HortFlora Research Spectrum, 1(3): 215-219 (2012) ISSN : 2250-2823

PATH ANALYSIS BETWEEN FRUIT YIELD AND SOME YIELD COMPONENTS IN TOMATO (*Lycopersicon esculeutum* Mill)

Madhurina Manna and Amitava Paul

Department of CIHAB; Palli Siksha Bhavana (Institute of Agriculture)

Visva-Bharati, Sriniketan–731236, Birbhum, West Bengal

E-mail: amitava. paul @ rediffmail.com

ABSTRACT : Path analysis was performed on plant and fruit characters of fifteen tomato genotypes grown in a two year field experiment to determine for fruit yield, the direct and indirect effects of the following traits: plant height, no. of primary branches/plant, no. of fruits/plant, fruit weight (g), fruit bearing length, fruit length, fruit width and pericarp thickness. Fruit yield per plant was positively and significantly correlated with pericarp thickness, fruit length, fruit weight and no. of fruits/plant, whereas, fruit yield per plant had negative and significant association with days to 50% flowering, plant height, no. of primary branches/plant, fruit bearing length. Path analysis showed that plant height, fruit length, fruit bearing length and pericarp thickness had positive direct effects on fruit yield while other traits under study had strong negative direct effects. The significant positive correlation coefficients of no. of fruits/plant with fruit yield was resulted from positive indirect effects of days to 50% flowering, fruit weight, fruit width and pericarp thickness, while for fruit weight with fruit yield, significant positive correlation resulted from positive indirect effects via days to 50% flowering, no. of fruits/plant and no. of primary branches/plant. Results suggest that indirect selection for days to 50% flowering, fruit weight, fruit width and direct selection for fruit bearing length and pericarp thickness should be primary selection criteria for improving fruit yield in tomato.

Keywords: *Path analysis, correlation, tomato, yield.*

Plant breeding may alleviate the deficiency in vegetable production by developing varieties yielding higher under the severe ecological conditions of dry tracts of West Bengal prevailing in the districts of Birbhum, Bankura and Purulia. For that purpose, superior varieties must be developed by selection among and within populations that have very rich variations in important agronomic traits. The success of selection depends on the choice of selection criteria for improving fruit yield. Yield components do not only directly affect the yield, but also indirectly by affecting other yield components in negative or positive ways. As a trait can affect another trait positively, it can affect some other or all traits negatively (Walton, 24). For that reason, it is clear that correlation coefficient, which measures the simple linear relationship between two traits, does not predict the success of selection. However, path analysis determines the relative importance of direct and indirect effects on fruit yield (Bhatt, 5). Path analysis has been used to define the best criteria for selection in biological and agronomic studies (Mishra and Drolsom, 18; Williams *et al.*, 25).

Received : 11.4.2012 *Accepted : 18.5.2012*

MATERIALS AND METHODS

Two field experiments were carried out during two 'rabi' seasons (the 2004-05 and 2005-06) at the Horticulture Farm of Palli Siksha Bhavana (Institute of Agriculture), Visva-Bharati , Birbhum, West Bengal (23°29' N, 87° 42' E)and 58.9 msl). The research field had a loamy sand (utisol) in texture with acidic (pH 4.4) in nature. Fifteen winter tomato genotypes which were improved by selection were used in the experiments. These genotypes were sown in seed bed during the month of November, and the seedlings were transplanted in the main field 25 days after sowing. The experiments were arranged in a randomized complete block design with three replications. Plots were 5m long and consisted of four rows, keeping plant-to-plant and row-row spacing of 0.5m apart.

Before transplanting, the land was prepared following proper agronomic practices. The field was frequently irrigated, to avoid visible symptoms of draught stress. Weeds and insects were effectively controlled.

Data on various quantitative characters viz. days to 50% flowering, plant height (cm), primary branches per plant, fruit bearing length (cm), fruits per plant, fruit weight (g), fruit yield per plant (g) were recorded. To achieve this, five plants (of two center rows leaving one row in the border areas to avoid border effects) were selected randomly per plot at the beginning of the growth seasons and various stages were recorded using these plants till the end of the growth seasons. Data on days to 50% flowering were recorded on whole plot basis. After harvesting of fruits, data on fruit length (cm), fruit width (cm), and pericarp thickness (mm) were also taken from five randomly selected fruits form each selected plant.

