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Full Length Research Paper

Genetics of fruit yield and it's contributing characters in tomato (*Solanum lycopersicom*)

S. K. Kaushik, D. S. Tomar* and A. K. Dixit

Krishi Vigyan Kendra (KVK), Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya (RVSKVV) M.L. Nagar, Ujjain (M.P.), India.

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Tomato is a premier vegetable crop of round the year and one of the prominent eco-industrial crops of India generating sizeable employment. The present study which consisted 10 genotypes was evaluated in randomized block design replicated thrice at Regional Agricultural Research Station-Ujjain during *Rabi* 2007 to 2008. The variation was maximum (424 to 825 qtl/ha) for fruit yield and minimum for fruit width (4.1 to 5.6 cm). The magnitude of genotypic and phenotypic coefficient of variation was higher for number of leaves (21.2 and 22.3), fruit length (cm) (19.6 and 19.7) and fruit yield (19.6 and 19.6). High values of heritability coupled with high genetic advance were observed for number of leaves at 60 days after transplanting (99.4 and 64.9), and fruit yield (99.9 and 24.7). A positive association of yield per hectare observed with number of leaves at 60 days after transplanting (0.78) followed by number of leaves at 30 days after transplanting (0.68), fruit length (0.66) and plant height (0.51).

Key words: Mean, phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability, genetic breeding, correlation, tomato.

INTRODUCTION

India is the second largest vegetable producer after china with 11% production share in the world. It is second largest producer of tomato followed by potato at global level. Tomato is a premier vegetable crop of round the year and one of the prominent eco-industrial crops of India generating sizeable employment. It is grown at farm and kitchen garden for slice, soup, sauce, ketch-up and vegetable. It is a rich source of vitamins A, B and C. It has medicinal values and used for blood purification and cure of digestive ailments. The average productivity of India is lower than developed nations of the world. The success of any crop improvement programme depends upon the nature and magnitude of the genetic variability existing in breeding material with which plant breeder is working. Effectiveness of selection directly depends on the amount of heritability and genetic advance as percent of mean for that character. Hence, an insight into the magnitude of variability present in available accessions of tomato is of utmost importance to a plant breeder for starting a judicious breeding programme. Therefore, in the present study, an attempt has been made to access the variability in core collection of tomato.

*Corresponding author. E-mail: dsingh_tomar@yahoo.co.in.

MATERIALS AND METHODS

The material for present study consisted of 10 diverse genotypes of tomato. The experiment was evaluated in randomized block design replicated thrice at Regional Agricultural Research Station-Ujjain (Ujjain falls under Xth Agroclimatic zone which comes under the Malwa Plateau of Madhya Pradesh of central zone of India) during *rabi* 2007-08. The 30 days old seedlings were transplanted in raised bed fields of two rows plots of 6 m row length keeping the row-to-row and plant-to-plant distances of 60 and 45 cm, respectively. Recommended agronomic package of practices were followed to raise a good crop. Observations on days to 50 flowering, days to 50% fruiting and fruit yield were recorded on plot basis whereas number of leaves at 30 days after transplanting, number of leaves at 60 days after transplanting, fruit length (cm), fruit diameter (cm), plant height (cm) shelf life at room temperature were recorded on five randomly selected plant basis. The genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV) was estimated as per Burton (1952). Heritability in broad sense (h2bs) and genetic advance as percent of mean (GA) were calculated as per procedure of Johnson et al. (1955) cited by Singh and Chaudhary (1979). Correlation coefficients were computed as per method suggested by Fisher (1918).

Table 1. Analysis of variance for yield and its contributing traits in tomato.

