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DIRECT SELECTION PARAMETERS FOR MORPHOLOGICAL AND QUALITATIVE TRAITS IN TOMATO (*LYCOPERSICON ESCULENTUM* MILL)

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Abstract

An experiment was conducted for increasing the productivity, the genetic variability, heritability and genetic advance was assessed for morphology and quality traits. Wide range of variation was observed for all most all morphological and quantitative traits. In general, phenotypic coefficients of variation were higher than the corresponding genotypic coefficients of variation for all the characters. Early fruit yield^{-1}, plant height, number of fruits plant^{-1}, average fruit weight, pericarp thickness and total fruit yield plant^{-1} exhibited high estimates of phenotypic (PCV) as well as genotypic coefficient of variation (GCV) indicating substantial scope of improvement in these traits in present material through selection. Estimate of PCV were higher than GCV indicating that apparent variation was not only due to genotypes but also due to environment. High heritability in broad sense (h^2b) coupled with high expected genetic advance (GA%) recorded for plant height, number of fruits plant^{-1}, average fruit weight, pericarp thickness, ascorbic acid content, titrable acidity, early yield plant^{-1} and total yield plant^{-1}, indicated greater scope for further improvement in these traits in advance generations.

Kew words : Tomato, qualitative traits, coefficient of variation, heritability, genetic advance.

Introduction

Tomato (*Lycopersicon esculentum* Mill) has a glorious position among the vegetables and is treated as "protective food" all over the world, a member of family solanaceae is a herbaceous, annual, prostrate and sexually propagated vegetable. Tomato is used as fresh vegetable and is also very important for processing industry ranking first as processing vegetable crop in the world. Tomato is one of the most popular vegetables grown throughout the world, ranking second in importance next to potato in many countries including India (Bose and Som, 1993). In India, tomato has wider coverage in comparison to other vegetables. It stood second next to bringal in area and production with contribution of 7.7 per cent in total annual production of Indian Vegetables (93.92 million tonnes) during the year 2000-01. Annual production of tomato in India is 7.27 million tonnes from 0.459 million ha of land accounting a productivity of 15.90 metric tonnes per ha (Pandey and Rai, 2004).

Though, lot of genetic studies have been done in tomato very thoroughly by evolving a larger number of tomato varieties/hybrids, there is still lack of adequate information for a very strong improvement programme to develop area and quality specific varieties. Development of hybrids with extreme earliness, yield quality, uniformity and adoptability to adverse conditions is easily possible in tomato though the crop is self-pollinated. The formulation of plant breeding strategy depends mainly on the support of genetic information provided by studies on inheritance and behaviour of major quantitative traits in which, the breeder is interested. The estimates of genotypic and phenotypic coefficient of variation are helpful in exposing the nature of variability in the breeding populations, whereas the heritability provides the index of transmissibility of characters and serves as a useful guide to the breeder for practicing selection. The parameter, genetic advance gives clearer picture about overall efficiency of the selection for improving a character.

Materials and Methods

The present investigation in tomato (*Lycopersicon esculentum* Mill) was undertaken to asses genetic variability for various traits by estimating heritability, genetic advance and coefficient of variation. The

Table 1 : Details of parental lines/genotypes.

S. no.	Genotypes	Source	Description of main features
1.	NDT-2	N.D.U.A. & T., Faizabad	Determinate, fruits round shaped and end pointed, medium in size.
2.	NDT-3	N.D.U.A. & T., Faizabad	Determinate, round and small size fruits are slightly grooved.
3.	KS-60	C.S.U.A.T. (Kanpur)	Indeterminate in nature with having round and medium size fruits.
4.	Money Maker	Denmark	Indeterminate in nature, oval and small size fruits with having pointed end.
5.	Himlata	S.K.U.A.T. Srinagar	Indeterminate in nature, medium size fruits.
6.	Bilahi-2	N.D.U.A. & T., Faizabad	Determinate in nature, fruits are round, small size and grooved.
7.	EC-2291-2	Exotic collection	Indeterminate, fruits are round, medium in size pink colour with having broad leaf.
8.	EC-168282	Exotic collection	Indeterminate in nature, fruits are round, medium in size with having pink colour.
9.	EC-7343	Exotic collection	Determinate in nature. Small and round fruits.
10.	EC-6148	Exotic collection	Indeterminate fruits are small in size and round.
11.	H-24	IIVR Varanasi	Determinate in nature. Fruits are round in shape, medium in size and slightly grooved.
12.	H-86	IIVR Varanasi	Determinate in nature, Round fruits with big size and slightly grooved.
13.	H-88	IIVR Varanasi	Determinate in nature, round, medium size fruit and slightly grooved.
14.	NDTH-7	N.D.U.A.T., Faizabad	Indeterminate, round fruits, medium in size with smooth feelings.

