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PERFORMANCE OF FOUR PARENTS OF MELON (*Cucumis melo*) AND THEIR SIX HYBRIDS

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ABSTRACT

The current study was carried out in 2014 and 2015 seasons in a plastic house at Kaha Research Farm, Kalubia Governorate. Heterosis in 6 hybrids of melon, *Cucumis melo*, involving 4 melon varieties, Shammam El-Jordan, Charentais, Kahera 6 and Shahd El-dokki were evaluated for average fruit weight, fruit length, fruit diameter, total soluble solids, total yield per plant, plant height, chlorophyll content, fruit shape index and fruit flesh thickness. The results of heterosis showed that the best crosses were Shammam El-Jordan × Charentais and Kahera 6 × Charentais which had desirable characters. Kahera 6 variety had high GCA effect for the character plant height. Shahd Eldokki exhibited GCA effects for 2 characters, namely, average fruit weight and fruit length. Charentais variety showed high values of GCA for 2 characters, namely, total soluble solids and chlorophyll content. Estimates of SCA effects showed that the best combination was Shammam El-Jordan × Charentais for total yield per plant, flesh thickness and total soluble solids. Kahera 6 × Charentais showed best SCA for plant height and average fruit weight. Heritability values for all studied characters were low in both broad and narrow sense in both 2014 and 2015 seasons.

Key words: *Melon, Cucumis melo, general combining ability, specific combining ability, heritability, heterosis, yield, average fruit weight, fruit shape index, TSS.*

1. INTRODUCTION

Melon, *Cucumis melo* L., is one of the most economically important vegetable crops of *Cucurbitaceae*. According to Luan *et al*. (2010), melon is a polymorphic species which is true for fruit related traits. Cultivation of F_1 hybrids has a major role in the improvement of crop production and fruit quality over the past few years (Duvick, 1999). Heterosis refers to the phenomenon that F_1 hybrids exhibit phenotypic characters exceed the mean of parents. Heterosis also has an important role in the fitness of natural populations. Many researches had been carried out on heterosis and combining ability in musk melon. Exploiting of heterosis and selecting parents depending on combining ability made it more beneficial in vegetable cultivar improvement. The general combining ability (GCA) allows the identification of parents with desirable characters. Meanwhile, the SCA effects indicate the most promising hybrid combinations (Valério*et et al*., 2009). Breeding for high yield and good horticultural characters of melon necessitates the evaluation and identification of varietal differences. Determination of heterosis and combining ability effects are important in identifying the best parents and combinations that could be used in a selection program to produce a new inbred line or cultivars that may possess higher quantity and quality characters such as fruit shape index, fruit firmness, total soluble solids, vitamin C content, flesh color and average fruit weight. Heterosis was detected for most plant and fruit characters of melon by many investigators. Hatem (1992) and Hatem *et al*. (1995) studying melon found heterosis for total yield as fruit weight and average fruit weight. Greish *et al*. (2005) studying melon reported heterosis for plant high, fruit weight, fruit length, fruit width and total soluble solids (TSS). Also, Feyzian *et al*. (2009a) reported heterosis for average melon fruit weight and total yield. Fernandez-Silva *et al*. (2009) recorded heterosis for melon fruit shape index. The main target of the current study was to compare the performance of the F_1 hybrids with their parents, and to estimate heterosis and combining ability to select a new local hybrid which possesses high total soluble solids, flesh firmness, small fruit core and orange flesh color.

2. MATERIALS AND METHODS

The current study on Melon, *Cucumis melo*, was conducted at Kaha Vegetable Research Farm, Kalubia Governorate during the seasons of 2014 and 2015 in a plastic house. Four genetically diverse varieties of melon, viz., Shammam El-Jordan, Shahd Eldokki, Kahera 6 and Charentais were provided by the Vegetable Research Department, Horticulture Research Institute, Agriculture Research Center, Ministry of Agriculture Egypt. The four melon varieties were crossed in one direction to produce 6 F_1 hybrids in a plastic house in September of 2013. Descriptions of these varieties are shown in Table (1). All the four parents and the 6 F_1 hybrids were grown for evaluation in two seasons in September of 2014 and 2015 in a randomized complete block design with three replicates. Each plot contained 20 plants, 10 on each ridge with 50 cm between plants. All agricultural practices were followed according to the recommendations of the Ministry of Agriculture and Land Reclamation, Egypt. Data were recorded on 10 randomly selected plants and 10 fruits per plant in each plot for total yield per plant, plant height, chlorophyll content in plant leaves, fruit length, fruit diameter, fruit shape index, fruit flesh thickness, total soluble solids and average fruit weight. Data were statistically analyzed according to Snedecor and Cochran (1980). Heterosis expressed by the F_1 hybrids was estimated over the mid-parent and high-parent as percentage. Combining ability and heritability in broad and narrow sense were estimated according to Griffing (1956) as described by Singh and Chaudhary (1977).

