Minufiya J. Agric. Res. Vol. 34 No.1(1):147-162 (2009) "http://www.mujar.net"

HETEROSIS AND COMBINING ABILITY FOR YIELD AND SOME CHARACTERS IN WATERMELON (Citrullus lanatus, Thunb).

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(Received: Dec., 21 , 2008)

ABSTRACT: *These experiments were carried out at Barrage Experimental Station of Hort. Res. Institute, during the two successive summer seasons of 2006 and 2007. Five parental inbred lines viz., Crimson Sweet (CS), Giza 1(G1), Congo (Co), Sugar Baby (SB) and Calsweet (Ca) were used in the study. In 2006 summer season, the five parents were planted in the field and all possible crosses, without reciprocals, were made to generate the experimental materials. The F1 crosses and their parents were evaluated in field experiment in the second season . The objective of this study was to determine the different types of gene effects in terms of general and specific combining ability (GCA and SCA), in addition to average degree of heterosis (ADH) regarding some characters viz., days to maturity, number of fruits per plant, mean weight of fruits, fruit shape index, yield per plant and total soluble solids. This knowledge about this sort of genetics would be helpful to the plant breeder for planning a successful breeding program. The obtained results could be summarized as follows:*

[1] Highly significant differences for general and specific combining abilities for all studied characters were found. These results indicated that genes with additive and non-additive effects are involved in the inheritance of these traits.

[2] The estimated ratio between GCA and SCA mean squares suggested that the additive gene effects have the main role in the inheritance of all traits.

[3] Obtained values of GCA for the studied traits in each of the studied parental cultivars showed that cv. Crimson Sweet is the best of all since it showed significant GCA values for most studied characters, followed by cvs. Giza 1 and Sugar Baby.

[4] A critical examination of data obtained on SCA effects for F_1 hybrids showed that certain crosses had high SCA effect values for certain traits, but not for all of them. The best crosses were "CS x G1", "CSxSB", "CS x Ca" , "G1 x SB" and "SB x Ca", since they showed significant SCA effect values for most evaluated traits. Accordingly, these superior and prospective materials can be used in watermelon improvement through breeding programs.

[5] Different degrees of dominance (hybrid vigour, completed and partial dominance) were found in most studied characters in watermelon.

Key words: *General and specific combining abilities, hybrid vigour, complete and partial dominance.*

INTRODUCTION

Cucurbits play a significant role in human nutrition, especially in tropical and Mediterranean countries. In Egypt the acreage of watermelon (*Citrullus lanatus*, Thump.) in 2006 was 152.381 Feddan or about more than 36% of the total area of cucurbits, total production of watermelon was 1.912.991 Tons, with average of 13.635 Tons/Feddan, according to Ministry of Agriculture.

To improve quantitative characters information's about the nature of gene action of these traits should be investigated with respect to the relative magnitudes of additive and non-additive genetic effects. When additive gene action represents the major components of the total genetic variation, a maximum progress would be expected in selection programs. Additive and non-additive genetic effects could be determined from the estimates of GCA and SCA. The improvement and producing of local watermelon hybrids may be achieved through a successful hybridization program.

The utilization of hybrid vigour in the breeding of various crops has a great practical importance. Accordingly, it is very important to increase watermelon yield per unit area, as well as improve the fruit traits.

Many investigators were conducted research on GCA and SCA for days to maturity, among them, Sachan and Nath (1976) who reported high effects on both general and specific combining abilities for earliness of watermelon. They added, however, that GCA variance was higher than that of the specific. Accordingly, they suggested that additive gene action had greater effects than the non-additive in the inheritance of this trait. Both GCA and SCA variance were also significant for earliness according to the results of Brar and Amrik (1977), Partap *et al.* (1984) and El-Meghawry *et al.* (2002).

Prosvirnin (1978) reported that earliness in watermelon was controlled by additive genes. While, Dyutin and Prosvirnin (1979), found that dominance and epistatic effects were more important in the inheritance of growth period length.

