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MODE OF INHERITANCE OF EARLINESS IN TOMATO (*Lycopersicon esculentum* Mil l.)

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ABSTRACT: Two tomato genotypes, i.e., the line S_{65}-R_2 and the cultivar Super Strain B were used as parents in studying the inheritance of earliness. Populations studied were the parents. F_1, F_2, Bcp_1 and Bcp_2 of the cross "S_{65}-R_2 × Super Strain B". A Randomized Complete Block Design was used. Data obtained indicated that the number of days to first ripe fruit is controlled by single pair of genes with dominance to the short period to maturity and presence of additive gene effects. Early yield as fruit number is controlled by one pair of major genes with over-dominance of the large number of fruits. Furthermore, the expression of heterosis requires the presence of many minor genes. Early yield as fruit weight is controlled by several number of genes with over-dominance for high early yield. The superiority of the F_1 population encourage the development of hybrid cultivars for early production.

Key words: *Tomato, inheritance, early and total yield, additive, dominance.*

INTRODUCTION

Earliness of maturity is an important factor in usefulness of vegetable crops. Early tomato cultivars are financially important especially in the countries where the season is short. Earliness extends the harvest season makes tomato harvest more manageable to the grower. For the process its means more efficient in plant operation through more even delivery of row product to the factory.

Earliness in tomato usually measured either by the number of days from transplanting to first ripe fruit or by number and weight of fruits per plant harvested in the first three harvests. Hassan *et al.* (1982), Nassar (1982), Nassar *et al.* (1984) and Nassar (1986). Nassar (1988) reported that, about 86% of the variability in early yield among hybrids or cultivars of tomato was dependent on genotype.

The inheritance and types of gene actions were studied for earliness by many investigators. Khalil *et al.* (1983) studied the mode of inheritance of number of days from transplanting to first flower anthesis and number of days from transplanting to first ripe fruit using the progenies of the cross "K.J. × K.E.". They found that, a single major gene apparently control most of the genetic variability in the two earliness factors. They added that, the additive gene action was observed for number of days to flowering.

Meanwhile, complete dominance of the short period to maturity was observed. Furthermore, the expression of dominant genes requires the presence of many minor genes. High heritability and high genetic advance under selection were calculated, indicating that considerable progress can be realized by selection for the short period to maturity. Also, the obtained results suggested that, the dominance of short period to maturity facilitates to considerable extent the breeding of early hybrid cultivars in tomato.

Genetic variation, heritability and genetic advance analysis for many traits were conducted, using 20 tomato cultivars, by Singh *et al.* (2001). High heritability with high genetic advance were found for number of days to flowering and number of days to 30% fruit ripening, indicating that selection for these characters may be beneficial for improvement of tomato. High heritability along with high genetic advance for days required to ripening were also observed by Sashikala *et al.* (2002), suggesting the effect of additive genes for controlling this character. On the other hand, the non-additive gene action played the main role in the inheritance of early yield in tomato as reported by Hosseny (2002).

Devi *et al.* (2005) reported that, early maturity was predominantly controlled by additive gene effects combined with high magnitude of additive × dominance and complementary of epistasis.

According to Ahmed *et al.* (2006), considerable genetic variability for yield and yield components was observed among the studied 60 tomato genotypes for earliness. High estimates of BSH and high genetic advance as percent of mean were observed, indicating the significance of additive gene effects and effectiveness of selection for this trait. High heritability, high G.C.V, and high or moderate genetic advance were also found for number of days to maturity by Nitu *et al.* (2007).

The aim of this study is to detect the mode of earliness of inheritance in tomato.

MATERIALS AND METHODS

This study was carried out at the Experimental Farm, Faculty of Agriculture, Minufiya University, Shibin El-Kom during two successive summer seasons from 2005 to 2006. The breeding line S_{65}-R_2 and the commercial cultivar Super strain B, which were widely differed in their characteristics were chosen as parental genotypes in this study. In the first season (2005), seeds of the two parents with their F_1 which were on hand from previous study to fulfill the requirements of Master Degree (Khalil, 2004) were sown into plastic house in the first week of January. The seedlings were transplanted in the field in the first week of March. Crossing was made between the two parents to produce the required F_1 seeds, at the same time, parents were selfed to produce enough seeds. The F_1 plants were selfed and backcrossed to both parents to develop the required F_2, Bcp_1 and Bcp_2 seeds.

