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GENERATION MEAN ANALYSIS FOR YIELD AND COMPONENT TRAITS IN TOMATO (*LYCOPERSICAN ESCULENTUM* MILL.)

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Abstract

Generation mean analysis was studied among eight traits in the cross EC – 461070 × MTM Local of tomato for six generations in randomized block design with three replications at Research Form, College of Agriculture, Vellayani, Thiruvananthapuram, Kerala Agricultural University. The results revealed that, Predominance of non-fixable (dominance and dominance × dominance) gene effects for weight of fruits per plant, number of days to first fruit harvest, number of days to first flowering, spread of the plant and number of branches per plant indicates that there is much scope for heterosis breeding.

Key words : Yield, Component traits and *Lycopersicon esculentum* Mill.

Introduction

Tomato (*Lycopersicon esculentum* Mill.) belongs to the family Solanaceae. It is an important vegetable crop and particularly now a commercial crop widely grown all over tropical, sub-tropical and temperate regions of the world both fresh and processing purpose. It is a rich source of Vitamin A, C and minerals. Popularity of this crop is due to wider adoptability, high yield potential, acceptable flavor, nutritive value and variety of uses in processing industries. Therefore, it is indispensable to understand the genetics of yield and its component traits to develop the cultivars with good quality suitable for fresh consumption and processing industries.

Generation mean analysis is a simple and useful technique for characterizing gene effects for a polygeneic character. The presence of non –allelic interaction was detected by scaling tests proposed by Mather (1949). Additive (D) and dominanace (H) components and genetic variance were estimated using the mean and variance of six generations viz., P_1, P_2, F_1, F_2, B_1 and B_2. The greatest merit of generation mean analysis is that helps in the estimation of epistasis gene effects namely additive × additive (i), additive × dominance (j) and dominance × dominance (l). The generation mean analysis was carried out in selected cross obtained from the Line × Tester programme. Any one or the scaling tests were found to be significant in all traits indicating the presence of epistasis. The types of epistasis was determined as complementary when dominance (h) and dominance × dominance (l) gene effects have same sign and duplicate epitasis when the sign was different. Keeping this view, six parameter model was suggested by Hayman (1958) was used for statistical analysis.

Materials and Methods

A field investigation was carried out with six generations namely P_1, P_2, F_1, F_2, B_1 and B_2 of a cross EC 461070 ×MTM local. The experiment was laid out in a randomized block design with three replications. The study was carried out at Research Form, College of Agriculture, Kerala Agricultural University, Vellayani, Thiruvananthapuram. Twenty five days after sowing the seedlings were transplanted in the main field. The seedlings were planted at a spacing of 60 cm × 60 cm. The cultural and management practices were done as per "Package of practices recommendations" of Kerala Agricultural University (KAU, 1996). The observations recorded for traits i.e., plant height, number of branches per plant, spread of the plant, number of days to first flowering, number of days to first fruit harvest, number of fruits per plant, weight of fruits per plant and weight of individual fruit. The presence of non-allelic interaction was detected by scaling tests proposed by Mather (1949). Hayman (1958) and Jinks and Jones (1958) to detect and estimate the additive (d), dominance (h) and genetic interactions viz., additive × additive (i), additive × dominance (j), dominance × dominance (l). The variation in all the eight characters studied suggesting the usefulness of the estimation of additive, dominance and epistatics interaction.

Results and Discussion

Generation mean analysis was carried out to study the nature of gene action governing the inheritance of yield and yield components of tomato in the present study. The best combiner (EC 461070 × MTM Local) was identified from the evaluation of Line × Tester crosses was utilized for generation mean analysis and the results were discussed.

Plant Height

The F_1 hybrid recorded highest value among the generations and the male parent P_2 (MTM Local) registered the lowest value for this character in the cross EC 461070 × MTM Local. The mean value of F_2 (82.28 cm) was less than that of F_1 (95.67 cm) for this cross. The scales A,B and C were significant indicating the presence of dominance effect (h) and additive × additive (i) interaction effects indicated that selection alone may not yield desirable progenies. Similar results were reported by Ghosh and Syamal (1995). Improvement of this character should be based on simultaneous exploitation of additive, dominance and epitasis mainly of additive × additive type.

