



ESTIMATION OF GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCE FOR GROWTH AND YIELD ATTRIBUTES IN TOMATO (*SOLANUM LYCOPERSICUM* L.)

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Abstract

The present research programme was carried out at Vegetable Research Farm, Kalyanpur, Department of Vegetable Science, C. S. Azad University of Agriculture & Technology, Kanpur during *rabi* season 2019-20. The experimental materials consisted of forty (40) genotypes of tomato. All the characters studied showed considerable amount of variability. Number of fruits per plant have highest coefficient of genotypic and phenotypic variability. Phenotypic coefficient of variability was higher than the genotypic coefficient variability. All the characters showed high heritability in broad sense, the highest heritability was observed for number of fruit per plant (99.3%) followed by plant height (98.4%), days to flowering (97.5%), fruit weight per plant (97.3%), days to maturity (97.1%), fruit length (cm) (95.7%), number of locule per fruit (92.6), number of primary branch per plant (92.2%) and number of fruit cluster (89.3%). Genetic advance confirm the heritability estimates with high genetic advance for number of fruits per plant (145.46) and minimum for days to maturity (41.02).

Keywords: Tomato, Genetic Variability, Heritability, Genetic Advance, Growth and Yield.

Introduction

Tomato is a warm season crop. Being a day neutral plant it can be grown throughout the year if climate is suitable. It is susceptible to cold, wind and frost. Though tomato is a summer vegetable but high temperature adversely affects its growth and development. Its flowers are yellow in colour, perfect, bisexual and radially symmetric, that in full bloom are generally less than an inch in diameter. The flowers can occur in a simple or a complex inflorescence (Raceme & Cyme). The cultivated tomato plants generally reproduce by means of self-pollination. Fruit is a fleshy berry. The colour of mature fruits may be red, pink, orange, yellow or white. Most commercial cultivars are red or pink. Tomato fruit is classified as a climacteric fruit. Commercially important tomato fruit can vary in colour, size and shape (Vaughan and Geissler, 1997). Tomato fruit takes about 6-7 weeks from flowering, depending on temperature, to reach full size (Srivastava and Handa, 2005). Tomato plants show three types of growth behaviour: determinate, semi-determinate and indeterminate. In determinate tomato plants primary shoot terminates in a flower cluster, forcing side shoots to develop. With the indeterminate types, the primary shoot dominates the side shoot development, resulting in a sprawling growth pattern. The primary shoot continues to grow as long as the plants remain healthy and growing conditions are suitable. The semi-determinate types have vine characteristics that are intermediate between the other two types (Tomar 2020a and Madhavi and Salunkhe, 1998).

Materials and Methods

The field experiment of this investigation was conducted at Vegetable Research Farm, Kalyanpur, Department of Vegetable Science, C. S. Azad University of Agriculture & Technology, Kanpur during *rabi* season 2019-20. The experimental materials consisted of forty (40) genotypes of tomato. These genotypes were selected out of the germplasm collection being maintained at Department of Vegetable Science, C.S. Azad University of Agriculture & Technology, Kanpur. The investigation was statistically laid out in the field adopting Randomized Block Design (RBD) with forty (40) genotypes in replicated thrice. The observations were recorded on characters *viz.*, Plant height at maturity (cm), Number of primary branch per plant, Number of days to flower initiation, Number of fruit cluster per plant, Number of days to first fruit maturity, Polar diameter of fruit (cm), Equatorial diameter of fruit (cm), Number of locule per fruit, number of fruit per plant, fruit weight per plant.

Broad sense heritability was calculated as per Lush (1940) and genetic advance assessed by the method of Johnson *et al.* (1955); Dubey *et al.* (2019); Tomar *et al.* (2020a). Genotypic and phenotypic coefficients of variation were deliberated by using the formulae of Burton (1952) and Tomar *et al.* (2017). Categorization of genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV) and genetic advance (GA) were done as per Sivasubramanian and Menon (1973) and heritability categorized as by Johnson *et al.* (1955) and Tomar *et al.* (2015).

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Result and Discussion

The perusal of the mean performance of genotype for all the 10 characters under study revealed wide range of variation among them illustrated in Table 1. The range among the genotypes for days to flowering was 12.00 to 30.00 days with mean value of 18.58, for day to maturity 61.00 to 96.00 with mean 73.62, for plant height (cm) 133.00 to 223.00 with mean 174.17, for number of primary branch per plant 9.00 to 17.00 with mean 12.14, for number of fruit cluster 5.80 to 9.20 with mean 7.12, for fruit length (cm) 2.30 to 4.71 with mean 3.30, for fruit width (cm) 2.00 to 4.50 with range 3.24, for number of locule per fruit 2.00 to 3.70 with mean 2.39, for number of fruit per plant 111.00 to 418.00 with mean 190.05 and for fruit weight per plant (kg) 1.71 to 4.30 with mean 2.70. Variations within the genotype were significant for all the characters. However, its magnitude varied from character to character. The variability was highest for number of fruits per plant, followed by fruit weight per plant (kg), plant height (cm), days to maturity, day of flowering, number of branches per plant, number of fruit cluster, fruit width (cm), fruit length (cm) and number of locule per fruit.