Data collected during two growing seasons on these quantitative characters were pooled and correlation was performed as suggested by Johnson *et al.* (15) and Al-Jibouri *et al.* (2). The relative importance of direct and indirect effects of measured traits on fruits yield was determined by path analysis following the method as suggested Dewey and Lu (10) and Burtan and De Vane (8). In the path analysis, fruit yield was the dependent variable and the rest eight parameters (mentioned above) were considered as independent variables.

RESULTS AND DISCUSSION

Information on correlation and path coefficients and heritability estimates of yield and yield contributing characters, in tomato genotypes, is the first requisite to define selection criteria for developing hybrid varieties. There exists a large variation among the germplasm collections of tomato in the fruit yield. The variation, however, has remained unexplored due to lack of information on the relationships between component traits and their contribution towards yield. Most former studies concentrated on small number of traits, but in this study, morphological and phonological traits have been investigated simultaneously.

Estimates of genotypic and phenotypic correlation coefficients among different pairs of characters of tomato is presented in Table 1. Highly significant and positive (genotypic and phenotypic) correlation coefficients with fruit yield were found for pericarp thickness, fruit length, fruit weight and number of fruits per plant, in that order. In former studies with tomato, fruit length, fruit weight (Das *et al.,* 9; Yadav and Singh, 26; Padma *et al.,* 21; Joshi *et al.,* 16), pericarp thickness (Bharti *et al.,* 4; Bhushana et al., 6; Kumar *et al.,* 17; Joshi *et al.,* 16) and fruits per plant (Dhankar *et al.,* 11; Harer et al., 14; Singh *et al.,* 23) exhibited strong positive correlations with fruit yield.

Fruit yield was negatively and significantly correlated with days to 50% flowering, plant height, primary branches per plant, fruit bearing length at both genotypic and phenotypic level. Our results confirm the findings of Mohanty (19, 20) for primary branches per plant, Padma et al. (21) and Mohanty (19, 20) for plant height, but not for days to 50% flowering.

Positive and significant correlation at both genotypic and phenotypic levels were also observed for days to 50% flowering with plant height, primary branches per plant, fruit bearing length; plant height with primary branches per plant, fruit bearing length; primary branches per plant with fruit bearing length; fruit weight with fruit length, fruit width and pericarp thickness; and fruit length with pericarp thickness. Barman *et al.,* (3), Padma *et al.* (21) recorded positive association between plant height and primary branches per plant. Das *et al.* (9) and Padma *et al.* (21) also reported positive correlation between fruit width and fruit weight.

Significant negative correlation at both the levels in this experiment were observed for days to 50% flowering with fruit weight, pericarp thickness; plant height with fruits per plant, fruit weight, fruit length and pericarp thickness; primary

Table 1: Genotypic (G) and phenotypic (P) correlation coefficients of different characters in tomato.

Characters		Plant height (cm)	Primary branches per plant	Fruit bearing length (cm)	Fruits per plant	Fruit weight (g)	Fruit length (cm)	Fruit width	Fruit yield per plant (g)
Days to 50% flowering	G	0.613**	0.408**	0.800**	-0.209*	-0.551**	0.194	-0.060	-0.607**
	P	0.496**	0.260*	0.616**	-0.182	-0.464**	0.143	-0.060	-0.470**
Plant height (cm)	G		0.580**	0.686**	-0.233*	-0.218**	-0.397**	0.043	-0.587**
	P		0.483**	0.669**	-0.208*	-0.211**	-0.378**	0.041	-0.569**
Primary branches per plant	G			0.483**	0.003	-0.110	-0.422**	-0.559**	-0.437**
	P			0.414**	0.015	-0.101	-0.325**	-0.453**	-0.358**
Fruit bearing length (cm)	G				-0.248*	-0.336**	-0.070	0.021	-0.612**
	P				-0.216*	-0.325**	-0.063	0.023	-0.598**
Number of fruits per plant	G					-0.343**	-0.258*	-0.704**	0.152
	P					-0.316**	-0.217*	-0.596**	0.145
Fruit weight (g)	G						0.263*	0.207*	0.455**
	P						0.253*	0.193	0.436**
Fruit length (cm)	G							-0.081	0.564**
	P							-0.068	0.533**
Fruit width (cm)	G								-0.093
	P								-0.078

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

Table 2: Genotypic path coefficient analysis showing direct and indirect effects of different characters on fruit yield in tomato.

