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GENETICAL STUDY ON SOME BREAD WHEAT CROSSES

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ABSTRACT

The objective of this study was to investigate general and specific combining ability, degree of dominance (potence ratio), heterosis and inbreeding depression for yield and its components, in six parents diallel crosses. The bread wheat genotypes were three newly released cultivars, Sakha 94, Gemmeiza 10 and Giza 170 and Line 5, Line 42, and Line 23. All traits exhibited predomination of non-additive gene action through low ratios of

GCA / SCA except 100 kernel weight. The best two combiners were one of the newly released cultivars, (Gemmeiza 10) for grain yield, , number of spikes / plant, number of kernels / spike, 100 kernel weight, and plant height, and one promising line;(Line 5) for number of spikes / plant, 100 kernel weight and plant height.

The best promising crosses to utilize non-additive gene action were five, i.e. $P_1 \times P_5$, $P_2 \times P_5$, $P_2 \times P_6$, $P_3 \times P_6$ and $P_4 \times P_5$ for grain yield / plant and at least one of yield components. Potence ratio showed different degrees of dominance in different directions, but averaged positively overdominance for all characters, except 100 kernel weight which gave negative average. Significantly positive heterosis were recorded for all the characters, ranging within (3.03-18.09 %) for tallness, (7.59-64.09 %) for number of spikes / plant, (6.19 - 25.23 %) for number of kernels / spike , (22.64 -137.95 %) for grain yield / plant, (41.30 - 114.63 %) for total plant weight, and (15.41 %) for 100 Kernel weight.

The study could relate heterosis to non-additive gene effect as main effects or epistasis utilizing such effects.

All these figures reflected the overdominance recorded for all the characters through potence ratio. On the other hand, all characters express considerable inbreeding depression in F_2 population ranging within (7-18 %) for plant height, as compared to (14 - 48 %), (13 - 39 %), (14 -22 %), (23 - 62 %), and (22 - 54 %) for number of spikes, number of kernels, 100 kernel weight, plant grain yield and total plant weight, respectively.

INTRODUCTION

Wheat (*Triticum aestivum L.*) is one of the major cereal crops in Egypt, which receives the most attention of specialists in plant breeding due to increasing population and the wide gab between production and consumption. To increase grain yield per unit area, the main or the only solution for overcoming the increasing demand of food from a limited cultivated area, plant breeders would develop high yielding wheat cultivars with high resistance to both biotic and abiotic stress conditions.

Successful breeding programs need continuous information about the genetic variation and systems governing grain yield and its components. However, contradictory results were obtained by several authors in this respect. Hendawy (1990), Ikram and Tanach (1991), El Hennawy (1992), Mahmoud (1999), El-Sayed *et. al.* (2000), Hamada and Tawfelis (2001), Mostafa (2000) and El-Sayed (2004) showed that both additive and non-additive gene effects have important roles in controlling the genetic system for plant height, number of spikes/plant, number of kernels/spike, 100 kernel weight and grain yield/plant.On the other hand, El-Sayed *et. al.* (2000), Ashoush *et. al.* (2001), Abd El-Hameed (2002), and El-Sayed (2004) found that both GCA and SCA were significant for plant height.

However, Sharma and Smith (1986) as well as Salem and Hassan (1991) found that non-additive gene effects were more important in the inheritance of number of spikes/plant and grain yield/plant. Similarly, Dawam and Hendawy (1990), and Darwish (1992) found that dominance genetic effects were significant for grain yield/plant, number of kernels/spike and kernel weight. Reversely, Mekhamer (1995) recorded additive genetic effects for number of kernels/spike and 100 kernel weights.

El-Sayed (1997), applying graphical analysis, reported partial dominance for plant height, 1000 grain weight, and number of tillers/plant, complete dominance for number of tillers/plant, and number of grains/spike, and overdominance for grain yield/plant and number of grains/spike.

Azza (2005), using the variance ratio $(H_1/D)^{1/2}$, determined partial dominance for all traits, complete dominance for number of grains/spike and overdominance for total yield/plant. However, these results depended on level of nitrogen applied.

Heterosis can be recongnized as the superiority in performance of hybrid individuals compared with their better parents, (Feher, 1987).

