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Triple test cross analysis for yield and yield traits in tomato (*Lycopersicon esculentum* Miller)

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ABSTRACT : The modified triple test-cross analysis was applied to estimate additive (D), dominance (H) and epistatic component of genetic variance for ten quantitative traits of tomato. Three testers, BT-17 and PS-1 and there hybrid (BT-17 x PS-1) were crossed to 15 inbred lines to develop the experimental material. Overall epistasis was important for days to flowering, number of flower/cluster and number of fruit/cluster. Significant estimate of both additive and dominance component were observed for all the characters, except number of branches per plant, number of fruit per cluster, fruit set per cent and number of fruit per plant for additive and plant height, number of branches per plant, number of fruit per cluster, fruit set per cent and number of fruit per plant for dominant component. The F value was positive and significant for number of branches per plant, number of fruit per cluster, number of fruit per plant and fruit size showing is odirectional nature of dominance. Significant of additive components and F parameter showing increasing effect on the characters, indicates that pedidree selection would be effective for improvement of such traits.

KEY WORDS : Modified triple test-cross, Additive, Dominance, Epistatic

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Tomato (*Lycopersicon esculentum* Miller) is an important solanaceous vegetable crop grown throughout India. Some reports on analysis of genetic variation for quantitative traits in tomato are available in literature but there are invariable based on either generation mean analysis involving few crosses or model of second degree statistics developed as summing absence of epistasis. The modified triple test-cross analysis Ketata *et al.* (1976) detect epistasis and estimates additive (D) and dominance (H) component of genetic variance with a high degree of precision using a larger sample of crosses. Therefore, an attempt was made to find out the role of various component was made to find out the role of various component of genetic variance in the inheritance of the ten important traits in tomato during spring-summer seasons using modified triple test cross (TTC) analysis.

RESEARCH PROCEDURE

Two tomato inbred lines , BT-17 (L_1) and PS-1 (L_2) and there hybrid (BT-17 X PS-1) referred as (L_3) were crossed as a tester with 15 pure breeding line of tomato, namely H-24, TC-1, S-12, Pant T-4 , BT-3, NDT-11, Sel-7, Anand T-1, Pusa Ruby, Angoor Lata, H-36, NDT-4, Azad T-2, EC-31515 and EC-1154 develop a set of 45 crosses. The experimental material consisting of 3 testers, 15 lines, 30 single crosses and 15 three-way crosses was evaluated in Randomized Blocks Design with three replications during spring-summer seasons of 1995-96 at Banaras Hindu Universit, Varanasi. The progenies were grown in row of 3 m width at inter row and intra row spacing of 60 and 50 cm, respectively. Observations were recorded on 5 randomly selected plants per plot for 10 quantitative traits (Table 1) and data were used for modified triple test-cross analysis (Ketata *et al.*,1976a and b) and Jinks *et al.* (1969).

RESEARCH ANALYSIS AND REASONING

Analysis of variance of modified triple test-cross to deduct the epistasis revealed that significant epistasi was present for days to flowering, number of flower per cluster and number of fruit per cluster. The epistasis X block was non-significant for all the character (Table 1).The analysis of variance for sums ($L_{1i}.+L_{2i}$) showed that variance due to sums are important for all the character except number of branches, fruit set per cent and number of fruit/plant. However, interaction of sums X block was non-significant for all the characters. When variance due to sums of these character were again tested with interaction item, it was found that sum item was non-significant for number of branches, fruit set per cent and number of fruit/plant. Thus, within family variance were the appropriate error items for testing the significant of major component.

The test of significant of differences ($L_{1i}.-L_{2i}$) item was also important for all the traits except plant height, number of branches, fruit set per cent and number of fruits per plant. The interaction component was not important for any traits. When these interaction items were used as determinate for testing the significance of difference variance, the significance of difference item was confirmed for all the characters except plant height,

Table 1 : Analysis of variance for the test of epistasis in 2nd modified triple test cross model for different characters in tomato

Source	d.f.	Plant height	No. of branches	Days to flowering	No. of flower/ cluster	No. of fruit/ cluster	Fruit set %	No. of fruit / plant	Fruit size	Fruit weight	Yield/ plant
Epistasis ($L_{1i}.+L_{2i}+Pi$)	14	155.22	2.07	27.30**	0.29**	0.28*	8.94	53.56	0.15	27.35	0.11
Epistasis X block	28	28.06	0.66	1.49	0.03	0.04	1.85	16.91	0.06	7.94	0.05
Within families	540	120.51	2.55	3.97	0.06	0.09	12.29	77.72	0.14	20.26	0.14

