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GENETIC VARIABILITY, CORRELATION AND PATH COEFFICIENT ANALYSIS IN TOMATO *(SOLANUM LYCOPERSICUM)*

HETAL RATHOD*, S. N. SARAVAIYA, A. I. PATEL AND KRISHNA PATEL
Department of Vegetable Science,
ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari - 396 450, INDIA
e-mail: rathod.rinki09@yahoo.in

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***Corresponding author**

ABSTRACT

Variability, correlation and path analysis were carried out in forty three genotypes for yield and quality characters. High estimates of GCV and PCV were obtained for fruit yield per plant(21.10 and 22.46 %), days to 50 per cent flowering(20.04 and 20.85 %), plant height (22.49 and 23.59 %), number of locules per fruit(22.23 and 22.97 %), pericarp thickness (24.76 and 25.49 %), lycopene content(78.56 and 78.59 %), ascorbic acid(25.77 and 25.90 %) and viscosity (33.24 and 33.59%)indicated a good deal of variability in those characters signifying the effectiveness of selection of desirable types for improvement. Hence, simple selection based on phenotypic performance of these traits would be more effective. The association studies showed that fruit yield plant^{-1} was positively and significantly correlated with number of truss plant^{-1}(rg = 0.54 and rp = 0.48), number of fruits plant^{-1} (rg = 0.66 and rp = 0.54), average fruit weight (rg = 0.59 and rp = 0.48), and equatorial diameter (rg = 0.51 and rp = 0.41) of fruits at genotypic and phenotypic levels. Path coefficient analysis indicated highest positive direct effect of number of fruits plant^{-1} (1.059) on fruit yield plant^{-1} followed by average fruit weight (0.744). Hence, direct selection for these traits is done for improving fruit yield plant^{-1}.

INTRODUCTION

Tomato (*Solanum lycopersicum*) (2n = 24) belongs to family *Solanaceae* has become one of the most popular and extensively consumed vegetables which is grown throughout the world because of its wider adaptability, high yielding potential and suitability for variety of uses in fresh as well as a processed food industries. The pigment in tomato (lycopene) is now being considered as the " World's most powerful natural antioxidant". Therefore, tomato is one of the most important "Protective food" because of its special nutritive value. However, the national productivity is very low [19.5 tonnes/ ha as compare to other countries like USA (81 t/ha), Spain (74 t/ha) and Brazil (60.7 t/ha)]. This indicates that there is a need to increase the productivity of this crop by developing high yielding varieties through appropriate breeding work to meet the demand of domestic and export markets.

The success of crop improvement programme depends on the extent of genetic variability existing in the population or germplasm with which plant breeder is working (Meena and Bahadur, 2013). Tomato breeding strategy involves assembling or generating variable germplasm and selection of superior genotypes for utilizing them in hybridization programme to develop a superior variety. The magnitude of genetic variability can determine the pace and quantum of genetic improvement through selection or through hybridization followed by selection. Study of genetic variability along with heritability is the first step to succeed in selection and utilization of genotypes in breeding programme (Vavilov, 1951). Hence, it is important to study the cause and effect relationship between yield and its component characters.

Correlation and path coefficient analysis give an insight into the genetic variability present in populations. Correlation coefficient analysis measures the mutual relationship between various plant characters and determines the component characters on which selection can be based for improvement in yield. To design an efficient plant breeding program, adequate knowledge of the magnitude and direction of inter-relationship of quantitative traits of economic importance with fruit yield and among themselves is essential. For this purpose correlation studies are helpful to breeder.

Path analysis is a standardized partial regression analysis, which splits the correlation coefficients into direct and indirect effects of a set of dependent variables on the independent variable thereby aids in selection of elite genotypes (Wright, 1921).

An improvement in yield and quality in self pollinated crop like tomato is normally achieved by selecting the genotypes with desirable characters combination existing in nature or by hybridization. Information on the nature and extent of variability present in genetic stocks, heritability, genetic advance and interrelationship among various characters is a prerequisite for framing any selection program. The present investigation was undertaken to ascertain the genetic variability and to find out association between fruit yield and its components with direct and indirect effects of fruit yield components which provide a basis for selection of parents for hybridization.

