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STUDY ON HERITABILITY AND GENETIC VARIABILITY AMONG DIFFERENT PLANT AND FRUIT CHARACTERS OF TOMATO (*Solanum lycopersicum* L.)

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ABSTRACT : The present investigation was conducted to elucidate the genetic characters viz. variability and heritability between yield and yield components of different tomato (*Solanum lycopersicum* L.) genotypes. Eighteen genotypes including released varieties, landraces and germplasms were used in this investigation for assessment of quality, yield and yield components. The experiment was conducted during summer; 2013-14 at field of Department Vegetable Science, K.R.C. College of Horticulture, Arabhavi, Belagavi district Karnataka, India. Data on morphological characters were recorded from mean value of five randomly selected plants in each genotype. The genotypes exhibited a wide range of variability for all the characters studied. Analysis of variance showed significant variation among the genotypes for all tested characters. Phenotypic coefficient of variation (PCV) was higher than genotypic coefficient of variation (GCV) for all the characters studied. Days to first fruit maturity showed the highest genotypic and phenotypic variance (3427.10and 6531.93) whereas TSS (°Brix) showed the lowest ones (0.55 and 0.63). High genotypic variance was observed for most of the characters indicating more contribution of genetic component for the total variation. Genotypic coefficient of variations (GCV) and phenotypic coefficient of variation (PCV) were highest for yield/ha (341.89 and 323.12), whereas the lowest ones were for days to first flowering (5.82 and 7.21). Higher GCV and PVC were recorded for most of the characters indicating higher magnitude of variability for these characters. The highest heritability was recorded for yield/ha (96.34%), while the lowest was for plant height (45.30%). High heritability (broad senses) estimates were observed for all the tested characters indicating that these characters are controlled by additive genes action which can be improved by simple selection.

Keywords : *Tomato, genotypic variance, phenotypic variance, GCV, PCV. heritability, genetic advance.*

Tomato (*Solanum lycopersicum* L.) belongs to the family *Solanaceae* and is one of the most remunerable and widely grown vegetables in the world. Among the vegetables, tomato ranks next to potato in world acreage and ranks first among the processing crops. Tomato is grown for its edible fruits, which can be consumed either fresh or in processed form and is a very good source of vitamins A, B, C and minerals. Tomato cultivation has become more popular since mid nineteenth century because of its varied climatic adaptability and high nutritive value. Tomato considered as protective food as it possesses several special nutritive value traits. Particularly antioxidants compound which are being used in several commercial therapeutical formulation (Simon, 12). Lycopene is the major antioxidental pigment, which is responsible for red colour in tomato. Lycopene and their production plays important role in human health in order to reduce the risk of chronic diseases (Mascio *et al.,* 7). Tomato is being exported in the form of whole fruits, paste and in canned form to West Asian countries, U.K. Canada and USA. Area and production of tomato in India was about 8.79 lakh hectares and 18.22 mt, respectively (Anon. 1). Genetic variability is essentially the first step of plant breeding for crop improvement which is immediately available from germplasm which is considered as the reservoir of variability for different characters reported by Vavilov (14). Since, most of the economic characters including yield are polygenically controlled and are much influenced by the environmental factors, an understanding of inheritance and study of association between yield and its components is necessary for planning an effective selection program in identifying high yielding genotypes. However, the inheritance of quantitative characters is often influenced by variation in other characters, which may be due to pleiotropy genetic linkage. Hence, it is necessary to partition the observed overall phenotypic variation into heritable and non-heritable components using suitable design which enable us to know whether the superiority of selection is inherited by the progenies. Information regarding the genetic parameters such as variation coefficient, heritability, expected genetic advance, degree of association between the various characters, direct and indirect effects of characters contributing to total fruit yield are of permanent significance in formulating appropriate breeding strategy and exploiting the inherent variability

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of the experimental materials. The present investigation was carried out to gather the information on collected some land races which would be utilized for further improvement of tomato yield and quality through an appropriate and sound breeding plan.

MATERIALS AND METHODS

The experimental material for the present study consistsed of 18 genotypes collected from different sources. The genotypes were evaluated in randomized block design with two replication, at the field of Vegetable Science unit of Kittur Rani Channamma College of Horticulture, Arabhavi, Belagavi District (Karnataka) during summer 2012-13. Thirty days old seedlings were transplanted in a spacing 60 × 45cm line to line and plant to plant, respectively, accommodating 20 plants in each row of genotype. Five plants were sampled at random in each genotype and observations were recorded on growth, fruit yield and quality parameters, viz., plant height (cm), number of primary and secondary branches per plant, days to first flowering, days to first fruit set, days to first fruit maturity, number of fruits per plant, average fruit weight (g), fruit yield per plant (kg), yield per ha, total soluble solid (°Brix),number of locules per fruit and lycopene (mg/100g) content. The total soluble solid (°Brix) of the selected samples was determined with hand refractometer and the estimation of lycopene was carried as described by Garge *et al.* (2). Analysis of variance genotypic variances, phenotypic variances, genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability in broad sense (h^2bs), genetic advance (GA) and genetic advance as percentage over mean (GAM) were analyzed following the formula illustrated by Singh and Chaudhary (13).