Tamam and Abdel-Gawad (1999), and Abdel-Wahed (2001) found significant heterosis over the better parents for number of of spikes/plant, 100 kernel weight, and grain yield/plant, while Mitkees (1981) reported heterosis for number of kemels/spike, and 100 kernel weight, where Hendawy (1998) recorded significant heterosis for grain yield.

Inbreeding depression is the converse of heterosis that reflect deterioration accompanying inbreeding through the successive generation of self pollination. Estimates of inbreeding depression in F_2 generation have been reported by many workers. Moustafa (1981) and Mitkees (1981) found significantly inbreeding depression for plant height, number of spikes/plant, number of kernels/spike, 100 kernel weight and grain yield. Mohammed (1999) found that fifteen crosses showed significantly inbreeding depression for grain yield/plant.

The objectives of this investigation were to study potence ratio (degree of dominance), heterosis, and inbreeding depression in some wheat crosses and to determine the combining ability effects on plant height, grain yield and its components in a half diallel set of crosses among six bread wheat genotypes to identify the best parents and crosses useful for breeding high yielding ability cultivars.

MATERIALS AND METHODS

The field work of this investigation was conducted at Etay El-Baroud Agricultural Research Station, EL- Behera Governorate, Egypt, during the three successive growing seasons 2002/2003, to 2004/2005. Six bread wheat genotypes (three newly released cultivars and three promising lines) representing a wide range of genetic variability were selected for this study. Names, pedigrees and sources of these genotypes are presented in Table (1).

Table(1): Names, pedigrees & sources of six parents of bread wheat.

No	Variety &line	Name & Pedigree	Sources
P_1	Sakha 94	OPATA/RAYON//KAUZ. CMBW 90Y3180 – OTOPM – 3Y – 010M-- 010M – 010Y -10M – 015Y – OY – OAP – OS.	EGYPT
P_2	Gemmeiza 10	MAYA 74 "S" / ON // 1160 – 147/3/BB/GLL/4/CHAT "S" /5/ CROW "S". CGM 5820 – 3GM -1GM – 2GM – OGM.	EGYPT
P_3	Giza 170	KAUZ //ALTRA84/AOS CM11163–6M–020Y– 010M – 010Y- 010Y -2Y – 0M – OGZ.	EGYPT
P_4	Line 5	MIANYANG 20 2CHN – OCHN – OET.	CIMMYT
P_5	Line 42	2V879 – C8 – 11/G//O// V979/3/STAR/4/STAR. CMSS92YOI815T – 20Y – 010M – 010Y – IKBY – 9M – OY – OET.	CIMMYT
P_6	Line 23	OAFIS/2*BORL95. CMBY91MO2626M – OTOBY – 16M – 010Y – OET.	CIMMYT

In 2002/2003 season, all possible crosses (excluding reciprocals) among the six parents were made. In the second season (2003/2004), the 21 entries (15 F_1's and 6 parents) were planted in field experiments with three replications, Also, some of F_1 plant were selfed to obtain F_2 seeds. In 2004 /2005, F_2 and parents were planted in an experiment with three replications. The two experiments were laid out in a randomized complete block design. Each entry was planted in a plot of two rows for each parent and F_1, being six rows for each F_2 population. Every row was 3 m long and 30 cm apart, and plants within rows spaced 20 cm, i.e. 15 seeds/row.

Data were recorded on a random sample of 10 guarded plants from each row. The studied characters were plant height (cm), number of spikes/plant, number of kernels/spike, 100-kernel weight (g), grain yield/plant (g), and total plant weight (g).

Regular analysis of variance followed Steel and Torri (1980) as General and specific combining ability effects (GCA and SCA) were obtained by employing Griffing's (1956) diallel crosses analysis designated as Method 2, Model 1(fixed Model). Better parent heterosis was estimated as the percentage deviationn of F_1 mean from the better parent; i.e. $H\% = ((F_1\text{-}BP)/BP) \times 100$.

Degree of dominance, expressed as potence ratio followed the method of Smith (1952), i.e. $P = 2|F_1 - MP|/|P_2 - P_1|$.

