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Heterosis and Combining Ability in Cucumber

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ABSTRACT

This study was conducted in research farm and laboratories of Horticultural Research Institute, Agric. Res. Center (ARC) during the period from 2009 to 2011 to estimate heterosis, general and specific combining ability of some cucumber economic characters, viz., main stem length (MSL), number of branches/plant (NB), number of female flowers / plant (NFF), average fruit length (AFL), average fruit diameter (AFD) average fruit weight (AFW), early yield/plant (EY), and total yield/plant (TY). Five different inbred lines of cucumber, namely Cus 3-2-14 (P_1), Cus 1-27-608 (P_2), Cus 2-11-519 (P_3), Cus 1-12-26 (P_4), and Cus 2-23-576 (P_5) were used as parental lines in the present investigation. Diallel crosses (without reciprocal) were made between these parents to obtain ten hybrids. Results showed that some hybrids were taller and of higher NB, AFL, and AFW than the highest parent. Most crosses were earlier and had higher TY. However, all crosses had lower NFF, and AFD. General and specific combining ability were highly significant for most studied traits and the variance of SCA was greater than that of GCA in the traits EY and TY, however, GCA was greater than SCA variance for the traits MSL, NB, NFF, AFL, AFD, and AFW. These results indicate that all these traits were influenced by both GCA and SCA with the later having a greater influence for the traits EY and TY, which reflects the role of non-additive type of gene action in the expression of these traits. On the contrary, the other characters exhibited that GCA was more important than SCA by nearly two times or more which reflects the role of additive type of gene action in the expression of these traits. The parental lines P_2 and P_4 were good general combiners and the cross $P_1 \times P_4$, $P_2 \times P_3$, $P_2 \times P_5$, $P_3 \times P_4$, and $P_3 \times P_5$ were the best and promising hybrids. However, the results also pointed to the potential of certain crosses as source for selecting high yielding lines in their segregating generations because additive gene effects were responsible for their performance.

Key words: ***Cucumis sativus*, Heterosis, GCA, SCA, Gene action.**

INTRODUCTION

Cucumber (*Cucumis sativus* L.) is one of the most important vegetable crops all over the world as well as in Egypt. In recent years, cucumber has become of special importance because it ranks first in cultivated area among all vegetable crops grown under greenhouses in Egypt, exceeding pepper and tomatoes.

The diallel analysis is a valuable method to evaluate parents and hybrid combinations. The presence of large amount of additive genetic variance would indicate that substantial progress could be achieved using selection in early segregating generations. On the other hand, the large amount of dominance and epistatic effects are necessary for heterosis and actually needed for the successful development of hybrids. Use of F_1 hybrids

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is the quickest way of combining the valuable traits into one, besides the added advantages of heterotic yield (Choudhury *et al*, 1965). The knowledge on gene action for expression of various quantitative characters is very essential in deciding the proper breeding method for genetic improvement.

Different heterosis values for cucumber were reported by several authors. Dogra *et al* (1997), Munshi *et al* (2006), and Hanchinamani and Patil (2009) showed positive heterosis over better parents for most of the horticultural traits. From the 75 heterosis estimates, only three were negative for total yield/plant (Cardoso 2006). However, Awad (1996) reported negative heterosis over high parent as -13.22% for NB, -8.50% for AFL, -14.94% for AFD, -12.37% for AFW, and -10.33% for TY. Heterosis for TY and yield components was observed in only one out of the four evaluated hybrids (Cramer and Wehner 1999). Moreover, Hanchinamani (2006) found that heterosis over the better parents ranged from -46.02 to 14.52% for MSL, -2[illegible].39 to 9.38% for AFW, and -50.51 to 31.73% for TY. Abd Rabou (2008) estimated heterosis over high parent as 8.1% for MSL, -45.6% for NFF, -15.9% for AFL, -8.9% for AFD, -5.63% for AFW, and P5% for TY.

Many authors directed studies of cucumber breeding mainly to analysis of combining ability and gene action for understanding the mode of inheritance of the economic traits as Awad (1996), Hanchinamani (2006), Munshi *et al* (2006), Nazim Uddin *et al* (2009), Moushumi and Sirohi (2010), Chirani *et al* (2011), and Dogra and Kanwar (2011) who found that mean squares for GCA and SCA were highly significant for most cucumber traits, suggesting the importance of both additive and non-additive genetic variance. Also, Cardoso (2006) found that additive and non additive effects were significant for total yield per plant.

