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SCREENING OF GERMPLASM FOR QUALITY AND YIELD TRAITS IN TOMATO (*SOLANUM LYCOPERSICUM* L.)

VIKTESH CHANDRA PANDEY [1], C. N. RAM[1]* CHANDRA DEO[1], S. K. CHAKRAVARTI[2] AND JEETENDRA KUMAR RAO
[1]Department of Vegetable Science, N.D.U.A & T, Kumarganj, Faizabad, (U.P.), INDIA
[2]Krishi Vigyan Kendra, Haidergar, Barabanki (N.D.U.A & T, Kumarganj, Faizabad U.P.), INDIA
e-mail: cnram2007@rediffmail.com

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***Corresponding author**

ABSTRACT
The present study was planned and executed during crop seasons of 2012-2013at Vegetable Research Farm, N.D.U.A &T. The experiment material consisted forty eight genotypes of tomato including three determinate checks (H-86, PbChhuhara and ArkaVikas) collected from different location of India.The observations were recorded on yield and quality traits to generate information regarding the extent of variability, heritability and genetic advance for nine quantitative characters, estimate correlation coefficients among the important economic traits. High GCV range from 8.7- 43.04and PCV ranging from 8.89- 43.05 were observed for all the traits, except50% flowering i.e. 4.1 and 3.6, GCV and PCV, respectively. High heritability were also reported for all the traits ranging from 74.4- 99.54%.Fruit yield per plant followed by average fruit weight, number of locules per fruit, number of fruits per plant and plant height were showed high level of genetic advance indicating opportunity for better selection response.The above results are very promising for advancing in tomato breeding.

INTRODUCTION

Tomato (*Solanumlycopersicum* L.) is most prominenetly grown vegetable crop and consider as a protective food in world. Due to its high nutritive value and wide spread production in several agro climatic conditions it has an important role in the economy of human societies (Meena *et al*., 2014). Commercially and dietary it is very important crop. It's area is expanding day by day because of its short duration growing period and high yielding vegetable(Pedapati *et al.,* 2013). Tomato has very prestigious position from the plate of poor to kitchen of rich man due to its value added products and diversenutritious values. It is designated as poor man's orange due to its richness in vitamin 'C' and nutritive measure (Giovannoni, 2001).

It is well known fact that for desirable selection, variability in germplasm prior knowledge of genetic association of yield with other component traitsis prerequsite. However, it is only genetic variation which is heritable hence important. Therefore, direct selection for yield alone is usually not very effective or may often Bemis leading. Hence, selection based on its contributing characters could be more efficient and reliable (Kumar *et al.,* 2012). Keeping the above facts in mind, present investigations was carried out to examine the existence of genetic variability, to establish such fundamental genetic facts as heritability and to determine the relative important traits so that feasibility of developing extraquality lines with high yield in tomato can be developed.

MATERIALS AND METHODS

Present investigation was conducted at the Vegetable Research Farm, Narendra Dev University of Agriculture and Technology, Kumarganj,Faizabad,UttarPredesh, India, during 2012-2013. The experiment was conducted to evaluate 48 genotypes of tomato. Seeds were sown innursery bed, 30 days old healthy seedlings were transplanted in the experimental field in two rows of 3 m length with interand intra row spacing of 60 and 50 cm, respectively. Three check varieties (PbChhuhara, H-86 and Arka Vikas) along with 45 genotypes were planted in two rows, keeping twelve plants in each row.The 48 genotypes were planted in Randomized Block Design with three replications. All the recommended cultural practices were followed to maintain good crop stand and growth of the plants. Data were recorded for nine characters *viz*days to 50 per cent flowering, plant height(cm), number of primary branches per plant, number of locules per fruit, pericarp thickness (mm),average fruit weight (g), total soluble solids, number offruits per plant, fruit yield per plant (kg).

Analysis of variance was done by the method suggested by Panse and Sukhatme (1985). The genotypic and phenotypic coefficients of variation were calculated using the formulae of Burton and De Vane (1953). Heritability and genetic advance were calculated according to Allard (1960) and genetic advance as per cent of mean was estimated using the method of Johnson *et al*. (1955).

