

## **GENETIC ANALYSIS TO IDENTIFY SUITABLE PARENTS FOR DEVOLEPMENT AND RELEASE OF NEW TOMATO HYBRIDS COMBINATIONS ( *Lycopersicom esculantum* Mill)**

**Assar, A. M.; H. M.M. Ghobary and M. H. Tolba.**

**Veg. Res. Dep., Hort. Res. Inst.,Agric. Res. Center, Giza, Egypt.**

### **ABSTRACT**

A study was conducted on a 7x 7 diallel set of tomato excluding reciprocals to identify desired parents and its cross combinations which appears high productivity and high quality under conditions in Egypt as well as to gather information on genetic behavior of some traits .The results revealed that both general and specific combining abilities were highly significant for all studied traits .therefore, both additive and non additive gene action were important in the expression of these traits .The magnitudes of additive genetic variances were larger than those of the non – additive variances for plant height ,number of branches / plant ,average fruit weight and TSS % .However ,for other traits ,the dominance gene effects play the major role in the inheritance of these traits. Degree of dominance  $(O^2 D/ O^2 A)^{1/2}$  revealing the importance of partial dominance and that the additive effects played the major role in the inheritance of the plant height ,number of branches / plant ,average fruit weight, fruit shape index and TSS % .Whereas revealing the importance of over dominance in the genetic control of other traits .In addition both broad and narrow sense heritability values were high for all studied traits ,indicating that all traits were highly heritable .

Heterosis over mid parents or better parents was present in most of crosses for the studied traits. LHT24 and CLN2498D were good combiner for vegetative traits. Peto 86 was the best combiner for number fruits/ plant and total yield/plant .Marglobe is consider good combiner for average fruit weight and fruit shape index .Advantage - 2 was best combiner for TSS.

Considering mean performances, SCA effects and hererosis, three hybrids LHT24 X Advantage -2, LHT24 X Floradade and Peto 86 X Advantage -2 may be recommended for heterosis breeding after further evaluation.

### **INTRODUCTION**

Tomato (*Lycopersicom esculantum* Mill) is the most important vegetable crops in Egypt as well as all over the world .The area of production increase from year to another to meet the demand increment of consumers. According to ministry of agriculture static's (2007) was 537,208 feddan that produced about 863,924 ton. Commercial seed companies are in full control for their hybrid seed production. Therefore, seeds of superior hybrids are usually very expensive .Though hybrid tomato pay-off their cost in terms of high ,good quality and disease resistant crops ,they are imported and paid for by hard currency .The production of competitive ,local ,high yielding and good quality tomato hybrids is the only practical solution to this problem . In order to produce tomato hybrids adapted to local conditions ,this study was conducted to obtain some local tomato hybrids through intervarietal crosses ,comparing these hybrids with their parents in order to choose the most promising ones to be replaced in cultivation instead of the true breeding tomato cultivars and imported hybrids .Genetic analysis provides a guide line for the assessment of relative breeding potential of the parents or identify the best good combiner in crops crosses (Khattak *et al.*, 2004 ; Weera Singh *et*

al., 2004 ; Sulodhani Devi *et al* .,2005)Which could be utilized either to exploit heterosis in F1 or the accumulation of fixable genes to evolve variety .

Hybrid vigor in tomato was the first observed by Hedric &Booth,(1907) Since then a number of workers have reported heterosis in tomato(Bhatt s., 1998 , Bhatt *et al*.,2001). In this study effort have been made to identify parents suitable for tomato hybrid seed production.

## **MATERIAL AND METHODS.**

A set of 7 X 7 diallel cross of tomato without reciprocals along with parents viz LHT24 (P<sub>1</sub>) , CLN2498D (P<sub>2</sub>), CLN2498E (P<sub>3</sub>), Marglobe (P<sub>4</sub>), Peto 86 (P<sub>5</sub>), Floradade (P<sub>6</sub>) and Advantage -2 (P<sub>7</sub>) all of them inbred lines and are belonging to species *Lycopersicon esculantum* Mill were evaluated in a randomized complete blocks design with three replications. Each replication contained 28 experimental plots .Each experimental plot consisted of two trellis of 4.5 meter long and 1 meter wide .The plants were spaced at 30 cm apart on one side trellis .The plot of each genotype contained 30 plants .The study was conducted during 2008-2009 at El-Baramoon Horticulture Research Farm , Dakahlia Governorate .Standard fertilization ,standard pesticides, fungicides, control and culture practices for tomato production were used according to the recommendations of Ministry of agriculture .Measurements for hybrids and their parents were recorded on plant height ,number of branches per plant , number of fruits per plant ,total yield per plant, average fruit weight ,fruit shape index ,number of locules per fruit ,flesh thickness and total soluble solids (TSS) .

Genotypes means were used for the analysis of variance (Stell and Torrie1980) .Analysis of combining ability by method 2 ,model 1 of Griffing (1956) and other genetic parameters was performed according to Hayman (1954) .Heritability values were categorized low (< 0.3),moderate (0.3-0.6) and high (> 0.6)as given by Johanson *et al* .,(1955).The distribution of crosses in relation to general combining ability (GCA) and specific combining ability (SCA) effects was worked out by taking combining ability effects as significant positive (high = h) ,non significant (average = a ) and significant negative (low = L).

