BREEDING FOR YIELD, YIELD COMPONENTS AND SOME AGRONOMIC CHARACTERS IN BREAD WHEAT

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Abstract

This investigation was carried out at El-Giza Agricultural Research Station, Agricultural Research Center (ARC), during three successive seasons, starting from 2001/2002 to 2003/2004. The objectives of this research were to estimate heterosis and combining ability, for yield, yield components and some other agronmoic characters in wheat.

Six local cultivars, namely, Giza 163, Giza 168, Giza 170, Sakha 93 and Gemmeiza 9 and the exotic cultivar, Irena, were used in the study.

All possible crosses among these parents excluding reciprocals were made in 2001/2002. In 2002/2003 the six parents and their 15 F_1 (21 entries) and in 2003/2004 the six parents and 15 F_2 crosses were evaluated using randomized complete block design (RCBD) with 4 replecations.

The obtained results indicated that heterosis (parents vs. crosses) were significant for most studied characters in the F_1 and F_2. Compared with better parent, the highest heterosis effect was registered by the crosses P_3 X P_4 (Giza 170 x Sakha 93) for plant hight, flag leaf area, number of spikes/plant, straw yield/plant and grain yield/ plant, cross P_4Xp_6 (Sakha 93 x Irena) for kernel weight, harvest index and grain production rate, and cross P_2xP_3 (Giza 168 x Giza 170) for number of kernels/spike in the F_1. On the other hand, in the F_2 generation cross P_3 X P_5 (Giza 170 x Gemmeiza 9) gave the highest heterosis values for plant height, number of spikes/plant and harvest index, P_1 x P_4 (Giza 163 x Sakha 93) for flag leaf area, P_1 X P_2 (Giza 163 x Giza 168) for number of kernels/spike, P_4xP_6 (Sakha 93xIrena) for kernel weight, P_3 X P_4 (Giza 170 x Sakha 93) for straw yield/plant, P_4 X P_5 (Sakha 93 x Gemmeiza) for grain production rate and P_3 x P_4 (Giza 170 xSakha93) for grain yield/plant.

General combining ability (GCA) and specific combining ability (SCA) mean squares were significant for all evaluated characters in the F_1 and/or in the F_2 generations. Giza 163, Giza 168 and Sakha 93 were the best general combiners for most studied characters. Meanwhile, results of SCA suggested that cross P_4 x P_6 (Sakha 93xIrena) in the F_1 and cross P_2 x P_5 (Giza 168 x Geemeiza 9) in the F_2 were the best combiners for grain yield/plant.

GCA/SCA ratio showed the important role of additive genetic effects for spike length, harvest index and grain yield/plant.

INTRODUCTION

The understanding of genetic effects controlling different characters in wheat are required before starting a breeding program. Joshi (1979) stated that genetic studies involving high yielding and widely adapted parents need more attention because their crosses are expected to offer desirable genetic variability .

Combining ability analysis is the most widely used biometrical tool for classifying parental lines in terms of their ability to combine with each other. With this method, the resulting total genetic variation is partitioned into the effect of general combining ability (GCA), as a measure of additive gene action, and specific combining ability (SCA), as a measure of non-additive gene action.

Successful breeding program needs continuous information on gene action and system controlling the studied characters. Dawam and Hendawy (1990) found that dominance gene effects were significant for grain yield/plant, number of kernels/spike, 1000-kernel weight. Ikram and Tanah (1991) indicated that additive and non-additive gene effects played an equal role in the inheritance of grain yield, number of spikes/plant, number of kernels/spike, and 1000-kernel weight. On the other hand, Salem and Hassan (1991) reported that non-additive gene effects were more important for grain yield/plant and number of spikes/plant. Meanwhile, El-Hennawy (1992) found that additive and dominance gene effects were important for grain yield and number of kernels/spike. On the other hand, Mekhamer (1995) reported that additive gene effects were significant for number of kernels/spike and 1000-kernel weight. Additive and dominance gene effects with greater importance of dominance were found to control the genetic system of number of kernels/spike, 1000-kernel weight and grain yield/plant (Alkaddoussi 1996) and number of spikes/plant (Awad 1996 and Tosun and Ozkan 1996). Moreover, Hassan (1997) using diallel analysis showed the importance of GCA and SCA (additive and non-additive gene effects) in the inheritance of number of kernels/spike, 1000-kernel weight and grain yield/plant.

In addition, El-Beially and El-Sayed (2002) and Mostafa (2002) found that additive and non-additive gene effects were significant for number of spikes/plant, number of kernels/spike, 1000-kernel weight, plant height, spike length, flag leaf area and grain yield/plant.

Heterosis in wheat has not been exploited yet, although several authors detected significant heterosis in most crosses of wheat for yield and its attributes as reported by Walia *et al.* (1993), their results indicated that such crosses are most beneficial and may produce transgressive segregates.

The main objectives of this study were to asses the magnitude of both GCA and SCA as well as heterosis for grain yield and other agronomic characters in some wheat crosses.

MATERIALS AND METHODS

The present study was carried out at El-Giza Agricultural Research Station, Agricultural Research Center (ARC), during the three successive seasons 2001/2002, 2002/2003 and 2003/2004. Names and pedigrees of the five local bread wheat cultivars and the exotic one selected for this study, are presented in Table 1.

In 2001/2002 season, all possible combinations of crosses without reciprocals among the six parents were made. In 2002/2003, the 15 obtained hybrids and the six parents were sown in a randomized complete block design (RCBD) with four replications according to Steel and Torrie (1980). In 2003/2004, the same parents and their F_2 crosses were sown using the RCBD with four replications for evaluation.

Each plot consisted of three rows, for parents and F_1 and six rows for F_2. Each row was three meters long and 30 cm apart, and plants within row was 20 cm apart.

