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ASSESSMENT OF GENETIC VARIABILITY AND ASSESSMENT OF GENOTYPE BASED ON MORPHOLOGICAL CHARACTERS OF TOMATO IN THE FIELD CONDITION

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ABSTRACT

The present investigation entitled "Assessment of Genetic variability and assessment of genotype based on morphological characters of tomato in the field condition" was conducted in randomized block design with 30 genotypes of tomato in three replications. The objectives were to assess the relative performance, estimation of genetic parameters. The characters studied were morphological. The experiment materials comprised of 30 genotypes of tomato were collected from IIVR, Varanasi. The experiment was laid out at Vegetable Research Farm, ICAR- Indian Institute of Vegetable Research, Varanasi. The results of the study revealed that high GCV and PCV estimates were recorded fruit set (%) (41.36 and 41.39), pollen viability (28.56 and 28.63), fruit length (37.90 and 39.11), fruit width (41.45 and 42.46), yield/plant (74.57 and 74.59) and number of fruits/plant (54.59 and 54.70). High heritability coupled with high genetic advance as per cent of mean indicates operation of additive gene action which was observed in traits plant height (cm) (98.79), number of primary branches/plant (75.51), days to first flowering (86.71), number of fruits/plant (99.61), flower drop (%) (99.98), fruit set (%) (99.84), pollen viability (99.49), fruit length (93.88), fruit width (95.32) and yield/plant (100.00).
Keywords: GCV, PCV, GA, GA in% mean, morphological and tomato

Introduction

Tomato (*Solanum lycopersicum l.syn.lycopersicon esculentum* Mill.) belongs to genus *lycopersicum* and the family Solanaceae, also called night shade family and tomato is called in india "poor man's orange" in India whereas called "Love of Apple" in England. Tomato with chromosome number 2n=24. Linnaeus are called *Solanum lycopersicon* and Miller called *Lycopersicon esculentum*. Tomato is referred as "Protective Food". Red colour of tomato is due to the presence of pigment 'Lycopene' ranges from 30 - 50 mg/100g of edible part. The yellow and orange colour of tomato fruit is due to the presence of carotene and prolycopene pigments, respectively Tomato fruit undoubtedly reduce the risk of cancer. Phenotypically stable genotypes are of great importance, because the environmental condition varies from year to year/region to region. Wide adoption to the particular environment and consistent performance of recommended genotypes is one of the main objectives in breeding programme (Kalloo, 1998). The efficiency of selection and proper handling of segregating generations depends upon the knowledge on nature and magnitude of genetic variability. The extent of genetic and non-genetic components of variation formulates the proper breeding program me to reach the goal. Higher genetic variation affords a scope for selection. Selection based on multiple traits is always better than selection based on yield alone. As we know that yield is a quantitative character controlled by many genes, an adequate knowledge about the magnitude and degree of association of yield with its attributing characters is

of great significance to the breeders, through which they can clearly understand the strength of correlated traits, when they have to exercise selection for simultaneous improvement of more than one character. The present studies was designed to estimate the coefficient of phenotypic variation (PCV %), coefficient of genotypic variation (GCV %), heritability and quantitative trait to measure the fruit borer resistant, Cracked resist fruit, Blossom end rot resist fruit, Cat face resist fruit, Sunscald resist fruit, and Blotchy ripened resist fruit in tomato. Precise heritability estimates obtained through present research will enable us to make estimates about the possible progress that can be achieved by making the more effective selection Iqbal *et al.* (2013).