In the second season (2006), the six populations, i.e., P_1 (S_{65}-R_2), P_2 (Super Strain B), F_1, F_2, Bcp_1 and Bcp_2 were grown in a Randomized Complete Block Design (R.C.B.D) with four replicates. In each replicate each of the six population was represented by one plot of 1 – 4 ridges. The ridge contains 10 plants. Number of ridges was one for each of the non-segregating populations (P_1, P_2 and F_1), two for each of Bcp_1 and Bcp_2, and four for the F_2 population. The ridge was 4.0 meters long and one meter wide with spacing of 40 cm between plants. The total number of plants were 40, 80 and 160 plants for each of the non-segregating, each of backcross, and F_2 populations, respectively. Fertilization, irrigation, disease and insect control programmes were carried out as usual in tomato.

Data were recorded on the individual plant of each population regarding the studied characters during the harvest period. Number of days from transplanting to first ripe fruit and total weight and number of mature fruits in the first three harvests were considered as expression for the earliness.

Data were statically analyzed using the standard method of a Randomized Complete Blocks Design (R.C.B.D), illustrated by Al-Rawi and Khalf-Allah (1980). The least significant differences (L.S.D) was used to test the significance of differences among the various means (Snedecor and Cochran, 1973).

Dominance relations:

(1) Heterosis percentages: Heterosis was determined as the percentage of deviation of the F_1 mean over the mid-parents (M.P.) and better parent (B.P.) according to Mather and Jinks (1971) formulas as follows:

$$H\,(M.P.)\% = \frac{\overline{F_1} - \overline{M.P.}}{\overline{M.P.}} \times 100$$

$$H\,(B.P.)\% = \frac{\overline{F_1} - \overline{B.P.}}{\overline{B.P.}} \times 100$$

where, H (M.P.)= heterosis from the mid-parents.

H (B.P.) = heterosis from the better parent.

$\overline{F_1}$ = the mean of F_1 generation.

$\overline{B.P.}$ = the mean of the better parent.

(2) Potence ratio (P):

This parameter was estimated to determine the nature of dominance and its direction. The formula used for estimating (P) according to Smith (1952) was as follow:

$$P = \overline{F_1} - \overline{M.P.} / \tfrac{1}{2}(\overline{P_2} - \overline{P_1})$$

where, P = relative potence of gene set.

$\overline{F_1}$ = first generation mean.

$\overline{P_1}$ = the mean of lower parent.

$\overline{P_2}$ = the mean of higher parent.

M.P.= mid-parent value $[\tfrac{1}{2}(\overline{P_1} + \overline{P_2})]$.

where,

1. Complete dominance is considered when potence ratio is equal $\pm$ 1.0.
2. Partial dominance is considered when potence ratio is between $\pm$ 1.0 and -1.0, but not equal zero.
3. Absence of dominance is indicated when potence ratio is equal zero.
4. Over dominance is considered when potence ratio exceeded $\pm$ 1.0 .

(3) Inbreeding depression was estimated by the formula:

$$I.D.\% = \frac{\overline{F_1} - \overline{F_2}}{\overline{F_1}} \times 100$$

where, $\overline{F_1}$ and $\overline{F_2}$ are the means of first and second generations, respectively.

(4) Genetic coefficient of variance (G.C.V) % = $\frac{\sqrt{VG}}{\overline{X}} \times 100$

Environmental variance (E) = $\frac{VP_1 + VP_2 + VF_1}{3} \times 100$

Genetical variance (VG) = $VF_2 - E$

Additive variance ($\frac{1}{2}$ D) = $2VF_2 - (VBcp_1 + VBcp_2)$

Dominance variance ($\frac{1}{4}$ H) = $VF_2 - (\frac{1}{2} D + E)$

Where, VP_1, VP_2, VF_1, VF_2, $VBcp_1$ and $VBcp_2$ are the variances of P_1, P_2, F_1, F_2, Bcp_1 and Bcp_2, respectively.

$\overline{X}$ = the mean of F_2 population.

