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INHERITANCE OF VEGETATIVE AND FRUIT QUALITY OF SOME TOMATO CROSSES IN LATE SUMMER SEASON

El-Gazar, T.; H. El-Sayed and O. Zanata
Vegetable and Floriculture Department, Faculty of Agriculture, Mansoura, Egypt

ABSTRACT

A half-diallel cross was performed among six cultivars of tomato. Then parents, 15 F_1 and 15 F_2 were evaluated during the two late summer seasons of 1999 and 2000. The obtained results could be summarized as follows: Heterosis over the mid-parental points was significant with a positive value of 13.6% for plant height; heterosis over the better parent was absent for plant height, while heterosis over the mid parent was absent for all studied traits while inbreeding depression was significant with a positive value for ascorbic acid; cultivar Peto 86 was good combiner for number of branches per plant and fruit firmness; cultivar Fla 7324 was good combiner for plant height, total soluble solids and ascorbic acid content; cultivar VF 145-B-7879 was good combiner for fruit firmness and total soluble solids; LHT 24 cultivar was good combiner for total soluble solids and ascorbic acid content; Fresh Market 9 was good combiner for ascorbic acid content. Heritability in broad sense was high for fruit firmness, total soluble solids and ascorbic acid content; heritability in narrow sense was intermediate for fruit firmness and low for the other studied traits.

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is considered the most important vegetable crops in Egypt. The area of production increases from year to mother to meet the demand increment of consumers. So that, the area devoted for production in 1999 was 450799 feddans that produced about 6273755 tons.* The average of productivity, per unit area, seemed to be low and could be elevated or improved through either improving the cultural practices or using improved genotypes; i.e., newly introduced improved cultivars or F_1 hybrid varieties.

Tomato is adapted to a wide range of climates, though fruit set is limited to a somewhat narrow rannge (Rick, 1976). For optimum fruit setting, tomato plants require night temperature of 14 to 20°C and day temperature of 25-30°C. When night or day temperatures reached either higher or lower levels than those ranges, fruit setting was either reduced or even completely terminated (Moore and Thomas, 1952; Schaible, 1962). The minimum (night) and maximum (day) temperatures at Kafr El-Sheikh Governorate are frequently getting higher than 20°C and 30°C, respectively, during June, July and August (Metwally *et al.*, 1988). Therefore, heat tolerant cultivars, capable of setting fruits during this particular period are urgently needed.

For this purpose, the genetic parameters; heterosis, type of gene action had to be exhibited in late summer season. Such study may help in improving tomato through hybridization and/or selection.

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* According to Ministry of Agriculture Statistics, 1999, Egypt.

MATERIALS AND METHODS

The genetic materials used in the present study included six cultivars of tomato namely: (1) Fresh Market-9 (F.M-9): medium to large fruited heat-tolerant cultivar VF1 res, determinate released from Texas ARM University, USA, (2) LHT24 is a determinate red-fruited, heat tolerant tomato released by the Louisiana Agricultural Experiment Station in 1991, (3) Fla7324, large-fruited, VF_2 res, determinate from Prof. Jow Scott, Florida University USA, (4) peto86, medium-fruited, widely adapted in Egypt, (5) North Carolina (NC-76), large-fruited, determinate from Peto Seed Company, USA and (6) VF145-B-7879, large fruited, determinate, widely adapted in Egypt.
All cultivars are belonging to the species *Lycopersicon esculentum* Mill.

This work was carried out during 4 successive years. In 1997 all possible combination crosses (excluding reciprocals) were executed in a half diallel mating design to produce 15 F_1 seeds. In 1998, 15 F_1 hybrids were planted to produce 15 F_2 seeds.

Therefore, the genetic materials used in this study were 6 parents, 15 F_1's and 15 F_2's.