Inbreeding depression, ID, is the converse of heterosis that reflects deterioration accompanying inbreeding through the successive generations of self pollination.This was estimated as the percentage of the difference between F_1 and F_2 generations means divided by F_1 mean; i.e.

$$ID\% = ((F_1 - F_2)/F_1) \times 100$$

RESULTS AND DISCUSSION

Analysis of variance (ANOVA):

Analysis of variance of parents and F_1 populations (Table 2), revealed significant differences among genotypes, in all characters under study. These differences could be considerably attributed to both general and specific combining ability effects. GSA / SCA ratios cleared predomination of general combining ability effects (GCA), i.e. additive gene action, on 100 kernel weight (100KW). In agreement with Mekhamer (1995) who reported significant additive genetic effects for kemel weight.

Table(2): Mean square analysis for traits studied in bread wheat crosses

Parents	d.f.	Pl. ht	#SP / P	# K / SP	100 KW	GY/ P	T. Pl. W
Blocks	2	2.1401⁻	8.8730⁻	5.7778⁻	12.0386⁻	210.6825⁻	5615.2500⁻
Genotype	20	126.6653**	48.6206**	114.1302**	55.6718**	2215.2825**	0435.1440**
G.C.A	5	190.6805**	40.8444**	127.3778**	124.9756**	797.2111**	8709.4944**
S.C.A	15	105.3136**	51.2127**	109.7143**	32.5706**	2687.9730**	2434.6944**
Error	40	2.2000	2.8730	9.0278	8.3600	198.2159	3019.1500
G.C.A/S.C.A ratio		1.8105	0.0164	1.1609	3.837*	0.2965	0.3577

Pl. ht =Plant height , # SP / P=Number of spikes / plant , # K / SP =Number of kernels / spike , 100 KW= 100 kernel weight , GY / P = Grain yield / plant , T. Pl. W = total plant weight.

Mean Performance:

The mean Performances of the six parental genotypes were presented in Table (3). The cultivar Gemmeiza 10 (P_2) was ranked the first for increased number of spikes / plant, number of kemels / spike, and grain yield / plant. The cultivar Giza 170 (P_3) was ranked the first for total plant weight while was the second for increased number of spikes and number of kemels / spike. The Line 42 (P_5) and Line 23 (P_6) were ranked the first for 100 kernel weight.

Regarding the F_1 hybrids for plant height, the tallest crosses were ; $P_2 \times P_5$, $P_3 \times P_4$, and $P_5 \times P_6$, while for number of spikes / plant, six crosses possessed the highest values; i.e. $P_5 \times P_6$, $P_2 \times P_5$, $P_4 \times P_5$, $P_2 \times P_4$, $P_3 \times P_4$ and $P_1 \times P_6$. Meanwhile, the three crosses; $P_1 \times P_5$, $P_2 \times P_4$, and $P_2 \times P_5$ possessed the highest number of kernels / spike. The three heaviest 100 kemel weight crosses were $P_2 \times P_4$, $P_4 \times P_5$ and $P_2 \times P_5$, while the four crosses; $P_1 \times P_5$, $P_2 \times P_5$, $P_2 \times P_6$ and $P_4 \times P_5$ gave the highest grain yield / plant. Finally, the crosses $P_3 \times P_6$, $P_1 \times P_5$ and $P_2 \times P_6$ possessed the highest total plant weight.

Combining ability effects:

Equal importance of both types, i.e. additive and non additive gene effects due to the unity ratio of GCA / SCA was indicated for number of kernels per spike (# K / S) and plant height (Pl. ht), being in full agreement with Hendawy (1990), Ikram and Tanach (1991), El-Henawy (1992), Mahmoud (1999), and El-Sayed *et al* (2000). Hamada and Tawfelis (2001), Mostafa (2000), and EL-Sayed (2004). Number of spikes / plant (# S / P), grain yield / plant (GY / P), and total plant weight (T.Pl.W), were completely controlled by non-additive gene action as affected greatly by variances due to SCA, similarly as reported by Sharma and Smith (1986), Salem and Hassan (1991).