Data were recorded on 25, 25 and 50 individual guarded plants, chosen at random from each plot for parents, F_1 and F_2, respectively, for plant height (PH), flag leaf area (FLA), number of spikes/plant (S/P), number of kernels/spike (K/S), 100-Kernel weight (100-K wt), grain yield/plant (GY/P) Straw yield plant (St. Y/P), grain production rate (GPR) (gm/day) and harvest index (HI).

General and Specific combining ability were obtained by employing Griffing (1956) diallel cross analysis method 2 model 1. Heterosis effect was computed as the percentage deviation of F_1 or F_2 mean performance from either mid-or better parent values according to Wynne *et al.* (1970).

Table 1. Name, Pedigree and Origin of the Six Parents Used in the Diallel Study

No.	Cultivar	Cross Name and pedigree	Origin
1	Giza 163	T. aest/Bon//Con/ 7C. CM-33027-F-15M-4Y-2Y-1M-1M-0-MS.	Egypt
2	Giza 168	MRL/BUC//SERI. CM93046-8M-0Y-0M-2Y-0B-0GZ.	Egypt
3	Giza 170	Kauz // Altra 84 / Aos. CM 11163 - 6M-020Y - 010M-010Y-010Y-2Y-0M.	Egypt
4	Sakha 93	Sakha 92 / TR810328 S. 8871-1S-2S-1S-0S .	Egypt
5	Gemmeiza 9	ALD "s" / HUAC//CMH74A. 630/SX CGM4583 - 5GM - 1GM - 0GM.	Egypt
6	IRENA		Mexico

RESULTS AND DISCUSSION

1) Analysis of Variance

The mean performance of the six wheat parental cultivars is presented in Tables 2 and 3 for F_1 and F_2, respectively. The results showed that there were significant differences among parents and in the F_1, F_2 generations of the crosses.

The analysis of variance for all the studied characters is presented in Table 4. Significant genotypes mean squares were detected for all studied characters indicating the wide diversity among the parental materials used in the present study. Results also showed that mean squares due to parents were significant for all studied characters, except for grain production rate in the F_1, number of kernels/spike as well as straw yield/plant in the F_2. Data presented in Table 4 showed also that crosses mean squares were significant for all the studied characters, except for harvest index in the F_1, revealing overall differences between hybrids.

Significance of the general combining ability (GCA), and specific combining ability (SCA), indicated the presence of both additive and non-additive types of gene effects in the genetic system controlling these characters in these materials.

Table 2. Mean Performance of Parents and F_1 for the Studied Characters in Six Diallel crosses

No.	Parents and crosses	PH	FLA	S/P	K/S	100-K Wt	St. Y/P	H I %	G P R	G Y/P
1	Giza 163 (P_1)	108.91	59.87	29.74	67.25	4.98	114.98	34.32	1.51	59.46
2	Giza 168 (P_2)	102.09	66.68	23.52	57.74	4.04	105.57	40.15	1.23	65.52
3	Giza 170 (P_3)	92.68	60.37	23.06	86.03	3.61	97.29	36.89	1.31	57.44
4	Sakha 93 (P_4)	91.45	61.36	20.74	67.50	4.30	90.94	43.16	1.14	58.09
5	Gemmeiza 9 (P_5)	107.09	72.80	26.00	64.81	4.60	155.87	23.20	1.04	46.96
6	Irena (P_6)	104.10	63.10	23.19	68.98	4.30	113.74	30.84	1.22	50.80
7	$P_1 \times P_2$	104.30	67.36	21.80	72.56	4.42	93.82	41.25	1.24	63.02
8	$P_1 \times P_3$	102.49	63.20	21.81	72.71	4.31	98.10	34.64	1.10	51.16
9	$P_1 \times P_4$	106.26	69.12	19.85	70.25	4.81	86.60	35.10	0.96	45.54
10	$P_1 \times P_5$	100.43	74.21	15.46	75.40	4.64	77.14	36.54	0.86	42.51
11	$P_1 \times P_6$	105.01	69.96	21.22	73.13	4.30	100.36	35.26	1.15	53.68
12	$P_2 \times P_3$	98.07	65.05	20.04	69.85	4.31	92.83	39.78	1.19	57.89
13	$P_2 \times P_4$	99.06	63.80	21.12	71.80	5.08	106.20	38.62	1.25	63.65
14	$P_2 \times P_5$	110.39	71.03	21.68	80.22	4.80	107.98	34.58	1.33	58.10
15	$P_2 \times P_6$	106.13	66.18	20.73	71.52	4.55	100.09	35.08	1.11	54.26
16	$P_3 \times P_4$	103.50	69.55	28.00	89.00	3.96	159.81	32.64	1.61	71.69
17	$P_3 \times P_5$	96.62	65.60	20.06	77.54	4.48	102.90	35.59	1.16	54.25
18	$P_3 \times P_6$	103.89	57.39	20.78	58.39	4.64	114.16	34.22	1.19	54.04
19	$P_4 \times P_5$	104.08	65.64	18.28	69.81	5.29	104.90	36.13	1.22	57.48
20	$P_4 \times P_6$	99.83	69.32	22.94	85.18	5.21	106.65	47.72	1.63	77.04
21	$P_5 \times P_6$	107.13	66.48	19.98	75.19	4.83	106.70	36.12	1.25	55.82
	Mean	102.55	66.10	21.90	72.61	4.55	106.51	36.28	1.22	57.07
	L.S.D 5%	5.53	7.45	4.32	12.14	0.39	32.12	9.97	0.32	14.82

Table 3. Mean Performance of Parents and F_2 Crosses for the Studied Characters in Six Diallel Crosses

