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Original Research Article

Genetic Studies of Wild and Cultivated Tomato (*Solanum lycopersicum* L.) Genotypes

Radhe Shyam Kherwa*, S. S. Solankey, Shirin Akhtar, Amit Kumar and Ritu Kumari

Department of Horticulture (Vegetable& Floriculture), Bihar Agricultural College, Bihar Agricultural University, Sabour, Bhagalpur-813210, Bihar, India
**Corresponding author*

A B S T R A C T

Twenty-nine tomato genotypes (including cultivated and wild species) were evaluated for genetic variability, heritability and genetic advance attributes at Vegetable Research Area, Bihar Agriculture University, Sabour, Bhagalpur (Bihar) during Autumn-Winter Season, 2015-17. Observations were recorded on thirteen characters *viz.*, days to first flowering, days to 50 percent flowering, days to first fruit set, plant height (cm), average fruit weight (g), equatorial fruit diameter (cm), polar fruit diameter (cm), number of fruits per plant, number of primary branches, pericarp thickness (mm), number of locules per fruit, yield per plant (kg), fruit yield (q/ha). high magnitude of phenotypic as well as genotypic coefficients of variation (GCV) were observed in case of average fruit weight (g) followed by number of locules per fruit, pericarp thickness, equatorial fruit diameter (mm) and total fruit yield (q). Days to 50 per cent flowering exhibited low level of variability. High heritability coupled with high genetic advance were estimated for all the traits except for days to first flowering, days to 50 per cent flowering and days to first fruit setting. The species of tomato *S. pimpinellifolium* is an important donor for improving of quality and yield of cultivated genotypes.

Keywords

Tomato, Genetic variability, Heritability, GCV

Introduction

Tomato (*Solanum lycopersicum* L.) is an important member of Solanaceae family having chromosome number 2n = 2X = 24. It is originated in South America and is grown in almost every corner of the world (Roberston and Labate, 2007). Tomato is one of the most important warm season fruit vegetable and is one of the most popular and widely grown vegetable in India and World. It was known as Poma amoris- Amorphus Apple or Love apple and Poma peruviana – apple of Peru. Tomato is typical day neutral plant and is mainly self-pollinated, but a certain percentage of cross pollination also occurs. Tomatoes are important source of lycopene (an important antioxidant), ascorbic acid, β-carotene and minerals like Ca, P and Fe (Saleem *et al*., 2013). India is known for diverse genotypes of tomato. Identification of superior genotypes among the existing germplasm becomes extremely important for future breeding programme. In tomato the wild species *S. pimpinellifolium* is easily crossable and very much useful donor for improving of quality, disease and yield. The development of an effective breeding programme depends upon the existence of genetic variability and diversity

for yield and yield attributing components.

Like other self-pollinated crops, tomato also needs attention to make improvement in its current cultivars. While initiating our breeding programme we should have knowledge of existing genetic variability in order to develop high yielding varieties (Reddy *et al*., 2015). Assessment of genotypic and phenotypic variability regarding yield and its components become absolutely indispensable before planning an appropriate breeding strategy for genetic improvement (Sunday *et al.*, 2014). There is also need to evaluate genetic resources properly to understand and estimate the genetic advance and heritability. The individual characteristics are measured quantitatively, so that by doing variance analysis we may partition variability into heritable and non-heritable traits with the help of genetic parameters such as genotypic co-efficient of variation (GCV), heritability and genetic advance (Osekita and Ajai, 2013). Genetic advance which estimates the degree of gain in a trait obtained under a given selection pressure is an important parameter that guides the breeder in choosing a selection programme (Hamdi *et al*., 2003). High heritability and high genetic advance for a given trait indicates that, it is governed by additive gene action and consequently provides the most effective condition for selection (Tazeen *et al*., 2009).