Number of Branches per Plant

The highest values (20.86) was recorded by B_1 (EC 461070 × MTM Local × EC 461070) and the lowest (11.90) by P_2 (MTM Local). The scales A, C and D were significant indicating the presence of non-allelic interaction. Significance of C and D scales suggests presence of additive × additive and dominance × dominance type of gene interactions. This result is in agreement with that of Ramamohan (1988). For improving number of branches per plant in this cross, combination breeding is the appropriate method. Heterosis breeding is also suitable because of the presence of non – fixable (dominance and dominance × dominance) gene effects for this trait.

Spread of the Plant

The cross B_1 (EC 4610710 × MTM Local × EC 461070) expressed the maximum value (72.79 cm) and P_2 (MTM local recorded minimum value 55.67 cm) for this character. Scales A and D were significant. Significance of the scaling test indicating the presence of non allelic gene interaction. All the genetic components were found to be significant in this cross. The magnitude of dominance (h) gene effects and dominance × dominance (l) were found to be greater than additive gene effect in this cross. The high magnitude of non – additive gene effects, low magnitude of additive gene effects suggest that, heterosis breeding or combination breeding is the appropriate method for improving this trait.

Number of Days to First Flowering

The maximum (52.90 days) and minimum (46.63 days) values for this trait was observed respectively in P_2 and F_1 for this cross. Scales A, B and C were significant indicating the presence of all the three types of non-allelic gene interactions. The dominance (h) and dominance × dominance (l) type of interaction were predominant for this cross. This indicated that selection in the early segregating generation might not yield desirable progenies. For improving earliness in this cross heterosis breeding or combination breeding is appropriate method.

Number of Days to First Fruit Harvest

The highest value (94.95 days) was recorded by F_2 and lowest (89.60 days) by P_2 (MTM Local). Significance of scales A,C and D indicate the presence of non-allelic interactions. The dominance (h) and additive × additive (i) type of interaction recorded higher values. Improvement of this trait therefore can be achieved through recurrent selection, Heterosis breeding is the most appropriate approach for exploiting earliness in this cross.

Number of Fruits per Plant

In this cross F_1 (EC 461070 × MTM Local) recorded maximum value (37.90) and P_2 MTM Local recorded minimum value (21.63). Scales C and D were significant in this cross. Only the additive effect (d) was found to be positive and significant in this cross which indicate that improvement for number of fruits per plant can be achieved by simple selection. The opposite signs of 'h' and 'l' indicate duplicate interaction. As observed in this study, Sonone *et al.* (1986) also reported the importance of additive gene action for number of fruits per plant.

Weight of Fruits per Plant

The maximum and minimum values were recorded by F_1 (3084.00 g) and P_2 (1585.50 g) respectively. Significance of B scale indicates the presence of non-allelic interaction. The additive (d) and dominance (h) were positive and significant for this trait. This agrees with the findings of Patil (1985) and Somraj *et al.* (2018). Predominance of dominance effect was observed in the inheritance of this trait. For exploiting this type of gene effects the appropriate breeding method would be heterosis breeding.

Weight of Individual Fruit

The highest average fruit weight was recorded by F_1 (86.03g) and the lowest by P_1 (64.83g) EC 461070. Significance of scales C and D were detected in this cross indicating the presence of additive × additive and dominance × dominance type of gene interactions. The dominance (h) and additive × additive (i) type of interaction recorded high value than others. Improvement of this trait therefore can be achieved through recurrent selection. The opposite sings of 'h' and 'l' indicated the presence of duplicate interaction.

From this investigation, it is concluding that single breeding approach cannot be followed to improve all the characters under study. Predominance of non – fixable (dominance and dominance × dominance) gene effects for weight of fruits per plant, number of days to first fruit harvest, number of days to first flowering, spread of the plant and number of branches per plant indicated that there is much scope for heterosis breeding.