Awad (1996), Hanchinamani (2006), Munshi *et al* (2006), Nazim Uddin *et al* (2009), Moushumi and Sirohi (2010) and Dogra and Kanwar (2011) revealed that variance of SCA was greater than that of GCA in all studied cucumber traits. This indicates that all these traits were influenced by both GCA and SCA, with the later having a greater influence. This reflects the role of non-additive type of gene action in the expression of these traits.

Therefore, the objective of the present study was to study the type of gene action controlling some economic characters in cucumber using diallel crossing system. Such study may help in suggesting an accurate and appropriate breeding program for improving yield and quality traits of cucumber. This permits the cucumber breeders to develop or select good lines or hybrids that are better adapted to greenhouse conditions in Egypt.

MATERIALS AND METHODS

This study was conducted in research facilities of Horticulture Research Institute during the period from 2009 to 2011. Five different inbred lines of cucumber, namely *Cus* 3-2-14 (P_1), *Cus* 1-27-608 (P_2), *Cus* 2-11-519 (P_3), *Cus* 1-12-26 (P_4), and *Cus* 2-23-576 (P_5) were used as parental lines in the present investigation. These inbred lines were developed by Dr. A. M. Abd Rabou, Hort. Res. Inst., ARC, Egypt (Abd Rabou 2003). Selfing of the five parents was done twice to insure high degree of purity of each parent before crossing. Thereafter, diallel crosses were made between these parents to obtain ten F_1 hybrids (without reciprocals) in 2010. The fifteen genotypes (5 parents, and 10 F_1 crosses) were grown under greenhouse conditions in a randomized complete block design with three replications at Kaha Vegetable Research Farm, Kaliobia Governorate during winter season of the year 2010/2011. Seeding and transplanting dates were September 2nd, and September 19th, 2010, respectively. The area of the greenhouse was divided into 4 rows. Each row was 1 m wide, plants were transplanted on both sides of the row. The distance between plants, on each side of the row was 50 cm apart. Each experimental plot area was 2.5 m^2 and consisted of ten plants. All agricultural practices were applied following the recommendations of Ministry of Agriculture, Egypt.

Data were recorded on various evaluated genotypes with regard to the following characters:

- Main stem length (MSL) was measured after 60 days from transplanting from the surface of the soil to the end of main stem in cm.
- Number of branches/plant (NB) was measured as the number of branches from the soil to 50 cm length of main stem.
- Number of female flowers / plant (NFF) was determined for the lower 10 nodes/plant (from cotyledons)
- Average fruit length (AFL) was determined in cm using average of 10 fruits in the 10th harvest by ruler.
- Average fruit diameter (AFD) was determined in cm using average of 10 fruits in the 10th harvest at the middle of the fruit by vernier caliper.
- Average fruit weight (AFW) was determined in grams as average weight of 10 fruits in the 10th harvest.
- Early yield/plant (EY) was determined in kg of total fruits weight of the first five pickings.
- Total yield/plant (TY) was determined in kg by weighting all produced fruits for all pickings.

Heterosis (H) was calculated as the percentage of deviation from the best parent according to following formula:

$$H = \frac{\overline{F_1} - \overline{BP}}{\overline{BP}} \times 100 \qquad \text{(Sinha and Khanna 1975)}$$

Where:

$\overline{F_1}$ = Mean of the first filial generation.

$\overline{BP}$ = Mean of the better parent.

Data were statistically analyzed for the study of general (GCA) and specific (SCA) combining ability according to Griffing (1956) method II, model I.

RESULTS AND DISCUSSION

Mean performance and heterosis

Means and heterosis estimates over high parent are given in Tables (1 a and b). Differences among genotypes (parents and hybrids) for all studied characters were highly significant, indicating wide diversity among the parental materials used in this study, which is essential for diallel cross design to be effective (Hayman 1954).

Table 1a. Mean performance (M) and heterosis (H%) over high parent of 10 F_1's and their parents for studied traits of cucumber.