No.	Parents and crosses	PH	FLA	S/P	K/S	100-K Wt	St. Y/P	H I %	G P R	G Y/P
1	Giza 163 (P_1)	118.75	63.80	13.15	49.30	4.32	148.33	15.44	0.46	26.11
2	Giza 168 (P_2)	110.75	67.10	10.10	54.90	4.27	140.67	12.71	0.34	20.43
3	Giza 170 (P_3)	106.35	68.95	8.60	51.95	3.43	139.38	9.93	0.25	15.34
4	Sakha 93 (P_4)	115.25	64.95	9.60	51.60	3.96	127.01	13.16	0.28	17.02
5	Gemmeiza 9 (P_5)	101.35	68.08	8.25	53.60	3.84	186.79	7.91	0.26	16.04
6	Irena (P_6)	100.95	67.90	9.50	46.70	3.82	150.45	8.54	0.24	14.09
7	$P_1 \times P_2$	97.25	68.65	5.46	36.55	4.82	143.36	7.33	0.19	10.98
8	$P_1 \times P_3$	97.80	73.98	9.50	51.45	4.08	132.14	11.72	0.29	17.12
9	$P_1 \times P_4$	99.12	76.25	14.62	52.82	4.78	112.23	15.56	0.34	19.90
10	$P_1 \times P_5$	104.10	69.40	8.80	52.40	4.32	102.97	12.61	0.25	14.18
11	$P_1 \times P_6$	106.45	66.82	11.00	45.45	4.12	138.21	11.11	0.26	15.84
12	$P_2 \times P_3$	107.70	62.77	8.75	40.60	4.24	127.40	12.88	0.30	18.32
13	$P_2 \times P_4$	104.35	69.20	9.15	42.50	3.75	148.38	10.21	0.30	16.48
14	$P_2 \times P_5$	97.60	67.70	9.90	47.50	4.64	93.04	14.06	0.41	23.04
15	$P_2 \times P_6$	108.35	70.80	8.90	39.20	3.30	139.30	9.85	0.26	15.06
16	$P_3 \times P_4$	106.90	65.78	10.95	47.30	3.96	208.75	10.72	0.40	22.75
17	$P_3 \times P_5$	111.75	66.90	10.28	44.39	4.38	134.82	11.75	0.28	17.33
18	$P_3 \times P_6$	98.70	68.88	9.18	39.92	4.26	192.37	11.72	0.32	18.32
19	$P_4 \times P_5$	105.00	67.73	9.70	48.75	4.50	137.92	13.74	0.39	21.71
20	$P_4 \times P_6$	102.00	70.97	7.20	40.20	5.07	168.27	9.38	0.27	15.50
21	$P_5 \times P_6$	105.45	73.37	5.75	39.57	3.48	142.31	9.79	0.26	15.21
	Mean	105.04	68.57	9.44	46.51	4.16	143.53	11.43	0.31	17.66
	L.S.D 5%	7.02	6.45	2.06	9.24	0.44	46.53	4.10	0.06	3.75

Table 4. Mean Squares Analysis for the Studied Characters in the F_1 and F_2 for the Diallel Crosses .

S. O. V.	d. f	PH	FLA	S/P	K/S	100-K Wt.	St. Y/P	H I %	G P R	G Y/P
F_1 hyprids										
Genotypes	20	97.34*	75.55*	39.31*	255.75*	0.70*	1512.57*	93.54*	0.140*	266.19*
Parents	5	216.67*	98.20*	38.76*	360.19*	0.88*	2104.43*	202.48*	0.103	173.50
Crosses "F_1"	15	52.56*	58.40*	25.82*	189.90*	0.51*	1218.90*	52.07	0.152*	296.02*
P. Vs. F_1	1	75.14*	144.01*	205.08*	465.54*	1.94*	1445.67	77.31	0.002	15.98
GCA	5	200.82*	119.28*	9.11*	200.34*	1.25*	938.01	160.31*	0.077*	387.62*
SCA	15	62.85*	60.97*	49.38*	274.22*	0.512*	1704.08*	71.28*	0.161	225.71*
Error	60	15.28	27.77	9.34	73.70	0.08	515.74	49.70	0.050	109.90
GCA / SCA		3.20	1.96	0.18	0.73	2.44	0.55	2.249	0.478	3.53
F_2 crosses										
Genotypes	20	135.95*	42.15*	16.94*	126.05*	0.86*	2060.36*	21.02	0.018*	51.31*
Parents	5	213.98*	15.98	12.21*	35.13	0.43*	1660.92	34.83*	0.030*	78.87*
Crosses "F_2"	15	76.64*	43.83*	18.12*	104.00*	0.90*	2131.89*	16.36*	0.014*	41.52*
P. Vs. F_2	1	499.58*	105.75	5.98	785.24*	1.57*	924.351	0.79	0.001	8.93
GCA	5	43.91*	11.21	18.08*	129.15*	0.69*	934.99	24.95*	0.011*	33.24*
SCA	15	166.64*	52.46*	16.56*	125.01*	0.92*	2435.49*	19.71*	0.020*	57.33*
Error	60	24.66	20.79	2.13	42.68	0.10	1082.52	8.41	0.002	7.05
GCA / SCA		0.264	0.21	0.31	1.03	0.75	0.384	1.27	5.500	0.58

* Significant at 5%

The ratio of GCA/SCA, were more than unity in most studied characters suggesting that additive gene effects were more important than the non-additive ones in the expression of these traits. However, a lower ratio of GCA/SCA than unity was observed for some characters in the F_1 and F_2 indicating that non-additive gene effects play an important role in the inheritance of these characters (Table 4).

These results are in line with those obtained by Ikram and Tanah (1991), El-Beially and El-Sayed (2002) and Mostafa (2002).

