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Estimations of Heritability in a Narrow Sense and Genetic Gain for Diverse Typescripts in Tomato (*Solanum lycopersicum* L.)

***Lav Kumar*[1*] *and G.C. Yadav*[2]**

[1]*Research Scholar, Department of Vegetable Science,*
Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (Uttar Pradesh), India.
[2]*Professor and Head, Department of Vegetable Science,*
Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (Uttar Pradesh), India.

(Corresponding author: Lav Kumar)*
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ABSTRACT: The present experiment was carried out to investigate the 55 genotypes (45 F1 and 10 parental lines) of tomato (*Solanum lycopersicum* L.) in a field trial at Experimental Station, Department of Vegetable Science, A.N.D. University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.). The treatments were arranged in a set of ten parental lines and their F_1developed by the diallel cross was later evaluated in a randomized block design and maintained three replications for each treatment in the year 2020-21 and 2021-22. The superiority of F_1 determines by the high estimate of heritability in narrow-sense (>30), which showed by the parameters including plant height, primary branch, total soluble sugar and non-reducing, in both experimental years as well in pooled whereas expected gain or high genetic advance in per cent of mean (>20%) was observed for total fruit yield per plant, marketable fruit yield per plant, locules per fruit, average fruit weight, fruit per plant, primary branch, plant height, days to 50 % flowering in both the years. High estimates of heritability with high genetic advance as per cent of mean provides a clear picture to the breeders for improvement during the process of selection. This investigation suggested that the selection of the high heritability (narrow sense) coupled with high genetic advance as per cent of the mean would be highly effective and efficient characters.

Keywords: Tomato, *Solanum lycopersicum* L., heritability, narrow sense, genetic gain.

INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is considered the Solanaceous crop which belongs to the family Solanaceae and originated from Western Southern America (Rick *et al.*, 1976). The plants are herbs in nature, grown annually and a size a meter tall. The tomato plants have a well-developed tap root system. The plants are self-pollinated, day-neutral plants and bloom in complete or perfect and hypogynous flowers with compound inflorescence in four to eight flowers in each cluster. The tomato plants closely resemble wild cherry tomatoes. The farmers cultivated both determinate and indeterminate types of variety of tomatoes. The determinate variety of tomatoes is bushy in nature and gives a one-time full yield as well as a specific height, whereas indeterminate, didn't have a specific height as well as gives a continuous yield of the fruit and flowers. The tomato plants are a significantly more important crop for the poor people also known as Poormen's fruit due to their wider adaptability and versatility as well as a 'Protective Food'. The fresh fruit of tomato is consumed by most people throughout the country due to its rich source of vitamins, minerals and organic acid. They estimated that a hundred grams of mature tomato contain 94 g moisture, 3.6 g carbohydrates, 0.9 g protein, 0.2 g fat, 585 IU Vitamin A, 48 mg calcium, 26 mg Vitamin C and Vitamin B (Thiamine 0.12 mg and Riboflavin 0.06 mg) (Choudhary *et al*., 2009).

In addition, to fulfil the demand of the locals, the tomato has also been consumed as a potential vegetable for export by the APEDA. In India, total area was 825 million hectares with production 20148 million tonnes and 25.42 tonnes per hectare productivity (NHB database, 2020-2021). In the international market generally, medium size, round, red colour of cherry tomato is preferred for trade. In the world, it ranks is the first among of all canned vegetables (Rashid, 1999). At the present time, production of tomatoes has increased via improved or hybrid varieties cultivation. The efforts made by many vegetable breeders to increase influential improvements in yield attributing and other quality characteristics. Resulting of such efforts are allowed to make new cultivars to meet food demand and to face changing climatic conditions. Thus, additional improvement in yield is essential to feed the ever-increasing population in future. Valuable information on heritability and heterosis can be easily obtained. It also helps in the selection of suitable parents for hybridization. Heritability and genetic advance help in determining the influence of the environment in expression of the characters and the effect to which improvement is possible after selection.