experiments were conducted at Main Experiment Station, Department of Vegetable Science, N.D. University of Agriculture and Technology, Kumarganj, Faizabad (U.P.), India. Ten lines, namely NDT-2, NDT-3, KS-60, MM, Himlata, Bilahi-2, EC 2291-2, EC 168282, EC 7343, and EC 6148 and three testers *viz*., H-24, H-86 and H-88, were selected on the basis of variability for various characters from the genetic pool maintained in Department of Vegetable Science. All the ten lines were crossed with three testers to generate experimental material during *Rabi*. Experimental material comprising thirteen genetically diverse genotypes/parents, thirty F_1's and one standard variety (NDTH-7) was evaluated in Randomized Block Design (RBD) with three replications in two separate experiments, planted during October and November. Recommended agronomical practices were followed to raise good crop during experiments. Each parent and F_1's was planted in two rows of 3.15 meter long which contains 14 seedlings of each segregating & parental lines in each replications (table 1). Thirty days old seedlings were transplanted at the spacing of 60 cm apart and 45 cm between plants.

The observations were recorded on twelve characters, namely, plant height (cm), number of primary branches and fruits plant^{-1}, average fruit weight (g), length of fruits (cm), diameter of fruits (cm), pericarp thickness (cm), total soluble solids (%), ascorbic acids (mg/100g), titrable acidity (%), early yield plant^{-1} (kg) and total yield plant^{-1} (kg). The data were analyzed by appropriate statistical analysis (Gomez and Gomez, 1984) using CropStat 7.2 (IRRI, 2009) programme. The genetic parameters were computed following Singh and Chaudhury (1985).

Results and Discussion

Coefficient of variation

The estimates of genotypic (GCV) and phenotypic (PCV) coefficient of variation for twelve characters in E_1 and E_2 environments are presented in table 2. For explanation, the estimates of GCV and PCV were graded into high (>30%), moderate (15 to 30%) and low (<15%). The higher estimates PCV than GCV for all the characters in both environments, except the number of primary branches per plant in E_1 indicating that the apparent variation was not only due to genotypes, but environment also influenced. The range of phenotypic co-efficient of variation was from 7.26 (number of primary branches plant^{-1}) to 69.16 per cent (early yield plant^{-1}) in E_1 and from 15.63 (number of primary branches plant^{-1}) to 38.83 per cent (plant height) under E_2 condition. High estimates of PCV (>30%) were noted for early yield (69.16%), plant height (39.09%) average fruit weight (36.88%) and number of fruits plant^{-1} (34.27%) in E_1 and for early yield (42.18), plant height (38.83%) and

Table 2 : Estimates of coefficient of variation, heritability and genetic advance in tomato for the pooled data of E_1 and E_2 environments.

S. no.	Characters	Environment	General mean	Coefficient of variation		Heritability (h^2b)	Genetic advance as per cent of mean
				GCV	PCV		
1.	Plant height	E_1	84.25	36.45	39.09	86.94	70.01
		E_2	89.08	36.15	38.83	86.66	69.32
		Pooled	86.47	35.25	37.98	86.18	67.42
2.	No. of Primary Branches plant^{-1}	E_1	4.57	7.27	7.97	74.06	14.13
		E_2	4.35	14.85	15.63	90.28	29.07
		Pooled	4.48	10.49	11.53	82.77	19.66
3.	No. of fruits plant^{-1}	E_1	46.18	33.48	34.27	95.48	67.40
		E_2	35.85	33.53	34.43	94.83	67.26
		Pooled	41.70	28.81	29.49	95.77	58.05
4.	Av. fruit weight (g)	E_1	46.40	34.69	36.88	88.47	67.20
		E_2	34.84	27.37	29.41	86.60	52.46
		Pooled	40.69	26.83	29.14	84.75	50.88
5.	Length of fruits (cm)	E_1	4.37	13.71	14.06	95.05	27.53
		E_2	3.07	16.43	17.22	91.01	32.29
		Pooled	3.78	14.47	14.78	95.91	29.20
6.	Diameter of fruits (cm)	E_1	4.89	14.11	15.38	84.27	26.69
		E_2	3.42	15.78	17.22	83.90	29.77
		Pooled	4.22	14.45	15.02	92.26	28.60
7.	Pericarp thickness (cm)	E_1	0.47	25.73	26.01	97.86	52.43
		E_2	0.47	22.14	22.60	95.92	44.66
		Pooled	0.47	21.04	21.36	97.08	42.71
8.	Total soluble solids (%)	E_1	4.98	9.74	10.10	92.89	19.34
		E_2	5.35	10.26	11.11	85.30	19.53
		Pooled	5.20	9.37	9.75	92.69	18.62
9.	Ascorbic acid content (mg/100g)	E_1	31.26	19.99	20.40	95.99	40.34
		E_2	27.92	21.89	22.40	95.48	44.06
		Pooled	30.81	20.67	20.93	97.56	42.06
10.	Titrable acidity	E_1	0.81	20.65	21.60	91.39	40.66
		E_2	0.78	20.39	21.07	93.64	40.64
		Pooled	0.80	20.47	21.24	92.87	40.64
11.	Early yield plant^{-1} (kg)	E_1	0.61	65.13	69.16	88.69	66.36
		E_2	0.71	39.71	42.18	88.63	77.00
		Pooled	0.69	10.49	11.53	82.77	67.66
12.	Total yield plant^{-1} (kg)	E_1	1.92	21.10	24.46	74.41	37.49
		E_2	1.09	22.16	25.32	76.62	39.96
		Pooled	1.59	21.33	24.62	75.10	38.08

