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Character Association and Path Coefficient Studies in Tomato

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A B S T R A C T

The present investigation was conducted at Regional Research Technology Transfer Station, Semiliguda, Koraput during kharif, 2017 in 40 advance lines of tomato to find out the degree of association of component characters with yield and the direct and indirect effects of the traits on fruit yield. The results revealed that the estimates of correlation at phenotypic and genotypic levels was positively significantly highest between fruit yield and number of fruits per plant followed by number of flower clusters per plant, number of fruits per cluster, number of flowers per cluster and root volume. Path coefficient studies at phenotypic level showed that the highest direct contribution to fruit yield was observed through number of fruits per plant followed by number of flower clusters per plant and average fruit weight. Hence for increasing the fruit yield, selection should be based on plants bearing more number of fruits, flower clusters and flowers per cluster.

Introduction

Tomato (*Solanum lycopersicum* L.) is one of the important and widely popular vegetable crops grown in India. India ranks 2nd in both area and production in world and ranks 5th among the vegetables in antioxidant activity assays. Selection based on yield alone is not reliable as influenced by the environment. Therefore indirect selections through component characters became important in a breeding programme for yield improvement. Studies on character association and path analysis not only help in understanding the physical linkage but also give useful information about the direction of selection.

Keeping this in view, the present investigation was undertaken to find out the nature and magnitude of correlations among the characters for selecting the character combinations and path analysis has been used to organize the relationships between the predicted and responsible variables to understand the direct and indirect effects of each of the characters on the fruit yield for increasing the productivity.

Materials and Methods

The experiment was conducted at Regional Research Technology Transfer Station, Semiliguda, Koraput during kharif, 2017 with 40 advance lines of tomato in a Randomized Block Design with two replications maintaining a spacing of 60 x 40 cm. The plot size was 3.0 m x 2.8m. Recommended cultural practices were followed. Observations on 15 morpho-physiological traits (Table 1) were taken from five competitive plants selected on random from middle rows of each plot. The mean data were used for analysis of variance and covariance (Panse and Sukhatme, 1967). From the covariance components, the correlation coefficients at genotypic and phenotypic levels were estimated (Miller *et al.,* 1958) and these were used for path coefficient analysis (Dewey and Lu, 1959).

Results and Discussion

Correlation studies (Table 1) showed that for most character pairs, genotypic and phenotypic associations were in the same directions and the genotypic estimates were higher than the phenotypic ones, indicating an inherent association between the characters. High significant positive association between flower clusters/plant and number of fruits/plant was observed both at genotypic and phenotypic levels, indicated that increase in number of flower clusters had direct bearing on more production of fruits. Further, total fruit yield, the most important economic trait, exhibited the highest positive association with number of fruits per plant followed by number of flower clusters per plant, number of fruits per cluster, number of flowers per cluster and root volume both at genotypic and phenotypic levels. The negative correlation of number of fruits/plant with fruit girth, fruit weight, leaf area index (LAI) and total chlorophyll content indicated that an increase in fruit girth, fruit weight, LAI and chlorophyll content would result in reduction of number of fruits production/plant.

From the Table 1, it was revealed that the highest estimates of correlation at phenotypic level was between fruit yield and number of fruits per plant (r_p=0.890), followed by number of clusters per plan t(r_p=0.868), number of fruits per cluster (r_p=0.549), number of flowers per cluster (r_p=0.536) and root volume (r_p=0.403). The highest estimates of genotypic correlation was between fruit yield and number of clusters per plant (r_g =0.972), followed by number of fruits per plant (r_g =0.914), number of fruits per cluster (r_g =0.586), number of flowers per cluster (r_g =0.567) and root volume (r_g =0.410). The rest characters showed non-significant correlations with total fruit yield.

When other characters considered (other than yield), plant height had a significant positive correlation at phenotypic level with number of branches per plant (r_p= 0.466) and at genotypic level, it had a significant correlation with number of branches per plant (r_g= 0.507) followed by LAI (r_g= 0.330) at 5% level. Number of branches per plant showed positive significant association with LAI at genotypic level (r_g= 0.330).

Number of clusters per plant had significant positive correlation with number of fruits per plant (r_p= 0.777, r_g= 0.861), followed by number of fruit per cluster (r_p= 0.746, r_g= 0.775) and number of flower per cluster (r_p= 0.739, r_g= 0.756). Number of flowers per cluster had significant positive correlation with number of fruits per cluster (r_p= 0.782, r_g= 0.810) followed by number of fruits per plant (r_p= 0.572, r_g= 0.619). Number of fruit per cluster had significant positive correlation with number of fruits per plant (r_p= 0.583, r_g= 0.634).

