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Research Article

Genetic Variability, Heritability and Genetic Advance for Yield and Yield Contributing Characters in Tomato (*Solanum lycopersicum* L.) Genotypes

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ABSTRACT

Twenty tomato genotypes were evaluated to variability, heritability and genetic advance in yield and genetic advance in yield and quality characters at Vegetable Research Farm, Department of Horticulture, SHUATS, Allahabad. A high analysis of variance revealed significant differences among germplasm for all the traits studies, suggesting sufficient variability for yield and quality characters. The overall values of PCV were higher than those of GCV. Higher magnitude of GCV and PCV, respectively were recorded in (28.21-42.89) acidity followed by (28.04-40.51) TLCV. High values of GCV are an indication of high genetic variability among the germplasm and thus the scope for improvement of these characters through simple selection would be better. In present study, all the characters showed high heritability the magnitude of heritability ranged from 95 % to 90% indicating that there traits are controlled by additive gene action which is very useful in standard selection. The traits like fruit weight, locules/ fruit, TSS, with high GCV, PCV, heritability and genetic advance as percentage of mean, indicating that these characters are under additive gene effects and more reliable for effective selection.

Key words: *Variabilty, Heritabilty, Genetic advance, Tomato.*

INTRODUCTION

Tomato (*Solanum lycopersicum* L.) 2n=2x=24 is one of the most important vegetable crop grown widely all over the world. It is a member of Solanaceae family and is native to Central and South America[31]. In the world, it ranks second in importance after potato but tops the list of processed vegetables. It is a very good source of income for small and marginal farmers and also contributes to the nutrition of the consumer. The ripe fruits are taken as raw or made into salads, soups, preserve, pickles, ketchup, puree, paste and many other products. Tomatoes are important source of lycopene (an important antioxidant), ascorbic acid and β-carotene and it‘s valued for their colour and flavour. It is one of the important raw materials for multimillion food industries. Tomatoes are also called as ―Poor man‘s apple.

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Majority of the farmers are still growing local varieties. There is lack of suitable cultivars in Allahabad Agro-climatic conditions. Therefore, there is need to evaluate the suitable collection will be utilized for development of new hybrids suitable and development of high yielding cultivar is a continuous process and there is an urgent need to select best hybrid or culture suitable for growing in Allahabad State. Considering the past increase in tomato area and lack of suitable variety for this state, generation of basic information about the extent of variability, existing diversity with the available materials, association of important yield and its attributes are pre-requisite to breed suitable cultivar for this region.

Burton[6] suggested that genetic variation together with heritability estimates would give the best estimate of genetic advance expected from the selection. Johnson *et al.*[12] also reiterated the above fact and stressed the need for genetic advance to assess the maximum effect of selection. Since the heritable and non-heritable components of variance are important to assess the true breeding nature character, such information on heritability is a prerequisite for improving the trait and the productivity of the crop in general, through the planned breeding programme. An attempt is therefore made with the objective of estimating genetic variability, heritability and genetic advance of important quantitative characters in each generation of tomato.

MATERIAL AND METHOD

The present investigation "Genetic variability, heritability and genetic advance for yield and yield contributing characters in tomato (*Solanum lycopersicum* L.) germplasm." was conducted during the Rabi season of the year 2015-16. The planting materials for the present study comprised of the 20 genotypes (released varieties and breeding lines) which were collected from IIVR Varanasi all the recommended agronomic package of practices was followed. The observation were recorded on five randomly selected plants per replication for each germplasm of 19 quantitative characters. Analysis of variance was done by the method suggested by Panse and Sukhatme[23]. The genotypic and phenotypic coefficients of variation were calculated using the formula of Burton and De Vane[6]. Heritability and genetic advance were calculated according to Allard and genetic advance as percent of mean was estimated using the method of Johnson *et al.*[12].

RESULTS AND DISCUSSION

Variability the extent of variability with respect to twenty quantitative characters in twenty germplasm measured in term of mean performance, phenotypic coefficient of variation (GCV, heritability, genetic advance and genetic advance as percent of mean are given in table. The success of breeding programme depends upon quantum of variability present in the available germplasm. Analysis of variance revealed significant differences among germplasm for all the traits studied indicating presence of significant variability in the germplasm. Similar results were noticed by Basavaraj *et al.*[5], Singh and Cheema[29], Kaushik *et al.*[14], Das and Sharma[8] and Meena and Bahadur[32].

