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## Correlation and path coefficient analysis for yield and yield contributing traits in double-cross $F_2$ populations of tomato (*Solanum lycopersicum* L.)

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### Abstract

Association studies in two double cross  $F_2$  populations revealed that plant height, number of clusters, number of fruits per plant and average fruit weight were positively associated with fruit yield per plant in both doublecross  $F_2$  populations. Plant height exhibited positive direct effect on fruit yield per plant in TSH-2 X TSH-6  $F_2$  populations while negative direct effect was indicated in  $F_2$  populations of the cross TSH-2 X TSH-8. Fruits per plant recorded positive direct effect on fruit yield per plant in the  $F_2$  populations of both double cross hybrids. Average fruit weight exhibited positive direct effect on fruit yield per plant in all the  $F_2$  populations except  $F_2$  population of TSH-2 hybrid and TSH-2 X TSH-8 hybrid.

**Keywords:** Path coefficient, direct effect, residual effect, selection

### Introduction

Tomato (*Solanum lycopersicum* L.) is one of the most economically important vegetable in India as well as the world. The fruit have manifold uses in human diet which can be consumed raw, cooked and can also be processed in to various products. It is a good source of an antioxidant (lycopene), Vitamin C and Vitamin B; consumption of tomato and its products has been associated with lower risk of developing digestive tract and prostate cancers (Giovannucci *et al.*, 2002) [3].

Selection based on multiple traits is always better than selection based on yield alone. Since yield is a quantitative character controlled by many genes, an adequate knowledge about the magnitude and degree of association of yield with its attributing characters is of great significance to the breeders, through which they can clearly understand the strength of correlated traits, when they have to exercise selection for simultaneous improvement of more than one character. However, correlation alone does not provide information on the contribution of related characters, which necessitates the study of cause and effect relationship of different characters among themselves. Therefore, the path analysis depicts the exact relationship of characters there by providing more information than correlation.

### Material and Methods

Phenotypic correlations were worked out in two double cross  $F_2$  populations *viz.*, TSH-2 X TSH-6 and TSH-2 X TSH-8 to determine the degree of association of a character with yield and also among the yield components using the formula given by Weber and Moorthy (1952) [6]. Estimated correlation coefficients were compared against *r* values given in Fisher and Yates (1963) [2] table at  $(n - 2)$  degrees of freedom at the probability levels of 0.05 to test their significance. Path coefficient analysis was carried out for all the traits to know the direct and indirect effects on yield as suggested by Wright (1921) [7] and illustrated by Dewey and Lu (1959) [1].

### Results and Discussion

Correlation studies give an idea about the positive and negative associations of different characters with yield and also among themselves. Path coefficient analysis partitions the correlation coefficient of the different characters to know direct and indirect effects on yield which helps in giving proper weightage to the various characters during various breeding programmes so that the improvement of desirable traits can be achieved effectively. The results are presented in Table 1.

It was found that Plant height, number of clusters, number of fruits per plant and average fruit weight was positively associated with fruit yield per plant in all both the  $F_2$  populations.

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Similar results were recorded Khapte and Jhansirani (2014)<sup>[4]</sup>. Fruit diameter exhibited significant positive association with fruit yield per plant in F<sub>2</sub> populations of the cross TSH-2 X TSH-8. Correlation studies indicated that number of

clusters, number of fruits per plant and average fruit weight deserve greater weightage and therefore emphasis should be given for these traits while making selection in tomato.

**Table 1:** Phenotypic correlations among different quantitative traits in F<sub>2</sub> population of double cross hybrids of tomato