SN	Character	Replication (2)	Genotype (9)	Error (19)
1	Plant height (cm)	0.17	5.45**	0.57
2	Days to 50% flowering	0.63	94.87**	0.26
3	Number of leaves at 30 days after transplanting	0.01	29.68**	0.25
4	Number of leaves at 60 days after transplanting	4.61	2997.30**	5.76
5	Days to 50% fruit setting	0.70	92.36**	0.48
6	Fruit length(cm)	0.003	1.87**	0.004
7	Fruit width (cm),	0.003	0.56**	0.004
8	Fruit shelf life at room temperature	0.30	0.98**	0.19
9	Fruit yield (qtl/ha)	4.80	43267.17**	13.62

*, significant at 0.05 level of probability; **, significant at 0.01 level of probability.

Table 2. Estimation of genetic components and correlation for yield and its components in tomato**.**

SN	Character	Mean	Range		CV	GCV	PCV	h^2_{bs}	GA	GCV/PCV	r-Value
			Min.	Max.	(%)	(%)	(%)				
1	Plant height (cm)	23.2	20.2	26	6.1	5.5	6.4	74.2	2.3	0.9	0.51
2	Days to 50% flowering	46	35	54	11.7	12.2	12.3	99.2	11.5	1.0	-0.16
3	Number of leaves at 30 days after transplanting	35.4	30	41	8.4	8.7	8.8	97.5	6.3	1.0	0.68
4	Number of leaves at 60 days after transplanting	141.6	98	180	21.2	22.3	22.4	99.4	64.9	1.0	0.78
5	Days to 50% fruit setting	72.6	60	79	7.3	7.6	7.7	98.5	11.3	1.0	0.76
6	Fruit length(cm)	4.0	3.0	5.6	18.7	19.6	19.7	99.4	1.6	1.0	0.66
7	Fruit width (cm),	4.6	4.1	5.6	8.9	9.3	9.4	98.0	0.9	1.0	0.03
8	Fruit shelf life at room temperature	4.8	4	6	13.6	10.7	14.0	58.2	0.8	0.8	0.1
9	Fruit yield (qtl/ha)	611	424	825	18.6	19.6	19.6	99.9	24.7	1.0	-

RESULTS AND DISCUSSION

The analysis of variance (ANOVA) revealed significant differences for treatment whereas it was non-significant for replications for all the traits suggesting the presence of degree of variability in the material studied indicating sufficient Similar findings were reported by Pradeepkumar et al. (2001), Haydar et al. (2007), Hidayatullah et al. (2008), Sharma et al. (2009) and Dar and Sharma (2011). The range of variation, correlations and other genetic diversity among the genotypes (Table 1). parameters like genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), genetic advance as percent of mean (GA), heritability in broad sense (h^2_{bs}), etc. are presented in Table 2. The variation was maximum (424 to 825 qtl/ha) for fruit yield as reported earlier by Haydar et al. (2007) followed by number of leaves at 60 days after transplanting (98 to180), days to 50% flowering (35 to 54), number of leaves at 30 days after transplanting (30 to 41), days to 50% fruit setting (60 to 79),plant height (20.2 to 26 cm), fruit length (3.0 to 5.6 cm), fruit shelf life (4 to 6

Table 3. Estimates of phenotypic correlation coefficients among different characters of tomato.

SN	Character	Plant height (cm)	Days to 50% flowering	No. of leaves at 30 DAT	No. of leaves at 60 DAT	Days to 50% fruit setting	Fruit length (cm)	Fruit width (cm)	Fruit shelf life (days)	Fruit yield (Q/ha)
1	Plant Height (cm)	1.00	0.1884	0.4808**	0.5959**	0.7059**	0.0448	-0.1412	-0.1405	0.5059**
2	Days to 50% flowering		1.00	0.1046	0.0840	0.3199	0.4202*	-0.1439	0.0069	0.1615
3	No. of leaves at 30 DAT			1.00	0.6866**	0.7140**	0.2001	0.0579	-0.2090	0.6801**
4	No. of leaves at 60 DAT				1.00	0.6940**	0.3685**	0.2945	-0.2445	0.7829**
5	Days to 50% fruit setting					1.00	0.2515	0.0322	-0.1372	0.7563**
6	Fruit length (cm)						1.00	0.1788	0.1283	0.6607**
7	Fruit width (cm)							1.00	-0.7313**	0.0327
8	Fruit shelf life (days)								1.00	0.0953
9	Fruit yield (Q/ha)									1.00