Table 1 : Generation means and ±SE m of yield traits in EC 461070 × MTM Local

Generations	Plant height, cm	Number of branches per plant	Spread of the plant, cm	Number of days to first flowering	Number of days to first fruit harvest	Number of fruits per plant	Weight of fruits per plant, g	Weight of individual fruit, g
P_1	85.03±0.86	18.77±0.54	70.03±1.24	50.20±0.52	94.50±0.24	36.07±1.49	2183.50±100.12	64.83±0.80
P_2	69.00±0.86	11.90±0.30	55.67±1.12	52.90±0.34	89.60±0.30	21.63±0.53	1585.50±39.93	77.83±1.03
F_1	95.67±1.28	19.17±0.52	68.23±1.10	46.63±0.37	89.90±0.29	37.90±1.17	3084.00±88.05	86.03±0.91
F_2	82.28±0.74	16.09±0.26	64.02±0.63	50.94±0.25	94.95±0.35	36.59±0.93	2430.72±57.77	72.07±0.95
B_1	87.94±0.63	20.86±0.44	72.79±0.63	49.80±0.29	93.38±0.28	37.07±1.20	2532.22±88.79	74.32±1.17
B_2	79.49±0.71	16.13±0.27	62.58±1.08	51.42±0.23	90.17±0.29	28.90±0.93	2171.23±47.79	82.44±1.13

Table 2 : Scale values and ± SE m of yield traits in EC-461070 x MTM Local

Scale	Plant height, cm	Number of branches per plant	Spread of the plant, cm	Number of days to first flowering	Number of days to first fruit harvest	Number of fruits per plant	Weight of fruits per plant, g	Weight of individual fruit, g
A	-4.81*±1.99	37.88**±1.16	7.31**±2.08	2.77**±0.87	2.36**±0.67	0.17±0.17	-203.06±222.06	-2.22±2.63
B	-5.69**±2.09	1.20±0.81	1.26±2.66	3.31**±0.69	0.83±0.71	-1.73±2.27	-327.03*±135.96	1.02±2.64
C	-16.26**±4.11	-4.62**±1.60	-6.10±3.74	7.41**±1.38	15.90**±1.56	12.86**±4.66	-214.11±309.87	-26.47**±4.42
D	-2.88±1.76	-4.80**±0.74	-7.33**±1.77	0.67±0.62	6.36**±0.80	7.21**±2.40	157.99±153.34	-12.63**±2.51

Table 3 : Estimate of additive, dominance and epistasis for yield traits of tomato (6 parameter model in EC 461070 x MTM Local)

Genetic component	Plant height, cm	Number of branches per plant	Spread of the plant, cm	Number of days to first flowering	Number of days to first fruit harvest	Number of fruits per plant	Weight of fruits per plant, g	Weight of individual fruit, g
m	82.28**±0.74	16.09**±0.26	64.02*±0.63	50.95**±0.25	94.95**±0.35	36.59**±0.93	2430.72**±57.76	72.07**±0.95
d	8.46**±0.94	4.72**±0.52	10.21**±1.25	-1.62**±0.38	3.21**±0.40	8.17**±1.52	360.99**±100.83	-8.12**±1.63
h	24.41**±30.80	13.43**±1.59	20.05**±3.81	-6.25**±1.33	-14.86**±1.64	-5.37±4.99	883.52**±323.59	39.97**±5.14
i	5.76±3.53	9.60**±1.48	14.67**±3.55	-1.33±1.24	-12.71**±1.61	14.42**±4.79	-315.98±306.68	25.27**±5.01
j	0.44±1.13	1.29*±0.61	3.03*±1.50	-0.27±0.49	0.76±0.45	0.95±1.71	61.99±114.33	-1.62±1.75
i	4.74±5.59	-14.58**±2.63	-23.23**±6.23	-4.74±2.04	9.52**±2.24	15 99**±7.65	846.07±508.61	-24.07**±7.86

Table 4 : Estimate of heterosis, epistasis and percentage of transgressive segregants in ECT461070 x MTM Local

SI. No	Character	Heterotic effect (h+l)-(d-i)	Sign of h, 1	Epistasis duplicate complements	Transgressive segregants (%) in F_2
1.	Plant height, cm	26.45	+h, +1	Complementary	28.33
2.	No. of branches per plant	-6.03	+h, -1	Duplicate	21.11
3.	Spread of the plant, cm	-7.64	+h, -1	Duplicate	15.56
4.	No. of days to first flowering	-13.94	-h,-1	Complementary	40.00
5.	No. of days to first fruit harvest	-20.96	-h, +1	Duplicate	10.55
6.	No. of fruits per plant	-11.97	-h, +1	Duplicate	42.22
7.	Weight of fruits per plant, g	1052.62	+h, +1	Complementary	56.11
8.	Weight of individual fruit, g	49.29	+h, -1	Duplicate	36.66

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