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Genetic variability, heritability and genetic advance in tomato (*Lycopersicon esculentum* M.)

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Abstract

The present study entitled “Genetic variability, heritability and genetic advance in tomato (*Lycopersicon esculentum* M.)” for estimating the extent of genetic variability yield and quality parameters of parents respectively and to identify superior parents. To achieve these objective parents (Abhilasha, Brahma, Aarya, Indam 14301, Ananta, Vishawanath super) were crossed in diallel fashion during the *rabi* 2021-22. Seven parents were obtained and grown at Department of Agril. Botany, College of Agriculture, GHRU Saikheda, Dist, Chhindwara, Madhya Pradesh in randomized block design with two replications. Spacing of 60 X 60 cm² was kept between row to row and plant to plant and 15 plants were raised in each row. The observations were recorded on days to 50% flowering, days to 1st flowering, plant height (cm) 60&90 DAT, Numbers of primary branches per plant 60&90 DAT, Stem girth 60&90 DAT, fruit length (cm), fruit diameter, Average fruit weight, Days to 1st maturity, Total yield per plant, Fruit yield per plot, TSS The results obtained were subjected to statistical analysis. The mean squares due to genotypes were highly significant for all the characters studied i.e. days to 50% flowering, days to 1st flowering, plant height (cm) 60&90 DAT, Numbers of primary branches per plant 60&90 DAT, Stem girth 60&90 DAT, fruit length (cm), fruit diameter, Average fruit weight, Days to 1st maturity, Total yield per plant, Fruit yield per plot, TSS. This indicates the high genetic variation among the genotypes for these characters.

Keywords: GCV, PCV, heritability, GAM, tomato

Introduction

Tomato (*Lycopersicon esculentum* L.) is an annual crop belonging to the family Solanaceae. The genus *Lycopersicon* consists of annual or short-lived perennial herbaceous plants. Tomato is a typical day neutral plant and is mainly self-pollinated, but a certain percentage of cross-pollination also occurs. It is a warm season crop reasonably resistant to heat and drought and grows under wide range of soil and climatic conditions. Although tomato has a good potential to be cultivated every location in the universe but it confronts many abiotic stresses in which, high temperature is a crucial problem now a days. It is known as protective vegetable due to its nutritional values, which protects human body from several ailments. It is also most extensively used vegetable in processing industry. Tomato ranks first in canned vegetables. Ripe fresh tomato fruit is consumed fresh as salads and consumed after cooking and utilized in the preparation of range of processed products such as puree, paste, powder, ketchup, sauce, soup and canned whole fruits. Unripe green fruits are used for preparation of pickles and chutney. Tomatoes are important source of lycopene (an antioxidant), ascorbic acid and β -carotene and valued for their color and flavor. The area and production of tomato has been increasing constantly over the years. India is the second largest producer of tomato next to China. The basic key to bring about genetic improvement to a crop is to utilize the available or created genetic variability. If the variability in the population is largely due to genetic cause with least environmental effect, the probability of isolating superior genotype is possible. The variability available in the population can be partitioned into heritable and non-heritable component *viz.*, phenotypic and genotypic coefficients of variation, heritability and genetic advance on which selection can be effectively carried out.

Materials and Methods

The experiment entitled, "Genetic variability and genetic advance studies in tomato (*Lycopersicon esculentum* M.)" was undertaken at experimental area of the Department of Agril. Botany, College of Agriculture, GHRU Saikheda, Dist, Chhindwara, Madhya Pradesh. during, 2021-2022. Six promising genotypes were sown in Randomized block design in three replications for recording observations on different parameters. The statistical analysis carried out as per Panse and Sukhatme (1965) [13].

Average annual rainfall is 1,183 mm. Minimum temperature during winter is 4 to 6 degrees Celsius while maximum temperature during summer is 38 to 42 degrees Celsius.