El-Meghawry *et al.* (2001 and 2002) showed that both general and specific combining ability variances were significant for number of fruits per plant. They also reported that the additive gene effects were the most important and showed partial dominance in the inheritance of this trait.

Additionally to Li and Shu (1985), El-Meghawry *et al.* (2001 and 2002), Ferreira *et al.* (2002) and Souza *et al.* (2002), significant effects for GCA and SCA for mean weight of fruits per plant, and additive gene effects were the most important in the inheritance of this trait. Considerable heterosis, due to over-dominance, was reported by Brar and Nandpuri (1974) and El-Meghawry

et al. (2001) in some crosses, while partial dominance for weight in other crosses was observed.

The inheritance of fruit shape in watermelon has been investigated by Brar and Nanduri (1974), Fulks *et al.* (1979), Abd El-Hafez (1983) and Afaf (1989). They reported that both additive and dominance effects were important in determining fruit shape in the studied watermelon crosses.

Regarding total yield, El-Meghawry *et al.* (2001 and 2002), Ferreira *et al.* (2002) and Gabriele and Todd (2005) reported that GCA and SCA were significant and the additive gene effects were the most important in the inheritance this trait. They also reported that partial and complete dominance for the high yield were observed.

Today, watermelon breeders as measurement necessary in releasing hybrids than cultivars interested in studying heterotic effects and combining ability.

Therefore, the objectives of this study were to measure and evaluate GCA, SCA and heterosis among 10 hybrids resulting from the crossing of five parental lines concerning some characteristics in watermelon.

MATERIALS AND METHODS

The present investigation was carried out at Barrage Experimental Station of Hort. Res. Institute, during two successive summer seasons (2006 and 2007). Five inbred lines of watermelon (*Citrullus lanatus*) were used in this study. These parental lines namely, viz., Crimson Sweet (CS), Giza 1 (G1), Congo (Co), Sugar Baby (SB) and Calsweet (Ca) were provided by Vegetable Research Department, Hort. Res. Institute, Agric. Res. Center.

The characters of these parental lines are shown in Table (1).

Table (1): Main characters of these parental lines.

Parental lines	Characters		
	Fruit	Flesh	Maturity
1-Crimson Sweet (CS)	Large, almost round, weighing up to 10 kgs., green rind with dark green strips	Bright red with firm texture and very sweet. Seeds are small and dark brown in color	Mid-season, 85 days from sowing
2- Giza 1 (G1)	Medium sized almost round, weighing about 5 kgs., green rind with very dark green strips	Medium red, fine textured and very sweet with large dark brown seeds.	Early, 70-80 days from sowing
3- Congo (Co)	Large oblong, blocky, weighing 12-16 kg., very thick rind with medium green and dark green strips	Medium red, fine and sweet with light tan colored seeds.	Late, long cropping period about 90 days from sowing
4- Sugar Baby (SB)	Medium sized almost round very dark green, weighing up to 5 kgs., rind is thin and tough	Bright red, fine textured, and very sweet with small dark brown seeds	Early, 75-80 days from sowing
5- Calsweet (Ca)	Large oblong shaped, weighing up to 12 kgs., rind is tough, medium thick, medium green in color with darker green marking	Medium red, crisp and very sweet, with large tan colored seeds	Mid-season, 85-90 days from sowing

These parental lines were at a high degree of homozygosity since they were previously selfed for tow generations.

The five parents were planted in the field in summer 2006, diallel crosses mating design in one direction were made to generate the experimental materials.

Seeds of the 15 genotypes collected viz., 5 parental lines and 10 F_1 crosses, were planted in the field on March 5th 2007 season. A randomized complete block design with three replicates was adopted, each replicate included 12 plants of each parent and F_1 were planted at 1 m., apart between plants. Standard cultural practices of watermelon were employed throughout the two experimental seasons, according to the recommendation of Ministry of Agriculture.

