

# Study of Genetic Variability, Heritability and Genetic Advance among different characters in tomato [*Solanum lycopersicum* (Mill.) Wettst.]

## Abstract:

The present investigation was carried out at the BBAU, Horticulture Research Farm No.1, Babasaheb Bhimrao Ambedkar University, Lucknow during Rabi season 2021-22 to evaluate tomato genotypes. The experiment was laid out in RBD with three replications. Total 20 genotypes including check cultivars were evaluated for horticultural traits growth and yield. There is a wide variability in different genotypes in tomato. Traits i.e., days to 50% flowering, plant height, number of primary branches per plant, polar diameter of fruit, equatorial diameter of fruit, total soluble solids, number of fruits per cluster, average fruit weight, number of fruits per plant, marketable fruit yield per plant, unmarketable fruit yield per plant and total fruit yield per plant were studied during the investigation. Analysis of variance showed significant differences among genotypes for all the characters under study during the investigation. The Phenotypic coefficient of variance (PCV) was higher than the genotypic coefficient of the variation for the characters studied. The high genotypic coefficient of variation observed for total fruit yield per plant, marketable fruit yield per plant, plant height, unmarketable fruit yield per plant and average fruit yield whereas, it was low for number of fruits per cluster, equatorial diameter of fruit, polar diameter of fruit, number of primary branches per plant, days to 50% flowering and number of fruits per plant. Therefore these characters also showed some scope for improvement through selection.

**Keywords:** Tomato, RBD, Traits, Genotypes, Heritability, PCV, GCV.

## 1. Introduction:

Tomatoes (*Solanum lycopersicum* (Mill.) Wettst.) are members of the Solanaceae family. Tomatoes are one of the world's most frequently produced crops because of its global acclimatization to wide variety of environment. It is widely utilised in the processing business as well as in fresh marketplaces. Alternative names for it comprise

poor man's orange, love apple, and wolf apple. It is universally treated as protective food due to its nutritive value. Several minerals and vitamins like A, C, and E, niacin, folic acid, biotin, and other chemicals, such as antioxidant-rich lycopene that guards against cancer and other chronic illnesses, are all found in tomatoes. Fruit, which is essential to human nutrition, is composed of 93.1% water. It contains Iron 0.8 mg, calcium 20 mg, phosphorus 36 mg, vitamin A 320 LU, vitamin B 0.07 mg, vitamin B 0.01 mg, vitamin C 31 mg, protein 1.9%, fat 0.3 g, fibre 0.7%, and carbs 3.6%. It contains important vitamins that aid in cholesterol reduction. Tomatoes contain about 20 to 50 mg of lycopene per 100 g of fruit weight (Thamburaj and Singh, 2016). Tomato is mostly grown in open fields, greenhouses, and net houses. It ranks third in total vegetable output, after only potatoes and sweet potatoes, but first in processed vegetables. China is the world's largest tomato producer, followed by India,

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the United States, Spain, and Egypt. The global tomato output is 38.82 million metric tonnes. India has a total area of 27.77 million hectares and a total production of 22.28 million tonnes, with a productivity of 25.74 tonnes per hectare that is much lower than the global average. According to an APEDA Agri Exchange (2021-2022) study, the major states involved in tomato production in India are Madhya Pradesh, Andhra Pradesh, Karnataka, Tamil Nadu, and Orissa, with 14.63%, 10.92%, 10.23%, and 7.34%, respectively.

Tomatoes, being a self-pollinated crop, have a remarkable potential for heterosis breeding and are employed in many breeding programmes. The variability available in the population can be partitioned into heritable and non-heritable components viz., phenotypic and genotypic coefficients of variation, heritability and genetic advance on which the selection can be effectively carried out (Saravanam, K.R., Vishnupriya, V., Prakash, M. and Anandan, R., 2019). The genetic improvement of any crop plant needs to have knowledge on the nature and the magnitude of variability in the base population (Dudley, J.W. and R.H. Moll, 1969). Tomato variability is predicted to be considerable, as the fruits vary significantly in shape and size (Bhardwaj and Sharma, 2005). To boost tomato output, the primary focus should be on crop genetic improvement and the development of superior varieties through cross- and within-population selection using available genetic diversity. Because yield is a breeder's primary aim, it is vital to understand the relationship between various qualities that contribute to output. Variability may be detected using genetic factors such as genotypic and phenotypic coefficients of variation (GCV and PCV). Heritability and genetic advancement aid in assessing the effect of environment on character expression and the extent to which improvement is feasible following selection (H.F. Robinson et al., 1949). As a result, the study was conducted in tomato with the goal of estimating the phenotypic coefficient of variation, genotypic coefficient of variation, heritability, and genetic progress. The genotypic and phenotypic coefficients of variation were computed using the Burton and De Vane technique (1953). Heritability (in the broad sense) and genetic gain was calculated as per suggestion by Johnson et al. (1955).

