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HERITABILITY STUDIES IN DUAL PURPOSE TOMATO GENOTYPES FOR GROWTH, YIELD AND QUALITY ATTRIBUTES

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Abstract

In present investigation, PCV and GCV estimates were high for plant height, number of fruit per cluster, fruit length, fruit width, average fruit weight, pericarp thickness, ascorbic acid and lycopene content indicating the existence of wider genetic variability and PCV and GCV estimates were moderate to low for number of primary branches per plant, days to 50% flowering, days to first fruit harvest, fruit yield per plant, total soluble solids, titrable acidity, total sugars and reducing sugars suggesting moderate to narrow range of genetic variability. High heritability coupled with high genetic advance as per cent of mean observed for plant height, fruit length, fruit width, average fruit weight, fruit yield per plant, pericarp thickness, total soluble solids, titrable acidity, ascorbic acid content, total sugars, reducing sugars and lycopene content. 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 reported for days to first fruit harvest. 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.

Key words : Heritability, genetic variability, genetic advance, vegetable crops.

Introduction

Tomato is important solanaceous vegetable crops grown in India for its versatile purposes *viz*., puree, paste, ketchup, sauce, soup etc. Assessment of genetic variation and degree of transmission of desirable characters is needed for planning a sound breeding programme. Therefore, it is necessary to evaluate variability and nature of association among the various traits in partitioning of the total variability into heritable and non heritable components which enables to know whether the superiority of genetic advance expected after selection (Robinson *et al*., 1949). Hence, the present investigation was takenup to study the genetic variability, heritability and genetic advance among germplasm lines.

Materials and Methods

The experiment was conducted at the Vegetable Research Station of the SKLTSHU, Rajendranagar, Hyderabad during *Kharif* 2013-14. The basic material for the study involving forty tomato genotypes were raised in nursery and transplanted in the main field in three replication following Randomized Complete Block Design. Five plants were tagged for recording nineteen quantitative and qualitative traits *viz.*, plant height, number of primary branches per plant, days to 50 per cent flowering, number of flowers per cluster, number of fruits per cluster, average fruit weight, fruit length, fruit width, days to first fruit harvest, days to last fruit harvest, fruit yield per plant, pericarp thickness, total soluble solids, fruit pH, titrable acidity, ascorbic acid content, total sugars, reducing sugars and lycopene content.

The various genetic parameters *viz*., genotypic coefficient of variation and phenotypic coefficient 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).

Results and Discussion

The analysis of variance revealed highly significant difference among the genotypes with respect to all the characters studied, such as genotypic variance, phenotypic variance heritability and genetic advance. The simple measure of variability like mean, range and the major components of variability such as phenotypic and genotypic coefficients of variation (PCV and GCV),

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heritability in broad sense (h^2), genetic advance and genetic advance as per cent of mean were presented in table 1.

All the nineteen characters studied exhibited high variability as evident from the estimates of mean, range, coefficients of variation, heritability and genetic advance. In general values relating to phenotypic variances and coefficients were found to be higher than corresponding genotypic variances and coefficients indicating the considerable influence of environment.

Plant height exhibited high phenotypic and genotypic coefficient of variation (32.61% and 32.04%) coupled with high heritability (96.50%), high genetic advance (63.57) and high genetic advance as per cent mean (64.84). The PCV and GCV values were high suggesting high range of genetic variability and considerable influence of environment in expression of the trait. High heritability coupled with high genetic advance as per cent of mean indicated the preponderance of additive gene action in the inheritance of this character and offers the best possibility of improvement through simple selection procedures which were in line with the findings of Mohamed *et al.* (2012), Dharminder (2013), Kumari and Sharma (2013).

Number of primary branches per plant recorded moderate PCV (17.03%) and GCV (14.95%), high heritability (77.10%), but low genetic advance (1.48) and high GA as per cent of mean (27.05) which infer that the character is under non additive genes control. Similar results were reported by Mehta and Asati (2008) in tomato.

Days to 50 per cent flowering exhibited moderate PCV (17.76%) and GCV (17.57%) values coupled with high heritability (97.90%), but moderate genetic advance (15.25) and high GA as per cent of mean (35.82) was exhibited by days to 50% flowering. Osekita and Ademiluyi (2014) reported analogous kind of results for this trait.

