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Correlation and Characters Association Studies in Tomato (*Solanum lycopersicum* L.)

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ABSTRACT

An experiment was conducted with 15 germplasm to study the correlation and direct and indirect effect of different characters on yield and quality of tomato. The experiment was conducted in a randomize block design. The correlation analysis of tomato revealed that yield was positively and significantly correlation with average fruit weight and fruit per plant. The path analysis indicated that average fruit weight followed by fruit per plant had maximum positive per plant had maximum positive direct on yield per plant. Therefore emphasis should be given on average fruit weight, fruit per plant and also fruit length, while selecting a good genotype for enhancing the yield of tomato.

Key words: *Genotypic, Phenotypic, Correlation, Path*

INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is an important vegetable of Solanaceae family having chromosome number 2n=2x=24. It has originated from wild form in the Peru-Equador-Bolivia region of South America[7], and is grown in almost every corner of the world[8]**.** Tomato is universally known as "Protective Food". It is a versatile vegetable for culinary purpose. Tomato is generally consumed as salad, cooked or as processed food. The unripe green fruits are used for making pickles and preserves and are consumed after cooking as vegetable[5]**.** Tomato is a rich source of antioxidants (mainly lycopene and β-carotene), Vitamin A, Vitamin C and minerals like Ca, P and Fe[9]**.** In tomato total antioxidant capacity ranges from 80 to 200 μ mol [6]**.** Lycopene is major antioxidantal pigmental, which is responsible for red color in tomato. Lycopene and their production plays important role in human health in order to reduce the risk of chronic diseases[2]**.** Lycopene varies between 4.31 to 5.97 mg/100g[4], total phenolic acid content ranges from 9.20 – 22 mg/100 g[3]**.** Ascorbic acid contents of tomatoes have been found to vary according to color and it ranged from 23.21-40.44 and 24.38 - 33.87 mg/100g in red and yellow cultivars, respectively[10]. A survey made by M. A. Stevens indicated that among the main fruits and vegetables tomato ranks16[th] as the source of both vitamins A and C[11].

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MATERIAL AND METHODS

The present investigation was done at Horticulture Research Farm, Department of Horticulture, Babasaheb Bhimrao Ambedkar University, Vidya - Vihar, Rea Bareli Road, Lucknow during the year 2014-15. Lucknow is characterized by sub-tropical climate with hot, dry summer and cold winter. The soil of experimental farm was saline with soil pH 8.2, Electrical conductivity 4.0 and sodium exchangeable percentage 15.0. During the period of experiment, meteorological observations were recorded from Indian Institute of Sugarcane Research, Lucknow. The experiment was laid out in Randomized Block Design twelve genetically diverse germplasm lines as females of tomato were crossed with the three testers as male to constitute thirty six crosses. These crosses along with fifteen parents constituted the total experimental materials for this present investigation. The lines were collected from Indian Institute of Vegetable Research, Varanasi (UP), considering the genetic constitution, the three tester namely Pusa Sadabhar, Kashi Vishesh and Kashi Amrit were chosen which were the popular commercial varieties grown Uttar Pradesh. Out of fifteen genotypes, twelve (IIVR-Sel.-1, G-3, S. Naveen, DVRT-2, H-24, H-86, H-88, Pusa Sheetal, FLA 7171, Hisar Arun, Sel.-32 and Flora Dode) were used as a lines and three (Pusa Sadabhar, Kashi Vishesh and Kashi Amrit) used as a testers. Each of the twelve lines (female parents) was crossed to all three testers (male parents) giving rise to 36 F_1's in line x testers during season 2014-15. The crosses were made by hand emasculation followed by pollination. Lines and testers were also maintained during season 2014-15. Observations were recorded on four randomly selected plants from each entry and the average of these four plants was worked out for the purpose of statistical computation. Plant height (cm), number of branches/plant, days to 50 % flowering, number of clusters/plant, number of flowers/cluster, number of fruits/cluster, number of fruits/plant, average fruit weight, number of locules/fruit, pericarp thickness, fruit length, fruit width, number of ridges on fruit, fruit yield/plant, TSS (^{0}Brix) and vitamin c (mg/100g) were recorded. Path analysis based on genotypic correlations was performed according to Dewey & Lu[1].

