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Genetic Variability and Scope of Response to Selection in Tomato (Solanum *lycopersicum* L.)

Lokesh Yadav [a*#], G. C. Yadav [a†], Shalu Yadav [a‡], Lav Kumar [a‡#] and Sandeep Kumar [a#]

[a] *Department of Vegetable Science, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India.*

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present investigation was carried out in randomized block design with three replications during *Rabi* season of 2020-21 to judge the extent of genetic variability and scope of selection among thirty-two genotypes including two checks of tomato Narendra Tomato-4 (NDT-4) & Narendra Tomato -7(NDT-7) for fourteen characters. In present study the analysis variance showed that all the treatments were significantly different for all the characters. Which, indicates wide range of genetic variability among the available genotypes. On the basis of mean performance, five genotypes namely NDT-28, NDT-29, NDT-30, NDT-32 and NDT-P were promising ones. High genotypic (GCV) and phenotypic (PCV) coefficient of variations were recorded for plant height, number of primary branches, polar diameter of fruit, equatorial diameter of fruit, locules per fruit, average fruit weight, marketable fruit yield per plant and total fruit yield per plant. Moderate genotypic coefficients of variation and phenotypic coefficients of variation were estimated for ascorbic acid content, number of fruits per plant and pericarp thickness. In contrast, low environment coefficient of variation was found for all the characters. High heritability (broad sense) coupled with high genetic advance in per cent of mean was observed for plant height, equatorial diameter of fruit, locules per fruit, pericarp thickness, average fruit weight, number of fruits per plant, marketable fruit yield per plant and total fruit yield per plant. Thus, ample variability is there and selection will be effective among the available germplasm of tomato.

[#] *PG Student;*
[†] *Associate Professor;*
[‡] *Research Scholar;*
**Corresponding author: E-mail: lokeshyadav9310@gmail.com;*

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1. INTRODUCTION

"Tomato (*Solanum lycopersicum* L.,) having chromosome number 2n=2X=24 is a member of the family Solanaceae and the genus *Solanum*. Tomato is a annual to perennial, prostrate and sexually propagated plant and bears perfect flowers. It has taproot and growth habit of the plant is determinate and indeterminate. The self-pollination in tomato is due to protective anther cone. Botanically, fruit of tomato is known as berry. Tomato is also known as Love apple; Poor man's orange and it is universally treated as Protective food" Anuradha et al. [1]. "It is rich in beta-carotene, folate, vitamin A, vitamin C, vitamin E, flavonoids, potassium and other minerals. Lycopene is the pigment principally responsible for the characteristic deep red colour of ripe tomato fruits and tomato products. Lycopene has important dietetic properties since it reduces the risk of some types of cancers and heart diseases" Eppakayala et al. [2].

Numbers of hybrids and open pollinated verities are available in the country even though the availability of vegetable per capita per day in the country is for below than the recommended by ICMR. Hence, there is still need to improve the crop particularly tomato for better verities and hybrids in future. The plant breeding industry relies heavily on genetic diversity as a resource to develop better genotypes through selection. As a result, breeding materials with more variance have a greater potential for improvement through selection. The genetic make-up of the plant and the environment in which it is growing determine the phenotypic expressions. Additionally, additive variance (heritable) and non-additive variance make up the genetic variation of any quantitative attribute. Therefore, it becomes essential to distinguish the observed phenotypic variability into its heritable and non-heritable genetic components. "Further, genetic advance are used to forecast the efficiency of selection. The efficiency of selection depends on the nature and magnitude of genetic variability and degree of transmissibility of desirable characters" [3]. Hence, the present investigation was performed to judge the extent of genetic variability and possibility of improvement through selection among the available germplasm of tomato.

2. MATERIALS AND METHODS

The site of experiment was Main Experimental Station of Department of Vegetable Science of Acharya Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Ayodhya, which is geographically situated at 25.56 N latitude, 82.12 E longitude and at an elevation of 113 m above the mean sea level. This area falls in sub-tropical area of Eastern India.

