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Study on genetic variability, heritability and genetic advance in tomato (*Solanum lycopersicum* L Mill.)

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Abstract
The present investigation, genetic variability, heritability and genetic advance in tomato was undertaken in randomized Block design with three replications on twenty genotypes at the Nana Ji Deshmukh Krishi Farm the objective of the study was to evaluate genetic variability and heritability of traits among tomato accession based on quantitative traits. Thirty tomato acessession were planted in 2014-15 in randomized block design with three replications. Data on 15 quantitative traits were collected and subjected to various statistical analyses. As the study revealed, the estimates of phenotypic and genotypic coefficient of variation showed the presence of variability among the accessions for majority of the characters. High heritability coupled with high expected genetic advance in per cent of mean was observed for fruit yield per plant, fruit weight per plant, plant height and days to maturity.

Keywords: genetic variability, heritability, tomato, genetic advance

Introduction
Tomato (*Solanum lycopersicum* L. *Syn*. *Lycopersicon esculentum* Mill., 2n=2x=24) is normally a self-pollinated crop and one of the most important and popular vegetables in the world because of its wider adaptability, high yielding potential and suitability for variety of uses in fresh as well as processed food industries (He *et al*., 2003) [6]. It belongs to the family Solanaceae and is native of Peru Equador region (Jenkins, 1948; Rick, 1969) [12]. In India, tomato occupies an area of 773.88 Thousand Ha with a production of 18731.97 Thousand MT (2015-16) (Horticultural Statistics at a Glance 2017) [1].
Significant improvement in tomato production requires information regarding nature and magnitude of genetic variation in quantitative traits (Kaushik *et al.*, 2011) [7] Yield is a quantitative character controlled by many genes (Lungu, 1978). Adequate knowledge about the magnitude and degree of association of yield with its attributing characters or components is of great importance to breeders. Using these components (Monamodi *et al*., 2013) [9]. Cramer and Wehner (1998) indicated that a way about improving yield indirectly is to select for traits that are highly correlated with yield but possess higher heritability. These traits are often referred to as yield components and may include; the number of harvests per plant, number of branches per plant and marketable yield (Rani *et al.*, 2008) [11]. According to Lungu (1978) the consideration of yield components in selection is based on the assumption that a strong positive correlation exists between yield and yield components and that these component characters have higher heritability than yield.

Material and Method
The Experiment was conducted to evaluate the thirty genotypes/varieties under normal soil and rain fed condition at Agriculture Farm, Nana Ji Deshmukh New Agriculture Campus, Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot, Satna (M.P.). The place of experiment in Chitrakoot is situated at $25^0$10' North latitude and $80^0$85' East longitude. The altitude is about 200m above mean sea level. The experiment was laid out fallowing Randomized Block Design (RBD) with three replications during *Kharif* 2015. Five competitive plants from each replication were randomly selected from recording observation for all the 13 quantitative traits except days to 50% flowering and days to maturity which was recorded on whole plot basis. Average data from the sampled plant of each replication in various statistical analyses:-The analysis of variance for the design of the experiment was carried out according to the procedure outlined by Panse and Sukhatme (1967). Heritability in broad sense (h^2) by (Burton & de Vane (1953). Genetic advance by Johnson *et al.* (1955).

Result and Discussion

Analysis of variance involving 30 genotypes/varieties lines was done for fifteen characters. The mean sum of squares due to replications, treatments and error are presented in Table 1. Variance due to replication were non- signification for all the parameters under study. The variance due to treatment was found highly significant for 12 traits out of 15 characters, while significant differences was recorded for days to first flowering, days to 50% flowering and no. of flowers per cluster.

