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STUDIES ON CORRELATION AND PATH COEFFICIENT ANALYSIS IN TOMATO (*SOLANUM LYCOPERSICON* L.)

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Abstract

Fifty genotypes of tomato collected from different location of India and maintained at Department of Vegetable Science were evaluated for ten quantitative characters in randomized complete block design with three replications at Main Experiment Station, Vegetable Research Farm, Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.), India, during 2011-2012. Genotypic correlation coefficients were generally similar in nature and higher in magnitude than the corresponding phenotypic correlation coefficients. Fruit yield per plant had exhibited highly significant and positive association with number of fruits per plant, number of primary branches per plant, plant height, pericarp thickness, average fruit weight and fruit diameter. While, days to 50 per cent flowering showed negative and significant association with yield per plant. Number of fruits per plant, pericarp thickness and fruit diameter were identified as most important traits which contributed considerable positive direct effect on fruit yield per plant. The negative direct effects on fruit yield per plant were exhibited by total soluble solids and number of locules per fruit. Substantial positive indirect effects on fruit yield per plant were exerted by number of primary branches per plant, plant height and total soluble solids *via* number of fruits per plant.

Key words : Tomato (*Solanum lycopersicon* L.), vegetable crops, plant height, fruit diameter.

Introduction

Tomato (*Solanum lycopersicon* L.) is one of the most important solanaceous vegetable crops grown widely all over the world. It is a very versatile vegetable for culinary purposes. Ripe fresh tomato fruits are consumed fresh as salads, cooked vegetable and processed products such as puree, paste, powder, ketchup, sauce, soup and canned whole fruits. Unripe green fruits are used for preparation of pickles and chutney. All the species of tomato are native to Western South America (Rick, 1976). Tomato is important source of lycopene (an antioxidant), ascorbic acid and ß-carotene and valued for their colour and flavour. It is one of the most popular and widely cultivated vegetable throughout the world and ranking second in importance after potato in many countries including India (Anonymous 2010-11). The total area of world under tomato cultivation is 4.58 m ha with total production being 150.51 m tonnes with productivity of 32.8 tonnes per hectare. Whereas in India, total area is 0.86 m ha and production is 16.82 m tonnes with 19.5 tonnes/ha productivity. Tomato is a typical day neutral plant and is mainly self-pollinated, but a certain percentage of cross-pollination also occurs. It is a warm season crop reasonably resistant to heat and drought and grows under wide range of soil and climatic conditions. Considering the importance and scope of this crop, there is a need to develop tomato varieties suitable to specific agro-ecological conditions and also for specific end use. Study of correlation between different quantitative characters provides an idea of association that could be effectively exploited to formulate selection strategy for improving yield components. For any effective selection programme it would be desirable to consider the relative magnitude of association of various characters with yield. The path coefficient technique helps in estimating the direct and indirect contribution of various traits out of the total correlation towards yield. On the basis of these strategies the quantum importance of individual characters is marked to facilitate the selection programme for better gains.

Materials and Methods

Present investigation was conducted at the Main Experimental Station of Vegetable Research Farm of Narendra Deva University of Agriculture and Technology, Narendra Nagar, Kumarganj, Faizabad (U.P.), India;

during *Rabi* 2011-2012. The experiment was conducted to evaluate 50 genotypes of tomato. Seeds were sown in nursery bed on 10th October 2011 and 30 days old healthy seedlings were transplanted in the experimental field on 10th November 2011 in two row of 4 m length with inter and intra row spacing of 60 and 50 cm, respectively. Four check varieties (H-86, H-24 and NDT-8 as determinate and NDT-4 as indeterminate) and 46 genotypes were planted in two rows, keeping 8 plants in each row. The 50 genotypes were planted in Randomized Block Design with three replications. All recommended cultural practices were followed to raise good crop stand and growth of the plants. Data were recorded for ten characters *viz* days to 50 per cent flowering, plant height (cm), number of primary branches per plant, fruit diameter (cm), number of locules per fruit, pericarp thickness (mm), average fruit weight (g), total soluble solids, number of fruits per plant and fruit yield per plant (kg). The data were analyzed as per methods suggested by Seale (1961) for correlation coefficient and Dewey and Lu (1959) for path coefficient analysis.

Results and Discussion

The knowledge of nature and magnitude of association between yield and its component traits is necessary for effective selection in advance generations. Correlations between pairs of characters are either due linkage of genes or due to pleiotropic gene action.

