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MORPHOLOGICAL CHARACTERIZATION OF TOMATO (*Solanum lycopersicum* L.) GERMPLASM IN *TARAI* REGION OF UTTARAKHAND

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ABSTRACT : The present investigation was conducted during 2012 at Vegetable Research Centre, Pantnagar, U.S.Nagar, Uttarakhand. The field experiment was laid out in Randomized Block Design with 29 genotypes along with two checks in three replications. Genetic variability was studied for 17 quantitative characters. The results revealed significant differences among the genotypes for all the characters. High genotypic and phenotypic coefficient of variations were observed for number of fruit clusters per plant (49.84 and 51.16, respectively) and lowest for days to first fruit picking (1.51 and 1.41 respectively). Heritability was found low for days to first fruit picking (0.13%) and high for number of fruit clusters per plant (100%). High genetic advance was observed for 1000 seed weight (484.88) whereas lowest for fruit diameter (0.24). Genotypic correlation coefficient was higher than phenotypic correlation coefficient.

Keywords : *Tomato, genetic variability, genetic advance, heritability, correlation coefficient.*

Tomato is one of the most important solanaceous vegetable crops grown for its delicious fruits. It is a versatile vegetable used for various culinary purposes. They are processed into puree, paste, ketchup, sauce, soup etc., It is cultivated both in the green houses or protective structures as well as under natural conditions. Worldwide tomato ranks third in area and production after potato and sweet potato but ranks first among processed vegetables. Tomato is a typical day neutral plant and is mainly self-pollinated, but a certain percentage of cross-pollination may also occur. It is a warm season crop and is highly sensitive to frost. It is grown in wide range of soil and climatic conditions. Tomato is one of such crop, which has received wider attention of vegetable breeders in various countries. Lot of diversity is found in growth and development pattern of tomato due to altitudinal variation in Uttarakhand. Improvement of crop depends on the magnitude of genetic variability in economic characters, therefore, the evaluation and utilization of genetic variability in desired direction becomes extremely important in any yield improvement programme. The extent of genetic variability in a specific breeding population depends on the genotypes included in it and its selection history. In this regard, it is necessary to survey the available useful variability in the various plant characters. The phenotypic expression of the plant characters is mainly controlled by the genetic makeup of the plant and the environment, in which it is growing. Further, the genetic variance of any quantitative trait is composed of additive variance (heritable) and non-additive variance and include dominance and epitasis (non-allelic interaction). Therefore, it becomes necessary to partition the observed phenotypic variability into its heritable and non-heritable components with suitable parameters such as phenotypic and genotypic coefficient of variation, heritability and genetic advance. Further, genetic advance can be used to predict the efficiency of selection. The exploitation of variability is of great importance and is a pre requisite for the effective screening of superior genotypes. The progress in breeding for the economic characters that are mostly polygenically controlled and environmentally influenced is determined by the magnitude and nature of their genetic variability. Hence, it is essential to partition the overall variability into its heritable and non-heritable components with the help of genetic parameters like genetic coefficient of variation, heritability and genetic advance. Hence the present study was conducted to study the genetic variability among tomato the germplasm lines and also to study the heritability and genetic advance.

MATERIALS AND METHODS

The present investigation was conducted during January- June, 2012 at Vegetable Research Centre, Pantnagar, U.S.Nagar, Uttarakhand. The basic material for the study involving 29 tomato genotypes along with 2 checks were raised in nursery and transplanted in the main field in three replications with spacing of 50 × 50 cm in a Randomized Complete Block Design. Normal packages of agronomic practices were adopted to raise the healthy crops. Five

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equally competitive plants were selected randomly and tagged for recording observations on 17 quantitative characters *viz.* plant height (cm), number of primary branches per plant, days to 50% flowering, number of fruit clusters per plant, number of fruits per cluster, days to first fruit ripening, days to first fruit picking, days to last fruit picking, average fruit weight (g), number of locules per fruit, number of fruits per plant, weight of fruits per plant (g), fruit diameter (cm), specific gravity(g/cm3), TSS (°B), 1000 seed weight (g) and fruit yield (q/ha). The data were analyzed statistically for their mean, range, heritability and genetic advance, genotypic and phenotypic coefficient of variability, using proper statistical techniques. The analysis of data was carried out to compute the variance components and coefficient of variation as per Burton and DeVane (4). Heritability was calculated by formula given by Hanson *et al.* (6). The extent of genetic advance to be expected by selecting 5% of the superior progeny and was calculated by using the formula given by Robinson *et al.* (13).