3.1 Genetic variability

The analysis of variance indicated significantly higher amount of variability present among the genotypes for all twenty characters at 1% and 5% probability level (Table 1). The mean performance and range of the genotypes for variability and estimates of different genetic variability parameters are presented in (Table.2). The range of variability was highest for Plant height (77.67-165.67), followed by fruit/plant (29.27-87.03), days to first flowering (29.15-40.55), days to 50% flowering (37.67-42.67), average fruit weight (23.20-84.50), ToLCV incidence (13.88-58.33), ToLCV severity (10.55-27.22), Ascorbic acid (11.13-19.78), branches/ plant (4.53-7.40), flower/ cluster (5.33-9.75), flower cluster/ plant (8.96-20.27), fruit set/ cluster (2.58-5.33), fruit yield/ plant (1.32-4.06), locules/ fruit (2.23-7.13), pericarp thickness (1.55-4.72), fruit shape index (0.37-1.47), TSS

(3.08-7.61), Acidity (0.28-1.13), lycopene (1.78-4.23), shelf life (2-5.67).

3.2 Genotypic variance and phenotypic variance

The highest genotypic variance recorded for Plant height (924.97), followed by fruit weight (251.38), fruits/ plant (211.03) whereas the lowest genotypic variance were estimated for the acidity (0.03) followed by (0.07) Fruit shape index, fruit set/cluster (0.29). Similarly, phenotypic variance were also the highest for (975.91) plant height, (301.25) fruit weight (234.77) fruits/ plant, (222.28) ToLCV incidence, whereas the lowest phenotypic variance were estimated for the (0.08) followed by acidity (0.09), fruit shape index (0.46). High genotypic variance indicating more contribution of genetic component for the total variation. Therefore, these characters could be considered and exploited for selection purpose whereas high phenotypic variance indicating the strong influence of environmental factors for their expression. Shashikanth *et al.*[26] also observed high genotypic variance for most of the characters studied and phenotypic variance for the plant height and TLCV incidence[32] also found in yield / plant. Therefore, these characters could be considered and exploited for selection purpose. These result were accordance of the results obtained by Mohanty *et al.*, Lecome *et al.*[17], Hyder *et al*.[11], Ghosh *et al.*[9], Bernousi *et al.*[4], Naik *et al.*[21], Patel *et al.*[24], Agrawal *et al.*[3] and Khaple *et al*.[15].

3.3 Genotypic coefficient variance and phenotypic variance

Higher magnitude of GCV and PCV, respectively recoded for (28.21-42.89) acidity, (28.04-40.51) TLCV incidence, (43.42) locules/ fruit and (28.13- 31.57) shelf life indicating higher magnitude of variability for these characters. Similar finding were also reported by Narolia *et al.*[22] for plant height, ascorbic acid and TSS, Kumar *et al*. 2001, Ahmed *et al*. 2006 and Kaushik *et al*.[14] for plant height and Manna and Paul[18], Shankar *et al.*[27] for ascorbic acid, Meena and Bahadur[32] TLCV incidence, Plant Height, Ascorbic acid and TSS. The moderate amount of GCV and PCV respectively were recoded for average in 50 % flowering (2.97- 4.18), first flowering (6.69-12.10), ascorbic acid (17.87-20.13) pericarp thickness. Similar result reports have also been put forward by Chernet *et al.*[7] for polar diameter of fruit and days to 50% flowering, Narolia *et al.*[22] for no. of branches. The high values of GCV are an indication of high genetic variability among the germplasm and thus scope for improvement of these characters through simple selection would be better.

3.4 Heritabilty and Genetic Advance

According to Johnson *et al.*[12] and Panse 1957 with the help of GCV and PCV alone, it is not possible to determine the amount of variation which is heritable. The heritability along with genetic advance is more meaningful and helps in predicating the resultant effect of selection on phenotypic expression. High heritability values also indicate that the traits are under the influence of additive gene action. This selection for such traits is effective for indicate that the traits are under the influence of additive gene action. The selection for such traits is effective for further breeding programme. High heritability in locules/ fruit 94% with expected GA (28.36), GA% of mean (73.96%), TSS 90% with GA (1.84%) and GA% of mean (54.93%), fruit weight 83% with expected genetic advance (29.84%) and GA % of mean (64.86%) indicating that these traits are controlled by additive gene action which is very useful in selection. While the lowest heritability, GA and GA % of mean respectively were (31%, 2.64, 9.76) for first flowering followed by fruit set/cluster (41%, 0.71%, 25.41%) and acidity (43%, 0.24%, 48.99%). These results agreed with those of Agong *et al.*[2], Mohanty *et al.*, Hyder *et al.*[11], Shasikant *et al.*[26], Meena and Bahadur[32] and Prajapati *et al.* Thus, heritability estimates appear to be essential when accompanied by estimates of genetic advance and as GA as % of mean.