Materials and Methods

The experimental materials consisted of 29 tomato genotypes along with one F_1 commercial check i.e. BSS- 488 and these were laid out in Randomized Block Design (RBD) with 3 replications. Transplanting was done at the spacing of 60 × 60 cm. Data were recorded for 13 morphological characters *viz.* days to first flowering, days to 50% flowering, days to first fruit set, plant height (cm), average fruit weight (g), equatorial fruit diameter (cm), polar fruit diameter (cm), number of fruits per plant, number of primary branches, pericarp thickness, number of locules per fruit, fruit yield per plant (kg) and total fruit yield (q/ha). Analysis of variance was done based on RBD for each of the characters separately. The phenotypic and genotypic coefficient of variance was estimated according to, Johnson *et al*. (1955) and Al-Jibouri *et al*. (1958). Heritability in broad sense was estimated according to Lush (1940) and genetic advance was estimated as per Lush (1949).

Results and Discussion

All the characters were highly significant in analysis of variance of experiment (Table 1). Moreover, the mean performance of 29 tomato genotypes for 13 characters presented in Table 2. A very wide range of variations in mean performance of genotypes were observed for all characters. The comparison of mean performance of twenty-nine genotypes for thirteen traits using critical differences revealed existence of very high level of variability in the used genotypes.

The genotypic and phenotypic coefficients of variation were computed to assess the exiting variability in the germplasm (Table 3). The estimates of highest phenotypic as well as genotypic coefficient of variation were observed for average fruit weight (g), while lowest magnitude of variability was exhibited for days to 50 per cent flowering. Dar and Sharma (2011) also reported the high estimates of PCV and GCV for these characters. Moderate variations were noted in case of locules per fruit, pericarp thickness, equatorial fruit diameter (mm) and total fruit yield. However, low GCV and PCV were observed for days to 50 per cent flowering. Moderate and low variability

were also reported by, Singh *et al.* (2015) and Prajapati *et al*. (2015).

The highest estimates of heritability were observed in case of pericarp thickness and number of locules per fruit. Highest genetic advance in per cent of mean was observed for average fruit weight (g)**.** Heritability in broad sense ranged from 39% (days to first flowering) to 99% per cent (pericarp thickness). Higher estimates of heritability (>60%) were recorded for nine characters *viz*. total fruit yield (81%), fruit yield/ plant (kg), average fruit weight (95%), plant height (90%), number of primary branches (91%), polar fruit diameter (96%), equatorial fruit diameter (97%), number of locules per fruit (98%), pericarp thickness (99%), while medium (>30%) estimates for number of fruits per plant (57%), days to first fruit setting (43%), days to 50% flowering (47%) and days to first flowering (39%). Higher value of genetic advance was recorded for average fruit weight (g) (49.03%) followed by number of locules per fruit (48.40%). In general the degree of success in selection depends upon the magnitude of the heritability. Furthermore the progress in the selection is also directly proportional to the amount of genetic advance. Therefore, the effect of selection is realized more quickly in those characters which have high heritability as well as high genetic advance.

Table.1 Analysis of variance for 24 morphological characters in tomato

Sl. No.	Characters	Mean Sum of Squares		
		Replication (df= 2)	Treatment (df= 27)	Error (df= 54)
1	Days to First Flowering	0.46	23.93*	8.12
2	Days to 50% Flowering	4.30	29.03**	7.56
3	Days to First Fruit Set	4.08	34.56**	10.71
4	Plant Height (cm)	2.01	611.13**	23.18
5	Primary branches/plant	0.28	8.26**	0.26
6	Polar fruit diameter(cm)	0.02	1.76**	0.02
7	Equatorial fruit diameter (cm)	0.05	2.24**	0.03
8	Average Fruit Weight (g)	16.41	370.13**	6.03
9	No.of Fruits/ Plant	30.27	56.26**	12.03
10	Fruit Yield/ Plant (kg)	0.04	0.35**	0.03
11	Total Fruit Yield (q/ha)	2949.43	27414.26**	1947.90
12	Locules/ fruit	0.01	1.34**	0.01
13	Pericarp Thickness	0.00	2.99**	0.01

*' **Significant at 5 % and Significant at 1 % level of significance, respectively.