RESULTS AND DISCUSSION

The nature and extent of genetic variability is one of the important criteria in formulating an efficient breeding programme and knowledge of phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) is much helpful in predicting the amount of variation present in a given genetic stock. Highly significant differences among the genotypes were observed for all the characters studied (Table 1). From the table, it is clear that there was a wide range of variability in the germplasm for all the characters except days to first fruit picking suggesting the presence of high genetic variability among the genotypes assessed.

The data for range, general mean, phenotypic coefficient of variation, genotypic coefficient of variation, heritability and genetic advance (Table 2) revealed that maximum variable character was weight of fruits per plant (273.72-519.39g), whereas minimum variable character was 1000 seed weight (1.23-2.45 g). In the present investigation phenotypic coefficient of variation was higher than that of genotypic coefficient of variation for all the characters. For most of the characters, the differences in estimates of PCV and GCV were less, indicating that these characters were less affected by environment and were therefore, stable. The present findings are in confirmatory with the findings of Asati *et al.* (2) Manna and Paul (12). Genotypic coefficient of variation was highest for number of fruit clusters per plant (49.84%) whereas lowest estimate of GCV was recorded for days to first fruit picking (0.55%). Phenotypic coefficient of variation was highest for number of fruit clusters per plant (51.16%) whereas lowest estimate of PCV was recorded for days to first fruit picking (1.51%). Lowest value of GCV and PCV for days to first fruit picking were also recorded by Ara *et al.* (1).

Moderate GCV and PCV values for characters such as number of locules per fruit plant height, weight of fruits per plant, number of primary branches per plant, TSS, number of fruits per plant, average fruit weight and specific gravity showed moderate GCV values. Moderate genotypic and phenotypic coefficient of variation for number of primary branches per plant was noticed by Singh (14). Moderate values of GCV for number of locules per fruit and average fruit weight were also obtained by Kumar (11) and Manna and Paul (12). The characters viz., days to first fruit ripening, days to last fruit picking, days to 50% flowering, 1000

Table 1: Analysis of variance with respect to various characters studied in tomato.

Source of variation	d.f.	Plant height (cm)	No. of primary branches/ plant	Days to 50% flowering	Days to first fruit picking	Days to last fruit picking	No. of fruit clusters/ plant	No. of fruits/ cluster	Days to first fruit ripening
Replication	2	390.07	0.12	0.84	5.03	52.03	1.83	0.23	3.30
Treatment	30	1719.87**	10.78**	33.47**	4.44	27.38**	38.37**	0.75**	16.88**
Error	60	87.37	0.34	3.35	3.43	12.77	0.67	0.17	6.08

Source of variation	d.f.	Average fruit weight (g)	No. of fruits/ plant	Weight of fruits/ plant (g)	No. of locules/ fruit	Fruit diameter (cm)	Fruit yield (q/ha)	Specific gravity (g/cm^3)	TSS (% Brix)	1000 seed weight (g)
Replication	2	58.88	23.93	2050.69	0.11	0.03	1709.42	0.11	0.02	0.10
Treatment	30	228.65**	50.37**	15191.28**	0.62**	0.31*	1444.80**	1.16**	2.19**	0.17**
Error	60	16.83	2.94	1250.35	0.10	0.15	319.48	0.04	0.07	0.02

seed weight and fruit diameter exhibited significantly lower values of GCV and PCV.

Heritability in broad sense is a parameter of tremendous significance to the breeders as its magnitude indicates the reliability with which a genotype can be recognized by its phenotypic expression. The estimates of range of heritability in broad sense varied from 0.13 to 0.95. The number of fruit clusters per plant (0.95%) showed highest per cent of heritability as compare to other characters followed by specific gravity (0.91%), TSS (0.91%), number of primary branches per plant (0.90%), plant height (0.86%), number of fruits per plant (0.84%) and average fruit weight (0.81%). Similar results have been reported by Singh (14) for average fruit weight. The moderate heritability recorded for weight of fruits per plant, days to 50% flowering, number of locules per fruit, fruit yield and number of fruits per cluster. The characters namely, days to first fruit ripening, fruit diameter, days to last fruit picking and days to first fruit picking (0.13%) showed the lowest values of heritability.