MATERIAL AND METHODS

The field experiment contained a hybrid population of 45 crosses developed by parents of tomato *viz*., NDT-4, NDT-5-, NDT Sel-3, NDT-P-1, NDT Sel-1, NDT Sel-2, 2012/ TOLCV Res-1, 2019/TOLCV Res-2, 2019/TOLCV Res-4, 2019/TOLCV Res-6. The 10 parental and their 45 hybrids were grown in a Randomized Complete Block Design (RBD) with three replications during *Rabi* 2020-21 and 2021-2022 at the Experiment Station of the Department of Vegetable Science, Acharya Narendra Deva University of Agriculture and Technology, Narendra Nagar, Kumarganj, Ayodhya (U.P.) India. In the cultivation, for each hybrid and parent, the spacing was maintained at 0.60 meters from row to row and 0.50 meters from plant to plant. In each replication, 12 plants were maintained in both years and followed recommended cultural practices. The observation was recorded on 5 randomly selected plants from each plot based on days to 50% flowering, days to first fruit harvest, plant height (cm), number of primary branches per plant, number of fruits per cluster, number of fruits per plant, average fruit weight (g), pericarp thickness (mm), number of locules per fruit, polar diameter (cm), equatorial diameter (cm), total fruit yield per plant (kg), marketable fruit yield per plant(kg), total soluble solids (TSS), titrable acidity (%), ascorbic acid content (mg/100g), reducing sugar (mg/100g), non-reducing sugar (mg/100g) and total sugar (mg/100g). The data were statical analysed for45 F_1's and 10 parents on nineteen characters to estimate the nature and magnitude of heritability in a narrow sense (Kempthorne, 1957) and genetic advance in per cent of mean (Johnson *et al.,* 1955).

RESULT AND DISCUSSION

The significance of heritability is considered one of the important bases for breeding which indicates the opportunity and degree of improvement selection (Robinson, 1964). Meena *et al.* (2014) reported that high heritability and genetic gain, have been showing additive gene action which is considered more authenticate for effective selection. In the current study, the aim of estimation of nature and magnitude of heritability in a narrow sense is significant to decide the phenotypic differences among observed individuals due to their genetic changes or environmental effect. Heritability indicates the opportunity and extent brought improvement through selection while genetic advance in per cent of the mean is the product of heritability and selection differential represented in terms of the phenotypic standard deviation. Heritability and genetic advance parameters were used in direct selection. Heritability estimates with selection differential indicate the expected genetic gain. Our results, based on heritability and genetic advance per cent of a mean of nineteen characters in Y_1, Y_2 and pooled were represented in Table 1. The results indicated that the nature and magnitude of heritability differed for different characters and over seasons. The estimates of heritability in narrow-sense (h2ns) have been categorised by Crumpacker and Allard (1962) into three categories *viz.*, high (> 30%), medium (10-30%) and low (<10%). Our results said that a high estimate of heritability in a narrow sense was documented for primary branches per plant followed by plant height, total soluble solid and non-reducing sugar in both the years and pooled. Consequently, additive components are prime in the traits with high heritability.

Table 1: Heritability (ns&bs) and genetic advance in tomato over two seasons (Y_1, Y_2) and pooled.