In the first and second season (1999, 2000) the experimental design used was a randomized complete block design with three replications. Each replicate or block contained 36 experimental units or plots (6 parents, 15 F_1's and 15 F_2's). The 36 genotypes were sown in nursery in seedling trays on April 5^{th} of 1999 and 2000. The seedlings were transplanted on May 5^{th} 40 cm apart. Each plot was two ridges, each 6 m long and 1.25m wide, thus making an area of 15 m^2. The experiment was conducted in Disuq district, Kafr El-Sheikh Governorate. Routine cultural practices were done as needed similar to those used in tomato production. The following data were recorded:

1. Plant height after 60 days from transplanting.
2. Number of branches per plant after 60 days from transplanting.
3. Fruit firmness was measured on the two opposite sides of fruit using Effige Pentrometer, 2 mm probe and data in Lbf recorded.
4. The percentage of total soluble solids (TSS%) in the fruit juice was determined by a hand refractometer (Cox and Pearson, 1962).
5. Ascorbic acid (V.C.) content was determined by titration with 2,6-dichlorophenolindophenol blue dye (Cox and Pearson, 1962).

Statistical procedures used in this study were done according to the variance for a randomized complete blocks design as outlines by Cochran and Cox (1957).

The amount of heterosis was determined as the percentage deviation of the F_1 hybrids mean ($\overline{F_1}$) over the average of the two parents ($\overline{M.P.}$) or above the better-parent ($\overline{B.P.}$) average values.

In order to estimate the different genetic parameters in terms of additive and dominance genetic variances, the F_1 hybrids were analyzed according to the analysis of the half diallel crosses mating system as out lined by Griffing (1956) method (2) model (II).Heritability estimates were determined.

RESULTS AND DISCUSSION

I. Analysis of variance:

The results of the analysis of variance are presented in Table (1). Test of significant indicated that the genotypes had highly significant differences in all studied traits indicating the presence of adequate genetic variation. The mean squares of genotypes by years interaction was highly significant for plant height and significant for number of branches per plant, while it was non-significant for fruit firmness, total soluble solids and ascorbic acid. However, it appeared that the magnitudes of the mean squares of genotypes in all traits under study were larger than their corresponding mean squares of error.

Table (1): The analysis of variance and mean squares of the half diallel design for plant height, number of branches per plant, fruit firmness, total soluble solids and ascorbic acid in the F_1 generation.

S.O.V.	d.F	Plant height (cm)	Number of branches/plant	Fruit firmness (Lbf)	Total soluble solids (TSS %)	Ascorbic acid (V.C.) mg/100g fresh weight
Rep.	4	12.9	0.75	533.1	0.500**	3.950*
Year	1	1261.6**	27.90**	380.4	0.039	52.200**
Geno.	20	98.5**	0.85**	63225.3**	1.898**	62.520**
G. x Y.	20	45.6**	0.77*	5.7	0.014	0.265
Error	80	18.7	0.40	465.9	0.025	1.453

* Significant at 5% level

** Highly significant at 1% level

II. Heterosis and inbreeding depression:

1. Plant height:

Data presented in Tables (2, 3) show that heterosis estimates over the mid-parents were significant or highly significant with positive values in 10 crosses from 15 ones. Four hybrids out of 15 showed significant or highly significant heterosis over the better parent. Heterosis values over the better parents ranged from 13.9 to 19.8% for crosses 2 x 6 and 1 x 3, respectively. The average inbreeding depression for plant height was absent. In this concern Misra and Khanna (1977) found that heterosis, with respect to the high parent, was present in 14 hybrids from 28 ones for plant height. Babu (1978) found that F_1 hybrids exceeded their parents in plant height. Abd El-Rahman (1983) indicated that means for F_1 hybrids were always greater than the means of all parents (M.P) and means of the high parent (H.P) for plant height.

2. Number of branches per plant:

Data presented in Tables (2, 3) show that non-significant of heterosis over mid and better parent for number of branches per plant. The average inbreeding depression for number of branches per plant was absent. Many investigators among them Misra and Khanna (1977), Babu (1978), and Abd El-Rahman (1983) reported that vegetative traits especially number of branches per plant showed inbreeding depression.

