Study of Genetic Variability, Heritability and Genetic Advance in Tomato Genotypes for Yield and its Components

ABSTRACT

To select prospective genotype variants for future breeding programs, research is currently being done to evaluate the degree of genetic variability, heritability, and genetic progress among various tomato varieties using morphological features.

Experimental material comprising thirty-seven species of tomato genotype was raised in the three-replication using Randomized Block Design during the Rabbi 2020-21 season and data were recorded in morphological and quality aspects. On the basis of mean performance of weight of fruits per plant, genotype superior to check genotypes are 7053, 8105, 8202, 8623, 8730 as compared to the best checks 8716 and 9426.Analysis of variance (ANOVA) of these experiments revealed significant for all morphological characters.The result showed higher phenotypic coefficients of variation of all characters compared to genotypic coefficients of variation. High PCV was recorded by fruit number per plant (38.07) followed by fruit weight per plant (33.49) and days to flowering (28.09) while high GCV was identified by fruit number per plant (37.60) and followed by fruit weight per plant (32.94) and flowering days (27.52). All the characters showed high divergence. The number of fruits per plant showed high genetic advance (53.66) followed by maturity days (23.27) and plant height (20.73). The study provided an opportunity to identify genotypes and appropriate parameters like number of fruits per plant, days to plant height to be used in future breeding programs.

Key Word: Genetic advance, Heritability, PCV, GCV, Variability

Introduction

~~Tomatoes are a green fruit vegetable and belongs~~Tomatoes are a green fruit vegetable and belong to the family Solanaceae, which includes about 100 species and 2500 species, including a few other important agronomic plants namely, potatoes, eggplant, peppers, and tobacco (Olmstead *et al*., 2008). *Solanumlycopersicum* has a relatively inter-related genome between the Solanaceae species, which is characterized by its diploid chromosome number (2n = 2X = 24). It is about 950 Mbp in size, and has one of the most notable genes in the Solanaceae (Arumuganathan*et al*., 1991). Tomatoes are successfully grown under different agro-climate conditions. It is a warm-growing plant that needs a long growing season to produce a profitable crop.

Tomatoes are one of the most important vegetable crops of special economic value in the horticulture industry, native to South America and many varieties are now grown in temperate climates (He *et al*., 2003). It is the most popular vegetable that is part of the Solanum variety, the similarity between the leaves and flowers of potatoes and tomato plants seems to confirm this taxonomic group (Wang*etal*., 2005 and Shidfar*et al*., 2011).There are about a dozen species among the Lycopersicon species. On the basis of fruit color, these varieties are divided into two subgroups, namely, Eulycopersicon (red fruit habit and year of growth) and Eriopersicon (green with anthocyanin pigmentation). The cultivated varieties of Tomato (*L. esculentum*) and wild varieties (*L. pimpinellifolium*) belong to Eulycopersicon and these species are further subdivided into five species. There are 16 wild tomato species, including *S.habrochaites, S.pennellii, S.pimpinellifolium, S.cheesmaniae, S.galapagense, S.peruvianum, S.corneliomulleri, S.chilense, S.chmielewskii, S.arcanum, S. neorickii, S.huaylasense, S.lycopersicoides, S.ochranthum, S.*

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jugandifolium, and *S. sitiens*(Knapp *et al*., 2009; Bedinger*et al*., 2011). One of these varieties, namely, *L. esculentum*var. Ceraseformea (cherry tomato) is considered to be the ancestor of modern planted tomatoes (kalloo, 1986, 1986).These species in the tomato clade are considered to have evolved primarily by genetic mutations rather than chromosomal regeneration on a large scale (Anderson*etal*.2010). Because of its high per capita consumption, tomatoes are nutritious because of their high vitamin A-and vitamin-C value and prioritize their nutritional contribution to food. The fruit is rich in ascorbic acid and the taste of the fruit is controlled by various variable components and sugar balance: acid-ratio. Tomato fruit is widely used in salads and in various processed forms namely, pastes, sauces, pulps, juices, sauces and flavoring ingredients in dishes, meat or fish dishes (Gosselin and Trudel,1984). The fruit contains large amounts of lycopene pigment, beta-carotene, magnesium, iron, phosphorus, potassium, riboflavin, niacin, sodium and thiamine. It has antioxidant properties and potentially beneficial health effects (Zhang*et al*. 2009).

