Int.J.Curr.Microbiol.App.Sci (2018) Special Issue-7: 4278-4285

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Special Issue-7 pp. 4278-4285**
Journal homepage: http://www.ijcmas.com

Original Research Article

Correlation and Path Coefficient Analysis in Tomato (*Solanum lycopersicum* L.)

Ashish K. Singh*, S. S. Solankey, Shirin Akhtar, Preeti Kumari and Jagdeep Chaurasiya

Department of Horticulture (Vegetable & Floriculture), Bihar Agricultural University, Sabour (Bhagalpur) – 813 210, Bihar, India
**Corresponding author*

A B S T R A C T

Seven parents including one hybrid check (BSS-488) were evaluated for yield and quality contributing traits during autumn winter season of 2014–2016. They were crossed in a half diallel fashion and the resultant 21 F_1 hybrids along with their parents and one check variety were evaluated in randomized complete block design with three replications for yield and quality contributing traits. Fruit yield per plant exhibited positive correlation with average fruit weight and titrable acidity at both genotypic and phenotypic levels. Total soluble solids found positive correlation with total phenolic content, total antioxidant, lycopene content and total carotenoid content whereas negative correlation with titrable acidity. The path coefficient analysis revealed that average fruit weight (1.069) exhibited very high positive direct effect on fruit yield per plant followed by number of fruits per plant (0.603), days to first fruit setting (0.456) and equatorial fruit diameter (0.307). Hence these characters may be simultaneously selected to develop the high yielding with quality rich varieties.

Keywords

Correlation, path analysis, yield, quality traits and tomato

Introduction

Tomato (*Solanum lycopersicum* L.) is one of the most economically important vegetable grown all over the world. It is universally treated as "protective food" due to its special value and widespread production. It is native of Peru Ecuador Bolivia Region of Andes, South America Rick (1969). Its production in 2016 estimated to be around 189 lakh tons from 7.76 lakh hectare area, Anonymous (2017). Tomato is mainly consumed as salad, cooked or processed into several products like ketchup, juice, puree, sauce and whole canned fruit Yadav *et al.,* (2013). It is a good source of an antioxidant (lycopene), ascorbic acid and Vitamin B; recent epidemiological studies have shown that consumption of tomato and its products reduce risk of developing digestive tract and prostate cancers Khapte and Jansirani (2014). The degree and direction of relationship between two or more variables could be find out through statistical measure of Correlation coefficient. It helps to measures the mutual relationship between various plant characters and determines the component characters on which selection could be made for genetic improvement of yield and quality contributing traits while the path analysis partitioning the correlation coefficient into the direct and indirect effect of a set of independent variables on dependent variables Nagariya *et al.,* (2015).

Hence, there is pre-requisite for preliminary investigations of characters in the genotypes for the development of superior hybrids in tomato.

Thus, keeping above considerations in view, the present research work has been conducted to study the correlation and path coefficient analysis in 29 genotypes (7 parents, 21F_1 hybrids and one hybrid check) on17 characters of tomato.

Materials and Methods

The experiment was conducted at vegetable research farm, Bihar Agricultural University, Sabour, Bhagalpur during the autumn winter season of 2014-2016. Seven parents of tomato viz., Kashi Vishesh (H-86), Pusa Rohini, Sel-12, Arka Alok, CLNR, CLNB and Pusa-120 were crossed in half-diallele mating design (Table 1).

The resulting 21 F_1s along with seven parents and one popular locally adapted standard variety named BSS-488 was used as check variety. The experiment was laid out in randomized complete block design with three replications. The transplanting was done in raised bed accommodating 12 plants per plot with row-to-row spacing of 70 cm and plant-to-plant spacing of 60cm. All recommended package and practices were followed to raise a good crop. The data recorded from each line and each replication by selecting five randomly plants.