Characters	Days to 50% flowering	Plant height (cm)	Primary branches per plant	Number of fruits per plant	Fruit weight (g)	Fruit bearing length (cm)	Fruit length (cm)	Fruit width (cm)	Correlation with fruit yield
Days to 50% flowering	**-1.224**	0.291	-0.465	0.239	0.251	0.164	0.043	0.094	-0.607 **
Plant height (cm)	-0.750	**0.475**	-0.661	0.265	0.099	0.141	-0.088	-0.068	-0.587 *
Primary branches per plant	-0.500	0.276	**-1.139**	-0.003	0.050	0.099	-0.094	0.874	-0.437 **
Number of fruits per plant	0.256	-0.110	-0.003	**-1.139**	0.156	-0.051	-0.057	1.100	0.152
Fruit weight (g)	0.675	-0.103	0.125	0.391	**-0.455**	-0.069	0.058	-0.167	0.455* *
Fruit bearing length (cm)	-0.980	0;.326	-0.550	0.283	0.153	**0.205**	-0.016	-0.033	-0.612 **
Fruit length (cm)	-0.238	-0.188	0.481	0.291	-0.120	-0.014	**0.223**	0.127	0.564* *
Fruit width (cm)	0.074	0.021	0.637	0.802	-0.049	0.004	-0.018	**-0.564**	-0.093

Residual = 0.273; * and **Significant at 5% and 1% level, respectively; Diagonal (Bold) values indicated direct effect.

branches per plant with fruit length, fruit width and pericarp thickness; fruit bearing length with fruits per plant, fruit weight and pericarp thickness; and fruits per plant with fruit weight, fruit length and fruit width. Significant negative correlation at both the levels were also found between number of fruits per plant and fruit weight by Mohanty (19, 20), Padma *et al.* (21), Joshi *et al.* (16) and Singh *et al.* (23); between number of fruits per plant and plant height by Mohanty (20).

However, reports on the nature of association between days to 50% flowering with pericarp thickness; plant height with pericarp thickness, fruit length and fruit width; fruit bearing length with fruits per plant, fruit weight and pericarp thickness; fruits per plant with fruit length and fruit width are scanty. Such type of negative association may arise primarily form developmentally induced relationship (Adams, 1) whereby the developing structures of the plant compete for a common factor, possibly limited nutrient supply and if one structure is more favoured than the other for any reason, a negative correlation may arise between them.

In the present investigation, in general the genotypic and phenotypic correlations showed similar trend but genotypic correlation were at higher magnitude than phenotypic correlation in most of the cases. Vary close values of genotypic and phenotypic correlation were also observed between some character combinations which might be due to reduction in error (environmental) variance to minor proportions as reported by Dewey and Lu (10). Wide difference between genotypic and phenotypic correlations between two characters is due to dual nature of phenotypic correlation, which is determined by genotypic and environmental correlation, and heritabilities of the character (Falconer, 12).

Path coefficients divided the correlation coefficient into a series of direct and indirect effects of morphological and phonological traits on the fruit yield of tomato (Table 2). Path analysis showed that only plant height, fruit length, fruit bearing length and pericarp thickness had positive direct effects, in that order, on the fruit yield while other traits had strong negative direct effects. The results are in conformity with Barman et al. (3), Bodunde (7), Singh et al. (22), Joshi *et al.* (16) for plat height; Padma *et al.* (21), Joshi *et al.* (16) and Singh *et al.* (23) for fruit length; and Singh *et al.* (23) for primary branches per plant and fruits per plant.

The main effects of plant height and fruit bearing length were significantly negative and resulted mainly from the negative indirect effects via days to 50% flowering and primary branches per plant, whereas the main effects of fruit length and pericarp thickness were significantly positive and resulted mainly from the positive indirect effects via primary branches per plant, number of fruits per plant, fruit width and fruit weight indicating selection of these traits would be rewarding at least for the present situation. Fruits per plant had high and negative direct effect, but high positive indirect effects through fruit width, days to 50% flowering and fruit weight caused positive correlation. Similarly, fruit weight showed negative direct effect on fruit yield, but due to positive indirect effects via days to 50% flowering, primary branches per plant, fruits per plant and fruit length, the correlation was significantly positive. So for the characters like fruits per plant and fruit weight, the indirect causal factors are to be considered simultaneously for selection, since indirect effects seem to be cause of correlation.

The residual effect (0.273) indicated that the nine characters included in this study explain moderate to high percentage of variation is fruit yield in this population. Moreover, majority of the values of path coefficients are less than unity indicating that inflation due to multicolinearity is minimal (Gravois and Helms, 13).

REFERENCES

1. Adams, M.W. (1967). Basis of yield component compensation in crop plants with special

reference to field bean (*Phaseolus vulgaris*). *Crop Sci.,* **7** : 505-510.

