J. Agric. Sci. Mansoura Univ., 29 (11): 6225 - 6249, 2004

HETEROTIC PERFORMANCE ON SOME HISTOLOGICAL; ELECTROPHORETIC AND AGRONOMIC TRAITS IN TOMATO (*Lycopersicon esculentum* L.)

El- Ghareeb, I. M.*; A. H. Amer* and M. N. A. Saeed**
*** Hort. Res. Inst., Res. Center. Giza, Egypt.**
**** Dept. of Botany and Plant Pathology, Fac. of Agric., Zagazig Univ.**

ABSTRACT

The (S_4) of seven tomato cultivars i.e. Prichard, Cal Rock; Beto 98; Ace 55 V.F; Floradade; Super strain B and Money Maker and their hybrids without reciprocals were used in this investigation to determine the heterotic performance on some histological leaflets; electrophoretic, and agronomic traits. Most of the hybrids showed positive and highly significant values for many histological leaflet traits i.e. thickness of upper; lower epidermis; palisade; spongy tissues; blade leaflet; dimensions of both upper epidermis cell and midvienal bundles as well as the diameters and thickness of vessels. Producing hybrids, heterotic for some histological leaflets traits may increase the mechanical resistance to stress conditions and some serious insects as white fly as well as other dangerous diseases.

The electrophoretic studies showed that all hybrids were characterized by the increase in band number and intensity as compared with their respective parents.

As for agronomic traits, most of the best heterotic combinations were identified as the combinations of most parental cultivars with Money Maker as a female parent. Total soluble solids traits showed positive and insignificant values over mid and better parent. Meanwhile more negative and insignificant values were detected for fruit pH.

Making use of protein electrophoretic studies the best hybrids that appeared highly band number and intensities, showed also the highest positive and significant heterosis values for agronomic traits, and the effective leaflets histological traits. The combinations between Prichard; Cal Rock; Beto 98 and Floradade as a male parent with Money Maker as a female, as well as, the hybrid Floradade × Super strain B, expressed such situation.

The study of protein band number and intensity, for the hybrids confirms the possibility of hybrids selection in labs before the field evaluation.

INTRODUCTION

Studying some histological traits in F_1 tomato hybrids may be of a great aspect. Measuring the increase of thickness of some leaflets histological traits by the anatomical investigation was scored in F_1 compared with their respective parents. Amer *et al.* (1999) found heterosis over mid and better parents in some leaflet histological traits. These estimations in relation with heterosis are of utmost importance in plant growth and may in plant tolerance to some stress conditions. Any attempt, such making use of hybridization, to increase some leaflet histological traits may also lead to increase the self plant mechanical resistance to many serious insects such as white fly and aphis and must occupy a great aspect in such investigation. Reddy *et al.* (1995) studied some histological traits in pigeon pea and the mechanism of resistance to *Aceri cajani* .

Electrophoretic studies of protein banding patterns have been widely used to screen the differences among populations. The development of electrophoretic banding patterns provides a new source of polymorphic biochemical genetic markers affecting quantitative traits and facilitates the genetic improvement programs (Doebely 1989; Ford and Gardiner 1990 and Eweda 1993); Ismail and Elghareeb 2000). Not only could qualitative variabilities, presence/ absence, of bands be detected but also quantitative variabilities in band intensities among the genotypes (Amet 1992). Best F_1 hybrids are distinguished with higher number of protein bands and intrnsities (El Maghawry *et al.* 1997; and Ismail and Elghareeb 2000).

Maximum yielding potential is the aime of tomato growers, for this reason producing local hybrids is necessary in view of such situation. Heterosis over mid and better parents was estimated in yield and some of its components (Xue-By, 1994; Hegazi *et al.* 1995; Singh *et al.* 1995 Suresh-Kumar *et al.*, 1995; El-Maghawry, 1997 Vidyasagar *et al.* 1997; Shrivastava 1998 and Bhatt *et al.* 2001).

The present research is an attempt to increase the mechanical resistance of tomato plants through some leaflet histological development by heterosis methods. In relation with protein electrophoresis banding patterns and heterosis of agronomic traits, selection of best hybrids must begin in labs before any open filed evaluation.

MATERIALS AND METHODS

The present work was carried out at the Experimental Farm of El-Kassasin Horticulture Research Station. Ismailia Governorate. The parental tomato genotypes were the fourth selfed generation derived from the cultivars, Prichard, Cal Rock; Beto 98; Ace 55 V.F; Floradade; Super strain B and Money Maker. The cultivars were obtained from Vegetable Research Department, Horticulture Research Institute, Agriculture Research Center, Giza. Egypt. The seven parental genotypes and their F_1,s excluding reciprocals were used in this investigation for anatomical investigation electrophoretic; and some agronomic traits with relation to heterosis.

I- Histological traits:

For the anatomical investigation specimens of tomato leaflets were taken. These specimens were from the third leaflet of the third associated compound leaf near the top of the plant during fruit set stage.

Samples were killed and fixed for 72 hours in formalin acetic acid alcohol solution; washed in 70% ethanol dehydrated in a series of alcohol solutions and then on bedded in paraffin wax; 56-58 C° m.p. (O'Brien and Mc Cully, 1981). Cross sectioned at 15 µ thickness, stained in safranin and mounted in canada blsma (Gerlach, 1977). The preparations were microscopically examined the traits were:

First part:

Thickness (µ) i.e. upper epidermis, lower epidermis, palisade tissues, spongy tissues and blade of leaf.

Second part

1- Dimensions of upper epidermis cell (μ) (length and width)
2- Dimensions midvienal bundles (μ) (length and width)
3- Vessels/bundls(μ) (diameters of vessels and thickness of vessels walls)

II- Electrophoretic studies

Protein electrophoresis

This investigation was carried out at the laboratory of genetic engineering. Department of genetics. Faculty of Agriculture. Ain Shams University. Sodium dodocyl sulphate- polyacrylamide gel electrophoresis (SDS-PAGE) was performed according to the method of Laemmli (1970) after being modified by Studier (1973).

Sample preparation:

Seed samples from the fourth selfed generation (S_4) derived from the seven tomato varieties and their F_1,s excluding reciprocal were used. Seeds were pressured by a drill to repture the cells and release their contents. Samples of 0.5 gram of each genotype with 5 ml of sample buffer was homogenized, then they were centrifuged for 15 minutes at 15000 rpm. Supernatants containing water soluble protein were used for SDS-PAGE.

Gel preparation:

Polyacrylamide standard gel at pH 8.9 consists of 150 ml monomer solution (8.55 Acrylamide; 0.45 Bisacrylamide in 0.150 M Tris-borate buffer). Then the following were added without delay: 300 mgs sodium sulphate (dissolve completely); 0.40 ml TEMED (Tetramethlenediamine), and 40 ml ammonium Presulphate (2%) freshly prepared 200 ای extract of each sample was mixed with 50 ای glecrol and 50 ای bromophenol blue.

Gel incubation and agitation were carried out at room temperature until the bands appear in clear background. Then the gel was washed with distilled water (Yamamoto *et al.* 1982) and photographed.

III- Agronomic Traits:

Data were recorded on the following:

1- Number of flowers per cluster
2- Number of flowers per plant
3- Fruit weight (gms)
4- Total yield per plant (gms)
5- Total soluble solids (T.s.s.), measured by refractomter.
6- Fruit pH, measured by pH instrument.

Heterosis expression:

Heterosis values were estimated in 21 F_1 hybrids derived from seven parental genotypes excluding reciprocals. Heterosis values over mid and better parent for the studied traits were calculated according the following formulae adapted by Bhatt (1971).

Heterosis over mid parent and over better parent

The significance of heterosis was tested by the comparison of the difference between F_1 value and each of M.P and B.P values with concerned L.S.D. values at 0.05 and 0.01.

RESULTS AND DISSECTION

I- Histological traits

First parts

Mean values of some leaflet histological traits thickness of upper and lower epidermis; palisade and spongy tissues, are presented in Table (1), and expressed in Fig (1-3).

Table (1): Means values of the thickness (ى) of the upper, lower epidermis and palisade; spongy tissues for 21 tomato hybrids leaves

	Upper Epidermis	Lower Epidermis	Palisade Tissues	Spongy Tissues	*Blade Leaf
1	18.20	26.52	85.80	96.2	345.28
2	18.72	20.28	59.80	65.0	235.04
3	20.28	17.16	80.60	80.6	272.48
4	18.72	19.24	83.20	78.0	309.92
5	16.12	19.24	41.60	72.8	251.68
6	20.28	22.36	98.80	72.8	297.44
7	26.52	26.52	85.80	109.2	405.60
1×2	24.44	27.56	93.60	101.4	378.56
1×3	28.08	27.56	93.60	114.4	443.04
1×4	29.64	32.24	106.60	150.8	532.48
1×5	27.04	27.56	137.80	98.8	409.76
1×6	29.12	25.48	114.40	122.2	540.80
1×7	47.45	36.40	111.40	130.0	544.96
2×3	27.56	19.24	96.20	124.8	490.88
2×4	28.60	22.88	101.40	111.8	368.16
2×5	26.52	26.00	91.00	114.4	422.24
2×6	30.16	24.96	87.36	119.9	486.72
2×7	34.84	31.72	135.20	122.2	617.76
3×4	25.48	15.60	46.80	119.6	316.16
3×5	26.52	21.84	57.20	109.2	380.64
3×6	28.08	27.04	98.80	137.8	459.68
3×7	32.24	26.00	119.60	117.0	468.02
4×5	30.16	27.56	106.60	117.0	524.16
4×6	29.64	26.52	64.48	122.2	416.00
4×7	31.20	27.04	135.20	117.0	600.60
5×6	26.52	19.76	122.20	132.2	447.20
5×7	30.16	39.52	78.00	117.0	417.04
6×7	31.20	27.04	75.40	119.6	509.60

1=Prichard 2 = Cal Rock 3 = Beto 98 4=Ace 55 V.F 5= Floradade 6= Super strain B 7= Money Maker.

*** These results were reckoned from the median and marginal regions of leaflet.**

Results in Table (2) showed positive and highly significant heterosis values over mid parent. For upper epidermis trait the best hybrid had the highest positive significant value (73.42%) was Ace 55 V.F × Floradade. Six out of the hybrids exceeded 50% heterosis value. Concerning lower epidermis trait, most hybrids showed highly significant heterosis values. The combination between the cultivar Prichard and Beto 98 with the cultivar Super strain B as a female parent showed lowest insignificant heterosis values.