Table (3) Mean performance of six varieties and their fifteen F_1's

Genotype	Pl. ht	#SP/ P	# K / SP	100 KW	GY/ P	T. Pl.W
P_1 (Sakha 94)	100.70	18.67	71.33	3.80	63.33	203.33
P_2 (Gemmieza 10)	118.33	24.67	79.00	4.89	82.67	201.67
P_3 (Giza 170)	100.67	22.00	78.00	4.45	62.33	247.00
P_4 (Line 5)	105.00	22.00	74.27	4.25	41.67	137.67
P_5 (Line 42)	110.00	21.33	64.67	5.10	45.67	205.00
P_6 (Line 23)	106.00	21.33	63.67	5.03	53.67	163.00
$P_1 \times P_2$	114.67	23.00	74.67	4.84	63.00	243.33
$P_1 \times P_3$	109.33	23.67	72.00	4.45	66.00	200.00
$P_1 \times P_4$	112.00	21.67	74.67	4.29	60.00	215.00
$P_1 \times P_5$	112.33	20.33	89.00	4.41	117.00	440.00
$P_1 \times P_6$	111.00	28.00	72.00	4.05	76.67	269.00
$P_2 \times P_3$	113.33	23.67	74.67	4.86	60.33	256.67
$P_2 \times P_4$	112.00	28.00	86.67	5.64	78.67	243.33
$P_2 \times P_5$	124.00	30.00	80.00	5.19	117.00	289.67
$P_2 \times P_6$	111.67	25.33	77.67	4.72	112.33	360.00
$P_3 \times P_4$	124.00	28.00	72.00	4.63	73.00	280.00
$P_3 \times P_5$	113.33	26.00	70.00	4.32	63.00	205.00
$P_3 \times P_6$	101.00	23.67	79.33	4.74	76.33	475.00
$P_4 \times P_5$	114.67	29.67	74.67	5.21	108.67	266.67
$P_4 \times P_6$	109.33	20.33	71.33	4.70	59.00	235.33
$P_5 \times P_6$	116.00	35.00	68.67	4.50	58.67	163.00
L.S.D. at 0.05 %	15.50	2.80	4.96	0.57	23.23	90.70

Pl. ht =Plant height , # SP / P=Number of spikes / plant , # K / SP =Number of kernels / spike , 100 KW= 100 kernel weight, GY / P = Grain yield / plant , T. Pl. W = total plant weight.

a- General combining ability:

For general combining ability effects, Table (4), the best combiners for tallness were P_2 and P_5 while P_1, P_3 and P_6 were good for shortness. The best combiners for tallness were also the best for increased number of spikes / plant, heavier 100 kernel weight and higher grain yield / plant. For number of kernels per spike, it was only P_2 which proved to be good combiner for such character.

Table (4): Estimates of general combining ability effects

Parents		Pl. ht	# SP / P	# K/SP	100KW	GY/ P	T.Pl. W
P_1 Sakha 94		-2.40**	-2.28**	0.26	-3.09**	-3.24	-0.89
P_2 Gemmeiza10		4.10**	0.93**	3.60**	2.91**	7.68**	1.90
P_3 Giza 170		-2.20**	-0.40	0.14	-0.97	-0.65	16.19
P_4 line 5		0.26	-0.07	0.72	0.34	-9.07**	36.76**
P_5 line 42		2.60**	1.47**	-1.40*	1.43**	2.56	8.19
P_6 line 23		-2.36**	0.35	-3.32**	0.10	2.72	11.36
L.S.D. ≤	G_i	0.5593	0.6385	1.1316	1.058	5.2798	20.69
0.05 %	G_i-G_j	0.8401	0.9590	1.7000	1.1167	7.9659	31.089

Pl. ht =Plant height , # SP / P=Number of spikes / plant , # K / SP =Number of kernels / spike , 100 KW= 100 kernel weight , GY / P = Grain yield / plant , T. Pl. W = total plant weight.

Thus, it is clear that both P_2 (Gemmeiza10) and P_5 (L 42) may have valuable genes to be used to improve grain yield / plant through increased number of spikes / plant and 100 kemel weight mainly, and probably number of kernels / spike, especially the newly released cultivar P_2 (Gemmeiza10)

b- Specific combining ability:

Table (5) presented specific combining ability effects, $\hat{S}_{ij}$. Irrespective of type of gene action, all characters showed significant $\hat{S}_{ij}$, either positively or negatively. Positively significant estimates were recorded in eight crosses for tallness, six crosses for increased number of spikes / plant, five crosses for increased number of kernels / spike, three crosses for heavier 100 kernel weight, five crosses for higher grain yield and three crosses for the high total plant weight.