Genotype	Main stem length (cm)		No. of branches		No. of female flowers		Average fruit length (cm)	
	M	H%	M	H%	M	H%	M	H%
P_1	98.22		3.78		2.55		18.30	
P_2	115.56		6.11		3.53		26.07	
P_3	103.44		4.67		2.80		13.82	
P_4	110.56		4.44		3.64		22.98	
P_5	103.89		4.17		1.55		19.83	
Mean	106.33		4.63		2.81		20.20	
$P_1 \times P_2$	120.33	4.13	6.44	5.17	3.84	8.69	28.43	9.08**
$P_1 \times P_3$	106.11	2.58	4.78	2.30	3.39	20.95	14.17	-22.57**
$P_1 \times P_4$	110.11	-0.40	3.28	-26.26	2.00	-45.01*	23.51	2.32
$P_1 \times P_5$	110.44	6.31*	3.61	-13.36	2.00	-0.22	17.54	-11.56**
$P_2 \times P_3$	119.56	3.46	6.55	7.26	3.66	3.78	18.67	-28.39**
$P_2 \times P_4$	131.78	14.04**	4.67	-23.62*	4.11	13.01	29.43	28.10**
$P_2 \times P_5$	97.89	-15.29**	5.78	-5.46	3.56	0.76	27.40	5.13*
$P_3 \times P_4$	109.67	-0.81	2.78	40.43*	3.P1	-14.48	19.33	-15.86**
$P_3 \times P_5$	87.22	-16.04**	4.56	-[illegible].02	2.33	-16.67	14.83	-25.23**
$P_4 \times P_5$	101.33	-8.34*	6.33	42.54*	4.44	22.18	19.33	-15.86**
Mean	109.45		4.88		3.24		21.26	
LSD at 0.05	6.52		1.41		1.24		1.28	
LSD at 0.01	9.46		2.06		1.81		1.85	

* and ** indicate significance at 0.05 and 0.01 probability levels, respectively.

Table 1b. Mean performance (M) and heterosis (H%) over high parent (HP) of 10 F_1's and their parents for studied traits of cucumber.

Genotypes	Average fruit diameter (cm)		Average fruit weight (g)		Early yield (kg/plant)		Total yield (kg/plant)	
	M	H%	M	H%	M	H%	M	H%
P_1	3.60		96.67		1.04		2.47	
P_2	2.64		94.57		0.77		2.16	
P_3	3.06		114.12		0.75		1.32	
P_4	2.53		69.27		0.22		2.05	
P_5	3.68		58.92		0.12		0.34	
Mean	3.10		86.71		0.58		1.67	
$P_1 \times P_2$	2.90	-19.52**	108.97	12.72**	0.81	-22.36*	2.23	-9.85
$P_1 \times P_3$	3.11	-13.60**	115.55	1.25	0.14	-86.26**	1.57	-36.57**
$P_1 \times P_4$	2.17	-39.87**	104.95	8.57**	1.92	83.72**	3.70	49.80**
$P_1 \times P_5$	2.57	-30.19**	72.13	-25.38**	1.43	37.38**	2.44	-1.35
$P_2 \times P_3$	2.44	-20.07**	110.78	-2.93	1.17	52.17**	2.94	36.17**
$P_2 \times P_4$	2.04	-22.70**	93.54	-1.08	1.43	86.94**	3.07	42.35**
$P_2 \times P_5$	2.66	-27.74**	92.22	-2.48	0.94	22.60	3.04	40.96**
$P_3 \times P_4$	2.62	-14.18**	96.22	-15.68**	1.11	48.44**	3.28	60.26**
$P_3 \times P_5$	3.52	-4.17	115.14	0.90	0.27	-64.44**	3.15	138.39**
$P_4 \times P_5$	2.44	-33.55**	71.26	2.87	1.03	337.83**	2.42	18.24*
mean	2.65		98.08		1.03		2.782	
LSD at 0.05	0.22		4.83		0.22		0.32	
LSD at 0.01	0.32		7.01		0.33		0.47	

* and ** indicate significance at 0.05 and 0.01 probability levels, respectively.