RESULTS AND DISCUSSION

The correlation coefficient at genotypic level are presented in (Table-1) that fruit yield per plant had positive and significant genotypic correlation coefficient with average fruit weight (0.632) followed by fruits per plant (0.173). However, negative and significant correlations were recorded for fruit yield per plant with clusters per plant (-0.337). Ridges on fruit showed positive and significant correlation with locules per fruit (0.434) and length of fruit (0.107). Fruit width had positive and significant correlation with pericarp thickness (0.429). Fruit length had negative and significant correlation with fruits per plant (-0.436). The pericarp thickness had negative and significant correlation with branches per plant (-0.198). Locules per fruit had negative and significant correlation with flowers per cluster (-0.523). Fruits per plant had positive and significant correlation with clusters per plant (0.365). Flowers per cluster had positive and significant correlation with days to 50% flowering (0.361). Days to 50% flowering had positive and significant correlation with plant height (0.166). Whereas, TSS, Vit. C, average fruit weight, fruits per cluster, clusters per plant and branches per plant showed negative and non significant correlation.

At the phenotypic level are presented in (Table-2), it was observed that fruit yield per plant had negative and significant correlation with fruit length (-0.423). Ridges on fruit had positive and significant correlation with fruits per plant (0.347) except negative and significant correlation with plant height (-0.399), locules per fruit (-0.351) and fruit width (-0.319). Fruit width had positively and significantly correlated with pericarp thickness (0.493) and fruit length (0.396). Fruit Length showed positive and significant correlation

with pericarp thickness (0.541). Pericarp thickness had positively and significantly correlated with average fruit weight (0.312) followed by fruits per cluster (0.308) except negative and significant correlation with locules per fruit (-0.466). Locules per fruit had negative and significant correlation with fruits per plant (-0.340). Average fruit weight had positively and significantly correlated with fruits per cluster (0.321). Fruits per cluster had positively and significantly correlated with flowers per cluster (0.843) followed by plant height (0.526) except negative and significant correlation with branches per plant (-0.352). Flowers per cluster had positively and significantly correlated with plant height (0.519) except negative and significant correlation with branches per plant (-0.333). Clusters per plant had negatively and significantly correlated with days to 50% flowering (-0.388). Whereas, TSS, Vit. C, fruits per plant, days to 50% flowering and branches per plant showed negative and non significant correlation.

The path coefficient analysis was obtained for clear, understanding of association of the genotypic correlation coefficient of yield with contributing components. The genotypic correlation coefficient was partitioned into direct and indirect effects through path coefficient analysis of parents. The results of path coefficient for parent are presented in Table-3. At genotypic level, highest positive direct effect towards yield per plant was showed by average fruit weight (0.365) followed by fruits per plant (0.307), pericarp thickness (0.196), locules per fruit (0.170), flowers per cluster (0.102), fruit width (0.070), plant height (0.039) and Vit. C (0.006), while, highest negative effect towards fruit yield per plant was showed by days to 50% flowering (-0.214) followed by branches per plant (-0.185), fruits per cluster (-0.166), fruit length (-0.094), clusters per plant (-0.077), ridges on fruit (-0.028) and TSS (-0.007).

From the estimate of correlation coefficient and direct and indirect effect of fruit yield attributing traits, it is clear that for bring out designed improvement towards fruit yield in future of tomato average fruit weight and fruits per plant can be used as direct selection parameters.

