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Studies on genetic diversity in growth, yield and quality traits in tomato (*Lycopersicon esculentum* Mill.)

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ABSTRACT

Evaluation of 35 genotypes of tomato for yield, quality and fruit characters under net-house revealed that PCV was higher than GCV for most traits. High heritability, with moderate to high GCV and genetic gain, was recorded for number of fruits per plant, yield per plant, fruit weight, number of fruit-clusters per plant, polar diameter and number of flower-clusters per plant indicating, that, these characters could be improved by simple selection. Total yield per plant had positive and highly significant correlation with number of fruit-clusters per plant, number of flower-clusters per plant and fruit weight. Number of locules per fruit showed positive and significant correlation with fruit weight and equatorial diameter but, significant negative correlation with polar diameter. Maximum direct contribution to total yield per plant was made by number of fruits per plant, followed by number of locules per fruit.

Key words: Tomato, heritability, PCV, GCV, growth, yield, quality traits

INTRODUCTION

Yield, being a polygenic character, is largely influenced by environmental fluctuations. Thus, direct selection on the basis of phenotypic variability is rarely effective as the response to selection depends upon magnitude of the genetic variability, degree of habitability and, the trait.

Partitioning of correlation coefficient into direct and indirect effects can be useful in providing information leading to improved yield or other, related characters. Therefore, the present studies were made to evaluate breeding material through variability/co-variability for isolation of superior genotype/s in tomato.

MATERIAL AND METHODS

The material comprising 35 genotypes of tomato, namely, Sel 53, Sel 52, Sel 19, Sel 6, Sel 31, Sel 33, Sel 15, Sel 11, Sel 5, Sel 49, Sel 16, Sel 18, Sel 17, Sel 34, Sel 4-1,Sel 39, Sel 1, Sel 7, Sel 12, Sel 36, Sel 35, Sel 46, Sel 3, Sel 27, Sel 26, Sel 4, Sel 24, Sel 25, Sel 1-1, Sel 47, Sel28, Sel 51, 'Punjab Chhuhara', 'Punjab Kesri' and 'Punjab Upma' sourced from Punjab Agriculture University, Ludhiana, were grown in Completely Randomized Block Design, replicated five times, during 2002-03. The nursery was raised starting 30th October 2002. Seedlings were transplanted into a net-house, on beds, in December 2002. Distance between rows and plants was 135 cm and 45cm, respectively. Ten plants were grown in each row, and 5 representative plants were selected at random from each cultivar/genotype for data recording on number of fruits per plant, number of fruits per cluster, yield per plant, fruit weight, number of fruit-clusters per plant, number of flower-clusters per plant, pericarp thickness, number of locules per fruit, polar diameter and equatorial diameter.

Mean values of 35 genotypes in each replication were used for analysis of variance. Genotypic and phenotypic coefficients of variation were calculated using the formula of Burton and De Vane (1953). Correlation coefficient at the phenotypic and genotypic levels was estimated for analysis of variance and co-variance for all characters, as suggested by Al-Jibouri *et al* (1958). Path coefficient analysis was done by the method of Dewey and Lu (1959).

RESULTS AND DISCUSSION

A wide range of variability was recorded for number of fruits per plant (10.0-62.8), yield per plant (0.34-1.56kg), fruit weight (22.4-66.4g), number of fruit clusters per plant (4.8-22.2) and number of flower clusters per plant (12.2-

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35.0). This was accompanied by higher values for genetic coefficient of variation (GCV) for number of fruits per plant, number of fruit-clusters per plant, number of flower-clusters per plant and number of locules per fruit. Pericarp thickness and equatorial diameter showed a wide range of variability, but the corresponding values for GCV were lower. Similarly, for the number of locules per plant and number of fruits per cluster, variability observed was not reflected in the GCV values (Table 1). Relatively low level of genetic variability was recorded for polar diameter, number of fruits per cluster and number of locules per fruit. Almost similar results were reported by Bhutani *et al* (1983), Kumar and Tewari (1999), Mittal *et al* (1996), and, Parthasarathy and Aswath (2002). Data further revealed higher values of heritability for number of fruits per plant (95.84%), yield per plant (99.97%) and polar diameter (95.65%). Fruit weight, number of flower-clusters per plant and number of fruit-clusters per plant showed values of 90.87%, 90.02% and 85.32%, respectively. Moreover, yield and yield components also recorded a fairly high degree of genetic advance. Therefore, there exists a tremendous scope for isolation of superior genotypes to improve yield through simple selection.