## **RESULTS AND DISCUSSION**

The analysis of variance based on mean squares (Table 1) showed the existence of significant variation for all studied traits ,indicating a wide range of variability among the genotypes .It is clear from the table 1 that GCA variances were higher than those for SCA variances for each of plant height, number of branches per plant ,average fruit weight , flesh thickness and total soluble solids (TSS) indicating that the additive gene effects appeared to be relatively more important than non-additive gene effects for those traits .Concerning another traits, it was found that non-additive gene effects appeared to play important roles than additive effects for these traits ,as reflected on the high estimates of SCA variances than GCA variances .As the results the ratio of  $\sigma^2_{SCA} / \sigma^2_{GCA}$  was also greater than one for plant height ,number of branches per plant ,average fruit weight ,flesh thickness

and TSS % but less one for the rest of the traits .Both  $O^2 A$  and  $O^2 D$  were found to be positive for all studied traits except the number of locules per fruit, the  $O^2 A$  was negative .These observations indicated the importance of both additive and non-additive gene actions in controlling the inheritance of most studied traits .These could be verified by the degree of dominance ( $O^2 D / O^2 A$ )<sup>1/2</sup> which were less than one ,revealing the importance of partial dominance and that the additive effects played the major role in the inheritance of these traits .Whereas the traits which the degree of dominance were higher than one, revealing the importance over dominance in the genetic control of these traits .Similar trend was observed by Omar *et al.*,(1988) ,Metwally *et al.*, (2004) ,Hannan *et al.*,(2007) and Saleem *et al.*,(2009).

**Table (1): Analysis of variance based on mean squares and estimates of genetic parameters in tomato.**

Source	d.f	Plant height (cm)	No. branches / plant	No. fruits / plant	Total yield/plant (Kg)	Average fruit weight (g)	Fruit shape index (L/D)	No. locules /fruit	Flesh thickness (cm)	T.SS %
Replication	2	2.3	0.4	346.3**	3.4**	744.5**	.0003	0.2	0.026**	1.857
Genotypes	27	323.2**	24.00**	3998.7**	1.3**	293.3**	0.026**	1.5	0.012*	1.307
Error	54	3.7	0.9	35.5	0.4	136.1	0.010	0.8	0.007	0.302
$O^2$ gca		38.031	28.512	26.63	0.014	21.67	0.003	0.0547	0.004	0.173
$O^2$ sca		30.618	2.166	68.16	0.267	9.05	.004	0.5800	.00196	0.086
$O^2$ gca / $O^2$ sca		1.242	13.163	0.391	0.052	2.394	0.75	0.094	2.041	2.011
$O^2 A$		76.062	5.854	53.26	0.028	43.34	0.006	-1.094	0.0088	0.346
$O^2 D$		30.618	2.161	68.16	0.267	9.05	0.004	0.580	0.00196	0.086
( $O^2 D / O^2 A$ ) <sup>1/2</sup>		0.634	0.608	1.131	3.087	0.457	0.816	-0.728	1.422	0.499
H <sup>2</sup> (bs)%		0.98	0.99	47.37	86.63	77.60	90.00	99.59	98.60	99.56
H <sup>2</sup> (ns)%		0.70	0.72	21.05	8.23	64.21	54.10	60.86	30.55	79.74

Concerning heritability percentage, it is likely to mention that broad sense heritability ( $h^2_b$ %) was high and exceeded 90 % for the most studied traits. The narrow sense heritability ( $h^2_n$ %) was low for number of fruits per plant and total yield per plant but moderate for fruit shape index and flesh thickness whereas high for plant height ,number of branches ,average fruit weight, number of locules per fruit and TSS% .These suggested that all traits were highly heritable. Estimates of general combining ability effects (gi) for each parental line of all studied traits are given in Table 2 .The obtain high positive values would be of interest in all studied traits .As for as GCA effects for plant height is concerned , CLN2498D surpassed it is rivals by attaining value of 17.075 followed by LHT24 (14.543), Advantage -2 (6.986) ,CLN2498E (6.708), Marglobe (4.541) and Floradade(2.186), respectively. In case of number of branches per plant ,the parent LHT24 expressed its superiority with GCA value of 2.406 followed by Advantage -2 (2.151) and CLN2498D (0.662) .As regarded the number of fruits per plant ,the parent Peto 86 gave higher magnitude of GCA (8.98) followed by CLN2498D (3.61) and CLN2498E (2.98), respectively. Only one parent Peto 86 could show desirable and significant GCA value of 0.34 for total yield per plant. Marglobe

was at the top with 6.24 GCA value among parents for average fruit weight .For fruit shape index ,the parent CLN2498D produced higher magnitude of GCA (0.07) followed by Marglobe (0.06) and Floradade (0.05) for number locules per fruit ,the parent LHT24 appeared the highest value of GCA 0.114 value followed by CLN2498E (0.092) and Advantage -2(0.059). All studied parents appeared none significant GCA effects for flesh thickness.