days) and fruit width (4.1 to 5.6 cm) (Table 3). The characters showing wide range of variation (high CV) offers ample scope for improvement through efficient selection of desirable types. The magnitude of GCV and PCV were almost equal for all the characters except two namely; plant height and fruit shelf life indicating that least influence of environment in expression of these traits whereas in case of plant height and fruit shelf life, the magnitude of PCV was higher than their respective GCV denoting environmental factor influencing their expression. The magnitude of genotypic and phenotypic coefficient of variation was higher for number of leaves at 30 days after transplanting, fruit length (cm) and fruit yield whereas they were low for rest of the characters. The number of leaves at 30 days after transplanting, fruit length (cm) and fruit yield described greater genotypic as well as phenotypic variability among the accession and sensitiveness of the attributes for mating further modifications by selection. Similar observations were also made in tomato by Mohanty (2002a), Singh and Narayan (2004), Mehta and Asati (2008) and Sharma et al. (2009).

The heritability in broad sense ranged from 58.2% for fruit shelf life to 99.9% for fruit yield (qtl/ha). The high heritability was recorded for all the traits studied except fruit shelf life (58%). Similar findings were reported by Pradeepkumar et al. (2001), Haydar et al. (2007) and Hidayatullah et al. (2008). Such high values of heritability for all these characters indicated that they were least affected by environmental modifications and selection based on phenotypic performance would be reliable. The genetic advance as percent of mean (genetic gain) varied from 0.8% for fruit shelf life to 64.9% for number of leaves at 60 days after transplanting. High estimates of genetic gain were obtained for number of leaves at 60 days after transplanting and fruit yield (kg/ha) suggesting that these characters were governed by additive gene effects and selection will be rewarding for improvement of such characters. The finding of Mehta and Asati (2008) and Sharma et al. (2009) were in accordance with the present study. On the contrary, low genetic gain was observed for the rest of the characters indicated that scope of improvement for these characters by simple pure line selection are less in this gene pool. The ratio between genotypic and phenotypic coefficient of variation (GCV/PCV) of all the traits showed near to unity indicating the role of environment factor in the expression of traits would be negligeable which elucidated that they could be improved to a large extent through selection.

The heritability estimates are the better indicators of heritable proportion of variation. The high heritability indicates the effectiveness of selection based on phenotypic but, does not necessarily mean a high genetic gain for a particular character (Swarup and Chougule, 1962). Hence, consideration of both, heritability and genetic advance is more important for predicting effective selection than heritability alone. Johnson et al. (1955) reported that heritability estimates along with genetic advance would be more rewarding than heritability alone in predicting the consequential effect of selection to choose the best individual. High values of heritability coupled with high genetic advance were observed for number of leaves at 30 days after transplanting and fruit yield (kg/ha) indicted that these traits were under the control of addictive