2) Heterosis

The values of heterosis estimates for nine studied characters are given in Tables 5 and 6 for F_1 and F_2, respectively. The results showed that the heterosis values were significantly different among hybrids for plant height, it ranged from -7.01 for cross P_1xP_5 to 12.42% for cross P_3xP_4 as mid-Parents and from -9.78 for cross P_3xP_5 to 11.67 % for cross P_3xP_4 as better parent in the F_1 and from -15.28 for cross P_1xP_4 to 7.61% for cross P_3xP_5 as mid-parent and from -18.10 for cross P_1xP_2 to 5.08% for cross P_3xP_5 as better-parent in the F_2 generation. For flag leaf area, 6 and crosses were significant and positive as mid-parents and 4 and 3 crosses were significant and positive as better-parents in the F_1 and F_2, respectively.

Table 5. Mid- and Better-Parents Heterosis (%) for Studied Characters in the F_1 Crosses.

No.	crosses	PH		FLA		S/P		K/S		100-K Wt.		St. Y/P		H I %		G P R		G Y/P	
		M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P
1	$P_1 \times P_2$	-1.14	-4.23	6.46*	1.02	-18.14*	-26.70*	7.61	7.90	-2.00*	-11.24*	-14.92	-18.40	10.78*	2.74	-9.49*	-17.88*	0.85	-3.82
2	$P_1 \times P_3$	1.68	-5.89*	5.12	4.69	-17.39*	-26.66*	-5.13	-15.48*	0.35*	-13.45*	-7.57	-14.68	-2.71	-6.10	-21.98*	-27.15*	-12.47	-13.96
3	$P_1 \times P_4$	6.07*	-2.43	14.03*	12.65*	-21.35*	-33.25*	4.27	4.07	3.66*	-3.41*	-15.89	-24.68	-9.40*	-18.67	-27.55*	-36.42*	-22.52*	-23.41*
4	$P_1 \times P_5$	-7.01*	-7.79*	11.87*	1.94	-44.53*	-48.02*	14.19*	12.12	-3.13*	-6.83*	-43.04*	-50.51*	27.05*	6.47*	-32.55*	-43.05*	-20.11*	-28.51*
5	$P_1 \times P_6$	-1.40	-3.59	13.78*	10.87*	-19.82*	-28.65*	7.36	6.02	-7.33*	-13.65*	-12.24	-12.72	8.22	2.74	-15.75*	-23.84*	-2.63	-9.72
6	$P_2 \times P_3$	0.70	-3.94	2.40	-2.43	-13.95*	-14.80*	-2.83	-18.81*	12.68*	6.68*	-8.48	-12.07	3.27	-0.92	-6.30*	-9.16*	-5.84	-11.64
7	$P_2 \times P_4$	2.37	-2.97	-0.34	-4.32	-4.56*	-10.20*	14.66*	6.37	21.82*	18.14*	8.09	0.60	-7.29	-10.52*	5.48*	1.63*	2.98	-2.85
8	$P_2 \times P_5$	5.54*	3.08	1.85	-2.43	-12.44*	-16.62*	10.62*	23.78*	11.11*	4.35*	-17.40	-30.72	9.17*	-13.87*	17.18*	8.13*	3.31	-11.32
9	$P_2 \times P_6$	2.94	1.95	1.99	-0.75	-11.24*	-11.86*	12.88*	3.68	9.11*	5.81*	-8.72	-12.00	-1.17	-12.68*	-9.39*	-9.76*	-6.70	-17.18*
10	$P_3 \times P_4$	12.42*	11.67*	14.27*	13.35*	27.85*	21.42*	15.94*	3.45	0.13	-7.91*	69.80*	64.26*	-18.45*	-24.37*	31.43*	22.90*	24.11*	23.41*
11	$P_3 \times P_5$	-3.27	-9.78*	-1.48	-9.89*	-18.22*	-22.85*	2.81	-9.87	9.14*	-2.61*	-18.71	-33.98*	18.46*	-3.52	-1.28*	-11.45*	3.93	-5.55
12	$P_3 \times P_6$	5.59*	-0.20	-7.04*	-9.05*	-10.14*	-10.39*	-24.66*	-32.13*	17.32*	7.91*	8.19	0.37	1.05	-7.24	-5.93*	-9.16*	-0.15	-5.92
13	$P_4 \times P_5$	4.84*	-2.81	-2.15	-9.84	-21.78*	-29.69*	5.52	3.42	18.88*	15.00*	-15.00	-32.70*	8.89*	-16.29*	11.93*	7.02*	9.43	-1.05
14	$P_4 \times P_6$	2.10	-4.10	11.39*	9.86*	4.44*	-1.08	24.82*	23.48*	21.16*	21.16*	4.21	-6.23	28.97*	10.56*	38.14*	33.61*	41.50*	32.62*
15	$P_5 \times P_6$	1.45	0.04	-2.16	-8.68	-18.76*	-23.15*	12.40*	6.21	8.54*	5.00*	-20.85	-31.54	33.68*	17.12*	1.28*	2.46*	14.20*	9.88
	L.S.D 5%	4.79	5.53	6.45	7.45	3.74	4.32	10.51	12.14	0.34	0.39	27.81	32.12	8.63	9.97	0.27	0.32	12.84	14.82

* Significant at 5%

Table 6. Mid- and Better-Parents Heterosis (%) for the Studied Characters in the F_2 Crosses .