Palisad tissues trait showed highly significant and positive heterosis values except, four hybrids only Beto 98×Ace 55 V.F; Beto 98×Floradade; Ace 55 V.F×Super strain B and Super strain B× Money Maker showed negative heterosis. The hybrids Prichard×Floradade and Cal Rock×Beto 98 were the best having the highest values (116.3 and 270 %) respectively. On the other hand the hybrids Beto 98×Floradade and Beto 98×Super strain B showed the lowest values. With regard to spongy tissues trait, it was found that the female parent Super strain B increased it where as the combinations between on of the male parents Cal Rock; Beto 98, Ace 55 VF.; Floradade, and the femal parent, Super strain B showed highly positive significant heterosis values (73.85; 79.66; 62.07 and 82.44 %) respectively. Results assumed positive highly significant heterosis over mid parent for blade leaf trait Table (2). Heterosis values ranged from 8.57% for the hybrid Beto 98 × Ace 55 V.F to 99.45% for the hybrid Ace 55 V.F×Floradade.

Results in Table (3) as shown in Fig (2 and 3) expressed heterosis values over better parent for leaflet thickness of upper and lower epidermis. Palisade and spongy tissues, as well as blade leaf. Positive and highly significant heterosis values were recorded for upper epidermis trait. Heterosis values ranged from 17.65% for hybrid, Super strain B×Money Maker to 78.92 % for the hybrid, Prichard×Money Maker that had the highest positive significant value. As for lower epidermis traits, three out of the hybrids showed insignificant heterosis values. The other remaine hybrids recorded highly significant values. Moreover negative heterosis was recorded for five hybrids Prichard×Super strain B, Cal Rock×Beto 98; Beto 98×Ace 55 V.F; Beto 98×Money Maker and Floradade×Super strain B. the highest value 49.02% was recorded by hybrid Floradade×Money Maker. Most hybrids in palisade tissues trait recorded positive and highly significant heterosis values. The hybrid Prichard×Floradade showed the highest heterosis value (60.61)%. Six out of the hybrids recorded negative significant heterosis. Highly positive and significant values were recorded for spongy tissues trait. The hybrid Floradade×Super strain B gave the highest heterosis value (81.59%) followed by (70.97%) for the hybrid Beto 98×Super strain B. Blade leaf trait showed positive and highly significant heterosis values, where the best hybrid Ace 55 V.F×Floradade recorded (69.13 %) followed by (67.77%) heterosis value for the hybrid Cal Rock×Floradade. The lowest values were (2.01-2.21%) for Beto 98×Ace 55 V.F and Floradade×Money Maker hybrids.

Table (2): Heterosis values over mid parents for thickness of leaf epidermis; palisade and spongy tissues for 21 tomato hybrids.

	Upper Epidermis			Lower Epidermis			Palisade Tissues			Spongy Tissues			Blade Leaf		
	F_1	F_1-M.P	H%	F_1	F_1-M.P	H%	F_1	F_1-M.P	H%	F_1	F_1-M.P	H%	F_1	F_1-M.P	H%
1×2	24.44	5.98	32.39**	27.56	4.16	17.36**	93.60	20.80	28.57**	101.4	20.8	25.81**	378.56	88.40	30.47**
1×3	28.08	8.84	45.95**	27.56	5.72	26.19**	93.60	10.40	12.58**	114.4	26.0	29.41**	443.04	134.16	43.54**
1×4	29.64	11.18	37.72**	32.24	9.36	40.91**	106.60	22.10	26.15**	150.8	63.7	73.13**	532.48	204.88	62.54**
1×5	27.04	9.88	51.57**	15.60	-7.28	-31.82**	137.80	74.10	116.33**	98.8	14.3	16.92**	409.76	111.28	37.28**
1×6	29.12	9.88	51.19**	25.48	1.04	4.26**	114.40	22.10	28.17**	122.2	37.7	44.62**	540.80	219.41	68.28**
1×7	47.45	4.16	9.61**	36.40	9.88	37.25**	111.80	26.00	30.30**	130.00	27.3	26.59**	544.96	169.52	45.15**
2×3	27.56	8.06	41.33**	19.24	0.52	2.78**	96.20	70.20	270.00**	124.8	52.0	71.43**	490.88	237.12	93.44**
2×4	28.60	9.88	52.78**	22.88	3.12	15.79**	101.40	29.90	41.82**	111.8	40.3	58.49**	368.16	95.68	35.11**
2×5	26.52	9.10	52.24**	26.00	6.24	31.58**	91.00	40.30	79.49**	114.4	45.5	66.04**	422.24	178.88	73.51**
2×6	30.16	10.66	54.67**	24.96	3.64	11.53**	87.36	8.06	10.16**	119.6	50.7	73.85**	486.72	220.48	82.81**
2×7	34.84	7.54	21.64**	31.72	8.32	35.56**	135.20	62.40	85.71**	122.2	35.1	40.30**	617.76	297.44	92.86**
3×4	25.48	5.98	30.67**	15.60	-2.60	-14.29**	46.80	-35.10	-42.86**	119.6	40.3	43.19**	316.16	24.96	8.57**
3×5	26.52	8.32	45.71**	21.84	3.64	20.00**	57.20	-3.90	-6.38**	109.2	32.5	42.37**	380.64	118.56	45.24**
3×6	28.08	7.80	38.46**	27.04	7.28	36.84**	98.80	9.10	10.15**	137.8	61.1	79.66**	459.80	174.84	61.36**
3×7	32.24	8.84	37.78**	26.00	4.16	19.05**	119.60	36.40	43.75**	117.00	22.1	23.29**	468.00	128.96	30.04**
4×5	30.16	12.74	73.42**	27.56	8.32	43.24**	106.60	44.20	70.83**	117.00	41.6	55.17**	524.16	261.36	99.45**
4×6	29.46	9.96	51.08**	27.00	6.20	29.81**	64.480	-26.52	-29.14**	122.2	46.8	62.07**	416.00	112.32	36.99**
4×7	31.20	8.50	37.45**	27.04	5.16	23.58**	135.20	50.70	59.51**	117.00	23.4	25.0**	600.60	242.24	67.60**
5×6	26.52	8.32	45.71**	19.76	-1.04	-5.00**	122.20	52.00	72.22**	132.6	59.8	82.14**	447.20	172.64	62.88**
5×7	30.16	8.84	41.46**	39.82	16.94	74.04**	78.00	14.30	22.45**	117.00	26.0	28.82**	417.04	88.68	27.01**
6×7	31.76	7.80	32.55**	31.20	6.76	27.66**	75.40	-16.90	-18.31**	119.6	28.6	31.43**	509.60	158.08	44.97**
L.S.D$_{0.05}$	0.501			1.0509			0.533			0.607			1.618		
L.S.D$_{0.01}$	0.715			1.716			0.679			0.801			2.05		

1=Prichard 2 = Cal Rock 3 = Beto 98 4=Ace 55 V.F 5= Floradade 6= Super strain B 7= Money Maker.

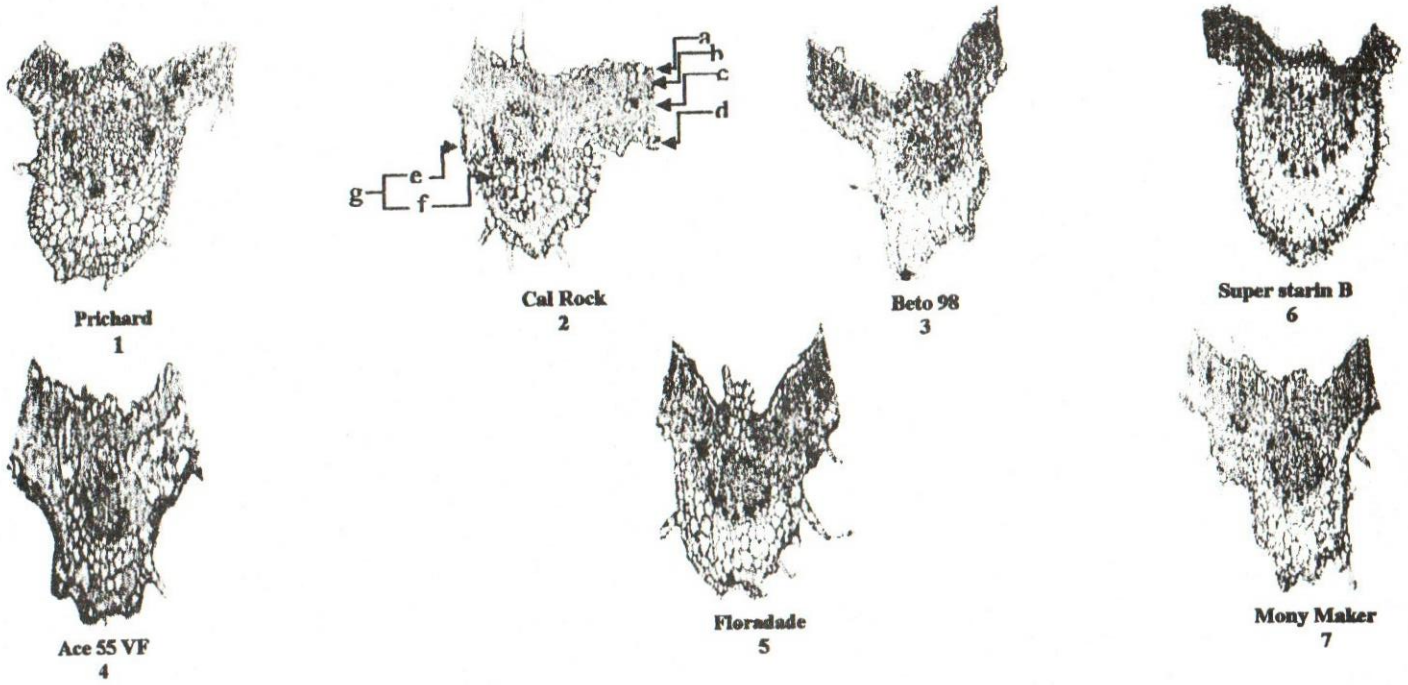

Fig (1): Tomato leaves structure in froth selfed generation of seven tomato parents (x40).
1- Prichard 2- Cal Rock 3-Beto 98 4-Acc 55 VF 5-Floradade 6- Super strain B 7- Money Maker
a- Upper epidermis b- Palisade tissue c-Spongy tissue d-Lower epidermis
e-Xylem f-Phloem G-Midveinal vascular bundle

Second part

More histological traits were being done. Mean values of both dimensions of the upper epidermis cell and midvienal bundles as well as diameters and thickness of vessels are listed in Table (4) and expressed in Fig (1 to 3). Different expressions heterotic effects were recorded over mid parent in the dimensions of upper epidermis cell. Whereas the length of dimensions of the upper epidermis cell showed positive highly significant value. Mean while nearly half out of the hybrids appeared negative significant value, in the width of dimensions of the upper epidermis traits. Heterosis values over mid parents ranged from (3.92-137.33)% for Floradade×Super strain B and Cal Rock×Floradade hybrids and from –29.59 to 111.43% for Ace 55 V.F×Money Maker and Cal Rock×Floradade for both length and width of dimensions of upper epidermis cell respectively as shown in Fig (2 and 3) and Table (5). As for dimensions of midvienal bundles (length and width), trait. It could be noticed that such trait gave positive and highly significant heterosis values, except the hybrid Beto 98×Ace 55 V.F showed negative heterotic effect. (312.98%) was the best heterosis value for the hybrid Prichard×Cal Rock in length of dimension midvienal bundle, while (210.14 %) was the highest value for the hybrid Cal Rock×Super strain B in width of the same trait over mid parents. Concerning the diameters of vessels trait, most hybrids showed positive highly significant heterosis values over mid parent.