Table (2): Mean for plant height, number of branches per plant, fruit firmness, total soluble solids and ascorbic acid for the parent and F_1 hybrids.

Genotypes	Plant height (cm)	Number of branches/ plant	Fruit firmness (Lbf)	Total soluble solids (TSS%)	Ascorbic acid (V.C.) mg/100g fresh weight
Parents					
1) Fresh Marked-9	44.6	5.1	441.5	4.7	25.1
2) LHT 24	50.8	5.9	462.5	4.5	28.1
3) Fla 7324	48.9	5.7	477.5	5.1	21.4
4) Peto 86	49.4	6.5	772.5	4.6	19.2
5) North Carolina 76	51.3	6.2	617.5	4.0	23.8
6) VF 145-B-7879	49.6	6.2	707.5	6.0	22.1
F_1's					
1 x 2	49.5	5.9	540.0	4.6	27.8
1 x 3	58.6	6.2	674.0	4.6	28.8
1 x 4	55.9	6.6	566.0	4.5	23.6
1 x 5	51.4	6.3	356.0	4.2	24.2
1 x 6	56.6	6.4	607.5	4.6	27.8
2 x 3	58.1	5.6	486.0	4.5	27.1
2 x 4	56.6	5.8	686.5	4.9	23.7
2 x 5	53.3	5.4	471.5	6.0	20.7
2 x 6	57.9	5.9	587.5	5.3	22.0
3 x 4	57.3	6.4	530.0	5.0	22.2
3 x 5	56.8	5.5	571.5	4.9	24.9
3 x 6	58.2	5.8	501.5	4.2	28.3
4 x 5	58.1	5.9	696.0	5.5	21.3
4 x 6	52.8	6.0	819.5	4.3	18.0
5 x 6	56.2	6.3	577.5	4.5	20.2
F_1's					
1 x 2	53.4	5.5	367.5	4.6	18.4
1 x 3	52.1	5.7	287.5	4.5	25.2
1 x 4	55.4	6.4	457.5	4.0	20.5
1 x 5	54.3	5.8	567.5	4.6	24.1
1 x 6	57.9	4.9	745.0	4.7	19.3
2 x 3	52.9	5.3	522.5	5.5	21.4
2 x 4	54.9	5.5	677.5	5.1	22.6
2 x 5	52.3	5.3	561.5	5.5	19.5
2 x 6	55.0	5.7	481.0	5.6	18.5
3 x 4	55.1	5.6	632.5	5.5	24.2
3 x 5	52.7	5.8	645.0	6.5	19.6
3 x 6	52.7	5.8	522.5	5.1	23.4
4 x 5	52.1	5.6	707.5	5.5	25.4
4 x 6	53.8	5.3	792.5	5.6	22.3
5x 6	51.6	6.6	592.5	5.9	22.8

Table (3): Percentage of heterosis over each mid-parent (M.P.), better parent (B.P) and inbreeding depression (I.D.) for plant height, number of branches per plant in the F_1 generation.

Crosses	Plant height (cm)			Number of branches/plant		
	Heterosis %		I.D. %	Heterosis %		I.D. %
	M.P	B.P		M.P	B.P	
1 x 2	3.8	-2.6	-7.9	7.3	0.0	6.8
1 x 3	25.3**	19.8**	11.1	14.8	8.8	8.1
1 x 4	18.9*	13.2	0.9	-12.1	-21.5	-25.5*
1 x 5	3.8	0.2	-5.6	10.6	1.6	7.9
1 x 6	20.2**	14.1	-2.3	12.4	3.2	23.4**
2 x 3	16.4**	14.4	8.9	-3.4	-5.1	5.4
2 x 4	12.9*	11.4	3.0	-6.5	-10.8	5.2
2 x 5	4.3	3.8	1.9	-10.8	-12.9	1.9
2 x 6	15.3*	13.9*	5.0	-3.1	-4.8	3.4
3 x 4	16.5*	15.9*	3.8	4.9	-1.5	12.4
3 x 5	13.4*	10.7	7.2	-6.7	-11.3	-5.5
3 x 6	18.1**	17.3*	9.5	-1.7	-0.1	0.0
4 x 5	50.4*	1.3	10.3	-7.9	-9.2	5.1
4 x 6	7.2	6.5	-1.9	-6.3	-3.1	11.7
5 x 6	11.4	9.6	8.2	1.6	1.6	11.1
Average	13.6*	8.8	3.8	0.0	-9.2	5.1
L.S.D.						
0.05	6.1	7.0	7.0	0.9	1.0	1.0
0.01	8.1	9.3	9.3	1.2	1.4	1.4