MATERIALS AND METHODS

The present investigation was undertaken during *rabi* 2012 at Regional Horticultural Research Station, Navsari Agricultural University, Navsari, Gujarat, India. The experimental material consisted of 43 diverse genotype of tomato. The experiment was carried out in a randomized block design with 3 replications. Each genotype consists of one row spaced at 75 cm between the lines. Plant to plant distance was 60 cm. Transplanting was done on 2nd November 2012 and gap filling was done on 10th November 2012. Rouging was done during (4th week of November 2012 and 2nd week of December 2012). Appropriate and uniform agronomical operations and timely plant protection measures were followed to raise the good crop. The genotypic and phenotypic coefficients of variation were calculated using the formula of Burton (1952). GCV and PCV values were categorized as low, moderate and high values as suggested by Shivasubramanian and Menon (1973). Heritability and genetic advance were calculated according to Allard (1960) and genetic gain was estimated using the method of Johanson *et al*. (1955). Genotypic and phenotypic correlations were calculated as per Panse and Sukhatme (1978). The genotypic and phenotypic correlation coefficients were used to determine direct and indirect contribution toward yield per plot. The direct and indirect paths were obtained according to the method of Dewey and Lu (1959).

RESULTS AND DISCUSSION

The analysis of variance revealed that highly significant differences among the genotypes for all the characters indicating sufficient variability existed in the present material selected for the study and indicating the scope for selection of suitable initial breeding material for crop improvement (Dhankhar and Dhankhar , 2006; Fehmida and Ahmad, 2007; Haydar *et al*., 2007; Asati *et al*, 2008). However, the absolute variability in different characters does not permit identification of the characters showing the highest degree of variability. Therefore, PCV and GCV values were estimated. The coefficient of variation whether it is genotypic or phenotypic, both are useful in studying the extent of variability in different characters as it measures the range of variability.

The PCV values were slightly higher than the respective GCV for all characters denoting little influence of environmental factor on their expression Dhankhar and Dhankhar, 2006; Asati *et al*., 2008; Ara *et al*., 2009; Al-Aysh *et al*., 2012; Dar *et al*., 2012 and Kumar *et al*., 2012). The high magnitude for genotypic and phenotypic coefficient of variation was observed for lycopene content (Kumar *et al*., 2012) followed by viscosity, ascorbic acid content (Asati *et al*., 2008), pericarp thickness (Dar *et al*., 2012 and Al-Aysh *et al*., 2012), plant height (Krishna Prasad and Rai ,1999; Mohanty, 2003; Golani *et al*., 2007; Kumar and Thakur , 2007; Asati *et al*., 2008; Mehta and Asati, 2008; Singh, 2009 and Kumar *et al*., 2013; number of locules fruit^{-1}, fruit yield plant^{-1} (Golani *et al*., 2007; Kumar and Thakur, 2007 and Kumar *et al*., 2013) and days to 50 per cent flowering (Shivakumar and Hosamani ,2006), while number of secondary branches plant^{-1} (Singh , 2009), number of flower truss^{-1}, number of truss plant^{-1}, number of fruits plant^{-1}, average fruit weight, fruit polar diameter (Singh, 2009), fruit equatorial diameter (Kumar *et al*., 2013), TSS, AIS and titrable acidity (Ara *et al*., 2009) exhibited moderate genotypic and phenotypic coefficients of variation. High estimates of heritability coupled with high genetic advance were observed for lycopene content (Kumar *et al*., 2012), ascorbic acid content (Asati *et al*., 2008), viscosity, TSS (Mehta and Asati, 2008), titrable acidity, pericarp thickness, alcoholic insoluble solids (Dar *et al*., 2012), number of locules fruit^{1}(Golani *et al*., 2007 and Asati *et al*., 2008) days to 50 per cent flowering (Shivkumar and Hosamani, 2006), fruit pH, plant height (Meena and Bahadur, 2014), number of secondary branches plant^{-1}, fruit yield plant^{-1} (Mohanty *et al*., 2003), fruit polar diameter, number of truss plant^{-1}(Mehta and Asati, 2008), fruit equatorial

Table 1: Genotypic and phenotypic co-efficient of variation, heritability, genetic advance as per cent of mean for various traits in Tomato.