The best promising crosses, to utilize non additive genes, may be $P_1 \times P_5$, $P_2 \times P_5$, $P_2 \times P_6$ and $P_3 \times P_6$ for grain yield and increased number of kernels / spike, beside increased number of spikes / plant in $P_2 \times P_5$ followed by $P_2 \times P_4$ for the three yield components and $P_4 \times P_5$ for number of spikes / plant, 100 kernel weight and grain yield / plant.

Table (5): Estimates of specific combining ability effects ($\hat{S}_{ij}$) of the fifteen F_1 crosses.

Crosses	Pl. ht (cm)	# SP / P	# K / SP	100 KW	GY/ P	T. Pl. W
$P_1 \times P_2$	1.55*	-0.26	-3.89*	0.87	-17.91*	-12.13
$P_1 \times P_3$	2.51**	0.88	-3.44*	2.60*	-6.57	-69.75*
$P_1 \times P_4$	0.39	-0.59	-1.02	-0.35	-4.16	-1.79
$P_1 \times P_5$	0.72	-3.46	15.44**	-0.20	41.22**	178.25**
$P_1 \times P_6$	4.34**	5.33**	0.36	-2.47*	0.72	4.08
$P_2 \times P_3$	0.02	-0.33	-3.56*	0.01	-23.16**	-15.86
$P_2 \times P_4$	6.94**	2.54**	7.65**	6.44**	3.60	23.75
$P_2 \times P_5$	6.23**	3.33**	3.11*	0.87	30.30**	25.13
$P_2 \times P_6$	-1.48	-0.55	2.69**	-2.55*	25.47**	92.29**
$P_3 \times P_4$	14.52**	3.87**	-3.56**	0.25	6.26	46.13
$P_3 \times P_5$	1.52*	0.33	-3.44**	-3.93**	-15.36*	-73.83**
$P_3 \times P_6$	-5.86**	0.88	7.82**	1.59	64.47**	193.00**
$P_4 \times P_5$	0.39	3.66**	0.65	3.67**	38.72**	40.79
$P_4 \times P_6$	0.02	-4.55**	-0.77	-0.17	-11.13	-22.38
$P_5 \times P_6$	4.35**	8.58**	-1.31	-3.25**	-23.07**	-38.67
L.S.D. ≤ 0.05 % $\hat{S}_{ij}$	1.54	1.75	3.11	2.04	14.56	56.83
$\hat{S}_{ij} - \hat{S}_{ik}$	2.52	2.54	4.50	2.95	21.08	82.25
$\hat{S}_{ij} - \hat{S}_{kl}$	2.16	2.35	4.16	2.74	19.51	76.15

Pl. ht =Plant height , # SP / P=Number of spikes / plant , # K / SP =Number of kernels / spike , 100 KW= 100 kernels weight , GY / P = Grain yield / plant , T. Pl. W = total plant weight.

Potence Ratio:

Values of potence ratio, Table (6), were significantly greater than unity (>1) in ten crosses for plant height and two for shortness, seven crosses for increased number of spikes/plant, nine crosses for increased number of kernels/spike and six for heavier 100 kernel weight, eight crosses for high plant grain yield, and seven crosses for total plant weight indicating overdominance for these characters in the respective crosses. Although, all characters showed different degrees of dominance for different crosses in different directions, they averaged positively overdominance. El-Sayed (1997) found overdominance for number of grains / spike and grain yield / plot, as Azza (2005) recorded it for total plant weight.