Sr. No.	Parameters Characters	Heritability in narrow sense (%)			Heritability in broad sense (%)			Genetic advance as per cent of mean		
		Y1	Y2	Pooled	Y1	Y2	Pooled	Y1	Y2	Pooled
1.	Days to 50% flowering	15.1	17.32	16.87	91.83	94.77	31.3	20.85	21.98	8.35
2.	Days to first fruit harvest	14	11.91	14.11	92.11	91.34	23.07	17.39	17.08	5.23
3.	Plant height (cm)	71.29	70.94	72.83	95.03	97.08	67.6	38.46	39.29	29.28
4.	Primary branches per plant	82.58	73.82	80.64	93.4	92.17	59.61	30.49	27.82	21.32
5.	No. of fruit per plant	8.54	8.71	8.52	95.39	96.15	30.45	27.47	26.32	9.54
6.	Average fruit weight (g)	10.46	10.41	11.18	89.23	94.33	28.85	20.11	22.67	8.18
7.	Pericarp thickness (mm)	14.25	12.75	13.45	74.78	88.7	22.06	9.83	15.54	4.85
8.	No. of locules per plant	13.62	12.89	14.07	94.05	94.16	32.47	21	20.55	8.22
9.	Fruit per cluster	20.27	21.03	26.81	71.03	70.03	16.25	12.18	12.02	4.74
10.	Polar diameter (cm)	13.39	13.31	13.97	94.03	93.54	25.84	19.93	19.03	6.27
11.	Equatorial diameter (cm)	14.61	15.36	18.88	79.11	76.12	19.33	8.07	7.66	3.07
12.	Marketable fruit yield per plant (Kg)	24.73	13.89	20.45	89.05	77.66	28.45	27.04	21.35	11.53
13.	Total soluble solid (%)	42.85	36.25	42.8	86.17	82.58	34.06	18.19	16.08	9.38
14.	Tritable acidity (%)	7.31	5.8	7.25	70.67	87.2	15.35	8.33	15.11	3.4
15.	Ascorbic acid content (mg/100g)	11.41	10.08	17.53	35.72	32.79	8.57	1.3	1.51	0.92
16.	Reducing sugar (mg/100g)	20.23	23.7	24	82.22	77.71	21.74	9.57	9.13	3.56
17.	Non-reducing sugar (mg/100g)	32.23	32.43	35.23	86.95	87.84	28.91	14.77	14.68	6.42
18.	Total sugar (mg/100g)	22.97	21.64	26.2	72.06	85.55	26.12	7.27	9.34	4.24
19.	Total fruit yield per plant (Kg)	18.57	15.28	17.59	94.15	91.83	32.43	31.29	29.65	12.55

The results for a high estimate of narrow sense heritability for different tomato traits have been obtained by Ghobary and Ibrahim (2010); Hasanuzzaman *et al.* (2012); Shalaby (2013); Meena *et al.* (2014); Amaefula *et al.* (2014); El-Gabry *et al.* (2014); Basfore *et al.* (2020); Kumar *et al.* (2020); Singh *et al.* (2020). Moderate heritability was recorded in fruit per cluster followed by total sugar and reducing sugar in both the years and pooled, while marketable fruit yield per plant recorded moderate heritability in Y_1 and Polled, but low in Y_2. These results were in agreement with those reported by Ghobary and Ibrahim (2010); Singh *et al.* (2011); Hasanuzzaman *et al.* (2012); Akhtar and Hazra (2013); Kumar *et al.* (2020); Saleem *et al.* (2009); Singh *et al.* (2011); Ahirwar *et al.* (2013); Meena *et al.* (2014); Meitei *et al.* (2014); Ahmad *et al.* (2017). Only two traits *viz.*, number of fruits per plant and titrable acidity showed low heritability in both years and pooled. Our results were supported by Hazra and Ansary (2008); Saleem *et al.* (2009) ; Kumar *et al.* (2020) in which a low estimate of narrow sense heritability for different tomato traits has been observed. High heritability in narrow-sense (h2ns) coupled with high genetic advance as per cent of mean was showed by plant height, and primary branch per plant in both years and pooled. Total fruit yield per plant, marketable yield, average fruit weight, number of locules per plant and days to 50% flowering in Y_1 and Y_2 and none of the traits were observed high heritable as well as high genetic advance as percent of mean in pooled. High heritability combined with high genetic advance indicates that additive gene action plays a significant role in leading these traits and it is improved by simple selection. The same observation was recorded by earlier workers (Rani *et al.*, 2011; Patel *et al.*, 2013; Meitei *et al.*, 2014; Doddamani *et al.*, 2017; Bhandari *et al.*, 2017; Singh *et al.*, 2020; Basfore *et al.*, 2020; Kumar *et al.*, 2020).

CONCLUSIONS

Our study suggested that the high heritability (narrow sense) coupled with high genetic advance as per cent of mean reflected that traits primary branches per plant and plant height were governed by additive gene action and therefore, selection may be highly effective for the above-recorded characters.

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Conflict of Interest. None.

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