RESULTS AND DISCUSSION

The analysis of variance expalined that all the characters dispalyed highly significant difference among the genotypes, which was manifested from the higher range for all the characters (Table 1).The mean performance of 48 genotypes including checks for nine characters of tomato were recorded (Table 2). A very wide range of variations in mean performance of genotypes were observed for all the characters understudy. The mean performance of 19 genotypes widely ranged for all studied characters(Reddy *et al.* 2013).The genotypes NDT-15 (1.67), NDTG-22 (1.32) and NDT-8 (1.27) gave significantly higher yield as compared to other genotypes as well as check varieties. The high yielding genotype NDT-7 also showed high mean performance for average fruit weight, number of fruits per plant and number of primary branches per plant. Other entries with higher fruit yield per plant were NDTG-35 (1.18), NDT-4(1.09) and NDT-5(1.08). These genotypes also showed high mean performance for one or other characters besides having higher yield. Earlier studies by Meena *et. al.* (2015) also concluded in his studies that the high yielding genotypes may be considered in varietal improvement programmes of tomato for desired characters

Variability is a very important and essential pre-requisite in any breeding programme and such variability will be driving force for improving the crop plants (Kumar *et al.* 2012). In general, the phenotypic coefficients of variation were higher than genotypic coefficients of variation for all the nine characters under study which indicates that environment played a considerable role in the expression of these traits (Table 3). The high estimates of PVC and GCV for these characters. The range of variability of different traits alone does not allow a decision as to which character was showing the highest degree of variability. Therefore, accurate relative comparison can be made with the help of phenotypic and genotypic coefficients of variation. Phenotypic variation was partitioned into genotypic and environmental components.The estimates of GCV and PCV respectively were high (>30%) for fruit yield per plant (43.05 and 43.04) followed by average fruit weight

Table 1: Analysis of variance (mean sum of squares) for nine characters in tomato

S. No.	Characters	Source of variation		
	d.f.	Replications	Treatments	Error
		2	47	94
1.	Days of 50 per cent flowering	0.00	13.72**	1.41
2.	Plant height (cm)	1.96	2365.81**	10.43
3.	Number of primary branches per plant	0.04	3.71**	0.034
4.	Number of locules per fruit	0.00	3.37**	0.01
5.	Pericarp thickness (mm)	0.02	2.36**	0.04
6.	Average fruit weight (g)	5.29	1045.16**	2.00
7.	Total Soluble Solids (TSS)	0.001	1.09**	0.01
8.	Number of fruits per plant	0.03	14.31**	0.93
9.	Fruit yield per plant (kg)	0.00	o.27**	0.00

*, ** Significant at 5 % and Highly significant at 1 % probability level.

Table 2: Mean performances for nine characters in tomato

S.No	Character Genotypes	Days to 50% Flow ering	Plant height (cm)	Primary Branches /plant	Pericarp Thickness (mm)	Locules / Fruit	Total Soluble Solids (T.S.S. %)	Fruits/ Plants	Average) Fruit Weight (gm)	Fruit Yield/ Plant (kg)
1	NDTG-9	55.67	62.33	3.47	3.5	3.37	6.9	14	50	0.64
2	NDTG-27	56.67	118.67	4.6	4.23	4.2	7.37	14.1	28.67	0.32
3	NDTG-42	57.33	110.67	3.57	3.73	2.63	7.3	15.23	28	0.38
4	NDTG-33	55.33	127.67	5.53	4.3	3.17	7.05	15.5	50.93	0.68
5	NDTG-32	55.33	77.22	3.43	4.1	2.3	7.18	17.1	32.2	0.49
6	NDTG-37	56.33	57.79	4.63	3.6	2.73	6.59	16.83	61.67	0.99
7	NDTG-39	60.33	95	3.33	2.6	3.27	7.07	15.2	73.33	1.08
8	NDTG-38	56.33	73.33	3.37	3.63	2.4	7.53	15.87	29	0.38
9	NDTG-36	59	88	4.43	5.07	2.17	7.63	17.07	49.9	0.77
10	Pb.Chhuhara	54	75	3.67	4.9	2.1	7.1	17.5	29.33	0.4
11	NDT-1	51.67	73.33	3.2	4.5	3.63	7.47	17.67	77	1.07
12	NDT-2	52	59	5.17	4.2	2.5	7.17	14.97	56.67	0.78
13	NDT-3	54.33	57.33	5.67	4.5	3.2	6.6	16.17	34.67	0.49
14	NDT-4	53.67	91.67	6.4	3.03	5.5	6.53	16.37	77.67	1.09
15	NDT-5	57	104	4.47	3.03	4.57	6.2	19.97	60.33	1.08
16	NDT-6	54.33	71.67	3.37	3.03	4.03	5.57	16.8	58.33	0.99
17	NDT-7	55.33	67.33	6.3	3.63	2.63	6.83	21.97	78.67	1.67
18	NDT-8	53.67	59.37	4.5	2.7	3.03	5.87	17.43	74.67	1.27
19	NDTG-35	56	56.67	3.47	4.13	2.2	6.27	16.4	31	0.4
20	NDTG-34	55	62	4.23	2.73	2.07	6.13	15.93	31.33	0.41

Table 2: Cont....