$$H\%_{MP} = \frac{\bar{F}_1 - \overline{MP}}{\overline{MP}} \times 100$$

$$H\%_{HP} = \frac{\bar{F}_1 - \overline{HP}}{\overline{HP}} \times 100$$

Where:

$H\%_{MP}$ = heterosis over mid − parent

$\bar{F}_1$ = hybrid mean

$\overline{MP}$ = two parents mean

$H\%_{HP}$ = heterosis over high − parent

$\overline{HP}$ = high parent mean

$$H^2 = \frac{V_A + V_D}{V_G + V_E}$$

$$h^2 = \frac{V_A}{V_G + V_E}$$

Table (1): Description of parental varieties of melon used in the current study.

Genotype name		Country of origin	Source	Fruit shuck color	Fruit flesh color
Common	**Scientific**				
Shammam El-Jordan	*Cucumis melo*	Jordan	Horticulture research institute	Light green, with net	Reddish orange
Shahd ElDokki	*C. melo*	Egypt	Horticulture research institute	Sandy yellow, with narrow net	Greenish white
Kahera 6	*C. melo var aegyptiacus*	Egypt	Horticulture research institute	Dark beige with bluish green strips, without net	Greenish white
Charentais	*C. melo*	France	Horticulture research institute	Dark beige with green strips, with narrow net	Dark orange

Where:

H^2 = heritability in broad sense

h^2 = heritability in narrow sense

V_A = Additive variance

V_D = Dominance variance

V_G = Genetic variance

V_E= Environmental variance

3. RESULTS AND DISCUSSION

Regarding the data presented in Tables (2 and 3), there were significant differences among genotypes for all the studied characters in both seasons. Wide range of variation was found among the selected parents. Parents in each cross differed for growth habit, fruit size and shape. In respect to the mean performance, the highest parents were Shahd ElDokki for total yield per plant, average fruit weight and fruit length and Kahera 6 for plant height and total soluble solids. The highest F_1 hybrids were Shammam El-Jordan × Charentais for total yield per plant, Shahd ElDokki × Kahera 6 for average fruit weight and Kahera 6 × Charentais for plant height.

Data in Table (3) showed the mean squares for analysis of variance of parents, F_1 hybrids, general and specific combining ability where there were significant differences for all the studied characters. These results agreed with those of Kupper and Jack (1988) who found highly significant differences of GCA and SCA for yield and its components in cucumber. GCA/SCA ratio was more than one for plant height, total yield per plant, average fruit weight and fruit length indicating that additive gene effects were more important in the inheritance of these characters. While, the ratio was less than one for fruit diameter indicating that non-additive gene effects were important in the inheritance of this character. This was in accordance with the results obtained by Feyzian *et al.* (2009b) in melon. Variance due to GCA was higher than that due to SCA for plant height, total yield per plant, average fruit weight and fruit length. This indicates the the additive type of gene action is more important than non-additive type in the inheritance of these characters and supporting the results obtained on GCA/SCA ratio.