Sr. No	Character	GCV%	PCV%	Heritability (Broad sense%)	Genetic advance	Genetic Advance % of mean
1	Fruit yield plant^{-1} (kg)	21.10	22.46	88.27	0.87	40.84
2	Days to 50 per cent flowering	20.04	20.85	92.33	12.45	39.67
3	Plant height (cm)	22.49	23.59	90.87	38.25	44.16
4	Number of primary branches plant^{-1}	8.62	10.86	63.08	1.53	14.11
5	Number of secondary branches plant^{-1}	15.13	16.06	88.78	9.02	29.36
6	Number of flowers truss^{-1}	15.93	17.50	82.87	1.73	29.88
7	Number of truss plant^{-1}	15.79	16.97	86.67	8.29	30.29
8	Number of fruits plant^{-1}	16.00	17.97	79.20	10.49	29.33
9	Number of locules fruit^{-1}	22.23	22.97	93.70	1.51	44.34
10	Average fruit weight (g)	13.98	16.42	72.47	16.72	24.52
11	Fruit polar diameter (cm)	13.59	14.54	87.28	1.23	26.15
12	Fruit equatorial diameter (cm)	11.38	12.47	83.38	1.01	21.41
13	Pericarp thickness (mm)	24.76	25.49	94.33	2.09	49.53
14	TSS (%)	14.55	14.76	97.19	1.27	29.55
15	Alcoholic insoluble solids (%)	10.81	11.15	94.02	24.92	21.59
16	Lycopene content (mg 100g^{-1})	78.56	78.59	99.91	8.35	161.75
17	Titrable acidity (%)	17.80	18.18	95.87	0.31	35.90
18	Ascorbic acid content in fruit (mg 100g^{-1})	25.77	25.90	98.95	14.67	52.80
19	Fruit pH	7.88	8.21	92.28	0.63	15.60
20	Viscosity (cSt)	33.24	33.59	97.89	104.53	67.74

Table 2: Genotypic and phenotypic correlation of fruit yield plant^{-1} with other characters in various genotypes of Tomato.

