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RESEARCH ARTICLE :

Heritability studies in tomato (*Solanum lycopersicum* L.) for growth, yield and quality

V. RAMANA, D. SRIHARI, R.V.S.K. REDDY, M. SUJATHA AND M.H.V. BHAVE

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SUMMARY : The present investigation to estimate and asses the genetic components of variation *i.e.* genotypic and phenotypic variation, heritability and genetic advance in tomato (*Solanum lycopersicum* L).” for yield and quality was carried out during at Vegetable Research Station, Rajendranagar, Hyderabad to study the genetic parameters in this ten parents (EC-165749, EC-157568, EC-164838, LE-56, LE-62, LE-64, LE-65, LE-66, LE-67 and LE-68) were crossed in diallele mating design (without reciprocals). The resultant 45 F_1's were evaluated along with their parents and two standard checks (Siri and US-618). The genetic variability studies indicated that high estimates of PCV and GCV were obtained for plant height, number of fruits per cluster, average fruit weight, fruit yield per plant, number of locules per fruit, pericarp thickness, ascorbic acid and lycopene content indicated a good deal of variability in those characters signifying the effectiveness of selection of desirable types for improvement. High heritability with high genetic advance as per cent of mean was observed for plant height, number of primary branches per plant, number of fruits per cluster, fruit length, average fruit weight, fruit yield per plant, number of locules per fruit, pericarp thickness, titrable acidity, ascorbic acid content, total sugars and lycopene content. Hence, simple selection based on phenotypic performance of these traits would be more effective.

KEY WORDS :
Tomato, Heritability, Genetic advance

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Author for correspondence :

V. RAMANA
SSPG Horticulture Polytechnic, Madakasira, ANANTHAPURAM (A.P.) INDIA
Email : hortirams@yahoo.co.in

See end of the article for authors' affiliations

BACKGROUND AND OBJECTIVES

Tomato (*Solanum lycopersicum* L.) (2n=2x=24) is one of the most important solanaceous vegetable crops of Peru-Euqador origin (Rick, 1969), especially grown in the tropics and subtropics. In many countries it is considered as “poor man's orange” because of its attractive appearance and nutritive value (Singh *et al.*, 2004). Tomatoes are being used in sandwiches, salads and processed products like paste, puree, soup, sauce, juice, ketchup, whole canned fruit and drinks (Bose *et al.*, 2002).

Tomato is universally treated as ‘Protective Food’ since it is rich of minerals, vitamins, antioxidents and organic acids Under Indian condition, the fruits are mainly consumed either as raw or in the preparation of chatni, pickles etc. Apart from these, lycopene is valued for its anti-cancer property (Bose *et al.*, 2002). It acts as an antioxidant

and scavenger of free radicals, which is often associated with carcinogenesis.Keeping these points in view the present study is under taken with the following objectivesto estimate and asses the genetic components of variation *i.e.* genotypic and phenotypic variation, heritability and genetic advance.

RESOURCES AND METHODS

The field experiment was carried out at Vegetable Research Station, Dr. Y.S.R. Horticultural University, Rajendranagar, Hyderabad.The experimental material consisted of ten lines (EC-165749, EC-157568, EC-164838, LE-56, LE-62, LE-64, LE-65, LE-66, LE-67 and LE-68).Ten parents were crossed with each other in diallel mating design (excluding reciprocals) during *Rabi*, 2010-11 at Vegetable Research Station, Rajendranagar, Hyderabad. The resultant 45 F_1s were evaluated for yield, yield contributing and quality characters.

All 57 entries comprising of ten parents and 45 F_1's along with two commercial hybrids (Siri and US-618) as checks were sown in a Randomized Block Design which was replicated thrice. Each entry was grown in two rows with 10 plants in each row by adopting inter row spacing of 60 cm and intra row spacing of 45 cm. In each entry, five plants were tagged randomly for recording data. The cultural practices and the plant protection measures were adapted uniformly to all the treatments, as recommended by Dr. YSRHU.

The various genetic parameters *viz.*, genotypic co-efficients of variation and phenotypic co-efficients of variation, heritability in broad sense and excepted genetic advance were calculated by the method suggested by Weber and Moorthy (1952), Burton and Devane (1953)

OBSERVATIONS AND ANALYSIS

The estimates of genotypic and phenotypic co-efficients of variation recorded for plant height were high *i.e.* 19.26% and 23.71%, respectively. The observed heritability for this character was high (66.00%) with high genetic advance (29.04%) and genetic advance as per cent of mean (32.22%).

The PCV and GCV values were moderate for this trait, suggesting moderate range of genetic variability and considerable influence of environment in the expression of the trait. High heritability coupled with high genetic advance as per cent of mean was observed for this trait which indicated the preponderance of additive gene action governing the inheritance of this character and offers the best possibility of improvement of this trait through simple selection procedures. These results were in line with the findings of Joshi *et al.* (2004); Golani *et al.* (2007); Shankar *et al.* (2013) and Madhavi *et al.* (2013).