Number of flowers per cluster recorded moderate PCV (18.02%) and GCV (16.19%), high heritability (80.80%) with low genetic advance (1.59) and high GA as per cent of mean (29.98).The PCV and GCV values were moderate. High heritability coupled with low genetic advance as per cent of mean indicated the influence of non-additive gene action and considerable influence of environment on expression of this trait. These results are comparable with the findings of Reddy *et al*. (2014). With respect to number of fruits per cluster, high PCV (26.79%) and GCV (25.26%), high heritability (88.80%), low genetic advance (1.87) and high GA as per cent of mean (49.04) estimates were observed. PCV and GCV values were high which indicates broad genetic variance. High heritability coupled with low genetic advance as per cent of mean was observed, indicates the influence of additive and non-additive gene action along with considerable influence of environment on expression of the trait. These results are in line with the findings of Sunil *et al.* (2013).

With regard to fruit length high PCV (22.38%), GCV (21.60%), high heritability (93.20%), low genetic advance (2.07) and high GA as per cent mean (42.97) was recorded. High PCV and GCV were recorded indicating the existence of wider genetic variability in genotypes studied. High heritability coupled with low genetic advance as per cent of mean indicates the influence of non-additive gene action. These results were in accordance with the findings of Kumar and Thakur (2007), Hidayatullah *et al.* (2008) and Singh (2009). The character fruit width recorded high PCV (24.64%), GCV (24.27%) values, high heritability (97.00%), low genetic advance (2.12) and high GA as per cent of mean (49.23). PCV and GCV values were high indicating the existence of wider genetic variability in the genotypes. High heritability coupled with low genetic advance as per cent of mean was observed. These results were in agreement with the findings of Singh (2009) and Shokat *et al*. (2013).

Average fruit weight exhibited high PCV (40.26%) and GCV (39.75%) were recorded for average fruit weight. High heritability (97.50%), high genetic advance (43.24) and high GA as per cent of mean (80.85) were observed. High PCV and GCV indicated the existence of wider genetic variability. High heritability coupled with high genetic advance as per cent of mean indicated the importance of additive gene action. These results are in conformity with the findings of Sunil *et al*. (2013), Bharati *et al*. (2014), Osekita and Ademiluyi (2014) and Reddy *et al*. (2014).

Moderate PCV (12.64%) and GCV (12.48%), high heritability (97.30%) coupled with moderate genetic advance (19.61) and GA as per cent mean (25.36) were observed for days to first fruit harvest which infers that the character is under the control of both additive and non-additive gene action. Hidayatullah *et al.* (2008) reported similar kind of results. For days to last fruit harvest low PCV (7.37%), GCV (7.03%) coupled with high heritability (91.10%), moderate genetic advance (17.38) with GA as per cent of mean (13.83) were observed for days to last fruit harvest which indicates the influence of non-additive gene action. The results are in line with the findings of Meitei *et al.* (2014).

Table 1 : Estimates of variability, heritability, genetic advance and genetic advance as percent mean.

S. no.	Character	Range		Mean	Variance		PCV (%)	GCV (%)	h^2 (%)	Genetic advance	GA % of mean
		Minimum	Maximum		Phenotypic	Genotypic					
1.	Plant height (cm)	50.37	182.47	98.04	1021.89	986.46	32.61	32.04	96.50	63.57	64.84
2.	Number of primary branches per plant	3.77	8.24	5.45	0.8628	0.66	17.03	14.95	77.10	1.48	27.05
3.	Days to 50% flowering	27.33	52.67	42.56	57.15	55.95	17.76	17.57	97.90	15.25	35.82
4.	Number of flowers per cluster	3.74	8.40	5.31	0.92	0.74	18.02	16.19	80.80	1.59	29.98
5.	Number of fruits per cluster	2.24	7.22	3.82	1.05	0.93	26.79	25.26	88.80	1.87	49.04
6.	Fruit length (cm)	1.74	6.42	4.81	1.16	1.08	22.38	21.60	93.20	2.07	42.97
7.	Fruit width (cm)	0.74	6.50	4.30	1.13	1.09	24.64	24.27	97.00	2.12	49.23
8.	Average fruit weight (g)	1.43	111.53	53.49	463.78	452.05	40.26	39.75	97.50	43.24	80.85
9.	Days to first fruit harvest	44.66	91.33	77.32	95.60	93.06	12.64	12.48	97.30	19.61	25.36
10.	Days to last fruit harvest	108.33	141.67	125.66	85.74	78.15	7.37	7.03	91.10	17.38	13.83
11.	Fruit yield per plant (kg)	1.04	2.06	1.48	0.08	0.06	18.88	16.84	79.60	0.46	30.96
12.	Pericarp thickness (mm)	0.88	5.54	4.20	1.10	1.05	24.98	24.37	95.20	2.06	48.97
13.	Fruit pH	4.11	5.46	4.89	0.15	0.13	7.99	7.47	87.50	0.70	14.40
14.	Total soluble solids (°Brix)	3.59	6.29	4.57	0.39	0.37	13.74	13.28	93.40	1.20	26.43
15.	Titrable acidity (%)	0.28	0.60	0.38	0.0051	0.0049	18.81	18.33	95.00	0.14	36.82
16.	Ascorbic acid content (mg/100g)	14.63	28.47	19.90	17.87	17.25	21.24	20.87	96.50	8.41	42.25
17.	Total sugars (%)	2.01	4.31	3.30	0.26	0.25	15.63	15.35	96.50	1.02	31.07
18.	Reducing sugars (%)	1.63	3.86	2.80	0.27	0.26	18.54	18.43	98.90	1.06	37.75
19.	Lycopene content (mg/100g)	3.91	9.07	6.01	1.58	1.52	20.93	20.50	96.10	2.49	41.41