Similarly, number of fruits per plant, yield per plant, fruit weight and number of fruit-clusters per plant were highly heritable, where, heritability values were 95.84, 99.97, 90.87 and 85.32%, respectively, with high to moderate level of genetic advance (80.32, 59.35, 55.25 and 63.08%, respectively) Burton and de Vane (1953) suggested that high GCV, along with high heritability and genetic advance, gave a better clue for selection of genotypes. Polar diameter and equatorial diameter also registered higher heritability, but, the corresponding values for genetic advance were rather low. The present study is in agreement with reports by Sidhu and Singh (1989), Pujari *et al* (1995) and Phookan *et al* (1998).

Studies on correlation between characters (Table 2) play an important role in deciding on the most efficient breeding procedures. Stronger the association of a trait with yield, more is the chance of success in selection a programme. Total yield per plant had a positive and highly significant correlation with number of fruit-clusters per plant (r=0.5459) and number of flower-clusters per plant (r=0.4952). Total yield per plant also showed positive and significant correlation with fruit weight (r=0.2475). Similar results were reported by Dudi and Kalloo (1982). Fruit weight had positive and significant correlation with equatorial diameter (r=0.3607) and polar diameter (r=0.2749). Number of locules per fruit also showed positive and significant correlation with fruit weight (r=0.2627) and equatorial diameter (r=0.5768), but a negative and significant correlation with polar diameter (r=-0.19). Similar results were reported by Mulge and Arvindkumar (2002). Fruit number showed highly positive and significant correlation with total yield (r=0.6046), number of flower-clusters per plant (r=0.8901), and number of fruit-clusters per plant (r=0.8829).

Genotypic and phenotypic correlation coefficients were both partitioned into direct and indirect effects with the aid of path analysis (Table 3). Partitioning the total genotypic association between total yield and other characters revealed that maximum direct contribution was made by fruit number. Fruit number also showed positive and significant correlation with total yield per plant. Locule number per fruit also made a direct contribution. Positive indirect effect was recorded in the case of number of flower-clusters per plant (via fruit number), number of fruit-clusters per plant (via fruit number), number of fruits per cluster (via fruit number) and fruit weight via number of fruits per cluster. Considering direct and indirect effects of the various characters, it may be concluded that fruit number, number of locules per fruit, number of flower-clusters per plant and

Table 1. Range, mean, variability and genetic advance as % of Mean for various characters

Character	Range		Mean	Variability (%)		Habitability (%)	Expected genetic advance (%) of Mean
				PCV	GCV		
Number of fruits/plant	10.00	62.80	24.98	40.68	39.83	95.84	80.32
Number of fruits/cluster	2.00	3.60	2.68	23.42	13.79	34.69	16.73
Yield per plant (kg)	0.34	1.56	0.98	28.77	28.77	99.97	59.35
Fruit weight (g)	22.40	66.40	42.37	29.53	28.14	90.87	55.25
Number of fruit clusters/plant	4.80	22.20	10.75	35.89	32.15	85.32	63.08
Pericarp thickness	0.36	0.66	0.54	20.06	12.60	39.41	16.29
Number of locules/fruit	2.00	4.00	2.57	29.89	13.98	21.86	13.46
Polar diameter (cm)	3.16	6.08	4.64	16.75	16.38	95.68	33.00
Equatorial diameter (cm)	3.08	5.00	4.27	10.29	9.10	78.23	16.58
Number of flower-clusters/plant	12.20	35.00	18.89	28.59	27.13	90.02	53.02

Table 2. Phenotypic and genotypic correlation coefficient among various characters in tomato

Character	No. of fruits/ plant	Number of fruits/ cluster	Yield/ plant (kg)	Fruit weight (g)	No. of fruit-clusters/ plant	No. of flower-clusters/ plant	Pericarp thickness (cm)	No. of locules/ fruit	Polar diameter (cm)
No. of fruits/cluster	(P) 0.2408*								
	(G)0.3164								
Yield/plant (kg)	(P)0.5948*	0.0234							
	(G)0.6046	0.0319							
Fruit weight (g)	(P)-0.5639*	-0.3296*	0.2319*						
	(G)-0.5533	0.4286	0.2475						
No. of fruit-clusters/plant	(P)0.7967*	-0.3299*	0.5041*	-0.4102*					
	(G)0.8829	-0.1285	0.5459	-0.4704					
No. of flower-clusters/plant	(P)0.8254*	-0.2117*	0.4698*	-0.4708*	0.9490*				
	(G)0.8901	-0.0869	0.4952	-0.5240	0.9727				
Pericarp thickness (cm)	(P)-0.0997	-0.1828**	0.0184	0.1264	-0.0234	0.0026			
	(G)-0.1742	-0.2925	0.0281	0.2070	-0.1484	-0.1238			
No. of locules/ fruit	(P)-0.1224	-0.0747	-0.0604	0.1186	-0.0916	-0.1540**	-0.1621**		
	(G)-0.2778	-0.1294	-0.1295	0.2627	-0.1893	-0.2581	-0.1394		
Polar diameter (cm)	(P)-0.0749	0.0082	0.1348	0.2645*	-0.1531**	-0.1301	0.3222*	-0.0773	
	(G)-0.0730	0.0247	0.1383	0.2749	-0.1746	-0.1405	0.5093	-0.1900	
Equatorial diameter (cm)	(P)-0.2224*	-0.2798*	-0.0605	0.3185*	-0.0954	-0.1378	0.2783*	0.2520*	0.2517*
	(G)-0.2514	-0.4256	-0.0677	0.3607	-0.1410	-0.1694	0.4281	0.5768	0.2000