Traits		DF	PH	NPBP	NSBP	NFPT	NTPP	NFPP	NLF	AFW	FPD	FED	PT	TSS	AIS	LC	TA	AC	FP	V
YLD	rg	-0.33**	0.09	-0.01	0.14	0.03	0.54**	0.66**	0.15	0.59**	-0.04	0.51**	0.26	0.19	-0.30*	0.17	0.00	-0.12	0.04	-0.31*
	rp	-0.30**	0.07	-0.02	0.13	0.04	0.48**	0.54**	0.13	0.48**	-0.02	0.41**	0.25	0.18	-0.28	0.16	0.01	-0.11	0.03	-0.29
DF	rg		-0.21	-0.14	-0.07	-0.27	-0.27	-0.44**	-0.16	0.09	0.08	0.17	0.17	0.05	0.15	0.01	0.23	-0.11	-0.05	0.01
	rp		-0.20	-0.10	-0.06	-0.24	-0.25	-0.36*	-0.15	0.07	0.05	0.13	0.16	0.05	0.14	0.01	0.21	-0.10	-0.04	0.01
PH	rg			0.58**	0.62**	0.18	0.19	0.14	0.08	0.02	-0.21	0.08	-0.09	0.13	-0.38**	-0.06	0.02	0.04	0.13	-0.23
	rp			0.42**	0.55**	0.13	0.16	0.10	0.09	0.01	-0.18	0.09	-0.09	0.12	-0.34*	-0.06	0.02	0.04	0.12	-0.22
NPBP	rg				0.60**	0.08	0.23	0.01	-0.01	0.20	-0.1	0.13	-0.15	-0.2	-0.25	-0.29	-0.03	0.32*	-0.02	0.10
	rp				0.47**	0.08	0.16	0.02	-0.03	0.21	-0.05	0.12	-0.13	-0.13	-0.19	-0.23	-0.03	0.24	-0.02	0.08
NSPB	rg					-0.09	0.28	0.13	0.22	0.14	-0.19	0.1	-0.13	-0.10	-0.18	-0.08	0.14	0.38**	0.09	-0.04
	rp					-0.06	0.25	0.11	0.20	0.09	-0.16	0.09	-0.11	-0.10	-0.17	-0.07	0.12	0.36*	0.08	-0.04
NFPT	rg						0.03	0.20	-0.28	-0.20	0.11	-0.26	0.25	0.35*	-0.13	-0.13	-0.16	0.11	0.18	-0.34*
	rp						0.01	0.15	-0.27	-0.17	-0.16	-0.22	-0.11	-0.10	-0.17	-0.07	0.12	0.36*	0.08	-0.04
NTPP	rg							0.70**	0.34**	0.05	-0.35*	0.19	-0.05	-0.02	-0.20	0.01	0.16	0.24	0.06	-0.17
	rp							0.61**	0.30*	0.02	-0.30*	0.18	-0.04	-0.01	-0.17	0.01	0.15	0.22	0.06	-0.15
NFPP	rg								-0.01	-0.20	-017	-0.08	0.19	0.11	-0.24	0.17	0.20	0.09	0.04	-0.29
	rp								0.00	-0.12	-0.15	-0.07	0.17	0.10	-0.20	0.15	0.18	0.07	0.04	-0.26
NLF	rg									0.19	-0.48**	0.46**	-0.26	-0.10	0.03	-0.02	-0.10	0.25	-0.30*	-0.02
	rp									0.16	-0.43**	0.40**	-0.24	-0.10	0.04	-0.02	-0.10	0.24	-0.29	-0.03
AFW	rg										0.17	0.66**	0.14	-0.02	0.03	-0.09	-0.14	-0.14	-0.20	-0.08
	rp										0.17	0.55**	0.12	-0.01	0.03	-0.08	-0.11	-0.12	-0.16	-0.08
FPD	rg											-0.09	0.51**	0.04	0.12	-0.12	-0.09	-0.30*	0.06	-0.00
	rp											-0.07	0.46**	0.03	0.12	-0.11	-0.08	-0.28	0.05	-0.01
FED	rg												0.22	0.02	-0.23	0.28	-0.03	-0.10	-0.22	-0.03
	rp												0.20	0.01	-0.21	0.03	-0.02	-0.09	-0.19	-0.03
PT	rg													0.21	0.09	0.07	-0.02	-0.29	0.06	-0.11
	rp													0.19	0.09	0.07	-0.03	-0.28	0.05	-0.10
TSS	rg														-0.27	0.10	-0.10	-0.08	0.28	-0.43**
	rp														-0.25	0.10	-0.09	-0.08	0.27	-0.41**
AIS	rg															0.10	0.07	-0.17	-0.27	0.15
	rp															0.10	0.07	-0.16	-0.25	0.15
LC	rg																0.15	-0.15	-0.09	-0.18
	rp																0.15	-0.15	-0.09	-0.18
TA	rg																	0.05	0.06	0.04
	rp																	0.05	0.06	0.03
AC	rg																		-0.07	0.22
	rp																		-0.07	0.22
FP	rg																			0.12
	rp																			0.11

DF	= Days to 50 per cent flowering	NTPP	= Number of truss plant^{-1}	FED	= Fruit equatorial diameter	LC	= Lycopene content
PH	= Plant height	NFPP	= Number of fruit plant^{-1}	PT	= Pericarp thickness	TA	= Titrable acidity
NPBP	= Number of primary branches plant^{-1}	NLF	= Number of locules fruit^{-1}	YLD	= fruit yield plant^{-1}	AC	= Ascorbic acid content
NSBP	= Number of secondary branches plant^{-1}	AFW	= Average fruit weight	TSS	= Total soluble solids	FP	= Fruit pH
NFPT	= Number of flower truss^{-1}	FPD	= Fruit polar diameter	AIS	= Alcoholic insoluble solids	V	= Viscosity