Estimates of heterosis over mid-parent and high-parent are presented in Tables (4a and 4b) show significant differences in both seasons. In respect to heterosis over mid-parent, the highest heterosis values were estimated for the hybrids Shammam El-Jordan × Shahd El-Dokki for plant height, Shammam El-Jordan × Charentais for total yield per plant, flesh thickness and total soluble solids and Kahera 6 × Charentais for average fruit weight. The values of heterosis over mid-parents showed that out of the six evaluated hybrids the crosses that surpassed their mid-parents were 5 hybrids (Shammam El-Jordan × Shahd El-Dokki, Shammam El-Jordan × Kahera 6, Shammam El-Jordan × Charentais, Shahd El-Dokki × Kahera 6 and Kahera 6 × Charentais) for plant height, 2 hybrids (Shammam El-Jordan × Charentais and Kahera 6 × Charentais) for total yield per plant, 1 hybrid (Kahera 6 × Charentais) for average fruit weight, 5 hybrids (Shammam El-Jordan × Kahera 6, Shammam El-Jordan × Charentais, Shahd El-Dokki × Kahera 6, Shahd ElDokki × Charentais and Kahera 6 × Charentais) for fruit length, 3 hybrids (Shammam El-Jordan × Kahera 6, Shammam El-Jordan × Charentais and Kahera 6 × Charentais) for fruit diameter, 3 hybrids (Shammam El-Jordan × Shahd El-Dokki, Shahd ElDokki × Kahera 6 and Shahd El-Dokki × Charentais) for fruit shape index, 2 hybrids (Shammam El-Jordan × Kahera 6 and Shammam El-Jordan × Charentais) for flesh thickness, 1 hybrid (Shammam El-Jordan × Charentais) for total soluble solids and 3 hybrids (Shammam El-Jordan × Kahera 6, Shahd El-Dokki × Kahera 6 and Shahd El-Dokki × Charentais) for chlorophyll content. The range of increase in the hybrids over their mid-parents (Table 4) was between 18.49% (Shammam El-Jordan × Kahera6 for Chlorophyll content) to 125.24% (Shammam El-Jordan × Charantais) for total yield per plant in the first season while it was 1.09% (Shammam El-Jordan × Charentais for total soluble solids) in the second one. Only the hybrid Kahera 6 × Charentais showed an increase over the mid-parents in the total yield per plant and average fruit weight. In respect to heterosis over high-parent, the highest heterosis values were estimated for the hybrids Shammam El-Jordan × Shahd El-Dokki average fruit weight (2015 season), fruit length (2014 season) and fruit shape index (2014 and 2015 seasons); Shammam El-Jordan × Kahera 6 for fruit diameter (2014 and 2015 seasons), flesh thickness (2015 season) and chlorophyll content (2015 season); Shammam El-Jordan × Charantais for total yield per plant (2014 and 2015 seasons), flesh thickness (2014 season) and total soluble solids (2014 season); Shahd ElDokki × Kahera 6 for chlorophyll content (2015 season) and Kahera 6 ×Charentais for plant height (2014 and 2015 seasons), average fruit weight (2014 season), fruit length (2015 season) and total soluble solids (2015 season). The crosses that surpassed their high-parents were Shammam El-Jordan × Shahd El-Dokki for fruit shape index, Shammam El-Jordan

Table (2): Mean performance of the 4 parents and their 6 F_1 hybrids in 2014 and 2015 seasons.

Genotypes	Plant height (cm)		Total yield per plant (kg)		Average fruit weight (kg)		Fruit length (cm)		Fruit diameter (cm)		Fruit shape index		Flesh thickness (cm)		Total soluble solids(%)		Chlorophyll content in leaves(%)	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
1	300	283.67	2.27	3.83	1.47	1.38	13	13.17	10	10.5	1.33	1.26	2.17	2.33	7.67	8	36.63	43.43
2	354.67	363.33	14.23	10.28	2.39	2.27	16.67	18.67	10.67	18	1.58	1.04	3.33	4	6.5	7.67	39.4	41.47
3	374	383	2.95	5.37	1.08	1	12.33	12.33	8.4	8.4	1.47	1.47	2.93	2.93	10.67	10.67	37.63	39.43
4	361	366.33	8.67	9.95	0.76	0.68	13.5	14.67	11.37	12.17	1.19	1.21	3.67	3.47	8.33	10.33	47.5	47.53
1 × 2	404	414.33	7.47	6.43	1.11	1.03	20	14.1	10.17	8.83	1.97	1.6	3.67	2.53	13	6.2	41.33	39.63
1 × 3	377	391.33	2.4	3.93	0.76	0.68	13.83	15.03	11.5	12.13	1.21	1.24	3	2.87	13	6.53	44	46.4
1 × 4	351	375.33	12.32	13.31	0.59	0.51	13.33	17.77	11.77	11.7	1.13	1.52	4.5	3.3	15	9.27	35.8	42.9
2 × 3	431.33	428	3.92	2.43	1.33	1.25	17.33	16.33	10.17	10.5	1.71	1.55	3.6	3.1	10	7	43.87	45.63
2 × 4	377	384.67	9.55	6.35	0.75	0.67	16.17	17.2	10	10.57	1.63	1.64	300	3.53	12.67	8.87	49.67	44.87
3 × 4	447.33	446	6.5	9.95	1.1	1.02	13.83	18	12.77	11.03	1.08	1.64	2.83	3	14	10	46.77	41.97
LSD at 5%	13.51	28.59	3.62	3.4	0.05	0.05	4.03	1.57	1.75	1.15	0.45	0.22	1.03	0.4	3.47	1.14	8.42	5.48

1: Shammam El-Jordan, 2: ShahdEl-Dokki, 3: Kahera 6 and 4: Charentais.