	F <sub>2</sub> population	Plant height (cm)	No. of clusters	Fruits per cluster	Fruits per plant	No. of branches	Fruit length (cm)	Fruit diameter (cm)	No. of locules	Pericarp thickness (mm)	TSS	Average fruit weight (g)	Fruit yield per plant (kg)
Plant height (cm)	TSH-2 XTSH-6	<b>1</b>	0.233**	0.001	0.29**	0.241	-0.009	0.072	-0.015	-0.066	-0.232**	-0.019	0.281**
	TSH-2 X TSH-8	<b>1</b>	0.278**	0.317**	0.281**	0.119	0.003	0.165	-0.045	0.056	0.104	0.292**	0.226**
No. of clusters	TSH-2 XTSH-6		<b>1</b>	0.122	0.719**	0.443**	-0.157	-0.086	-0.019	-0.027	0.062	0.051	0.751**
	TSH-2 X TSH-8		<b>1</b>	0.896**	0.970**	0.227**	0.124	0.427**	-0.004	0.245**	0.297**	0.921**	0.928**
Number of fruits per cluster	TSH-2 XTSH-6			<b>1</b>	0.205*	0.001	-0.041	-0.022	0.019	0.038	-0.004	-0.073	0.121
	TSH-2 X TSH-8			<b>1</b>	0.941**	0.291**	0.126	0.411**	-0.062	0.210*	0.265**	0.930**	0.884**
Number of fruits per plant	TSH-2 XTSH-6				<b>1</b>	0.418**	-0.134	-0.008	-0.102	-0.113	0.09	-0.096	0.906**
	TSH-2 X TSH-8				<b>1</b>	0.254**	0.111	0.441**	-0.025	0.221*	0.311**	0.971**	0.956**
No. of branches	TSH-2 XTSH-6					<b>1</b>	-0.039	0.086	-0.095	0.017	-0.121	0.091	0.442**
	TSH-2 X TSH-8					<b>1</b>	0.131	0.164	-0.016	0.035	0.063	0.269**	0.193**
Fruit length(cm)	TSH-2 XTSH-6						<b>1</b>	0.469**	0.056	0.113	0.016	0.065	-0.079
	TSH-2 X TSH-8						<b>1</b>	0.426**	-0.155	0.291**	0.185*	0.099	0.152
Fruit diameter(cm)	TSH-2 XTSH-6							<b>1</b>	0.055	0.185*	-0.014	0.2	0.073
	TSH-2 X TSH-8							<b>1</b>	0.068	0.341**	0.210*	0.392**	0.476**

<b>No. of locules</b>	TSH-2 XTSH-6	<b>1</b>	0.129	0.049	0.079	-0.072
	TSH-2 X TSH-8	<b>1</b>	-0.135	0.076	-0.018	-0.022
Pericarp thickness(mm)	TSH-2 XTSH-6		<b>1</b>	0.098	0.022	-0.086
	TSH-2 X TSH-8		<b>1</b>	0.164	0.207*	0.291**
TSS	TSH-2 XTSH-6			<b>1</b>	0.109	0.137
	TSH-2 X TSH-8			<b>1</b>	0.310**	0.350**
Average fruit weight(g)	TSH-2 XTSH-6				<b>1</b>	0.267**
	TSH-2 X TSH-8				<b>1</b>	0.917**
Fruit yield per plant(kg)	TSH-2 XTSH-6					<b>1</b>
	TSH-2 X TSH-8					<b>1</b>

\*, \*\* indicates significant at 5 per cent and 1 per cent level of probability, respectively

**Table 2:** Direct and indirect effect of different quantitative traits on fruit yield in F<sub>2</sub> population of double cross hybrids of tomato

	F <sub>2</sub> popula-tion	Plant height (cm)	No. of clusters	Fruits per cluster	Fruits per plant	No. of branches	Fruit length (cm)	Fruit diameter (cm)	No. of locules	Pericarp thickness (mm)	TSS	Average fruit weight (g)	Fruit yield per plant (kg)
Plant height (cm)	TSH-2 XTSH-6	0.014800	0.029590	-0.000060	0.247490	-0.000900	-0.000230	0.000680	0.000170	-0.000330	-0.004140	-0.006530	0.281000**
	TSH-2 X TSH-8	-0.036320	-0.027560	-0.026590	0.350450	-0.005520	0.000050	0.005350	-0.000230	0.003860	0.004450	-0.041620	0.226000**
No. of clusters	TSH-2 XTSH-6	0.003450	0.127120	-0.005270	0.613600	-0.001650	-0.004180	-0.000810	0.000210	-0.000130	0.001110	0.017080	0.751000**
	TSH-2 X TSH-8	-0.010100	-0.099100	-0.075240	1.209340	-0.010560	0.001910	0.013790	-0.000020	0.016930	0.012630	-0.131390	0.928000**
Nmuber of fruits per cluster	TSH-2 XTSH-6	0.000020	0.015560	-0.043080	0.174740	0.000000	-0.001100	-0.000200	-0.000210	0.000190	-0.000070	-0.024620	0.121000
	TSH-2 X TSH-8	-0.011500	-0.088790	-0.083980	1.173320	-0.013490	0.001940	0.013280	-0.000310	0.014550	0.011300	-0.132640	0.884000**
Nmuber of fruits per plant	TSH-2 XTSH-6	0.004290	0.091340	-0.008810	0.853990	-0.001560	-0.003560	-0.000070	0.001140	-0.000560	0.001610	-0.032300	0.906000**
	TSH-2 X TSH-8	-0.010210	-0.096100	-0.079010	1.247040	-0.011770	0.001720	0.014270	-0.000130	0.015290	0.013260	-0.138490	0.956000**
No. of branches	TSH-2 XTSH-6	0.003560	0.056320	-0.000050	0.356980	-0.003730	-0.001030	0.000810	0.001050	0.000080	-0.002160	0.030440	0.442000**
	TSH-2 X TSH-8	-0.004320	-0.022530	-0.024400	0.316280	-0.046420	0.002020	0.005310	-0.000080	0.002410	0.002690	-0.038350	0.193000**