Table (3): Heterosis% over better parents for thickness of leaf epidermis; palisade and spongy tissues for 21 tomato hybrids.

	Upper Epidermis		Lower Epidermis		Palisade Tissues		Spongy Tissues		Blade Leaf	
	F_1-M.P	H%	F_1-M.P	H%	F_1-M.P	H%	F_1-M.P	H%	F_1-M.P	H%
1×2	5.72	30.56	1.04	3.92	7.80	9.09	5.2	5.41	33.28	9.64
1×3	7.80	38.46	1.04	3.92	7.80	9.09	18.2	18.92	97.76	28.31
1×4	10.92	58.33	5.72	21.57	20.80	24.24	54.6	56.76	187.20	54.22
1×5	8.84	48.57	1.04	3.92	52.00	60.61	2.6	2.71	64.48	18.67
1×6	8.84	43.59	-1.04	-3.92	15.60	15.79	26.0	27.03	195.52	56.63
1×7	20.93	78.92	9.88	37.25	26.00	30.30	20.8	19.05	139.36	34.36
2×3	7.28	35.90	-1.04	-5.13	15.60	19.35	44.2	54.84	218.40	49.30
2×4	9.88	52.78	2.60	12.82	18.20	21.88	33.8	43.00	58.24	18.79
2×5	7.80	41.67	5.72	28.21	31.20	52.17	41.6	57.14	170.56	67.77
2×6	9.88	48.72	2.60	11.63	-11.44	-11.58	46.8	64.29	189.28	63.64
2×7	8.32	31.38	5.20	19.61	49.40	57.58	13.0	11.90	212.16	52.31
3×4	5.20	25.64	-3.64	18.92	-36.40	43.75	39.0	48.39	6.24	2.01
3×5	6.24	30.77	2.60	13.51	-23.40	-29.03	28.6	35.48	108.17	39.70
3×6	7.80	38.46	4.68	20.93	0.05	0.05	57.2	70.97	162.24	54.55
3×7	5.72	21.57	-0.52	-0.02	33.80	39.39	7.8	7.16	62.42	15.40
4×5	11.44	61.00	8.32	43.24	23.40	28.13	39.0	50.00	214.24	69.13
4×6	9.36	64.15	4.16	18.61	-13.52	-13.68	44.2	56.67	106.08	43.23
4×7	4.68	17.65	0.52	1.96	49.40	57.58	7.8	7.14	194.40	47.93
5×6	6.24	30.80	-2.60	-11.63	36.40	36.84	59.4	81.59	149.76	50.35
5×6	3.64	13.73	13.00	49.02	-20.80	-21.05	7.8	7.14	11.44	2.21
6×7	4.68	17.65	0.52	1.96	-23.40	-27.27	10.4	9.52	104.00	25.64
$L.S.D._{0.05}$	0.709		0.637		0.593		0.622		0.563	
$L.S.D._{0.01}$	0.912		0.805		0.819		0.704		0.704	

1= Prichard 2 = Cal Rock 3 = Beto 98 4=Ace 55 V.F 5= Floradade 6= Super strain B 7= Money Maker.

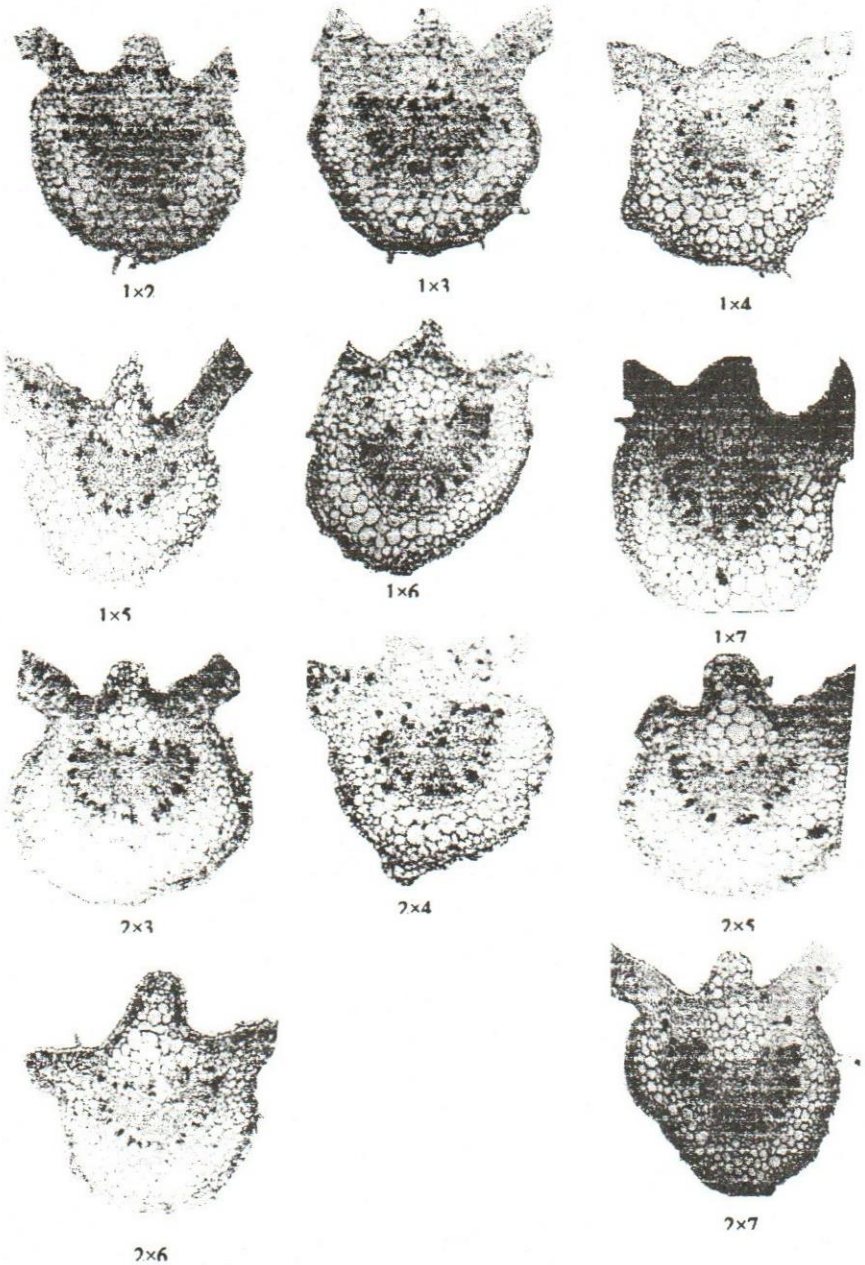

Fig (2): Tomato leaves structure in 11 out of 21 tomato hybrids (x40).
1- Prichard 2- Cal Rock 3-Beto 98 4-Acc 55 VF
5-Floradade 6- Super strain B 7- Money Maker