Table 1: Analysis of variance for different characters in twenty tomato genotypes

Sl. No.	Characters	Replication 2	Treatment 19	Error 38
1	Plant height (cm)	110.44	53690.94 **	1935.77
2	Branches/ plant	1.77	32.21 **	15.03
3	Days to first flowering	67.86	539.79*	465.33
4	Days to 50% flowering	4.90	107.91**	53.42
5	Flower/ cluster	7.42	127.98 **	56.20
6	Flower cluster/ plant	12.61	500.52**	117.54
7	Fruit set/ cluster	1.50	24.32**	15.64
8	Fruit weight	44.34	15276.42**	1894.97
9	Fruit yield/plant	0.55	29.26**	4.280
10	Locules/ fruit	0.097	151.98**	6.08
11	Pericarp thickness	0.289	27.57**	4.52
12	Fruit Shape Index	0.045	4.42**	0.61
13	TSS	0.092	52.125**	3.62
14	Ascorbic acid	0.42	240.96**	60.75
15	Acidity	0.022	2.672**	1.625
16	Lycopene	0.093	20.822**	5.12
17	Shelf Life	0.0258	40.266**	6.40
18	TLCV incidence	286.94	8373.82**	4296.22
19	TLCV severity	26.19	1321.32**	521

Significant at 0.05*, 0.01**

Table 2: The mean performance and range of variability and different genetic parameters in tomato genotypes

Character	Range Min.	Range Max.	Mean	GV	PV	GCV %	PCV %	h^2 (bs)	GA 5%	GA as % of mean
Plant Height (cm)	77.67	165.67	115.70	924.97	975.91	26.29	27	95.8	60.99	67.56
Branches/ plant	4.53	7.40	5.84	0.43	0.83	11.28	15.60	52.3	0.98	21.53
Days to first flowering	29.15	40.55	34.72	5.39	17.63	6.69	12.10	31.6	2.64	9.76
Days to 50% flowering	37.67	42.67	40.25	1.42	2.83	2.97	4.18	50.3	1.74	5.55
Flowers/ cluster	5.33	9.75	7.84	1.75	3.23	16.88	22.92	54.2	2.01	32.81
Flower cluster/ plant	8.96	20.27	13.98	7.75	10.84	19.91	23.55	71.5	4.85	44.43
Fruit set/ cluster	2.58	5.33	3.59	0.29	0.70	14.98	23.31	41.3	0.71	25.41
Fruits/ plant	29.27	87.03	49.14	211.03	234.97	29.56	31.10	89.8	28.36	73.96
Average fruity weight (g)	23.20	84.50	58.96	251.38	301.25	26.89	29.44	83.4	29.84	64.86
Fruit yield/ plant (kg)	1.32	4.06	2.61	0.48	0.59	26.39	29.35	80.9	1.28	62.66
Locules/ fruit	2.23	7.13	3.74	2.61	2.77	43.42	44.53	94.2	3.23	110.76
Pericarp Thickness (mm)	1.55	4.72	3.73	0.44	0.56	17.87	20.13	78.8	1.22	41.90
Fruit Shape Index	0.37	1.47	0.96	0.07	0.09	28.09	31.10	81.6	0.50	66.99
TSS (°Brix)	3.08	7.61	4.29	0.88	0.98	21.90	23.05	90.3	1.84	54.93
Ascorbic acid (mg/100gm)	11.13	19.78	14.87	3.69	5.29	12.92	15.47	69.8	3.31	28.50
Acidity (%)	0.28	1.13	0.64	0.03	0.08	28.21	42.89	43.3	0.24	48.99
Lycopene (mg/100g)	1.78	4.23	3.06	0.32	0.46	18.50	22.05	70.4	0.98	40.96
Shelf life (Days)	2.00	5.67	2.87	0.65	0.82	28.13	31.57	79.4	1.48	66.17
ToLCV incidence	13.88	58.33	36.80	109.22	222.28	28.04	40.51	49.1	15.09	52.55
ToLCV severity	10.55	27.22	19.14	18.60	32.34	22.54	29.72	57.5	6.74	54.13

CONCLUSION

It is concluded from the present study that the genotypes expressed high genotypic and phenotypic coefficient of variation, heritability and Genetic advance plant height, fruit/ plant, acidity, TLCV, Fruit weight, Locules/ fruit, TSS revealed these characters are under the control of additive gene action. This indicated high response to selection for genetic improvement of tomato genotypes under study they may bear good result in the future.

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