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RESEARCH ARTICLE

Study on genetic variability, heritability and genetic advance in tomato

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SUMMARY

Thirteen tomato genotypes were evaluated to estimate variability, heritability and genetic advance in yield and yield contributing characters at AICRP on vegetable crop, M.P.K.V., Rahuri. A high degree of significant variation was observed for all the characters studied except pericarp thickness and number of locules. A highest GCV was observed for fruit yield per plant and PCV for fruit yield per plant and number of locules while lowest GCV was noticed for days to first harvest, days to 50 per cent flowering and pericarp thickness and PCV for days to first harvest and days to 50 per cent flowering. High heritability with high genetic advance as per cent of mean was observed for fruit yield per plant and average fruit weight which could be improved by simple selection.

Key Words : Tomato, Variability, Heritability, Genetic advance

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Tomato (*Lycopersicon esculentum* Mill.) is one of the most popular and widely grown vegetable in the world ranking second in importance only next to potato in many countries and ranked 1st in preserved and processed vegetables. Information on genetic diversity among available genotypes is essential for development of promising variety (Balash *et al.*, 1984) and on the other hand, information on nature of total phenotypic variability together with the magnitude of heritability for any given quantitative characters under improvement is of utmost importance to the breeder to proceed towards fruitful hybridization programme. Yield improvement would be facilitated only when genetic diversity exists in the material chosen for improvement. The genotypic and phenotypic co-efficients of variation are useful in detecting amount of variability present in the available genotypes. Heritability and genetic advance help in determining the influence of environment in expression of the characters and the extent to which improvement is possible after selection. Hence, the study was conducted to quantify the variability in tomato genotypes for yield and its related characters.

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MATERIALS AND METHODS

The experimental material consisted of 13 genotypes which includes 10 progenies of cross M-3-1 x H-36 along with two parents and check Dhanshree were laid out in Randomized Block Design (RBD) with 3 replications at All India Coordinated Research Project on Vegetable Crops, MPKV Rahuri during autumn-summer (October to April) 2010-11. Transplanting was done at a spacing of 90 x 30 cm in a plot size 3.60 x 3.0 m^2. Data were recorded on various 15 quantitative characters. Analysis of variance was done based on RBD as suggested by Panse and Sukhatme (1985) for each of the characters separately. The phenotypic and genotypic co-efficient of variance and heritability in broad sense was estimated according to Burton and De Vane (1953). Genetic advance was estimated as per Allard (1961).

RESULTS AND DISCUSSION

In Table 1, the Analysis of Variance (ANOVA) revealed

highly significant difference among genotypes for all the characters under study except pericarp thickness and number of locules suggesting presence of substantial amount of variability for all the characters in 13 genotypes.

The extent of variability measured in term of range, mean, genotypic co-efficient of variance, phenotypic co-efficient of variance, heritability, expected genetic advance and the expected genetic advance as per cent of mean are presented in Table 2.

A considerable variation was observed in most of the characters. Among the characters maximum range of mean values was observed for harvesting duration (44.83 - 64.87 days) followed by fruit yield per plant (0.92 – 2.24 kg) and average fruit weight (39.67 – 82.67 g). The minimum range was recorded with pericarp thickness (0.61 – 0.81 cm). The characters showing wide range of variation provides ample scope for selecting the desirable genotypes.

In the study, PCV were higher than the respective GCV for all the characters which indicated environmental influence in expression of the characters considered in the present investigation. These findings are in consonance with Mohanty (2003). On the other hand, a wide range of variability recorded for all characters also indicates the scope for selection of better genotypes. The maximum PCV was observed for fruit yield per plant (25.11%) and number of locules (20.11%) indicated that, these characters were highly influenced by environmental factors. These results are also in agreement of Rani and Anitha (2011). Most of the characters have moderate PCV except days to 50 per cent flowering and days to 1st harvest. These results are in accordance with Kumar (2010). High estimates of phenotypic variability alone will not be enough to determine exact nature of variability. GCV would be more useful for assessing the variability (Allard, 1970). Most of the characters showed moderate to low GCV except fruit yield per plant (23.45%). Wide difference between PCV and GCV for yield implies it's susceptibility to environmental fluctuation, whereas narrow difference suggested their relative resistance to environmental alteration.