The morphological characters were recorded as per the DUS guidelines. The genotypic and phenotypic correlation coefficient of yield and quality contributing traits were estimated as per described method Al-Jibouri *et al.,* (1958). The direct and indirect effect was estimated as per the method of Wright (1921) and elaborated by Dewey and Lu (1959) respectively.

Results and Discussion

The knowledge of association of various characters related to yield is important for future improvement in a complex polygenic character through selection. The genetic improvement in fruit yield is not possible without bringing an improvement in the yield component characters. The inclusion of various component characters in a selection scheme is obviously not practicable and under these situations, knowledge with respect to relationship of various traits with fruit yield and quality parameters would be of great help in formulating an effective and efficient selection. All the possible genotypic and phenotypic correlation coefficient between fruit yield and quality components is given in (Table 2 and Figure 1). The present study discloses that in general, genotypic correlation coefficient were higher than their phenotypic ones. Similar finding were observed by Nagariya *et al.,* (2015) and Sudesh and Anita (2016).

Fruit yield per plant exhibited highly significant positive correlation with average fruit weight and titrable acidity at both genotypic and phenotypic level respectively, whereas it showed significant negative correlation with days to first fruit set at genotypic and phenotypic levels. These observations were in accordance with the finding of Meena and Bahadur (2014) and Singh *et al.,* (2015). This indicates that fruit yield in tomato can be improved by direct selection of fruit characters like average fruit weight and titrable acidity.

The genotypic as well as phenotypic association of days to first flowering showed highly significant positive correlation with days to 50% flowering and days to 1st fruit set, which is corroboration with Khapte and Jansirani (2014) and Nagariya *et al.,* (2015).

Similarly number of fruits per plant exhibited highly significant positive correlation with total soluble solids and total antioxidant capacity at genotypic and phenotypic levels. Similar observations were obtained by Rani *et al.,* (2010). Average fruit weight showed highly significant positive correlation with polar fruit diameter, equatorial fruit diameter, number of locules per fruit, pericarp thickness, titrable acidity, ascorbic acid content and fruit yield per plant at both genotypic as well as phenotypic level while it has significant negative correlation with total soluble solids at genotypic and phenotypic level, respectively. This was also confirmed by Kumar *et al.,* (2013).

Plant height had highly significant positive correlation with polar fruit diameter, equatorial fruit diameter and pericarp thickness at genotypic and phenotypic level, respectively. Polar fruit diameter had highly significant positive correlation with equatorial fruit diameter, number of locules per fruit and pericarp thickness at genotypic and phenotypic level, respectively. Highly significant and positive correlation was shown by equatorial fruit diameter with number of locules per fruit, pericarp thickness, titrable acidity and ascorbic acid content at genotypic and phenotypic level, respectively.

Total soluble solids were found highly significant positive correlation with total phenolic content, total antioxidant, lycopene content and total carotenoid content at genotypic and phenotypic levels respectively, whereas it has significant negative correlation with titrable acidity at genotypic and phenotypic levels. The results of present study were in agreement with the result reported by Rani *et al.,* (2010) and Nagariya *et al.,* (2015). Titrable acidity exhibited highly significant negative correlation with total phenolic content, lycopene content and total carotenoid content at genotypic and phenotypic levels. Ascorbic acid content was found highly significant positive correlation with total phenolic content, total antioxidant and total carotenoids content at genotypic and phenotypic levels.

Table.1 Genotypes of tomato employed in the present investigation

Sl.no.	Genotype	Source	Specific traits
1	Kashi Vishesh (H-86)	IIVR, Varanasi	Fresh Market, Good GCA, Large size fruits, High yielding, thick pericarp
2	Pusa Rohini	IARI, New Delhi	Thick Pericarp, Processing variety
3	Selection -12	HAU, Hisar	Thick pericarp, high TSS, Vitamin C rich
4	Arka Alok	IIHR, Bengaluru	Table Purpose variety, Green shoulder, High TSS content
5	CLN R	AVRDC, Taiwan	Lycopene and Vitamin C rich
6	CLN B	AVRDC, Taiwan	Lycopene and Vitamin C rich
7	Pusa 120	IARI, New Delhi	Low acidity and less seeded, resistant to nematode.
	Check Variety		
1	BSS - 488 (F_1)	Bejo Sheetal seed company, coimbtore	Large size fruit, thick pericarp, lycopene rich