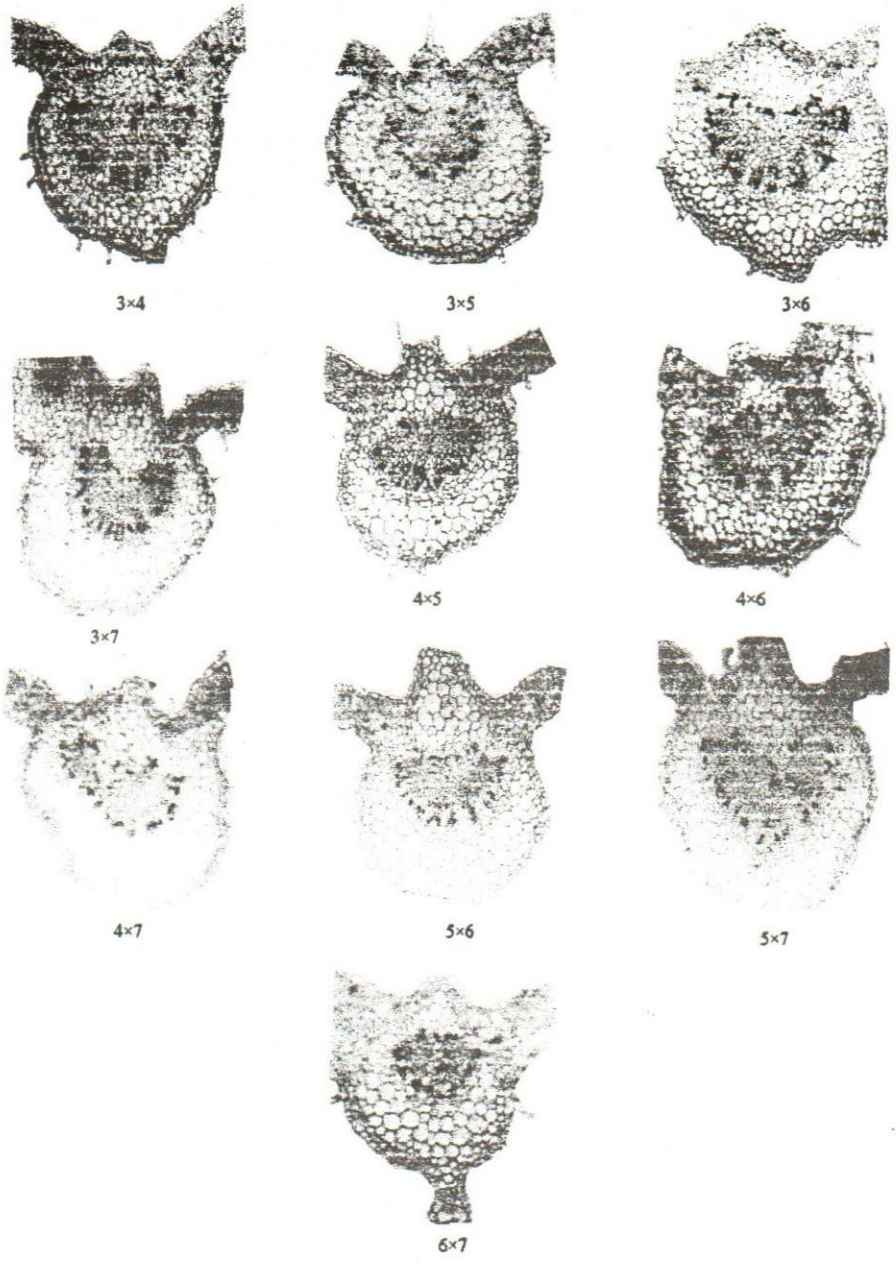

Fig (3): Tomato leaves structure in 10 out of 21 tomato hybrids (x40).
1- Prichard 2- Cal Rock 3-Beto 98 4-Acc 55 VF
5-Floradade 6- Super strain B 7- Money Maker

The best heterotic value was identified as the combination between Cal Rock×Money Maker with (116.67%), however, nine out of the hybrids showed negative heterosis values. Same trend was observed for thickness of vessels walls over mid parent, where the hybrid Cal Rock×Super strain B with (116.67%) heterosis value was the best.

Table (4): Means values of both dimensions of upper epidermis cell and midvienal bundles as well as the diameters and thickness (ى) of vessels / bundles for 21 tomato leaflets hybrids and their parents

Genotypes	Dimensions of upper epidermis cell		Dimensions of midvienal bundles		Vessels/ bundles	
	Length	Width	Length	Width	Diameters of vessels	Thickness (μ) of vessels walls
1	18.20	32.76	312.00	384.80	31.20	4.16
2	18.72	37.96	159.43	218.40	17.16	3.12
3	20.28	31.72	214.86	273.83	20.28	2.60
4	18.20	33.28	412.46	526.86	27.30	5.20
5	20.28	16.12	276.64	416.64	28.60	6.40
6	32.76	20.28	235.04	304.72	21.32	3.12
7	26.52	35.88	395.20	572.00	22.88	3.12
1×2	45.24	32.24	973.44	595.92	19.76	5.20
1×3	43.16	28.08	582.40	713.44	23.92	5.20
1×4	42.12	29.12	676.00	998.40	24.44	2.60
1×5	29.64	31.72	502.32	738.40	19.76	3.64
1×6	44.20	29.12	668.72	970.32	22.88	3.12
1×7	55.25	50.70	603.20	816.40	21.32	5.20
2×3	34.84	27.10	624.00	738.40	23.92	4.68
2×4	31.20	30.68	398.32	443.04	28.08	2.60
2×5	46.28	25.48	343.20	478.40	26.52	6.76
2×6	48.36	30.16	478.40	811.20	23.40	5.20
2×7	43.68	34.84	676.00	1098.20	29.64	6.76
3×4	30.16	24.96	280.80	374.40	18.20	3.25
3×5	39.00	24.96	443.04	744.64	24.44	5.20
3×6	35.88	28.08	536.64	554.32	22.88	4.16
3×7	28.02	32.24	640.64	744.64	27.04	3.64
4×5	40.04	30.16	588.64	863.20	24.96	4.68
4×6	39.52	30.16	443.04	682.24	28.08	5.72
4×7	50.96	31.20	536.64	904.80	22.36	4.68
5×6	27.56	38.48	294.63	474.86	23.14	3.64
5×7	30.68	24.96	422.24	619.84	20.28	6.24
6×7	34.84	31.20	723.84	842.40	26.00	5.20

1=Prichard 2 = Cal Rock 3 = Beto 98 4=Ace 55 V.F
5= Floradade 6= Super strain B 7= Money Maker.

Fig (2 and 3) and Table (6) showed heterosis values % over better parent for both dimensions of upper epidermis cell and midvienal bundles as well as diameters and thickness of vessels. Results proved that the expression of the heterotic effects for either length or width of dimensions of the upper epidermis cell is different. Whereas all hybrids showed positive and highly significant values for length in dimensions of upper epidermis cell

except one hybrid Floradade×Super strain B recorded negative value. At the contrary, width of the same trait recorded highly negative significant heterosis values for all hybrids except three out of the hybrids (Prichard×Money Maker; Beto 98×Super strain B and Floradade×Super strain B) showed positive and highly significant values. With regard to the dimensions of midvienal bundles (length and width), it could be noticed that most hybrids recorded positive and highly significant values over better parent.(212%) and (169.66 %) were the best heterotic values for the hybrids Prichard×Cal Rock and Cal Rock×Beto 98 for length and width of dimensions of midvienal bundles respectively. On the other hand, the diameter of vessels showed negative and highly significant heterosis values over better parents for most studied hybrids. Mean while, the heterosis values either positive or negative were low except the hybrid (Cal Rock×Money Maker) that gave the highest positive significant heterotic effect (116.67%) for thickness of vessels walls. Generally most of the best heterotic combinations were identified as the combinations of male parental cultivars, Prichard; Cal Rock; and Floradade with

Money Maker as a female parent. Most hybrids exceeded their respective parents and scored highly significant heterosis values for all studied histological traits Amer *et al.* (1999) found heterosis for same histological traits in peas over mid and better parent. Such increasment in any histological traits such as thickness of leaflet traits in tomato may be of a great aspect. Any development in leaflet thickness using hybridization methods in the hybrids may also increase and develop of the mechanical resistance to some serious insects such as white fly and aphis. Reddy *et al.* (1995) study the histology traits and the mechanical resistance of the plant, thus in our point of view, further investigations must be carried out to detect higher values for the leaflet thickness in tomato either by double hybrid method or a gene pool development to make more studies on the mechanical resistance to white fly and aphis as well as their effects on the infection for many serious diseases and produce hybrids heterotic for more self mechanical resistance to stress conditions. Same trend was observed by El-Shenawy *et al.* (1987) who mentioned that there was a correlation between cucumber susceptibility to downy mildew and cuticle thickness (upper surface and lower surface) where as the resistant c.v. possessed more thicker upper and lower epidermis.

II- Electrophoretic traits:

Electrophortic banding patterns (SDS-PAGE) of extracted protein from dry seeds of seven tomato parents, (S_4), and their F_1 hybrids are presented in Fig (4) for the parents and Fig (5a+b) for the F_1s.

a- The parents:

Large differences were observed for the major protein banding patterns of the seven parental parents Fig (4). The appearance of the four major bands for each cultivar is completely differed compared with other parents. Even the degree of appearance or density also differs for each parent. The first region (1) contains either very faint or disappeared bands. The band density increases in Region (2) to reach the maximum appearance with higher intensity in Region (3). Moreover band density decreased in Region (4).

Fig (4) clearly shows how protein banding patters are completely differed in size and density. Thus, it could be concluded according to the arrangement in descending order that the two parents of, Pritchard and Mony Maker, were the best, followed by Ace 55 V.F., Nearly the three parents, Beto 98; Floradade and Super strain B are equal in band intensities.

The previous conclusions indicated that the variations in banding patterns between the six parents tomato parents are genotypically and evolutionary different. This was substantiated by the facts that some of the sub fractions of a particular protein either slightly disappeared or were reduced in size and mobility. Such quantitative and qualitative variations in the parent banding patterns could be found if one assumes that the genes responsible for these metabolic phenomena are different in their action. A reasonable explanation that could be forwarded, is that these parents are of different origins and they have gone through completely different pathes during evolutionary processes. Same results were obtained by Cooke (1990); Charkabatri *et al.* (1992); Fahym, Eman and Okasha (1992); El-Maghawry *et al.* (1997); Matsumoto *et al.* (1997); Ismail and El-Ghareeb (2000)

b- F_1 hybrids

Fig (5a+b)), showed the great appearance in the F_1 either in size of protein banding patterns or in intensity as well as the increase in band number. All F_1,s were characterized by increasing band number and intensity, inspite of having the same number four regions, of major genes as in the parents

Comparing the major bands of the F_1,s with their respective parents, it could be concluded that, Region (1) that had slightly appearance (very faint) or was absent in the parents showed an increase in density in the F_1,s (faint). The comparison of the other 3 major bands in all genotypes clear that, the major bands in Region (2) and (3) contained very dark and high intensities as well as some faint bands that were absent in the parents.

All hybrids recorded dark stained bands, "heavy molecular weight",. Such intensities are equal in both, Region (2) and (3). Being less in intensity, the region (1) and (4) were different from the others. Moreover some hybrids showed an equality distribution of heavy density for all four regions. On the other hand, many hybrids showed equality intensities for Region 2, 3 and 4.

The de novo appearance of these darkly stained " heavy molecular weight" bands in the F_1,s reflected over dominance action frame for the genes that control a particular protein fraction.

Heterosis estimates over mid and better parents for some agronomic traits, Table (7 and 8), were positive and highly significant values. Comparing electrophoretic banding patterns of protein with such heterosis values, some interesting results were observed. The increase in band number with higher size and intensities in F_1s bands. Moreover the slight appearance or the absence of the major bands in Region (1) of the parents lead to conclude that such situation may play a role of heterotic performance in tomato plants.

From the previous results, it could be concluded that qualitative and quantitative differences expressed a considerable amount of heterotic effects among the studied tomato populations. Thus some sorts of association between percent of heterosis and the kind of electrophortic, must be

mentioned. These results were very near to those reported by Charkabarti *et al.* (1992) who suggested that the Indian tomato varieties and the hybrids derived from them could be distinguished on the basis of protein pattern bands and their intensities, and Amet (1992) who detected not only qualitative variability, presence/ absence, of bands but also quantitative variability, variation in band number and intensities among the genotypes. Same results were obtained by Bush *et al.* (1989); Doebely (1989); Ozbek *et al.* (1991); Rashed *et al.* (1991); Abd El-Salam (1991); Abdel Tawab (1993), Amer *et al.* (1999) and Ismail and El-Ghareeb (2000).