In the present study, correlations between ten characters were worked out in all possible combinations at phenotypic and genotypic levels (tables 1 and 2). In general, the magnitude of genotypic correlation coefficients were higher than the corresponding values of the phenotypic correlation coefficients. This indicated a strong genetic association between these traits. The present study also suggested that both genotypic and phenotypic correlations were similar in direction. Kumar *et al.* (2003), also reported higher estimates of genotypic correlation than the corresponding phenotypic correlation coefficients between yield and yield components. A perusal of data (tables 1 and 2) revealed that most important traits fruit yield per plant had highly significant and positive association with number of fruits per plant, number of primary branches per plant, plant height, pericarp thickness, average fruit weight and fruit diameter and negative significant correlation with days to 50 per cent flowering at both phenotypic and genotypic level. Thus, these characters emerged as most important associates of fruit yield in tomato. The available literature has also indicated positive correlation between fruit yield per plant and number of fruit per plant, number of primary branches per plant, plant height, pericarp thickness, average fruit weight and diameter of fruit in tomato (Kumar *et al*., 2003; Kumar *et al*., 2004; Mukesh *et al*., 2006; Maurya *et al*., 2011; Madhurina and Paul, 2012).

The number of fruits per plant had highly significant and positive association with number of primary branches per plant, plant height, total soluble solids and significant and negative correlation with days to 50 per cent flowering. Total soluble solid had highly significant and positive correlation with plant height, number of primary branches per plant, fruit diameter and average fruit weight. Average fruit weight had highly significant and positive correlation with fruit diameter, number of locules per fruit, plant height and significant and negative correlation with days to 50 per cent flowering. Pericarp thickness had significant and positive correlation with plant height and number of primary branches per plant. Number of locules per fruit had highly significant and positive correlation with fruit diameter and plant height. Diameter of fruit had highly significant and positive correlation with number of primary branches per plant and plant height. Primary branches per plant had highly significant and positive correlation with plant height. These results are in consonance with the finding of Madhurina and Paul (2012), Maurya *et al*. (2011), Ara *et al*. (2009) and Singh 2007).

Thus, on the basis of above discussion it can be concluded that selection for number of fruit per plant, average fruit weight, diameter of fruit, primary branches per plant, plant height and early days to 50 per cent flowering would be effective for yield improvement. Emphasis for selection of these traits in desired direction for higher yield had also been suggested by earlier workers (Singh, 2007; Madhurina and Paul, 2012; Narolia *et al.*, 2012).

Path coefficient analysis is a tool to partition the observed correlation coefficient of yield components on yield into direct and indirect effects to provide clearer picture of character associations for formulating effective selection strategy. Path analysis differs from simple correlation in that it points out the causes and their relative importance whereas; the latter measures simply the mutual association ignoring the causation.

In present study, the path coefficient analysis was carried out at phenotypic as well as genotypic levels (tables 3 and 4). High positive direct effects were exerted by number of fruits per plant, pericarp thickness and fruit diameter on fruit yield per plant. This indicates that direct selection for number of fruits per plant, pericarp thickness and diameter of fruit in desired direction would be very

Table 1: Estimates of phenotypic correlation coefficients between ten characters in tomato

Characters	Days to 50 per cent flowering	Plant height (cm)	Number of primary branches per plant	Fruit diameter (cm)	Number of locules per fruit	Pericarp Thickness (mm)	Average fruit weight (g)	Total soluble solids (TSS)	Number of fruits per plant	Fruit yield per plant (kg)
Days to 50 per cent flowering**1.000**	-0.023	-0.152	-0.152	-0.024	-0.111	-0.199*	-0.100	-0.179*	-0.177*	
Plant height (cm)		**1.000**	0.683**	0.253**	0.272**	0.176*	0.334**	0.357**	0.468**	0.507**
Number of primary branches per plant			**1.0000**	0.271**	0.167*	0.163*	0.165*	0.325**	0.525**	0.529**
Fruit diameter (cm)				**1.000**	0.533**	0.075	0.683**	0.261**	0.038	0.350**
Number of Locules per fruit					**1.000**	0.070	0.365**	0.122	-0.178*	0.061
Pericarp thickness (mm)						**1.000**	-0.043	0.126	0.128	0.361**
Average fruit weight (g)							**1.000**	0.255**	0.153	0.357**
Total soluble solids (TSS)								**1.000**	0.213**	0.206*
Number of fruits per plant									**1.000**	0.677**

*- Significant at 5 per cent probability level
**- Significant at 1 per cent probability level.

Table 2 : Estimates of genotypic correlation coefficient between ten characters in tomato.