number of fruits plant^{-1} (34.43%) in E_2 condition. The characters early yield, plant height, fruits per plant and fruit weight expressed high estimates of genotypic coefficients of variation, heritability and high expected genetic advance, indicating scope for their improvement through selection (Das *et al*., 1998). The genotypic coefficient of variation provides help to measure the genetic variability in a character and accordingly, it is not possible to partition existing heritable variation in population based solely on this estimate (Meena *et al*., 2012).

The moderate PCV per cent were recorded for diameter of fruits, pericarp thickness, ascorbic acid content, titrable acidity and total yield plant^{-1} under both the environments and for number of primary branches

plant^{-1} and length of fruits in E_2 environment. Whereas, number of primary branches plant^{-1}, length of fruits and total soluble solids in E_1 exhibited very low magnitude of phenotypic coefficient of variation. The genotypic coefficient of variation (GCV) ranged from 7.97 (number of primary branches plant^{-1}) to 65.13 per cent (early yield plant^{-1}) in E_1 and from 14.85 (number of primary branches plant^{-1}) to 39.71 per cent (early yield plant^{-1}) under E_2 condition. The high estimates of GCV were recorded for early yield, plant height and number of fruits plant^{-1} in both the environments. While, average fruit weight had high magnitude of GCV under E_1. The moderate estimates of GCV were exhibited by total yield plant^{-1}, titrable acidity, ascorbic acid content and pericarp thickness in both the seasons and by average fruit weight and length of fruits in E_2. The estimates of GCV were very low for number of primary branches plant^{-1}, total soluble solids, length of fruits and diameter of fruits in E_1 and for number of primary branches and total soluble solids in E_2. A high degree of disparity between PCV and GCV was observed for early yield plant^{-1} and total yield plant^{-1} depicting their susceptibility to environmental fluctuation.

Heritability in broad sense (h^2b) and genetic advance in per cent of mean $(\overline{Ga})$

Burton and Devane (1953) suggested that genotypic coefficient of variation together with heritability estimates would give the best result of the amount of genetic advance to be expected from selection. The plant height and number of fruits plant^{-1} were the only traits which possessed very high estimates of phenotypic (PCV) and genotypic (GCV) coefficients of variation, heritability in broad sense (h^2b) and genetic advance in per cent of mean $(\overline{Ga})$ in E_1, E_2 and pooled basis. Thus, plant height and number of fruits plant^{-1} emerged as ideal traits for improvement through selection owing to its high transmissibility and variability in all conditions in context experimental material of the present study. Early yield plant^{-1} (kg) exhibited high heritability and genetic advance along with high PCV and GCV values in E_1 and E_2 while, low PCV and GCV values on pooled basis. These three characters are likely to provide good selection response under both the conditions due to presence of high transmissibility with high variability. The high estimates of heritability and genetic advance were also reported earlier for plant height and number of fruits plant^{-1} by Phookan *et al*. (1998) and Indrajyothi *et al*. (2001). The broad sense heritability ranged from 74.06 (number of primary branches plant^{-1}) to 97.86 per cent (pericarp thickness) in E_1 and from 76.62 (total yield plant^{-1}) to 95.48 per cent (ascorbic acid content) in E_2. The high estimates of heritability in broad sense were observed for all the traits in both environments. The genetic advance (Ga) in absolute term varied from 0.25 (pericarp thickness) to 58.62 (plant height) in E_1 and from 0.21 (pericarp thickness) to 62.18 (plant height) under E_2 condition. Very high-expected genetic advance (Ga) was observed for plant height (58.62%), number of fruits per plant (32.32%) and average fruit weight (31.41%) in E_1 and for plant height (62.18%) and number of fruits per plant (24.36%) in E_2 environment. Estimates of high genetic advance in per cent of mean were recorded for plant height (70.01%), number of fruits plant^{-1} (67.40%), average fruit weight (67.20%) and pericarp thickness (42.43%) in E_1 and for early yield plant^{-1} (77.00%) plant height (69.32%) and number of fruits plant^{-1} (67.26%) in E_2 conditions. Remaining others was categorized under moderate estimates of genetic advance in per cent of mean. High estimates of heritability coupled with low genetic advance was observed for total soluble solids which may be attribute to the non additive gene affects and these trait can be improved through hybridization and use of hybrid vigour (Panse and Sukhatme, 1956). While, low heritability and low genetic advance indicating the role of non additive genes suggesting that their improvement could be achieved through heterosis breeding.

$(\overline{Ga})$

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