Materials and Methods

The present investigation entitled "Assessment of Genetic variability and assessment of genotype based on morphological characters of tomato in the field condition" was conducted in randomized block design with 30 genotypes of tomato in three replications. The objectives were to assess the relative performance, estimation of genetic parameters. The characters studied were morphological. The experiment materials comprised of 30 genotypes of tomato were collected from IIVR, Varanasi. The experiment was laid out at Vegetable Research Farm, ICAR- Indian Institute of Vegetable Research, Varanasi. The experimental site is located at ICAR- Indian Institute of Vegetable Research, Varanasi, about 20 Km south-west of Varanasi situated at 25.18^{o}N latitude and 83.03^{o}E longitude in North Genetic plain in eastern part of Uttar Pradesh (India) and an elevation of 128.93 m above mean sea level (MSL). All the parental seedlings were transplanted in the crossing block with spacing of 60 cm × 60 cm on 20th August 2017. The crop was raised as per package of practices of tomato. The mean data of each character was subjected to statistical analysis for variance and test the significance of each character as per the procedure of Panse and Sukhatme (1967). Genotypic and phenotypic correlation coefficients were calculated by standard procedures Johnson *et al.* (1955) and Hanson *et al.* (1956). Heritability (h^2 broad sense) and Genetic advance method by Robinson *et al.* (1949) Genetic advance as percentage over mean method by Johnson *et al.* (1955).

Observation recorded

Three plants in each replication per entry were selected and tagged randomly for recording the data for changes in morphological viz., vegetative, reproductive and fruit quality traits in tomato by the effect of high temperature. The process of recording data is described below:-

Plant height: At the time of last harvesting of fruits plant height was recorded and plant height was measured from base of plant to the tip of shoot.

Number of primary branches/plant: At the time of last picking number of branches was recorded its time maximum branches were produce by each plant was recorded.

Days of first flowering: After sowing of the seed, experimental plots were visited in between 9 AM to 11 AM daily to examine the tagged plants for ascertaining appearance of first flower there upon. The date of first flowering was observed and the time span for the process was calculated by the interval in days between date of first flowering and the date of transplanting.

Number of fruit/plant: Total number of fruit of randomly tagged plants was counted from each picking and average was calculated.

Flower drop in %: flower drop efficiency of each treatment was assessed by marking the total no of flower in cluster at full bloom stage during first week of May and count no of fruit was set in this cluster worked out by dividing total number of fruit set in cluster the total number of flowers in cluster and the values obtained were multiplied by hundred.

Fruit set (%): Fruit set efficiency of each plant was marking three cluster and count no of flowers in cluster of tagged plant four time called sampling and Average all sampling of tagged plant no of flower and no of fruits and calculation of per cent of fruit set was worked out by dividing the Average of total number of flowers all sampling with average of total number of fruit set of and the values obtained were multiplied by hundred.

Pollen viability: Pollen viability by staining of pollen grains with acetocarmine dye and estimation of pollen viability according to the method followed by Moreira and Cruegel, 1941.

Fruit length: The length of fruit was measured in centimeters (cm) from the base of the calyx to tip of fruit with the help by verniearcalipers.

Fruit width: Diameter of the fruit was measured in centimeters (cm) with the help of a vernier calipers at the center (equatorial length) of the fruit.

Yield/plant (gm): Total yield per plant was calculated by summing the fruit weight from all pickings at the end of crop.

Results and Discussion

Analysis of variance showed significant differences among the genotypes for the 10 characters studied. Analysis of variance showed significant difference among the genotypes for the different characters at 0.1% and 5% significance. The mean sum of squares due to genotype for different characters are presented in Table 1. Similar observations in tomato were also reported by Shravan *et al.* (2004) Singh & Raj (2004) and Barman *et al.* (1995) (Noureen *et al.* (2010); Jilani *et al.* (2013) Asati *et al.* (2008), Manna and Paul (2012), Mohammed *et al.* (2012) and Narolia *et al.* (2012).

Table 1: Analysis of variance for ten morphological characters in tomato

S. N.	Source of variation / characters	Mean sum of squares		
		Replication D.f=2	Treatments D.f=29	Error D.f=58
1.	Plant height (cm)	3.46	410.42**	1.67
2.	Number of primary branches/plant	0.58	2.90**	0.28
3.	Days to first flowering	1.28	12.72**	0.61
4.	Number of fruits/plant	3.46	1973.36**	1.67
5.	Flower drop (%)	0.20	1973.30**	0.10
6.	Fruit set (%)	1.87	1730.67**	0.90
7.	Pollen viability	2.76	781.60**	1.33
8.	Fruit length	0.17	4.01**	0.08
9.	Fruit width	0.17	5.28**	0.08
10	Yield/plant	13.60	718135.24**	6.56