In general, parental lines showed narrower ranges than F_1's for all studied characters except fruit weight which showed wider range for parents than F_1's and total yield which gave similar range. Moreover, means of parental lines were less than means of F_1's for all studied characters, except fruit diameter.

Main stem length (MSL) ranged from 87.22 to 131.78 cm. The cross $P_2 \times P_4$ produced the highest significant MSL (131.78 cm) followed by the cross $P_1 \times P_2$ (120.33 cm) with a significant difference between them. With regard to heterosis, 2 out of the 10 evaluated hybrids exhibited significant positive heterosis over the higher parent for MSL. These crosses are $P_2 \times P_4$ (14.04%), and $P_1 \times P_5$ (6.31%).

Number of branches (NB) per plant ranged from 2.78 to 6.55. The crosses $P_2 \times P_3$ (6.55), $P_1 \times P_2$ (6.44), $P_4 \times P_5$ (6.33), $P_2 \times P_5$ (5.78), and the parent line P_2 had, significantly, the highest NB without significant differences between them. Concerning heterosis, 2 out of the 10 evaluated hybrids exhibited significant positive heterosis over the higher parent for NB. These crosses are $P_4 \times P_5$ (42.54%), and $P_3 \times P_4$ (40.43%).

Number of female flowers (NFF) per plant ranged from 1.55 to 4.44. The crosses $P_4 \times P_5$ (4.44), $P_2 \times P_4$ (4.11), $P_1 \times P_2$ (3.84), $P_2 \times P_3$ (3.66), $P_2 \times P_5$ (3.56), $P_1 \times P_3$ (3.39), and the parent lines P_4 (3.64), and P_2 (3.53) had, significantly, the highest NFF without significant differences between them. With regard to heterosis, no crosses exhibited significant positive heterosis over its higher parent for this trait.

Average fruit length (AFL) ranged from 13.82 to 29.43 cm. The highest value of AFL was detected in fruits of the F_1 hybrid $P_2 \times P_4$ (29.43 cm) followed by the cross $P_1 \times P_2$ (28.43) without a significant difference between them. With regard to heterosis, 3 out of the 10 evaluated hybrids exhibited significant positive heterosis over its higher parent for AFL. These crosses are $P_2 \times P_4$ (28.10%), $P_1 \times P_2$ (9.08%), and $P_2 \times P_5$ (5.13%).

Average fruit diameter (AFD) ranged from 2.04 to 3.68 cm. The parents P_5 (3.68 cm), and P_1 (3.60 cm), and the hybrid $P_3 \times P_5$ (3.52 cm) significantly had the highest AFD among all evaluated genotypes without significant differences between them. The lowest AFD was found in fruits of hybrids $P_2 \times P_4$ (2.04 cm), and $P_1 \times P_4$ (2.17 cm) without a significant difference between them. With regard to heterosis, all the evaluated hybrids showed significant negative heterosis over its higher parent for AFD trait ranging from -39.87% to -4.17% for the hybrids $P_1 \times P_4$ and $P_3 \times P_5$, respectively.

Average fruit weight (AFW) ranged from 58.92 to 115.55 g. The highest AFW was found in fruits of the hybrids $P_1 \times P_3$ (115.55 g), $P_3 \times P_5$ (115. 14 g), and $P_2 \times P_3$ (110.78 g), and the parent P_3 (114.12 g) without significant differences between them. The lowest mean of AFW was given by the parent P_5 (58.92 g). Concerning heterosis, 2 out of the 10 evaluated hybrids exhibited significant positive heterosis over its higher parent for AFW. These crosses are $P_1 \times P_2$ (12.72%), and $P_1 \times P_4$ (8.57%). The two crosses had P_1 as a common parent.

Early yield per plant (EY) ranged from 0.12 to 1.92 kg/plant. The hybrid $P_1 \times P_4$ produced the highest significant EY (1.92 kg) followed by the crosses $P_1 \times P_5$, and $P_2 \times P_4$ (1.43 kg) with significant differences between them. With regard to heterosis, 6 out of the 10 evaluated hybrids exhibited significant positive heterosis over its higher parent for EY ranging from 37.38% for the hybrid $P_1 \times P_5$ to 337.83% for the hybrid $P_4 \times P_5$. Four out of these 6 crosses had P_4 as a common parent. Also, all the hybrids involved the genotype P_4 had positive heterosis over its higher parent.