r at 5% = 0.1487 * Significant only at 5%
r at 1% = 0.1938 ** Significant both at 5% and 1%

Table 3. Direct and indirect values of path coefficient for various characters in tomato

Character	No. of fruits/ plant	No. of fruits/ cluster	Fruit weight (g)	No. of fruit-clusters/ plant	No. of flower-clusters/ plant	Pericarp thickness (cm)	No. of locules/ fruit	Polar diameter (cm)	Equatorial diameter (cm)
No. of fruits/ plant	P=07265	0.1131	-0.4159	0.4230	-0.0920	0.0182	0.0353	0.0115	-0.2250
	G=11.1640	-1.8183	0.5545	-6.0680	-3.3368	0.0633	-0.3056	-0.0246	0.3762
No. of fruits/ cluster	0.1750	0.4698	-0.2431	-0.1752	0.0236	0.0334	0.0216	0.0013	-0.2829
	3.5318	-0.7476	0.4294	0.8831	0.3259	0.1062	-0.1423	0.0083	0.6368
Fruit weight (g)	-0.4097	-0.1549	0.7375	-0.2178	0.0525	-0.0231	-0.0343	-0.0405	0.3221
	-6.1775	2.4632	-1.0021	3.2329	1.9643	-0.0752	0.2889	0.0928	-0.5398
No. of fruit clusters/plant	0.5788	-0.1550	-0.3026	0.5309	-0.1057	0.0043	0.0265	0.0235	-0.0965
	9.8571	0.7385	0.4714	-6.8726	-3.6465	0.0539	-0.2082	-0.0589	0.2111
No. of flower clusters/plant	0.5997	-0.0995	-0.3472	0.5038	-0.1114	-0.0005	0.0445	0.0199	-0.31394
	9.9370	0.7997	0.5250	-6.6848	-3.7489	0.0450	-0.2839	-0.0474	0.25535
Pericarp thickness (cm)	-0.0725	-0.0859	0.0932	-0.0124	-0.0003	-0.1826	0.0468	-0.0494	0.2815
	-1.9443	1.6811	-0.2074	1.0200	0.4641	-0.3632	-0.1533	0.1718	-0.6407
Number of locules/Fruit	-0.0889	-0.0351	0.0875	-0.0487	0.0172	0.0296	-0.2887	0.0188	0.2549
	-3.1017	0.7437	-0.2632	1.3008	0.9677	0.0506	1.0999	-0.0641	-0.8631
Polar diameter (cm)	-0.0544	-0.0039	0.1951	-0.0813	0.0145	-0.0588	0.0223	-0.1533	0.2545
	-0.8150	-0.1421	-0.2755	1.1999	0.5268	-0.1850	-0.2090	0.3374	-0.2992
Equatorial diameter (cm)	-0.1616	-0.1314	0.2349	-0.0506	0.0154	-0.0508	-0.0728	-0.0386	0.1951
	-2.8068	2.4461	-0.3615	0.9693	0.6352	-0.1555	0.6344	0.0675	-1.4964

P explained variation = 0.762 p unexplained variation = 0.238
G explained variation = 0.707 g unexplained variation = 0.293

fruit weight were characters that need to be emphasized upon in improving yield. However, simultaneous improvement in number of fruits/plant and average fruit weight seems far - fetched. The same was reported by Mohanty (2000).

The present investigation was carried out to evaluate various tomato genotypes for genetic diversity. Heritability, genetic advance, correlation coefficient and direct & indirect effects were estimated by path analysis. Both phenotypic good genotypic coefficients of variation were high for

number of flower-clusters per plant, number of fruit-clusters per plant and yield per plant. Total yield per plant had positive and highly significant correlation with number of fruit-clusters per plant, number of flower-clusters per plant and fruit weight. Maximum direct contribution to total yield per plant was made by number of fruits per plant, followed by number of locules per fruit.

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