(Fig 5a + b) showed that the appearance of very distinctive; darkly stained protein bands were identified as the combinations between parents i.e. Prichard; Cal Rock; Beto 98; Ace 55. VF and Flordadade as male parents with Mony Maker as a female parent. On other hand, the crosses, which, Super strain B was a female parent and Prichard; Cal Rock and Floradade as a male appeared also darkly stained protein band. Same crosses were the best having highly significant and positive heterosis values for agronomic traits as well as most effective histological traits.

These conclusions clearly suggest that protein SDS-PAG would be of great aspect in producing F_1 tomato hybrids. Moreover, selection of the best F_1,s among many tested hybrids must begin in lab before open filed evaluation.

III- Agronomic traits

Estimates of heterosis percent over mid parent for some agronomic traits are presented in Table (7). Positive and significant heterosis percentages for number of flowers per cluster and per plant; fruit weight (gm), and total yield (gm) per plants were observed for 21 hybrids (without reciprocals) derived from seven parental tomato parents.

For number of flower traits, the hybrids Prichard×Beto 98 and Beto 98×Money Maker were the best having the highest positive heterosis values (104.42-102.65%). These values were followed by (91.25-92.98-97.5) % for the hybrids Cal Rock×Money Maker; Prichard×Super strain B and Prichard×Money Maker respectively. Generally any hybridesation consists of Money Maker as female parent increases number of flowers per cluster in their hybrids. Such situation reflects the same trend that was observed in number of flowers per cluster with those were reported by El-Maghawry *et al* (1997). The best hybrids that showed the positive and highly number of flowers per cluster showed also the highest values of heterosis in the same trait per plant.

The present study assumed heterosis over mid parent for fruit weight (Table 7) whereas the increase of fruit weight ranged from (2.81%) for Cal Rock×Beto 98 hybrid to (123.96%) for the hybrid Beto 98×Money Maker. The highly positive heterosis values were (109.60-119.47-115.44, 123.19, 123.96) for the hybrids Prichard×Money Maker, Cal Rock×Money Maker, Beto 98×Money Maker, Ace 55 V.F×Money Maker, Super strain B×Money Maker. Concerning total yield trait, Large amounts of heterosis were obtained. The values ranged from 35.56% for Ace 55 V.F×Super strain B to (101.68%) for Prichard×Money Maker. These results are in agreement with Bhuiyan *et al.* (1986); Pujari and Kale (1994) Uppal *et al.* (1997) and Surjan *et al.* (1999).

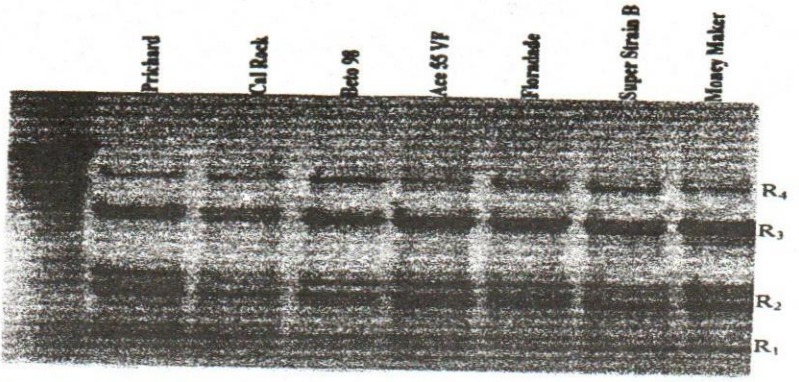

Fig (4) Sodium dodocyl sulphate polyacrylamide gel electrophoresis (SDS-PAGE) for (S_4) seed protein extracts of seven tomato parents

Fig (5a)

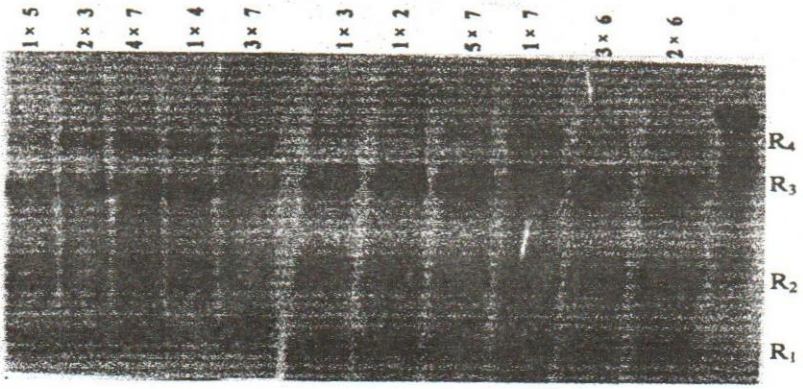

Fig (5b)

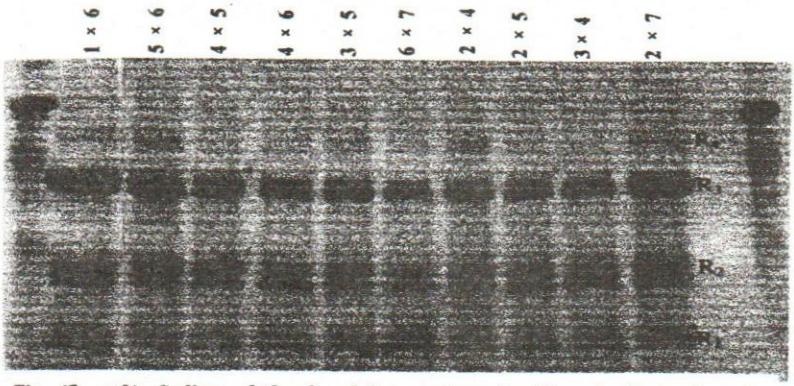

Fig (5. a+b) Sodium dodocyl sulphate polyacrylamide gel electrophoresis (SDS-PAGE) for (S_4) seed protein extracts of 21 tomato hybrids

Table (5): Heterosis over mid parents for both dimensions of upper epidermis cell and midvienal bundles as will as the diameters and thickness (μ) of vessels/walls in 21 tomato hybrid leaflets

Crosses	Dimensions of upper epidermis cell				Dimensions of midvienal bundles				Vessels/bundles			
	Length		Width		Length		Width		Diameters of vessels		Thickness (μ) and vessels walls	
	F_1-M.P	H%	F_1-M.P	H%	F_1-M.P	H%	F_1-M.P	H%	F_1-M.P	H%	F_1-M.P	H%
1×2	24.26	115.36 **	-8.82	-91.18 **	737.73	312.96 **	294.32	97.59 **	4.42	28.81 **	1.56	42.86 **
1×3	23.92	124.32 **	-4.16	-12.90 **	318.97	121.08 **	384.13	116.65 **	-1.82	-7.07 **	3.38	185.71 **
1×4	23.92	131.42 **	-3.9	-11.81 **	313.77	86.62 **	542.57	119.03 **	-24.44	-50.0 **	-2.08	44.44 **
1×5	10.4	54.05 **	7.28	29.79 **	208.0	70.67 **	337.68	84.27 **	-10.14	33.91 **	-1.64	-31.06 **
1×6	18.72	73.47 **	2.60	9.80 **	395.2	144.49 **	625.56	181.45 **	-3.38	-12.87 **	-0.52	-14.29 **
1×7	32.89	147.1 **	16.38	47.73 **	249.6	70.59 **	338.0	70.65 **	-5.72	21.17 **	1.56	42.86 **
2×3	15.34	78.67 **	-9.82	-26.30 **	436.86	233.44 **	492.29	200.03 **	5.2	27.78 **	1.82	63.64 **
2×4	12.74	69.01 **	-4.94	-13.87 **	112.38	39.30 **	70.41	18.90 **	5.85	26.32 **	-1.56	-37.5 **
2×5	26.78	137.33 **	-1.56	-5.79 **	152.17	79.66 **	160.88	50.67 **	3.64	15.92 **	2.00	42.02 **
2×6	22.62	87.71 **	1.04	3.57 **	281.17	142.56 **	549.64	210.14 **	4.16	21.62 **	2.08	66.67 **
2×7	21.06	93.10 **	-2.08	5.63 **	398.69	143.87 **	703.0	177.88 **	9.62	48.05 **	3.64	116.67 **
3×4	10.92	56.76 **	-7.54	-23.2 **	-32.8	-10.48 **	25.95	7.45 **	5.59	44.33 **	-0.65	-16.67 **
3×5	18.72	92.31 **	1.04	4.35 **	197.29	80.28 **	399.41	115.69 **	-0.04	-0.16 **	0.7	15.56 **
3×6	9.36	35.29 **	2.08	7.69 **	311.69	138.56 **	256.05	85.85 **	2.08	10.0 **	0.76	22.35 **
3×7	4.62	19.74 **	-1.56	-4.62 **	335.81	110.16 **	321.73	76.08 **	5.46	25.30 **	0.78	27.27 **
4×5	20.8	108.11 **	5.46	22.11 **	244.0	70.80 **	391.45	82.98 **	-2.99	-10.7 **	-1.12	-19.31 **
4×6	14.04	55.10 **	3.38	12.62 **	119.29	36.85 **	266.45	64.08 **	3.77	15.51 **	1.56	37.50 **
4×7	28.6	127.91 **	-3.38	-29.59 **	132.81	32.89 **	355.37	64.08 **	-2.73	-10.88 **	0.52	12.5 **
5×6	1.04	3.92 **	20.28	111.43 **	38.79	15.16 **	114.44	31.75 **	-1.82	-7.29 **	-1.12	23.35 **
5×7	7.28	31.11 **	5.20	26.32 **	86.32	26.70 **	125.52	25.39 **	-5.46	-21.21 **	1.48	31.59 **
6×7	5.2	17.54 **	3.12	11.11 **	408.72	129.70	404.04	92.17 **	3.9	17.65 **	2.08	66.67 **
L.S.D.$_{0.05}$	0.498		0.337		1.576		1.23		0.513		0.217	
L.S.D.$_{0.01}$	0.602		0.510		1.707		1.441		0.683		0.416	

1=Prichard 2 = Cal Rock 3 = Beto 98 4=Ace 55 V.F 5= Floradade 6= Super strain B 7=Money Maker.