Table.2 Genotypic and phenotypic correlation between fruit yield and quality components in tomato

Character		D50%F	DFFS	NFPP	AFW	PH	PFD	EFD	NLPF	PT	TSS	TA	AAC	TPC	TAC	LC	TCC	FYPP
DFF	G	0.977**	0.891**	0.102	-0.154	0.214*	0.078	0.102	0.219*	-0.294**	-0.442**	-0.018	-0.474**	-0.514**	-0.519**	-0.302**	-0.148	-0.141
	P	0.958**	0.866**	0.074	-0.132	0.190	0.064	0.089	0.220*	-0.217*	-0.379**	-0.017	-0.444**	-0.479**	-0.487**	-0.295**	-0.139	-0.129
D50%F	G		0.917**	0.064	-0.231*	0.122	0.014	0.022	0.210*	-0.273**	-0.400**	-0.056	-0.456**	-0.500**	-0.482**	-0.301**	-0.171	-0.263*
	P		0.888**	0.043	-0.203	0.109	0.009	0.017	0.203	0.214*	-0.335**	-0.052	-0.424**	-0.464**	-0.450**	-0.288**	-0.159	-0.243*
DFFS	G			0.001	-0.264*	0.170	-0.079	-0.052	0.137	-0.283**	-0.456**	-0.030	-0.382**	-0.505**	-0.433**	-0.336**	-0.187	-0.311**
	P			-0.022	-0.228*	0.155	-0.074	-0.037	0.145	-0.224*	-0.393**	-0.028	-0.355**	-0.467**	-0.404**	-0.316**	-0.171	-0.283**
NFPP	G				-0.382**	-0.088	-0.173	-0.294**	-0.346**	-0.434**	0.333**	-0.366**	-0.388**	0.251*	0.493**	0.156	0.035	0.190
	P				-0.387**	-0.090	-0.136	-0.243*	-0.308**	-0.343**	0.292**	-0.343**	-0.366**	0.238*	0.463**	0.153	0.033	0.224*
AFW	G					0.040	0.304**	0.387**	0.292**	0.338**	-0.414**	0.593**	0.416**	-0.112	-0.190	-0.087	-0.072	0.821**
	P					0.038	0.291**	0.368**	0.274**	0.298**	-0.384**	0.582**	0.408**	-0.111	-0.186	-0.088	-0.071	0.794**
PH	G						0.497**	0.586**	0.051	0.340**	0.041	-0.037	0.248*	0.035	-0.165	-0.145	-0.104	0.002
	P						0.475**	0.543**	0.045	0.300**	0.039	-0.037	0.246*	0.036	-0.164	-0.142	-0.102	-0.005
PFD	G							0.782**	0.404**	0.458**	0.016	0.153	0.215*	0.065	-0.137	-0.122	-0.116	0.239*
	P							0.782**	0.358**	0.396**	0.020	0.147	0.207	0.063	-0.135	-0.117	-0.112	0.238*
EFD	G								0.423**	0.470**	-0.137	0.297**	0.424**	0.128	-0.105	-0.397**	-0.205	0.236*
	P								0.378**	0.396**	-0.129	0.278**	0.395**	0.119	-0.101	-0.370**	-0.193	0.234*
NLPF	G									0.249**	-0.226*	-0.045	0.170	-0.016	-0.368**	-0.317**	-0.180	0.101
	P									0.223*	-0.230*	-0.043	0.159	-0.018	-0.349**	-0.293**	-0.171	0.093
PT	G										0.092	0.128	0.465**	0.177	-0.189	-0.203	-0.209*	0.068
	P										0.075	0.115	0.419**	0.159	-0.171	-0.187	-0.189	0.082
TSS	G											-0.588**	0.204	0.579**	0.612**	0.473**	0.362**	-0.203
	P											-0.564**	0.197	0.557**	0.584**	0.442**	0.348**	-0.190
TA	G												0.005	-0.456**	-0.256*	-0.308**	-0.327**	0.406**
	P												0.006	-0.455**	-0.256*	-0.304**	-0.327**	0.395**
AAC	G													0.342**	0.286**	0.240*	0.350**	0.215*
	P													0.342**	0.285**	0.238*	0.349**	0.209*
TPC	G														0.623**	0.255*	0.257*	0.052
	P														0.622**	0.252*	0.257*	0.050
TAC	G															0.412**	0.403**	0.116
	P															0.409**	0.402**	0.112
LC	G																0.853**	0.051
	P																0.845**	0.053
TCC	G																	-0.002
	P																	-0.001