Results and Discussion

Estimation of variability, heritability and genetic advance

1. Plant height

The data regarding plant height showed very high phenotypic and genotypic variances (994.66 and 961.95) which were combined with high PCV (28.78%) and GCV (28.30%) respectively (Table 1). This trait exhibited high heritability (96.70%) with high genetic advance (62.83) and high GA as per cent mean (57.34).

The outcome for the trait plant height are in proof with the results of Sajjan *et al.*, (2016) [14], Somraj *et al.*, (2017) [16], Kumar Nitish *et al.*, (2018) [7] and Sritama Kundu *et al.*, (2018) [17].

2. Numers of branches per plant

The data regarding number of primary branches per plant revealed low phenotypic and genotypic variances of 4.83 and 4.71 respectively with high PCV (37.30%) and GCV (36.86%). The high heritability (97.70%), low genetic advance (4.42) and high GA as per cent mean (75.05) were also noticed for this trait.

Comparable results were reported by Mehta and Asati (2008) [11], Anitha *et al.*, (2013) [1], Arun *et al.*, (2016) [2], Shankar *et al.*, (2016) [15], Kumar Manish *et al.*, (2017) [8] and Somraj *et al.*, (2017) [16].

3. Numbers of leaves per plant

High Phenotypic and genotypic variance values of 44.20 and 29.38 with moderate PCV and GCV of 14.64 % and 11.94 %, very high heritability (66.50%), moderate genetic advance (9.10) and high GA as per cent mean (20.05) respectively were noticed for the numbers of leaves per plant.

4. Days of 1st flowering

Moderate phenotypic and genotypic variances (22.45 and 14.26 respectively) with moderate PCV (14.98%) and GCV (11.94%), high heritability (63.50%), low genetic advance (6.20) and moderate GA as per cent mean (19.61) were revealed for the character days to first flowering.

5. Days to 50 % flowering

The data regarding days to 50 per cent flowering exhibited high phenotypic and genotypic variances (26.94 and 21.85 respectively) with moderate PCV (13.98%) and GCV (12.59%). High heritability (81.10%), moderate genetic advance (8.67) and high GA as per cent mean (23.35) estimates were noticed for this trait. The results are similar with findings of Anitha *et al.*, (2013) [1], Arun *et al.*, (2016) [2] and Shankar *et al.*, (2016) [15].

6. Fruit length (cm)

The data regarding fruit length exhibited very high phenotypic and genotypic variances of (3.83 and 3.71 respectively) were recorded with very high PCV and GCV of 15.59% and 14.71%. Very high heritability (89.10%), very high genetic advance (3.24) and very high GA as per cent mean (28.60) were recorded for this trait.

7. Fruit width (cm)

The data regarding fruit length exhibited very high phenotypic and genotypic variances of (4.03 and 3.93 respectively) were recorded with very high PCV and GCV of 13.46% and 12.32%. Very high heritability (83.70%), very high genetic advance (3.44) and very high GA as per cent mean (23.23) were recorded for this trait.

8. Numbers of fruits per plant

The data regarding number of fruits per plant exhibited very high phenotypic and genotypic variances of (6038.11 and 6026.12 respectively) were recorded with very high PCV and GCV of 142.69% and 142.54%. Very high heritability (99.80%), very high genetic advance (159.75) and very high GA as per cent mean (293.35) were recorded for this trait. The results are similar with findings of Kumari and Sharma, Vinod Kumar *et al.*, (2013) [16], Sajjan *et al.*, (2016) [14].

9. Average fruit weight (g)

The data regarding average fruit weight revealed high phenotypic and genotypic variances (1645.41 and 1625.22) along with high PCV (75.29%) and GCV (74.82%), very high heritability (98.80%), high genetic advances (82.53) as well as high GA as per cent mean (153.19) were recorded for this trait. Comparable results are noticed by Lal *et al.*, (1991) [10], Brar and Singh (1998) [3], Mohanty (2002) [12], Sharma *et al.*, (2006) [16], Islam *et al.*, (2012) [5].