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Material and Method

The research has been conducted at Vegetable Research Farm, Kalyanpur, Department of Vegetable Science, C. S. Azad University of Agriculture & Technology, Kanpur during the rabbi season 2020-21. Thirty-seven genotype was taken from Chandra Shekhar Azad university of Agriculture and Technology, Kanpur. The experiments are laid out in three replicationsin random block design and the size of the building is kept at 75 × 60 $cm^2$for Plant to plant and 2 x 2 m^2distance for rows to row.The morphologicalcharacters were recorded in five randomly selected plants for each replication and treatment. The observation of the following characters were recorded namely, days to flowering, ripening dates, plant length, number of branches per plant, fruit number per cluster, fruit length per fruit, fruit length, number of locules per fruit, fruit number per plant, fruit weight, fruit weight per plant.The mean values of genotypes in each replication were used for statistical analysis. The steps involved in the analysis of the Randomized Block Design were as described by Panse and Sukhatme (1985).Heritability in broad sense h^2 (b) was computed as a ratio of genotypic variance to phenotypic variance by applying the method of Allard, (1960). The expected genetic advance under selection for the different characters was estimated as suggested by Johnson *et al.*, (1955).

Result & and Discussion

A distinctive feature of the current study is discussed below: Analysis of variance, mean genotype performance, variability parameters, heritability and genetic advance.

Analysis of variance

Analysis of variance (ANOVA) has shown significant difference for all Morphological characters under study and it is presented in (Table 1). A variety of genotypes can be helpful in the development of high yielding variety. The similar results for these characters were observed by Golaniet al. (2007).

Mean and range for genotypes for each characters Data obtained from 37 genotypes were analyzed and the results were interpreted in comparison with the best check 8716, 9426 .Performance of promising genotypes given in (Table 3). Specify the range of characters for all 10 characters provided (Table.2The similar results for these characters were observed by Golaniet al. (2007).

Analysis of coefficient of variation

The phenotypic coefficient of variation (PCV) ranged from 14.59 to 38.07 and thevalue was recorded the number of fruits per plant (38.07) followed by the fruit weight per plant (33.49) and

day to flowering (28.09),number of locule(23.75), Fruit length (22.97), number of fruits per cluster (22.65), fruit width (21.95), number of branch(21.80), plant height (18.11), days to maturity (14.49). The genotypic coefficient of variance (GCV) ranges from 14.31 to 37.60. The highest GCV was obtained by fruit number per plant (37.60) and followed by fruit weight per plant (32.94) and day to flowering (27.52), fruit length (22.15), number of locule (22.15), fruit width (20.98),number of branch (20.46),number of fruit per cluster (19.37), plant height (17.80), days to maturity (14.31). . Phenotypic variability was high compared to genotypic variability in all the character under the study. These results are similar to the comments recorded by Henareh (2015) and Golani*et al.* (2007). PCV was higher than the appropriate GCV for all characters exhibiting natural traits that influence by environment to some extent, these results agree with Henareh's comments, (2015). The results of this study are closely related to the results of Nair and Thamburaj, (1995) which are an important component of the yield.

Heritability

Heritability (%) ranging from 73.20 percent in fruit value per cluster to 97.60 percent in number. fruit / vegetable. The highest heritabilitywas observed for number of fruits per plant (97.60) followed by weight of fruit per plant (96.70), plant height (96.50), days to maturity (96.10), days to flowering (96.00), fruit length (93.00), fruit width (91.40), number of branch (88.10), number of locule (87.00), number of fruit per cluster (73.20). All Character indicates a high heritability. The results are closely related to Golani*et al*. (2007) observed the high inheritance of fruit weight, fruit length, number of locules per fruit and fruit yield.

