GENERATION MEAN ANALYSIS FOR SOME QUALITY TRAITS IN TOMATO (*LYCOPERSICON ESCULENTUM* MILL.)

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Abstract

Generation mean analysis was studied among seven quality traits in the cross EC 461070x MTM Local of tomato for five generations in randomized block design with three replications at Research Form, College of Agriculture, Vellayani, Thiruvananthapuram, Kerala Agricultural University. The results revealed that number of seeds per fruit, pericarp thickness, vitamin C content, carotene content, pH of juice, TSS%, sugar content and shelf life were governed by duplicate epistasis and number of locules per fruit is governed by complementary interaction.

Key words : Tomato (Lycopersicon esculentum), sugar content, locules per fruit, vitamin C content.

Introduction

Tomato (*Lycopersicon esculentum* Mill.) is one of the most important vegetable crops grown throughout the world because of its wider adaptability, high yielding potential and used as a raw material for processing industries.

It is a rich source of vitamins A, C, minerals and potassium. In the world, it ranks second in importance after Potato but tops the list of processed vegetables (Chaudhary, 1996). The ripe fruits are taken as raw or made into salads, soups, pickles, Ketchup and many other products. Therefore, it is indispensable to understand the genetics of quality characters to develop the cultivars with good quality suitable for fresh consumption and processing industries.

Generation mean analysis is a first degree statistics and a simple but useful technique for characterizing gene affects for a polygenic character (Hayman, 1958), which determines the presence and absence of non-allelic interactions. The greatest merit of generation mean analysis is that helps in the estimation of epistasis gene effects namely additive x additive (i), additive x dominance (j) and dominance x dominance (l). The generation mean analysis was carried out in selected cross obtained from the Line x Tester tester programme. Any one or both the

scaling tests were found to be significant in all the traits indicating the presence of epistasis. The type of epistasis was determined as complementary when dominance (h) and dominance x dominance (l) gene effects have same sign and duplicate epistasis when the sigh was different. Keeping the above view, five generations of tomato have been studied to estimate the genetics of quality characters in tomato.

Materials and Methods

An field investigation was carried out with five generations namely, P_1, P_2, F_1, F_2, B_1 and B_2 of cross EC461070 $\times$ 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 $\times$ 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., number of locules per fruit, number of seeds per fruit, pericarp thickness, vitamin C, carotene, pH of juice, TSS, sugar content and shelf life. 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 ten characters studied suggesting the usefulness of the estimation of additive, dominance and epistatic interaction.

Results and Discussion

Generation mean analysis was done to study the nature of gene action governing the inheritance of quality traits in tomato in the present study. The best combiner (EC-461070 × MTM Local) identified from the evaluation of line × tester crosses was utilized for generation mean analysis and the results are discussed.

Number of locules per fruit

In this cross, F_1 expressed the maximum value (3.70) and P_2 (MTM local) expressed minimum value. Scale A, B, and C are significant indicating the presence of non allelic interaction. In this cross, only dominance × dominance (l) type of interaction was significant and positive. Khattra *et al.* (1992) reported that dominance × dominance type of epistasis interaction is governing number of locules per fruit. This is in accordance with the present findings. Heterosis can be resorted for the improvement of this character.

Number of seeds per fruit

Parents P_2 and P_1 recorded the maximum (95.82) and minimum (59.63) values respectively for this trait. Scales A and B were significant. The non significance of C and D scales revealed the absence of additive x additive and dominance × dominance type of gene interactions. The significance of additive effect (d) was greater than dominance effect (h) indicating the predominance of additive gene action in controlling this character. The importance of additive effect in governing this trait reported by Varghese (1998) supports this finding. For the improvement of the trait in this cross, direct selection may be advocated. In this trait, the 'h'

and 'l' effects had opposite signs indicating duplicate type of gene action.