** - Significant at p = 0.01; * - Significant at p = 0.05

diameter, number of flowers truss^{-1} (Haydar *et al.*, 2007) indicating that phenotypic selection would be effective for genetic improvement in these traits. Similar findings were also made by Asati *et al*. (2008). Low GCV and PCV for number of primary branches plant^{-1} suggesting less variability existed in this character. This moderate to low variability indicates the need for improvement of base population through intercrossing in F_2 generation followed by recurrent selection to increase the gene flow and to fix favourable alleles.

High heritability coupled with high genetic advance as percentage mean were more useful than heritability alone in predicting the resultant effect during selection of best individual genotype (Johnson *et al.*, 1955). Genetic advance is the measure of genetic gain under selection and expression in percentage of mean.

In the present experiment, high heritability and high genetic advance as per cent of mean was recorded for all the characters (except fruit pH) indicating predominance of additive gene action for these characters. Simple selection based on phenotypic performance of these characters would be more effective.

High heritability and moderate genetic advance as per cent of mean values was observed for fruit pH. This indicates the influence of non-additive gene action and considerable influence of environment in the expression of these traits. These traits could be exploited through manifestation of dominance and epistatic components through heterosis.

Simple correlation studies were carried out for all the characters. Fruit yield plant^{-1} was found to be highly significant and positively correlated with number of fruits plant^{-1} (Mayavel *et al.*, 2005; Raut *et al.*, 2005; Kumar and Thakur, 2007; Patel *et al.*, 2015; Kumar and Dudi, 2011; Manna and Paul, 2012), number of truss plant^{-1}(Souza *et al.*, 2012), average fruit weight (Dharwad *et al.*, 2009; Indu Rani *et al.*, 2010; Kumar and Dudi, 2011; Kumar and Arumugam, 2013) and fruit equatorial diameter (Asati *et al.*, 2008) at genotypic and phenotypic level (Table 2), while highly significant negative correlation with days to 50 per cent flowering (Kaushik *et al.*, 2011 and Manna and Paul, 2012) at genotypic and phenotypic level. Plant height showed highly significant and positive correlation at genotypic and phenotypic levels with number of primary branches plant^{-1} and number of secondary branches plant^{-1}

Table 3: Direct and indirect effect of ninteen causal variables on fruit yield plant^{-1} in various genotypes of Tomato.