* and ** indicate significance of values at P=0.05 and 0.01, respectively

Table 2 : Analysis of variance for sums and differences in 2nd modified triple test cross model for different character in tomato

Source	d.f.	Plant height	No. of branches	Days to flowering	No. of flower/ cluster	No. of fruit/ cluster	Fruit set %	No. of fruit / plant	Fruit size	Fruit weight	Yield/ plant
Sums ($L_{1i}.+L_{2i}$)	14	378.5**	2.76	13.85**	1.16**	0.68**	6.74	122.32	0.63**	101.92**	0.70**
Sum x Blocks	28	21.05	0.65	2.54	0.05	0.04	4.02	21.20	0.04	6.95	0.08
Differences ($L_{1i}.-L_{2i}$)	14	238.65	5.16	39.73**	0.41**	0.26**	11.38	108.54	0.74**	107.12**	0.47**
Differences x block	28	27.61	0.97	4.32	0.06	0.07	2.99	10.36	0.07	6.23	0.03
Within families	360	122.56	2.67	4.06	0.10	0.12	9.67	86.24	0.20	23.16	0.17

* and ** Indicate significance of values at P=0.05 and 0.01, respectively

Table 3 : Estimate of additive (D), dominance (H), genetic components of variance and other estimates in modified triple cross model for different characters in tomato

Genetic component and other estimates		Plant height	No. of branches	Days to flowering	No. of flower/ cluster	No. of fruit/ cluster	Fruit set %	No. of fruit / plant	Fruit size	Fruit weight	Yield/ plant
TTC	D	341.25**	0.12	13.06**	1.41**	0.75	-3.91	48.10	0.57**	105.01**	0.71**
families	H	154.78	3.32	47.56**	0.41**	0.19**	2.28	29.73	0.72**	111.95**	0.40**
	F	65.48**	2.03**	-0.67	0.06	0.08**	0.08	16.59**	0.12*	0.65	-0.03
	r (RF)	-0.36**	0.42**	0.05	-0.14	-0.34**	-0.16	-0.25*	-0.29*	-0.01	0.08
	$(H/D)^{½}$	0.68	1.78	1.91	0.54	0.50	-0.76	0.42	1.12	1.03	0.75

Note:- RF= 'r' value to show the significance of 'F' parameter *and ** indicate significance of values at P=0.05 and 0.01, respectively number of branches, fruit set per cent and number of fruits per plant.

The variance due to sums (L_{1i}. +L_{2i}) were used for estimating additive (D) component of genetic variation, whereas the variance due to differences (L_{1i}.-L_{2i}) item were used for estimation of dominance (H) component (Table 3). The estimate of both additive and dominance components were significant for all the characters, except number of branches per plant, number of fruit per cluster, fruit set per cent and number of fruit per plant for additive and plant height, number of branches per plant, number of fruit per cluster, fruit set per cent and number of fruit per plant for dominant component. In general, the estimate of additive component were grater in magnitude than the dominant component for most of the except number of branches per plant, days to flowering, fruit set per cent and fruit size. The presence of common alleles in the tester increases the magnitude of additive component.

The directional element F was estimated from the covariance of the sums and differences and its significance was tested in directly as the correlation r (RF) of sums and differences. When the value of r (RF) and F were considered together it was found that the estimate of directional element (F) was important and significant for plant height, number of branches per plant, number of fruit per cluster, number of fruit per plant and fruit size. The related isodirectional nature of dominance, suggesting that gens with increasing effects were most predominant for this traits. The positive and non-significance value of F for number of flower per cluster, fruit set per cent and fruit weight suggested am bidirectional nature of dominance.

It may be argued that epistasis or dominance do not have much of the directional element. Nanda *et al.* (1982) also did not observed the confounding effects of F with dominance for most of the traits in triple test cross analysis in wheat. However, the possibility of confounding of directional element with epistasis and dominance cannot be underrated as the component F was presented along with high co-efficient of dominance and epistasis assessed for plant height, number of branches per plant and number of fruit per plant.

The dominance $(H/D)^{½}$ was in the range of partial dominance for most of the traits. Tall plant, more flower and fruit number/cluster, large fruit size and heavy fruit weight appears to be dominant in this investigation. Similar result were also reported in pea (Singh *et al.*, 1986 and 1987). The overall degree of dominance suggested that most of the character studied are controlled predominanantly by additive gene effects, however, dominance and epistatic components played a major role in controlling the expression of different traits which was also reported in pea (Singh *et al.*, 1986 and 1987).

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