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Research article

STUDIES ON GENETIC PARAMETERS TO IMPROVE THE GENETIC ARCHITECTURE OF TOMATO (SOLANUM LYCOPERSICUM L.)

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ABSTRACT: Selection which is the basis of every breeding programme operates only on variation which is of genetic nature. A wide range of variability present in any crop always provides the better chances of selecting desired types. A field experiment was carried out at Vegetable Research Farm, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University during 2012 to evaluate the diverse genotypes of tomato. Analysis of variance indicated highly significant differences among the genotypes for all the characters. The highest GCV and PCV were observed with the character fruit yield per plant followed by number of seeds per fruit. Whereas, the lowest GCV and PCV were recorded by the character days to 50% fruiting followed by days to 50% flowering. The heritability estimates were high for all the characters except number of branches per plant which showed moderate heritability. The maximum heritability was observed for number of seeds per fruit and average fruit weight. High GCV and heritability coupled with high genetic advance was observed for fruit yield per plant followerd by number of seeds per fruit indicating that they are governed by additive genes and could be effectively improved through selection.

Keywords: Genetic advance, Genotypic coefficient of variation, Heritability, Phenotypic coefficient of variation, Variability, *Solanum lycopersicum*

INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is one of the major income generating vegetable crops grown widely in tropical and sub-tropical parts of the world. Tomato has acquired the status of world's most popular vegetable crop due to its wider adaptability to various agro-climatic conditions. At present tomato ranks, second next to potato in terms of global vegetable production. It is mostly used for both fresh market and processing. It is an important source of vitamin A, vitamin C and lycopene. Tomato consumption is believed to prevent cancer and heart diseases due to antioxidant properties of lycopene (Kaur et al., 2013). Phenotypic and genotypic coefficients of variation (PCV and GCV) are useful in detecting the amount of variability present in the available genotypes. Heritability and genetic advance help in determining the influence of environment in the expression of the characters and the extent to which the improvement is possible after selection (Robinson et al., 1949). Crop improvement depends on the magnitude of genetic variability and the extent to which desirable characters are heritable. Hence, the present study was carried out to find the genetic parameters for yield and its component traits in tomato genotypes.

MATERIALS AND METHODS

The present experiment was conducted on sandy loam soil at Vegetable Research Farm, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, which is situated at 83.03^{o} E longitude and 25.02^{o} N latitude at an altitude of 128.93 m above mean sea level in the North gangetic zone. The investigation was carried out during 2012 with diverse genotypes of tomato. The experiment was laid out in randomized block design with three replications. Experimental field was brought to fine tilth by repeated ploughing and harrowing. Thirty days old seedlings of each genotype were transplanted by adopting a spacing of 60 cm row to row and 45 cm plant to plant.

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All the recommended agronomic package of practices were followed to grow a healthy crop. In each replication, randomly 5 plants in each genotype were marked for observation. Observations were recorded on 12 characters viz., plant height, days to 50% flowering, days to 50% fruiting, number of branches per plant, number of flowers per cluster, number of fruits per cluster, number of clusters per plant, number of locules per fruit, number of seeds per fruit, average fruit weight (g), total number of fruits per plant and fruit yield per plant (g). The data recorded were analysed as suggested by Panse and Sukhatme (1967) for analysis of variance, Burton and Devane (1953) for phenotypic coefficient of variation, Johnson *et al*. (1955) for heritability and genetic advance.

RESULTS AND DISCUSSION

A analysis of variance was carried out for twelve different yield attributing traits i.e. plant height, days to 50% flowering, days to 50% fruiting, number of branches per plant, number of flowers per cluster, number of fruits per cluster, number of clusters per plant, number of locules per fruit, number of seeds per fruit, average fruit weight, total number of fruits per plant and fruit yield per plant to test the significance of the inherent genetic difference present between various genotypes of tomato. Highly significant differences among the genotypes of tomato for all the characters (Table 1) under study were observed. The results suggested the presence of inherent genetic differences among the genotypes. The extent of variability present in tomato genotypes was measured in terms of mean, range, phenotypic variance, phenotypic coefficient of variation (PCV), genotypic variance, genotypic coefficient of variation (GCV), heritability (broad sense), genetic advance (GA) and genetic advance as % of mean (Table 2). All the genotypes differed significantly with respect to different characters studied. A wide range of variation was observed for all the characters. Plant height varied from 33.43 to 56.51 cm, days to 50% flowering from 33.33 to 44.66, days to 50% fruiting from 49.00 to 61.66, number of branches per plant from 3.00 to 5.33, number of flowers per cluster from 5.33 to 7.66, number of fruits per cluster from 1.00 to 3.66, number of clusters per plant from 5.66 to 11.66, number of locules per fruit from 2.00 to 4.66 , number of seeds per fruit from 26.33 to 173.33, average fruit weight from 15.13 g to 58.18 g, total number of fruits per plant from 6.33 to 31.00. Fruit yield per plant varied from 221.55 to 1803.85 g. These results are in agreement with the findings of Mandal et al. (2000), Singh et al. (2002) and Joshi and Singh (2003). The difference between genotypic and phenotypic variables for all characters were relatively low (Table 2) which indicated that these characters were comparatively stable and highly heritable. This also suggested that selection for such characters could be made effectively on the basis of phenotypic performance. The GCV was less than corresponding PCV indicating the role of environment in the expression of the traits under observation. A narrow difference between GCV and PCV indicated less influence of environment for most of the characters. High GCV and PCV were recorded for fruit yield per plant, which indicated the presence of high amount of heritability for this character, thus selection may be more effective for this character because the response to selection is directly proportional to the variability present in the experimental material. These results are in conformity with the findings of Ahmed et al. (2006), Mehta and Asati (2008) and Singh et al. (2011). The magnitude of heritability ranged from 34.52% (number of branches per plant) to 99.72% (number of seeds per fruit and average fruit weight). Heritability estimates were high for all the characters except number of branches per plant which showed moderate heritability. High heritability for the characters controlled by polygenes might be useful to the plant breeder for making effective selection. These results are in line with those of Singh et al. (2004) and Srivastava et al. (2007).