The observed genotypic and phenotypic co-efficients of variation for number of priary branches per plant were moderate *i.e.* 17.55% and 17.90%, respectively. This character recorded a high heritability of 96.00 % and low genetic advance of 2.79%. However, genetic advance as per cent of mean was high (35.26%).

The PCV and GCV values were moderate for this trait. High heritability coupled with high genetic advance as per cent of mean was also observed for this trait. Similar results were reported by Nadar *et al.* (1980), is low GCV, Kumari and Subramanian (1994), moderate PCV, Shankar *et al.* (2013) and Madhavi *et al.* (2013) in tomato.

The genotypic and phenotypic co-efficients of variation were low *i.e.* 6.22% and 6.98%, respectively for days to 50% flowering. The heritability estimates for this character was high (79.00%) with low genetic advance (4.05%) and moderate genetic advance as per cent of mean (11.41).

The PCV and GCV values were low for this trait. High heritability coupled with moderate genetic advance as per cent of mean was also observed for this trait. This indicates the influence of non-additive gene action and considerable influence of environment on the expression of these traits. These results are comparable with the findings of Shankar *et al.* (2013).

The observed genotypic and phenotypic co-efficients of variation for number of flowers per plant were low (13.71%) and moderate (14.35%), respectively. This character recorded a high heritability of 91.00 % and low genetic advance of 1.25% and genetic advance as per cent of mean was moderate (26.98).

The PCV and GCV values were moderate for this trait. High heritability coupled with high genetic advance as per cent of mean was also observed for this trait. These results are comparable with the findings of Ara *et al.* (2009).

The genotypic and phenotypic co-efficients of variation for number of fruits per plant were moderate (14.07%) and (15.98%), respectively. The character number of fruits per cluster recorded a high heritability

of 77.00 % and low genetic advance (0.69%) coupled with high genetic advance as per cent of mean (25.51).

PCV and GCV values were moderate for this trait. High heritability coupled with moderate genetic advance as per cent of mean was also observed for this trait. This indicates the influence of non-additive gene action and considerable influence of environment on the expression of these traits. These results are comparable with the findings of Joshi *et al*. (2004) and Ara *et al.* (2009).

The estimates of genotypic and phenotypic co-efficients of variation recorded for fruit length were moderate *i.e*. 14.18% and 16.48%, respectively for fruit length. The observed heritability for fruit length was high (74.00%) with low genetic advance (0.93%) and high genetic advance as per cent of mean (25.13) (Table 1).

Moderate PCV and GCV were recorded for fruit length indicating the existence of moderate genetic variability for this trait. These results were in accordance with the findings of Shankar *et al*. (2013) and Madhavi *et al*. (2013).

The observed genotypic and phenotypic co-efficients of variability for this trait were low to moderate *i.e*. 8.54% and 10.87%, respectively for fruit width. This character recorded a high heritability of 62.00 % and low genetic advance of 0.64% and genetic advance as per cent of mean was moderate (13.82).

PCV and GCV were recorded moderate and low for fruit width. High heritability coupled with moderate genetic advance as per cent of mean was observed for this trait. This indicates the influence of non-additive gene action and considerable influence of environment in the expression of these traits. These results were in agreement with the findings of Madhavi *et al.* (2013) and Golani *et al.* (2007), GCV moderate.

The genotypic and phenotypic co-efficients of variation were moderate *i.e*. 13.32% and 15.71%, respectively for average fruit weight. The observed heritability estimate was high (72.00%) with high genetic advance (14.46%) and high genetic advance as per cent of mean (23.26).

Moderate PCV and GCV were observed for average fruit weight indicating the existence of wider genetic variability for this trait in the genotypes under study. High heritability coupled with high genetic advance as per cent of mean was also observed for average fruit weight. These results are in conformity with the findings of Sharma *et al*. (2006).

Moderate genetic (15.16%) and phenotypic (17.89%) co-efficients of variation were recorded with high heritability estimate of 72.00% for fruit yieldper plant. The genetic advance was very low (0.58%), while genetic advance as per cent of mean was high (26.47).

The estimates of both GCV and PCV were moderate

Table 1 : Estimation of variability, heritability, genetic advance and genetic advance as per cent mean for growth, yield and quality characters in tomato

Sr. No.	Character	PCV (%)	GCV (%)	h2 (%) Heritability in broad sence	Genetic advance	GA % of mean
1.	Plant height (cm)	23.71	19.26	66	29.04	32.22
2.	Number of primary branches/ Plant	17.90	17.55	96	2.79	35.46
3.	Days to 50% flowering	6.98	6.22	79	4.05	11.41
4.	Number of flowers/ cluster	14.35	13.71	91	1.25	26.98
5.	Number of fruits / cluster	15.98	14.07	77	0.69	25.51
6.	Fruit length (cm)	16.48	14.18	74	0.86	25.13
7.	Fruit width (cm)	10.87	8.54	62	0.64	13.82
8.	Average fruit weight (g)	15.71	13.32	72	14.46	23.26
9.	Fruit yield per plant (kg)	17.89	15.16	72	0.58	26.47
10.	Number of locules per fruit	16.03	13.80	74	0.80	24.47
11.	Pericarp thickness (mm)	12.30	10.90	78	0.95	19.89
12.	Total soluble solids (ºBrix)	17.98	15.54	75	1.13	27.67
13.	Titrable acidity (%)	30.78	24.30	62	0.16	39.51
14.	Ascorbic acid content (mg/100 g)	20.47	19.44	90	8.90	38.04
15.	Total sugars (%)	18.10	17.89	98	1.05	36.41
16.	Lycopene content (mg/100g)	25.92	24.21	87	3.00	46.58

