

Original Research Article

Genetic variability and scope of response to selection in tomato (*Solanum lycopersicum* L.)

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 (NDT-4 & 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 and phenotypic coefficient of variations were observed 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 GCV and PCV 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.

Key words: Tomato, PCV, GCV, Variability, Heritability and genetic advance

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 herbaceous, annual to perennial, prostrate and sexually propagated plant with perfect flowers. It has taproot and growth habit of the plant is determinate and indeterminate. There is a light protective anther cone close the stigma to promote self-pollination. Botanically, tomato fruit is a known as a berry. Tomato is known as protective food because of its special nutritive value and also for its high level of antioxidant. It is rich in beta-carotene, folate, vitamin A, vitamin C, vitamin E, flavonoids, potassium and other minerals.

Numbers of hybrids and open pollinated varieties 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 varieties and hybrids in future. The genetic variability is the raw material in the plant

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breeding industry on which selection act to evolve superior genotypes. Thus, higher amount of variation presents for a character in the breeding materials, prominent scope for its improvement through selection. The phenotypical expression of the plant character is principally controlled by the genetic makeup of the plant and the environment, in which it is growing. Further, the genetic-variance of any quantitative attribute consists of additive variance (heritable) and non-additive variance and embrace dominance and epistasis (non-allelic interaction). Therefore, it becomes essential to partition the observed phenotypic variability into its heritable and non-heritable components with appropriate parameters like genotypic and phenotypic coefficient of variation, heritability and genetic advance. Further, genetic advance can be used to forecast the efficiency of selection. The efficiency of selection depends on the nature and magnitude of genetic variability, degree of transmissibility of desirable characters (Golani *et al.*, 2007). Hence the present investigation was performed to judge the extent of genetic variability and scope of improvement through selection among the available germplasm of tomato.

2. MATERIALS AND METHODS

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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 (1987), GCV and PCV by Burton and de Vane. (1953), heritability (broad sense) by Burton and de Vane. (1953) and genetic advance in percent of mean by Johnson *et al.* (1955).

3. RESULTS AND DISCUSSION

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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 higher than genotypic coefficients of variation (GCV) for all the traits. The high phenotypic along with genotypic coefficients of variation was observed 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. Moderate phenotypic as well as genotypic variation was estimated for pericarp thickness, number of fruits per plant and ascorbic acid content, respectively. Whereas, TSS content shows only moderate PCV. While low magnitude of coefficient of variability was exhibited by the rest of the traits. Very little differences were observed between genotypic coefficient of variation and phenotypic coefficient of variation for all the characters which showed very little influence of the environment in the expression of traits. High magnitude of phenotypic as well as genotypic coefficient of variation were observed 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 indicates 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.* (2015), Ahmad *et al.* (2016), Lekshmi *et al.* (2017) and Khuntia *et al.* (2019). 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 exhibited by total soluble solids and days to 50% flowering. Moderate and low magnitude of coefficient of variability for most of the traits was also reported by Singh *et al.* (2017), Prakash *et al.* (2019), Akhter *et al.* (2021) and Singh *et al.* (2022).

Heritability estimates is the informative parameter to breeders for selecting the genotypes for further use. Higher magnitude 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 present in table-1. Heritability in broad sense ranged from 37.00 % in case of days to 50 % flowering to 99.00 % marketable fruit yield per plant. The estimates of high heritability was 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 also reported by Aralikatti *et al.* (2018) and Maunika *et al.* (2019) Saravanan *et al.* (2019) Singh *et al.* (2020) However, days to 50 % flowering shows low estimates of heritability.

The genetic advance in per cent of mean varied 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. 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 magnitude 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 plant, 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 exhibited high heritability in broad sense and high expected genetic advance as per cent of mean may be considered to be largely governed by additive gene action and therefore, could be effectively improved through selection. Such traits are less under the influence of environment. High heritability along with high genetic advance have also been reported for most of the yield and yield attributing traits by Sajjan *et al.* (2016), Bhandari *et al.* (2017), Singh *et al.* (2020) and Kumar and Yadav (2021).

4. CONCLUSION

Thus, ample variability is there and selection will be effective among the available germplasm of tomato.