Fruits were determined to be ripe by looking for a dried tendril nearest the fruit, a light-colored ground spot, and a dull sound of the fruit when thumped (Maynard, 2001).

The studied traits were:

[1] Number of days from planting to the first mature fruit: It was counted as the mean of 12 plants per replicate.

[2] Number of fruits per plant, mean of 12 plants per replicate.

[3] Mean weight of fruits (kg.).

[4] Fruit shape index : was estimated as the ratio of the measured polar diameter to the equatorial diameter of fruits.

[5] Total yield as fruits weight (kg.): It was counted as the mean of 12 plants per replicate.

[6] Total soluble solids content (TSS): was determined as percentage using a hand refractometer.

Analysis of variance was done in order to test the significance of differences among the means of tested populations as shown by Cochran and Cox (1957). Differences among means for all studied characters were tested for significance according to the least significant differences (L.S.D.).

The analysis of general and specific combining abilities (GCA and SCA) was calculated according to Griffing;s method 2 model 1 (1956).

The average degree of heterosis (ADH %) was calculated as percent increase or decrease of the F_1 performance above the mid-parents (MP) value and the high parent (HP) value (Sinha and Khanna, 1975).

$$ADH\% \text{ (in relation to MP)} = (\overline{F_1} - MP)/ MP \times 100$$

$$ADH\% \text{ (in relation to HP)} = (\overline{F_1} - \overline{HP})/ \overline{HP} \times 100$$

Potence ratio (PR) was calculated using the following formula:

$$PR = (\overline{F_1} - \overline{MP}) / \tfrac{1}{2}\,\overline{P_2} - \overline{P_1}$$

Where, MP, $\overline{HP}$, $\overline{F_1}$, $\overline{P_1}$ and $\overline{P_2}$ are the mid-parents, mean of high performed parent in the trait, F1 hybrids and the means of the low and high parents, respectively.

Significance of the estimates was tested with "t" test at error degrees of freedom by Chaudhary *et al.* (1978).

t for heterosis over mid-parents value =

$$= \overline{F} - MP \,/\, \sqrt{\frac{Me}{r} \times 3/2}$$

t for heterosis over high parent value =

$$= \overline{F} - \overline{HP} \,/\, \sqrt{\frac{Me}{r} \times 2}$$

where, Me = error variance; r = number of replications.

The potence ratio was not estimated for crosses resulting from parents showing insignificant differences.

RESULTS AND DISCUSSION

(I) Combining ability:

The analysis of variance for GCA and SCA for the studied characters is given in Table (2). The variance associated with both GCA and SCA were highly significant for all studied traits. This result suggested that genes with additive and non-additive effects are involved in the inheritance of these traits in watermelon. The ratio between the mean squares of GCA and SCA showed that the additive component of genetic variance played the main role in the inheritance of all studied characters. These ratios ranged from 2.49 to 5.15. These results are in agreement with those of Sachan and Nath (1976), Brar and Amrik (1977), Partap *et al.* (1984), El-Meghawry *et al.* (2002) and Ferreira *et al.* (2002), who found that both additive and non-additive genes were involved in the inheritance of these studied traits, and that the additive genes were more important.

Highly significant negative GCA effects (-2.35, -2.03 and -1.78) were shown by the three parental lines G_1, SB and CS, respectively, for the days to maturity (Table 3), indicating that they posses genes for early fruit maturity. Positive significant GCA effects (4.45 and 1.71) were exhibited by the parental

lines Co and Ca, respectively, indicating that these parental lines possess genes for late maturity.

Table (2): Mean squares for general and specific combining abilities for the studied characters.