Table 1: Analysis of variance for different characters in tomato

Source of variance	df	Ph (cm)	B/ P	DIF	DFF	DFH	HD	NH	F/P	Y/P (kg)	AFW (g)	PD (cm)	ED (cm)	Pt (cm)	NL	TSS (°Brix)
Replication	2	60.83	0.02	6.82	6.86	3.07	37.50	1.02	28.96	0.22	39.38	0.10	0.11	0.01	0.09	0.18
Genotypes	12	2162.26	6.36	289.59	259.74	400.69	1322.54	32.78	474.47	4.59	5259.35	16.58	14.18	0.20	2.01	24.15
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Error	24	705.79	5.34	143.18	167.64	328.92	231.85	4.23	140.86	0.72	385.39	5.94	2.56	0.13	3.14	3.05
C.V. %		7.92	9.89	7.66	6.77	5.41	5.71	7.02	10.06	8.98	6.13	7.95	5.91	9.66	8.71	6.97

** Indicate significance of value at P=0.01

Ph- plant height (cm), B/P- Number of branches/plant, DIF - Days to initiation of flowering, DFF - days to 50% flowering, DFH - Days to first harvest, HD - Harvesting Duration, NH - Number of harvesting, F/P - number of fruits/plant, Y/P - fruit yield/plant (kg), AFW - Average fruit weight (g), PD – Polar diameter (cm), ED - Equatorial diameter (cm), PT - Preicarp thickness (cm), NL - Number of locules, TSS (°Brix)

Table 2: Estimates of mean, range, variance components and genetic parameters for different characters

Name of characters	Range	Mean ± S.E.	GCV	PCV	Heritability (b.s.)	Genetic advance	GA as % of mean
Plant height (cm)	59.00-85.13	68.50 ± 3.13	10.35	13.03	63.1	11.60	16.93
Number of branches / plant	3.26-4.57	3.80 ± 0.21	9.47	13.70	47.8	0.51	13.49
Days to initiation of flowering	26.33-36.33	31.90 ± 1.41	7.71	10.87	50.4	3.60	11.28
Days to 50% flowering	32.33-43.00	39.05 ± 1.52	6.10	9.11	44.8	3.28	8.41
Days to first harvest	60.33-71.81	68.37 ± 2.14	3.75	6.58	32.4	3.00	4.39
Harvesting duration	44.83-64.87	54.39 ± 1.79	9.25	10.87	72.4	8.81	16.21
Number of harvesting	4.43-7.87	5.99 ± 0.24	15.41	16.94	82.8	1.73	28.90
Number of fruits / plant	16.67-28.67	22.80 ± 1.32	14.65	17.77	68.0	5.67	24.89
Fruit yield per plant (kg)	0.92-2.24	1.48 ± 0.08	23.45	25.11	87.2	0.67	45.12
Average fruit weight (g)	39.67-82.67	65.38 ± 2.31	18.16	19.15	89.8	23.15	35.41
Polar diameter (cm)	5.30-7.48	6.25 ± 0.29	9.84	12.65	60.5	0.98	15.76
Equatorial diameter (cm)	4.57-6.78	5.53 ± 0.19	10.82	12.33	77.0	1.08	19.57
Pericarp thickness (cm)	0.61-0.81	0.73 ± 0.04	6.61	11.70	31.9	0.06	7.69
Number of locules	3.00-3.73	3.40 ± 0.15	18.12	20.11	81.2	1.03	33.64
Total Soluble Solids (°Brix)	3.77-6.31	5.12 ± 0.21	15.49	16.99	83.2	1.49	29.10

The relative magnitude of difference between PCV and GCV was low for average fruit weight, TSS, equatorial diameter, number of harvesting, harvesting duration and fruit yield per plant indicating the low influence of environmental factors on these characters. These findings suggest that selection can be effective on the basis of phenotypic along with equal probability of genotypic values. With the help of GCV alone, it is not possible to determine the extent of variation which is heritable. Hence, the knowledge of heritability helps the plant breeder in prediction. The genetic advance for quantitative characters aids in exercising necessary selection procedure.

According to Burton and De Vane (1953); GCV along with heritability estimate would give the best scope for selection. Highest heritability (b.s.) were found for average fruit weight (89.8%) followed by fruit yield per plant (87.2%) and TSS (83.2%). The above findings are in broad conformity with Singh *et al.* (2011), while the characters like number of branches, number of harvesting, number of fruit per plant and pericarp thickness showed moderate heritability. These results corroborate the view of Tasisa *et al.* (2011) and Singh *et al.* (2006).

Genetic advance as per cent of mean was highest for average fruit weight (45.12%) and number of locules (33.64%) indicating important role of genetic factor towards expression of these characters as genetic advance was estimated on the basis of heritability (b.s.). Thus for these characters, there is maximum possibility of fruitful phenotypic selection. Heritability estimates along with genetic advance is more useful than the heritability alone. Highest estimates of heritability accompanied with high genetic advance were found in average fruit weight, fruit yield per plant, number of harvesting, TSS and number of locules. The above findings stood parallel with Tasisa *et al.* (2011) and Rani and Anitha (2011). High heritability along with moderate genetic advance was observed in plant height, harvesting duration and equatorial diameter which promotes scope for selecting a better progenies. These findings also agree with the findings of Singh *et al.* (2011).

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