0.0227
16	0.0146	0.0092	0.009	-0.0062	0.0029	0.0114	0.0081	-0.0061	0.0016
17	-0.0321	-0.075	0.1269	-0.1086	-0.0709	0.1371	0.1013	0.0872	-0.0154
18	0.0598	0.2319	-0.264	0.3642	0.388	-0.3952	-0.0934	-0.5357	0.0127

Table 2. Conti...

	10	11	12	13	14	15	16	17
1	-0.2966	-0.1738	-0.0734	-0.1554	0.0671	0.4732	0.4209	-0.1894
2	-0.0886	0.0555	-0.0428	0.1259	-0.7145	-0.1745	-0.3323	0.557
3	-0.0061	-0.0424	-0.0686	-0.092	0.0675	-0.0382	-0.0598	-0.1724
4	-0.1952	0.0941	0.011	0.0912	-0.0561	0.0721	0.0594	0.2131
5	-0.0555	0.0012	-0.0932	-0.077	-0.0959	-0.0262	-0.0237	0.1194
6	-0.0641	-0.0701	-0.1066	-0.1369	0.1097	-0.102	-0.1927	-0.4733
7	0.0209	-0.0524	-0.0475	-0.0548	-0.0115	-0.0243	-0.0301	-0.0771
8	-0.0229	-0.0029	-0.0064	-0.0053	-0.023	0.0093	-0.0079	0.023
9	-0.0057	0.0005	-0.0008	0.0009	-0.0021	0.0038	-0.0006	0.0011
10	0.9664	0.0473	0.1782	0.0855	0.0581	-0.4435	-0.1766	-0.0758
11	0.0539	1.1011	0.4073	0.7832	-0.0162	-0.4179	-0.6834	0.0336
12	0.4068	0.8161	2.206	1.9155	-0.2336	-0.1827	-0.7835	-0.4991
13	-0.1741	-1.3998	-1.7089	-1.968	0.1446	0.3226	0.9243	0.1154
14	0.059	-0.0145	-0.1039	-0.0721	0.9816	0.0556	0.342	-0.3291
15	-0.042	-0.0348	-0.0076	-0.015	0.0052	0.0916	0.0588	0.0061
16	-0.0078	-0.0264	-0.0151	-0.0199	0.0148	0.0272	0.0425	0.0067
17	-0.0163	0.0063	-0.0469	-0.0122	-0.0695	0.0137	0.0329	0.2073
18	0.5324	0.3052	0.4807	0.3936	0.2262	-0.34	-0.4098	-0.5336
R square = 0.9744; Residual effect = 0.1599								

1. Plant Height (cm); 2. Number of primary branches per plant; 3. Days to 50% flowering; 4. Number of clusters per plant; 5. Number of flowers per cluster; 6. Days to first fruit set; 7. Days to first fruit harvest; 8. Days to last fruit harvest 9. Number of fruits per cluster; 10. Number of fruits per plant; 11. Fruit length (cm); 12. Fruit width (cm); 13. Fruit weight (g); 14. Ascorbic acid (mg/100g); 15. Acidity (%); 16. TSS (oBrix); 17. Shelf life (Days); 18. Fruit yield per plant (kg)

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