The experimental material of the investigation consisted of thirty-two genotypes including two checks (NDT-4 & NDT-7). The experiment was sown in Randomized Block Design with three replications keeping the distance of 60 cm row to row and 50 cm plant to plant. Observations were recorded on fourteen quantitative including quality characters *viz.,* days to 50% flowering, days to first fruit harvest, plant height (cm), number of primary branches per plant, polar diameter of fruit (cm), equatorial diameter of fruit (cm), locules per fruit, pericarp thickness (mm), total soluble solids, ascorbic acid (mg/100 g), average fruit weight, number of fruits per plant, marketable fruit yield per plant (kg) and total fruit yield per plant (kg). The analysis of variance of the design of the experiment was estimated using formula suggested by Panse and sukhatme [4], GCV and PCV by Burton and de Vane [5], heritability (broad sense) by Burton and de Vane [5] and genetic advance in percent of mean by Johnson et al. [6].

3. RESULTS AND DISCUSSION

The estimates of genotypic and phenotypic coefficients of variation for fourteen characters of tomato genotypes had been given in Table-1. The perusal of Table-1 reveals that the estimates of phenotypic coefficients of variation (PCV) were greater than genotypic coefficients of variation (GCV) for all the traits. The high phenotypic along with genotypic coefficients of variation was recorded for traits namely total fruit yield per plant, marketable fruit yield per plant, plant height, average fruit weight, equatorial diameter of fruit, number of primary branches per plant, polar diameter of fruit and locules per fruit, respectively. Medium phenotypic as well as genotypic variation was estimated for pericarp thickness, number of fruits per plant and ascorbic acid content, respectively. Whereas, total soluble solid content shows only moderate PCV.

Table 1. Estimates of range, grand mean, phenotypic and genotypic coefficients of variation, heritability in broad sense(h^2bs) and genetic advance in per cent of mean (Ga) for fourteen characters in tomato germplasm

S. No.	Genetic Parameters characters	Range		Grand mean	PCV (%)	GCV (%)	ECV (%)	Heritability in broad sense (%) (h^2_{bs})	Genetic advance	Genetic advance in per cent of mean
		Lowest	Highest							
1.	Days to 50% flowering	25.63	38.00	34.15	7.21	4.37	9.93	37	1.86	5.45
2.	Days to first harvest	75.03	97.57	89.94	8.48	8.30	3.04	96	15.04	16.72
3.	Plant height(cm)	63.50	171.67	119.90	28.02	27.82	5.72	99	68.23	56.91
4.	Number of primary branches per plant	3.43	7.67	4.91	25.48	25.35	4.48	99	2.55	51.95
5.	Polar diameter of fruit(cm)	3.33	8.57	5.34	22.95	22.83	4.06	99	2.50	46.79
6.	Equatorial diameter of fruit(cm)	3.53	8.37	5.51	25.64	25.53	4.29	99	2.89	52.34
7.	Pericarp thickness(mm)	2.53	5.53	4.38	17.25	17.07	4.30	98	1.52	34.81
8.	Locules per fruit	3.50	6.53	4.82	20.23	20.04	4.68	98	1.97	40.92
9.	TSS (^{0}brix)	4.40	6.70	5.99	10.26	9.97	4.21	94	1.20	19.95
10.	Ascorbic acid(mg/100g)	17.43	24.87	21.07	11.70	11.38	4.71	95	4.80	22.80
11.	Average fruit weight(g)	33.63	93.53	57.16	27.96	27.54	8.39	97	31.94	55.88
12.	Number of fruits per plant	34.40	61.73	51.50	17.13	16.90	4.86	97	17.69	34.35
13.	Marketable fruit yield per plant(kg)	1.45	4.27	2.52	28.41	28.33	3.77	99	1.46	58.19
14.	Total fruit yield per plant(kg)	1.55	4.75	2.74	32.19	31.82	8.39	98	1.78	64.81