*, ** Verify significance for the herterotic effects on the original scale at 0.05 and 0.01 of probability, respectively

1) Fresh Market-9 2) LHT 24 3) Fla 7324 4) Peto 86
5) North Carolina 76 6) VF 145-B-7879

3. Fruit firmness:

Data presented in Table (2, 4) show that heterosis over the mid-parents was absent in 11 crosses from 15, only 4 crosses showed significant with the crosses 1 x 2, 1 x 3 and 4 x 6 showed significant with positive values of positive values heterosis over the mid parents heterosis over the better parent. In this concern El-Sayed *et al.* (1966) and Kanno and Kamimura (1985) found that firmness among six parental varieties of tomatoes were highly significant. In each cross, the F_1 progeny was similar to the soft parent. Also, Hatem (1994) reported that both of heterosis over the mid-parent and better parent was absent, therefore the mean of most F_1 crosses was similar to their mid-parents. Data presented in Table (4) show that inbreeding depression was absent in all crosses except 4 namely 1 x 2, 1 x 3, 1 x 4 and 2 x 6.

4. Total soluble solids:

Data presented in Tables (2, 4) show that average heterosis over the better parent was highly significant with a negative values, this indicates that the better parent had more T.S.S. % in their fruits than the F_1 crosses. In this respect Lower (1963) and Lower Thompson (1967) observed a heterotic increase in soluble solids in the F_1. Ibarbia and Lambeth (1969) reported that

F_1 hybrid was intermediate in T.S.S. content between the parents. Khalil (1979) reported that the average of all F_1 hybrids surpassed that of parents. Finally Metwally *et al.* (1990) found that on tomato grown under heat stress conditions, heterosis over the mid-parent was significant while heterosis relative to the high parent was absent.

Table (4): Percentage of heterosis over each mid-parent (M.P.), better parent (B.P) and inbreeding depression (I.D.) for fruit firmness, total soluble solids and ascorbic acid in the F_1 generation.

Crosses	Fruit firmness (Lbf)			Total soluble solids T.S.S.%			Ascorbic acid (V.C) mg/100 fresh weight		
	Heterosis %		I.D. %	Heterosis %		I.D. %	Heterosis %		I.D. %
	M.P	B.P		M.P	B.P		M.P	B.P	
1 x 2	19.5**	16.8**	31.9**	0.0	-2.1	0.0	4.5	-1.1	33.8**
1 x 3	18.8**	14.3**	47.3**	-11.5**	-17.9	2.2	23.6**	14.7**	12.5**
1 x 4	-6.8**	-26.7**	19.2**	-4.2	4.3	11.1**	6.3	-5.9	13.1**
1 x 5	-32.4**	-42.3**	-59.4**	-4.5	-10.6**	-9.5**	-1.2	-15.5**	0.4
1 x 6	4.7*	-14.1**	-22.6**	-14.8**	-23.3**	-2.2	17.8**	10.8	30.6**
2 x 3	3.4	1.7	-7.5*	-11.8**	-19.6**	-22.2**	9.3**	-3.6	21.0**
2 x 4	11.2**	-11.1**	1.3	6.5**	6.5*	-4.1	0.0	-15.7**	4.6
2 x 5	-12.7**	-23.6**	-19.1**	39.5**	-33.3**	8.3**	-20.1	-26.3**	5.8
2 x 6	0.4	-16.9**	18.1**	0.0	-11.7**	-5.7*	-12.4**	-21.7**	15.9
3 x 4	-15.2**	-31.4**	-19.3**	-1.9	-10.7**	2.0	9.4*	3.7	-9.0*
3 x 5	4.4	-7.4*	-12.9**	2.1	-12.5**	-32.7**	10.2**	4.6	21.3**
3 x 6	-15.4**	-29.1**	-4.2	-27.6**	30.0**	-21.4**	29.8**	28.1**	17.3**
4 x 5	0.1	-9.9**	-1.7	27.9**	19.6**	0.0	-0.9	-10.5	-19.2**
4 x 6	-8.9**	12.8**	-17.6**	-18.9**	-28.3**	-30.2**	-13.0**	-18.6**	-23.9**
5 x 6	-12.8**	-18.4**	-2.6	-10.0**	-25.0**	-31.1**	-11.8**	-15.1**	-12.9**
Average	-3.4	-27.5**	-1.9	-2.0	-20.0**	-8.3**	3.0	-14.6**	9.2*
L.S.D.									
0.05	30.4	35.1	35.1	0.22	0.26	0.26	1.69	1.96	1.96
0.01	40.3	46.5	46.5	0.29	0.34	0.34	2.25	2.59	2.59