No.	crosses	PH		FLA		S/P		K/S		100-K Wt.		St. Y/P		H I %		G P R		G Y/P	
		M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P
1	$P_1 \times P_2$	-15.25*	-18.10*	4.89	2.31	-53.03*	-58.48*	-29.85*	-33.42*	12.22*	11.57*	-0.78	-3.35	-47.92*	-52.52*	-52.50*	-58.70*	-52.81*	-57.95*
2	$P_1 \times P_3$	-13.10*	-17.64*	11.46*	7.30*	-12.64*	-27.76*	1.63	-0.96	5.29*	-5.56*	-8.14	-10.91	-7.61*	-24.09*	-18.31*	-36.96*	-17.39*	-34.43*
3	$P_1 \times P_4$	-15.28*	-16.53*	18.45*	17.40*	28.53*	11.18*	4.70	2.36	15.46*	10.65*	-8.48	-24.34	8.81*	0.78	-8.11*	-26.09*	-7.72*	-23.78*
4	$P_1 \times P_5$	-5.41	-12.34*	5.25	1.94	3.22*	-33.08*	1.85	-2.24	5.98*	0.00	-38.56	-44.88	8.01*	-18.33*	-30.56*	-45.65*	-32.72*	-45.69*
5	$P_1 \times P_6$	-3.10	-10.36*	1.47	-1.59	-2.87*	-16.35*	-5.31	-7.81	1.23*	-4.63*	-7.48	-8.14	-7.42*	-28.11*	-25.71*	-43.48*	-21.19*	-39.33*
6	$P_2 \times P_3$	-0.78	-2.75	-7.72*	-8.96*	-6.42*	-13.37*	-24.00*	-26.05*	10.13*	-0.70*	-9.01	-9.43	13.78*	1.34	1.69*	-11.76*	2.43	-10.33*
7	$P_2 \times P_4$	-7.65*	-9.46*	4.81	3.13	-7.11*	-9.40*	-20.19*	-22.59*	-8.87*	-12.18*	10.87	5.49	-21.07*	-22.42*	-3.22*	-11.76*	-11.99*	-19.33*
8	$P_2 \times P_5$	-7.97*	-11.87*	0.16	-0.56	7.90*	-1.98	-12.44*	-13.48*	14.43*	8.66*	-12.63	-23.42	36.37*	10.62*	36.67*	20.58*	26.35*	12.78*
9	$P_2 \times P_6$	2.36	-2.17	4.89	4.27	-9.18*	-11.88*	-22.83*	-28.60*	-18.42*	-22.72*	-4.30	-7.41	-7.29*	-22.50*	-10.34*	-23.53*	-12.75*	-26.28*
10	$P_3 \times P_4$	-3.52	-7.24*	-1.75	-4.60	20.33*	14.06*	-8.64*	-8.95	7.17*	0.00	56.72*	49.77*	-7.14*	-18.54*	50.94*	42.86*	40.60*	33.67*
11	$P_3 \times P_5$	7.61*	5.08	-2.36	-2.97	22.02*	19.53*	-15.89*	-17.18*	20.50*	14.06*	-17.33	-27.82	31.73*	18.33*	9.80*	7.69*	10.45*	8.04*
12	$P_3 \times P_6$	-4.78	-7.19*	0.66	-0.10	1.44	-3.37*	-19.07*	-23.16*	17.52*	11.52*	-1.76	-5.37	26.91*	18.03*	30.61*	28.00*	24.50*	19.43*
13	$P_4 \times P_5$	-3.05	-8.89*	1.83	-0.51	8.68*	1.04	-7.32	-9.05	15.38*	13.64*	-12.10	-26.16	30.42*	4.41*	44.44*	39.28*	31.34*	27.56*
14	$P_4 \times P_6$	-5.64	-11.50	6.84*	4.52	-24.61*	-25.00*	-18.21*	-22.09*	30.33*	28.03*	21.29	11.84	-13.64*	-28.80*	3.85*	-3.57*	-0.35	-8.93*
15	$P_5 \times P_6$	4.25	4.04	7.91*	7.77*	-35.21*	-39.47*	-21.10*	-26.18*	-9.14*	-9.38*	-15.60	-23.81	19.03*	14.64*	4.00*	0.00	0.96	-5.17*
	L.S.D 5%	6.08	7.02	5.58	6.45	1.79	2.06	8.00	9.24	0.38	0.44	40.30	46.53	3.55	4.10	0.06	0.06	3.25	3.75

* Significant at 5%

The hybrid vigor in number of spikes/plant ranged from -44.53 for cross P_1xP_5 to 27.85% for cross P_3XP_4 in the F_1 and from -53.03 for cross P_1xP_2 to 28.53% for cross P_1xP_4 in the F_2 as mid-parents and from -48.02 for cross P_1xP_5 to 21.42% for cross P_3xP_4 in the F_1 and from -58.48 for cross P_1xP_2 to 19.53 % for cross P_3xP_5 in the F_2 as better-parents. On the other hand heterosis for number of kernels/spike varied from 24.82 for cross P_4 xP_6 to -24.66% for P_3xP_6 for F_1 and from 4.7 for cross P_1xP_4 to -29.85 for cross P_1xP_2 in the F_2 as mid-parents and from 23.78 for cross P_2xP_5 to -18.81% for cross P_2xP_3 in the F_1 and from 2.36 for cross P_1xP_4 to -33.42% for cross P_1xP_2 in the F_2 as better-parents. For 100-kernel weight the hybrid vigor varied from -7.33 for cross P_1xP_6 to 21.82% for cross P_2xP_4 in the F_1 and from -18.42 for cross P_2xP_6 to 30.33 % for cross P_4xP_6 in the F_2 as mid-parents and from -13.65 for cross P_1xP_6 to 21.15 for cross P_4xP_6 in the F_1 and from -22.72 for cross P_2xP_6 to 28.03 for cross P_4xP_6 in the F_2 as better parent.

For heterosis values for straw yield/plant only one cross (P_3xP_4), was positive and significant for mid and better parents in the F_1 and F_2 generations. For harvest index seven and two crosses in the F_1 and eight and five crosses in the F_2 were positive and significant for mid and better parents heterosis, respectively. On the other hand in the grain production rate the heteroisis values were significant and positive in six and five crosses for F_1 and eight and five crosses for F_2 as mid and better parents.

