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DETERMINATION OF ASSOCIATION OF YIELD COMPONENTS BY PATH ANALYSIS IN TOMATO (*SOLANUM LYCOPERSICUM* L.)

Himanshu Singh[1], G.C. Yadav[2*], Hareesh Kumar Maurya[2], Brijesh Kumar Maruya[3], Niharika Singh[4] and Joginder Singh[5]

[1]Department of Vegetable Science, College of Horticulture,
Banda University of Agriculture and Technology Banda, Uttar Pradesh-210001, India
[2]School of Agricultural Sciences and Technology, Department of Horticulture,
Babasaheb Bhimrao Ambedkar University, Lucknow, Uttar Pradesh-226025, India
[3]Department of Vegetable Science, College of Horticulture,
Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, (U.P.)-208002, India
[4]Department of Vegetable Science, College of Horticulture and Forestry,
ANDU&T Kumarganj Ayodhya, Uttar Pradesh-224229, India
[5]Department of Horticulture, J. V. Collge Baraut, Baghpat, U.P.
*Corresponding author E-mail: gcy1972@gmail.com

ABSTRACT

The present investigation was conducted in Randomized Block Design with 38 genotypes (including three checks) of tomato in three replications for thirteen quantitative traits. The present experiment was conducted at Main Experiment Station of Department of Vegetable Science, Acharya Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Ayodhya (U.P.) during *Rabi* 2019- 20. The objectives were to assess the path analysis for fruit yield and yield contributing characters. Path coefficient analysis indicated that highest positive direct effect on fruit yield per plant was exerted by average fruit weight followed by marketable fruit yield per plant, number of fruits per plant, total soluble solids, number of fruits per cluster, plant height and locules per fruit. These traits may be given more emphasis for direct selection of high yielding tomato genotypes in future breeding programmes.

***Keywords*:** Path, tomato, genotypes

Introduction

Tomato is universally treated as "Protective food" and considered as "Poor man's Orange". Tomato is a native of Peru Equador region and having chromosome number 2n=24. Tomato fruits are consumed raw or cooked. It is grown at farm and kitchen garden for slice, soup, sauce, ketchup, cooked vegetable etc. It is a rich source of vitamins A, B and C. It has taproot and growth habit of the plant is determinate and indeterminate. In the determinate types, plants are dwarf wherever growth is restricted with the appearance of terminal flower, whereas in indeterminate plant, growth is sustained and there is less initiation of flower and fruit on the stem.

Yield is a complex character controlled by a large number of contributing characters and their interaction. The path coefficient technique evolved by Wright (1921) helps in estimating direct and indirect contribution of various components in building up the total correlation towards yield. Based on these studies the quantum importance of individual character is marked to facilitate the selection programme for better gains.

Material and Methods

The experiment was conducted at Main Experimental Station, Department of Vegetable Science, Acharya Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Ayodhya, Uttar Pradesh, India during

Rabi 2019. The experimental material for study consisted of thirty-eight genotypes including three checks (Arka Vikas, Kashi Aman and DVRT-2). The experiment was conducted in Randomized Block Design with three replications. Each genotype consisted of two row spaced 60 cm apart with plant to plant spacing of 50 cm. Observation were recorded for thirteen different characters of tomato i.e. days to 50% flowering, plant height, locules per fruit, pericarp thickness (mm), polar diameter of fruit (cm), equatorial diameter of fruit (cm), number of fruits per cluster, average fruit weight (g), number of fruits per plant, marketable fruit yield per plant, unmarketable fruit yield per plant, total fruit yield per plant and total soluble solids (°Brix). Path analysis was carried out as per Wright (1921), Dewey and Lu (1959).

Result and Discussions

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

The path coefficients analysis was carried out from phenotypic and genotypic correlation coefficient of yield to resolve direct and indirect effect of characters on fruit yield per plant. The direct and indirect effect of different characters on total fruit yield per plant at phenotypic level had presented in table 1. The highest positive direct effect on fruit yield per plant was exerted by average fruit weight (0.590) followed by marketable fruit yield per plant (0.532), number of fruits per plant (0.277), total soluble solids (0.105), number of fruits per cluster (0.086), plant height (0.024) and locules per fruit (0.006). The substantial negative direct effect on total fruit yield per plant was showed by equatorial diameter (-0.128), days to 50% flowering (-0.079), pericarp thickness (-0.075), polar diameter of fruit (-0.065), unmarketable fruit yield per plant (-0.026).