RESULTS AND DISCUSSION

The analysis of variance indicated that there was highly significant difference among the genotypes for all the characters. The significant difference indicated existence of good amount of variability with respect to various traits (Table 1). The mean values for different characters are presented in Table 2. The data revealed that maximum plant height at 90 DAT (94.95 cm) was produced by T-26 and were minimum plant height was observed in the genotype K-3 (54.43 cm). The maximum number of primary branches at 90 DAT was observed in genotype Arka Alok (11.80) and minimum was observed in the DMT-1(6.30). The maximum numbers of secondary of branches at 90 DAT was recorded in genotype Megha (8.70) and lowest was observed in T-36 (4.60).

Farmers prefer to grow early maturity varieties in order to get high profit and avoid the problem of market glut. The days to first flowering was observed in the genotype Vaibhav (28) followed by DMT-1 (28.50). Days to first fruit set was observed in genotype Hub-18 (36) followed by S-22 (36.50). The genotype Hub-18 (77.50) was recorded days to first fruit maturity.

The average fruit weight was maximum in genotype DMT-2 (88.70). The maximum number of fruits per plant, yield per plant and yield per hacter was observed in the genotype DMT-2 (37.83), (3.25kg) and yield per hacter (72.22tonnes). The genotype T-57(5.40) were showed maximum number of locules per fruit and minimum was observed in Hub-18 (2.30). The highest lycopene content was recorded with genotype DMT-5 (6.08mg/100g) and minimum was observed in T-36 (2.93) and TSS was more in genotype S-22 (5.80 °Brix) and the genotype DMT-2 (2.93) were shows least TSS (4.10 °Brix). The yield results of present investigation of in according to those of Sharma et al. (11) and Satish *et al.* (10) who have also reported variation in yield ranged from 12.54 to 41.43 t/ha.

Table 1: Analysis of variance (mean sum of squares) for various characters in tomato.

Characters	Replication	Treatments	Error
Degrees of freedom	1	17	17
Plant height (cm)	4.17	156.80**	8.37
Number of primary branches/plant	0.002	3.15**	0.54
Number of secondary branches/plant	1.17	6.76**	0.52
Days to first flowering	4.96	10.64**	5.37
Days to first fruit set	14.67	4.19 **	2.61
Days to first fruit maturity	6.22	11.91*	6.62
Average fruit weight (g)	9849.17	7914.22**	92.40
Number of fruits/plant	30.80	362.12**	3.91
Yield per plant (kg)	0.46	0.75**	0.01
Yield per ha (t)	166.75	392.00**	7.69
Number of locules/fruit	0.02	1.15**	0.09
TSS (°Brix)	0.62	0.71**	0.13
Lycopene (mg/100g)	652.72	582.67**	58.01

*and** indicate significance of values at p=0.05 and p=0.01, respectively.

Table 2: Mean performance of different genotypes of tomato (*Solanum lycopersicum* L.) for yield and quality traits.