Pericarp thickness

Parents P_2 and P_1 expressed the highest (6.56mm) and lowest (4.43mm) values respectively. Significance of scales C and D were detected in this trait indicating the presence of additive × additive and dominance × dominance type of gene interactions. The magnitude of dominance (h) and additive × additive (i) type of interaction were greater than the other components indicating the predominance of dominance and epistatic components mainly additive × additive type in controlling this trait. Therefore, in order to improve this trait, recurrent selection is advocated. In accordance with the present findings of Ghosh and Syamal (1995) also reported that dominance effects governing the pericarp thickness. The 'h' and 'l' had opposite sign, indicating the presence of duplicate type of gene action.

Vitamin C

For this trait parent P_2 (MTM Local) (25.13mg) and B_2 (EC 461070 × MTM Local × MTM Local) expressed maximum value and F_2 expressed the minimum value. All the scales A, B, C and D were non significant, indicating the absence of non allelic interaction. Similar results were reported by Somraj *et al.* (2017). The magnitude of additive effect (d) was greater than dominance and interaction effects and hence simple selection is advocated for the improvement of this character.

Carotene

For this trait F_1 recorded maximum value (1960.00 μg). Of the four scales, Scale C registered negative significant value. The magnitude of dominance (h) gene effects was found to be greater than other effects. The high magnitude of non-additive gene effects and low magnitude of 'd' component suggest that this trait can be improved by recurrent selection. Heterosis breeding is the appropriate breeding method for exploiting higher carotene content in tomato fruits.

Table 1 : Generation means and ± SEm on quality traits in EC-461070 × MTM Local.

Generation	Number of locules per fruit	Number of seeds per fruit	Pericarp thickness, mm	Vitamin C, mg	Carotene, μg	pH of juice	TSS, %	Sugar content, %	Shelf life, days
P_1	3.58±0.15	59.63±6.59	4.43±0.21	22.05±1.03	2173.33±121.29	4.59±0.06	4.66±0.07	3.63±0.11	11.33±0.88
P_2	3.09±0.05	95.82±5.89	6.56±0.08	25.13±1.02	1960.00±60.28	4.71±0.04	3.59±0.09	2.85±0.02	26.67±1.76
F_1	3.70±0.12	85.93±5.50	6.31±0.06	22.05±1.03	2450.00±147.99	4.59±0.03	4.88±0.06	3.37±0.17	21.00±1.15
F_2	3.24±0.07	76.54±4.48	5.14±0,27	22.04±0.81	1866.00±89.60	4.51±0.03	4.36±0.07	3.29±0.11	I9.33±1.26
B_1	3.26±0.10	95.35±3.67	5.13±0.15	21.28±0.62	2163.33±100.22	4.55±0.03	4.55±0.05	3.54±0.06	14.67±1.17
B_2	3.18±0.07	63.98±2.95	6.32±0.10	25. 13±0.65	1986.67±81.31	4.49±0.06	4.24±0.07	2.95±0.11	22.33±0.95

Table 2 : Scale values and ±SEm on quality traits in EC-461070 × MTM Local.

Scale	Number of locules per fruit	Number of seeds per fruit	Pericarp thickness, mm	Vitamin C, mg	Carotene, µg	pH of juice	TSS, %	Sugar content, %	Shelf life, days
A	-0.77**±0.277	45.13**±11.29	-0.46±0.36	-1.54±1.91	-296.67±277.11	-0.08±0.09	-0.22**±0.15	0.08±0.23	-3.0±2.76
B	-0.44**±0.19	-53.79**±9.99	-0.24±0.22	3.08±1.95	-436.67±227.99	-0.32*±0.14	0.22±0.19	-0.32±0.28	-3.00±2.84
C	-1.11**±0.40	21.16±22.81	-3.04**±1.10	-3.08±4.09	-1569.33**±484.13	-0.43**±0.17	-0.14±0.33	-0.03±0.56	-2.67±5.88
D	0.05*±0.19	-6.25±10.12	-1.17*±0.56	-2.31±1.84	-417.99±220.83	-0.01±0.10	-0.07±0.17	0.10±0.25	1.67±2.94

Table 3 : Estimate of additive, dominance and epistasis for quality traits in tomato (6 parameter model in EC-461070 × MTM Local.