Table (3): Mean square for analysis of variance of genotypes (parents and F_1) and combining ability (GCA and SCA) of melon in 2014 and 2015 seasons.

Source of Variance	df	Plant height		Total yield per plant		Average fruit weight		Fruit length		Fruit diameter		Fruit shape index		Flesh thickness		Total soluble solids		Chlorophyll content in leaves	
		2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Mean squares for analysis of variance of genotypes																			
Genotypes	9	5330.43*	5878.28*	53.27*	37.14*	3.19*	2.8*	17.81*	14.28*	4.44*	20.94*	0.25*	0.14*	1.2*	0.72*	25.1*	7.79*	70.69*	22.56ns
Error	18	62.04	277.74	4.44	3.92	0.001	0.001	5.53	1.04	0.74	0.45	0.07	0.02	0.36	0.06	4.09	0.44	24.09	10.21
Mean squares for analysis of variance of combining ability (General, GCA and Specific, SCA)																			
GCA	3	2162.98*	2407.25*	36.43*	15.81*	0.46*	0.45*	10.76*	5.77*	1.26*	7.41*	0.15*	0.01ns	0.22ns	0.52*	3.52ns	5.07*	30.39*	5.14ns
SCA	6	1583.73*	1735.52*	8.42*	10.67*	0.18*	0.17*	3.53*	4.25*	1.59*	6.76*	0.05ns	0.06*	0.49*	0.10*	10.79*	1.36*	20.15ns	8.71ns
Error	18	20.68	92.58	1.48	1.31	0.0003	0.0003	1.84	0.35	0.25	0.15	0.02	0.01	0.12	0.02	1.36	0.15	8.03	3.4
GCA/SCA		1.37	1.39	4.33	1.48	2.63	2.63	3.05	1.36	0.79	1.1	2.79	0.17	0.44	5.12	0.33	3.74	1.51	0.99
O^2_g		96.54	111.95	4.67	0.86	0.05	0.05	1.2	0.25	-0.06	0.11	0.02	-0.01	-0.05	0.07	-1.21	0.62	1.71	-0.95
O^2_s		1563.05	1642.94	6.94	9.36	0.18	0.17	1.69	3.9	1.35	6.61	0.03	0.06	0.37	0.08	9.42	1.21	12.12	5.31

*** significant at 5%**

Table (4a): Heterosis over mid-parent (%) of F_1 hybrids in 2014 and 2015 seasons.

Genotype	Plant height		Total yield per plant		Average fruit weight		Fruit length		Fruit diameter		Fruit shape index		Flesh thickness		Total soluble solids		Chlorophyll content in leaves	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
1 × 2	23.42 a	28.08 ns	-9.49 abd	-8.95 abc	-42.56 a-d	-48.82 a	34.83 a	-11.41 a-e	-1.61 a-e	-38.01 a-e	35.85 a	39.03 ab	33.33 ab	-20 a-e	83.53 ab	-20.85 a-d	8.72 ae	-6.16 abc
1 × 3	11.87 ns	17.4 ns	-7.99 abc	-14.64 a-d	-40.31 abc	-42.85 ab	9.21 ab	17.91 abc	25 ab	28.4 a	-13.48 a-e	-9.18 a-e	17.65 abc	8.86 ab	41.82 a-e	-30 a-e	18.49 a	11.99 b
1 × 4	6.2 abc	15.49 ns	125.24 a	93.13 a	-46.75 a-e	-50.22 abc	0.63 abc	27.66 ab	10.14 abc	3.24 abc	-10.1 a-d	23.19 a-d	54.29 a	13.79 a	87.5 a	1.09 a	-14.9 a-e	-5.68 abc
2 × 3	18.39 c	14.69 ns	-54.41 a-e	-68.9 a-e	-23.45 ab	-23.85 a-d	19.54 abd	5.38 a-d	6.46 a-d	-20.45 a-d	12.02 abc	23.74 abc	14.89 a-d	-10.58 a-e	16.5 a-e	-23.64 a-e	13.89 c	12.81 a
2 × 4	5.36 abc	5.44 ns	-16.61 a-e	-37.23 a-e	-52.4 a-e	-54.73 a-e	7.18 abe	3.2 a-e	-9.23 a-e	-29.94 a-e	17.49 ab	45.65 a	-14.29 a-d	-5.38 abc	70.79 abc	-1.48 ab	14.31 b	0.82 abc
3 × 4	21.72 b	19.04 ns	11.88 ab	29.97 ab	20.19 a	22.11 a-e	7.1 a-e	33.33 a	29.17 a	7.29 ab	-18.54 a-e	22.5 a-e	-14.14 a-d	-6.25 a-d	47.37 a-d	-4.76 abc	9.87 ad	-3.49 ab
CD at 5%	11.70	24.76	3.13	2.94	0.05	0.04	3.49	1.52	1.28	1.00	0.39	0.19	0.90	0.35	3.01	0.98	7.29	4.75