Characters / Source of variation	Days to maturity		No. of fruits per plant (kg.)		Mean weight of fruits (kg.)		Fruit shape index		Total yield per plant (kg.)		Total soluble solids (TSS)	
	MS	F	MS	F	MS	F	MS	F	MS	F	MS	F
GCA	95.48	69.12**	75.19	42.15**	59.30	18.36**	2.01	37.16**	109.61	40.11**	89.19	56.39**
SCA	27.13	17.01**	19.80	11.35**	23.80	9.08**	0.39	17.11**	42.03	17.00**	22.05	11.03**
GCA/SCA	3.52		3.80		2.49		5.15		2.61		4.04	

** Significant at 0.01 level of probability according to the "T" test.

Regarding number of fruits per plant, two parental lines viz, G1 and CS showed significant positive GCA effects. Their GCA values were 4.13 and 1.61, respectively. These results suggest that these parents are good combiners for total fruit number per plant. On the contrary, the parents SB, Co and Ca are poor combiners for this character. They showed negative significant values (-2.52, -2.13 and -1.09, respectively), Table (3).

GCA effects of the parental lines are given in Table (3). Three lines viz., Co, Ca and CS showed significant positive GCA effects for fruit weight. The highest GCA value (5.37) was given by the parental line Co, while significant negative GCA effects was shown by G_1 (-10.97), for lower mean of fruit weight.

GCA effects of parental lines for fruit shape index are given in Table (3). Significant positive GCA effects were shown by parent Ca whose GCA value (4.65). Meanwhile, the other parents showed insignificant for this trait as shown in Table (3).

Examination of GCA effect values illustrated in Table (3) show that the three parental lines CS, Co and G_1 are the best combiners for breeding to high total fruit yield. They showed the highest values (6.35, 2.45 and 2.34, respectively). Significant negative effects were observed in the other two parents.

Significant GCA effects for high TSS content were reflected by the parental lines CS and SB. They showed positive GCA values of 3.00 and 2.89, respectively. While, negative GCA values were obtained by the parent Ca, this value (-3.85) indicating significant effect for the lower TSS content.

In general, the parental line CS is the best general combiner, since it showed significant GCA values for most of studied characters (5 out of 6), followed by the parental lines G1 and SB, which gave significant GCA values in 3 out of 6 studied traits.

A critical examination of data obtained on SCA effects values for certain characters, but not for all of them, is shown in Table (3).

The best crosses combinations for each studied traits were:

The crosses "CS x G1", "CS x SB", "CS x Ca", "G1 x SB", "G1 x Ca","Co x SB","Co x Ca" and "SB x Ca" for short period to maturity. These values ranged from -3.41 in the cross CS x G1 to -1.72 in the cross Co x SB.

The crosses "CS x G1", "CS x SB", "CS x Ca","G1 x Co", "G1 x SB", "G1 x Ca" and "SB x Ca" for number of fruits per plant, these values (2.21, 1.75, 2.53, 1.75, 1.65, 3.35 and 1.65, respectively).

Out of the 10 F_1's studied, the crosses "CS x G1", "CS x Co", "CS x SB", "CS x Ca", "G1x Co", "G1x SB", "Co x SB", "Co x Ca" and "SB x Ca" were the best for average fruit weight. These values ranged from 4.32 in the cross "G1x Co" to 1.79 in the cross "CS x G1".

The crosses, "G1 x Ca" and "Co x Ca" for the high fruit shape index, with shape index values of 1.59 and 1.71, respectively.

The crosses "CS x G1", "CS x Co", "CS x SB", "CS x Ca", "G1 x Co", "G1 x SB", "Co x SB" and "SB x Ca" for total fruit weight/plant. These estimated SCA values were 4.21, 3.65, 3.12, 2.85, 1.70, 1.75, 1.69 and 2.01, respectively.

The F_1's "CS x G1", "CS x SB", "CS x Ca", "G_1 x SB" and "SB x Ca" are the best cross combinations for TSS. The SCA values ranged from 3.00 in the cross "CS x G1" to 1.75 in the cross "CS x Ca".