## **2. Materials and Methods:**

This experiment was examined out at the Horticultural Research Farm No. 1 of the Department of Horticulture of Babasaheb Bhimrao Ambedkar University, Lucknow, on a well-leveled field with appropriate drainage facilities during the Rabi Season 2021-22. The

experimental material included 20 genotypes with two check cultivars NDT-4© and NDT-7©. Geographically, Babasaheb Bhimrao Ambedkar University (A Central University), Vidya-Vihar, Rae Bareilly Road, Lucknow, is located at 80.52' east longitude; 26.56' north latitude and 111 metres above mean sea level (MSL), lies in upper Gangetic Alluvial Plain and it has a humid subtropical climate.

### **2.1. Experimental Details:**

In this experiment there are 20 genotypes of tomato including two checks which were maintained by ANDUAT, Kumarganj, Ayodhya were collected for the examination. The list of genotypes used in this experiment are mentioned in Table 1. The experiment used randomized block design (RBD), with three replications for each treatment. On November 15, 2021, the plants were replanted. The spacing between rows and between plants was set at 60 cm and 45 cm, respectively. Each plot is 2.00 m × 2.00 m in size and accommodated 16 seedlings.

### **2.2. Parameter Recorded:**

In this study, 12 characters were studied from 16 sample plants in each net plot and the results were expressed as mean values. List of characters for experimental analysis during the trial are: Days to 50% flowering, Plant height (cm), Number of primary branches per plant, Polar diameter of fruit (cm), Equatorial diameter of fruit (cm), TSS (°Brix), Number of fruits per cluster, Average fruit weight (g), Number of fruits per plant, Marketable fruit yield per plant (g), Unmarketable fruit yield per plant (g), Total fruit yield per plant (g). All the data represent per plant observation except for marketable fruit yield and unmarketable fruit yield which are computed from net plot observation and days to flowering and maturity were recomputed on the basis of harvestable rows in each net plot.

## **3. Results and Discussion:**

### **3.1. Genetic variability:**

The mean sums of squares associated with treatments were significantly significant for all characters. In other words, the genotypes' performance on these variables was statistically

significant, demonstrating that there is plenty of potential for selection in a variety of tomato features. However, in order to determine the absolute magnitude of the variability, the phenotypic and genotypic coefficients of variance were determined. It indicates only the extent of variability present in the genotypes for different traits. The genotypic coefficient of variation (G.C.V.) was lower than the phenotypic coefficient of variation (P.C.V.), indicating that the environment played a role in the expression of the observed traits. As a consequence, the differences in P.C.V. and G.C.V. values for all characters are small. The difference in

P.C.V. and G.C.V. values observed for different morphological traits suggest that characters will demonstrate notable genetic advancement. As a result of the additive gene effects, it is obvious that selection based on phenotypic values for these qualities may be useful in strengthening these characters. The genotypic coefficient of variation (G.C.V.) result showed that the unmarketable fruits yield per plant had the highest genotypic coefficient of variation (30.23). G.C.V. was followed by Total fruit yield per plant, which was 29.52 where the least genotypic coefficient of variation was observed in TSS (7.76) followed by the Days to 50% flowering (8.46) and Number of fruits per cluster (13.11). The moderate to low variation observed for these attributes suggested that there is substantial room for improvement. Madhurina (2012) found similar results in their research.

### **3.2. Heritability:**

For the prediction of the response to selection, heritability estimates are very useful. Considering the heritability in broad advance along with genetic advance may reveal the prevalence of specific components (additive and non additive) of genetic variance and thus helps in judging the effectiveness of selection for the trait more accurately (Johnson *et al.* 1955). The present investigation revealed that low to high heritability estimates represent almost all the characters. The heritability estimates for characters ranged from 72.89 to 99.66 per cent. High heritability recorded for marketable fruit yield per plant (99.66) followed by unmarketable fruit yield per plant (99.08), average fruit weight (97.43), plant height (96.19), total fruit yield per plant (95.30), equatorial diameter of fruit (92.27), polar diameter of fruit (89.57) and number of primary branches per plant (87.33). However, number of fruits per cluster (80.29) showed the moderate level of heritability. The TSS (°

B) showed to have lower heritability i.e., 72.89 followed by days to 50% flowering (76.54). It

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was evident that improving characters with high heritability would be more effective if regular selection processes were used, but improving those with low heritability would necessitate the use of other suitable breeding approaches, such as a population improvement programme.

### **3.3. Genetic advance and Genetic gain:**

The genetic gain (genetic advance expressed in the percentage of the population mean) was ranged from 13.64 to 61.98 %. High heritability combined with high genetic advance was found for marketable fruit yield per plant (61.98), total fruit yield per plant (59.37), plant height (58.96), average fruit weight (53.31), polar diameter of fruit (50.89) and marketable fruit yield per plant (50.56). Moderate heritability with high genetic advance was recorded for number of primary branches per plant (47.47), equatorial diameter of fruit (43.82) and number of fruits per plant (28.08). While least heritability was observed in total soluble solids (13.64) which was followed by days to 50% flowering (15.25). However, unmarketable fruit yield per plant exhibited low heritability associated with high genetic advance. Unmarketable fruit production per plant had the most genetic diversity, followed by total fruit output per plant and plant height. Prerna et al. (2011) found similar results in their research.