Fruit length (cm)	TSH-2 XTSH-6	-0.000130	-0.019960	0.001780	-0.114140	0.000140	0.026620	0.004420	-0.000620	0.000560	0.000280	0.021960	-0.079000
	TSH-2 X TSH-8	-0.000110	-0.012280	-0.010550	0.138910	-0.006080	0.015400	0.013770	-0.000790	0.020130	0.007870	-0.014130	0.152000
Fruit diameter (cm)	TSH-2 XTSH-6	0.001060	-0.010980	0.000940	-0.006570	-0.000320	0.012490	0.009410	-0.000610	0.000910	-0.000250	0.067140	0.073000
	TSH-2 X TSH-8	-0.006010	-0.042270	-0.034490	0.550250	-0.007620	0.006560	0.032340	0.000340	0.023620	0.008950	-0.055960	0.476000**
No. of locules	TSH-2 XTSH-6	-0.000220	-0.002370	-0.000820	-0.087520	0.000350	0.001490	0.000520	-0.011100	0.000630	0.000880	0.026650	-0.072000
	TSH-2 X TSH-8	0.001630	0.000390	0.005190	-0.031520	0.000730	-0.002390	0.002180	0.005080	-0.009310	0.003240	0.002560	-0.022000
Pericarp thickness (mm)	TSH-2 XTSH-6	-0.000980	-0.003470	-0.001650	-0.096860	-0.000060	0.003010	0.001740	-0.001430	0.004920	0.001740	0.007460	-0.086000**
	TSH-2 X TSH-8	-0.002030	-0.024250	-0.017660	0.275510	-0.001620	0.004480	0.011040	-0.000680	0.069210	0.006980	-0.029500	0.291000**
TSS	TSH-2 XTSH-6	-0.003440	0.007920	0.000160	0.077080	0.000450	0.000420	-0.000130	-0.000550	0.000480	0.017810	0.036510	0.137000**
	TSH-2 X TSH-8	-0.003790	-0.029400	-0.022280	0.388370	-0.002940	0.002850	0.006800	0.000390	0.011340	<b>0.042570</b>	-0.044180	0.350000
Average fruit weight (g)	TSH-2 XTSH-6	-0.000290	0.006480	0.003160	-0.082280	-0.000340	0.001740	0.001880	-0.000880	0.000110	0.001940	<b>0.335290</b>	0.267000
	TSH-2 X TSH-8	-0.010590	-0.091260	-0.078070	1.210440	-0.012480	0.001530	0.012680	-0.000090	0.014310	0.013180	<b>-0.142680</b>	0.917000

Residual effect: TSH-2 X TSH-6 = 0.21

TSH-2 X TSH-8 = 0.26

Plant height, number of clusters and Average fruit weight exhibited positive direct effect on fruit yield per plant in TSH-2 X TSH-6 F<sub>2</sub> populations while, negative direct effect was observed for the same in the cross TSH-2 X TSH-8. It is mainly due to its indirect effect via major characters which affect the fruit yield per plant, like number of inflorescence per plant and number of fruits per plant were positive and of higher magnitude. Plant height appears to be most desirable trait to get more number of fruits per plant. Patil *et al.* (2013)<sup>[5]</sup> also reported positive direct effect for plant height Average fruit weight by Khapte and Jhansirani (2014)<sup>[4]</sup>. It was found that in F<sub>2</sub> populations of double cross number of fruits per cluster and number of branches had negative direct effect both the populations. Fruits per plant, fruit diameter and TSS recorded positive direct effect on fruit yield per plant in the F<sub>2</sub> populations of both double cross hybrids which indicates that emphasis should be laid on fruits per plant while applying selection strategies in these populations and the present investigation is in accordance with the reports made by Khapte and Jhansirani (2014)<sup>[4]</sup>.

Though very low direct effect of plant height, number of branches and number of locules was observed on fruit yield per plant, these contributed via fruits per plant in all populations. Low residual effect indicated that the selection of traits for path coefficient analysis is appropriate and none of the character was neglected.

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