While, low magnitude of coefficient of variability was showed by the rest of the traits. For all the features, there were relatively few discrepancies between the genotypic and phenotypic coefficients of variation, indicating that the environment had very little impact on how traits were expressed. High magnitude of phenotypic as well as genotypic coefficient of variations were found in case of total fruit yield per plant, marketable fruit yield per plant, plant height, average fruit weight, equatorial diameter of fruit, number of primary branches per plant, polar diameter of fruit and locules per fruit. "This reflects possibility of obtaining higher selection response in respect of these seven traits. The high estimates of PCV and GCV for most of the traits were also reported" by Singh et al. [7], Ahmad et al. [8], Lekshmi et al. [9] and Khuntia et al. [10]. "Moderate variations were noticed in case of plant height, number of fruits per cluster, polar diameter and equatorial diameter. While, low magnitude of coefficient of variability was showed by total soluble solids and days to 50% flowering. Moderate to low magnitude of coefficient of variability for most of the traits was also reported" by Singh et al. [11], Prakash et al. [12], Akhter et al. [13] and Singh et al. [14].

"Heritability is the informative biometrical parameter to breeders which helps in the selection of the genotypes for further use. Higher degree of heritability suggests the major role of genotypic factors in the expression of the characters. Estimates of heritability and genetic advance for different characters had been presented in Table 1. Heritability in broad sense varied from 37.00 % in case of days to 50 % flowering to 99.00 % marketable fruit yield per plant. The estimates of high heritability were calculated for all the twelve characters viz., marketable fruit yield per plant, plant height, number of primary branches, polar diameter of fruit, equatorial diameter of fruit, total fruit yield per plant, pericarp thickness, locules per fruit, average fruit weight, numbers of fruits per plant, days to first fruit harvest and ascorbic acid. Higher heritability for most of the traits were also advocated" by Aralikatti et al. [15] and Maunika et al. [16] Saravanan et al. [17], Singh et al. [18] However, days to 50 % flowering shows low estimates of heritability.

The genetic advance in per cent of mean ranged from 5.45 % in days to 50% flowering to 64.81 % in total fruit yield per plant. The high genetic advance in per cent of mean were calculated for total fruit yield per plant, marketable fruit yield per plant, average fruit weight, plant height, equatorial diameter of fruit, number of primary branches per plant, polar diameter of fruit, locules per fruit, pericarp thickness and number of fruits per plant. It is to be noticed that these traits also showed high estimates of broad sense heritability [19]. The moderate values of genetic advance of per cent of mean showed for ascorbic acid content.

The degree of success in selection depends upon the expression of the heritability value. Further, more the progress in the selection is also directly proportional to the amount of genetic advance in per cent of mean. High heritability (>75%) coupled with high genetic advance in per cent of mean were estimated for plant height, number of primary branches per plant, polar diameter of fruit, equatorial diameter of fruit, pericarp thickness, locules per fruit, total fruit yield per plant, marketable fruit yield per plat, average fruit weight and number of fruits per plant, respectively. "High heritability with moderate genetic advance in percent of mean was recorded for ascorbic acid content, respectively. Thus, those traits which showed high heritability in broad sense and high genetic advance as per cent of mean may be considered to be mainly governed by additive gene action and therefore, could be effectively improved through selection. Such traits are less under the influence of environment. High heritability coupled with high genetic advance have also been reported for most of the yield and yield attributing traits" by Sajjan et al. [20], Bhandari et al. [21], Singh et al. [18], Kumar et al. [22] and Kumar and Yadav [23].

4. CONCLUSION

Since high heritability (>75%) coupled with high genetic advance in per cent of mean were estimated for plant height, number of primary branches per plant, polar diameter of fruit, equatorial diameter of fruit, pericarp thickness, locules per fruit, total fruit yield per plant, marketable fruit yield per plat, average fruit weight and number of fruits per plant, respectively. Hence, ample variability is there and selection will be effective among the available germplasm of tomato.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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