About the TSS % the estimation of GCA effects show that all parents were exhibited high and significant positive values and the parent Advantage -2 had the greatest GCA effects (1.535) ,while the Peto 86 was the lowest GCA effect (0.0523) .In confirmation to the finding of Srivastara *et al.*, (1998) and Dhaliwal *et al.*,(2003) ,none the parent was the best general combiner for all the traits .The high GCA effect are attributed to additive gene effects or additive X additive interaction effects and represent a fixable portion of genetic variation (Sarma *et al.*, 2004) .However none of the parents was best general combiner for all the traits indicating differences in genetic variability for different characters among the parents. Estimates of specific combining ability effects of the hybrids are presented in Table2 for plant height P<sub>1</sub>XP<sub>5</sub> showed maximum SCA effects (14.88) followed by P<sub>2</sub>XP<sub>6</sub> (11.78) , P<sub>1</sub>XP<sub>4</sub> (7.302) , P<sub>3</sub>XP<sub>6</sub> (3.146), P<sub>2</sub>XP<sub>7</sub> (2.68) and P<sub>4</sub>XP<sub>5</sub>(2.636).The cross P<sub>2</sub>XP<sub>4</sub>,P<sub>2</sub>XP<sub>7</sub>,P<sub>1</sub>XP<sub>5</sub>,P<sub>3</sub>XP<sub>4</sub>, P<sub>2</sub>XP<sub>6</sub> and P<sub>1</sub>XP<sub>7</sub> displayed highly significant effects ( 2.314,1.570,1.481,1.459,1.159 and 1.225 respectively )for number of branches per plant .Seven crosses displayed high value and its highly significant SCA values for number of fruit per plant ; the hybrid P<sub>1</sub>XP<sub>3</sub> was at the highest SCA value of 27.63 .For yield per plant; the SCA effect of hybrid P<sub>1</sub>XP<sub>7</sub> was the most highest(1.36) as concerns P<sub>6</sub>XP<sub>7</sub> (0.99) , P<sub>5</sub>XP<sub>6</sub> (0.85) and P<sub>1</sub>XP<sub>6</sub> (0.78) .None of the crosses indicated positive significant value of SCA effects for average fruit weight .In case of shape index of fruit only the hybrid P<sub>5</sub>XP<sub>7</sub> could show positive and significant SCA effect value of 0.21.Twelve crosses displayed highly significant SCA value for number of locules per fruit ; the hybrid P<sub>1</sub>XP<sub>3</sub> was at the top with highest SCA value of 0.873 .For the flesh thickness of fruit none of the crosses exhibited positive significant value of SCA effects. For TSS%, the SCA effect of hybrid P<sub>4</sub>XP<sub>5</sub> was the highest (0.55) followed by P<sub>2</sub>XP<sub>6</sub> (0.428), P<sub>5</sub>XP<sub>6</sub> (0.317), P<sub>3</sub>XP<sub>7</sub> (0.294), P<sub>3</sub>XP<sub>6</sub> (0.205), P<sub>2</sub>XP<sub>4</sub> (0.161) and P<sub>1</sub>XP<sub>7</sub> (0.150).

P<sub>1</sub>XP<sub>3</sub> was at the highest SCA value of 27.63 .For yield per plant; the SCA effect of hybrid P<sub>1</sub>XP<sub>7</sub> was the most highest(1.36) as concerns P<sub>6</sub>XP<sub>7</sub> (0.99) , P<sub>5</sub>XP<sub>6</sub> (0.85) and P<sub>1</sub>XP<sub>6</sub> (0.78) .None of the crosses indicated positive significant value of SCA effects for average fruit weight .In case of shape index of fruit only the hybrid P<sub>5</sub>XP<sub>7</sub> could show positive and significant SCA effect value of 0.21.Twelve crosses displayed highly significant SCA value for number of locules per fruit ; the hybrid P<sub>1</sub>XP<sub>3</sub> was at the top with highest SCA value of 0.873 .For the flesh thickness of fruit none of the crosses exhibited positive significant value of SCA effects. For TSS%, the SCA effect of hybrid P<sub>4</sub>XP<sub>5</sub> was the highest (0.55) followed by P<sub>2</sub>XP<sub>6</sub> (0.428), P<sub>5</sub>XP<sub>6</sub> (0.317), P<sub>3</sub>XP<sub>7</sub> (0.294), P<sub>3</sub>XP<sub>6</sub> (0.205), P<sub>2</sub>XP<sub>4</sub> (0.161) and P<sub>1</sub>XP<sub>7</sub> (0.150).

**Table (2): Estimates of GCA and SCA effects for nine studied traits of seven tomato parents and their F<sub>1</sub> hybrids**