Meanwhile for grain yield/plant crosses P_3xP_4 , P_4xP_6 and P_5xP_6 in the F_1 and crosses P_2XP_5, P_3XP_4, P_3XP_5, P_3XP_6 and P_4XP_5 in the F_2 were significant and positive for mid-parents. On the other hand crosses P_3xP_4 and P_4xP_6 in the F_1 and P_2xP_5 , P_3xP_4, P_3xP_5, P_3xP_6 and P_4xP_5 in the F_2 were positive and significant for better-parents.

3) General combining ability (GCA)

GCA effect for the studied characters in the F_1 and F_2 generations are presented in Table 7. With respect to plant height three parents in the F_1, Giza 163, Gemmeiza 9 and Irena and two parents in the F_2, Giza 163 and Sakha 93 were positive and significant for GCA effects. For flag leaf area Gemmeiza 9 was good combiner for these characters in the F_1. Irena was good combiner for flag leaf area in the F_2 On the other hand, Giza 163 and Giza 170 in the F_1 and Giza 163 and Sakha 93 in the F_2. so Giza 163 was good combiner for this character. For number of kernels/spike two parents Giza 170 and Sakha 93, in the F_1 and Giza 163, Sakha 93 and Gemmeiza 9 in the F_2 were positive and significant, so, these parents considered good combiner for number of kernels/spike. On the other hand, Giza 163 and Sakha 93 are good combiners for 100-kernels weight. For the straw yield Giza 168 and Sakha 93 were positive and significant in the F_2. Giza 168 and Sakha 93 in the F_1 and F_2 were good combiners for harvest index. On the other hand Giza 163 and Sakha 93 in the F_1 and Giza 163 in the F_2 had the highest positive and significant values of GCA for grain yield/plant.

Table 7. General Combining Ability (GCA)effects of wheat parents for the Characters Studied in the F_1 and F_2 for the Diallel Crosses .

No.			PH	FLA	S/P	K/S	100-K Wt.	St. Y/P	H I %	G P R	G Y/P
	F_1 hyprids										
1	Giza 163 (P_1)		2.309*	0.112	0.784*	-1.217	0.076*	-9.891*	-0.315	-0.029	-3.080
2	Giza 168 (P_2)		0.536	0.512	-0.116	-3.355*	-0.072*	-2.738	1.959*	0.003	3.562*
3	Giza 170 (P_3)		-3.488*	-2.645*	0.434*	3.909*	-0.362*	2.443	-0.412	0.037	0.554
4	Sakha 93 (P_4)		-2.774*	-0.317	-0.206	1.593*	0.142*	3.108	2.821*	0.048	4.014*
5	Gemmeiza9 (P_5)		1.873	3.234	-0.733*	-0.064	0.177*	3.743	-3.571*	-0.083*	-4.673*
6	IRENA (P_6)		1.544*	-0.897	-0.163	-0.866	0.039	3.334	-0.480	0.024	-0.377
	L.S.D 5%	gi	0.631	0.850	0.363	1.385	0.045	5.309	1.138	0.036	1.692
		gi- gj	0.977	1.317	0.764	2.146	0.069	8.225	1.762	0.056	2.621
	F_2 crosses										
1	Giza 163 (P_1)		0.865*	0.329	1.197*	1.465*	0.206*	-0.315	1.145*	0.017	0.831*
2	Giza 168 (P_2)		0.180	-0.834*	-0.469*	-1.175*	0.021	1.959*	-0.036	0.002	0.143
3	Giza 170 (P_3)		0.030	-0.474	-0.033	0.251	-0.167*	-0.412	-0.173	-0.002	0.118
4	Sakha 93 (P_4)		1.671*	-0.021	0.589*	1.153*	0.109*	2.821*	0.736*	-0.018	0.849
5	Gemmeiza9 (P_5)		-1:089	0.158	-0.648*	1.782*	-0.013	-3.571*	-0.282	-0.000	-0.006
6	IRENA (P_6)		-1.657*	0.832*	-0.636*	-3.476*	-0.156*	-0.480	-1.390*	-0.034*	-1.936*
	L.S.D 5%	gi	0.802	0.736	0.236	1.054	0.050	1.138	0.468	0.010	0.428
		gi- gj	1.241	1.140	0.365	1.633	0.077	1.762	0.725	0.010	0.663

* Significant at 5%

Generally the variety Giza 163 was good combiner for plant height, number of spikes/plant, 100-kernel weight. Giza 168 was good combiner for grain yield/plant. Sakha 93 was good combiner for number of kernels/spike, 100-kernel weight, straw yield/plant, harvest index and grain yield/plant. Cn the other hand Gemmeiza 9 was good combiner for flag leaf area, number of Kernels/spike and 100-kernel weight. Giza 170 was good combiner for number of kernels/spike.