Table.2 Mean performance of 29 tomato genotypes for 13 morphological characters

Genotypes	DFF	D50%F	DFFS	NLPF	PH (cm)	PB /P	PFD (cm)	EFD (cm)	PT	AFW (g)	NFPP	FYPP(kg)	TFY(q/ha)
Pusa Rohin×H-86	47.00	58.33	60.33	2.77	101.80	8.75	3.38	3.99	4.98	54.01	36.10	1.94	540.42
Pusa Rohin×CLNB	49.33	61.00	63.33	2.13	83.30	5.84	4.99	5.18	6.42	38.45	37.67	1.44	401.37
Pusa Rohin×Arka Ahuti	56.00	70.33	71.33	4.10	92.36	5.99	4.20	5.74	3.15	41.29	35.65	1.47	407.86
Pusa Rohin×ArkaVikas	53.00	65.33	66.00	2.20	99.32	7.64	5.05	5.67	5.07	54.03	39.27	2.12	590.30
Pusa Rohin×Arka Abha	52.67	67.00	67.33	2.17	92.41	5.66	4.99	5.37	5.86	40.58	42.21	1.71	475.39
PusaRohin×*S.pimpinellifolium*	54.67	67.00	69.67	2.10	107.76	9.78	3.78	3.74	4.20	37.25	37.77	1.40	388.42
H-86×CLNB	48.00	60.00	61.33	4.00	72.64	7.66	4.09	4.20	4.48	52.11	32.89	1.71	474.63
H-86×Arka Ahuti	53.00	65.00	68.00	2.10	70.65	7.54	5.15	4.23	2.96	58.25	32.03	1.87	518.72
H-86×Arka Vikas	53.33	66.67	69.00	2.73	96.33	10.16	5.85	4.49	7.01	67.42	32.58	2.19	609.17
H-86×Arka Abha	54.33	66.00	70.33	3.77	90.96	9.16	4.95	5.95	3.74	69.13	30.85	2.14	594.13
H-86×*S.pimpinellifolium*	49.67	62.67	65.33	2.30	106.83	10.39	4.09	3.38	2.81	49.16	34.04	1.68	466.04
CLNB×Arka Ahuti	53.00	65.33	68.00	2.23	62.05	7.00	3.22	3.55	4.30	37.97	35.78	1.36	377.15
CLNB×ArkaVikas	49.00	60.33	62.33	2.73	85.01	8.29	5.03	5.24	5.35	37.83	38.26	1.44	400.27
CLNB×Arka Abha	51.67	64.00	66.67	2.20	71.15	5.78	4.43	5.05	3.73	49.54	37.62	1.86	516.24
CLNB×*S.pimpinellifolium*	52.33	65.33	65.67	2.10	98.23	10.19	3.44	3.79	4.33	29.70	42.34	1.26	350.01
Arka Ahuti×ArkaVikas	52.33	67.33	68.67	3.20	98.68	6.91	4.20	3.51	5.70	41.78	40.92	1.71	475.14
Arka Ahuti×Arka Abha	58.33	71.00	73.00	2.40	93.37	6.30	4.08	4.11	4.24	37.58	38.50	1.45	403.81
Arka Ahuti×*S.pimpinellifolium*	52.00	66.00	69.33	2.83	104.24	11.09	3.79	3.07	3.80	37.14	43.71	1.63	452.83
Arka Vikas×Arka Abha	58.33	69.00	71.67	2.70	99.88	9.51	5.33	5.78	5.11	53.34	32.18	1.72	477.34
ArkaVikas×S.pimpinellifolium	51.67	66.00	69.67	3.10	115.08	9.99	3.15	3.68	4.98	44.86	35.05	1.56	434.36
ArkaAbha×*S.pimpinellifolium*	52.67	64.33	65.67	2.90	111.48	11.53	3.80	3.60	4.34	52.48	33.15	1.73	481.25
Pusa Rohini	54.33	65.67	69.33	2.27	92.84	7.20	4.77	5.01	5.78	38.39	32.05	1.23	341.31
H-86	53.67	65.67	68.33	3.90	74.94	9.11	5.13	3.63	4.38	50.23	27.20	1.36	378.77
CLNB	54.33	66.33	68.33	2.40	62.71	8.77	4.94	5.24	5.19	29.05	34.48	1.00	276.86
Arka Ahuti	57.67	70.33	73.67	2.73	94.12	7.29	4.75	3.91	4.75	30.65	32.72	1.00	277.59
Arka Vikash	53.67	65.67	66.00	4.10	89.69	8.62	3.23	4.11	4.34	43.29	30.63	1.32	367.11
Arka Abha	56.33	70.00	73.33	2.10	95.41	8.73	3.67	4.31	4.98	47.10	26.71	1.25	347.89
Solanum pimpinellifolium	53.67	64.67	67.67	3.20	106.04	8.01	3.24	3.35	3.61	21.21	39.21	0.83	229.91
BSS-488	55.00	66.33	69.67	3.20	109.12	8.08	5.05	6.06	4.32	42.39	40.60	1.72	478.41
Grand Mean	53.14	65.61	67.90	2.78	92.36	8.31	4.34	4.45	4.62	44.35	35.59	1.56	432.16
C.V.	5.31	4.19	4.74	3.25	5.20	6.00	3.14	3.95	2.61	5.51	9.60	10.17	10.19
S.E. ±	1.63	1.59	1.86	0.05	2.77	0.29	0.08	0.10	0.07	1.41	1.97	0.09	25.42
C.D. at 5%	4.61	4.50	5.26	0.15	7.85	0.82	0.22	0.29	0.20	4.00	5.59	0.26	72.01