However, the crosses, "CS x G1", "CS x SB", "CS x Ca", "G1 x SB" and "SBxCa" was generally the best combinations, since they showed significant SCA values for most evaluated traits (5 traits, out of 6 ones), followed by cross "CoxSB" (4 traits out of 6 ones). Accordingly, these superior and prospective watermelon materials can be used in watermelon improvement through breeding programs.

Table (3): Estimates of general and specific combining ability effects for the studied characters

Parents Designation and Name	Characters	SCA effect					GCA effects
		CS	G_1	Co	SB	Ca	
1. Crimson Sweet (CS)	Days to maturity		-3.41**	0.93	-2.85**	-2.74**	-1.78**
	No. of fruits/plant		2.21**	1.35	1.75*	2.53**	1.61*
	Mean weight of fruits (kg.)		1.79*	3.57**	2.36**	2.78**	2.18**
	Fruit shape index		0.78	0.92	0.78	1.31	-1.08
	Total yield/plant (kg.)		4.21**	3.65**	3.12**	2.85**	6.35**
	Total soluble solids (TSS)		3.00**	1.21	2.79**	1.75*	3.00**
2. Giza 1 (G1)	Days to maturity			0.75	-1.80*	-1.93*	-2.35**
	No. of fruits/plant			1.75*	1.65*	3.35**	4.13**
	Mean weight of fruits (kg.)			4.32**	2.53**	-1.17	-10.97**
	Fruit shape index			0.92	1.31	1.59*	-1.30
	Total yield/plant (kg.)			1.70*	1.75*	0.90	2.34**
	Total soluble solids (TSS)			1.03	2.30**	-1.00	0.52
3. Congo (Co)	Days to maturity				-1.72*	-1.83*	4.45**
	No. of fruits/plant				-2.00*	-1.21	-2.13**
	Mean weight of fruits (kg.)				2.54**	2.00*	5.37**
	Fruit shape index				0.69	1.71*	-1.32
	Total yield/plant (kg.)				1.69*	0.37	2.45**
	Total soluble solids (TSS)				1.82*	-0.72	-1.52
4. Sugar Baby (SB)	Days to maturity					-2.85**	-2.03**
	No. of fruits/plant					1.65*	-2.52**
	Mean weight of fruits (kg.)					2.53**	1.06**
	Fruit shape index					-0.71	-0.95
	Total yield/plant (kg.)					2.01**	-4.57**
	Total soluble solids (TSS)					2.33**	2.89**
5. Calsweet (Ca)	Days to maturity						1.71*
	No. of fruits/plant						-1.09*
	Mean weight of fruits (kg.)						2.36**
	Fruit shape index						4.66**
	Total yield/plant (kg.)						-6.57**
	Total soluble solids (TSS)						-3.85**

* Significant at 0.05 level of probability according to the (T) test.
** Significant at 0.01 level of probability according to the (T) test.

(II) Average degree of heterosis:

The average degree of heterosis (ADH%) as percent based on the mid-parents (MP) and high parent (HP), in addition to potence ratio for the studied trait are tabulated in Table (4).

Regarding number of days from sowing to fruit maturity, seven crosses "CS x G1", "CS x SB", "G1 x Co", "G1 x Ca", "Co x SB", "Co x Ca" and "SB x Ca" showed significant negative ADH% values, based on MP (-5.19, -3.85, -10.00, -4.70, -8.64, -5.33 and -4.64, respectively). These crosses reflecting dominance towards the short period to maturity. From these crosses which showed dominance towards the earlier parents, the crosses "CS x G1", "G1 x Co", "Co x SB", "Co x Ca" and "SB x Ca" showed insignificant the earlier parents, indicating complete dominance for the short period to maturity. Partial dominance for the short period was detected in the crosses "CS x SB" and "G1 x Ca", since they gave significant values from their earlier parents. The obtained potence ratio for the two crosses was moderate (-0.50 and -0.78, respectively) in accordance with the partial dominance postulated. The same conclusion regarding heterosis was reported by Dyutin and Prosvirnin (1979), Afaf (1989) and El-Meghawry *te al.* (2001).