Table.1 Phenotypic (r_p) and genotypic (r_g) correlation co-efficient among various characters for 40 tomato genotypes

Characters		Days to 50% flowering	Plant height	No. of branches/ plant	No. of cluster/ plant	No. of flower /cluster	No. of fruit/ cluster	No. of fruit/ plant	Polar diameter of plant	Equitorial diameter of plant	Pericarp thickness	Average fruit weight	Root volume	Leaf area index	Total chlorophyll content
Plant height	r_p	-0.138													
	r_g	-0.285													
No. of branch/plant	r_p	-0.393	0.466**												
	r_g	-0.882	0.507**												
No. of cluster/plant	r_p	-0.057	-0.050	0.052											
	r_g	0.010	-0.054	0.047											
No. of flower / cluster	r_p	-0.074	0.061	-0.010	0.739**										
	r_g	-0.143	-0.057	0.013	0.756**										
No. of fruit/ cluster	r_p	-0.005	-0.125	-0.133	0.746**	0.782**									
	r_g	-0.047	-0.119	-0.124	0.775**	0.810**									
No. of fruit/ plant	r_p	-0.154	-0.194	0.126	0.777**	0.572**	0.583**								
	r_g	-0.217	-0.197	0.128	0.861**	0.619**	0.634**								
Polar diameter of fruit	r_p	0.030	0.147	-0.026	0.177	0.096	0.070	0.122							
	r_g	0.206	0.160	-0.017	0.173	0.086	0.088	0.126							
Equatorial diameter of fruit	r_p	-0.041	0.108	-0.167	0.098	0.082	0.065	-0.139	0.331						
	r_g	-0.158	0.109	-0.182	0.103	0.081	0.086	-0.139	0.330						
Pericarp thickness	r_p	-0.122	0.283	0.196	0.216	0.059	0.072	0.184	0.413**	-0.127					
	r_g	-0.213	0.287	0.231	0.256	0.076	0.097	0.195	0.444**	-0.150					
Average fruit weight	r_p	0.182	0.001	0.016	0.241	-0.004	-0.006	-0.164	0.157	0.415**	0.071				
	r_g	0.224	0.001	0.099	0.306	0.012	-0.006	-0.131	0.204	0.448**	0.070				
Root volume	r_p	0.123	0.222	0.003	0.308	-0.001	-0.018	0.188	0.198	0.337*	0.137	0.420**			
	r_g	0.260	0.220	0.220	0.336*	0.001	-0.013	0.191	0.211	0.348*	0.141	0.455**			
Leaf area index	r_p	0.220	0.251	0.161	0.021	-0.022	-0.050	-0.100	0.168	-0.066	0.380*	0.255	0.054		
	r_g	0.629**	0.330*	0.330*	-0.021	-0.092	-0.108	-0.127	0.174	-0.121	0.463**	0.336*	0.065		
Total chlorophyll content	r_p	0.211	0.013	-0.056	0.147	0.069	0.259	-0.003	0.092	0.176	0.165	0.207	0.109	0.249	
	r_g	0.427**	0.014	0.014	0.173	0.081	0.289	-0.006	0.101	0.181	0.169	0.222	0.108	0.308	
Fruit yield	r_p	-0.077	-0.127	0.138	0.868**	0.536**	0.549**	0.890**	0.190	0.064	0.188	0.225	0.403**	-0.016	0.051
	r_g	-0.187	-0.135	-0.135	0.972**	0.567**	0.586**	0.914**	0.214	0.063	0.190	0.242	0.410**	0.002	0.051

$r \geq 0.312$ sig at 5% level* $r \geq 0.403$ sig at 1% level**

r_p= correlation at phenotypic level, r_g= correlation at genotypic level

Table.2 Direct (diagonal) and indirect effects of component traits on yield at phenotypic level for 40 tomato advance lines