(5) Heritability: heritability in both broad (BSH) and narrow (NSH) sense were estimated as follows:

$$BSH\% = \frac{VG}{VP} \times 100$$ (Allard, 1960)

$$NSH\% = \frac{\frac{1}{2}D}{VP} \times 100$$ (Mather, 1949)

where, VG = genetical variance.
VP = total variance (F_2 variance).
$\frac{1}{2}$ D = additive variance.

(6) Predicted gain under selection (ΔG), was estimated according to Johanson *et al.* (1955) as follows:

$$\Delta G = K . \sqrt{VF_2} . NSH$$

where, K = a selection differential with a value of 2.06 under 5% selection intensity.

(7) Genetic advance under selection as percentage of F_2 mean (ΔG)% was estimated according to Miller *et al.* (1958) as follows:

$$\Delta G\% = \frac{\Delta G}{\bar{X}} \times 100$$

where, $\bar{X}$ = mean of the F_2 generation.

(8) The minimum number of genes differentiating the parents was determined according to Castle and Wright (1921) and Burton (1951).

(9) Chi-square test was used to compare the observed and theoretical ratios in segregating populations (Steel and Torrie, 1960).

(10) Frequency distribution tables and curves were prepared for the populations tested concerning each studied character. In Each character, class interval was ½ - ⅓ the arithmetic average of the standard deviation of the non-segregating populations (Khalil, 1974).

RESULTS AND DISCUSSION

The analysis of variance of population means showed that, there were no significant differences, at 5% level of significance, among the replicates in the studied characters. Consequently, data of the four replications of each studied populations (P_1, P_2, F_1, F_2, Bcp_1 and Bcp_2) were pooled and handled for genetic analysis and to form the frequency distribution.

1. Number of days to first ripe fruit:

Data concerning number of days to first ripe fruit are presented in Tables (1 & 2). The two parents significantly differed in number of days required to first ripe fruit. The number of days ranged from 76 to 88 in P_1 (S_{65}-R_2) with an average of 81.5 days and from 63 to 74 in P_2 (Super Strain B) with an average of 67.3 days as shown in Table (1). It is noticed that, the two parents have distinctly non-over Lapping ranges. The Super Strain B cultivar was earlier than the line S_{65}-R_2 by a mean of 14.2 days.

Table (1). Statistics obtained for the number of days to first ripe fruit in parents and hybrid generations of tomato cross "S_{65}-R_2 × Super Strain B".

Populations	Number of plants	Range	Obtained mean ± SE	Theoretical mean	Variances S^2	c.v.%
S_{65}-R_2 (P_1)	40	76 – 88	81.5 ± 0.4	–	7.5	3.4
Super Strain B (P_2)	40	63 – 74	67.3 ± 0.5	–	10.1	4.7
F_1	40	64 – 73	68.8 ± 0.4	74.4	6.4	3.7
F_2	160	62 – 86	71.0 ± 0.5	71.6	34.3	8.3
Bcp_1	80	65 – 86	74.7 ± 0.7	75.2	34.2	7.9
Bcp_2	80	63 – 76	69.2 ± 0.4	68.1	11.6	4.9

L.S.D at 5% and 1% level = 1.0 and 1.4, respectively.

Regarding F_1 population, the number of days ranged from 63 – 73 with an average of 68.8 days. This average is very close to that of P_2, the early parent, suggesting dominance of short period to maturity. On the other hand, it was significantly lower than mid-parents value. The average degree of heterosis was estimated as -8.0 and 2.0% in relation to both mid-parents (MP) and better parent (BP), respectively. The high negative heterosis value from the mid-parents and the low value from the early parent revealed the complete dominance of early maturity. The estimated potence ratio (0.79) is relatively low according to the postulated complete dominance, and could be explained by the presence of some additive effects in the inheritance of this trait. The distribution of F_1 population (Table 2) suggests a strong evidence for the complete dominance. All plants were distributed within the range of the earlier parent (P_2).

Regarding F_2 plants, the number of days showed wide range, they ranged from 62.0 – 86.0. The obtained and theoretical means (71.0 and 71.6, respectively) were very close. Theoretical F_2 mean was calculated for one factor-pair difference using Powers (1955) formula: $\overline{F_2} = \overline{P_1}\left(\frac{3}{4}\right) + \overline{P_2}\left(\frac{1}{4}\right)$, where, P_1 is the mean of the dominant parent and P_2 is the mean of recessive parent. The absence of significant difference between actual and theoretical means reflected presence of one pair of genes is responsible and control this character.