Genotype	Plant height (cm)	No. of primary branches/ plant	No. of secondary branches/ plant	Days to first flowering	Days to first fruit set	Days to first fruit maturity	Av. fruit wt. (g)	No. of fruits / plant	Yield/ plant (kg)	Yield /ha (t)	No. of locules/ fruit	Lycopene (mg/ 100 g)	TSS (°Brix)
T-26	94.95	8.10	7.00	29.50	37.50	82.00	47.75	28.55	1.20	25.00	3.42	5.45	5.13
T-36	71.95	7.20	4.60	31.50	43.50	81.50	33.60	30.55	1.01	21.55	2.45	2.93	4.40
ArkaVikas	63.15	8.00	6.60	35.50	42.00	80.00	34.00	33.22	1.20	24.44	3.10	3.18	5.10
Swarna Naveen	73.90	6.40	5.40	34.00	43.00	82.00	50.50	30.80	1.50	29.55	4.10	3.07	4.80
Vaibhav	66.30	8.30	8.20	28.00	37.00	78.50	44.00	33.90	1.39	30.88	3.10	3.11	5.45
DMT-1	60.10	6.30	7.90	28.50	37.50	82.00	46.00	22.52	1.00	21.13	2.90	4.48	5.10
DMT -3	56.10	6.70	5.00	36.00	42.50	81.50	64.50	32.00	2.01	44.66	2.80	3.40	4.65
DMT -5	61.20	8.10	5.20	32.00	40.50	82.00	67.75	24.67	1.40	31.11	4.10	6.08	5.40
S-22	70.30	6.70	5.40	28.50	36.50	80.50	75.25	19.80	1.30	24.44	3.65	4.15	5.80
Arka Meghali	59.10	9.60	7.80	28.50	37.00	78.00	54.50	22.35	1.20	26.66	3.15	4.31	4.70
Megha	70.30	9.70	8.70	30.50	38.00	80.50	56.20	23.67	1.26	28.00	3.00	3.34	5.65
K-3	54.43	6.50	6.00	31.00	39.00	84.50	51.50	18.87	0.90	20.00	4.10	5.63	4.65
T-57	67.87	8.10	7.50	35.00	42.00	83.00	49.20	22.37	1.11	24.66	5.40	3.10	5.35
TB-1	66.40	7.60	5.30	32.50	41.00	78.50	48.20	20.77	1.02	22.66	4.40	3.49	4.95
Hub-18	78.70	7.80	6.30	28.50	36.00	77.50	33.50	36.44	1.20	26.66	2.30	3.16	5.10
Arka Abha	64.85	9.95	8.30	34.50	43.00	81.00	69.00	32.00	1.93	42.88	3.40	5.65	5.05
Arka Alok	59.10	11.80	8.20	33.50	40.00	76.00	78.70	30.20	2.03	45.11	3.65	4.98	4.45
DMT -2	80.89	9.38	6.40	32.00	39.50	83.00	88.70	37.83	3.25	72.22	3.70	4.59	4.10
CD (P = 0.05)	3.55	1.61	1.66	4.69	4.22	2.52	3.89	3.74	0.28	6.23	0.63	0.82	0.94
CD (P=0.01)	4.74	2.14	2.21	6.24	5.61	3.36	5.17	4.97	0.38	8.28	0.84	1.09	1.25

Table 3: Estimation of range, mean, genotypic and phenotypic coefficient of variation (GCV and PCV), heritability and genetic advance for different traits of tomato genotypes.

Characters	GV	PV	Coefficient of variation		Heritability % (H)	Genetic advance (%)	
			GCV	PCV		GA	GA(%) of mean
Plant height (cm)	24.60	54.30	12.40	17.35	45.30	21.26	46.22
No. of primary branches/plant	7.96	11.99	23.68	30.06	66.38	35.49	308.20
No. of secondary branches/plant	55.00	76.01	16.84	19.14	72.35	27.48	54.49
Days to first flowering	9.09	13.24	5.82	7.21	68.65	11.69	30.29
Days to first fruit set	55.58	72.32	16.92	19.10	76.85	27.84	56.72
Days to first fruit maturity	3427.10	6531.93	30.02	41.01	52.46	47.10	23.85
Average fruit weight (g)	921.37	1164.32	42.88	50.03	79.13	76.73	111.11
Number of fruits/plant	484.48	630.92	57.30	65.38	76.78	103.43	269.23
Yield per plant(kg)	2.65	3.50	60.39	69.40	75.71	108.25	4016.15
Yield per ha (t)	67.17	63.49	341.89	323.12	96.34	89.20	81.21
Number of locules/fruit	0.86	0.93	21.80	26.80	92.47	2.31	13.60
Lycopene (mg/100g)	1642.97	1999.11	85.55	89.05	82.18	79.92	92.90
TSS (°Brix)	0.55	0.63	15.71	14.83	87.30	1.37	28.90

Estimation of different genetic variability parameters are presented in Table 3. Results showed that the phenotypic coefficient of variation (PCV) was higher than genotypic coefficient of variation (GCV) for all the characters studied. Days to first fruit maturity showed the highest genotypic and phenotypic variance (3427.10 and 6531.93) whereas TSS (°Brix) showed the lowest ones (0.55 and 0.63). High genotypic variance was observed for most of the characters indicating more contribution of genetic component for the total variation. Genotypic coefficients of variations (GCV) and phenotypic coefficient of variation (PCV) were highest for yield per ha (341.89 and 323.12), whereas the lowest ones were for days to first flowering (5.82 and 7.21). Higher GCV and PVC were recorded for most of the characters indicating higher magnitude of variability for these characters. The highest heritability was recorded yield per ha (96.34%), while the lowest was for plant height (45.30%).similarly the highest GCV and PCV values were reported for days to first fruit maturity by Manna and Paul (6), Mohanty (8), Haydar *et al.* (3) and Kumar *et al.* (4). Genotypic coefficient of variation, which is true indicator of the extent of genetic variability in a population results were obtained by Pradeepkumar and Tiwari (9). Generally, higher PCV values than GCV were obtained for all tested traits. These results are in accordance of the results obtained by Mandal *et al.* (5) and Vineet (15).

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