Genetic populations	Traits	Plant height (cm)	No. Branches / plant	No. fruits/ plant	Total yield /plant (Kg)	Average fruit weight (g)	Fruit shape index (L/D)	No. locules /fruit	Flesh thickness (cm)	T.SS %
<b>Parents</b>										
LHI24(P1)		14.543**	2.406**	-0.46	0.02	0.23	-0.02	0.114**	-0.033	1.379
CLN2498D(P2)		17.075**	0.662**	3.61**	-0.18	-9.26**	0.07**	-0.186**	0.011	1.412
CLN2498E(P3)		6.708**	-0.483**	2.98**	0.23	1.45	0.02	0.092**	-0.001	1.235
Marglobe(P4)		4.541**	-1.894**	-9.69**	-0.38**	6.24**	0.06**	0.003	-0.001	0.690
Peto86(p5)		-1.436**	-1.805**	8.98**	0.34**	-4.90**	0.02	-0.041	0.043	0.0523
Floredade(P6)		2.186**	-1.038**	-3.65**	-0.06	-3.66	0.05**	-0.041	0.021	0.623
Advanlage-2(P7)		6.986**	2.151**	-1.76	0.03	2.97	0.02	0.059**	-0.012	1.535
S.E(g)		0.319	0.0204	1.06	0.12	2.08	0.02	0.022	0.025	0.0126
<b>Crosses</b>										
<b>SCA</b>										
P1 X P2		0.370	0.714	-9.00**	-0.16	8.32	0.05	-7.806**	0.061	-4.806
P1 X P3		-0.264	0.449	27.63**	-0.22	-6.22	0.004	0.873**	0.072	-0.150
P1 X P4		7.302**	0.270	5.63*	-0.10	-11.81**	0.06	0.662**	-0.028	0.392
P1 X P5		14.880**	1.481**	-6.04*	-0.86**	-11.20*	0.03	0.758**	-0.072	-0.139
P1 X P6		-1.720	0.714	9.26**	0.78	4.30	0.02	0.006	-0.005	0.061
P1 X P7		0.858	1.225**	17.37**	1.36**	6.07	0.02	0.306**	0.048	0.150
P2 X P3		1.558	-0.097	16.23**	0.27	-10.10	0.05	-0.127**	-0.072	-0.183
P2 X P4		-1.875*	2.314**	-4.44	0.12	7.17	0.01	-0.038	0.028	0.161
P2 X P5		-0.898	0.225	0.89	0.03	1.25	0.08	0.006	0.017	-0.472
P2 X P6		11.780**	1.159**	-3.15	-0.43	-8.97	-0.06	0.006	0.006	0.428
P2X P7		2.68**	1.570**	8.30	0.44	0.72	-0.12**	0.206**	-0.061	0.028
P3 X P4		-1.209	1.459**	-8.82	-2.44**	-0.56	0.05	-0.016	-0.061	-0.139
P3X P5		2.469**	0.370	0.52	0.37	4.67	0.03	0.728**	0.094	-0.295
P3 X P6		3.147**	0.630	-5.18	-0.03	7.14	0.03	0.728**	-0.083	0.205
P3X P7		1.347	-2.086	-1.07	0.35	10.27	0.01	0.628**	-0.51	0.294
P4X P5		2.636**	-0.219	-0.95	0.30	3.82	-0.13	0.817**	0.094	0.550
P4 X P6		-0.386	0.014	2.48	-0.03	-4.85	0.01	0.417**	0.016	-0.450
P4 X P7		-5.186**	-2.175**	8.59**	0.57	0.89	0.03	0.017	-0.05	-0.161
P5 X P6		-0.753**	-0.375	13.15**	0.85**	0.90	0.01	0.162**	-0.028	0.317
P5X P7		-4.809**	-0.264	2.26	0.48	0.21	0.21*	0.362**	0.006	0.005
P6 X P7		1.569	-8.522**	12.11**	0.99**	0.05	0.05	-0.383**	-0.006	-0.395
S.E(ij)		0.845	0.162	2.63	0.29	5.19	0.05	0.077	0.064	0.0333

**GCA = general combining ability**  
**SCA= specific combining ability.**

The distribution of crosses in relation to GCA effects of parental combinations (h x h, h x a, h x L, L x h, L x a, L x L, a x h, a x a and a x L) showed that almost all types of SCA effects were obtained from any kind of GCA effects and hence performance of hybrids was independent of parents .High SCA effects manifested by crosses where both the parents were good general combiner might be attributed to sizeable additive X additive gene action .The high X low combination ,besides expressing the favorable additive effect of the high parent ,manifested some complementary gene interaction effects with a higher SCA .However major part of the heterosis displayed by such crosses may be due to additive X dominance type of gene action and be non fixable .An appreciable amount of the heterosis expressed by low X low crosses might be ascribed to dominance X dominance type of

non allelic gene action producing over dominance and are non fixable .Thus it appears that the superior performances of most hybrids may be largely due to epistatic interaction .Similar results were reported in earlier studied (Batt *et al.*,2004; Thakur *et al.*,2004;Haripasma *et al.*,2006). The best crosses involved at least one parent with high GCA effects can be used as a selection criteria for the identification of superior genotypes .Parents with high GCA did not necessary produced hybrid with high SCA (Sharma *et al.*, 1999),but combination of parents with average or low GCA usually produced hybrids with high SCA. In our results, the best crosses viz; P<sub>1</sub>XP<sub>5</sub> for plant height, P<sub>2</sub>XP<sub>4</sub> for number of branches per plant, P<sub>1</sub>XP<sub>3</sub> for number of fruits per plant, P<sub>1</sub>XP<sub>7</sub> for total yield per plant, P<sub>5</sub>XP<sub>7</sub> for fruit shape index , P<sub>1</sub>XP<sub>3</sub> for number of locules per fruit and P<sub>4</sub>XP<sub>5</sub> for TSS % had h x L, h x L, L x h, L x a, a x a, h x L and h x h GCA parental combinations respectively .