Traits	Direct effect on fruit yield plant^{-1}	Indirect effect via DF	PH	NPBP	NSBP	NFPT	NTPP	NFPP	NLF	AFW	FPD	Correlation Coefficient
DF	0.041		-0.009	-0.006	-0.003	-0.011	-0.011	-0.018	-0.007	0.004	0.003	-0.331*
PH	-0.047	0.010		-0.027	-0.029	-0.008	-0.009	-0.007	-0.004	-0.001	0.010	0.091
NPBP	-0.151	0.022	-0.087		-0.091	-0.013	-0.034	-0.001	0.001	-0.030	0.015	-0.010
NSPB	0.055	-0.004	0.034	0.033		-0.005	0.016	0.007	0.012	0.008	-0.011	0.135
NFPT	0.134	-0.036	0.024	0.011	-0.012		0.005	0.027	-0.038	-0.027	0.014	0.032
NTPP	-0.260	0.071	-0.049	-0.059	-0.074	-0.009		-0.182	-0.088	-0.013	0.091	0.545**
NFPP	1.059	-0.468	0.151	0.008	0.138	0.213	0.743		-0.008	-0.213	-0.180	0.661**
NLF	0.074	-0.012	0.006	-0.001	0.016	-0.021	0.025	-0.001		0.014	-0.004	0.155
AFW	0.744	0.064	0.015	0.148	0.105	-0.147	0.038	-0.149	0.139		0.123	0.589**
FPD	0.052	0.004	-0.011	-0.005	-0.010	0.005	-0.018	-0.009	-0.024	0.008		-0.035
FED	0.257	0.043	0.022	0.034	0.025	-0.067	0.050	-0.020	0.117	0.168	-0.023	
PT	-0.220	-0.038	0.022	0.034	0.028	-0.055	0.011	-0.043	0.058	-0.031	-0.111	
TSS	-0.003	-0.0001	-0.0003	0.001	0.0002	-0.001	0.0001	-0.0003	0.0002	0.0001	-0.0001	
AIS	-0.045	-0.007	0.017	0.011	0.008	0.006	0.009	0.011	-0.002	-0.001	-0.005	
LC	0.099	0.001	-0.006	-0.028	-0.008	-0.013	0.001	0.017	-0.002	-0.009	-0.012	
TA	-0.075	-0.018	-0.001	0.003	-0.010	0.012	-0.012	-0.015	0.008	0.011	0.007	
AC	-0.055	0.006	-0.002	-0.017	-0.021	-0.006	-0.013	-0.005	-0.014	0.008	0.016	
FP	0.220	-0.011	0.028	-0.005	0.020	0.039	0.014	0.009	-0.067	-0.045	0.013	
V	0.062	0.001	-0.015	0.006	-0.002	-0.021	-0.010	-0.018	-0.001	-0.005	-0.0002	

DF	= Days to 50 per cent flowering	NTPP	= Number of truss plant^{-1}	FED	= Fruit equatorial diameter	LC	= Lycopene content
PH	= Plant height	NFPP	= Number of fruit plant^{-1}	PT	= Pericarp thickness	TA	= Titrable acidity
NPBP	= Number of primary branches plant^{-1}	NLF	= Number of locules fruit^{-1}	YLD	= fruit yield plant^{-1}	AC	= Ascorbic acid content
NSBP	= Number of secondary branches plant^{-1}	AFW	= Average fruit weight	TSS	= Total soluble solids	FP	= Fruit pH
NFPT	= Number of flower truss^{-1}	FPD	= Fruit polar diameter	AIS	= Alcoholic insoluble solids	V	= Viscosity

** - Significant at p = 0.01; * - Significant at p = 0.05; Residual effect = SQRT (1- 1.1030)

Table 3: Cont....

Traits	Direct effect on fruit yield plant^{-1}	Indirect effect via FED	PT	TSS	AIS	LC	TA	AC	FP	V	Correlation Coefficient
DF	0.041	0.007	0.007	0.002	0.006	0.001	0.010	-0.004	-0.002	0.001	
PH	-0.047	-0.004	0.005	-0.006	0.018	0.003	-0.001	-0.002	-0.006	-0.011	
NPBP	-0.151	-0.019	0.023	0.030	0.037	0.043	0.005	-0.048	0.003	-0.016	
NSPB	0.055	0.005	-0.007	-0.006	-0.010	-0.004	0.007	0.021	0.005	-0.002	
NFPT	0.134	-0.035	0.033	0.047	-0.017	-0.017	-0.022	0.014	0.023	-0.046	
NTPP	-0.260	-0.051	0.013	0.006	0.053	-0.003	-0.042	-0.062	-0.017	0.043	
NFPP	1.059	-0.084	0.205	0.114	-0.253	0.176	0.215	0.096	0.041	-0.304	
NLF	0.074	0.034	-0.020	-0.007	0.003	-0.001	-0.007	0.019	-0.023	-0.002	
AFW	0.744	0.487	0.106	-0.016	0.019	-0.070	-0.106	-0.104	-0.151	-0.061	
FPD	0.052	-0.005	0.026	0.002	0.006	-0.006	-0.005	-0.015	0.003	-0.0002	
FED	0.257		0.058	0.005	-0.060	0.007	-0.007	-0.025	-0.056	-0.007	0.514**
PT	-0.220	-0.049		-0.046	-0.021	-0.016	0.004	0.063	-0.014	0.024	0.256
TSS	-0.003	0.00	-0.0005		0.0006	-0.0002	0.0002	0.0002	-0.0007	0.001	0.192
AIS	-0.045	0.010	-0.004	0.012		-0.005	-0.003	0.007	0.012	-0.007	-0.298*
LC	0.099	0.003	0.007	0.010	0.010		0.015	-0.015	-0.009	-0.018	0.173
TA	-0.075	0.002	0.001	0.008	-0.005	-0.011		-0.004	-0.005	-0.003	0.001
AC	-0.055	0.005	0.016	0.005	0.009	0.008	-0.003		0.004	-0.012	-0.115
FP	0.220	-0.048	0.014	0.063	-0.059	-0.020	0.014	-0.016		0.027	0.038
V	0.062	-0.002	-0.007	-0.027	0.009	-0.011	0.002	0.014	0.008		-0.308*