*****Significant at 5%level of probability ******Significant at 1%level of probability

Characters: DFF= Days to first flowering, D50%F= Days to 50% flowering, DFFS= Days to first fruit set, NFPP= Number of fruit per plant, AFW= Average fruit weight (g), PH= Plant height (cm), PFD= Polar fruit diameter (mm), EFD= Equatorial fruit diameter (mm), NLPF= Number of locules per fruit, PT= Pericarp thickness (mm), TSS= Total soluble solid (%), TA= Titrable acidity (%), AAC= Ascorbic acid content (mg/100g), TPC= Total phenol content (mgCE/100g), TAC= Total antioxidant capacity (µMol/Te/G), LC= Lycopene content (mg/100g), TCC= Total carotenoid content (mg/100g) and FYPP= Fruit yield per plant (g).

Table.3 Direct and indirect effect of component characters on fruit yield in tomato

Character	DFF	D50%F	DFFS	NFPP	AFW	PH	PFD	EFD	NLPF	PT	TSS	TA	AAC	TPC	TAC	LC	TCC	GCY
DFF	**0.224**	0.219	0.200	0.023	-0.035	0.048	0.017	0.023	0.049	-0.066	-0.099	-0.004	-0.106	-0.115	-0.117	-0.068	-0.033	**-0.141**
D50%F	-0.709	**-0.725**	-0.665	-0.046	0.167	-0.088	-0.010	-0.016	-0.152	0.198	0.290	0.041	0.331	0.362	0.350	0.218	0.124	**-0.263***
DFFS	0.406	0.418	**0.456**	0.000	-0.120	0.078	-0.036	-0.024	0.063	-0.129	-0.208	-0.014	-0.174	-0.230	-0.197	-0.153	-0.085	**-0.311****
FPP	0.061	0.039	0.001	**0.603**	-0.231	-0.053	-0.104	-0.178	-0.209	-0.262	0.201	-0.221	-0.234	0.152	0.297	0.094	0.021	**0.190**
AFW	-0.165	-0.246	-0.282	-0.409	**1.069**	0.043	0.325	0.414	0.312	0.361	-0.442	0.634	0.444	-0.119	-0.203	-0.093	-0.077	**0.821****
PH	-0.023	-0.013	-0.019	0.010	-0.004	**-0.109**	-0.054	-0.064	-0.006	-0.037	-0.005	0.004	-0.027	-0.004	0.018	0.016	0.011	**0.002**
PFD	-0.009	-0.002	0.009	0.020	-0.035	-0.057	**-0.114**	-0.089	-0.046	-0.052	-0.002	-0.018	-0.025	-0.007	0.016	0.014	0.013	**0.239***
EFD	0.031	0.007	-0.016	-0.090	0.119	0.180	0.240	**0.307**	0.130	0.144	-0.042	0.091	0.130	0.039	-0.032	-0.122	-0.063	**0.236***
NLPF	0.009	0.009	0.006	-0.014	0.012	0.002	0.017	0.018	**0.042**	0.010	-0.009	-0.002	0.007	-0.001	-0.015	-0.013	-0.007	**0.101**
PT	0.007	0.006	0.007	0.010	-0.008	-0.008	-0.011	-0.011	-0.006	**-0.023**	-0.002	-0.003	-0.011	-0.004	0.004	0.005	0.005	**0.068**
TSS	-0.067	-0.060	-0.069	0.050	-0.062	0.006	0.002	-0.021	-0.034	0.014	**0.150**	-0.088	0.031	0.087	0.092	0.071	0.054	**-0.203**
TA	0.000	0.001	0.001	0.008	-0.013	0.001	-0.003	-0.006	0.001	-0.003	0.013	**-0.022**	0.000	0.010	0.006	0.007	0.007	**0.406****
AAC	0.070	0.067	0.056	0.057	-0.061	-0.036	-0.032	-0.062	-0.025	-0.068	-0.030	-0.001	**-0.147**	-0.050	-0.042	-0.035	-0.051	**0.215***
TPC	0.028	0.028	0.028	-0.014	0.006	-0.002	-0.004	-0.007	0.001	-0.010	-0.032	0.025	-0.019	**-0.055**	-0.034	-0.014	-0.014	**0.052**
TAC	0.046	0.042	0.038	-0.043	0.017	0.014	0.012	0.009	0.032	0.017	-0.054	0.022	-0.025	-0.055	**-0.088**	-0.036	-0.035	**0.116**
LC	-0.059	-0.059	-0.066	0.031	-0.017	-0.028	-0.024	-0.078	-0.062	-0.040	0.093	-0.060	0.047	0.050	0.081	**0.196**	0.167	**0.051**
TCC	0.005	0.006	0.006	-0.001	0.002	0.003	0.004	0.007	0.006	0.007	-0.012	0.011	-0.011	-0.008	-0.013	-0.028	**-0.033**	**-0.002**