Table 1: Analysis of variance for yield and yield components in tomato.

Source	Plant height	Days to 50% flowering	Days to 50% fruiting	No. of branches /plant	No. of flowers /cluster	No. of fruits/ cluster	No. of clusters / plant	No. of locules/ fruit	No. of seeds/ fruit	Average fruit weight(g)	No. of fruits/plant	Fruit yield/ plant (g)
R	1.86	3.23	7.23	1.23	0.23	0.23	0.13	0.13	3.03	1.64	5.23	15096.87
G	201.86**	31.11**	46.33**	1.94*	1.57**	2.01**	9.63**	2.00**	6213.8**	491.74**	183.85**	668215.03**
Er	0.96	0.67	3.64	0.75	0.27	0.085	0.91	0.17	5.85	0.46	2.08	4945.85

*, **Significant at the 0.05 and 0.01 probability levels, respectively. R-Replication, G- Genotypes, Er-Error

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Table 2: Genetic Parameters for yield and yield components in tomato.

S. No	Characters	Grand mean	Range		Phenotypic Variance	Genotypic Variance	PCV (%)	GCV (%)	Heritability (%) (Broad Sense)	Genetic advance	Genetic advance (as % of mean)
			Lowest	Highest							
1.	Plant height (cm)	46.17	33.43	56.51	67.28	66.96	17.85	17.72	98.57	16.74	36.24
2.	Days to 50% flowering	38.33	33.33	44.66	10.37	10.14	8.52	8.31	93.74	6.35	16.57
3.	Days to 50% fruiting	54.96	49.00	61.66	15.44	14.22	7.69	6.86	79.62	6.93	12.62
4.	No. of branches/plant	4.13	3.00	5.33	0.65	0.39	25.92	15.23	34.52	0.76	18.43
5.	No. flowers/cluster	6.53	5.33	7.66	0.52	0.43	12.84	10.07	61.58	1.06	16.29
6.	No. of fruits/cluster	2.16	1.00	3.66	0.67	0.64	39.42	37.05	88.33	1.55	71.73
7.	No. of clusters/plant	8.76	5.66	11.66	3.21	2.90	22.29	19.45	76.14	3.06	34.96
8.	No. of locules/fruit	3.56	2.00	4.66	0.66	0.61	24.78	21.92	78.19	1.42	39.92
9.	No. of seeds/fruit	75.86	26.33	173.33	2071.26	2069.31	60.04	59.96	99.72	93.57	123.34
10.	Average fruit weight(g)	32.75	15.13	58.18	163.91	163.76	39.12	39.06	99.72	26.32	80.36
11.	No. of fruits/plant	17.33	6.33	31.00	61.28	60.58	45.67	44.91	96.67	15.77	90.96
12.	Fruit yield/ plant (g)	587.70	221.55	1803.85	222738.34	221089.73	80.89	80.01	97.81	95.79	162.99

PCV = Phenotypic coefficient of variation, GCV = Genotypic coefficient of variation

In the present study, high heritability was accompanied with high genetic advance for number of seeds per fruit, fruit yield per plant and average fruit weight. This indicated the importance of the considerable additive (heritable) gene effect in governing their inheritance and phenotypic selection for their improvement could be achieved by simple methods like pure line or mass selection or bulk method following hybridization and selection in early generations. Therefore, these characters were more reliable for effective selection to improve the yield of tomato. These results are in agreement with the findings of Mehta and Asati (2008), Singh (2009) and Ghosh (2010).

CONCLUSION

High GCV along with high heritability and genetic advance provide better information than other parameters alone. On the basis of the present study, it can be concluded that number of seeds per fruit, fruit yield per plant and average fruit weight are important quantitative characters to be taken into consideration for effective selection in tomato.

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