Note, Days to first flowering (DFF), Days to 50% flowering (D50%F) Days to first fruit set (DFFS), Number of locules per fruit (NLPF), Plant height (PH), Polar

fruit diameter (PFD), Equatorial fruit diameter (EFD), Pericarp thickness (PT), Average fruit weight (AFW), Number of fruit per plant (NFPP), Fruit yield per plant (FYPP(kg) and Toatl fruit yield (TFY(q/ha).

Table.3 Genetic performance of 29 tomato genotypes for 13 morphological characters

Sl. No.	Characters	General Mean	GCV (%)	PCV (%)	h^2 (Broad sense) %	Gen. Adv as % of Mean 5%
1.	Days to First Flowering	53.14	4.28	6.82	39	5.53
2.	Days to 50% Flowering	65.61	3.98	5.78	47	5.65
3.	Days to First Fruit Setting	67.90	4.11	6.27	43	5.54
4.	Fruits/ Plant	35.59	10.92	14.54	56	16.90
5.	Fruit Yield/ Plant (kg)	1.56	20.98	23.32	81	38.90
6.	Fruit Yield (q/ha)	432.16	21.01	23.35	81	38.95
7.	Average Fruit Weight (g)	44.35	24.40	25.02	95	49.03
8.	Plant Height (cm)	92.36	15.28	16.14	90	29.80
9.	Primary Branches/ Plant	8.31	19.31	20.22	91	37.98
10.	Polar Fruit Diameter (mm)	4.34	17.53	17.81	97	35.55
11.	Equatorial Fruit Diameter (mm)	4.45	20.17	20.55	96	40.77
12.	Locules/ Fruit	2.78	23.72	23.94	98	48.40
13.	Pericarp Thickness	4.62	21.19	21.35	99	43.34

Where, GCV = Genotypic coefficient of variation, PCV= Phenotypic coefficient of variation, H= Heritabilty, Gen. Adv. = GeneticAdvance

Perusal of data (Table 3) on heritability and genetic advance revealed that high heritability coupled with high genetic advance (>20%) were recorded for all traits except for days to first flowering, days to 50% flowering, days to first fruit setting and number of fruits per plant. Thus, these traits which exhibited high heritability in broad sense and high expected genetic advance as per cent of mean may be considered to be largely governed by additive gene action therefore, it could be effectively improved through selection. High heritability along with high genetic advance have also been reported for most of the yield and yield attributing traits by several workers, Meena and Bahadur (2014), Patel *et al*. (2015), Kathayat *et al*. (2015), Kumar *et al*. (2015).

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