* Significant at 1%, ** Significant at 5 %

The variance measures the variation within a particular trait. But it does not provide any real measure for comparison of variance between different traits. The term "Coefficient of Variation (CV.)" truly provides a relative measure of variance among different traits. In general, estimates of phenotypic coefficient of variation (PCV) were found to be higher than their corresponding genotypic coefficient of variation (GCV), this was due to environmental component, which was being added to GCV. The estimates of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) for all the 10 characters were presented in table 2 Similar observations in tomato were also reported Singh *et al.* (2006) and Hayadar *et al.* (2007). According to Sivasubramanian and Madhavamenon (1973), genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) have been classified into low when less than 10%, moderate when 10-20% and high when greater than 20%. Wide range of genotypic and phenotypic coefficient of variation (GCV & PCV) was observed for the characters ranging from flower drop (%) (79.02 and 79.02) to days to first flowering (8.67 and 9.31). High magnitude of GCV and PCV were recorded for fruit set (%) (41.36 and 41.39), pollen viability (28.56 and 28.63), fruit length (37.90 and 39.11), fruit width (41.45 and 42.46), yield/plant (74.57 and 74.59) and number of fruits/plant(54.59 and54.70). Whereas moderate estimates were observed for plant height (cm)(18.20 and 18.31) and number of primary branches/plant(16.05 and 18.47). Whereas low estimates were observed for days to first flowering (8.67 and 9.31). Similar observations in tomato were also reported Shravan *et al.* (2004), Nakawuka & Adipala (1999), Singh *et al.* (2006), Sivaprasad, (2008), Gosh *et al.* (2010), Haydar *et al*. (2007), and Islam *et al.*(2010). According to Johnson et al. (1955), heritability estimates were classified into low, when less than 30%, moderate when 30-60% and high when greater than 60%. In the present investigation, the heritability estimates were found to be high (more than 60%) for plant height (cm)(98.79), number of primary branches/plant (75.51), days to first flowering (86.71), number of fruits/plant (99.61), flower drop (%) (99.98), fruit set (%) (99.84), pollen viability (99.49), fruit length (93.88), fruit width (95.32) and yield/plant (100.00). The results were in agreement with the findings of Bhandari *et al.* (2017), Singh and Singh (2019) and Sushma *et al.* (2020). However, when the estimate of expected genetic advance accompanies heritability, then the prediction of genetic gain under selection is more accurate (Johnson et al. 1955). The classification of genetic advance as percent of mean has been given by Johnson et al. (1955) as low, when less than 10%, moderate when 10-20% and high when greater than 20%. In the present investigation, the genetic advance estimates were found to be high for

plant height (cm) (23.90), number of fruits/plant (22.83), flower drop (%) (52.83), fruit set (%) (49.43), pollen viability(33.14) and yield/plant (100.786). Whereas number of primary ranches/plant, days to first flowering, fruit length and fruit width showed low genetic advance. Genetic advance as percent of mean for various characters are presented in table 2 and noticed that high genetic advance as percent of mean was recorded for plant height (cm) (37.27), number of primary branches/plant (28.72), number of fruits/plant (112.23), flower drop (%) (162.77), fruit set (%) (85.14), pollen viability (58.68), fruit length (75.64), fruit width (83.37) and yield/plant (153.62). Whereas days to first flowering (16.63) showed moderate genetic advance which are in line with the findings of Kumar *et al.* (2006), Anitha *et al.* (2013), Shankar *et al.* (2013), Arun *et al.* (2016) and Shankar *et al.* (2016).

Conclusion

On the basis of mean performance of 30 genotypes of tomato, three promising genotype significantly superior in order of merit for this trait was Kashi aman (1419.70), Punjab bharkha-1 (1360.00) and Kashi chayan (1302.20). Analysis of variance showed significant differences among the genotypes for the 10 characters studied. Analysis of variance showed significant difference among the genotypes for the different characters at 0.1% and 5% significance. Genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) have been classified into low when less than 10%, moderate when 10-20% and high when greater than 20%. The heritability, genetic advance and genetic advance as per cent of mea estimates were found to be high for plant height (cm), number of primary branches/plant, days to first flowering, number of fruits/plant, flower drop (%), fruit set (%), pollen viability, fruit length, fruit width and yield/plant.