*, ** Verify significance for the herterotic effects on the original scale at 0.05 and 0.01 of probability, respectively

1) Fresh Market-9 2) LHT 24 3) Fla 7324 4) Peto 86
5) North Carolina 76 6) VF 145-B-7879

5. Ascorbic acid content:

Data presented in Tables (2, 4) show that average heterosis over the better parent was negative and highly significant with a value of -14.6%, indicating that F_1 hybrids had a less ascorbic acid content in their fruits than their better parent. In this connection Mochizuki and Kamimura (1984) reported that in the F_1 of some crosses; vitamin C content was similar to that of the lower parents. On the contrary, Khalil *et al.* (1988) found that some crosses were intermediate between the parental values in vitamin C content, but were closer to the higher parent value. The average inbreeding depression for ascorbic acid content was significant with a value of 9.2%.

III. General and specific combining ability effects:

The results of the analysis of variance and mean squares of the half diallel crosses design for all traits are shown in Table (5).

Table (5): The analysis of variance and mean squares for general and specific combining ability for half diallel crosses analysis for plant height, number of branches per plant, fruit firmness, total soluble solids and ascorbic acid in the F_1 generation.

S.O.V.	d.F	Plant height (cm)	Number of branches/ plant	Fruit firmness (Lbf)	Total soluble solids (T.S.S. %)	Ascorbic acid (V.C.) mg/100g fresh weight
G.C.A	5	9.4*	0.154	28209.4**	0.1563**	22.51**
S.C.A.	15	18.8**	0.133*	4646.9**	0.3608**	6.36**
G.C.A. x Y	5	116.2**	0.667**	8.1	0.158**	0.0515
S.C.A. x Y	15	22.0**	0.804**	4.8	0.118**	0.3362
Error	80	3.1	0.067	77.6	0.0041	0.2425

* Significant at 5% level
** Highly significant at 1% level

1. Plant height:

Data presented in Tables (5, 6 and 7) show that GCA variation was significant, while SCA was highly significant. These results indicate that both additive and non-additive gene effects were important in the inheritance of plant height. In this concern Babu (1978) reported that additive genetic variance was positive and appeared to be larger tghan those of the non-additive genetic variance for plant height.

Fla 7324 cultivar had the greatest GCA effects (1.200 ± 0.570). This parent was good combiner, while the other parents were poor combiners. The diversity in the GCA effects of various parent can be attributed to genetic as well as geographic diversity in the material (Brar and Sukhija, 1977). The crosses 1 x 3, 1 x 4, 1 x 6, 2 x 6 and 4 x 5 showed significant or highly significant positive SCA effect on plant height while the other crosses had negative or non-significant SCA effects.

Table (6): Estimate of general combining ability effects for plant height, number of branches per plant, fruit firmness total soluble solids and ascorbic acid in the F_1 generation.