According to the postulated monogenic hypothesis, F_2 plants should segregate into two classes with 3 : 1 ratio. The first class should be similar to P_2 and F_1 populations, and the second class should be similar to P_1, the other parent. As shown in Table (2) this was a real. About 72.5% of the plants covered the range exhibited by P_2 and F_1 plants, and the remaining portion (27.5%) covered the range exhibited by P_1 plants. This ratio represent 3 : 1

ratio using X^2 test with probability of 0.20 – 0.50 and support the monogenic hypothesis.

Support to the monogenic inheritance of number of days from transplanting to first ripe fruit could be shown by the segregation of Bcp_1 plants. They segregated into two classes with a ratio of 55.0 : 45.0%. The first class was distributed within the range of P_1, while the second class was distributed within the range of P_2 and F_1 populations. This ratio was fit a 1 : 1 ratio using X^2 test with probability 0.20 – 0.50.

All plants of Bcp_2, except three ones, were distributed within the range of F_1 and P_2 without any segregation. This is expected when the character is controlled by single pair of genes and dominance of the short period to maturity.

The obtained and theoretical means were approximately similar in the two backcrosses, supporting the monogenic inheritance. The actual means of Bcp_1 and Bcp_2 were significantly different, supporting the dominance of the short period.

An examination of variances and variability of all tested populations, as shown in Table (1), show that the non-segregating populations, i.e., P_1, P_2 and F_1 were the least variable as shown by the calculated variances and coefficient of variability. This indicates that, they are more homogeneous compared with the segregating populations, i.e., F_2 and Bcp_1, which are consist of homozygous and heterozygous plants.

A heritability was estimated as 76.7 and 65.9% in broad (BSH) and narrow (NSH) sense, respectively, indicating that the character is controlled by dominant and additive genes. Genetic coefficient of variation (G.C.V%), predicted gain (ΔG) and genetic advance under selection (ΔG%) were estimated as 7.2, 7.92 and 11.2%, respectively, these estimated genetic parameters indicate that considerable progress could be realized by breeding and selection. High estimates of each of BSH, (ΔG) and genetic (ΔG%) were also obtained by Ahmed *et al.* (2006) and Nitu (2006).

Minimum number of genes controlling the number of days to maturity was found to be 0.9 and 1.1 using Castle-Wright and Burton formulae, respectively, indicating that the number of gene pairs is at least one. The additive (½ D) and dominance genetic variances (¼ H) were calculated as 22.6 and 3.7, respectively.

Finally, it could concluded that the number of days from transplanting to the first ripe fruit in the cross "S_{65}-R_2 × Super Strain B" is controlled by single pair of genes with dominance of the short period and presence of additive effects. The monogenic inheritance and the dominance of short period to maturity with presence of additive gene effects was also reported by Khalil *et al.* (1983) in tomato.

Table (2). Frequency distribution for number of days from transplanting to first fruit for P_1, P_2, F_1, F_2, Bcp_1 and Bcp_2 of the tomato cross "S_{65}-R_2 × Super Strain B".

Upper class limit	Number of plants of each tested population					
	P_1	P_2	F_1	F_2	Bcp_1	Bcp_2
60						
61						
62				6		
63		2		10		3
64		1	1	4		–
65		15	3	3	7	5
66		5	7	20	6	14
67		3	1	8	1	11
68		1	5	13	5	9
69		–	4	16	2	4
70		6	9	4	-	5
71		2	4	9	3	1
72		2	2	9	2	10
73		2	4	5	2	8
74		1		9	6	7
75	–			–	2	–
76	1			10	7	3
77	1			11	3	
78	7			6	16	
79	1			2	5	
80	1			6	5	
81	9			1	1	
82	2			–	1	
83	13			4	1	
84	1			–	–	
85	2			–	2	
86	–			4	3	
87	–			–	–	
88	2			–	–	

2. Early yield (fruit number):

Data of number of fruits of early yield are shown in Tables (3 & 4). Significant difference was observed between the two parents in this character. The number of early fruits ranged from 4 – 9 with an average of 6.3

fruits / plant and from 12 – 17 with an average of 14.6 fruits / plant in the breeding line S_{65}-R_2 (P_1) and the cv. Super Strain B (P_2), respectively. It is clear that Super Strain B cultivar exceeded S_{65}-R_2 by about 138.0% in early fruit number.