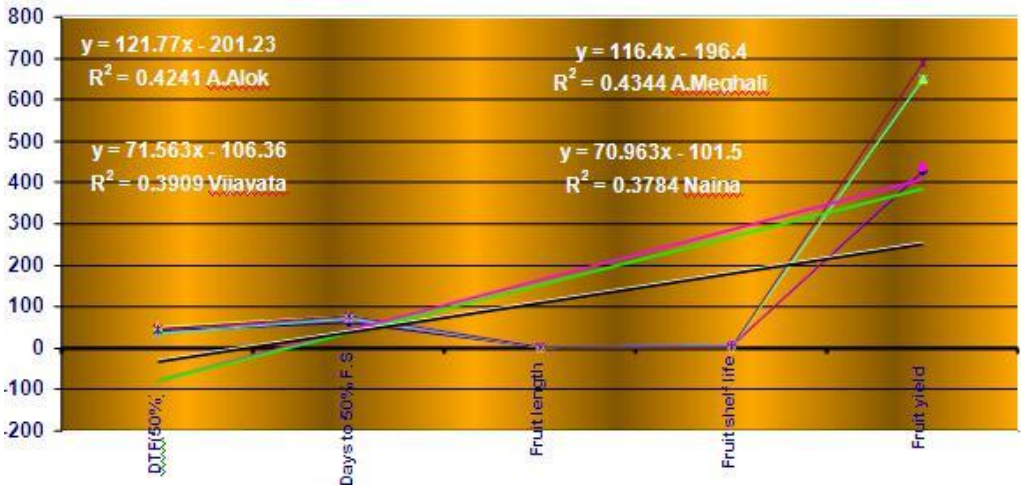

Figure 1. Performance of varieties.

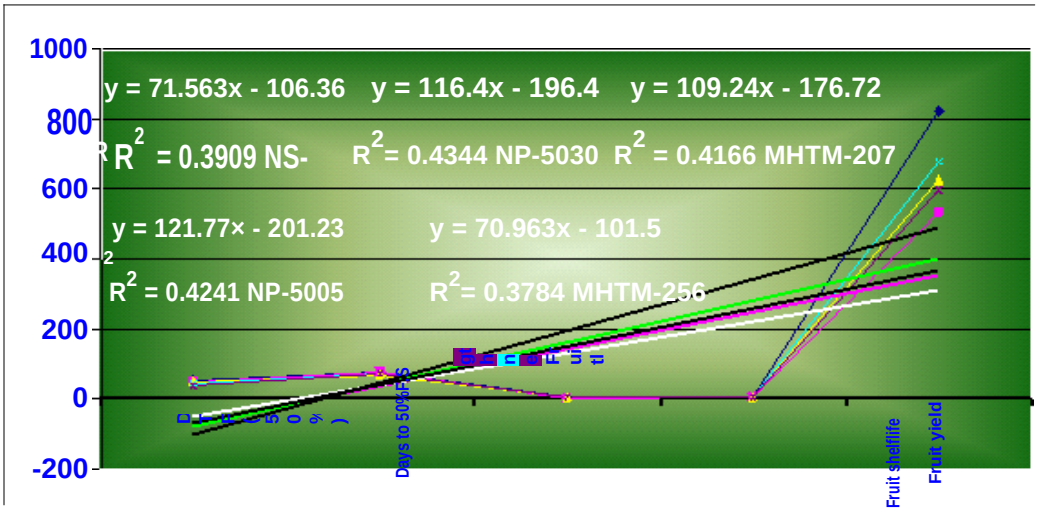

Figure 2. Performance of hybrids.

gene action and directional selection for these characters in the genetically diverse material could be effective for desired genetic improvement. Similar findings were reported earlier by Mohanty (2002a), Mehta and Asati (2008), Sharma et al. (2009) and Ghosh et al. (2010) in tomato.

In the present study, a very strong and positive association of yield per hectare observed with number of leaves at 60 days after transplanting (0.78) as reported by Haydar et al. (2007) followed by number of leaves at 30 days after transplanting (0.68), fruit length (0.66) and plant height (0.51) indicated that these traits are important for selection view point for getting high fruit yield in tomato. On the other hand, days to 50% flowering showed negative correlations with fruit yield in varieties as well as hybrids (Figures 1 and 2). These findings were in consonance with Singh et al. (2002), Laxmi and Mani (2004), Mehta and Asati (2008) and Sharma et al. (2009) indicated that selection of early flowering would be beneficial for attaining higher yield in tomato.

For the foregoing discussion, it can be concluded that high GCV coupled with high heritability and expected genetic gain were observed for number of leaves, days to 50% fruit setting and fruit yield indicating that the variation for the aforementioned characters was most likely due to additive gene effects, hence, simple pure line selection may be effective to improve these characters.

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