1: Shammam El-Jordan, 2: ShahdEl-Dokki, 3: Kahera 6 and 4: Charentais.

Table (4b): Heterosis over high-parent (%) of F_1 hybrids in 2014 and 2015 seasons.

Genotype	Plant height		Total yield per plant		Average fruit weight		Fruit length		Fruit diameter		Fruit shape index		Flesh thickness		Total soluble solids		Chlorophyll content in leaves	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
1 × 2	13.91 c	14.04 ns	-47.54 a-e	-37.5 a-d	-53.61 a-d	2.16 a	20 a	-24.46 a-e	-4.69 a-d	-50.93 a-e	25.24 a	26.95 ab	10 ab	-36.67 a-e	69.57 ab	-22.5 a-d	4.91 ac	-8.29 ab
1 × 3	0.8 abc	2.18 ns	-18.64 ab	-26.83 abc	-48.14 abc	-45.13 ab	6.41 ab	14.18 abc	15 a	15.56 a	-17.64 a-e	-15.75 a-e	2.27 a-d	-2.27 a	21.88 a-e	-38.75 a-e	16.92 a	6.83 b
1 × 4	-2.77 abc	2.46 ns	42.06 a	33.77 a	-59.68 a-e	-50.68 abc	4 ac	21.14 ab	3.52 abc	-3.84 ab	-14.85 a-d	20.75 abc	22.73 a	-4.81 ab	80 a	-10.32 ab	-24.63 a-e	-9.75 ab
2 × 3	15.33 b	11.75 ns	-72.48 a-e	-76.34 a-e	-44.35 ab	-54.85 a-d	2.47 abd	-12.5 a-e	-4.69 abce	-41.67 abce	8.3 ab	5.59 a-e	8 abc	-22.5 a-e	-6.25 a-e	-34.38 a-e	11.34 b	10.05 a
2 × 4	4.43 a	5 ns	-32.9 a-d	-38.25 abce	-68.67 a-e	-62.94 a-e	-1.23 a-d	-7.86 a-d	-12.02 a-e	-41.3 a-d	3.07 abc	35.47 a	-18.18 a-e	-11.67 abc	52 abc	-14.19 abc	4.56 ad	-5.61 abc
3 × 4	19.61 a	16.45 ns	-25.03 abc	0.03 ab	0.08 a	-70.65 a-e	-3 a-d	22.73 a	12.32 ab	-9.32 abc	-26.35 a-e	11.57 a-d	-22.73 a-e	-13.46 a-d	31.25 a-d	-6.25 a	-1.54 abe	-11.71 abc
CD at 5%	11.70	24.76	3.13	2.94	0.05	0.04	3.49	1.52	1.28	1.00	0.39	0.19	0.90	0.35	3.01	0.98	7.29	4.75

1: Shammam El-Jordan, 2: ShahdEl-Dokki, 3: Kahera 6 and 4: Charentais.

Table (5) : General combining ability effects of parents, specific combining ability effects of F_1 hybrids and heritability in broad (H^2%) and narrow (h^2%) sense in 2014 and 2015 seasons.

