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Gene action studies for yield and its contributing characters

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ABSTRACT : Gene effects with respect to its nature and magnitude for yield and its contributing traits were studied by involving 28 cross combinations obtained by crossing 7 lines and 4 testers in Line X Tester fashion. The study revealed higher estimates of s^2sca than s^2gca (average) for yield and most of its contributing traits, While for earliness s^2gca (average) was higher than s^2sca. s^2gca (testers) were higher than. s^2gca (lines) for both yield and earliness. For yield and its contributing traits. s^2_D was again higher than s^2_A. The contribution of lines for marketable yield/plant was 14.56, 12.23, and 4.97 % in 2003, 2005 and pooled analysis, respectively. Contribution of testers for marketable yield/plant was 19.53 in 2003, 47.8 in 2005 and 13.24 in pooled analysis. Line X tester interaction contributed 65.96, 39.96, and 81.79 in 2003, 2005, and pooled analysis, respectively. These results clearly depicts that in majority of yield attributes non additive gene action were in preponderance or in appreciable magnitude lending credence to the already well established practice of exploitation of hybrid vigor in tomato.

Keywords : Tomato, gene action, combining ability, line X tester

INTRODUCTION

Tomato carves for itself a distinct niche in the realm of the vegetable. Due to its adaptability to a wide range of environment with their characteristic, climatic and cultural conditions, as well as its high nutritive values, tomato remains in the focus of the horticultural industry, as is evidenced by an increase in its cultivation, ever since the mid nineteenth century. World wide, tomato is grown in an area of 3.75 MH with production of 101.98 MT as compared to India where area under tomato is just 0.46 MH with 7.28 MT productions. The average productivity in India is just 15.90 t/ha in comparison to 27.20 t/ha in the world. The main reason for low yield is inability to break the yield barriers in the available germplasm. The knowledge of the nature and magnitude of gene effects controlling inheritance of characters related to productivity would add in the choice of efficient breeding methods and thus accelerate the pace of its genetic improvement and also breaking the yield barriers. Breeding methods selected in the absence of such knowledge may not result in appreciable improvement. Considering the importance of such information, an experiment was conducted to understand the gene effects governing various yield and related traits in tomato.

MATERIAL AND METHOD

The present study entitled, "Line x tester analysis involving bacterial wilt resistant genotypes across environments" were carried out at CSK HPKV, Palampur during summer-rainy season of 2003 and 2005. CSK HPKV is situated at 32°6′ N latitude and 76°3′ E longitude at an elevation of 1290.8 m above mean sea level, with very high rainfall.

The experimental material comprised of F_1 population, developed by crossing 7 lines of tomato viz., BT-18 (L1), Rodade (L2), BL-342 (L3), BL-333 (L4), CLN-2123 (L5), CLN-2116 (L6), and CLN-2026 (L7) with 4 testers, namely EC-191536 (T1), PTOM-9802 (T2), Hawaii-7998 (T3) and EC-392698 (T4). Crosses were made manually using the standard procedure of hand emasculation and pollination. The experimental material was grown in Randomized Block Design keeping three replications during summer rainy season at the Vegetable Research Farm of the Department of Vegetable Science and Floriculture, CSK HPKV, Palampur. Each F_1 and parent was grown in a single row of 3.15m length. The plants were placed at 75cm row to row and 45cm plant to plant. Thus, there were 7 plants in each entry per replication.

The data were recorded for the characters viz., days to flowering, days to harvest, gross yield per plant (kg), total fruits per plant, marketable yield per plant (kg), marketable fruits per plant , average fruit weight (g) and plant height in each entry and replication. The data recorded for both the years was pooled later on. The line x tester analysis was carried out as per the method.

RESULTS AND DISCUSSION

The estimates of general combining ability variances σ^2gca, (lines), σ^2gca (testers) and σ^2gca (average), specific combining ability variances (σ^2sca), additive variances (σ^2A), dominance variances (σ^2D) and proportional contribution of lines, testers and their interaction to total variances are presented in Table 1.