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Table1. Estimates of range, grand mean, phenotypic and genotypic coefficients of variation, heritability in broad sense(h^2_{bs}) and genetic advance in per cent of mean (Ga) for fourteen characters in tomato germplasm

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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 ($^{\circ}$ 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

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REFERENCES

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- Ahmad, M.; Khan, B.A.; Iqbal, M.; Khan, Z.U.; Kanwal, A.; Saleem, M. and Khursid, I. (2016)** Study of genetic variability, heritability and genetic advance in F₁ generation of tomato. *Food Sci. Quality Mngmt.* 47: 22-25.
- Akhter, M.; Apon, F.N.; Bhuiyan, M.M.R.; Siddique, A.B.; Husna, A. and Zeba, N. (2021)** Genetic variability, correlation coefficient, path coefficient and principal component analysis in tomato (*Solanum lycopersicum* L.) genotypes. *Plant Cell Biotechnol. Mol. Biol.* 22(25 & 26): 46-59.
- Aralikatt, O.; Kanwar, H.S.; Chatterjee, S.; Patil, S. and Khanna, A. (2018)** Genetic variability, heritability and genetic gain for yield and quality traits in tomato (*Solanum lycopersicum* L.). *Int. J. Chem. Stud.* 6(5): 3095-3098.
- Burton, G.W. and De Vane, E.H. (1953)** Estimated heritability in tall replicated clonal material. *Agron. J.* 45: 474-478.
- Bhandari, H.R.; Srivastava, K. and Reddy, G.E. (2017)** Genetic variability, heritability and genetic advance for yield traits in tomato (*Solanum lycopersicum* L.). *Int. J. Curr. Microbiol. Appl. Sci.* 6(7): 4131-4138.
- Golani, I.J.; Mehta, D.R.; Purohit, V.L.; Pandya, H.M. and Kanzariya, M.V. (2007)** Genetic variability, correlation and path coefficient studies in tomato. *Indian J. Agric. Res.* 41(2): 146-149.
- Johnson, H. W.; Robinson, H. F. and Comstock, R. E. (1955)** Estimates of genetic and environmental variability in soybean. *Agron. J.*; 47: 314-318.
- Khuntia, S.; Premalakshmi, V. and Vethamoni, P.I. (2019)** Studies on genetic variability, heritability and genetic advance for yield and quality traits in tomato (*Solanum lycopersicum* L.) under poly house. *Pharma Innovation.* 8(4): 525-526.
- Kumar, J. and Yadav, G. C. (2021).** Appraisalment of heritability in narrow sense and genetic advance in per cent of mean for different characters in tomato (*Solanum lycopersicum* L.). *The Pharma Innovation Journal* 10(7): 1084-1087
- Lekshmi, S.L. and Celine, V.A. 2017.** Genetic variability studies of tomato (*Solanum lycopersicum* L.) under protected conditions of Kerala. *Asian J. Hortic.* 12(1): 106-110.
- Mounika, B.; Goud, R.CH.; Nayak, H.M.; Saidaiah, P. and Holajjer, P. (2019)** Genetic variability, heritability and genetic advance for yield and quality in tomato (*Solanum lycopersicum* L.) genotypes. *Int. J. Chem. Stud.* 7(5): 1401-1405.
- Prakash, O.; Bahadur, V.; Choyal, P. and Choudhary, S. (2019)** Study on genetic variability studies in tomato (*Solanum lycopersicum* L.). *Int. J. Chem. Stud.* 7(3): 4371-4373.
- Panse, V. G. and Sukhatme, P. V. (1987)** Statistical method for Agriculture workers. ICAR, Pub., New Delhi.
- Singh, N; Ram, CN; Deo, C; Yadav, G.C. and Singh, D.P. (2015)** Genetic variability, heritability and genetic advanced in tomato (*Solanum Lycopersicon* L.) *Plant Archives* 15(2):705-709.

Sajjan, A.M.; Lingaiah, H.B. and Fakrudin, B. (2016)Studies on genetic variability, heritability and genetic advance for yield and quality traits in tomato (*Solanum Lycopersicon*L. *Int. J. Hortic.* 6(18): 1-15.

Singh, A.K.; Ram, C.N.; Yadav, G.C.; Srivastava, R.K.; Deo, C. and Gautam, D. K, (2017)Studies on genetic variability, heritability and genetic advance in tomato (*Solanum lycopersicum* L.).*int.J. Pure App. Biosci.*(2): 908-912.

Saravanan, K.R.; Vishnupriya, V.; Prakash, M. and Anandan, R. (2019)Variability, heritability and genetic advance in tomato genotypes. *Indian J. Agric. Res.* 53(1): 92-95.

Singh, G.; Singh, PK.; Yadav, GC, Singh, A. and Pandey, VP and Singh, M. (2020)Studies on heritability in narrow genetic advance in tomato (*Solanum Lycopersicon*L.) crops. *Int. J. Chem. Stud.* 8(4): 1333-1336.

Singh, H. Yadav, G.C.; Maurya, H.S. and Singh R.P. (2022).Study on genetic variability studies in tomato (*Solanum lycopersicum* L.). *The Pharma Innovation journal* 10(7):1422-1425

Thamburaj, S. and Singh, N. (2013)Tomato, Vegetable, tuber crops and spices. *Sci.*, 11(1): 87-94.

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