Heritability would provide information only on magnitude of interference of quantitative characters, while genetic advance will be helpful in formulating selection procedure to be adopted. The genetic advance recorded highest in weight of fruits per plant (124.66) and plant height (44.60) whereas lowest genetic advance was recorded in 1000 seed weight (0.21). Genetic advance for plant height was high and it indicates that this character had additive gene effects and, therefore, more reliable for effective selection for bringing about improvement in tomato crop.

High heritability coupled with high genetic advance provides better information rather than the heritability alone and considerable improvement could be made in characters by predicting the results and selecting the best individual as mentioned by Johnson *et al.* (7). In present study high genetic advance coupled with high heritability was observed for average fruit weight and plant height. Similar observations for this character were obtained by Dhankhar and Dhankhar (5), and Kumar and Thakur (10). Plant height showed high heritability coupled with high genetic advance as a percent of mean, which also supported by Joshi and Singh (9), Kumar and Thakur (10), and Aysh *et al.* (3). Number of locules per fruit showed moderate heritability and moderate genetic advance as

Table 2: Coefficient of variation and other genetic parameters of tomato.

S. No.	Characters	Range	GM	SEm	Coefficient of variation (%)		Heritability (h^2 %)	Genetic advance	Genetic Advance as (%) of mean
					GCV (%)	PCV (%)			
1.	Plant height (cm)	67.9-174.03	130.32	5.40	17.89	19.28	0.86	44.60	34.22
2.	No. of primary branches/ plant	5.82-15.60	9.60	0.34	19.12	20.06	0.90	3.60	37.50
3.	Days to 50% flowering	68.67-81.00	74.67	1.06	4.24	4.90	0.75	5.65	7.56
4.	Days to first fruit picking	121-125	121.65	1.07	0.55	1.51	0.13	0.50	0.41
5.	Days to last fruit picking	142-151	149.61	2.06	1.42	2.88	0.24	2.15	1.44
6.	No. of fruit clusters/plant	3.28-15.70	7.11	0.47	49.84	51.16	0.95	7.11	100
7.	No. of fruits/cluster	3.07-5.09	3.64	0.24	12.00	16.47	0.53	0.66	9.28
8.	Days to first fruit ripening	107-116	111.63	1.42	1.81	2.84	0.40	2.64	2.36
9.	Average fruit weight (g)	22.33-58.67	32.56	2.37	25.80	28.72	0.81	15.55	47.76
10.	No. of fruits/ plant	11.9-29.73	16.78	0.99	23.63	25.75	0.84	7.49	44.63
11.	Weight of fruit /plant (g)	273.72-519.39	362.53	20.42	18.80	21.18	0.79	124.66	34.39
12.	No. of locules/fruit	1.93-3.73	2.69	0.18	15.55	19.53	0.63	0.69	25.65
13.	Fruit diameter (cm)	2.26-3.60	3.08	0.23	7.43	14.74	0.25	0.24	7.79
14.	Fruit yield (q/ha)	117.27-196.64	145.69	10.32	13.29	18.09	0.54	29.32	20.12
15.	Specific gravity (g/cm^3)	1.12-3.54	2.15	0.11	28.55	29.90	0.91	1.20	55.81
16.	TSS (^0B)	3.25-6.32	4.02	0.16	20.87	21.93	0.91	1.64	40.80
17.	1000 seed weight (g)	1.23-2.46	2.05	0.88	7.06	10.23	0.47	0.21	10.24

per cent of mean, similar findings were reported by Joshi *et al.* (8) and Kumar and Thakur (10).

Depending upon the variability, heritability and genetic advance estimates, it could be predicted that improvement by direct selection was possible in tomato for traits like plant height, average fruit weight and number of fruits per plant and these characters will be more useful for the improvement of this crop.

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