Parents	Plant height (cm)	Number of branches /plant	Fruit firmness (Lbf)	Total soluble solids (T.S.S.%)	Ascorbic acid (V.C.) mg/100g fresh weight
P_1	-2.038*	-0.025	-57.550**	-0.219**	1.957**
P_2	-0.025	-0.163	-32.800**	0.088**	1.344**
P_3	1.200*	-0.100	-46.100**	0.088**	0.925**
P_4	0.263	0.200*	92.350**	-0.038	-2.450**
P_5	0.138	-0.025	-6.400*	-0.082**	-2.994**
P_6	0.438	0.138	50.500**	0.163**	-0.769**
S.E	0.570	0.084	2.843	0.0207	0.1589

* Significant at 5% level, ** Highly significant at 1% level

1) Fresh Market-9
2) LHT 24
3) Fla 7324
4) Peto 86
5) North Carolina 76
6) VF 145-B-7879

Table (7): Estimate of specific combining ability effects for plant height, number of branches per plant, fruit firmness, total soluble solids and ascorbic acid in the F_1 generation.

Crosses	Plant height (cm)	Number of branches plant	Fruit firmness (Lbf)	Total soluble solids (T.S.S.%)	Ascorbic acid (V.C.) mg/100g fresh weight
1 x 2	-2.3	0.133	64.750**	-0.100	0.700
1 x 3	5.6**	0.371	84.100**	-0.100	2.100**
1 x 4	3.7*	0.371	-34.350**	-0.050	0.300
1 x 5	-0.6	0.396	-145.600**	-0.350**	-0.550
1 x 6	4.2**	0.333	48.950**	-0.200**	2.750**
2 x 3	2.9	-0.092	-0.650	-0.500**	1.050*
2 x 4	2.5	-0.192	61.400**	0.050	1.000*
2 x 5	-0.7	-0.367	-54.850**	1.150**	-3.500**
2 x 6	3.6*	-0.029	4.200	0.200**	-2.400**
3 x 4	2.0	0.346	-81.800**	0.100	-0.150
3 x 5	1.6	-0.329	58.450**	0.050	1.100*
3 x 6	2.7	-0.192	-68.500**	-0.900**	4.350**
4 x 5	3.7*	-0.329	44.500**	0.700**	0.900*
4 x 6	-1.8	-0.292	-34.400**	-0.600**	-2.600**
5 x 6	1.6	0.233	-32.150**	-0.350**	-1.850**
S.E.	1.566	0.229	7.808	0.0568	0.437

* Significant at 5% level, ** Highly significant at 1% level

1) Fresh Market-9 4) Peto 86
2) LHT 24 5) North Carolina 76
3) Fla 7324 6) VF 145-B-7879

2. Number of branches per plant:

Data presented in Tables (5, 6 and 7) show that GAC was not significant, while the mean squares of SCA was significant. The interaction of GCA and SCA by years GCA x Y and SCA x Y were highly significant. Scossirali *et al.* (1976) and Shalaby *et al.* (1983) revealed that both additive and non-additive genetic variances in tomato, were important for plant morphology. However, Babu (1978) reported that additive genetic variance was more important than non-additive genetic variance for number of branches per plant.

Peto 86 cultivar had the greatest GCA effect (0.200 ± 0.084). The other parents had low GCA values.

3. Fruit firmness:

Data presented in Tables (5, 6 and 7) showed that GCA and SCA were highly significant. These results indicate that both additive and non-additive genetic variances were important for inheritance of fruit firmness. Al-Falluji and Lambeth (1980) reported that additive gene action was predominated. Zanata (1994) reported that GCA was highly significant, however SCA was non-significant. The interaction of GCA and SCA by years GCA x Y and SCA x Y were non-significant.

Peto 86 cultivar had the greatest GCA effect (92.35 ± 2.84) followed by VF 145-B-7879 (50.50 ± 2.84). Such parents were good combiners, while the other parents were poor combiners. The crosses 1 x 2, 1 x 3, 1 x 6, 2 x 4, 3 x 5 and 4 x 5 had positive and highly significant SCA effects. The other crosses had negative or non-significant values of SCA.