Genetic advance

Genetic improvement of various factors ranging from 1.31 per fruit weight per plant to 53.66 per fruit yield per plant. The number of fruits per plant showed high genetic growth (53.66) followed by day to maturity (23.27) and plant length (20.73) and other remaining characters showed low genetic advance. The results are obtained in the same way as Golanetal., (2007).High heritability coupled with high genetic advance ~~were~~was observed for number of fruits per plant, day to maturity, plant height.

Conclusion

On the basis of mean performance of weight of fruits per plant, genotype superior to check genotype are 7053, 8105, 8202, 8623, 8730 as compared to the best checks 8716 and 9426. The high value for both phenotypic and genotypic coefficient of variation recorded the number of fruits per plant and fruit weight per plant. The number of fruits per plant, day to maturity, plant height has high heritability with high genetic advance indicate Additive Gene action and other Character shows high heritability with low genetic advance indicate non additive gene action and presence of epistasis. High heritability coupled with high genetic advance are the best character combination for its improvement and this character should be select in future tomato breeding program for its improvement and variety development.

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Table.1: Analysis of variance for 10 characters in tomato.

S.V	D.F	Mean Sum of Square									
		1	2	3	4	5	6	7	8	9	10
Replication	2	2.45	2.15	5.79	1.16	0.69	0.19	0.27	0.10	1.06	0.02
Treatment	36	105.03	403.43	318.34	9.53	5.49	2.59	2.54	1.19	2103.69	1.12
Error	72	1.43	5.32	3.76	0.41	0.59	0.06	0.07	0.05	17.38	0.01

1. days to flowering
2. days to Maturity
3. Plant height
4. Number of Branches per plant
5. Number of Fruits per cluster
6. Fruit Length
7. Fruit width
8. Number of Locules per fruit
9. Number of fruits per Plant
10. Weight of fruits per plant

Table.2: Estimates of variability parameters for yield and quality traits in tomato.

Character	mean	Range (min-max.)	PCV(%)	GCV(%)	Heritability(%)	GA

Days to Flowering	21.35	12.00 - 31.00	28.09	27.52	96.00	11.86
Days to Maturity	80.51	63.00 - 109.00	14.59	14.31	96.10	23.27
Plant height	57.54	38.50 - 80.00	18.11	17.80	96.50	20.73
No. of Branch	8.52	6.00 – 12.50	21.80	20.46	88.10	3.37
No. of Fruit/cluster	6.59	4.00 – 11.00	22.65	19.37	73.20	2.25
Fruit Length	4.15	2.72 – 6.50	22.97	22.15	93.00	1.83
Fruit width	4.32	3.22 – 6.60	21.95	20.98	91.40	1.79
No. of Locule	2.78	2.00 – 5.20	23.75	22.15	87.00	1.18
No. of fruit/Plant	70.13	27.00 – 130.00	38.07	37.60	97.60	53.66
Weight of fruit/plant(kg)	1.96	0.83 – 3.11	33.49	32.94	96.70	1.31

PCV: Phenotypic coefficient of variation
GCV: Genotypic coefficient of variation
H^2bs: Heritability in broad sense
GA: Genetic advance(%)

Table.3: Promising genotype identified on the basis of mean value for All Character

S No.	Characters	Genotype
1	Days to Flowering	8730, 9424, 9425, 9429, 1903
2	Days to Maturity	8761, 9424, 9425
3	Plant height	8730, 8731, 8202, 8203, 7053, 7206, 8708,
4	No. of Branch	8731, 6512, 7053, 8203, 8506, 8623
5	No. of Fruit/cluster	8752
6	Fruit Length	1904,9432, 1901, 1902,1903,8767, 1905,1906
7	Fruit width	1904, 9432, 1901, 1903, 1905, 1906, 8506, 9429, 1902,
8	No. of Locule	9432,1906,1903,9429, 8761
9	No. of fruit/Plant	8730, 7202
10	Weight of fruit/plant(kg)	7053, 8105, 8202, 8623, 8730