The perusal of values Table 1 revealed that the estimates of σ^2sca were higher as compared to σ^2gca

(average) for the traits *viz.*, gross yield/plant, total fruits/plant, marketable yield/plant, marketable fruits/plant and average fruit weight in 2003, whereas in 2005 all the characters except average fruit weight exhibited higher s^2sca than s^2gca (average). In pooled analysis, all the traits except days to harvest depicted higher s^2sca than s^2gca (average). In pooled over years analysis at location I (Palampur), $s^2D > s^2A$ for all the characters except average fruit weight ($s^2A > s^2D$).

Table 1 : Estimation of genetic components of variance and proportional (%) contribution of lines, testers and their interactions in 2003 (P1), 2005 (P2) and pooled (P) at Palampur.

Character		^{2}GCA (Lines)	^{2}GCA (Testers)	^{2}GCA (average)	^{2}SCA	^{2}A	^{2}D	% Contribution Lines	Interaction	Testers
Days to flowering	P1	2.31	0.67	1.49	0.86	2.53	0.86	46.01	14.90	39.10
	P2	0.35	1.28	0.82	8.16	1.88	8.16	22.40	17.84	59.77
	P	1.67	0.37	1.02	5.85	0.52	1.58	32.52	11.97	53.41
Days to harvest	P1	1.83	4.40	3.12	-0.05	6.93	-0.05	26.75	36.84	36.41
	P2	-0.65	0.83	0.09	2.31	0.59	2.31	12.46	21.65	65.90
	P	0.66	2.77	1.72	0.77	-0.25	0.74	21.95	33.10	44.96
Gross yield/plant	P1	-0.01	0.01	0.00	0.19	0.00	0.19	18.32	13.69	67.99
	P2	0.00	0.02	0.01	0.06	0.02	0.06	21.73	24.66	53.60
	P	-0.01	0.00	-0.005	0.04	0.02	0.11	9.85	9.95	80.20
Total fruits/plant	P1	-6.19	16.65	5.23	97.82	16.68	97.82	15.50	22.48	62.01
	P2	7.42	12.07	9.72	73.20	20.70	73.20	25.59	19.48	54.92
	P	-11.47	0.58	-5.45	76.95	26.29	47.04	10.51	13.35	76.14
Marketable yield/plant	P1	-0.01	0.01	0.00	0.07	0.01	0.07	14.56	19.49	65.96
	P2	0.00	0.03	0.02	0.03	0.03	0.03	12.23	47.81	39.96
	P	0.00	0.00	0.00	0.01	0.07	0.14	4.97	13.24	81.79
Marketable fruits/plant	P1	-5.87	23.59	8.86	84.05	25.75	84.05	13.97	28.25	57.78
	P2	0.87	16.69	8.78	21.22	21.88	21.22	16.04	42.18	41.79
	P	-3.62	0.63	-1.50	37.52	25.65	33.87	15.06	13.29	71.65
Average fruit weight	P1	16.15	15.20	15.68	76.79	31.09	76.79	29.21	18.41	52.38
	P2	42.05	20.48	31.27	7.90	56.64	7.90	57.20	24.81	17.99
	P	-0.50	8.26	3.88	41.45	33.77	21.62	19.40	20.27	60.33
Plant height	P1	0.00	0.00	0.00	0.00	0.01	0.00	18.90	45.13	35.98
	P2	0.00	0.00	0.00	0.01	0.00	0.01	10.10	15.85	73.96
	P	0.00	0.00	0.00	0.00	0.00	0.00	14.26	27.80	57.94

The proportional contribution of lines ranged from 13.97 (marketable fruits/plant) to 46.01 (days to flowering) in 2003, 10.10 (plant height) to 57.20 (average fruit weight) in 2005 and 4.97 (marketable yield/plant) to 32.52 (days to flowering) in pooled analysis. The range of proportional contribution of testers were 13.69% (gross yield/plant) to 45.13% (plant height) in 2003, 15.85 (plant height) to 47.81 (marketable yield/plant) in 2005 and 9.95 (gross yield/plant) to 33.10 (days to harvest) in pooled analysis. The proportional contribution of line x tester interaction ranged from 35.98 (plant height) to 67.99 (gross yield/plant) in 2005 and 44.96 (days to harvest) to 80.20 (gross yield/plant) in pooled analysis.