Table (6) : Potence ratio of the twenty one crosses for the six traits

Crosses	Dominance degree					
	Pl. Ht (cm)	# SP / P	# K S/P	100 KW	GY/ P	T. Pl. W
$P_1 \times P_2$	0.58*	0.44	-0.13	0.91**	-1.03	24.59
$P_1 \times P_3$	8.63**	2.00+	-0.80	1.01*	6 34	–1.15
$P_1 \times P_4$	4.26**	0.80	1.27	1.18+	0.69	1.36
$P_1 \times P_5$	1.50**	0.25	6.31**	0.06	7.08**	282.43**
$P_1 \times P_6$	2.89**	6.02**	1.17*	–0.59**	3.76*	4.26*
$P_2 \times P_3$	-0.43**	0.25	–7.66+	0.90	-1.20	1.43
$P_2 \times P_4$	-0.05	3.49**	4.24**	3.36**	0.80*	2.30
$P_2 \times P_5$	5.67**	4.20**	1.14**	1.88	2.85**	51.86*
$P_2 \times P_6$	-0.08	1.40	0.83**	–3.31+	3.05**	18.38**
$P_3 \times P_4$	9.78**	∞**	-2.23*	2.79*	2.03*	1.60*
$P_3 \times P_5$	1.67**	12.94**	-0.20	-1.40**	1.08	–1.00
$P_3 \times P_6$	-0.88*	5.99+	1.19**	0.00	4.23*	6.43
$P_4 \times P_5$	2.87**	11.95**	1.03*	1.27**	32.50**	2.83*
$P_4 \times P_6$	7.66**	-3.99	0.45	0.15	1.89	6.71*
$P_5 \times P_6$	0.00**	∞**	4.46*	-17.45**	2.25	–1.00
Average	3.40+	3.34**	2.21**	-2.42**	4.59+	27.16*

Pl. ht =Plant height , # SP / P=Number of spikes / plant , # K / SP =Number of kernels / spike , **100 kw = 100 kernel weigh t** , GY / P = Grain yield / plant , T. Pl. W = total plant weight.

N.B.: **Significancy of potance ratio was investigated by the difference $(F_1 - MP)/(P_2 - P_1/2)$ compared with it's respective error.**

Heterosis:

Due to predomination of SCA, i.e. non-additive gene action for all characters, except 100 kernel weight, as well as average overdominance, valuable heterosis was indicated considerably for number of crosses in all characters, e.g. ten for tallness, eight for increased number of spikes / plant, three for increased number of kernels / spike, six for higher grain yield / plant and five for higher plant weight, with ranges of 3.03 - 18.09 % , 7.59- 64.09 % , 6.19 – 25.23 % , 22.46 -137.95 % , and 41.30 – 114.63 % for the five characters respectively, Table (7). Most of these crosses exhibited significant non-additive gene action, through significant estimates of $\hat{S}_{ij}$, i.e. six out of ten crosses, six out of eight crosses, two out of three crosses, five out of six crosses and two out of five crosses for the five reported characters, respectively. Mitkees (1981) recorded 12 % heterosis for number of kemels / spike, as Hendawy (1998) obtained heterosis of 62.9-81.3 % for grain yield. Azza (2005) obtained heterosis of 1.65-3.28 %, 0.48-3.35 %, 2.8-21.59 %, 4.19-15.26 % and 0.17-8.54 % for plant height, number of kemels / spike, 100 kernel weight, grain yield / plant and total plant weight, respectively.

Furthermore, all crosses exhibiting significant heterosis did also show overdominance through potence ratio, Table (6).

This result indicates that heterosis exhibited on characters, except 100 kernels weight, could be attributed to non-additive gene action and may be to epistate effects utilizing non-additive gene.

On the other hand, though predomination of additive genetic effects for 100 kernel weight, one cross only showed 15.41 % heterosis to suggest effects with additive gene action, e.g. additive × additive, or additive × dominance.

Table (7): Percentage of heterosis over better parent (B.P.) for all triats recorded in fifteen hybrid bread wheat.

Crosses	Pl. ht (cm)	# SP / P	# K / SP	100 KW	GY/ P	T. Pl. W
$P_1 \times P_2$	-3.09	- 6.77	-5.48	-1.02	-23.79	19.67
$P_1 \times P_3$	8.57**	7.59	-7.69	0.04	4.22	-19.03
$P_1 \times P_4$	6.67**	-1.50	0.59	0.97	-5.26	5.74
$P_1 \times P_5$	2.12*	-4.69	25.23**	-13.44	84.75**	114.63**
$P_1 \times P_6$	4.72**	31.27**	0.94	-19.48	42.85*	32.30
$P_2 \times P_3$	-4.23	-4.06	-5.48	0.45	-27.02	3.91
$P_2 \times P_4$	-5.35	13.50*	9.71**	15.41**	-4.84	20.66
$P_2 \times P_5$	4.79**	21.61**	1.27	1.82	41.53 **	41.30*
$P_2 \times P_6$	-5.63	2.68	-1.68	-6.30	35.88**	78.51**
$P_3 \times P_4$	18.09**	27.27**	-7.69	4.09	17.12	13.36
$P_3 \times P_5$	3.03**	18.18**	-10.26	-15.21	1.07	17.00
$P_3 \times P_6$	-4.72	7.59*	1.71	-5.76	22.46*	92.31**
$P_4 \times P_5$	4.25**	39.09**	0.54	2.28	137.95**	30.08
$P_4 \times P_6$	3.14**	4.69	-3.95	-6.66	9.93	44.37*
$P_5 \times P_6$	5.45**	64.09**	6.19*	- 11.77	9.13	-20.48