Range, mean values of parents ,F<sub>1</sub> hybrids and heterosis over their mid-parental (MP) and bitter parent with the best for hybrids are presented in Table (3) .For plant height ,parents varied widely in plant height ranging from 40.3 to 78.3 cm while F<sub>1s</sub> was ranged from 50.0 to 81.3 cm and heterosis estimates ranged from -1.84 to 32.83 % and from -19.52 to 12.02 % over MP and B.P, respectively .The hybrids P<sub>1</sub>XP<sub>5</sub>, P<sub>2</sub>XP<sub>6</sub> , P<sub>1</sub>XP<sub>4</sub> and P<sub>4</sub>XP<sub>5</sub> were taller than their mid-parental values by 16.4 to 32.83 % while the hybrids P<sub>1</sub>XP<sub>5</sub> , P<sub>1</sub>XP<sub>4</sub> and P<sub>1</sub>XP<sub>2</sub> were taller than their respective tallest parent by 3.83 to 12.02 %.For the character number of branches per plant, the mean performances of parents ranged from 6.3 to 15.7 % while F<sub>1s</sub> ranged from 7.0 to 16.7 and the estimates heterosis ranged from -18.18 to 53.84 % and from -42.68 to 29.3 % over MP and BP ,respectively .Heterosis over MP in the best four hybrids (P<sub>2</sub>XP<sub>4</sub>, P<sub>2</sub>XP<sub>6</sub> , P<sub>3</sub>XP<sub>6</sub> and P<sub>3</sub>XP<sub>4</sub>) ranged from 33.33 % for the cross P<sub>3</sub>XP<sub>4</sub> to 53.84 % for the P<sub>2</sub>XP<sub>4</sub> while the estimated values over the BP ranged from 25.56 % for the cross P<sub>1</sub>XP<sub>7</sub> to 29.03 % for the cross P<sub>2</sub>XP<sub>4</sub> .For the number of fruits per plant, the results in table 3 showed that ,parents varied widely ranging from 19.7 (P<sub>4</sub>) to 53.3 (P<sub>5</sub>) ,while range was observed in the F<sub>1s</sub> from 23.00 P<sub>6</sub>XP<sub>7</sub> to 63.3 (P<sub>2</sub>XP<sub>3</sub>) and heterosis estimates ranged from -23.08 to 98.82% and from -44.85 to 81.51 % over MP and BP respectively .The cross P<sub>1</sub>XP<sub>7</sub> had the highest heterosis (98.82 % ) over the mid-parent and also the best parent.

Concerning the total yield per plant ,the results in table 3 showed the values of mean performances ranged from 1.350 to 1.750 for parents and 1.370 to 3.800 for F<sub>1s</sub> while heterosis estimates ranged from -22.6 to 83.8 % and from -38.91 to 87.19 % over mid-parents and bitter parents respectively .Heterosis over MP for the best four hybrids ranged from 50.43 % for the cross P<sub>5</sub>XP<sub>6</sub> to 83.8 % for the cross P<sub>4</sub>XP<sub>7</sub> .Heterosis over BP for the best four cross ranged from 41.37 % for the cross P<sub>5</sub>XP<sub>6</sub> to 87.91% for the cross P<sub>1</sub>XP<sub>7</sub>.Concerning fruit characteristics, data in table 3 showed that the performance of parents and their F<sub>1</sub> hybrids for the trait average fruit weight ,parents ranged 42.6 (P<sub>1</sub> ) to 75.1(P<sub>4</sub>) while F<sub>1s</sub> ranged from 44.1 (P<sub>1</sub>XP<sub>3</sub> ) to 74( P<sub>3</sub>XP<sub>7</sub> ).

**Table(3): Range, mean values of parents,F1 hybrid and heterosis over MP and BP with the best four hybrids among the evaluated in tomato crosses.**