Total yield per plant (TY) ranged from 0.34 to 3.70 kg. The hybrid $P_1 \times P_4$ produced the highest TY (3.70 kg) followed by the hybrid $P_3 \times P_4$ (3.28 kg) with a significant difference between them. Concerning heterosis, 7 out of the 10 evaluated hybrids showed significant positive heterosis over its higher parent ranging from 18.24% to 138.39% for the crosses $P_4 \times P_5$ and $P_3 \times P_5$, respectively. All the hybrids that involved P_4 as a common parent had positive heterosis over its higher parent.

In general, some hybrids were taller and of higher NB, AFL, and AFW. Most crosses were earlier and had higher TY than their higher parent. However, all crosses were lower in NFF, and AFD. This could be attributed to the highly significant superiority of parents over crosses. These results are in agreement with those of Hanchinamani (2006) who found different heterosis values for cucumber traits in some crosses. Also, Abd Rabou (2008) reported positive heterosis over higher parent for the traits MSL, and TY and negative heterosis for the traits NFF, AFL, AFD, and AFW. Dogra *et al* (1997), Munshi *et al* (2006), and Hanchinamani and Patil (2009) showed positive heterosis over better parent for most of the horticultural traits. Cardoso (2006) reported positive heterosis in most of studied crosses for TY. On the contrary, Awad (1996) reported negative heterosis over higher parent for all studied traits. Also, heterosis for TY and yield components was observed in only one out of the four evaluated hybrids by Cramer and Wehner (1999).

Combining ability

The combining ability analysis (Table 2) showed highly significant mean squares due to both general and specific combining abilities for all studied traits, indicating that both additive and non- additive gene action existed except for NFF trait, which was controlled by additive gene action only. With regard to GCA/ SCA ratio, it was found that the characters MSL, NB, NFF, AFL, AFD, and AFW exhibited high GCA/ SCA ratio which exceeded the unity, indicating that additive type of gene action was more important than non- additive effects in controlling these traits. For the traits EY and TY, low GCA/ SCA ratio of less than unity was detected, revealing the predominance of non- additive gene effects in the inheritance of these traits. These results agree with those of Awad (1996), Hanchinamani (2006), Munshi *et al* (2006), Nazim Uddin *et al* (2009), Moushumi and Sirohi (2010), Chirani *et al* (2011), and Dogra and Kanwar (2011) who found that mean squares due to GCA and SCA were highly significant for most cucumber traits. However, they revealed that variance of SCA was greater than GCA in all studied traits.

Table 2. Mean squares for general (GCA) and specific (SCA) combining ability from ANOVA for 10 F_1's and their parents for studied traits in cucumber.

Character	GCA	SCA	GCA/ SCA
Main stem length	202.20**	83.17**	2.43:1
No. of brunches/plant	2.34**	1.09**	2.16:1
No. of female flowers/plant	1.21**	0.54	2.26:1
Average fruit length	75.20**	7.03**	10.70:1
Average fruit diameter	0.49**	0.16**	3.04:1
Average fruit weight	889.71**	123.48**	7.21:1
Early yield/plant	0.18**	0.31**	0.58:1
Total yield/plant	0.51**	0.85**	0.60:1

Estimates of GCA effects for individual parents are presented in Table (3). The GCA effects differed significantly in most traits. The parental genotypes P_2 and P_4 had positive GCA effects for MSL, proving that they are good combiners for this trait. For NB and NFF traits, only the genotype P_2 exhibited positive GCA effects. Average fruit length showed positive GCA effects for the parents P_2 and P_4. Significant positive GCA effects were observed in AFD for parents P_1, P_3, and P_5, indicating that these parents appeared to be good general combiners for developing this trait. The parental genotypes P_1, P_2, and P_3 had considerable significant positive GCA effects for AFW and proved to be good combiners in this respect, while, parents P_4, and P_5 appeared to be poor general combiners for AFW. In respect to EY and TY, the same parents (P_2, and P_4) exhibited desirable positive GCA effects, meanwhile, the parent P_1 exhibited significant positive GCA effects for EY trait only. However, the other two parents (P_3 and P_5) exhibited significant negative GCA effects for these two traits.