Pl. ht =Plant height , # SP / P=Number of spikes / plant , # K / SP =Number of kernels / spike , 100 KW= 100 kernel weightGY / P = Grain yield / plant , T. Pl. W = total plant weight.

N.B. : Significancy of hetrosis was investigated by the difference $((F_1 - BP)/BP \times 100)$ compared with it's respective error.

Inbreeding depression:

Average performance of F_2 populations are given in Table (8). As compared to F_1 average performance, it showed valuable depression by inbreeding, Table (9). This depression supported the dominance effect indicated for all the six characters. The least depression was recorded for plant height 7 – 18 % as compared to 14 – 48 %, 13 – 39 %, 14 -22 %, 23 – 62 %, and 22 – 54 % for number of spikes / plant, number of kernels / spike, 100 kernel weight, plant grain yield and total plant weight, respectively. Mitkees (1981) recorded inbreeding depression of 3-43 % for plant height, 20-36 % for number of spikes/plant, 15-21 % for number of kernels / spike and 9-40 % for 100 kernel weight.

Table (8) : Mean performance of six varieties and their fifteen F_2's

Genotype	Pl. ht	# SP / P	# K / SP	100 KW	GY/ P	T. Pl. W
P_1	96.66	19.67	69.00	42.17	64.00	203.33
P_2	115.00	23.33	81.00	45.89	82.00	200.67
P_3	97.33	23.34	71.33	38.98	59.00	248.33
P_4	100.00	21.00	74.00	39.88	48.00	141.67
P_5	107.00	19.00	60.33	44.26	48.00	210.00
P_6	93.00	21.66	61.67	41.98	54.00	164.00
$P_1 \times P_2$	102.23	19.33	63.33	38.30	51.33	186.67
$P_1 \times P_3$	89.67	22.67	62.33	48.62	47.00	208.67
$P_1 \times P_4$	98.67	18.66	62.66	35.37	38.00	135.00
$P_1 \times P_5$	92.00	17.33	54.33	36.43	58.00	315.67
$P_1 \times P_6$	101.00	18.67	69.33	34.83	58.67	232.76
$P_2 \times P_3$	104.33	22.00	53.67	41.95	42.33	200.00
$P_2 \times P_4$	110.33	21.33	55.00	44.00	57.00	196.67
$P_2 \times P_5$	101.33	22.66	67.67	45.55	65.00	233.33
$P_2 \times P_6$	107.67	19.67	52.33	39.96	59.00	280.00
$P_3 \times P_4$	107.67	21.67	51.67	41.84	51.00	206.67
$P_3 \times P_5$	100.00	19.33	54.67	48.02	47.00	179.67
$P_3 \times P_6$	100.67	19.33	62.00	40.66	47.67	220.00
$P_4 \times P_5$	104.67	18.00	61.33	43.65	41.66	208.67
$P_4 \times P_6$	98.33	20.00	55.00	41.75	46.00	182.33
$P_5 \times P_6$	103.00	18.33	50.00	37.06	43.00	173.33
L.S.D. at 0.05 %	7.18	3.05	9.20	8.18	10.76	46.38

Pl. ht =Plant height , # SP / P=Number of spikes / plant , # K / SP =Number of kernels / spike , 100 KW= 100 kernels weight, GY / P = Grain yield/plant, T. Pl. W = total plant weight.