	Days to 50% flowering	Plant height	No. of branches/ plant	No. of cluster/ plant	No. of flower /cluster	No. of fruit/ cluster	No. of fruit/ plant	Polar diameter of plant	Equitorial diameter of plant	Pericarp thickness	Average fruit weight	Root volume	Leaf area index	Total chlorophyll content	Fruit yield
Days to 50% flowering	0.019	-0.002	-0.011	-0.015	0.007	0.001	-0.123	-0.001	-0.001	0.004	0.047	0.006	-0.001	-0.007	-0.077
Plant height	-0.003	0.016	0.013	-0.013	0.006	0.003	-0.154	0.001	0.004	-0.010	0.001	0.011	-0.001	0.001	-0.127
No. of branch/plant	-0.007	0.007	0.028	0.014	0.001	0.003	0.099	0.001	-0.006	-0.007	0.004	0.001	-0.001	0.002	0.138
No. of cluster/plant	-0.001	-0.001	0.001	0.266	-0.067	-0.019	0.618**	0.002	0.003	-0.007	0.063	0.016	0.001	-0.005	0.868**
No. of flower / cluster	-0.001	-0.001	0.000	0.196	-0.091	-0.020	0.455**	0.001	0.003	-0.002	-0.001	0.001	0.001	-0.002	0.536**
No. of fruit/ cluster	0.001	-0.002	-0.003	0.198	-0.071	-0.026	0.464**	0.001	0.002	-0.002	-0.002	-0.001	0.001	-0.009	0.549**
No. of fruit/ plant	-0.003	-0.003	0.003	0.206	-0.052	-0.015	0.796**	0.001	-0.005	-0.006	-0.043	0.010	0.001	0.001	0.890**
Polar diameter of fruit	0.001	0.002	-0.001	0.047	-0.009	-0.002	0.097	0.010	0.011	-0.014	0.041	0.010	-0.001	-0.003	0.190
Equatorial diameter of fruit	-0.001	0.002	-0.005	0.026	-0.007	-0.002	-0.111	0.003	0.034	0.004	0.108	0.017	0.001	-0.006	0.064
Pericarp thickness	-0.002	0.005	0.005	0.057	-0.005	-0.002	0.146	0.004	-0.004	-0.036	0.019	0.007	-0.002	-0.006	0.188
Average fruit weight	0.003	0.001	0.001	0.064	0.001	0.001	-0.130	0.002	0.014	-0.002	0.261	0.021	-0.001	-0.007	0.225
Root volume	0.022	0.044	0.001	0.082	0.001	0.001	0.0150	0.002	0.012	-0.005	.110	0.051	0.001	-0.004	0.403**
Leaf area index	0.004	0.004	0.004	0.006	0.002	0.001	-0.080	0.002	-0.002	-0.013	0.067	0.003	-0.005	-0.009	-0.016
Total chlorophyll content	0.04	0.001	-0.002	0.039	-0.006	-0.007	-0.002	0.001	0.006	-0.006	0054	0.006	-0.001	-0.035	0.051

Sig at 5% level* sig at 1% level**

Polar diameter of fruit had positive significant correlation with average fruit weight (r_p= 0.415, r_g= 0.444). Equatorial diameter of fruit had significant positive correlation with average fruit weight (r_p= 0.415, r_g= 0.448) followed by root volume (r_p= 0.337, r_g= 0.348). Pericarp thickness had positive significant correlation with leaf area index (r_p= 0.380, r_g= 0.463). Average fruit weight had positive significant correlation with root volume (r_p= 0.420, r_g= 0.455). Similar type of results were also obtained by Mahapatra *et al.*, (2013), Kumar (2014) and Khan and Samadia (2018).

The path coefficient analysis was done for clear understanding of the phenotypic correlation coefficient of fruit yield with contributing component traits. The phenotypic correlation coefficient was partitioned into direct and indirect effects of different traits on fruit yield (Table 2).

The results revealed that the highest direct effect to fruit yield was observed through number of fruits per plant (0.796) followed by number of flower clusters per plant (0.266) and average fruit weight (0.261). It was also revealed that the direct effect of number of fruits/plant was further intensified with the indirect effect of number of flower clusters/plant (0.206).Similar type of results were also obtained by Saleem *et al.,* (2013), Kumar *et al.,* (2013), Meena and Bahadur (2015) and Prajapati *et al.,* (2015).

Thus the association and cause effect studies showed that total fruit yield/plant was significantly and positively correlated with number of fruits/plant and number of flower clusters/plant. High direct effects were also observed for these characters. Hence for increasing the fruit yield, selection should be based on plants bearing more number of fruits, flower clusters and flowers per cluster.

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