Respecting SCA, the data obtained in Table (4) indicated that the F_1 hybrids $P_1 \times P_2$, $P_1 \times P_5$, $P_2 \times P_3$, and $P_2 \times P_4$ achieved significant positive SCA effects for MSL trait. Two crosses ($P_1 \times P_2$, and $P_4 \times P_5$) showed significant SCA effects for NB trait. Only one cross ($P_4 \times P_5$) showed highly significant SCA effect for NFF trait. Five crosses ($P_1 \times P_2$, $P_1 \times P_4$, $P_2 \times P_4$, $P_2 \times P_5$ and $P_3 \times P_4$) showed significant SCA effects for long fruit; and four hybrids ($P_1 \times P_3$, $P_1 \times P_5$, $P_2 \times P_3$, and $P_4 \times P_5$) exhibited significant SCA effects for fruit shortness. Only the cross $P_3 \times P_5$ had highly significant positive SCA effects for AFD. However, the crosses $P_1 \times P_4$, $P_1 \times P_5$, $P_2 \times P_3$, $P_2 \times P_4$, $P_2 \times P_5$, and $P_4 \times P_5$ gave the lowest SCA effects for narrowest fruit. Five hybrids, viz., $P_1 \times P_2$, $P_1 \times P_4$, $P_2 \times P_4$, $P_2 \times P_5$, and $P_3 \times P_5$ showed significant positive SCA effects. Highly significant positive SCA

Table 3. Estimates of general combining ability effect ($\hat{g}_i$) of studied cucumber parents.

Parents	Main stem length (cm)	No. of brunches/plant	No. of female flowers/plant	Average fruit length (cm)	Average fruit diameter (cm)	Average fruit weight (g)	Early yield / plant (kg/plant)	Total yield / plant (kg/plant)
P_1	-1.00	-0.45*	-0.33	-0.74**	0.17**	4.17**	0.16**	0.06
P_2	7.17**	0.98**	0.52**	.37**	-0.21**	4.13**	0.09**	0.16**
P_3	-3.00**	-0.11	-0.07	-4.40**	0.15**	14.32**	-0.15**	-0.13**
P_4	3.37**	-0.40	0.33	.73**	-0.35**	-8.75 **	0.10**	0.30**
P_5	-6.54**	-0.02	-0.45*	-0.96**	0.25**	-13.87**	-0.19**	-0.39**
S.E. ($\hat{g}_i$)	0.92	0.20	0.17	.18	0.03	0.68	0.03	0.05
S.E. ($\hat{g}_i$-$\hat{g}_j$)	1.45	0.31	0.28	.28	0.05	1.07	0.05	0.07

Table 4. Estimates of specific combining ability effect (s_{ij}) of F_1s among five cucumber parents.

Crosses	Main stem length	No. of brunches/plant	No. of female flowers/plant	Average fruit length	Average fruit diameter	Average fruit weight	Early yield / plant	Total yield / plant
$P_1 \times P_2$	5.75*	1.11*	0.54	3.89**	0.14	6.37**	-0.32**	-0.40**
$P_1 \times P_3$	1.70	0.54	0.68	-1.59**	-0.01	2.77	-0.74**	-0.77**
$P_1 \times P_4$	-0.66	-0.67	-1.11*	1.61**	-0.44**	15.24**	0.78**	0.93**
$P_1 \times P_5$	9.57**	-0.72	-0.32	-1.67**	-0.65**	-12.45**	0.59**	0.36**
$P_2 \times P_3$	6.97**	0.88	0.12	-2.21**	-0.29**	-1.96	0.85**	0.49**
$P_2 \times P_4$	12.83**	-0.71	0.16	2.42**	-0.20*	3.87*	0.37**	0.20
$P_2 \times P_5$	-11.16**	0.02	0.39	3.08**	-0.18*	7.68**	0.17	0.86**
$P_3 \times P_4$	0.89	-1.50**	-0.25	1.10*	0.03	-3.63**	0.29**	0.70**
$P_3 \times P_5$	-11.64**	-0.10	-0.24	-0.72	0.33**	20.42**	-0.31**	1.26**
$P_4 \times P_5$	-3.90	1.97**	1.46**	-2.35**	-0.26**	-0.41	0.25**	0.10
S.E.(S_{ij})	3.50	0.76	0.67	.69	0.12	2.59	0.12	0.17
S.E.(S_{ij}-S_{ik})	5.02	1.09	0.96	.98	0.17	3.72	0.17	0.25