With respect to fruit yield per plant, moderate PCV (18.88%), GCV (16.84%), high heritability (79.60%), low genetic advance (0.46) and high GA as per cent of mean (30.96) estimates were observed. The estimates of PCV and GCV were high indicating wide genetic variability. High heritability coupled with high genetic advance as per cent of mean reveals the importance of additive gene action. These results were in accordance with the findings of Meena and Bahadur (2014) and Reddy *et al.* (2014).

Pericarp thickness exhibited high PCV (24.98%), GCV (24.37%), high heritability (95.20%) coupled with low GA (2.06) and high GA as per cent mean (48.97) was recorded which are governed by non-additive gene action. Hidayatullah *et al.* (2008) and Osekita and Ademiluyi (2014) reported similar kind of results.

Fruit pH revealed low PCV (7.99%), GCV (7.47%), high heritability (87.50%) coupled with low genetic advance (0.70) and moderate GA as per cent mean (14.40)but low GA as per cent mean indicating the importance of non-additive genes. Similar kind of results arereported by Kumari and Subramanian (1994). The trait total soluble solids recorded moderate PCV (13.74%), GCV (13.28%) high heritability (93.40%) coupled with low GA (1.20) and high GA as per cent mean (26.43), which are influenced by additive genes. The results are in consonance with the findings of Arun and Veeraragavathatham (2005), Kumar and Thakur (2007).

Titrable acidity recorded moderate PCV (18.81%), GCV (18.33%), high heritability (95.00%) coupled with low genetic advance (0.14) and high GA as per cent mean (36.82) were recorded which mean that the trait is controlled by additive gene action. Present results are in accordance with that reported by Vijayamohan *et al.* (1986). High PCV (21.24%), GCV (20.87%), high heritability (96.50%), moderate genetic advance (8.41) and high GA as per cent of mean (42.25) values were recorded for ascorbic acid content which are under the influence of additive genes. Kumar *et al.* (2006) reported similar findings for this character.

With respect total sugars moderate PCV (15.63%) and GCV (15.35%), high heritability (96.50%), low genetic advance (1.02) and high GA as per cent of mean (31.07) estimates were recorded. Moderate PCV and GCV values were recorded for along with high heritability coupled with high genetic advance as per cent of mean indicates the influence of additive gene action and considerable influence of environment on the expression of the trait. Similar kinds of results were reported by Nair and Thambu Raj (1995). Reducing sugars exhibited moderate PCV (18.54%) and GCV (18.43%), high heritability (98.90%), low genetic advance (1.06) and high GA as per cent of mean (37.75). PCV and GCV estimates were moderate to low with high heritability coupled with high genetic advance as per cent mean indicating the importance of additive gene action on the expression. Similar kinds of results were reported by Kurian and Peter (1995), Nair and Thambu Raj (1995).

Lycopene content exhibited high PCV (20.93%), GCV (20.50%) high heritability (96.10%) coupled with low GA (2.49) and high GA as per cent mean (41.41) which are in agreement with the findings of Kumar *et al.* (2006), Dar and Sharma (2011).

Conclusion

High PCV and GCV estimates were recorded for plant height, number of fruit per cluster, fruit length, fruit width, average fruit weight, pericarp thickness, ascorbic acid and lycopene content indicating the existence of wider genetic variability for these traits in the genotypes under study. On the other side, PCV and GCV estimates were moderate to low for traits *viz.,* number of primary branches per plant, days to 50% flowering, days to first fruit harvest, fruit yield per plant, total soluble solids, titrable acidity, total sugars and reducing sugars suggesting moderate to narrow range of genetic variability.

High heritability coupled with high genetic advance as per cent of mean indicates operation of additive gene action which was observed in characters plant height, fruit length, fruit width, average fruit weight, fruit yield per plant, pericarp thickness, total soluble solids, titrable acidity, ascorbic acid content, total sugars, reducing sugars and lycopene content. 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 first fruit harvest. 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.

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