Characters	Days to 50 per cent flowering	Plant height (cm)	Number of primary branches per plant	Fruit diameter (cm)	Number of locules per fruit	Pericarp Thickness (mm)	Average fruit weight (g)	Total soluble solids (TSS)	Number of fruits per plant	Fruit yield per plant (kg)
Days to 50 per cent flowering	**1.000**	-0.031	-0.176	-0.169	-0.031	-0.124	-0.224	-0.109	-0.194	-0.197
Plant height (cm)		**1.000**	0.711	0.281	0.275	0.191	0.347	0.370	0.481	0.531
Number of primary branches per plant			**1.000**	0.302	0.175	0.172	0.173	0.348	0.563	0.575
Fruit diameter (cm)				**1.000**	0.577	0.085	0.724	0.294	0.039	0.377
Number of locules per fruit					**1.000**	0.076	0.375	0.129	-0.186	0.064
Pericarp thickness (mm)						**1.000**	-0.046	0.124	0.127	0.402
Average fruit weight (g.)							**1.000**	0.269	0.158	0.368
Total soluble solids (TSS)								**1.000**	0.226	0.220
Number of fruits per plant									**1.000**	0.691

Table 3: Direct and indirect effects at phenotypic level in tomato for ten characters

Characters	Days to 50 per cent flowering	Plant height (cm)	Number of primary branches per plant	Fruit diameter (cm)	Number of Locules per fruit	Pericarp thickness (mm)	Average fruit weight (g)	Total soluble solids (TSS)	Number of fruits per Plant	Correlation with fruit yield per plant (kg)
Days to 50 per cent flowering	**0.016**	-0.002	-0.016	-0.034	0.001	-0.030	-0.027	0.009	-0.094	**-0.177**
Plant height (cm)	-0.0004	**0.086**	0.075	0.057	-0.017	0.047	0.045	-0.032	0.245	**0.527**
Number of primary branches per plant	-0.002	0.059	**0.109**	0.061	-0.010	0.043	0.022	-0.029	0.275	**0.529**
Fruit diameter (cm)	-0.002	0.022	0.029	**0.225**	-0.034	0.020	0.093	-0.023	0.020	**0.350**
Number of locules per fruit	-0.000	0.023	0.018	0.120	**-0.064**	0.018	0.050	-0.011	-0.0938	**0.061**
Pericarp thickness (mm)	-0.001	0.015	0.017	0.017	-0.004	**0.267**	-0.006	-0.011	0.0676	**0.361**
Average fruit weight (g)	-0.003	0.029	0.018	0.154	-0.023	-0.011	**0.137**	-0.023	0.0806	**0.357**
Total soluble solids (TSS)	-0.001	0.031	0.035	0.058	.-0.008	0.033	0.035	**-0.090**	0.112	**0.206**
Number of fruits per plant	-0.003	0.040	0.057	0.008	0.011	0.034	0.021	-0.019	**0.525**	**0.677**

Residual effect = 0.5853, R^2 = 0.6574.

Table 4: Direct and indirect effects at genotypic level in tomato for ten characters

Characters	Days to 50 per cent flowering	Plant height (cm)	Number of primary branches per plant	Fruit diameter (cm)	Number of locules per fruit	Pericarp thickness (mm)	Average fruit weight (g)	Total soluble solids (TSS)	Number of fruits per plant	Correlation with fruit yield per plant (kg)
Days to 50 per cent flowering	**0.027**	-0.002	-0.022	-0.045	0.002	-0.038	-0.028	0.011	-0.102	**-0.197**
Plant height (cm)	-0.000	**0.074**	0.091	0.075	-0.024	0.058	0.044	-0.039	0.253	**0.531**
Number of primary branches per plant	-0.004	0.052	**0.129**	0.080	-0.015	0.052	0.022	-0.037	0.296	**0.575**
Fruit diameter (cm)	-0.004	0.020	0.039	**0.267**	-0.052	0.026	0.091	-0.031	0.020	**0.377**
Number of Locules per fruit	-0.000	0.020	0.022	0.154	**-0.090**	0.023	0.047	-0.014	-0.098	**0.064**
Pericarp Thickness (mm)	-0.003	0.014	0.022	0.022	-0.006	**0.305**	-0.005	-0.013	0.067	**0.402**
Average fruit weight (g)	-0.006	0.025	0.022	0.193	-0.033	-0.014	**0.126**	-0.029	0.083	**0.368**
Total soluble solids (TSS)	-0.003	0.027	0.045	0.078	-0.011	0.038	0.034	**-0.107**	0.119	**0.220**
Number of fruit per plant	-0.005	0.035	0.072	0.010	0.016	0.038	0.020	-0.024	**0.526**	**0.691**

Residual effect = 0.5354, R^2 = 0.713

effective for yield improvement. These results are in accordance with the findings of Singh *et al*. (2004), Makesh *et al.* (2006), Madhurina and Paul (2012) and Narolia *et al.* (2012).

Thus, the above discussion reveals the facts that important direct and indirect component exhibited substantial positive effect *via* some characters along with considerable negative effect *via* some other traits. The occurrence of negative as well as positive direct and indirect effects by yield components on fruit yield *via* one or other characters simultaneously presents a complex situation, where a compromise is required to attain a proper balance of different yield components for determining the ideotype for high fruit yield in tomato. The character mentioned above, merit due consideration at the time of formulation of selection strategy aimed at developing high yielding varieties in tomato.

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