effects were observed in six crosses ($P_1 \times P_4$, $P_1 \times P_5$, $P_2 \times P_3$, $P_2 \times P_4$, $P_3 \times P_4$, and $P_4 \times P_5$) for EY trait. For TY, the SCA effects for $P_1 \times P_4$, $P_1 \times P_5$, $P_2 \times P_3$, $P_2 \times P_5$, $P_3 \times P_4$, and $P_3 \times P_5$ were highly significant and positive, however the SCA effects for $P_1 \times P_2$, and $P_1 \times P_3$ were highly significant and negative.

CONCLUSION

Results showed that the parental lines P_2 and P_4 were good general combiners and the crosses $P_1 \times P_4$, $P_2 \times P_3$, $P_2 \times P_5$, $P_3 \times P_4$ and $P_3 \times P_5$ were the best and promising hybrids. However, the results also point at the potential of certain crosses as source for selecting high yielding lines in their segregating generations because additive gene effects were responsible for their performance.

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قوة الهجين والقدرة على التآلف فى الخيار

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أجريت هذه الدراسة بمعهد بحوث البساتين – مركز البحوث الزراعية – خلال الفترة من 2009 إلى 2011 و ذلك بهدف تقدير قوة الهجين وكلا من القدرة العامة والخاصة على التآلف لبعض الصفات الإقتصادية فى الخيار وهى صفة طول الساق الرئيسى ، وعدد الأفرع بالنبات ، وعدد الأزهار المؤنثة بالنبات ، ومتوسط طول الثمرة ، ومتوسط قطر الثمرة ، ومتوسط وزن الثمرة ، وكلا من المحصول المبكر والكلى للنبات. وقد إستخدمت فى الدراسة خمس سلالات مرباة تربية داخلية وهى *Cus* 3-2-14 (P1) ، *Cus* 1-27-608 (P2) ، *Cus* 2-11-519 (P3) ، *Cus* 1-12-26 (P4) ، *Cus* 2-23-516 (P5) وأجرى التهجين فيما بينها بإتباع طريقة الهجن الدائرية بدون التلقيح العكسى. وأظهرت النتائج الآتى:

– وجد قوة هجين فى بعض الهجن بالمقارنة بالأب الاعلى لصفات طول الساق الرئيسى ، وعدد الأفرع/النبات ، ومتوسط طول الثمرة ، ومتوسط وزن الثمرة. وظهرت قوة الهجين فى معظم الهجن لصفتى المحصول المبكر والكلى. فى حين لم تظهر قوة الهجين لصفتى عدد الأزهار المؤنثة بالنبات ، ومتوسط قطر الثمرة.

– وجود معنوية عالية لكلا من تباين القدرة العامة والخاصة على التآلف لمعظم الصفات المدروسة.

– أظهرت النسبة المحسوبة بين متوسط مربعات الإنحرافات للقدرتين العامة والخاصة على التآلف أن الفعل المضيف للجينات كان يلعب دورا أكثر أهمية من الفعل غير المضيف فى وراثة جميع الصفات ما عدا صفتى المحصول المبكر والكلى حيث لعب الفعل غير المضيف لجينات الدور الأكثر أهمية فى وراثة هاتين الصفتين.

– إتضح أن السلالتين P_2 ، P_4 كانتا متفوقتين تفوق إيجابيا فى القدرة العامة على التآلف لكثير من الصفات وخاصة صفتى المحصول المبكر والكلى. فى حين أثبتت القدرة الخاصة على التآلف تفوق الهجن $P_1 \times P_4$ ، $P_2 \times P_3$ ، $P_2 \times P_5$ ، $P_3 \times P_4$ ، $P_3 \times P_5$ فى معظم الصفات المدروسة وبالتالى تعتبر هجن واعدة يمكن الإنتخاب فى الأجيال الإنعزالية منها لتراكيب وراثية عالية المحصول.

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