Characters	Range				The best four hybrids (heterosis) over	
	Mean performance		Heterosis		M.P	B.P
	Parents	F <sub>1</sub> s	M.P	B.P		
Plant height(cm)	40.3-787.3	50.0-81.3	-1.84-32.83	-19.52-12.02	P <sub>1</sub> XP <sub>5</sub> (32.83), P <sub>2</sub> XP <sub>6</sub> (22.86), P <sub>1</sub> XP <sub>4</sub> (21.41), P <sub>4</sub> XP <sub>5</sub> (16.4)	P <sub>1</sub> XP <sub>5</sub> (12.02), P <sub>1</sub> XP <sub>4</sub> (9.71), P <sub>1</sub> XP <sub>6</sub> (3.91), P <sub>1</sub> XP <sub>2</sub> (3.83)
No. of branches/plant	6.3-15.7	7.0-16.7	-18.18-53.84	-42.68-29.3	P <sub>2</sub> XP <sub>4</sub> (53.84), P <sub>2</sub> XP <sub>6</sub> (46.25), P <sub>3</sub> XP <sub>4</sub> (33.33)	P <sub>2</sub> XP <sub>4</sub> (29.03), P <sub>3</sub> XP <sub>6</sub> (26.43), P <sub>2</sub> XP <sub>6</sub> (25.81), P <sub>1</sub> XP <sub>7</sub> (25.56)
No. fruits/plant	19.7-53.3	23.0-63.3	-23.08-98.82	-44.85-81.51	P <sub>1</sub> XP <sub>7</sub> (98.82), P <sub>4</sub> XP <sub>7</sub> (67.42), P <sub>1</sub> XP <sub>6</sub> (48.09), P <sub>2</sub> XP <sub>7</sub> (47.60)	P <sub>1</sub> XP <sub>7</sub> (81.51), P <sub>1</sub> XP <sub>6</sub> (47.32), P <sub>2</sub> XP <sub>3</sub> (39.71), P <sub>4</sub> XP <sub>7</sub> (21.51)
Total yield/plant(kg)	1.350-2.750	1.370-3.800	-22.6-83.8	-38.91-87.19	P <sub>4</sub> XP <sub>7</sub> (83.8), P <sub>2</sub> XP <sub>7</sub> (64.81), P <sub>5</sub> XP <sub>7</sub> (58.75), P <sub>5</sub> XP <sub>6</sub> (50.43)	P <sub>1</sub> XP <sub>7</sub> (87.19), P <sub>4</sub> XP <sub>7</sub> (76.35), P <sub>1</sub> XP <sub>6</sub> (42.92), P <sub>5</sub> XP <sub>6</sub> (41.37)
Average fruit weight (g)	42.6-75.1	44.1-74.0	-22.43-28.64	-35.82-22.91	P <sub>3</sub> XP <sub>7</sub> (28.64), P <sub>5</sub> XP <sub>7</sub> (28.29), P <sub>3</sub> XP <sub>5</sub> (14.61), P <sub>1</sub> XP <sub>7</sub> (13.84)	P <sub>3</sub> XP <sub>7</sub> (22.91), P <sub>5</sub> XP <sub>7</sub> (18.59), P <sub>1</sub> XP <sub>7</sub> (4.48), P <sub>3</sub> XP (1.89)
Fruit shape index	0.9-1.3	0.9-1.3	-14.14-23.3	-24.60-23.13	P <sub>5</sub> XP <sub>7</sub> (23.3), P <sub>1</sub> XP <sub>5</sub> (5.0), P <sub>3</sub> XP <sub>5</sub> (4.76), P <sub>1</sub> XP <sub>4</sub> (4.17)	P <sub>5</sub> XP <sub>7</sub> (23.1), P <sub>1</sub> XP <sub>4</sub> (4.17), P <sub>3</sub> XP <sub>5</sub> (2.80), P <sub>1</sub> XP <sub>5</sub> (1.94)
No. of locules/fruit	3.3-4.3	4.7-6.0	11.9-54.05	9.3-54.05	P <sub>1</sub> XP <sub>5</sub> (54.05), P <sub>4</sub> XP <sub>5</sub> (54.1), P <sub>1</sub> XP <sub>3</sub> (53.85), P <sub>3</sub> XP <sub>6</sub> (50.0)	P <sub>3</sub> XP <sub>5</sub> (54.05), P <sub>4</sub> XP <sub>5</sub> (52.5), P <sub>3</sub> XP <sub>6</sub> (42.5), P <sub>1</sub> XP <sub>3</sub> (39.53)
Flesh thickness(cm)	0.3-0.5	0.4-0.6	-20.0-42.85	-20.0-25.0	P <sub>1</sub> X P <sub>2</sub> (42.85), P <sub>1</sub> XP <sub>7</sub> (42.85), P <sub>4</sub> XP <sub>5</sub> (33.3), P <sub>1</sub> XP <sub>3</sub> (25.0)	P <sub>1</sub> XP <sub>2</sub> (25), P <sub>1</sub> XP <sub>7</sub> (25.00), P <sub>2</sub> XP <sub>4</sub> (25.00), P <sub>4</sub> XP <sub>7</sub> (25.00)
TSS %	4.3-6.3	4.7-6.3	-11.3-16.28	-17.54-16.28	P <sub>4</sub> XP <sub>5</sub> (16.28), P <sub>1</sub> XP <sub>4</sub> (14.0), P <sub>2</sub> XP <sub>6</sub> (10.67), P <sub>1</sub> XP <sub>2</sub> (7.69)	P <sub>4</sub> XP <sub>5</sub> (16.28), P <sub>5</sub> XP <sub>6</sub> (9.3), P <sub>1</sub> XP <sub>7</sub> (10.53), P <sub>1</sub> XP <sub>2</sub> (5.00)

MP= Mid-Parent.  
 Bp=Best-Parent.  
 F<sub>1</sub>'s= First hybrids.

Heterosis estimates over MP that ranged from -22.64 % ;while those over BP ranged from -35.82 to 22.91 % .Heterosis MP for the best four crosses ranged from 13.84 % for the cross P<sub>1</sub>XP<sub>7</sub> to 28.64 % ( P<sub>3</sub>XP<sub>7</sub> ). Heterosis over BP for the best four crosses ranged from 1.89 for the cross P<sub>3</sub>XP<sub>6</sub> to 22.91 % for the cross P<sub>3</sub>XP<sub>7</sub> .In fruit shape index character, data show that the mean performance values for parents and their F<sub>1</sub> hybrids ranged from 0.9 to 1.3 ,while the detected heterosis ranged from -14.14 to 23.3 % and from -24.6 to 23.3 % over MP and BP respectively .Heterosis over MP for best four crosses ranged from 4.17 for the cross (P<sub>1</sub>XP<sub>4</sub>) to 23.3 % for the cross (P<sub>5</sub>XP<sub>7</sub>) ,while heterosis over the BP in the best four crosses ranged from 1.94 for cross (P<sub>1</sub>XP<sub>5</sub>) to 23.3 % for the cross (P<sub>5</sub>XP<sub>7</sub>) .For number of locules per fruit ,the data in table 3 showed that the mean values ranged from 3.3 to 4.3 for parents and 4.7 to 6.0 for their F<sub>1</sub> hybrids . Heterosis estimates ranged from 11.9 to 54.05 % and from 9.3 to 54.0 % over their MP and BP respectively .All crosses (21) showed high significant and positive heterosis over MP and BP .In the best four crosses ,heterosis estimates ranged from 50.0 to 54.05 % and from 39.53 to 54.05 % over MP and BP respectively .Concerning flesh thickness data in table 3 show that values of general performance ranged from 0.3 to 0.5 cm and from 0.4 to 0.6 cm for parents and their F<sub>1</sub> hybrids ,respectively Heterosis estimates ranged from -20.0 to 42.85 % . and from -20.0 to 25 % over MP and BP ,respectively .In the best four crosses ,heterosis estimates ranged from 25.0 to 42.85 % over MP and 25 for BP .