4) Specific Combining ability (SCA)

The results in Tables 8 and 9 showed that five crosses in the F_1 and four crosses in the F_2 showed positive and significant SCA effects for plant height. For flag leaf area P_1xP_4, P_1xP_5, P_1xP_6, P_3xP_4 and P_4xP_6 in the F_1 and P_1XP_3, P_1xP_4 , P_2xP_6 , P_5xP_6 in the F_2 showed positive and significant SCA effects. On the other hand two crosses in the F_1, P_3xP_4 and P_4xP_6 and five crosses in the F_2, P_1xP_4, P_1XP_6, P_2xP_5, P_3xP_4 , and P_3xP_5 showed positive and significant SCA effects for number of spikes/plant indicating that they had a considerable non-allelic gene effects in these combinations. For number of kernels/spike five crosses in the F_1, P_1xP_2, P_1xP_5, P_2xP_5 , P_3xP_4 and P_4xP_6 and two crosses, in the F_2 P_1xP_3 and P_1xP_4 showed positive and significant SCA effects, so segregating lines may have high number of kernels/spike. The crosses P_2xP_3 , P_2xP_4 , P_2xP_5 , P_3xP_6 , P_4xP_5 and P_4xP_6 in the F_1 and crosses P_1xP_2 , P_1xP_4 , P_2xP_3 , P_2xP_5 , P_3xP_5 , P_3xP_6 , P_4xP_5 and P_4xP_6 in the F_2 showed positive and significant SCA effects in 100-kernel weight, these results indicating these crosses contained an epistatic effect in the inheritance of this trait. For straw yield/plant crosses P_3xP_4 and P_4xP_6 in the F_1 and crosses P_1xP_2, P_1xP_5, P_3xP_5, P_4xP_6 and P_5xP_6 in the F_2 showed positive and significant SCA effects. Meanwhile five croses in the F_1, P_1xP_2, P_1xP_5, P_3xP_5 , P_4xP_6 and P_5xP_6 and another five crosses in the F_2, were P_1xP_4 , P_2xP_3 , P_2xP_5 , P_3xP_6 and P_4xP_5 showed positive and significant SCA effects for harvest index. For grain production rate crosses P_2xP_5 , P_3xP_4 and P_4xP_6 in the F_1 and crosses P_2xP_5 , P_3xP_4 P_3xP_6 and P_4xP_5 showed positive and significant SCA effects, so segregating lines may have high ratio grain production rate. Meanwhile for grain yield/plant the crosses P_1xP_2, P_3xP_4 and P_4xP_6 in the F_1 and crosses P_2xP_5 , P_3xP_4, P_3xP_6 and P_4xP_5 showed positive and significant SCA effects, these results suggesting that these crosses had non-allelic gene action for increasing grain yield/plant and could be used in the segregating generations to produce lines that have high grain yield/plant. Similar results were obtained by Dawam and Hendway (1990), Ikram and Tanah (1991), Hassan (1997), and Mostafa (2002).

Table 8. Specific Combining Ability (SCA) for the Studied Characters in the F_1 for the Diallel Crosses.

No.	crosses		PH	FLA	S/P	K/S	100-K Wt.	St. Y/P	H I %	G P R	G Y/P
1	$P_1 \times P_2$		-1.098	0.640	-0.774	4.520*	-0.133*	12.457	3.326*	0.048	5.469*
2	$P_1 \times P_3$		1.121	- 0.365	-1.315	-2.591	0.053	-3.944	-0.910	-0.133*	-3.381
3	$P_1 \times P_4$		4.182*	3.227*	-2.633*	-2.738	0.046	-24.514*	-3.686*	-0.283*	-12.461*
4	$P_1 \times P_5$		-6.303*	4.763*	-6.494*	4.068*	-0.164	-34.414*	4.147*	-0.247*	-6.804*
5	$P_1 \times P_6$		-1.389	4.646*	-1.311	2.603	-0.359*	1.240	-0.216	-0.071	0.070
6	$P_2 \times P_3$		-1.523	1.085	-2.188*	-3.313	0.195*	-15.838	1.955	-0.071	-3.295
7	$P_2 \times P_4$		-1.244	-2.489*	-0.460	0.953	0.463*	4.477	-2.437	-0.025	-0.990
8	$P_2 \times P_5$		5.431*	1.185	0.626	11.027*	0.153*	-1.498	-0.081	0.190*	2.139
9	$P_2 \times P_6$		1.499	0.466	-0.896	3.132	0.036	-4.826	-2.672	-0.143*	-5.989*
10	$P_3 \times P_4$		7.214*	6.414*	5.868*	10.887*	-0.361*	59.669*	-6.050*	0.302*	10.055*
11	$P_3 \times P_5$		-4.316*	-1.085	-1.548*	1.083	0.119	-14.899*	3.299*	-0.023	1.304
12	$P_3 \times P_6$		3.283*	-5.169*	-1.393*	-17.267*	0.422*	-6.932	-1.164	-0.094	-3.209
13	$P_4 \times P_5$		2.436*	-3.375*	-2.686*	-4.334*	0.422*	-12.458	0.601	0.032	1.070
14	$P_4 \times P_6$		-1.485	4.438*	1.405*	11.838*	0.485*	18.298*	9.100*	0.337*	16.339*
15	$P_5 \times P_6$		1.165	-1.961	-1.024	3.505	0.065	-8.294	3.893	0.085	3.808
	L.S.D 5%	Sij	1.733	2.336	1.354	3.804	0.122	14.582	3.125	0.099	4.646
		Sij - sik	2.586	3.486	2.021	5.678	0.182	21.762	4.663	0.148	6.934
		Sij - skl	2.393	3.227	1.871	5.257	0.169	20.148	4.317	0.137	6.419

* significant at 5%

Table 9. Specific Combining Ability (SCA) for the Studied Characters in the F_2 for the Diallel Crosses.