DF	= Days to 50 per cent flowering	NTPP	= Number of truss plant^{-1}	FED	= Fruit equatorial diameter	LC	= Lycopene content
PH	= Plant height	NFPP	= Number of fruit plant^{-1}	PT	= Pericarp thickness	TA	= Titrable acidity
NPBP	= Number of primary branches plant^{-1}	NLF	= Number of locules fruit^{-1}	YLD	= fruit yield plant^{-1}	AC	= Ascorbic acid content
NSBP	= Number of secondary branches plant^{-1}	AFW	= Average fruit weight	TSS	= Total soluble solids	FP	= Fruit pH
NFPT	= Number of flower truss^{-1}	FPD	= Fruit polar diameter	AIS	= Alcoholic insoluble solids	V	= Viscosity

** - Significant at p = 0.01; * - Significant at p = 0.05; Residual effect = SQRT (1- 1.1030)

(Ara *et al.*, 2009 and Kumar *et al.*, 2012). Days to 50 per cent flowering had negative and significant correlation at genotypic level and phenotypic level with number of fruit plant^{-1} (Manna and Paul, 2012). Number of flower truss^{-1} showed significant and positive correlation with TSS at genotypic level. Number of truss plant^{-1} showed positive and highly significant correlation with number of fruit plant^{-1} at genotypic and phenotypic levels (Mahapatra *et al.,* 2013). Number of locules fruit^{-1} showed positive and highly significant correlation with fruit equatorial diameter at genotypic and phenotypic levels. It also showed negative and highly significant correlation with fruit polar diameter at genotypic and phenotypic levels and significant with fruit pH at genotypic level. Fruit polar diameter had highly significant and positive correlation at genotypic and phenotypic levels with pericarp thickness. Average fruit weight showed positive and highly significant correlation with fruit equatorial diameter at genotypic and phenotypic levels (Asati *et al.*, 2008; Singh, 2009 and Islam *et al.*, 2010).

The path coefficient studies revealed that number of fruits plant^{-1}, average fruit weight (Ara *et al.*, 2009), fruit equatorial diameter (Kumar *et al.,* 2013) , Fruit pH, number of flowers truss^{-1} (Ara *et al.*, 2009), lycopene content, number of locules fruit^{-1} (Golani *et al.,* 2007), viscosity, number of secondary branches plant^{-1}, fruit polar diameter (Kumar *et al.,* 2013) and days to 50 per cent flowering (Table-3) had high positive direct effect on fruit yield plant^{-1}. Plant height, number of primary branches plant^{-1} (Asati *et al.*, 2008), number of truss plant^{-1}, pericarp thickness, TSS (Golani *et al.,* 2007), AIS, Titrable acidity and ascorbic acid content (Asati *et al.*, 2008) in fruit had negative direct effect on fruit yield plant^{-1}. Therefore, indirect selection practiced on these characters will result in the improvement of respective characters and ultimately fruit yield. The study of path analysis indicated that the direct selection of number of fruits plant^{-1} and average fruit weight could be used as selection criteria for improvement in tomato.

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