For TSS % the calculated values of mean performance for both parents and their F<sub>1</sub> hybrids were ranged from 4.3 to 6.3 % and from 4.7 to 6.3 % respectively .While ranged from -11.3 to 16.28 % and from -17.54 to 16.28 over MP and BP, respectively. In the best four crosses, heterosis estimates ranged from 7.69 to 16.28 % and from 5.0 to 16.28 % over MP and BP, respectively. In our results four crosses viz P<sub>1</sub>XP<sub>7</sub>, P<sub>4</sub>XP<sub>7</sub> , P<sub>5</sub>XP<sub>7</sub> and P<sub>1</sub>XP<sub>6</sub> displayed high heterosis of 87.19 ,83.8,76.35 and 42.92 % with mean performance of 3.8,2.61,3.240 and 3.13 kg respectively for yield .These hybrids were emerged from L X a,h X L GCA parental combination and had higher value of mean performance and SCA effects .Durick (1999) reported that high degree of heterosis did not essentially correlate to SCA effects ,therefore ,genotype X environment interaction might be conducted as suggested by Fox *et al.*,(1997) and Bakhsh *et al.*,(2006).

Out of the present study, keeping in view mean performances SCA effects and their heterosis. The hybrids LHT24 (P<sub>1</sub>) X Advantage -2,LHT24 (P<sub>1</sub>) X Floradade (P<sub>6</sub>), Peto 86(P<sub>5</sub>), X Advantage -2 may be recommended for heterosis breeding after further evaluation.

## REFERENCES

- Bakhsh,A.M.Arshad and A.M.H.Hqqani.(2006)Effects of genotype X environment interaction on relation ship between grain yield and its components in Chick pea (*Cicer arietinum* L)Pak.J.Bot.,38(3) :683-690.



- Bhatt,R.P.,R.S.Adhekari,V.R.Biswas and Karendra(2004) Genetic analysis for *Lycopersicom esculantum* Mill under open and protected environments .Ind.j.Genet.and Pl.Br.,64(2) : 125-129.
- Bhatt,R.P.,N.R.Biwas and N.Kumar,(2001) Heterosis ,combining ability ,genetics for vitamin C,total soluble solids and yield in tomato *Lycopersicom esculantum* Mill at 1700 m altitude .J.Agric.Sci.,137:71-75.
- Bhatt,R.P., N.R.Biwas, H.K. Pandy,G.S.Verma and K.Narendra(1998) Heterosis for vitamin C in tomato *Lycopersicom esculantum* Mill Ind.J.Agric.Sci.,68:176-178.
- Dhaliwal,M.S.,S.Singh and D.S.Cheema (2003).Line X tester analysis for yield and processing attributes in tomato J.Res.,40(1):49-53.
- Durick,D.N.(1999).Heterosis :feeding people and protecting natural Resources .In: The genetic and exploitation of heterosis of heterosis in crops.(Eds.):J.G.Coors and S.pandey,American Society of Agronomy,Inc.,crop Science Society of American ,Inc,soil science society of American ,Inc.,Madison,WI,p 19-29.
- Fox,P.N.,J.Crossa and I.Ramagosa(1997).Multienviroment testing and genotype X Environment interaction .In: Statistical methods for plant variety evaluation .(Eds):R.A.Kempton and P.N.Fox.champan and Hall,P.117-138.
- Griffing,B.(1956).Concept of general and specific combining ability in relation to diallel crossing system Aust.J.Biol.Sci.,90:463-492.
- Hannan,M.M.,M.B.Ahmed,U.K.Roy,M.A.Razry,A.Hayder,M.A.Rahman,M.A.Islam and R.Islam(2007).Heterosis ,combining ability and genetics for Brix % days to first fruit ripening and yield in tomato *Lycopersicom esculantum* Mill.Middle East J.Sci.Res.2 (3-4): 128-131.
- Hariprasanna,K.,F.U.Zaman,A.K.Singh and S.M.S.Tomar (2006)Analysis of combining ability status among parents and hybrids in rice (*Oryza sativa* L) .Ind.J.Gent.,66(1): 28-30.
- Herdic, U.P.and N.O.Booth (1907) . Menian characters in tomato Proc.An.Soc Horti. 5: 19-24.
- Hayman,B.I.(1954).The theory and analysis of diallel crosses Genetic,39:789-809.
- Johanson,H.W.,H.F.Robinson and R.E.Comstock(1955).Estimates of genetic and environmental variability in soyabean Agron.J.,47:314-318.
- Kemphrone.O.(1957).An introduction to genetic statistics Johan Willey and Sons.,NewYork.
- Khattak,G.S.S.,M.Ashraf and R.Zamir (2004).Gene action for synchrony in pod maturity and indeterminate growth habit in mung bean (*Vinga radiate* L.) Wilczek, Pak.J.Bot. 589 - 594.
- Kumar,S.,R.Kumar,S.Kumar,M.Singh,M.K.Benerjee and M.Rai(2003).Hybrid seed production of Solanaceous vegetables: Apractical Manual ,IIVR Technical Bulletin,9:1-34.
- Metwally,E.I.; H.M.M.Ghobary and M.H.Kassem(2004).Production of local tomato hybrids show high yielding ability and heat tolerance J.Agric.Sci.Mansoura Univ.,29 :7321-7338.