4. Total soluble solids content:

Data presented in Tables (5, 6 and 7) show that both GCA and SCA were highly significant. The interaction of GCA and SCA years GCA x Y and SCA x Y were highly significant, indicating that both additive and non-additive genetic effects were important for total soluble solids. Similar results were obtained by Metwally *et al.* (1990) who reported that general and specific combining ability were found highly significant. The additive gene effects appeared more important than non-additive gene effects.

VF 145-B-7879 cultivar had the greatest GCA effect (0.163 ± 0.0207) followed by LHT 24 (0.088 ± 0.0207) and Fla 7324 cultivar (0.088 ± 0.207). Such parents were good combiners, while the other parents were poor combiners. The crosses 2 x 5, 2 x 6 and 4 x 5 had positive and highly significant SCA effects.

5. Ascorbic acid content:

Data presented in Tables (5, 6 and 7) show that both GCA and SCA were highly significant. Metwally *et al.* (1990) found that both general and specific combining ability were highly significant. The non-additive gene effects appeared more important than additive gene effects. The interaction of GCA and SCA by years GCA x Y and SCA x Y were non-significant for both of them.

Fresh Market 9 cultivar had the greatest GCA effect (1.957 ± 0.1589) followed by LHT 24 (1.344 ± 0.1589) and Fla 7324 (0.925 ± 0.1589). Such parents were good combiners, while the other parents were poor combiners. The crosses 1 x 3, 1 x 6 and 3 x 6 had positive and highly significant SCA effects also the crosses 2 x 3, 2 x 4, 3 x 5 and 4 x 5 had positive and significant effects.

IV. Heritability:

1. Plant height:

Data presented in Table (8) show that heritability estimate in broad and narrow sense were low with a value of 35.9% and 0.0, respectively.

2. Number of branches per plant:

Data presented in Table (8) show that heritability estimate in broad and narrow sense were low with a value of 43.9% and 43.9%, respectively. On the contrary, Prasad and Prasad (1977) and Abd El-Rahim (1989) reported that vegetative traits such as plant height and number of branches per plant had heritability values that were greater than 50% for all traits.

3. Fruit firmness:

Data presented in Table (8) show that heritability estimate in broad sense was high with a value of 97.9%, while heritability estimate in narrow sense was intermediate with a value of 54.7%.

4. Total soluble solids:

Data presented in Table (8) show that heritability estimate in broad sense was high with a value of 69.6%, while heritability estimate in narrow sense was low.

5. Ascorbic acid content:

Data presented in Table (8) show that heritability estimate in broad sense for ascorbic acid was high, with a value of 93.9%. However, heritability estimate in narrow sense for ascorbic acid was low, with a value of 38.1%. These results agreed with those of Metwally *et al.* (1990). Who found, on tomato, that heritability estimates in narrow sense were low for most fruit quality under heat stress conditions in Egypt.

Table (8): Estimate of different genetic parameters and heritability values in broad (h^2_b%) and narrow (h^2_n%) senses for plant height, number of branches per plant, fruit firmness, total soluble solids and ascorbic acid.

Genetic parameters	Plant height (cm)	Number of branches/plant	Fruit Firmness (Lbf)	Total soluble solids (T.S.S.%)	Ascorbic acid (V.C.) mg/100g fresh weight
σ^2g	-6.475	0.009	14721.450	-0.015	1.027
σ^2s	1.600	-0.336	2321.050	0.121	3.012
σ^2gy	11.775	-0.017	0.413	0.005	-0.036
σ^2sy	18.900	0.737	-72.800	0.114	0.094
h^2_b%	35.9	43.9	97.900	69.600	93.9
h^2_n%	0.0	43.9	54.7	0.0	38.1