Genotype	Plant height		Total yield per plant		Average fruit weight		Fruit length		Fruit diameter		Fruit shape index		Flesh thickness		Total soluble solids		Chlorophyll content in leaves	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
General combining ability effects																		
1	-26.11 abc	-28.28 abc	-1.4 ab	-0.76 a	-0.05 a	-0.04 ab	-0.31 a	0.9 ab	0.01 a	-0.54 abc	-0.03 a	-0.04 ns	-0.14 ns	-0.36 abc	0.15 ns	-0.71 ab	-2.82 a	-0.12 ns
2	5.5 ab	5.94 ab	2.38 a	-0.02 ab	0.38 a	0.37 a	1.97 a	1.06 a	-0.29 a	1.5 a	0.22 a	-0.04 ns	0.1 ns	0.27 a	-1.13 ab	-0.81 ab	0.39 ns	-0.58 ns
3	19.17 a	18.89 a	-2.74 ab	-1.48 ab	-0.05 a	-0.05 ac	-0.89 a	-0.77 ab	-0.36 a	-1.08 abc	-0.03 a	0.05 ns	-0.18 ns	-0.12 abc	0.49 a	0.43 ab	-0.23 ns	-0.64 ns
4	1.44 ac	3.44 ac	1.76 b	2.27 a	-0.29 a	-0.28 abc	-0.78 a	0.61 b	0.64 a	0.12 ab	-0.16 a	0.02 ns	0.22 ns	0.21 b	0.49 b	1.09 a	2.66 a	1.34 ns
CD at 5% (g_i - g_j)	5.52	11.67	1.48	1.39	0.02	0.02	1.65	0.72	0.6	0.47	0.18	0.09	0.42	0.17	1.42	0.46	3.44	2.24
Specific combining ability effects																		
1 × 2	46.88 b	53.07 a	-0.53 a	0.03 ac	-0.36 a-e	-0.35 a-e	3.33 a	-1.78 a-e	-0.23 ab	-3.51 a	0.35 a	0.25 a	0.44 b	-0.48 ab	2.89 b	-0.73 a	1.5 d	-2.81 ab
1 × 3	6.21 abc	17.12 ad	-0.49 a	-1.01 ab	-0.28 a-d	-0.28 a-d	0.03 ns	0.97 ac	1.18 b	2.37 ab	-0.16 a	-0.19 a-e	0.05 a	0.24 b	1.28 ns	-1.64 abc	4.79 a	3.82 a
1 × 4	-2.07 abc	16.57 abe	4.93 a	4.63 a	-0.21 abc	-0.21 abc	-0.58 ns	2.33 b	0.44 ac	0.74 ac	-0.11 a	0.12 abe	1.15 a	0.35 a	3.28 a	0.44 a	-6.3 a-e	-1.67 ab
2 × 3	28.93 abc	19.57 ac	-2.75 ab	-3.25 abc	-0.14 ab	-0.13 ab	1.25 a	0.32 abd	0.14 a	-1.31 a-d	0.09 ns	0.12 abd	0.41 c	-0.16 ab	-0.44 ab	-1.08 abc	1.45 e	3.51 b
2 × 4	-7.68 abc	-8.32 a-e	-1.62 a	-3.08 abc	-0.48 a-e	-0.47 a-e	-0.03 a	-0.19 abe	-1.04 abc	-2.43 a-e	0.13 ns	0.23 b	-0.59 abc	-0.05 a	2.22 ns	0.14 b	4.36 b	0.75 ns
3 × 4	48.99 a	40.07 b	0.45 ab	1.98 b	0.31 a	0.31 a	0.5 a	2.43 a	1.8 a	0.61 a-e	-0.16 a	0.15 ac	-0.48 abc	-0.2 ab	1.94 ns	0.02 c	2.08 c	-2.08 ab
CD at 5% (s_{ij} - s_{kl})	11.03	23.34	2.95	2.77	0.04	0.04	3.29	1.43	1.2	0.94	0.37	0.18	0.84	0.33	2.83	0.93	6.87	4.48
Heritability in broad and narrow sense																		
H^2%	0.15	0.09	0.03	0.05	0.06	0.06	0.01	0.07	0.06	0.26	0.02	0.12	0.04	0.03	0.46	0.03	0.02	0.01
h^2%	0.02	0.00	0.02	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.05	0.01	0.02	0.16	0.02	0.00	0.00

1: Shammam El-Jordan, 2: Shahd El-Dokki, 3: Kahera 6 and 4: Charentais.