S.No	Character Genotypes	Days to 50% Flow ering	Plant height (cm)	Primary Branches/ plant	Pericarp Thickness (mm)	Locules/ Fruit	Total Soluble Solids (T.S.S. %)	Fruits/ Plants	Average Fruit Weight (gm)	Fruit Yield/ Plant (kg)
21	NDTG-14	56.67	51	3.63	2.67	4.07	6.09	16.03	48.93	0.68
22	NDTG-31	59	62.33	3.37	3.8	2.4	6.6	16.67	22	0.48
23	NDTG-43	57	52.07	4.27	3.1	3.53	7.4	16.87	79.67	1.18
24	NDTG-23	56	72.67	5.53	2.63	5.07	5.17	17.83	65	0.98
25	NDTG-21	56.67	78.33	5.37	5.47	2.17	7.2	16.27	57.17	0.76
26	NDTG-24	55.33	117.67	3.47	3.17	2.1	7.43	13.9	39	0.49
27	NDTG-10	59	53.33	4.23	2.17	3.03	6.43	16.67	39.67	0.57
28	NDTG-16	59.33	46.33	6.37	4.07	2.3	7.5	19.87	31.33	0.59
29	NDTG-13	60.33	58.33	6.4	2.23	3.23	6.54	20.5	32	0.58
30	NDTG-12	60	68	5.3	3.17	2.63	7.15	18.07	31.67	0.51
31	NDTG-41	59	71.67	3.3	4.17	2.43	7.07	15.77	32.33	0.41
32	NDTG-28	58	126.33	3.4	4.17	5.07	7.25	14.97	64	0.78
33	NDTG-29	56.33	135	4.4	5.97	2.1	7.03	17.33	54.5	0.87
34	H-86	53.67	119.33	3.5	4.5	4.17	6.13	15.67	68.33	0.98
35	NDTG-40	55.67	77.67	4.4	4.43	4.73	7.47	17.27	50.33	0.79
36	NDTG-19	55	49	3.33	3.1	4.2	7.07	16	38	0.58
37	NDTG-12	55	49.67	4.2	4.3	5.53	7.47	17.7	29.67	0.48
38	ArkaVikas	54.67	94.33	4.5	3.63	2.5	7.2	17.17	29	0.59
39	NDTG-17	55	112	6.43	2.43	2.77	7.1	20.97	21.33	0.39
40	NDTG-15	56.67	60.27	4.27	5.03	3.17	6.93	18.17	25.33	0.4
41	NDTG-20	56	58.33	7.07	2.1	2.1	7.57	25.23	15.33	0.29
42	NDTG-11	59	58	6.4	3.57	3.43	7.33	19.87	39	0.67
43	NDTG-18	60.33	72	5.4	3.77	2.27	7.53	19.03	29	0.49
44	NDTG-25	56	108.67	6.47	5.07	2.03	6.27	20.4	49.23	0.81
45	NDTG-22	55.33	121.33	4.53	3.63	5.17	6.47	17.27	89.33	1.32
46	H-24	54.33	96	4.07	4.1	4.5	6.1	15.03	46.67	0.61
47	NDTG-26	54	130.33	5.6	4.07	3.4	7.53	18.87	31.67	0.49
48	NDTG-30	54.33	155.33	5.2	3.17	5.03	5.73	17.63	50.33	0.78
	Mean	56.19	82.15	4.61	3.73	3.27	6.86	17.27	46.32	0.71
	C.V.	2.11	3.93	4.06	5.56	3.59	1.48	5.6	3.06	0.88
	F ratio	9.73	226.69	106.12	55.27	245.37	106.48	15.32	521.12	195.09
	F Prob.	0	0	0	0	0	0	0	0	0
	S.E.	0.69	1.87	0.11	0.12	0.07	0.06	0.56	0.82	0
	C.D. 5%	1.93	5.24	0.3	0.34	0.19	0.16	1.57	2.3	0.01
	C.D. 1%	2.55	6.94	0.4	0.44	0.25	0.22	2.08	3.04	0.01
	Range Lowest	51.67	46.33	3.2	2.1	2.03	5.17	13.9	15.33	0.29
	Range Highest	60.33	155.33	7.07	5.97	5.53	7.63	25.23	89.33	1.67