Residual value: 0.0673, Diagonal and bold values shows direct effect on fruit yield

Characters: DFF= Days to first flowering, D50%F= Days to 50% flowering, DFFS= Days to first fruit set, NFPP= Number of fruit per plant, AFW= Average fruit weight (g), PH= Plant height (cm), PFD= Polar fruit diameter (mm), EFD= Equatorial fruit diameter (mm), NLPF= Number of locules per fruit, PT= Pericarp thickness (mm), TSS= Total soluble solid (%), TA= Titrable acidity (%), AAC= Ascorbic acid content (mg/100g), TPC= Total phenol content (mgCE/100g), TAC= Total antioxidant capacity (µMol/Te/G), LC= Lycopene content (mg/100g), TCC= Total carotenoid content (mg/100g) and GCY= Genotypic correlation with yield.

Fig.1 Genotypic correlation and phenotypic correlation between fruit yield and quality components in tomato

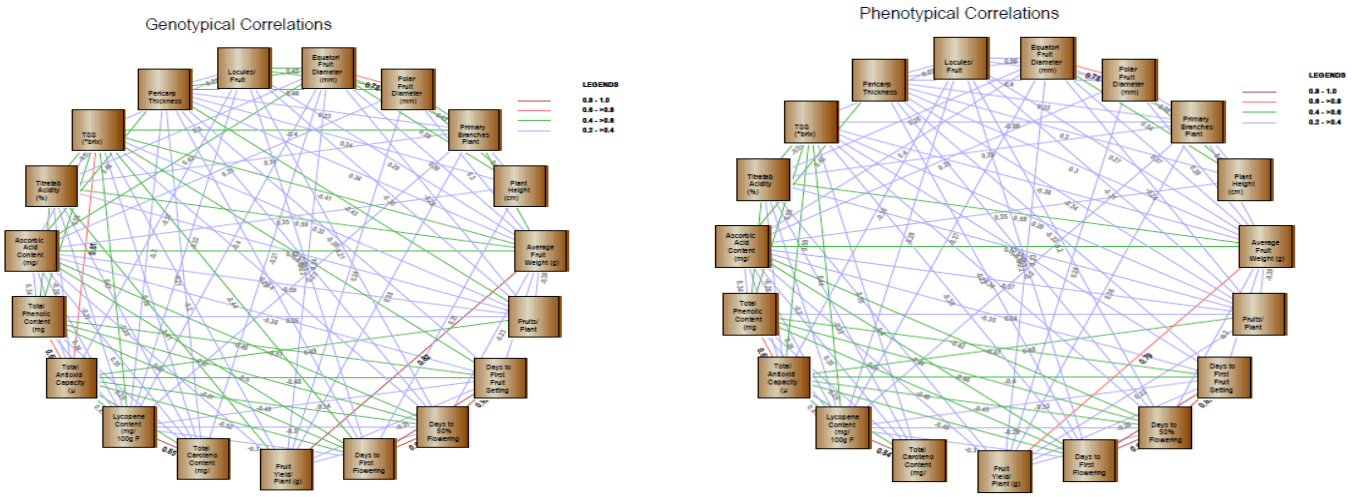
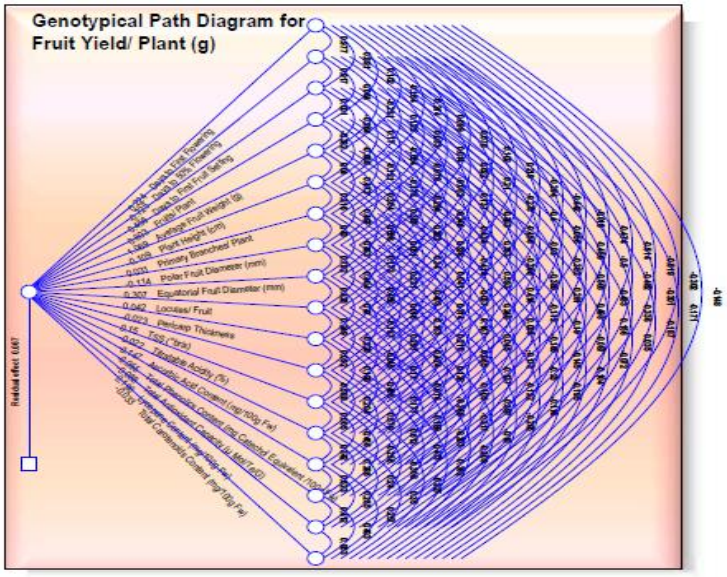


Fig.2 Direct and indirect effect of component characters on fruit yield in tomato



Total phenolic content exhibited highly significant positive correlation with total antioxidant at genotypic and phenotypic levels. Total antioxidant showed highly significant positive correlation with lycopene content and total carotenoid content at genotypic and phenotypic levels. Lycopene content found that significant positive correlation with total carotenoid content at genotypic and phenotypic levels (Table 2 and Figure 1). This was also confirmed by Rani *et al.*, (2010).

Path coefficient analysis facilitates the partitioning of correlation coefficients into direct and indirect effects of various characters on yield its attributing traits and quality. Therefore, information on the cause

and effect of various yield and quality attributes and the relative importance of their direct and indirect effects on yield and quality in tomato are essential in crop improvement programme. Correlation studies in conjunction with path coefficient analysis revealed a better picture of the cause and effect relationship of different attributes. The data on path coefficient analysis at genotypic level showing direct and indirect effects of significant characters over fruit yield per plant is tabulated in (Table 3 and Figure 2).