For total number of fruits per plant, significant differences between all parental lines of studied crosses were observed. When the obtained means of the studied crosses were compared with their arithmetic MP means, nine ones significantly exceeded their mid-parental values in this respect, suggesting dominance towards the high fruit number. Comparing the observed means for these F_1's versus their respective high parents, the crosses "CS x Co", "CS x SB", "CS x Ca", "G1 x Co", "Co x Ca" and "SB x Ca" did not differ significantly from their high parental means, indicating complete dominance for the high parents. The complete dominance was supported by the estimated ADH% values for these crosses (-0.50%,-1.43%, 0.00%, 0.30%, 3.33% and -4.29%, respectively). The estimated potence ratio values (0.96, 0.96, 1.00, 1.01, 1.35 and 0.86, respectively) supported the complete dominance.

Table (4): Average degree of heterosis (ADH%), based on mid-parents (MP) and high parent (HP), as well as potence ratio for some traits in watermelon.

Crosses	Days to maturity			No. of fruits/ plant		
	ADH%		Potence	ADH%		Potence
	MP	HP	ratio	MP	HP	ratio
CS x G1	-5.19**	-13.10**	-0.84	12.36*	-10.18*	0.49
CS x Co	-2.30	-5.56	-0.67	15.02*	-0.50	0.96
CS x SB	-3.85*	-10.71**	-0.50	15.00*	-1.43	0.90
CS x Ca	-1.84	-4.76**	-0.60	10.00*	0.00	1.00
G1 x Co	-10.00**	-20.00**	-0.86	39.58**	0.30	1.01
G1 x SB	....	....	....	2.93	-5.39	0.33
G1 x Ca	-4.70**	-10.13**	-0.78	21.40**	-9.59*	0.71
Co x SB	-8.64**	-17.78**	-0.88	20.19*	-9.57*	0.46
Co x Ca	-7.33**	-11.11**	-0.82	14.11*	3.33	1.35
SB x Ca	-6.64**	-8.86**	-1.00	16.52*	-4.29	0.86
	Average fruit weight			Fruit shape index		
CS x G1	23.43**	-11.48**	0.57	....	....	....
CS x Co	0.00	-6.43**	0.00	....	....	....
CS x SB	14.94*	-18.03**	0.47	....	....	....
CS x Ca	3.77	-9.84**	0.25	3.70	-12.50*	0.00
G1 x Co	15.79*	-21.43**	0.42	....	....	....
G1 x SB	....	....	....	....	....	....
G1 x Ca	14.29	-11.11**	0.50	3.70	-12.50*	0.20
Co x SB	15.63*	-20.71**	0.54	....	....	....
Co x Ca	4.35	-14.29**	0.20	5.70*	-12.50*	0.40
SB x Ca	4.23	-17.78**	0.36	7.85*	-15.63*	0.47
	Total yield (kg.)/plant			Total soluble solids (TSS)		
CS x G1	16.38**	4.65*	1.42	....	....	....
CS x Co	16.94**	5.24*	1.39	5.76**	3.78*	3.06
CS x SB	14.50**	-3.72*	0.77	5.69**	3.70*	3.00
CS x Ca	10.28**	-9.09*	0.68	4.85*	0.00	1.00
G1 x Co	6.45*	-3.41*	0.73	0.00	-1.85*	0.00
G1 x SB	....	....	....	0.00	-1.85*	0.00
G1 x Ca	1.24	-1.80	0.20	0.97	-3.70*	0.20
Co x SB	8.11**	-2.44*	0.75	....	....	....
Co x Ca	7.18**	-5.37*	0.68	0.99	-1.92*	0.33
SB x Ca	1.24	-2.21	0.22	5.20*	2.92*	1.67

* Significant

** Highly significant

.... No significant differences were found between the parents

Partial dominance for the high fruit number was detected in the crosses "CS x G1", "G1 x Ca" and "Co x SB", since it showed significant ADH values (12.36%, 21.40% and 20.19%, respectively), based on MP and (-10.18%, -9.59% and -9.57%, respectively), based on high parent (Table 4). The obtained potence ration values were moderate (0.49, 0.71 and 0.46, respectively) in accordance with the partial dominance postulated.