The contribution of line x tester interaction was found to be higher than the individual contribution of lines x testers for all the traits except days to flowering, days to harvest and plant height in 2003; except marketable yield/plant, marketable fruits/plant and average fruit weight in 2005. In 2003, the testers showed a higher σ^2gca than the lines for days to harvest, gross yield/plant, total number of fruits/plant, marketable yield/plant, marketable fruit/plant. σ^2gca (testers) and σ^2gca (lines) were equal for plant height. In 2005, greater σ^2gca (testers) than σ^2gca lines were observed for all the traits except average fruit weight and plant height. Equal σ^2gca (lines) and σ^2gca (testers) were observed for plant height.

In pooled analysis, σ^2gca (testers) were greater than σ^2gca (lines) only for days to harvest, gross yield/plant, total fruit/plant, marketable fruits/plant and average fruit weight. For rest it was equal except days to flowering σ^2gca (lines) > σ^2gca (testers).

In 2003, dominant component of variance (σ^2D) were greater than the additive component (σ^2A) for all the traits except days to flowering, days to harvest and plant height for which σ^2A was greater than σ^2D. Greater σ^2D than σ^2A were revealed for days to flowering, gays to harvest, gross

yield/plant, total fruit/plant and plant height, while these were equal for marketable yield/plant in 2005. For rest σ^2A was higher than σ^2D and for all traits in pooled analysis which again suggests the importance of hybrid vigour in tomato. Days to flowering in 2003 and average fruit weight in 2005 revealed greater contribution of lines than the individual contribution of testers and interaction between line x tester. The contribution of testers was found to be higher than individual contribution of lines and line x testers for days to harvest and plant height in 2003 and marketable yield/plant and marketable fruits/plant in 2005.

The higher magnitude of SCA variances indicates the preponderance of non additive gene action. However, σ^2gca (average) as higher in magnitude in all sets of evironments was not observed for any of the traits studies. The results of analysis of variance was also confirmed from the study of additive (σ^2A) and dominant (σ^2D) components of variances. In all the traits where σ^2sca was higher than σ^2gca (av.), σ^2D was also higher than σ^2A, except for average fruit weight in which σ^2 sca was higher than σ^2gca (av.), but σ^2D was relatively lower than σ^2A. This might attribute to the fact that statistically GCA variance is the additive portion of variability, but it also includes additive X additive and higher orders of epistatic interactions (Matzinger and Kempthorne, 1956).

The results are in broad conformity with the findings of earlier researchers viz., Amaral *et. al.* (1996) , Chadha *et. al.* (1997), Sharma (1998), Sharma (2003), Dhaliwal *et. al.* (2004) with respect to yield and yield attributing traits. Additive gene action for earliness in studies is in the line with the findings of Brandolini (1974).

REFERENCES

Amaral Junior, A. T-do., Casali, V.W.D. Scapim, C. A., Silva, D.J. H-da, Cruz, C.D., Do- Amaral Junior, V. W.D. and Da-Silva, D.J.H. (1996). Diallel analysis of combining ability of tomato cultivars. *Bragantia* **55:** 67-73

Vandoni, G. C. (1974). Breeding tomatoes for fresh consumption. *Italia Agricola* **3**(12)**:** 95-115.

Chadha, S., Vidyasagar and Kumar, J. (1997). Combining ability and gene action studies in tomato involving important bacterial wilt resistant lines. *Himachal Journal of Agricultural Research* **23:** 26-32.

Dhaliwal, M.S., Singh, S., Cheema, D.S. and Singh, P. (2004). Genwtic analysis of important fruit characters of tomato by involving lines possessing mail sterlity genes. *Acta Horticulturae* **637:** 123-132.

Matzinger, D. and Kempthorne, O. (1956). The modified diallel table with partial inbreeding and intraction with environment. *Genetics*. **41:** 822-833.

Sharma, P. (1998). Genetic analysis of fruit yield components and bacterial wilt resistance in tomato (*Lycopersicon esculentum* Mill.). Ph. D. Thesis, Himachal Pradesh Krishi Vishvavidyalaya, Palampur, India.

Sharma, R. (2003). Heterosis and combining ability studies in tomato (*Lycopersicon esculentum* Mill.). M. Sc. Thesis, Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishva Vidyalaya, Palampur, India.