In general, phenotypic coefficients of variation were higher than genotypic coefficient of variation for all the characters. A large amount of variability was found for fruit yield per plant which ranged from 1142.30 g (DT-10) to 1903.05 g (H-86) and the grand mean was 1465.60. The phenotypic (16.53) and genotypic (15.28) coefficients of variation was exhibited moderate values for this character indicating that environment has played significant role in the expression of this character. Heritability in broad sense was computed for all the characters and has been presented in Table 2. In general, high to low estimates of broad sense heritability were observed for all the characters. High estimates of broad sense heritability (h^2b) (>75%), moderate (50-75%) estimation of broad sense heritability (h^2b) and low (<50%) broad sense heritability (h^2b).The heritability values ranged from 20.99 per cent for days to 50% flowering to 98.83% for days to maturity. High heritability estimates were found for days to maturity (98.83), fruit weight per plant (98.57), average fruit weight (92.34), locules per fruit, (90.52), fruit yield per plant (85.37) and fruit diameter (81.26). The moderate heritability estimates were found for plant height (74.16), fruits per plant(65.63) and pericarp thickness(63.90), while low estimates were found for Number of flower per inflorescence (42.64) followed by number of branches per plant (37.08), fruit per cluster (36.83), flower per cluster(24.74), days to first flowering (21.73) and days to 50% flowering (20.99) showed low values of heritability. The expected genetic advance in per cent of mean ranged from 1.57 per cent for days to 50% flowering to 108.47 per cent for average fruit weight (Table 2). High estimates of expected genetic advance were found for average fruit weight followed by locules per plant, pericarp thickness, plant height, fruit diameter, fruit yield per plant days to maturity, fruits per plant, fruit weight per plant and number of flower per inflorescence, while low expected genetic advance were found for branches per plant, fruits per cluster and number of flower per cluster. The very low estimates of expected genetic advance were found for days to first flowering and days to 50% flowering, showed very low estimates of expected genetic advance for this study.

High heritability coupled with high expected genetic advance in per cent of mean was observed for fruit yield per plant, fruit weight per plant, plant height and days to maturity. in accordance with earlier reports by Dudi *et al.* (1983), Ghosh *et al.* (1995), Dar *et al.* (2011) Tausa *et al.* (2011), Dar *et. al.* (2012) [2], Firas *et al.* (2012) [4] and Mohamed *et al. (*2012) [8].

Table 1: Analysis of Variance for Fifteen quantitative characters in Tomato.

S. No.	Character	Mean Sum of Square		
		Replication	Treatments	Error
	D.F.	2	29	58
1	Days to First Flowering	1.12	1.88*	1.03
2	Days to 50 % Flowering	0.06	1.06*	0.59
3	Branches/ Plant	0.31	4.41***	1.59
4	Flowers/ Inflorescence	0.700	2.50***	0.78
5	Flowers/ Cluster	0.740	0.58*	0.29
6	Fruit/ Cluster	0.230	0.35***	0.13
7	Fruits/ Plant	10.420	29.59***	4.35
8	Average Fruit Weight (g)	0.050	64.75***	1.74
9	Fruit Weight/ Plant (g)	0.24	469.58***	2.27
10	Locules/ Fruit	0.14	1.37***	0.05
11	Pericarp Thickness (mm)	0.003	0.012***	0.00
12	Fruit Diameter (cm)	0.14	0.76***	0.05
13	Plant Height (cm)	50.83	533.05***	5.46
14	Days to Maturity	0.58	322.11***	1.27
15	Fruit Yield/ Plant (g)	10190	158954.25***	8590.72
* Significant at 5% probability level; **Significant at 5% Probability level.				

Table 2: Heritability (%) in broad sense, genetic advance and genetic advance in percent of mean for 15 quantitative characters in Tomato Traits

S. No	Characters	GCV	PCV	Heritability (%)	Genetic advance adadvance Advance	Genetic advance in percent of Mean (%)
1	Days to First Flowering	2.05	4.41	21.73	0.51	2.53
2	Days to 50 % Flowering	1.30	2.84	20.99	0.37	1.57
3	Branches/ Plant	11.75	19.30	37.08	1.21	18.89
4	Flowers/ Inflorescence	13.53	20.72	42.64	1.02	23.30
5	Flowers/ Cluster	7.03	14.14	24.74	0.32	9.23
6	Fruit/ Cluster	8.49	13.99	36.83	0.34	13.61
7	Fruits/ Plant	11.96	14.73	65.93	4.85	25.64
8	Average Fruit Weight (g)	42.76	44.50	92.34	9.07	108.47
9	Fruit Weight/ Plant (g)	9.46	9.52	98.57	25.53	24.79
10	Locules/ Fruit	21.52	22.67	90.52	1.30	54.19
11	Pericarp Thickness (mm)	23.15	28.96	63.90	0.09	48.85
12	Fruit Diameter (cm)	16.13	17.89	81.26	0.90	38.39
13	Plant Height (cm)	19.05	22.12	74.16	22.38	43.30
14	Days to Maturity	10.78	10.84	98.83	21.18	28.29
15	Fruit Yield/ Plant (g)	15.28	16.53	85.37	426.11	37.26

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