Table (3). Statistics obtained for early fruit number in parents and hybrid generations of tomato cross "S_{65}-R_2 × Super Strain B".

Populations	Number of plants	Range	Obtained mean ± SE	Theoretical mean	Variances S^2	c.v.%
S_{65}-R_2 (P_1)	40	4 – 9	5.3 ± 0.2	–	1.8	20.9
Super Strain B (P_2)	40	12 – 17	14.6 ± 0.3	–	1.6	11.4
F_1	40	15 – 19	17.2 ± 0.2	10.0	1.2	7.6
F_2	160	7 – 18	12.8 ± 0.3	12.6	3.4	24.2
Bcp_1	80	5 – 17	11.0 ± 0.5	11.3	4.1	33.6
Bcp_2	80	13 – 18	15.5 ± 0.2	15.9	1.5	8.2

L S.D at 5% and 1% level = 0.70 and 0.97, respectively.

Table (4). Frequency distribution of early number for P_1, P_2, F_1, F_2, Bcp_1 and Bcp_2 of the tomato cross "S_{65}-R_2 × Super Strain B".

Upper class limit	Number of plants of each tested population					
	P_1	P_2	F_1	F_2	Bcp_1	Bcp_2
4	4					
5	8				4	
6	9				3	
7	12			8	17	
8	5			16	17	
9	2			21		
10				9		
11				7		
12		2		2		
13		10		10	1	8
14		12		21	14	16
15		3	5	21	8	17
16		6	6	24	11	13
17		7	12	16	5	19
18			11	5		7
19			6			

The F_1 population exceeded the two parents in this respect. Its mean was 17.2 fruits / plant, suggesting over dominance or / hybrid vigour for the high early fruit number. The average degree of heterosis (ADH%) was estimated as 63.8 and 17.8% based on MP and BP values, respectively supporting the over-dominance postulated. The over-dominance was also verified by the high estimated potence ratio (1.6).

Variances of the non-segregating populations, i.e., P_1, P_2 and F_1 differed, indicating that the environmental variance varies considerably among different genotypes. However, they were the least variable comparing with the segregating populations as shown by the lowest cv.% values, which were 20.9, 11.4 and 7.6 for P_1, P_2 and F_1 populations, respectively (Table 3). This indicates that they were more homogeneous than the F_2 and Bc populations which had greater variances.

The means of F_1 and F_2 populations significantly differed. The mean of F_2 (12.8) was lower than that of the F_1 by 4.4 fruits / plant. The calculated inbreeding depression was 25.6%; this relatively high value is expected when the character is controlled by over-dominance genes. The distribution of F_1 plants clearly reveals the over-dominance of the large number of early fruits / plant. As shown in Table (4), the number of fruits ranged from 12 – 17 in P_2 (better parent) and from 15 – 19 in F_1 plants. About 42.5% of the F_1 plants had higher number of fruits than the early parent and the remaining portion (56.5%) is similar to the cv. Super Strain B.

Plants of the Bcp_1 segregated into almost two equal portions. The two classes were (51.25 and 48.75%) and exhibited distributions similar to P_1 and P_2. Their distribution fit a 1 : 1 ratio using X^2 test with a probability of 0.50 – 0.95. This ratio support that number of early fruits is monogenic character. On the other hand, plants of the Bcp_2 did not segregate and had a mean number of fruits approximately similar to that of P_2 (Super Strain B cv.) plants. This result support the advanced suggestion, that the character is controlled by few number of genes with dominance for the high fruit number. The dominance hypothesis was evident from the means of both Bcp_1 and Bcp_2 which showed significant differences. The monogenic inheritance was also verified by the obtained means of F_2, Bcp_1 and Bcp_2 which were very close to the expected means.

For F_2 plans, the number of fruits/plant ranged from 7–18 with an average of 12.8. The plants distributed on a wide range without distinct classes. About 38% of the plants had an average number of fruits within the range of P_1 and the remaining portion (62.0%) had an average within the range of P_2 and F_1 plants. According to the presented hypothesis (monogenic trait), more than 62.0% of the F_2 plants should have an average fruit number similar to those of P_2 and F_1. This unexpected distribution of F_2 plants could be explained, however, if it is assumed that the appearance of the high fruit number character requires the presence of many minor genes. Segregation of such miner genes in the F_2 population would be independent upon the other major genes. Consequently, chances would be very small that all minor and major genes present in F_2 plants, particularly, since the size of F_2 population in this test was only 160 plants. This result is in agreement with Khalil *et al.* (1983) who suggested that the appearance of earliness in tomato requires the presence of many minor genes.