The estimates of genotypic and phenotypic variance as well as coefficient of variance for all the traits are illustrated in Table 2. In general the value of genotypic coefficient of variance was lower than the phenotypic coefficient variance for all the characters. The maximum amount of coefficient of genotypic variance was observed for number of fruit per plant (34.40%), followed by day to flowering (22.68%), number of locule per fruit (22.58%), fruit weight per plant (22.24%), number of primary branch per plant (17.14%), fruit length (16.99%), fruit width (16.85%), plant height (13.57%), number of fruit cluster (7.06%) and days to maturity (9.81%). Maximum the difference between PCV and GCV was observed for number of fruit cluster per plant (0.76%) followed by number of primary branch (0.71%) and fruit length (cm) (0.37%) showed the effect of environment for experiment of the traits, While minimum difference for rest of the characters showed stability of character.

The estimation of heritability in broad sense and genetic advance in percent of mean was done for all the 10 characters and the same is presented in table 4. High heritability observed in all characters viz., number of fruit per plant (99.3), plant height (98.4), days to flowering (97.5), days to maturity and fruit width are equals (97.1), fruit length (95.7), fruit weight per plant (97.3), number of locule per fruit (92.6), number of primary branch per plant (92.2) and number of fruit cluster (89.3). Similarly genetic advance at $K=2.06$ observed high for number of fruit per plant (276.45), plant height (99.51) and days to maturity (30.20), moderate for days to flowering (17.65); number of primary branch per plant (8.49), number of fruit cluster (3.70), fruit weight per plant (2.51), fruit length (2.32), fruit width (2.28) and number of locule per fruit (2.20) showed low genetic advance.

Genetic advance in per cent of mean was high for number of fruits per plant (145.46) followed by days to flowering (94.99), fruit weight per plant (92.96). The present study revealed that the maximum coefficient of variance or variability was observed in number of fruits per plant (34.40). It indicates that simple selection for number of fruits per plant may be advantageous as compared to other yield contributing characters under study. Although several characters viz., days to flowering (22.68) followed by number of locule per fruit (22.58), fruit weight per plant (22.24), number of primary branch per plant (17.14), fruit length (16.99), fruit width (16.85), plant height (13.57), number of fruit cluster (13.00) and days to maturity (9.81) have shown high degree of coefficient of variability, providing sufficient scope to bring an improvement in these characters.

Conclusion

Studies of variation indicated that considerable amount of variation existing for number of fruits per plant followed by fruit weight per plant, day of flowering and number of fruit cluster, could be utilized for bringing out an improvement through breeding programme. Studies on heritability indicated high heritability for most of the character viz., number of fruits per plant, plant height, days to flowering and fruit weight per plant (kg). The higher genetic advance for number of fruits per plant and followed by plant height (cm).

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Table 1: Grand mean range of 10 characters in tomato

S. No.	Characters	Mean (X)	Range		S.E.D	CV%
			Minimum	Maximum		
1	Days to flowering	18.58	12.00	30.00	0.55	3.62
2	Days to maturity	73.62	61.00	96.00	1.01	1.69
3	Plant height (cm)	174.17	133	223.00	2.44	1.71
4	Number of primary branch per plant	12.14	9.00	17.00	0.49	4.97
5	Number of fruit cluster per plant	7.12	5.80	9.20	0.26	4.49
6	Fruit length (cm)	3.30	2.30	4.71	0.10	3.58
7	Fruit width (cm)	3.24	2.00	4.50	0.80	2.89
8	Number of locule per fruit	2.39	2.00	3.70	0.12	6.38
9	Number of fruit per plant	190.05	111.00	418.00	4.46	2.87
10	Fruit weight per plant (kg)	2.70	1.71	4.30	0.08	3.69

Table 2: Estimate of genotypic and phenotypic coefficient of variance for 10 characters in tomato

S. No.	Characters	Phenotypic coefficient of variance (%)	Genotypic Coefficient of Variance (%)	Heritability (bs)%	Genetic advance	Genetic advance in % over mean
1	Days to flowering	22.96	22.68	97.5	17.65	94.99
2	Days to maturity	9.95	9.81	97.1	30.20	41.02
3	Plant height	13.68	13.57	98.4	99.51	57.13
4	Number of primary branch per plant	17.85	17.14	92.2	8.49	69.93
5	Number of fruit cluster/ plant	13.76	13.00	89.3	3.70	51.97
6	Fruit length	17.36	16.99	95.7	2.32	70.3
7	Fruit width	17.10	16.85	97.1	2.28	70.37
8	Number of locule per fruit	23.46	22.58	92.6	2.20	92.05
9	Number of fruit per plant	34.52	34.40	99.3	276.45	145.46
10	Fruit weight per plant	22.55	22.24	97.3	2.51	92.96