Table (6) Heterosis % over better parents for both dimensions of upper epidermis cell and midvienal bundles as well as the diameters of vessels / bundles in 21 tomato hybrid leaves

Crosses	Dimensions of upper epidermis cell				Dimensions of midvienal bundles				Vessels/bundles			
	Length		Width		Lenth		Width		Diameter of vessels		Thickness of vessels walls	
	F_1-B.p	H%	F_1-B.P	H%	F_1.B.P	H%	F_1-B.P	H%	F_1.B.P	H%	F_1-B.P	H%
1×2	26.52	141.67	-5.72	-15.07	661.44	212.00	211.12	54.86	-11.44	-36.67	1.04	25.00
1×3	22.88	112.82	-4.68	-14.29	270.40	86.67	328.64	85.41	-7.28	-23.33	2.08	50.00
1×4	23.92	131.43	-4.16	-12.50	263.54	63.89	471.54	89.50	-6.76	-21.67	-2.60	-50.00
1×5	9.36	46.15	-1.04	-3.17	190.32	61.00	321.76	77.23	-11.44	-36.67	-2.76	-43.13
1×6	11.44	34.90	-3.64	-11.11	356.72	114.33	585.52	152.16	-8.32	-26.67	-1.04	-25.00
1×7	28.73	108.33	14.82	41.30	208.00	52.63	244.40	148.65	-9.88	-31.67	1.04	25.00
2×3	14.56	71.79	-10.86	-28.61	409.14	190.42	464.57	169.66	3.64	17.95	1.56	50.00
2×4	12.48	66.67	-7.28	-19.18	-14.54	-3.53	-83.82	-15.91	0.78	2.86	-2.60	-50.00
2×5	26.00	128.21	-12.48	-32.88	66.56	24.06	61.76	14.82	-2.08	-7.27	0.36	5.63
2×6	81.12	247.62	-7.80	-20.55	243.36	103.54	506.48	166.21	2.08	9.76	2.08	66.67
2×7	17.16	64.71	-3.12	-8.22	280.80	71.05	526.20	91.99	6.76	29.55	3.64	116.67
3×4	9.88	48.72	-8.32	-25.50	131.66	31.92	-152.46	-28.94	-9.10	-33.33	1.95	37.50
3×5	18.20	89.74	-6.76	-21.31	166.40	60.15	328.00	78.73	-4.16	-14.55	-1.20	-18.75
3×6	3.12	9.52	59.80	188.52	301.60	128.32	249.60	81.91	1.56	7.32	1.04	33.33
3×7	1.50	5.66	-3.64	-10.14	245.44	62.11	172.64	30.18	4.16	18.18	0.52	16.67
4×5	19.76	97.44	-3.12	-9.38	176.18	42.71	336.34	63.84	-3.64	-12.73	-1.72	26.88
4×6	6.76	20.63	-3.12	-9.38	30.58	7.41	155.38	29.49	0.78	2.86	0.52	10.00
4×7	24.44	92.16	-2.08	5.80	124.18	30.11	332.80	58.18	-4.94	-18.10	-0.52	-10.00
5×6	-5.20	-15.87	18.20	89.74	17.99	6.50	58.22	13.97	-5.46	-19.09	-2.76	43.13
5×7	4.16	15.69	-10.92	-30.43	27.04	6.84	47.84	8.36	-8.32	-29.09	0.10	1.56
6×7	2.08	6.34	-4.68	-13.04	328.64	83.16	270.4	47.20	3.12	13.64	2.08	66.67
$L.S.D._{0.05}$	0.619		0.513		0.828		0.618		0.513		0.622	
$L.S.D._{0.01}$	0.873		0.729		1.211		0.806		0.692		0.819	

1=Prichard 2= Cal Rock 3 = Beto 98 4=Ace 55 V.F
5= Floradade 6= Super strain B 7= Money Maker

Table (7): Heterosis values over mid parents for some agronomic traits in F_1 tomato hybrids

Crosses	No. of flowers/cluster			No. of flowers/plant			Fruit weight (gm)s			Total yield/plant (gm)s		
	F_1	F_1-M.P	H%	F_1	F_1-M.P	H%	F_1	F_1-M.P	H%	F_1	F_1-M.P	H%
1×2	10.88	4.79	78.65	72.58	26.89	58.85	96.67	17.76	22.51	5284.20	2243.33	73.77
1×3	11.55	5.90	104.42	72.26	32.07	79.80	98.31	17.20	21.21	5204.33	2184.63	72.51
1×4	11.47	5.38	88.34	77.91	31.72	68.67	99.55	25.97	35.41	5591.33	2595.08	86.61
1×5	10.76	4.51	72.16	72.26	24.96	52.77	98.11	24.34	32.99	5074.67	1944.60	62.13
1×6	11.27	5.43	92.98	81.82	37.87	86.17	97.01	37.60	63.29	5723.40	2554.36	80.60
1×7	13.43	6.63	97.50	89.18	39.19	78.40	99.69	56.94	133.19	6590.43	3322.68	101.68
2×3	8.87	3.16	55.34	61.31	18.04	41.69	98.01	2.68	2.81	4475.67	1381.27	44.64
2×4	9.66	3.52	57.33	62.10	16.15	35.15	99.23	15.72	9.34	4478.83	1407.88	45.85
2×5	9.34	3.03	48.02	62.71	15.33	32.36	97.81	7.80	8.67	4624.77	1420.00	44.31
2×6	9.78	3.88	65.76	66.99	22.96	52.15	96.71	9.94	11.46	4887.49	1643.75	50.67
2×7	13.12	6.26	91.25	80.27	30.29	60.60	100.89	54.06	115.44	5860.01	2517.56	75.32
3×4	9.09	3.38	59.12	59.84	16.39	37.72	100.89	5.94	6.26	4601.77	1559.19	51.25
3×5	9.21	3.34	56.90	62.27	17.39	38.75	99.45	3.99	4.18	4393.63	1210.03	38.00
3×6	8.86	2.94	49.66	59.82	18.29	44.04	98.35	12.50	14.56	4389.16	1166.51	36.20
3×7	13.01	6.59	102.65	85.30	37.77	79.47	102.53	56.75	123.96	6195.50	2874.22	86.67
4×5	8.39	2.08	32.96	60.50	12.94	27.21	100.62	12.33	13.97	4351.88	1191.74	37.71
4×6	8.99	3.00	50.08	60.18	15.97	36.12	100.68	13.88	15.99	4373.13	1179.02	35.56
4×7	11.37	4.51	65.74	77.75	27.50	54.73	103.77	54.28	109.68	5953.78	2657.45	80.09
5×6	10.60	4.54	74.92	64.70	19.06	41.76	98.14	18.55	23.31	4868.50	1535.57	46.07
5×7	12.20	5.18	73.79	69.35	17.67	35.88	102.33	43.32	73.41	5842.11	2410.46	70.24
6×7	11.47	4.86	73.52	78.31	30.03	62.20	101.23	54.03	114.47	5475.85	2005.23	57.78
$L.S.D._{0.05}$	0.612			0.518			1.638			0.997		
$L.S.D._{0.01}$	0.830			0.786			2.811			1.236		

1=Prichard 2 = Cal Rock 3 = Beto 98 4=Ace 55 V.F
5= Floradade 6= Super strain B 7= Money Maker.

Heterosis values over better parent, for some agronomic traits are presented in Table (8). Results clear positive significant heterosis percentage for flower number per cluster and per plant; fruit weight and total yield per plant. For number of flowers per cluster traits, results showed that heterosis ranged from (29.68%) to (91.54 %) for Ace 55 V.F×Floradade and Prichard×Beto 98. The best hybrids having also highest values heterosis were Prichard×Super strain B and Prichard×Ace 55 V.F. As for number of flowers per plant, it was found that, heterosis percentage ranged from (12.1%) for the hybrid Ace 55 V.F×Floradade to 102.38% for Beto 98×Money Maker. The best hybrids that gave the highly positive heterosis were the combinations between Prichard as a male parent with each of Super strain B and Ace 55. V.F as female.

With regard to fruit weight most hybrids showed positive and highly significant except the hybrid Cal Rock×Beto 98 showed no significant values. The combination that the female parent was Money Maker increases fruit

weight heterosis values. Heterosis increases to 51.11% for Beto 98×Money Maker hybrid.

Heterosis values for total yield per plant, Table (8), ranged from (30.17%) for the hybrid Beto 98×Super strain B to (84.64%) for Prichard×Money Maker hybrid. The highest values for heterosis were obtained from the combinations of the studied parents with Money Maker as a female parent. These results are in harmony with those reported by many investigators, Mochizuki and Kamimura (1986); Martinez (1989); Araujo *et al.* (1991); Kordus (1991); Danailov *et al.* (1997); Wang *et al.* (1998); Mageswari and Natrajan (1999); Zenner and Polania (1999) Bhatt *et al.* (2001) and Kurian *et al.* (2001).

Generally, most of the best combinations were identified as the combination of most parents with Money Maker as a female parent.

Table (8): Heterosis values over better parents for some agronomic trails in F_1 tomato hybrids