× Kahera 6 for fruit diameter, Shammam El-Jordan × Charantais for total yield per plant and Kahera 6 × Charentais for plant height. The range of increase in the hybrids over high-parents was between 15% (Shammam El-Jordan × Kahera 6 for fruit diameter) to 42.06% (Shammam El-Jordan × Charantais for total yield per plant) in both 2014 and 2015 seasons. These results are in agreement with those obtained by Kitroongruang *et al*. (1992) and Ramaswamy *et al*. (1977) they recorded high heterosis estimates for melon for fruit diameter, fruit length, fruit shape index, the number of fruits per plant, total fruit weight per plant, fruit weight and percentage total soluble solids content.

The GCA and SCA effects and heritability estimates in narrow and broad sense are presented in Table (5). Out of the 4 parents, the cultivar Shahd ElDokki had the highest GCA effect in both seasons for average fruit weight and fruit length and cv Charentais had the highest values for total soluble solids and chlorophyll content. High positive SCA effects were found in the crosses Shammam El-Jordan × Shahd El-Dokki for fruit shape index, Shammam El-Jordan × Kahera 6 for chlorophyll content, Shammam El-Jordan × Charentais for total yield per plant, fruit thickness and total soluble solids and Kahera 6 × Charentais for average fruit weight. These results indicated that no cross combinationis consistently good for all characters. These results agreed with the results of Kitroongruang *et al*. (1992) and Ramaswamy *et al*. (1977) who reported high GCA and positive SCA for yield, fruit weight, fruit diameter and fruit length in melon.

Heritability values in broad and narrow sense are shown in Table (5). In respect to broad sense heritability, the values were low for all the studied characters in both 2014 and 2015 seasons. Also, the values of narrow sense heritability were low for all the studied characters in both seasons indicating that non-additive gene effects had the major role in inheritance of these characters. The results are in agreement with the results of Reddy *et al*. (2013) and Rakhi and Rajamony (2005) on melon who found low values of heritability for some yield components.

The SCA effects of the crosses Shammam El-Jordan × Charentais and Kahera 6 × Charentais were correlated with their GCA parent effects. The two crosses were the best cross combination in three characters, viz., total yield per plant, flesh thickness and total soluble solids in the cross Shammam El-Jordan × Charentais and in two-characters, viz., plant height and average fruit weight in the cross Kahera 6 × Charentais. In addition, the two crosses involved at least one parent with high GCA effects. Thus, these two crosses have the availability to be exploited in future breeding program to produce new local hybrids of melon.

It could be concluded that high GCA can be used to choose the parents with desirable characters to produce new local hybrids. The parents with desirable characters and high GCA may produce hybrids with high heterosis and SCA. According to that in the current study the best crosses which can be produced as new local hybrids of melon are Shammam El-Jordan × Charentais and Kahera 6 × Charentais.

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سلوك أربعة آباء من الشمام وهجنهم الستة

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ملخص

أجرى تقييم قوة الهجين في 6 من هجن الشمام التي نتجت من تهجين 4 أصناف فى اتجاه واحد وذلك لصفات متوسط وزن الثمرة، طول الثمرة، قطر الثمرة ،المواد الصلبة الذائبة الكلية ،المحصول الكلي للنبات ،طول النبات ،محتوى الكلوروفيل في الاوراق ، معامل شكل الثمرة وسمك اللحم. كانت قيمة القدرة العامة على الائتلاف مرتفعة بالنسبة للصنف قاهرة 6 وذلك لصفة طول النبات، والصنف شهد الدقى لصفتى متوسط وزن الثمرة وطول الثمرة، والصنف شارنتيز لصفتى المواد الصلبة الذائبة الكلية ومحتوى الكلوروفيل في الاوراق. أظهرت تقديرات القدرة الخاصة على التآلف أن أفضل الهجن هو الهجين شمام الأردن × شارنتيز لصفات المحصول الكلي للنبات وسمك اللحم والمواد الصلبة الذائبة الكلية، والهجين قاهرة 6 × شارنتيز لصفتى طول النبات ومتوسط وزن الثمرة. قيم الكفاءة التوريثية في كل من معناها الواسع والضيق كانت منخفضة لكل الصفات المدروسة في كلا موسمى الدراسة 2014 و2015.

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