This indicates that direct selection for average fruit weight, marketable fruit yield per plant, total soluble solids, number of fruits per cluster, plant height and locules per fruit in desired direction would be very effective for yield improvement as also suggested by many workers (Rawat *et al.,* 2017, Sharma *et al.,* 2019, Doddamani *et al.,* 2019 and Maurya *et al.,* 2020).

Substantial positive indirect effect by equatorial diameter of fruit (0.501), polar diameter of fruit (0.477), marketable fruit yield per plant (0.449), days to 50% flowering (0.198), plant height (0.179) and unmarketable fruit yield per plant (0.109) on total fruit yield per plant via average fruit weight and average fruit weight (0.406), equatorial diameter of fruit (0.329), unmarketable fruit yield per plant (0.252), polar diameter of fruit (0.245), number of fruits per plant (0.174), number of fruits per cluster (0.142) plant height (0.127) and locules per fruit (0.110) via marketable fruit yield per plant and unmarketable fruit yield per plant (0.150) via number of fruits per plant.

While number of fruits per plant (-0.181) via average fruit weight, days to 50 % flowering (-0.142) and polar diameter of fruit (-0.138) via number of fruits per plant and average fruit weight (-0.109) and polar diameter of fruit (-0.102) via equatorial diameter of fruit were found to had substantial negative indirect effect on total fruit yield per plant.

Thus, average fruit weight, marketable fruit yield per plant and number of fruit yield per plant were identified as positive direct contributor for higher fruit yield. Equatorial diameter of fruit and days to 50% flowering were found to be the negative direct contributor towards yield. Equatorial diameter of fruit and polar diameter of fruit, number of fruits per plant and days to 50% flowering were found as the main traits which showed substantial indirect effect on total fruit yield per plant via average fruit weight (Table 1).

The direct and indirect effect of different traits on total fruit yield per plant at genotypic level had represented in table 2. The highest magnitude of positive direct effect on total fruit yield per plant was exerted by marketable fruit yield per plant (1.196), followed by total soluble solids (0.099), number of fruits per cluster (0.082), unmarketable fruit yield per plant (0.063) and plant height (0.029), while substantial higher negative direct effect on total fruit yield per plant was exerted by number of fruit yield per plant (-0.177) followed by average fruit weight (-0.132), pericarp thickness (-0.111), days to 50% flowering (-0.087), equatorial diameter (-0.075), locules per fruit (-0.073) and polar diameter (-0.041).

The highest positive indirect effect for total fruit yield per plant was exerted by average fruit weight (0.924), equatorial diameter of fruit (0.746), unmarketable fruit yield per plant (0.572), polar diameter of fruit (0.548), number of fruit yield per plant (0.353), plant height (0.297), number of fruits per cluster (0.289) and locules per fruit (0.267) via marketable fruit yield per plant, while substantial negative indirect effect for total fruit yield per plant was exerted by total soluble solids (-0.131) via marketable fruit yield per plant and equatorial diameter

of fruit (-0.112), polar diameter of fruit (-0.106) and marketable fruit yield per plant (-0.102) via average fruit weight. Similar result for most of the traits also reported by Tamuly *et al.* (2018), Alam *et al.* (2019) and Basfore *et al.* (2020).

Thus, the above discussion reveals the fact that important direct and indirect components 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 accomplish a proper balance of different yield components for determining the ideotype for high fruit yield in tomato. The character mentioned above, excellence due to consideration at the time of formulating selection strategy aimed at developing high yielding varieties in tomato.

Table 1: Direct and indirect effect of twelve characters on fruit yield per plant (g) at phenotypic level