Variances of plants of Bcp_1 was higher than those of F_2 and Bcp_2. This could be due to that the character is controlled by one pair of major genes with over dominance of the large number of fruits. Also, the presence of many minor genes with the major genes would make this Bc distribution stretched evenly over a wide range of the number of fruits scale, thus increasing the variance of this population. On the other hand, the over-dominance of the large number of fruits would result much skewness of F_2 plants, consequently, decreasing their variance.

Heritability in Broad-sense (BSH) was estimated as 83.2% and in narrow-sense was 31.3%, this values indicative with the postulated hypothes. The minimum number of genes was calculated as 0.86 and 1.0 using Castle and Wright (1921) and Burton (1951) equations. According to this result, it could be concluded that this character is controlled by one pair of genes with over-dominance of the large number of early fruits. However, the expression of heterosis requires the presence of many minor genes.

The estimated additive variance (½ D) and dominance variance (¼ H) were 7.4 and 6.0, respectively. Predicted gain (ΔG) and genetic advance under selection (ΔG%) were estimated as 7.38 and 57.65%, respectively. The high heritability and high genetic advance for early fruit number were also found by Singh (2001) and Sashikala (2002).

The over-dominance of the large number of early fruits, which is an important component of commercial earliness, facilitates a considerable extent for breeding of early hybrid cultivars by heterosis breeding. Hybrid vigour for large early number fruit was found by Hassan *et al.* (2000).

3. Early yield (fruit weight):

Data of early yield as fruit weight showed that the two parents significantly differed in early fruit weight. The cultivar Super Strain B (P_2) exceeded the line S_{65}-R_2 (P_1) by about 30.8%. The early fruit weight ranged from (0.520 – 1.080) and from (0.920–1.400) kg/plant in P_1 and P_2, respectively (Tables 5 & 6).

The F_1 population exceeded the two parents in this trait. Its mean was 1.286 kg / plant. Plants of F_1 ranged from 1.080 – 1.560, it is clear that about 22.5% of F_1 plants had higher early yield than P_2 (the earlier parent), the remaining protein was similar to P_1 plants, since they distributed within the range of Super Strain B cultivar (better parent). The average degree of heterosis in relation to both mid parent (MP) and better parent (BP) was estimated as 34.5 and 18.7%, respectively. These high values suggested presence of hybrid vigour for the high early yield. The postulated hybrid vigour is verified by the high estimated potence ratio (2.58).

Table (5). Statistics obtained for the early fruit weight in parents and hybrid generations of tomato cross "S_{65}-R_2 × Super Strain B".

Populations	Number of plants	Range	Obtained mean ± SE	Theoretical mean	Variances S^2	c.v.%
S_{65}-R_2 (P_1)	40	0.520-1.080	0.828±0.037	–	0.055	25.7
Super Strain B (P_2)	40	0.920-1.400	1.083±0.026	–	0.027	16.2
F_1	40	1.080-1.560	1.286±0.022	0.956	0.020	12.6
F_2	160	0.600-1.560	1.018±0.023	1.100	0.084	26.9
Bcp_1	80	0.520-1.480	0.887±0.027	1.057	0.058	24.1
Bcp_2	80	0.840-1.480	1.112±0.017	1.185	0.024	13.3

L.S.D at 5% and 1% level = 0.070 and 0.097, respectively.

Table (6). Frequency distribution for early fruit weight for P_1, P_2, F_1, F_2, Bcp_1 and Bcp_2 of the tomato cross "S_{65}-R_2 × Super Strain B".