### **Conclusion:**

The primary purpose of the study was to find significant variation, heritability, and genetic advances in the numerous genotypic traits studied. The outcomes of the study can be utilized to guide future tomato breeding initiatives. We identified significant genetic variability in the variables studied. Except for TSS (72.89%), all characteristics had high heritability along with high genetic progress. As an outcome of the high heritability and genetic advancement of these features, selection may successfully improve the attributes to increase tomato yield. The data presented above confirmed that additive gene activity and the suggested parameters would be beneficial for future enhancement.

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**Table1.Listoftomatogenotypesused inthepresentstudy:**

<b>S.No.</b>	<b>Nameofgenotypes</b>	<b>Sourceoforigin</b>
1.	<b>NDT-2</b>	A.N.D.U.A.&T,Ayodhya
2.	<b>NDT-p</b>	A.N.D.U.A.&T,Ayodhya
3.	<b>NDT-5</b>	A.N.D.U.A.&T,Ayodhya
4.	<b>NDT-6</b>	A.N.D.U.A.&T,Ayodhya
5.	<b>NDT-8</b>	A.N.D.U.A.&T,Ayodhya
6.	<b>NDT-5-1-1</b>	A.N.D.U.A.&T,Ayodhya
7.	<b>NDT-67</b>	A.N.D.U.A.&T,Ayodhya
8.	<b>NDT-45</b>	A.N.D.U.A.&T,Ayodhya
9.	<b>NDT-27</b>	A.N.D.U.A.&T,Ayodhya
10	<b>NCT-2</b>	A.N.D.U.A.&T,Ayodhya
11	<b>NCT-1</b>	A.N.D.U.A.&T,Ayodhya
12	<b>NDT-56</b>	A.N.D.U.A.&T,Ayodhya
13	<b>NDT-17</b>	A.N.D.U.A.&T,Ayodhya
14	<b>NDT-15</b>	A.N.D.U.A.&T,Ayodhya
15	<b>NDT-52</b>	A.N.D.U.A.&T,Ayodhya
16	<b>NDT-25</b>	A.N.D.U.A.&T,Ayodhya
17	<b>NDT-47</b>	A.N.D.U.A.&T,Ayodhya
18	<b>NDT-38</b>	A.N.D.U.A.&T,Ayodhya
19	<b>NDT-4©</b>	A.N.D.U.A.&T,Ayodhya
20	<b>NDT-7©</b>	A.N.D.U.A.&T,Ayodhya

**Table.2:Mean,Range,GenotypicandPhenotypiccoefficientofVariance,Heritability,andGeneticAdvanceinpercentageofmeanofdifferenttraitsof Tomato**

SI. No.	CHARACTERS	MEAN	MIN	MAX	GV	PV	GCV(%)	PCV (%)	h <sup>2</sup>	GA	GAM (%)
1.	<b>Daysto50%flowering</b>	34.83	25.93	38.03	8.68	11.34	8.46	9.67	76.54	5.31	15.25
2.	<b>Plantheight(cm)</b>	123.60	70.53	171.87	1301.20	1352.79	29.18	29.76	96.19	72.88	58.96
3.	<b>No.ofprimary branchesperplant</b>	4.98	3.43	7.67	1.51	1.73	24.66	26.39	87.33	2.36	47.47
4.	<b>Polar diameteroffruit (cm)</b>	5.20	3.33	8.37	1.84	2.06	26.10	27.58	89.57	2.65	50.89
5.	<b>Equatorialdiameterof fruit(cm)</b>	5.51	3.53	7.83	1.49	1.61	22.14	23.05	92.27	2.41	43.82
6.	<b>TSS(°B)</b>	6.00	4.53	6.67	0.22	0.30	7.76	9.08	72.89	0.82	13.64
7.	<b>No.offruitspercluster</b>	3.98	2.70	4.77	0.27	0.34	13.11	14.63	80.29	0.96	24.19
8.	<b>Averagefruitweight(g)</b>	53.41	33.37	83.23	196.08	201.26	26.22	26.56	97.43	28.47	53.31
9.	<b>No.offruitsperplant</b>	52.86	35.27	61.73	63.38	77.34	15.06	16.64	81.94	14.85	28.08

10.	<b>Marketablefruityield perplant(g)</b>	2419.49	1594.37	3947.97	353781.6	354978.8	24.58	24.63	99.66	1223.21	50.56
11.	<b>Unmarketablefruit yieldperplant(g)</b>	72.79	31.53	120.23	484.11	488.62	30.23	30.37	99.08	45.12	61.98
12.	<b>Totalfruityieldper plant(g)</b>	2558.51	1610.23	4516.80	570557.7	598710.0	29.52	30.24	95.30	1519.00	59.37

**Abbreviationsusedintable2:**

**GV**-Genotypicvariance

**PCV**-Phenotypiccoefficientofvariation

**h<sup>2</sup>**-Heritabilityinbroad sense

**PV**-Phenotypicvariance

**GCV**-Genotypiccoefficientofvariation

**MIN**-Minimumrange

**GA**-Geneticadvance

**GAM**-Geneticadvanceaspercentageovermean

**MAX**-Maximumrange