Concerning mean weight of fruits, data in Table (4) showed that the crosses "CS x G1", "CS x SB", "G1 x Co", "G1 x Ca" and "Co x SB" have significant positive heterosis values (23.43%, 14.94%, 15.79%, 14.29% and 15.63%, respectively), relative to MP. Meanwhile, their ADH% values (-11.48%, -18.03%, -12.43%, -11.11% and -20.71%, respectively), based on HP were significant negative, indicating partial dominance for the high weight. This partial dominance was verified by the obtained potence ratio values (0.57, 0.47, 0.42, 0.50 and 0.54, respectively). No dominance was observed in the rest crosses. It is noticed that none of the studied F_1 crosses exhibited hybrid vigour or dominance for the large weight. Similar results were obtained by Afaf (1989), El-Mehgawry *et al.* (2001) and Souza *et al.* (2002).

Out of the four crosses, "CS x Ca", "G1x Ca", "Co x Ca" and "SB x Ca" whose parents differed significantly in fruit shape index, two crosses, viz, "Co x Ca" and "SB x Ca", significantly exceeded the mid-parental values (5.70% and 7.85% respectively), suggesting dominance towards the high index. These crosses exhibited partial dominance when compared with the high fruit shape index, since they were significantly negative values (-12.50% and 15.63%, respectively). Similar results were obtained by Brar and Nandpuri (1974), Fulks *et al.* (1979), Abd El-Hafez (1983) and Afaf (1989).

Among nine F_1 crosses, whose parents significantly in total yield, two ones "CS x G1" and "CS x Co" exhibited significant positive heterosis values based on both MP and HP, reflecting over-dominance for the high yield. The ADH% (based on HP) was estimated as 4.65% and 5.24%, respectively in the two crosses. Moreover, the five crosses "CS x SB", "CS x Ca", "G1 x Co", "Co x Ca" and "Co x Ca" exhibited partial dominance for the high yield, though significant positive values (14.50%, 10.28%, 6.45%, 8.11% and 7.18%, respectively), based on MP, and significant negative values (-3.72%, -9.09%, -3.41%, -2.44% and -5.37%, respectively), based on high parents. The obtained patience ratio values were moderate (0.77, 0.68, 0.73, 0.75 and 0.68, respectively) in accordance with the partial dominance postulated. It is noticed that none of the studied F_1 crosses exhibited dominance towards the low parent. Different degree of heterosis for the total yield were found by El-Meghawry *et al.* (2001), Ferreir *et al.* (2002) and Gabriele and Todd (2005).

Out of the eight crosses, viz, "CS x Co", "CS x SB", "CS x Ca", "G1 x Co", "G1 x SB", "G1 x Ca", "Co x Ca" and "SB x Ca" whose parents differed

significantly in TSS, four crosses, viz, "CS x Co", "CS x SB", "CS x Ca" and "SB x Ca", significantly exceeded the mid-parental values, suggesting dominance towards the high content of TSS. Among these crosses, the hybrids "CS x Co", "CS x SB" and "SB x Ca" showed hybrid vigour for the high content with ADH values 3.78% , 3.70% and 2.92%, respectively. This hybrid vigour was verified by the obtained potence ratio values (3.06, 3.00 and 1.67, respectively). The remaining cross viz, "CS x Ca" exhibited complete dominance for the high content, since it is similar to high parent in TSS (Table 4).