Genotypes	No of flowers/ clusters			No. of Flowers/plant			Fruit weight (gms)			Total yield /plant (gms)		
	F_1	F_1.H.P	H%	F_1	F_1-B.P	H%	F_1	F_1-B.P	H%	F_1	F_1-B.P	H%
1×2	10.88	4.74	77.2	72.58	26.81	58.58	114.43	17.46	18.01	5284.2	2168.63	69.61
1×3	11.55	5.52	91.54	75.26	26.66	58.46	115.51	15.86	15.92	5204.33	2131.10	69.34
1×4	11.47	5.33	86.81	77.91	31.78	68.15	125.42	23.33	22.85	5591.33	2565.01	84.76
1×5	10.76	4.29	66.31	72.26	23.27	47.5	122.45	23.21	23.39	5074.67	1780.71	54.06
1×6	11.27	5.24	86.90	81.82	36.22	79.43	134.61	37.57	38.72	5723.4	2351.50	69.74
1×7	13.43	5.86	77.41	89.18	34.81	64.02	156.63	51.22	48.59	6590.43	3021.10	84.64
2×3	8.87	2.73	44.46	61.31	15.54	33.55	100.69	1.04	1.04	4475.67	1360.10	43.65
2×4	9.66	3.52	57.33	62.10	15.96	34.62	114.97	12.85	12.58	4478.83	1363.26	43.76
2×5	9.34	2.87	44.43	62.71	13.72	28.01	105.61	6.37	6.42	4624.77	1330.81	40.40
2×6	9.78	3.64	59.28	66.99	21.22	46.36	106.65	9.61	9.90	4887.49	1515.59	44.95
2×7	13.12	5.55	73.32	80.27	25.9	47.64	154.95	49.52	46.98	5860.01	2290.68	64.18
3×4	9.09	2.95	48.05	59.84	13.71	29.72	106.83	4.59	4.50	4601.97	1528.74	49.74
3×5	9.21	2.74	42.35	62.24	16.14	32.95	103.44	3.79	3.80	4393.63	1099.67	33.38
3×6	8.86	3.21	56.81	59.82	10.28	24.31	110.85	11.2	11.23	4389.16	1017.26	30.17
3×7	13.01	5.44	71.86	85.30	43.01	102.38	159.28	53.87	51.11	6195.50	2626.17	73.58
4×5	8.39	1.92	29.68	60.50	5.93	12.10	112.95	10.83	10.61	4351.88	1057.92	32.12
4×6	8.09	2.85	46.42	60.18	11.51	24.9	114.56	12.44	12.17	4378.13	1084.17	32.15
4×7	11.37	3.8	50.20	77.75	14.35	26.39	158.05	52.64	49.94	5953.78	2384.45	66.80
5×6	10.6	4.13	63.83	64.70	23.38	47.72	116.69	17.45	17.58	4868.5	1496.6	44.38
5×7	12.20	4.63	61.16	79.65	15.71	28.90	145.65	40.24	38.17	5842.11	2272.78	63.68
6×7	11.47	3.9	51.52	78.36	23.99	44.12	155.26	49.85	47.29	5475.85	1906.52	54.41
L.S.D.$_{0.05}$	0.703			1.733			1.511			0.621		
L.S.D.$_{0.01}$	0.853			1.907			2.717			0.815		

1=Prichard 2 = Cal Rock 3 = Beto 98 4=Ace 55 V.F
5= Floradade 6= Super strain B 7= Money Maker.

Total soluble solids and fruit pH

Heterosis values over mid parents for total soluble solids (T.S.S.) and fruit pH are presented in Table (9), most hybrids showed positive and insignificant heterosis effects for T.S.S. trait except two hybrids Prichard×Beto 98 Cal and Rock×Beto 98 showed highly positive significant values (9.02; 8.22)% respectively. The best hybrid was Prichard×Floradade having the highest insignificant values (12.81). Insignificant values of T.S.S. were obtained by Zhou and Xu (1984), Chan and Zhao (1990) El- Maghawry *et al.* (1997). As for fruit pH trait nearly half out of the hybrids showed positive insignificant values, meanwhile the remaining hybrids showed negative insignificant values. Two out only of the hybrids showed positive and significant values i.e. Beto 98×Super strain B; and Beto 98×Money Maker with 7.94 and 11.73% respectively. Less than 4.5 fruit pH value was obtained by Shoba and Arumugam (1991).

Table (9): Heterosis values over mid parents for total soluble solids T.S.S. and fruit pH in tomato hybrids

Crosses	Total soluble solids (T.S.S)			Fruit pH		
	F_1	F_1-M.P	H%	F_1	F_1-M.P	H%
1×2	5.50	0.37	7.21	5.51	-0.21	-2.10
1×3	5.56	0.46	9.02	5.78	0.320	5.860
1×4	5.30	0.30	6.00	5.86	0.070	1.210
1×5	5.90	0.67	12.81	5.35	-0.23	-4.12
1×6	5.36	0.10	1.90	5.79	0.230	4.140
1×7	5.40	0.15	2.83	5.46	-0.19	-3.360
2×3	5.66	0.43	8.22	5.60	0.160	2.940
2×4	5.20	0.07	1.36	5.54	-0.30	-5.14
2×5	5.26	0.03	0.56	5.54	-0.08	-1.42
2×6	5.73	0.24	4.36	5.41	-0.21	-3.740
2×7	5.40	0.02	0.37	5.52	-0.18	-3.16
3×4	5.13	0.03	0.59	5.22	-0.29	-5.26
3×5	5.50	0.27	5.16	5.41	0.120	2.270
3×6	5.60	0.14	2.56	5.71	0.420	7.940
3×7	5.45	0.10	1.80	6.00	0.630	11.73
4×5	5.40	0.17	3.25	5.80	0.120	2.110
4×6	5.46	0.30	5.60	5.36	-0.33	-5.80
4×7	5.36	0.11	2.10	5.43	-0.33	-5.73
5×6	5.76	0.17	3.04	5.59	0.120	2.190
5×7	5.66	0.18	5.48	5.40	-0.15	-2.16
6×7	5.80	0.20	3.57	5.72	0.180	3.250
$L.S.D._{0.05}$	0.429			0.305		
$L.S.D._{0.01}$	0.599			0.496		

1=Prichard 2 = Cal Rock 3 = Beto 98 4=Ace 55 V.F
5= Floradade 6= Super strain B 7= Money Maker.

Heterosis values over better parents for total soluble solids (T.S.S.) and fruit pH Table (10) showed that, nearly half of the hybrids showed positive and insignificant heterosis values for (T.S.S.) trait. One hybrid only, Prichard×Floradade showed 8.06 % as a positive and significant value. As for fruit pH trait, most hybrids showed negative heterosis values even the three hybrids that had significant values. Six out of the hybrids showed positive insignificant heterosis values. These results are in agreement with those reported by Uppal *et al.* (1997); Shrivastava (1998); Wang *et al.* (1998)and Rego *et al.* (1999) Alice Kurian *et al.* (2001) and Bhatt *et al.* (2001) .

Table (10): Heterosis values over better parents for total soluble solids (T.S.S.) and fruit pH in tomato hybrids

Crosses	Total soluble solids (T.S.S)			Fruit pH		
	F_1	F_1-M.P	H%	F_1	F_1-M.P	H%
1×2	5.50	0.24	4.56	5.51	-0.20	-3.47
1×3	5.56	0.36	6.92	5.78	0.10	1.76
1×4	5.30	0.30	6.00	5.86	-0.02	-0.34
1×5	5.90	0.44	8.06	5.35	-0.12	-2.11
1×6	5.36	-0.34	-5.96	5.79	0.11	1.94
1×7	5.40	-0.10	1.82	5.46	-0.20	-3.52
2×3	5.66	0.40	7.60	5.60	-0.17	-2.95
2×4	5.20	-0.06	1.14	5.54	-0.36	-6.10
2×5	5.36	-0.10	1.83	5.54	-0.23	-3.99
2×6	5.73	0.03	0.55	5.41	-0.36	-6.24
2×7	5.40	-0.10	1.89	5.52	-0.25	-4.33
3×4	5.13	0.07	0.77	5.22	-0.68	-11.53
3×5	5.50	0.04	0.73	5.41	-0.07	-1.28
3×6	5.60	0.10	1.75	5.71	0.36	6.58
3×7	5.45	-0.05	-0.91	6.00	0.38	6.76
4×5	4.40	-0.06	-1.10	5.80	-0.10	-1.70
4×6	5.66	-0.04	-0.70	5.36	-0.54	-9.15
4×7	5.36	-0.14	-2.55	5.43	-0.47	-7.97
5×6	5.76	0.06	1.05	5.59	0.12	2.19
5×7	5.66	0.16	2.91	5.40	-0.22	-3.91
6×7	5.70	0.20	3.51	5.72	0.20	3.56
$L.S.D._{0.05}$	0.433			0.398		
$L.S.D._{0.01}$	0.671			0.603		

1=Prichard 2 = Cal Rock 3 = Beto 98 4=Ace 55 V.F
5= Floradade 6= Super strain B 7= Money Maker.

REFERENCES

Abd El-Salam, T.Z (1991). Physiological genetic studies in gamma irradiated wheat cultivars. Ph.D. Thesis, Fac. of Agric. Ain Shams University.

Abdel-Tawab, F.M.; M.A. Rashed, Eman M. Fahmy and F.M. El-Domyati (1993). Soybean cultivar identification by biochemical genetic markers. Ann. Agric. Sci. 4th Conf Agric. Dev. Res. Ain Shms Univ. Cairo.

Alice-Kurian; Peter-KV; and Kurian-A (2001): Heterosis for quality traits in tomato. J-of-Tropical-Agric-39: 1, 13-16; 8 ref.

Amer, A.H.; I.M. El-Ghareeb; El-S.M.S. El- Sharkawy and M.N.A. Saeed (1999): Effect of hybridization on some yield components and some biochemical and histological characters in pea *Pisum sativum* L. J. Agric. Sci. Mansoura Univ., 24 (6): 1841-1857.

Amet, T.M. (1992). Allozyme evidence bearing the gene pool of *Vicia faba* L. Gen. Cytol., 12:1 57-60.

Araujo-ML-de; Campos-JP-de; De-Araujo-ML; De-Campos-JP (1991). Evaluation of prostrate cultivars of tomato and F_1 hybrids in diallel creosses. Hort. Brsilaira 9:1, 10-12; 13 ref.

Bhatt. G.M. (1971). Heterotic performance and combining ability in a diallel cross among spring wheat *Triticum gestivum*, L. Australian J. of Agric. Res., 22(3): 359-369.

Bhatt-RP; Biswas-VR; and Kumar-N (2001); Heterosis, combining ability, and genetics for vitamin c, total soluble solids and yield in tomato *Lycopersicon esculentum* Mill. at 1700 m altitude-J-of Agric. Science 137: 1, 71-75, 18 ref.

Bhuiyan-SR; Newaz-M.A.; and Faridi-M.N. (1986). Heterosis for fruit yield, ascorbic acid and other plant characters in tomato Bengladish. Hort. 14:1, 34-39; 8 ref.

Bush, R.; D. Schrechensteion, S. Meier-Davis; J. Balmes and D. Rempel (1989). Soybean flour asthma detection of allergens by immunoblotting. Soyabean Abst., 12: 1842.

Charkabatri, A.K.; A.K. Das and N.C. Chattopadhyay (1992). Identification of some electrophorosis of seed proteins. Coll. of Agric. Calcutta Univ. 35 Bally gunga circular road, Calcutta 700 019 India seed Ress 1992 Publ. 1993. 20-30.

Chen-os; Zhao-Yw (1990) study on genetically effects on four characteristics of tomato J. of Jiangsu-Agric-College 11:4, 33-38; 9 ref.

Cooke, R.J. (1990). The use of electrophoresis for the distinctness testing of varieties of utogamous species. Plant Br. Abst., 60:2902.