for fruit yieldper plant. Similar results were also reported by Mehta and Asati (2008) and Singh *et al*. (2004). High heritability coupled with high genetic advance as per cent of mean was observed for this trait. These results were in agreement with the findings of Shankar *et al*. (2013) and Madhavi *et al.* (2013).

Number of locules per fruit expressed moderate genotypic and phenotypic co-efficients of variation *i.e.* 13.80% and 16.03%, respectively, the heritability estimate was high (74.00%) with low genetic advance (0.80%), while genetic advance as per cent of mean was high (24.47).

The estimates of both GCV and PCV were moderate for this trait. High heritability coupled with high genetic advance as per cent of mean was observed for this trait. These results were in conformity with the findings of Shankar *et al*. (2013).

The estimates of genotypic (10.90%) and phenotypic (12.30%) co-efficients of variation were found to be moderate for pericarp thickness. The heritability estimates was very high (78.00%) with low genetic advance (0.95%) and high genetic advance as per cent of mean (19.89).

The estimates of both GCV and PCV were moderate for pericarp thickness. High heritability coupled with high genetic advance as per cent of mean was observed for this trait. These results were in accordance with the findings of Anandgowda (1997), Sivaprasad *et al.* (2009) and Shankar *et al.* (2013).

The estimates of genotypic and phenotypic co-efficients of variation recorded for TSS were moderate (15.54%) and (17.98%), respectively. The heritability for this character was high (75.00%) with low genetic advance (1.13%), while genetic advance as per cent of mean was high (27.67).

Moderate estimates of both GCV and PCV were observed for this trait. High heritability coupled with high genetic advance as per cent of mean was observed for this trait. These results were in agreement with the findings of Anandgowda (1997) and Ara *et al*. (2004).

The genotypic and phenotypic co-efficients of variation for titrable acidity were high *i.e*. 24.30% and 30.78%, respectively. The observed heritability estimate was high (62.00%) with very low genetic advance (0.16%), while genetic advance as per cent of mean (39.51) was recorded high.

High estimates of both GCV and PCV were observed for titrable acidity. High heritability coupled with high genetic advance as per cent of mean was observed for this trait. These results were in agreement with the findings of Kumar *et al.* (2006) and Shankar *et al.* (2013).

The genotypic and phenotypic co-efficients of variation for total sugars were moderate *i.e.* 17.89% and 18.10%, respectively. The observed heritability estimate was high (98.00%) with low genetic advance (1.05%), while genetic advance as per cent of mean (36.41) was recorded high.

Moderate GCV and PCV were observed for this trait. High heritability coupled with high genetic advance as per cent of mean was observed for this trait. These results were in comparable with the findings of Nair and Thamburaju (1995) and Madhavi *et al*. (2013).

The estimated genotypic and phenotypic co-efficients of variation for lycopene content were high *i.e*. 24.21% and 25.92%, respectively. This character recorded a high heritability of 87.00% and low genetic advance of 3.00%. However, genetic advance as per cent of mean was high (46.58).

High GCV and PCV were observed for this trait. High heritability coupled with high genetic advance as per cent of mean was observed for this trait. These results were in conformity with the findings of Kurian and Peter (1995b); Kumar *et al.* (2006) and Madhavi *et al.* (2013).

Conclusion :

The genetic variability studies indicated that high estimates of PCV and GCV were obtained for plant height, number of fruits per cluster, average fruit weight, fruit yield per plant, number of locules per fruit, pericarp thickness, ascorbic acid and lycopene content indicated a good deal of variability in those characters signifying the effectiveness of selection of desirable types for improvement. High heritability with high genetic advance as per cent of mean was observed for plant height, number of primary branches per plant, number of fruits per cluster, fruit length, average fruit weight, fruit yield per plant, number of locules per fruit, titrable acidity, ascorbic acid content, and lycopene content. Hence, simple selection based on phenotypic performance of these traits would be more effective.

Hence, directional selection could be effective for desired genetic improvement. Moderate genetic advance as per cent of mean with high heritability suggests the action of both additive and non-additive genes and

favorable influence of environment in the expression. The same was reported in case of days to 50% flowering, number of fruits per cluster, fruit width, Therefore, the breeder should adopt suitable breeding methodology to utilize both additive and non-additive gene effects simultaneously, since varietal and hybrid development will go a long way in the breeding programmes.

Authors' affiliations :

D. SRIHARI, R.V.S.K. REDDY, M. SUJATHA AND M.H.V. BHAVE, College of Horticulture, Rajendranagar, HYDERABAD (TELANGANA) INDIA

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