Genetic component	No. of locules per fruit	No. of seeds per fruit	Pericarp thickness, mm	Vitamin C, mg	Carotene, µg	pH of juice	TSS, %	Sugar content, %	Shelf life, days
m	3.24**±0.07	76.54**±4.48	5.14**±0.27	22.05**±0.81	1866.00*±86.60	4.51**±0.03	4.36**±0.07	3.29**±0.11	19.33**±1.26
d	0.08±0.12	31.36**±4.71	-1.17**±0.18	-3.85±0.90	176.67±129.06	0.06±0.07	0.31**±0.09	0.59**±0.12	-7.67±1.51
h	0.26±0.40	20.71±21.44	3.16**±1.13	3.08±3.89	1219.33**±470.69	-0.03±0.20	0.67±0.35	-0.07±0.53	-1.33±6.07
i	-0.11±0.38	12.50±20.24	2.34±1.12	4.62±3.68	836.00±441.66	0.03±0.19	0.14±0.34	-0.20±0.50	-3.33±5.88
j	-0.16±0.14	49.46**±6.45	-0.11±0.21	-2.31±1.15	70.00±145.75	0.12±0.08	-0.22±0.11	0.20±0.14	-0.00±1.81
l	1.32±0.63	-3.84±29.57	-1.64±1.31	-6.15±5.45	-102.67±707.72	0.38±0.33	-0.14±0.49	0.43±0.75	9.33±8.44

pH of juice

The parent P_2 (MTM Local) AND B_2 (EC-461070 × MTM Local × MTM Local) recorded maximum (4.71) and minimum (4.49) values respectively. Significance of scales B and C indicate the presence of non allelic interactions. The epistatic gene action dominance × dominance type of interaction governing pH of juice was previously reported by Khattra *et al.* (1992). This is in agreement with the present finding. Improvement of this trait therefore needs recurrent selection. The opposite signs of 'h' and 'l' indicated the presence of duplicate interaction.

Total soluble solids (TSS)

The F_1 and the P_2 (MTM Local) recorded the maximum (4.88%) and minimum (3.59%) values, respectively. Significance of scale A indicate the presence of non allelic interaction. Significance of additive (d) gene effect alone indicating that by simple selection the character can be improved.

Sugar content

Parents P_1 and P_2 expressed the highest (3.63%) and lowest (2.85%) values respectively for this trait. All the four scales A, B, C and D were non significant, indicating the absence of non allelic interaction for this character. The magnitude of additive effect (d) was greater than dominance and interaction effects for this character and hence simple selection is advocated for the improvement of this character.

Shelf life

Parents P_2 and P_1 had maximum (27.67 days) and minimum (11.33 days) values, respectively. All the four scales A, B, C and D were non-significant, indicating the absence of non allelic interaction for this trait. The magnitude of additive effect (d) was greater than dominance and interaction effects in this trait and hence for improvement of this character simple selection is suitable.

From the present investigation, it is concluded that single breeding approach cannot be followed to improve all the characters under study, predominance of non-fixable (dominance and or dominance × dominance) gene effects for pericarp thickness and carotene content of fruit indicated that there is much scope for heterosis breeding and predominance of fixable (additive and or additive × additive) gene effects exhibited for number of seeds per fruit, TSS, sugar content and shelf life indicate these characters can be improved through pure line breeding.

Table 4 : Estimate of heterosis, epistasis and percentage of transgressive segregants in EC-461070 x MTM Local.

S.no.	Character	Heterotic effect (h+l)-(d-i)	Sign of h, l	Epistasis, duplicate complements	Transgressive segregants (%) in F_2
1.	No. of locules per fruit	1.39	+h, +l	Complementary	6.66
2.	No. of seeds per fruit	-1.99	$_+$h, -l	Duplicate	13.33
3.	Pericarp thickness, mm	5.03	+h, -l	Duplicate	13.33
4.	Vitamin C, mg	5.40	+h, -l	Duplicate	26.66
5.	Carotene, µg	1775.99	+h, -l	Duplicate	20.00
6.	pH of juice	0.32	-h,+l	Duplicate	73.33
7.	TSS, %	0.36	+h,-l	Duplicate	13.33
8.	Sugar content, %	-0.43	-I, + h	Duplicate	33.33
9.	Shelf life, days	12.34	-h, +1	Duplicate	13.83

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