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قوة الهجين والقدرة علي التآلف لبعض الصفات في البطيخ

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الملخص العربي :

أجريت التجارب الخاصة بهذه الدراسة بمزرعة محطة بحوث البساتين بالقناطر الخيرية خلال الموسم الصيفي لعامي ٢٠٠٦ ، ٢٠٠٧ . وكان الهدف من هذا البحث هو تقييم مدى قدرة هذه السلالات على الائتلاف وكذلك دراسة درجة قوة الهجين للحصول على مزيد من المعلومات الخاصة بوراثة بعض الصفات لمساعدة المربى على وضع وتنفيذ برامج التربية لتحسين محصول البطيخ والذي يعتبر من محاصيل الخضر الهامة في مصر .

واستخدم في هذه الدراسة ٥ أصناف هي (كريمسون سويت ، وجيزة ١ ، وكونجو ، وشوجربيبى ، كالسويت) . وقد أجريت التربية الداخلية لهذه الأصناف لعده أجيال لتنقيتها وراثيا . وأجرى التهجين فيما بينها في موسم ٢٠٠٦ للحصول على بذور الجيل الأول اللازمة للدراسة . في موسم ٢٠٠٧ زرعت الآباء والهجن العشرة في تجربة مصممه بطريقة القطاعات الكاملة العشوائية في ثلاث مكررات ــ وكانت الصفات التي تناولتها الدراسة هى (عدد الأيام من الزراعة حتى نضج الثمار ــ عدد الثمار الكلى ــ متوسط وزن الثمرة ــ وزن المحصول الكلى ــ معامل شكل الثمرة ــ محتوى الثمار من المواد الصلبة الذائبة الكلية).

وكانت أهم النتائج المتحصل عليها هي :

[١] كان التباين لكل من القدرة العامة والخاصة على الائتلاف معنويا لكل الصفات التي تم دراستها ــ وهذا يوضح أهمية كلا من الفعل المضيف والغير مضيف للجينات في وراثة هذه الصفات .

[٢] أظهرت النسبة المحسوبة بين متوسط مربع الانحرافات للقدرة العامة والخاصة على الائتلاف أن الفعل المضيف يلعب دورا أكثر أهمية من الفعل الغير مضيف في الصفات تحت الدراسة .

[٣] اختلفت الآباء في تأثيرات القدرة العامة على الائتلاف فكل سلالة أبوية أظهرت قدرة عالية ومعنوية لعدد من الصفات ــ واتضح من الدراسة أن الصنف كريمسون سويت كان أفضل الأصناف من حيث القيم المعنوية العالية لمعظم الصفات المدروسة . يليه الأصناف جيزة ١ . وشوجربيبى .

[٤] أوضحت دراسة تأثيرات القدرة الخاصة على الائتلاف أن الهجن التي يدخل في تكوينها أحد هذه الآباء (كريمسون سويت . وجيزة ١ . وشوجربيبى) أعطت قيم عالية ومعنوية للقدرة الخاصة على الائتلاف في مختلف الصفات المدروسة وعلى هذا يمكن استخدام هذه الاصناف للاستفادة منها في برامج تربية وتحسين البطيخ .

[٥] ظهرت كل نظم السيادة (عدم سيادة . سيادة جزيئية . سيادة تامة . قوة هجين) للهجن تحت الدراسة في الصفات المختلفة . وكانت أهم هذه الحالات :

أ- ظهور سيادة تامة للآباء المبكرة في نضج الثمار لكلا من الهجن (كريمسون سويت × جيزة ١ . جيزة × كونجو . وشوجربيبى × كالسويت) .

ب- ظهرت قوة الهجين في المحصول لكلا من الهجينين (كريمسون سويت × جيزة ١ . كريمسون سويت × كونجو) مما يشجع من استخدام هذه الهجن لتحسين محصول البطيخ على النطاق التجارى .