Table 2: Variance, coefficient of variability, heritability, genetic advance and genetic advance in % of mean for ten characters in tomato

Character	Grand mean ± SE	Range	Coefficient of Variation		Coefficient of variability		Herita-bility	Genetic advance	Genetic advance in % mean
			Genotypic	Phenotypic	Geno-typic	Pheno-typic			
Plant height (cm)	64.48±1.06	90.60-45.4	136.25	137.92	18.20	18.31	98.79	23.90	37.27
Number of primary branches/plant	5.78 ± 0.44	8.60-4.00	0.88	1.16	16.05	18.47	75.51	1.67	28.72
Days to first flowering	23.20 ± 0.64	28.0-18.0	4.04	4.65	8.67	9.31	86.71	3.85	16.63
Number of fruits/plant	20.30± 0.57	42.77-0.00	123.34	123.82	54.59	54.70	99.61	22.83	112.23
Flower drop (%)	32.73± 0.26	100-1.30	657.75	657.85	79.02	79.02	99.98	52.83	162.77
Fruit set (%)	57.90± 0.78	58.0-00	576.59	577.50	41.36	41.39	99.84	49.43	85.14
Pollen viability	57.18± 0.94	85.0-30.5	260.09	261.42	28.56	28.63	99.49	33.14	58.68
Fruit length	3.00 ± 0.24	4.80-00.00	1.31	1.39	37.90	39.11	93.88	2.28	75.64
Fruit width	3.16 ± 0.24	5.40-0.00	1.73	1.82	41.45	42.46	95.32	2.65	83.37
Yield/plant	653.18±2.09	1419.70-0.00	239376.23	239382.79	74.57	74.59	100.00	100.786	153.62

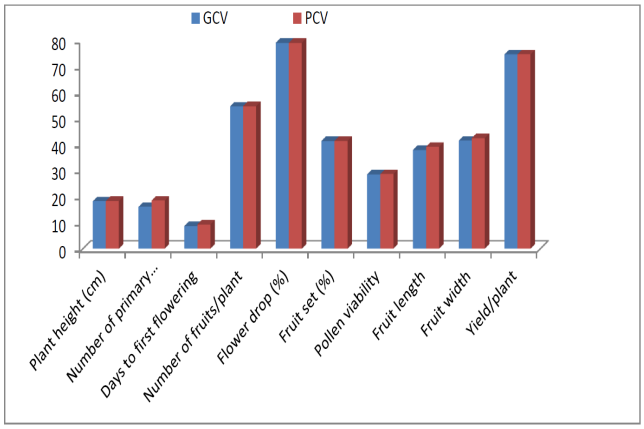

Fig. 1 : Estimates of GCV and PCV for morphological traits of tomato

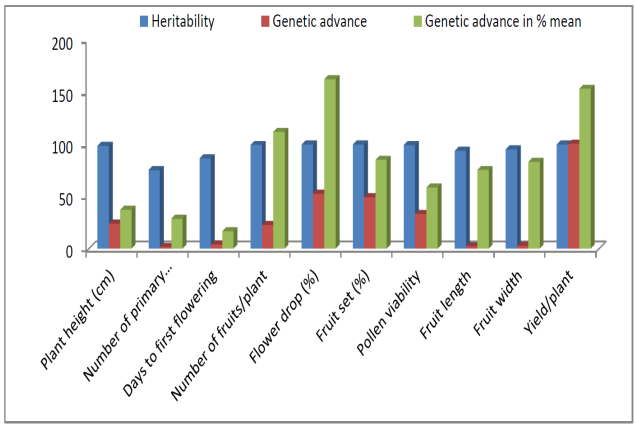

Fig. 2 : Estimates of Heritability, G. A. and G. A. as mean (%) for morphological traits traits of tomato

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