Table 1: Genotypic Correlation coefficient for different pairs of characters in 15 parents of tomato

Character	Branches/ plant	Days to 50% flowering	Clusters / plant	Flowers/ cluster	Fruits/ cluster	Fruits / plant	Average fruit weight (g)	Locules/ fruit	Pericarp thickness (mm)	Fruit length (cm)	Fruit width (cm)	Ridges on fruit	Vit. C mg/100g	TSS (°BRIX)	Fruit Yield/ plant (kg)
Plant Height (cm)	0.048	0.166**	0.212	0.676	0.716	0.011	0.498	-0.087	-0.119	-0.346	0.019	-0.392	0.256	-0.401	-0.171
Branches/plant		-0.293	0.285	-0.328	-0.358	0.069	-0.115	0.556	-0.198**	-0.137	0.338	0.042	0.117	0.281	-0.283
Days to 50% flowering			-0.639	0.361*	0.463	0.078	0.350	-0.570	0.170	0.163	-0.435	0.169	0.395	0.177	-0.222
Clusters Per Plant				0.402	0.301	0.365*	-0.260	-0.199	0.124	-0.163	0.194	0.309	0.137	-0.099	-0.337**
Flowers/cluster					0.920	0.340	0.225	-0.523*	0.255	-0.348	-0.065	0.059	0.201	-0.221	-0.064
Fruits/cluster						0.332	0.543	-0.452	0.310	-0.436*	-0.068	0.105	0.244	-0.289	0.129
Fruits/plant							0.020	-0.498	0.338	0.002	-0.181	0.416	-0.620	0.449	0.173*
Average fruit weight (g)								-0.524	0.478	0.444	0.229	-0.045	0.021	-0.066	0.632**
Locules/fruit									-0.697	-0.395	-0.067	0.434**	0.103	-0.146	-0.201
Pericarp thickness (mm)										0.579	0.429*	0.249	-0.188	0.056	0.488
Fruit length (cm)											0.541	0.107*	-0.912	0.118	0.577
Fruit width (cm)												-0.519	-0.334	-0.141	0.449
Ridges on fruit													0.143	0.053	-0.108
Vit. C mg/100g														0.114	0.113
TSS (°BRIX)															-0.321

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

Table 2: Phenotypic Correlation coefficient for different pairs of characters in 15 parents of tomato

Character	Branches/ plant	Days to 50% flowering	Clusters/ plant	Flowers/ cluster	Fruits / cluster	Fruits / plant	Average fruit weight (g)	Locules/ fruit	Pericarp thickness (mm)	Fruit length (cm)	Fruit width (cm)	Ridges on fruit	Vit. C mg/100 g	TSS (°BRIX)	Fruit yield/ plant (kg)
Plant height (cm)	0.018	0.155	0.130	0.519**	0.526**	-0.068	0.268	-0.040	-0.080	-0.248	0.085	-0.399**	-0.147	-0.285	0.086
Branches per plant		-0.071	0.097	-0.333*	-0.352*	0.075	-0.167	0.148	-0.109	-0.016	0.047	0.037	-0.264	0.194	-0.055
Days to 50% flowering			-0.388**	0.248	0.089	0.001	-0.027	-0.247	0.078	-0.026	-0.086	0.137	-0.172	0.062	0.192
Clusters/ plant				0.274	0.200	0.091	-0.076	-0.017	-0.080	-0.283	-0.062	0.253	-0.252	-0.033	0.014
Flowers/ cluster					0.843**	0.259	0.074	-0.227	0.255	-0.105	0.096	0.027	-0.085	-0.182	0.163
Fruits/ cluster						0.215	0.321*	-0.217	0.308*	-0.156	0.040	-0.002	0.067	-0.225	0.288
Fruits/plant							-0.053	-0.340*	0.237	0.052	-0.075	0.347*	0.181	0.303	-0.272
Average fruit weight (g)								-0.275	0.312*	0.055	0.219	-0.024	0.500	-0.010	0.086
Locules/ fruit									-0.466**	-0.280	0.038	-0.351*	-0.089	-0.111	0.015
Pericarp thickness (mm)										0.541**	0.493**	0.161	0.358	0.022	-0.060
Fruit length (cm)											0.396**	0.073	0.245	0.016	-0.423**
Fruit width (cm)												-0.319*	0.252	-0.006	-0.107
Ridges on fruit													-0.089	0.044	0.001
Vit. C mg/100g														0.107	-0.172
TSS (°BRIX)															-0.152