Upper class limit	Number of plants of each tested population					
	P_1	P_2	F_1	F_2	Bcp_1	Bcp_2
0.440						
0.520	4				3	
0.600	5			11	3	
0.680	3			15	11	
0.760	7			12	11	
0.840	5			14	14	3
0.920	8	8		12	8	7
1.000	5	6		13	7	16
1.080	3	8	4	18	6	18
1.160		5	4	13	4	12
1.240		3	8	9	4	9
1.320		7	6	10	4	6
1.400		3	9	9	3	2
1.480			4	15	2	
1.560			5	9		

The obtained mean of F_2 (1.018) was significantly lower than that of the F_1 (1.286) with an inbreeding depression of 20.8%. The reduction of F_2 yield comparing with F_1 may be due to the observed over-dominance in the F_1 population. The expected and obtained F_2 means were also different, indicating that this character clearly affected by the environmental factors and may be controlled by several pairs of genes. The F_2 plants distributed within the range of both parents and F_1 plants, ranging from 0.600 – 1.560 kg / plant without distinct classes. In other word, the distribution of F_2 plants was continuous, suggesting that this trait is under polygenic control.

Also, the plans of Bcp_1 (the recessive parent) distributed in a wide range on the early yield scale with markedly skewness towards the P_1 (the lower parent in early yield). Therefore, the obtained mean of this population was significantly lower than the theoretical one. Moreover, continues distribution of Bcp_1 plants without distinct classes again suggests that the character is under polygenic control. The means of Bcp_1 and Bcp_2 are significantly differed due to the over-dominance of the high early yield. Their means were (0.887 and 1.112 kg/plant), respectively. Most plants of Bcp_2 were distributed within the range exhibited by F_1 and P_2 as expected according to dominance hypothesis.

Examination of variances and variability of various studied populations showed that the non-segregating populations in addition to, Bcp_2 were the least variable as indicated by the calculated variances and cv.%. This indicates that, these populations are more homogeneous comparing with both F_2 and Bcp_1, which are consisted of different genotypes, particularly when the trait is controlled by many genes.

Estimation of broad sense heritability (BSH%) showed moderate value (59.4%). Genetic coefficient of variation (G.C.V%), predicted gain (ΔG) and genetic advance under selection (ΔG%) were came to be 22.0, 35.0 and 34.4%, respectively. From all these findings it could be concluded that early yield as fruit weight in this investigation is controlled by several number of genes with over-dominance / or hybrid vigour for the high early yield. The superiority of F_1 production encourage the development of hybrid cultivars for early yield production. Similar results were reported by Khalil (1979), Hassan *et al.* (2000) and Hatem (2003), who mentioned that hybrid vigour was strongly expressed in early yield in tomato.

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طبيعة وراثة صفة التبكير فى الطماطم

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الملخص العربى

أجريت هذه الدراسة بمزرعة كلية الزراعة بشبين الكوم – جامعة المنوفيه لدراسة طبيعة وراثة صفة التبكير (عدد الايام من الشتل حتى احمرار اول ثمرة على النبات . عدد ثمار المحصول المبكر . وكمية المحصول المبكر) . استخدم فى الدراسة السلالة اس[illegible] ار والصنف سوبر سترين ب كاباء حيث أجريت التهجينات بينهما للحصول على عشائر الجيل الأول والثانى والجيل الرجعى الأول لكلا الأبوين . وزرعت التراكيب الوراثية الستة فى تجربة مصممة بطريقة القطاعات الكاملة العشوائية وسجلت القراءات اللازمة على النباتات الفردية لكل عشيرة .

ولقد أوضحت النتائج المتحصل عليها الآتى :

تعتبر صفتى عدد الأيام من الشتل حتى النضج وعدد ثمار المحصول المبكر من الصفات البسيطة التوريث حيث يتحكم فيها زوج واحد من العوامل الوراثية . مع الاختلاف فى درجة السيادة . فكانت السيادة تامة لفترة النضج القصيرة مع وجود التأثير المضيف للجينات .

بالنسبة لعدد الثمار فأظهرت سيادة فائقة (قوة هجين) للعدد الكبير من الثمار . فضلا عن وجود الفعل المضيف أيضا . ووجود بعض الجينات المحورة (القليلة التأثير) التى تسهم فى إظهار قوة الهجين الملاحظة فى الجيل الأول . كما اوضحت النتائج أيضا أن صفة كمية المحصول المبكر صفة كمية محكومة بعدد من العوامل الوراثية مع وجود السيادة الفائقة (قوة الهجين) للمحصول المبكر العالى . وهذا يشجع على إنتاج اصناف هجينية للانتاج المبكر فى الطماطم .