- Omar, M.K.; S.E.A.Younis; T.H.I.Serif ; S.M.Y. Hussein and H.M.El-Aref(1988).A genetic analysis of yield and yield components in the tomato *Lycopersicom esculantum* Mill .Assuit J.Agric Sci.9:227-238.
- Saleem ,M.Y. ,M.A. Asghar,M.A.Haq,T.Rafioue, A.Kamran and A.Alikhan (2009).Genetic analysis to identify suitable parents for hybrids seed production in tomato *Lycopersicom esculantum* Mill Pak.J.Bot.,41 (3) :1107-1116.
- Sarma,R.N.,Bahar,J.Borah and D.Barooah (2004) Genetics of Ric hispa tolerance .New directions for a diverse plant. Poc.for the 4<sup>th</sup> Inst.Crop Sci.Cong.Brishane Australia,26 sep-1 Oct.
- Sharma,D.K.; Chaudhary and P.P.Sharma (1999). Line X tester analysis for study of combining ability of quantitative traits in tomato.In.J.Hort., 56(2):163-168.
- Singh,R.K. and B.D.Caudhary (1999).Biometrical methods in quantitative genetics and analysis .Kalyani Pulbl.,New Delhi.
- Srivastava,J.P.; S.Hamreer; B.P.Srivastava; H.P.S.Verma and H.Singh (1998).Heterosis in relation to combining ability in tomato Vegetable Sci.,25 (1):43-47.
- Steel,R.G.D.and J.H.Torrie,(1980). Priciples and procedures of statistics .Mc.Graw Hill Book Co., New York.
- Sulodhani, Devi. E., N.B. Singh,A.Bijaya Devi, N. G. Singh and G.M.Laishrma (2005).Gene action for fruit yield and its components in tomato *Lycopersicom esculantum* Mill Ind. J . Genet., 106-108.
- Thakur,A.K.,U.K.Kholi and A.Joshi(2004)Evaluation of diallel progeny and heterosis for yield and yield components in tomato *Lycopersicom esculantum* Mill ) Haryma J.Hort.Sci.,33(1/2):106-108.
- WeerSingh,O.R.; A.LT. Perea; W.AJ.M.de Costa,D.M. Jinadase and R.Yishnukarthasingham (2004). Production of tomato hybrids for dry zone condition of Sirlanka using combining ability analysis ,heterosis and DNA testing procedure.Trop.Agric.Res.,16:79-90.

**التحليل الوراثي لتحديد آباء مناسبة لإنتاج بعض الهجن الجديدة من الطماطم**  
احمد مختار عصر ، حامد محمد غباري و محمد حامد طلبه  
قسم بحوث الخضر – معهد بحوث البساتين – مركز البحوث الزراعية – مصر.

أجريت هذه الدراسة بغرض تحديد آباء وكذلك الاتحادات الوراثية الجديدة التي تظهر كفاءة إنتاجيه عاليه تحت الظروف المصرية علاوة على ذلك معرفه السلوك الوراثي لبعض الصفات المكونة لمحصول من خلال برنامج التهجين بنظام التزاوج النصف دائري لسبعه آباء من الطماطم شامله تراكيب وراثية محليه وأخرى مستورده وقيمت الآباء والهجن الناتجة منها في العروة الصيفي موسم ٢٠٠٩ وأوضحت النتائج الآتى:-

- كانت كلا من القدرة العامة والخاصة على التآلف عاليه المعنوية لكل الصفات التي درست وهذا يدل على أهميه كلا من التأثير المضيف والسيادي في وراثه هذه الصفات .
- كانت قيمه التباين الاضافى اكبر من قيمه التباين السيادي لصفات طول النبات – عدد الأفرع/ نبات – متوسط وزن الثمرة – المواد الصلبة الذائبة , بينما باقي الصفات فقد كان الفعل السيادي له الدور الرئيسي في وراثتها.

- أظهرت النتائج بصورة عامه أن القيم المقدرة للقدرة العامة والخاصة على التآلف معنوية لمعظم الصفات المدروسة.
- قوه الهجين عند حسابها سواء بالنسبة لمتوسط الأبوين أو الأب الأفضل كانت معنوية لمعظم الهجن في الصفات المدروسة ماعدا صفة سمك اللحم.
- أشارت النتائج أن الأباء LHT24 و CLN2498E أظهرت قدره عامه على التآلف بالنسبة للصفات الخضرية طول النبات وعدد الأفرع بينما كان الأب Peto 86 كان أحسن الأباء قدره على التآلف بالنسبة لعدد التمار على النبات والمحصول الكلى للنبات وسمك اللحم والصنف Marglobe يعتبر أعلى قدره على التآلف بالنسبة لوزن الثمرة ودليل شكل الثمرة والصنف Advantage-2 كان أعلى الأباء قدره على التآلف بالنسبة للمواد الصلبة الذائبة .
- أشارت النتائج إلى أن أفضل ثلاثة هجن يمكن أن يوصى بها بعد التقييم فيما بعد هي: LHT24(P<sub>1</sub>) X Advantage -2, LHT24 (P<sub>1</sub>) X Floradade (P<sub>6</sub>), Peto 86(P<sub>5</sub>), X Advantage -2

قام بتحكيم البحث

أ.د / طه محمد السيد عمر الجزار

أ.د / حورية محمد فتحي حسن

كلية الزراعة – جامعة المنصورة

مركز البحوث الزراعية