***,**Significant at 5% and 1% level, respectively.**

Table 3: Genotypic path coefficient analysis (direct and indirect effect) of yield contributing characters in 15 parents of tomato

Character	Plant height (cm)	Branches / plant	Days to 50% flowering	Clusters/ plant	Flowers/ cluster	Fruits/ cluster	Fruits / plant	Average fruit weight (g)	Locules/ fruit	Pericarp thickness (mm)	Fruit length (cm)	Fruit width (cm)	Ridges on fruit	Vit. C mg/100g	TSS °BRIX
Plant Height (cm)	**0.039**	0.002	-0.002	0.006	0.001	0.007	-0.001	0.004	-0.002	-0.007	-0.007	-0.005	-0.006	0.004	-0.006
Branches/ Plant	-0.008	**-0.185**	0.053	-0.040	0.024	0.007	-0.034	0.010	-0.014	0.015	0.000	0.015	-0.013	-0.002	-0.026
Days to 50% Flowering	0.011	0.061	**-0.214**	0.029	-0.040	0.024	0.085	0.040	0.001	-0.007	0.010	-0.008	-0.018	0.015	-0.027
Clusters/ Plant	-0.012	-0.017	0.010	**-0.077**	-0.026	-0.024	-0.003	0.006	-0.009	-0.003	-0.001	-0.009	-0.020	-0.010	-0.009
Flowers/cluster	0.003	-0.013	0.019	0.034	**0.102**	0.067	0.007	-0.024	0.011	0.034	0.022	0.053	0.018	0.003	0.013
Fruits/ cluster	-0.031	0.006	0.019	-0.052	-0.108	**-0.166**	-0.028	-0.009	-0.020	-0.065	-0.030	-0.057	-0.032	-0.006	0.001
Fruits/plant	-0.005	0.057	-0.122	0.012	0.020	0.052	**0.307**	0.024	-0.033	0.042	0.025	0.003	0.023	0.024	-0.024
Average fruit weight (g)	0.037	-0.020	-0.068	-0.029	-0.085	0.021	0.029	**0.365**	-0.058	0.041	0.011	-0.015	-0.053	0.059	-0.005
Locules/ Fruit	-0.010	0.012	-0.001	0.019	0.018	0.021	-0.018	-0.027	**0.170**	0.014	0.024	0.036	-0.024	0.028	0.019
Pericarp thickness (mm)	-0.036	-0.015	0.006	0.008	0.065	0.077	0.027	0.022	0.017	**0.196**	0.146	0.092	0.037	0.022	0.055
Fruit length (cm)	0.018	0.000	0.004	-0.002	-0.020	-0.017	-0.008	-0.003	-0.013	-0.070	**-0.094**	-0.042	-0.012	-0.003	-0.028
Fruit width (cm)	-0.009	-0.005	0.003	0.008	0.036	0.024	0.001	-0.003	0.015	0.033	0.031	**0.070**	0.000	0.001	0.012
Ridges on fruit	0.004	-0.002	-0.002	-0.008	-0.005	-0.005	-0.002	0.004	0.004	-0.005	-0.004	0.000	**-0.028**	0.001	-0.004
Vit. C mg/100g	-0.024	0.023	0.020	0.019	0.021	-0.001	-0.012	-0.002	0.018	0.045	0.048	0.027	0.024	**0.006**	0.161
TSS (°BRIX)	-0.017	-0.002	0.012	-0.024	-0.006	-0.006	-0.014	-0.029	-0.030	-0.020	-0.005	-0.003	0.007	-0.179	**-0.007**
Fruit yield /plant (Kg)	-0.041	-0.100	-0.264	-0.096	-0.002	0.080	0.335	0.379	0.056	0.241	0.175	0.159	-0.097	0.124	-0.037

Residual effect = 0.781

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