2. Al-Jibouri, H.A., Miller, P.A. and Robinson, H.F. (1958). Genotypic and environmental variances and covariances in an upland cotton cross of interspecific origin. *Agron. J.,* **50** : 633-636.
3. Barman, D., De. L.C., Sharma, C.K. and Singh, I.P. (1996). Correlation and path coefficient analysis of some quantitative character in tomato. *J. Hill Res.,* **9:** 414-418.
4. Bharti, A., Jain, B.P., Verma, A.K. and Bharti, O.A. (2002). Genetic variability, heritability and genetic advance in tomato. *J. Res.* **14:** 249-252.
5. Bhatt, G. M. (1973). Significance of path coefficient in determining the nature of character association. *Euphytica,* **22**(3):38-43
6. Bhushana, H.O., Kulkarni, R.S., Basavarajaiah, D., Halaswamy, B.H. and Halesh, G.K. (2001). Correlation and path analysis for fruit quality traits on fruit yield in tomato. *Crop Res.*, **22**(1): 107-109.
7. Bodunde, J.G. (2002). Path coefficient and correlation studies in tomato. *Moor J. Agric. Res.,* **3:**195-198.
8. Burton, G.W. and De Vane, E.W. (1953). Estimating heritability in tall fescue (*Festuca arundinacea*) from replicated clonal material. *Agron. J.,* **45 :** 468-471.
9. Das, B., Hararika, M.H. and Das, P.K. (1998). Genetic variability and correlation in fruit character in tomato. *Ann. Agric. Res.,* **19** (1): 70-80.
10. Dewey, D.R. and Lu, K.H. (1959). A correlation and path coefficient analysis of components of crested wheat grass seed production. *Agron. J.* **15**: 515-518.
11. Dhankar, S.K., Dhankar, B.S. and Sharma, N.K. (2001). Correlation and path analysis in tomato under normal and high temperature condition. *Haryana J. Hort. Sci.,* **30** (1/2) : 89-92.
12. Falconer, D.S. (1960). *Introduction to quantitative* genetics . Long man, New York, pp 85-90.
13. Gravois, K.A. and Helms, R.S. (1992). Path analysis of rice yield and yield components as affected by seedling rate. *Agron. J.*, **84:** 1-4.
14. Harer, P.N., Lad, D.B. and Bhor, T.J. (2003). Correlation and path analysis studies in tomato. *J. Maharashtra Agric. Univ.,* **27** (3): 302-303.
15. Johnson, H.W., Robinson, H.F. and Comstock, R.E. (1955). Estimates of genetic and environmental variability in soybeans. *Agron J.,* **47**:314-318.
16. Joshi, A., Vikram, A. and Thakur, M.C. (2004). Studies on genetic variability, correlation and path analysis for yield and physiochemical traits in tomato. *Prog. Hort.,* **36:** 51-58.
17. Kumar, V.R.A., Thakur, M.C. and Hedau, N.K. (2003). Correlation and path coefficient analysis in tomato. *Ann. Agric. Res.,* **24**: 175-177.
18. Mishra, S. N. and Drolsom, P.N. (1973). Association among certain morphological traits of diallel cross progenies in *Bromus inermis* LEYSS. *J. Agric. Sci.,* **81**:69-76
19. Mohanty, B.K. (2002). Studies on variability, heritability, interrelationship and path analysis in tomato. *Ann. Agric. Res.,* **23:** 65-69.
20. Mohanty, B.K. (2003). Genetic variability, correlation and path coefficient studies in tomato. *Indian J. Agric. Res.,* **37:** 68-71.
21. Padma, E., Ravisankar, C. and Srinivasulu, R. (2002). Correlation and path coefficient studies in tomato. *J. Res.,* **30:** 68-71.
22. Singh, D.N., Sahu, A. and Parida, A.K. (1999). Genetic variability and correlation studies in tomato. *Env. and Ecol.,* **15:** 117-121.
23. Singh, J.K., Singh, J.P., Jain, S.K. and Aradhana, Joshi. (2004). Correlation and path coefficient analysis in tomato. *Prog. Hort.,* **36:** 82-86.
24. Walton, P.D. (1980). The production characteristics of *Bromus inermis* LEYSS and their inheritance. *Adv. Agron.,* **32:** 341-369.
25. Williams, W.A.,Jones, M.B. and Demment, M.W. (1990). A concise table for path analysis statistics. *Agron. J.,* **82:** 1022-24.
26. Yadav, D.S. and Singh, S.P. (1998). Correlation and path analysis in tomato. *J. Hill Res.*, **11:** 207-11.