Traits	Days to 50% Flowering	Plant Height	Locules Per Fruit	Pericarp Thickness	Polar Diameter	Equatorial Diameter	Number of Fruits Per Cluster	Average fruit weight	Number of fruits per plant	Marketable Fruit Yield Per Plant	Unmarketable Fruit Yield Per Plant	TSS	Correlation with Total Fruit Yield Per Plant
Days to 50% Flowering	**-0.079**	0.009	0.000	-0.016	-0.030	-0.047	0.008	0.198	-0.142	0.018	0.009	0.001	-0.071
Plant Height	-0.029	**0.024**	0.002	-0.021	-0.015	-0.038	0.008	0.179	-0.034	0.127	-0.004	-0.034	0.165
Locules Per Fruit	-0.006	0.010	**0.006**	-0.011	0.001	0.000	0.021	0.042	0.039	0.110	-0.012	-0.022	0.177
Pericarp Thickness	-0.017	0.007	0.001	**-0.075**	-0.005	-0.010	0.006	0.055	-0.035	0.046	0.004	0.010	-0.012
Polar Diameter	-0.036	0.005	0.000	-0.005	**-0.065**	-0.102	0.002	0.477	-0.138	0.245	0.003	0.004	0.391*
Equatorial Diameter	-0.029	0.007	0.000	-0.006	-0.052	**-0.128**	0.010	0.501	-0.077	0.329	-0.001	0.003	0.557**
Number of Fruits Per Cluster	-0.007	0.002	0.001	-0.005	-0.001	-0.015	**0.086**	0.068	0.054	0.142	-0.009	-0.023	0.292
Average Fruit Weight	-0.027	0.007	0.000	-0.007	-0.053	-0.109	0.010	**0.590**	-0.085	0.406	-0.005	-0.005	0.723**
Number of Fruits Per Plant	0.041	-0.003	0.001	0.009	0.033	0.035	0.017	-0.181	**0.277**	0.174	-0.014	-0.006	0.382*
Marketable Fruit Yield Per Plant	-0.003	0.006	0.001	-0.006	-0.030	-0.079	0.023	0.449	0.090	**0.532**	-0.012	-0.008	0.963**
Unmarketable Fruit Yield Per Plant	0.027	0.004	0.003	0.011	0.008	-0.006	0.031	0.109	0.150	0.252	**-0.026**	-0.009	0.554**
TSS	-0.001	-0.008	-0.001	-0.007	-0.003	-0.004	-0.019	-0.028	-0.016	-0.040	0.002	**0.105**	-0.019

Coefficient of determination: 0.968; Effect of the residual variable: 0.176

Table 2: Direct and indirect effect of twelve characters on fruit yield per plant (g) at genotypic level

Traits	Days to 50% Flowering	Plant Height	Locules Per Fruit	Pericarp Thickness	Polar Diameter	Equatorial Diameter	Number of Fruits Per Cluster	Average fruit weight	Number of fruits per plant	Marketable Fruit Yield Per Plant	Unmarketable Fruit Yield Per Plant	TSS	Correlation with Total Fruit Yield Per Plant
Days to 50% Flowering	**-0.087**	0.012	-0.006	-0.026	-0.021	-0.030	0.008	-0.049	0.112	0.007	-0.024	0.001	-0.103
Plant Height	-0.036	**0.029**	-0.030	-0.032	-0.009	-0.022	0.008	-0.040	0.025	0.297	0.010	-0.034	0.164
Locules Per Fruit	-0.007	0.012	**-0.073**	-0.017	0.000	0.000	0.023	-0.010	-0.025	0.267	0.032	-0.021	0.181
Pericarp Thickness	-0.021	0.008	-0.011	**-0.111**	-0.003	-0.006	0.007	-0.013	0.024	0.112	-0.010	0.009	-0.014
Polar Diameter	-0.044	0.006	0.001	-0.008	**-0.041**	-0.060	-0.005	-0.106	0.100	0.548	-0.010	0.001	0.382*
Equatorial Diameter	-0.035	0.009	0.000	-0.010	-0.033	**-0.075**	0.005	-0.112	0.058	0.746	0.002	0.000	0.556**
Number of Fruits Per Cluster	-0.009	0.003	-0.021	-0.009	0.002	-0.005	**0.082**	-0.008	-0.030	0.289	0.022	-0.030	0.287
Average Fruit Weight	-0.032	0.009	-0.006	-0.011	-0.033	-0.064	0.005	**-0.132**	0.065	0.924	0.010	-0.008	0.727**
Number of Fruits Per Plant	0.055	-0.004	-0.010	0.015	0.023	0.025	0.014	0.048	**-0.177**	0.353	0.035	-0.009	0.368*
Marketable Fruit Yield Per Plant	0.000	0.007	-0.016	-0.010	-0.019	-0.047	0.020	-0.102	-0.052	**1.196**	0.030	-0.011	0.996**
Unmarketable Fruits Per Plant	0.033	0.004	-0.037	0.017	0.007	-0.002	0.029	-0.021	-0.098	0.572	**0.063**	-0.011	0.556**
TSS	-0.001	-0.010	0.016	-0.011	0.000	0.000	-0.025	0.011	0.015	-0.131	-0.007	**0.099**	-0.044

Coefficient of determination: 1.00; Effect of the residual variable: 0.00

Conclusion

From the conducted experiment it can be concluded that path coefficient analysis revealed that marketable fruit yield per plant, total soluble solids, number of fruits per cluster, unmarketable fruit yield per plant and plant height had direct positive effect on fruit yield per plant, indicating these traits are the main contributors to fruit yield per plant.

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