The path coefficient analysis revealed that among these characters, average fruit weight (1.069) exhibited very high positive direct effect on fruit yield per plant followed by number of fruits per plant (0.603), days to first fruit setting (0.456) and equatorial fruit diameter (0.307). Similar finding were observed by Meena *et al.,* (2014), Nagariya *et al.,* (2015) and Sudesh and Anita (2016). Days to first flowering showed positive moderate direct effect whereas total soluble solids (0.150) and lycopene content (0.196) exhibited low direct effect on fruit yield per plant. However, days to 50% flowering (-0.725), plant height (-0.109), polar fruit diameter (-114), pericarp thickness (-0.023), titrable acidity (-0.022), ascorbic acid content (-0.147), total phenolic content (-0.055), total antioxidant (-0.088), total carotenoid content (-0.033) showed negative direct effect on fruit yield per plant. Similar observations were obtained by Rani *et al.,* (2010) and Nagariya *et al.,* (2015).

The present research findings indicate that direct selection of average fruit weight and number of fruits per plant can be used as basis of selection for improvement in tomato in respect of yield.

It can be concluded that days to first fruit set, number of fruits per plant, average fruit weight, equatorial fruit diameter, TSS content and lycopene content can be put to direct selection pressure to increase both yield along with the quality simultaneously in tomato because these characters exerted direct effect on yield and quality tomato. This study also revealed that large size tomato fruit are not just good yielder moreover they are also nutritionally rich in quality traits.

References

Al-Jibouri, A., Miller, P. A. and Robison, H. F. 1958. Genotypic and environmental variation and covariation in upland cotton crops of inter-specific origin. Agronomy Journal. 50: 626-636.

Anonymous, 2017. Indian Horticulture Database, Second Advance Estimates (2016-17). National Horticulture Board. Gurgaon, Haryana, India.

Dewey, D. and Lu, K. H. 1959. A correlation and path coefficient analysis in crested wheat grass seed production. Journal of Agronomy. 54: 515-518.

Khapte, P. S. and Jansirani, P. 2014. Correlation and path coefficient analysis in tomato (*Solanum lycopersicum* L.). Electronic Journal of Plant Breeding. 5(2): 300-304.

Kumar, D., Kumar, R., Kumar, S., Bhardwaj, M. L., Thakur, M. C., Kumar, R., Thakur, K. S., Dogra, B. S., Vikram, A., Thakur, A. and Kumar, P. 2013. Genetic Variability, Correlation and Path Coefficient Analysis in Tomato. International Journal of Vegetable Science. 19(4): 313-323.

Meena, O. P. and Bahadur, V. 2014. Assessment of correlation and path coefficient analysis for yield and yield contributing traits among tomato (*Solanum lycopersicum* L.)

germplasm. Agricultural Science Digest. 34(4): 245-250.

Nagariya, N. K., Bhardwaj, R., Sharma, N., Mukherjee, S. and Umesh 2015. Correlation and path analysis in tomato (*Solanum lycopersicon* L.). International Journal of Farm Sciences. 5(4): 111-117.

Rani, C. I., Muthuvel, I. and Veer, D. 2010. Correlation and path analysis of yield components and quality traits in tomato (*Lycopersicon esculentum* Mill.). Agricultural Science Digest. 30(1): 11-14.

Rick, C. M. 1969. Origin of cultivated tomato, current status and the problem. Abstract, XI International Botanical Congress, pp 180.

Singh, N., Ram, C. N., Deo, C. and Yadav, G. C. 2015. Studies on correlation and path coefficient analysis in tomato (*Solanum lycopersicum* L.). Plant Archive. 15(2): 869-873.

Sudesh, K. and Anita, S. 2016. Assessment of genetic variability, character association and path analysis in tomato (*S. lycopersicum* L.) under *tarai* condition of Uttarakhand. International Journal of Agriculture Sciences. 34(8): 1706-1709.

Wright, S. 1921. System of mating biometric relation between parent and offspring. Genetics. 6: 111-123.

Yadav, S. K., Singh, B. K., Baranwal, D. K. and Solankey, S. S. 2013. Genetic study of heterosis for yield and quality components in tomato (*Solanum lycopersicum*). African Journal of Agricultural Research. 8(44): 5585-5591.