10. Fruit yield per plant (kg)

The data regarding fruit yield per plant revealed very low phenotypic and genotypic variances (0.28 and 0.27) with high PCV (45.30%), GCV (44.82%) and high heritability (97.90%) but very low genetic advance (1.07) and high GA as per cent mean (91.38). The results are in line with the findings of Umesh *et al.*, (2015) [19], Arun *et al.*, (2016) [2] and Shankar *et al.* (2016) [15], and Dixit and Pandey *et al.*, (2017) [4].

11. Days to 1st fruit harvest

The data regarding fruit length exhibited very high phenotypic and genotypic variances of (68.45 and 70.75 respectively) were recorded with very high PCV and GCV of 4.45% and 3.68%. Very high heritability (68.50%), very high genetic advance (63.75) and very high GA as per cent mean (6.27) were recorded for this trait.

12. TSS (%)

With regards to total soluble solids, low phenotypic and genotypic variances (1.35 and 1.31), moderate PCV (26.92%) and GCV (26.57%), high heritability (97.40%), low genetic advance (2.33), and high GA as per cent mean (54.03) estimates were noted. The results are in similar with the findings of Arun and Veeraraghavatham *et al.*, (2005) [2], Anitha *et al.*, (2013) [1].

Table 1: Estimation of variability, heritability and genetic advance as % of mean for twelve characters in six genotypes of tomato

Sr.no.	Characters	Range		Mean	Variance		PCV (%)	GCV (%)	H ² _{bs} (%)	Genetics advance	GA as % of mean
		Maximum	Minimum		Phenotypic	Genotypic					
1	Plant height	68.60	197.56	109.56	994.66	961.95	28.78	28.30	96.70	62.83	57.34
2	No. of branches per plant	2.43	9.83	5.89	4.83	4.71	37.30	36.86	97.70	4.42	75.05
3	No. of leaves per plant	37.60	63.13	45.40	44.20	29.38	14.64	11.94	66.50	9.10	20.05
4	Days of 1 st flowering	21.26	43.86	31.62	22.45	14.26	14.98	11.94	63.50	6.20	19.61
5	Days to 50% flowering	29.00	52.00	37.13	26.94	21.85	13.98	12.59	81.10	8.67	23.35
6	Fruit length (cm)	3.12	5.34	4.47	3.83	3.71	15.59	14.71	89.10	3.24	28.60
7	Fruit width (cm)	3.47	5.94	4.67	4.03	3.93	13.46	12.32	83.70	3.44	23.23
8	No. of fruit per plant	10.58	323.00	54.45	6038.11	6026.12	142.69	142.54	99.80	159.75	293.35
9	Average fruit weight (g)	0.96	194.44	53.87	1645.41	1625.22	75.29	74.82	98.80	82.53	153.19
10	Fruit yield per plant (kg)	0.26	2.28	1.17	0.28	0.27	45.30	44.82	97.90	1.07	91.38
11	Days to 1 st fruit harvest	69.06	82.90	73.86	68.45	70.75	4.45	3.68	68.50	63.75	6.27
12	TSS(%)	2.96	8.16	4.31	1.35	1.31	26.92	26.57	97.40	2.33	54.03

PCV and GCV: Phenotypic and genotypic coefficient of variation, h²_{bs}: Heritability in broad sense, GA: Genetic Advance

Conclusion

The analysis of variance for genetic advance estimated for all the twelve characters which indicated that the means square due to genotypes were significant for all the ten twelve characters studied. The variation due to genotypes was further partitioned into variation due to parents. The means square due to parents exhibited significant difference for all the characters. Crosses exhibited significant difference for all characters except for Numbers of primary branches per plant 60&90 DAT, TSS and fruit diameter. The means square due to parent exhibited significant difference for all the characters. The mean square due to genetic variability significant for all characters studied and mean square due to reciprocal combining ability significant for all characters except fruit diameter and days to 50% flowering.

The result on *per se* performance revealed that the parent Aarya and Indam 14301 was found to be significantly superior for total yield per plant and other yield contributing characters. Among the seven parents, the Aarya, Indam 14301, Brahma, Abhilasha, Vishwanath found significantly superior for total yield per plant and some other yield components.

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