σ^2g General combining ability variance
σ^2s Specific combining ability variance
σ^2gy GCA by years variance
σ^2sy SCA by years variance
h^2_b Broad sense heritability
h^2_n Narrow sense heritability
Y_1 1999
Y_2 2000

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دراسات وراثية على بعض الصفات الخضرية وصفـــات جـــودة الثمـــار لنباتـــات الطماطم المنزرعة خلال العروة الصيفية المتأخرة

طه محمد عمر الجزار ، هالة عبد الغفار السيد وأسامة عبد الفتاح زناته
قسم الخضر والزينة ـ كلية الزراعة ـ جامعة المنصورة

أجرى هذا البحث لدراسة السلوك الوراثى لصفات ارتفاع النبات ، عدد الأفرع الخضرية ، صلابة الثمار ، نسبة المواد الصلبة الذائبة الكلية وفيتامين ج لنباتات الطماطم المنزرعـــة خـــلال العـــروة الصيفيـــة المتأخرة. أستخدم فى هذه الدراسة ستة أصناف من الطماطم هى:

1) Fresh Market 9, 2) LHT24, 3) Fla7324, 4) Peto86, 5) North Carolina76, 6) VF145-B-7879

وجميعها تتبع النوع *Lycopersicon esculentum* Mill وتم تهجين هذه الاباء الستة معا (غير مشـــتملة على الهجن العكسية) ونتج عن ذلك ١٥ هجين جيل أول زرعت لانتاج ١٥ هجين جيل ثانى. تم زراعة الآباء والهجن الناتجة منها فى تجربة حقلية فى مركز دسوق بمحافظة كفرالشيخ خلال عامى ١٩٩٩ ، ٢٠٠٠ فـــى العروة الصيفية المتأخرة. وصممت التجربة بنظام القطاعات الكاملة العشوائية مع استخدام ثلاث مكررات قدر ارتفاع النبات و عدد الافرع الخضرية لكل نبات وصلابة الثمار ونسبة المواد الصلبة الذائبة الكلية وفيتـــامين ج. أخذت النتائج على متوسطات القطع التجريبية لكل تركيب وراثى على حده وحللت النتائج باستخدام طريقة Griffing 1956 مع استخدام Model II Method 2.

ويمكن تلخيص النتائج المتحصل عليها فيما يلى:

كانت قوة الهجين عند حسابها على أساس متوسط الآباء معنوية بينما كانت غائبة عند حسابها على أساس الاب الافضل بالنسبة لصفة ارتفاع النبات. قوة الهجين عند حسابها على حساب الاب المتوسط لم تكـــن معنوية لباقى الصفات تحت الدراسة. الانخفاض الناتج عن التربية الداخلية كان معنوى لصفـــة فيتـــامين ج. الصنف Peto 86 كانت له قدرة ائتلافية عامة بالنسبة لصفات عدد الافرع الخضرية لكل نبـــات وصلابـــة الثمار. الصنف Fla7324 كانت له قدرة ائتلافية عامة بالنسبة لصفات ارتفاع النبات ونسبة المواد الصلبـــة الذائبة الكلية ومحتوى الثمار من فيتامين ج. الصنف VF145-B-7879 كانت له قدرة ائتلافية عامة لصفات صلابة الثمار ونسبة المواد الصلبة الكلية. الصنف LHT24 كانت له قدرة ائتلافية عامة بالنسبة لصفات نسبة المواد الصلبة الذائبة الكلية ومحتوى الثمار من فيتامين ج ، الصنف Fresh Market 9 كانت لـــه قـــدرة ائتلافية عامة بالنسبة لصفة محتوى الثمار من فيتامين ج. درجة التوريث بالمعنى الواســـع كـــانت مرتفعـــة بالنسبة لصفات صلابة الثمار ، نسبة المواد الصلبة الذائبة الكلية ومحتوى الثمار مـــن فيتـــامين ج. درجـــة التوريث بالمعنى الضيق كانت متوسطة بالنسبة لصفة صلابة الثمار بينما كـــانت منخفضـــة بالنســـبة لبـــاقى الصفات تحت الدراسة.