Danailov-Z.P.; Russanov-L.P.; Jevtic,S. (ed.); Lazic, B(1997). Astudy on the possibility for increasing the adaptability in tomatos. Acta, Hort. Culturae 463:2, 627-632; 26 ref.

Doebely, J. (1989). Isozyme evidence and evaluation of crop plant. P. 165-191. In: D.E. Soltis and P.S. Soltis (eds). Isozyme in plant Biology. Champan and Hall London.

El-Maghawry, A.; A.A. Abd-El-Raheem;. M.A. Ismail. and I.M. El. Ghareeb (1997). Effect of hybridization on some biochemical characters in tomato. Egypt. J. App;. Sci., 12 (11). 38-51.

El-Shenawy, Z.; S.A. Mohamed; M.M. Amar and A.A. Awad (1987): Response of cucumber to " *Pseudoprenospora cubensis*" and it's virulence. Munufiya. J. Agric. Fac. Vol. 12 No 2.

Eweda, M.A. (1993). Isozymes as genetic markers to study intervarietal variation in soybean. Zagazig. J. Agric. Res. Vol. 20, No. 1, 235-261.

Fahym, Eman. M. and Okasha K.A. (1992). Phylogenetic relationships and biochemical genetic markers as fingerprints in two fragaria sp. J. Agric. Sci. Mansoura Univ., 17:335.

Ford, M.B. and Gardiner S.E. (1990). Electrophortic seed banding patterns as a genetic resource discreptors. Internat Workshop on tissue Culture for the Conservation of Biodiversity and Genet. Resources. May 1990 Kuala-Lumper, Malysia.

Gerlach, D. (1977). Botanische mikrotecnik, Ein Einfuhrung, Thieme veriag, Stuttgart, BRD.

Hegazi-HH; Hassan-HM; Moussa-AG and Wahab- Allah-MAE (1995): Heterosis and heritability estimation for some characters of some tomato cultivars and their hybrid combinations Alex. J-of Agric-Res. 40: 2, 265-267, 15 ref.

Ismail. T. A. and El- Ghareeb, I.M. (2000): The inheritance of yield and some of it's components and some biochemical studies in cowpea *Vinga unguiculata*. Zagazig. J. Agric. Res. Vol. 27 No (2), 537-555.

Kordus-R (1991). Development of yield and soluble solids content in fruit of inter specific F_1 hybrids of tomato *Lycopersicon esculentum.* × *L. pimpinellifolium* Mill. Biuletyn-Warzwniczy. 37: 19-27.

Kurian-A; Peter-KV; and Rajan-S (2001): Heterosis for yield components and fruit characters in tomato. J-of-Tropical-Agric. 39: 1, 5-8; 14 ref.

Laemmli, U.K. (1970). Cleavage of structural proteins during the assembly of the head of bacteriophage T_2 Nature 227:680.

Mageswari-K; and Natrajan-S (1999): Studies on heterosis for yield and quality in tomato *Lycopersicon esculentum* Mill. South-Indian-Horticulture 47: 1-6, 216-217; 1 ref.

Martinez-P-BA; Sanint-P-R; and Valleje-C- FA (1989). Analysis of heterosis and combining ability between different cultivars of tomato *Lycopersicon esculentum* Mill. using a diallel cross. Acta-Agronomica-Universided-National de- Colombia. 39: 1-2, 24-33; 14.

Matsumoto, T.; Sakai, F.; and Hayashi, T. (1997). A xyloglucan specific endo 1,4-beta glucanase isolated from auxin-treated Pea stem. Plant Pathology, 114 (2), 661-667.

Mochiznki-T; Kamimura-S. (1986). Variation in vitamin C content of the fruit of tomato lines with the high pigment gene. Buletin-Veg and ornamental crops Res. St. B. Morioka No. 6, 1-16; 24 ref.

O'Brien, T.P. and Mc Cully. M.E. (1981). The study plant structure principles and selected methods. Termarcarphipty. Melbourne, Australia, 271.

Ozbek, N. Atila, As.S. and Sagel, Z. (1991). Radiation induced mutations for yield and oil content in soybean (G. max, Merril, L). international. Atomic. Energy (I.A.E.A.). P. 193-198.

Pujari-CV; Kale-PN (1994). Heterosis studies in tomato. J-of- Maharashtra-Agric Unive. 19: 1,83-85; 6 ref.

Reddy, M.V.; Sheila, V.K.; Murthy, A.K. and Padma, N. (1995). Mechanism of resistance to *Aceria cajani* in pigeon pea. Interactional J. of Top. Plant Disease. 13(1):51-57

Rashed, M.A. ; A. Bahieldin and A.A. Godo (1991). The use of protein electrophoretic patterns and some isozyme for characterization of diverse male sterile cytoplasm of wheat Ann. Agric. Sci. Ain Shams Univ. 36: 549.

Rego-ER-do; Finger-FL-; Casall-VWD and do-Reg-ER (1999). Quality of fruits of tomato cv. Santa Clara, its yellow mutant and their F_1 hybrids. Horticultura – Brasilerira, 17:2, 106-109; 22 ref

Shoba-N; and Arumugam-R (1991). Evaluation of quality attributes in intervarietal crosses of tomato. South-Indian-Hort. 39:6, 350-352; 3.

Shrivastava-AK (1998). Heterosis and inbreeding depression for acidity and total soluble solids, reducing sugar and dry matter content in tomato (*Lycopersicon esculentum* Mill.). Advances-in-plant-Sciences, 11-2, 150-160, 8.

Singh-A; Sigh-PK; Dixit-J; and Gautam-JPS (1995): Heterosis and inbreeding depression in tomato Hort.J. 8:2, 125-129; 8 ref.

Studier, F.W. (1973). Analysis of bacteriophage T_2 early RNA and proteins in slab gels. J.Mol.Biol., 47: 237.

Suresh-Kumar; Banerjee-MK; Partap-PS; and Kumar-S (1995). Heterosis standy for fruit yield and its components in tomato Annals-of-Agric-Res. 16:2 , 212-217; 9ref.

Surjan-S; Dhaliwal-Ms; Cheema-DS; Brar-GS; and Sing-S (1999). Breeding tomato for high productivity Advances-in-Agric-Science,13:3 95-98;9

Uppal-G.S.; Tarsem- Lal; Cheema- D.S.; Lal-T (1997). Performance of tomato hybrids with regared to yield and quality characters. J. of Res. Agric. Univ. 34:1, 45-56, 5ref

Vidyasagar; Chadha-S; Kumar-J (1997). Heterosis in bacterial wilt resistance tomato lines. Himachal-J-of Agric-Res, 23: 1-2, 40-44; 9 ref.

Wang-YF; Wang-M; Wang-DY; and Wang-L (1998). Studies on heterosis in some processing tomato *Lycropersicon essulentum* Mill. lines Acta-Agriculturae-Shanghai 14:3, 29-34., 9 ref.

Xue-By (1994). Breeding tomato green stemmed (aw) lines and utilization of heterosis. China-vegetables No. 4, 32-33, 50.

Yamamoto, K.; O. Maritain and Ando (1982). Karyotypic and isozymatic polymorphism in species of the section faba (Genus vicia). Tech. Bull. Fac. Agric. Kagawa., 34:1

Zenner. De. and Polania-I (1999). Aspects of biology and economics of Melanagramiza socolena (Diptera: Agromyzidae), a new pest of garden tomato. Hort. Brasileira, 17:2, 106-109; 22 ref

Zhou- yJ.; XU-HJ (1984). Inheritance of soluble solids contents in tomato fruit. Acta-Hort-Sinica, 11:1, 29-34, 4 ref.

J. Agric. Sci. Mansoura Univ., 29 (11), November, 2004

أداء قوة الهجين علي بعض الصفات التشريحية والتفريد الكهربي والصفات المحصولية في الطماطم

إكرام محمد الغريب* ، عبد الحميد حبشي عامر* ، محمد نبيل عطية سعيد**

* معهد بحوث البساتين-الجيزة-مصر

** كلية الزراعة-جامعة الزقازيق-قسم النبات الزراعي وأمراض النبات

استخدم الجيل الذاتي الرابع من الأصناف برنشارد-كالروك-بينو ٩٨-ايس ٥٥ ف اف-فلورايديد-سوبر تريت ب وموني ميكر لتوضيح ما تؤدي إليه قوة الهجين علي بعض الصفات التشريحية للورقة والتفريد الكهربي للبروتين بالإضافة إلي بعض صفات المحصول.

أظهرت النتائج أن معظم الهجن تميزت بقوة هجن عالية لمعظم الصفات التشريحية مثل سمك البشرة العليا والسفلي والنسيجين العمادي والإسفنجي ونصل الوريقة وأبعاد خلايا البشرة العليا والحزمة الوعائية للعرق الوسطي، وهذا بالإضافة إلي قطر وسمك الأوعية.

إن إنتاج هجن ذات قوة هجين عالية للصفات التشريحية في الورقة قد تزيد المقاومة الميكانيكية للظروف السيئة وبعض الحشرات الخطيرة مثل الذبابة البيضاء وكذلك بعض الأمراض. وبالنسبة للتفريد الكهربي للبروتين أظهرت النتائج أن الهجن الناتجة قد تميزت بزيادة عدد وكثافة حزم البروتين إذا ما قورنت بالآباء الداخلة في تركيبها.

وبخصوص الصفات المحصولية وجد معظم أفضل التركيبات الهجينية عبارة عن اتحاد معظم التراكيب الوراثية المستخدمة كآباء مع التركيب الوراثي موني ميكر كأم. ولقد أظهرت صفة المواد الصلبة الذائبة غير معنوية وموجبة بينما أظهرت قوة الهجين بأنها سالبة وغير معنوية لصفة حموضة الثمرة.

ولقد وجد أنه بالاستفادة من التفريد الكهربي للبروتين أن أفضل الهجن التي تميزت بعدد وكثافة أكبر في حزم البروتين أظهرت أيضاً أعلا نسبة موجبة لقوة الهجين في الصفات المحصولية وكذلك الصفات التشريحية المؤثرة. ولقد وجد أيضاً أن الأتحادات بين برينشارد- كارل روك-بيتو ٩٨- فلورادا كآباء مع الموني ميكر كأم وكذلك الهجين فلورادا × سوبر سترين ب يوضح هذه العلاقة.

إن دراسة حزم البروتين من حيث العدد والكثافة في الهجن يؤيد أولاً انتخاب الهجن في المعمل قبل تقييمهم في الحقل.