No.	crosses		PH	FLA	S/P	K/S	100-K Wt.	St. Y/P	H I %	G P R	G Y/P
1	$P_1 \times P_2$		-8.839*	0.575	-4.710*	-10.248*	0.429*	3.326*	-5.212*	-0.132*	-7.646*
2	$P_1 \times P_3$		-8.139*	5.540*	-1.109*	3.226*	-0.116	-0.910	-0.689	-0.027*	-1.483*
3	$P_1 \times P_4$		-8.354*	7.362*	3.394*	3.699*	0.303*	-3.686*	2.242*	0.000	0.568
4	$P_1 \times P_5$		-0.720	0.334	-1.193*	2.645	-0.032	4.147*	0.316	-0.071*	-4.299*
5	$P_1 \times P_6$		2.099	-2.915*	0.994*	0.953	-0.094	-0.216	-0.086	-0.030	-0.717
6	$P_2 \times P_3$		2.446*	-4.495*	-0.193	-4.983*	0.227*	1.955	1.655*	-0.004	0.408
7	$P_2 \times P_4$		-2.445*	1.485	-0.415	-3.985*	-0.542*	-2.437	-1.926*	-0.028*	-2.174*
8	$P_2 \times P_5$		-6.536*	-0.194	1.573*	0.386	0.469*	-0.081	2.949*	0.108*	5.242*
9	$P_2 \times P_6$		4.683*	2.232*	0.560	-2.658	-0.718*	-2.672	-0.159	-0.015	-0.806
10	$P_3 \times P_4$		0.255	-2.301*	0.949*	-0.611	-0.144*	-6.050*	-1.272	0.082*	4.129*
11	$P_3 \times P_5$		7.764*	-1.354	1.512*	-4.153*	0.399*	3.299*	0.772	-0.016	-0.438
12	$P_3 \times P_6$		-4.817*	-0.045	0.399	-3.360*	0.419*	-1.164	1.848*	0.057*	2.484*
13	$P_4 \times P_5$		-0.526	-0.974	0.315	-0.692	0.250*	0.601	1.851*	0.068*	3.210*
14	$P_4 \times P_6$		-3.058*	1.586	-2.198*	-3.984*	0.958*	9.100*	-1.404	-0.014	-1.073
15	$P_5 \times P_6$		3.052*	3.806*	-2.410*	-5.243*	-0.512*	3.893*	0.028	-0.006	-0.502
	L.S.D 5%	Sij	2.201	2.021	0.647	2.895	0.137	3.125	1.285	0.020	1.177
		Sij - sik	3.285	3.016	0.966	4.282	0.204	4.663	1.918	0.030	1.756
		Sij - skl	3.041	2.792	0.894	4.000	0.189	4.317	1.776	0.028	1.626

* Significant at 5%

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التربية للمحصول ومكوناته وبعض الصفات المحصولية في قمح الخبز

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البرنامج القومي لبحوث القمح – معهد بحوث المحاصيل الحقلية – مركز البحوث الزراعية – الجيزة – مصر

أجـــرى هذا البحث في محطة بحوث الجيزة – مركز البحوث الزراعية خلال ثلاثة مواسم زراعـــية متتالـــية هي ٢٠٠١/٢٠٠٢ و ٢٠٠٢/٢٠٠٣ و ٢٠٠٣/٢٠٠٤ بهدف دراسة قوة الهجين والقـــدرة علـــي الائـــتلاف لتحديد أفضل الآباء والهجن التي يمكن إدخالها في برامج التربية لبعض الصفات الاقتصادية في القمح .

وقـــد اســـتخدمت في هذه الدراسة ستة أصناف من قمح الخبز ، خمسة أصناف محلية هي جيزة ١٦٣ – جيزة ١٦٨ – جيزة ١٧٠ – سخا ٩٣ – جميزة ٩ وصنف سادس مستورد وهو إرينا . وقـــد تـــم عمل كل التهجينات الممكنة بين هذه الآباء مع استبعاد الهجن العكسية في موسم ٢٠٠١/ ٢٠٠٢ ، ثم تمت زراعة الآباء والجيل الأول للخمسة عشر هجيناً الناتجة في موسم ٢٠٠٢/٢٠٠٣ ، ونفـــس الآبـــاء والجـــيل الثاني لنفس الهجن في موسم ٢٠٠٣/٢٠٠٤ باستخدام تصميم القطع كاملة العشوائية في ٤ مكررات .

وقـــد درست الصفات الآتية : طول النبات و مساحة ورقة العلم و عدد السنابل في النبات و عـــدد حبوب السنبلة و وزن الـــ ١٠٠ حبة و محصول القش للنبات و دليل الحصاد و معدل امتلاء الحبوب و محصول الحبوب للنبات .

وأوضـــحت النتائج أن التباين الراجع للآباء والهجن كان معنوياً لكل الصفات محل الدراسة وكان التباين الراجع للتفاعل المشترك بين الآباء والجيل الأول أو الآباء والجيل الثاني معنوياً لأغلب الصفات محل الدراسة .

كـــان الصنفان جيزة ١٦٨ و جيزة ١٦٣ هما أعلى الآباء في محصول النبات من الحبوب وكذلـــك الهجـــن P_2xP_1 (جيزة ١٦٣ × جيزة ١٦٨) ، P_4xP_2 (جيزة ١٦٨ × سخا ٩٣) ، P_4xP_3 (جيزة١٧٠×سخا ٩٣) في الجيل الأول وفي الجيل الثاني P_4xP_1 (جيزة ١٦٣ × جميزة ٩) ، P_5xP_2 (جيزة١٦٨ × جميزة ٩) ، P_4xP_3 (جيزة ١٧٠ × سخا ٩٣) .

أظهرت قوة الهجين أن الهجين P_4xP_3 (جيزة ١٧٠ × سخا ٩٣) هو أفضل الهجن في قوة الهجيـــن بالنســـبة لصفة محصول الحبوب في الجيل الأول والثاني كذلك أظهرت نتائج تحليل التباين معـــنوية كـــل مـــن القـــدرة العامة(GCA) والخاصة (SCA)علي الائتلاف بما يوضح أثر فعل الجين الإضـــافي والســـائد علـــي صفات الدراسة . وكانت النسبة بين GCA/SCA أكبر من الوحدة لأغلب الصـــفات محـــل الدراســـة ممـــا يوضـــح أهمية فعل الجين الإضافي مقارنة بالفعل السائد للجين .