Table 3: Estimates of range, grand mean, phenotypic and genotypic coefficients of variation, heritability in broad sense(h^2_{bs}) and genetic advance in per cent of mean (GA) for nine characters in tomato

S.No.	Genetic parameters Characters	Range Lowest	Highest	Grand mean	PCV (%)	GCV (%)	ECV (%)	Heritability in broad sense(%) (h^2_{bs})	Genetic advance	Genetic advance in per cent of mean
1.	Days of 50 per cent flowering	51.67	60.33	56.18	4.18	3.60	2.11	74.40	3.60	6.40
2.	Plant height (cm)	46.33	155.33	82.15	34.33	34.10	3.93	98.70	57.34	69.79
3.	Number of primary branches per plant	3.20	7.066	4.60	24.37	24.03	4.05	97.20	2.24	48.81
4.	Number of locules per fruit	2.03	5.53	3.26	32.57	32.37	3.58	98.80	2.16	66.29
5.	Pericarp thickness (mm)	2.10	5.96	3.72	24.28	23.63	5.55	94.80	1.76	47.40
6.	Average fruit weight (g)	15.33	89.33	46.31	40.37	40.26	3.05	99.40	38.30	82.69
7.	Total Soluble Solids (TSS)	5.16	7.63	6.85	8.89	8.77	1.47	97.20	1.22	17.81
8.	Number of fruits per plant	13.90	21.96	17.27	13.44	12.22	5.59	82.70	3.95	22.90
9.	Fruit yield per plant (kg)	0.29	1.66	0.70	43.05	43.04	0.87	99.54	0.62	88.65

(46.31and 40.26), plant height (34.33 and 34.10) and number of locules per fruit (32.57 and 32.37)while moderate (20-30%) for number of primary branches per plant (24.37 and 24.03) and pericarp thickness(24.28 and 23.63); and low (<20%) for number of fruits per plant (13.44 and12.22), TSS (°Brix) (8.89 and 8.77) and days of 50 per cent flowering(4.18 and

3.60). These reported results of high, and moderate to high GCV and PCV for these characters were also observed earlier by Manna and Paul (2012). Lowes timates of GCV and PCV for TSS were earlier reported by Prema *et al*. (2011).

Heritability in broad sense of a character is important to the breeder since it indicates the possibility and extent to which improvement is possible through selection. It also indicates direction of selection pressure to be applied for the traits during selection because it measures relationship between parent and their progeny, widely used in determining the degree to which a character may be transmitted from parent to offspring. However, high heritability alone is not enough to make efficient selection in advanced generations unless accompanied by substantial amount of genetic advance (Burton, 1952). High estimates of heritability along with high genetic advance provides good scope for further improvement in advance generations (Saxesena *et al*. 2014). The result of present investigation (Table 3) revealed that low to high heritability estimates were present in almost all the characters. The heritability estimates for different characters ranged from 74.40%(days of 50 per cent flowering) to 99.54%(yield per plant). High heritability were recorded for fruit yield per plant (99.54%), average fruit weight (99.40%), number of locules per fruit (98.80%), plant height (98.70%), number of primary branches per plant (97.20%), TSS(97.20%),pericarp thickness(94.80%) and number of fruits per plant(82.70%). However, days to 50 per cent flowering (74.40%) showed moderate level of heritability.The results observed in present investigation were in agreement with the findings of Manna and Paul (2012) and Reddy *et al*. (2013). It was obvious that improvement of the character exhibiting high heritability would be more efficient by adopting normal selection procedures and for those having lower value, some other suitable breeding techniques, like population improvement programme would have to be adopted.

The genetic advance is commonly predicted as a product of heritability ratio and selection differentials. Panse (1967) mentioned that high heritability value is accompanied by high genetic advance. The progress realized by selection would be most appropriate. In the present study, the value of genetic advance aspercent of mean (genetic gain) ranged from 6.40 (Days of 50 per cent flowering) to 88.65 (Fruit yield per plant) (Table 3). The highest estimates of genetic advance observed in plant height (57.34) and average fruit weight (38.30). earlier studies on the heritability and genetic advance concluded the similar results with the studied traits (Manna and Paul, 2012 and Reddy *et al*. 2013).Therefore, this report indicated that the secharacters are under additive gene effects and more reliablefor effective selection.

From the foregoing results it can be said that characters showing high heritability coupled with high genetic advance in per cent of mean were recorded for fruit yield per plant, average fruit weight, plant height and number of locules per fruit indicating that these traits were less influenced by environment and could be exploited for improvement thorough selection and proved as important components of fruit yield. The selection based on these characters may exploited indevelopment of high yielding genotypes.

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