Table (9): F_2 inbreeding depression % from F_1

Crosses	Pl. Ht (cm)	# SP / P	# K / SP	100 KW	GY/ P	T. Pl. W
$P_1 \times P_2$	10.85**	15.96*	15.19**	20.79**	18.52	23.29
$P_1 \times P_3$	17.98**	4.22	13.43**	9.21	28.79*	-4.34
$P_1 \times P_4$	11.90**	13.89*	16.08**	17.51*	36.67*	37.21*
$P_1 \times P_5$	18.10**	14.76*	38.96**	17.43*	50.43**	28.26**
$P_1 \times P_6$	9.01**	33.32**	3.71	14.04	23.48*	13.47
$P_2 \times P_3$	7.94**	7.06	28.12**	13.74*	29.84*	22.08
$P_2 \times P_4$	1.49	23.82**	36.54**	21.96**	27.54*	71.24
$P_2 \times P_5$	18.28**	24.47**	15.41**	12.24*	44.44**	19.45
$P_2 \times P_6$	3.58	22.35*	32.63**	15.25*	47.47**	22.22**
$P_3 \times P_4$	13.17**	22.61**	28.24**	9.67	30.14*	26.19*
$P_3 \times P_5$	11.76**	25.65**	21.90**	11.11	25.40	12.36
$P_3 \times P_6$	0.33	18.34**	21.85**	14.26*	37.55**	53.68**
$P_4 \times P_5$	8.72**	39.33**	17.87**	16.27**	61.66**	21.75
$P_4 \times P_6$	9.48**	1.62	22.89**	11.11	22.03	22.52
$P_5 \times P_6$	11.21**	47.63**	27.19**	17.59*	26.71	6.34

Pl. ht =Plant height , # SP / P=Number of spikes / plant , # K / SP =Number of kernels / spike , 100 KW= 100 kernels weight , GY / P = Grain yield / plant , T. Pl. W = total plant weight.

N.B. : Significancy of inbreeding depression was investigated by the difference $((F_1-F_2)/F_1 \times 100)$ compared with it's respective error.

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لتحليل الوراثى لبعض هجن قمح الخبز

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أجرى هذا البحث بمحطة إيتاى البارود بمحافظة البحيرة فـي ٢٠٠١/٢٠٠٢ و ٢٠٠٢/٢٠٠٣ و ٢٠٠٣/٢٠٠٤ لتقدير القدرة العامة و الخاصة على الائتلاف و تقدير قيمة و اتجاه السيادة و قوة الهجـن و التدهور الوراثى بتعاقب الأجيال و ذلك من خلال هجن دائرية بين ستة أصناف من قمـح الخبـز :(ثلاثـة حديثي الاستنباط و ثلاث سلالات مبشرة) و قد شملت الدراسة صفات : طول النبات و محصول النبـات و مكوناته

و قد أفادت النتائج بالآتي:

- بينت جميع الصفات القدرة الخاصة على الائتلاف وبالتالي تفوق الجينات السائدة لجميع الصفات فيما عدا صفة وزن المائة حبة التي أوضحت قدرة عامة على الائتلاف مما يدل على تفوق الجينات المضيفة.
- أعلى الأصناف في القدرة العامة على الائتلاف كانت (Gemmeiza 10) و السلالة(Line 5).
- كما بين الهجن ١ × ٥ ، ٢ × ٥ ، ٢ × ٦ ، ٣ × ٦ ، ٤×٥ قدرة خاصة على الائـتلاف فـي صـفة المحصول و صفة واحدة على الأقل في مكونات المحصول.
- سجلت مختلف الصفات اتجاهات و قيم مختلفة للسيادة و إن كان المتوسط العام لجميع الهجين يشير إلـى السيادة الفائقة.
- جميع الصفات أظهرت درجات مختلفة من تفوق الهجن(heterosis) و قد تراوحت هـذه القـيم مـن ٣,٠٣-١٨,٠٩ % ، ٧,٥٩-٦٤,٠٩ % ، ٦,١٩-٢٥,٢٣ % ، ٢٢,٤٦-١٣٧,٩٥ % ، ٤١,٣٠-١١٤,٦٣ % لصفات طول النبات ، عدد السنابل للنبات ، عدد حبوب السنبلة ، محصول الحبوب للنبات ، ووزن النبات الكلي.
- جميع حالات التفوق الهجينى عزيت اسبابها الى التاثيرات الغير مصنفة بصفة اساسية او الى التفـاعلات مع هذا النوع من التاثير الجينى.
- من ناحية أخرى و تأييدا للسلوك السيادي أظهرت جميع الصفات تدهورا متباينا بالتربية الداخلية في الجيل الثاني قدرت بنحو يتراوح بـين ١٤- ٤٨ % ، ١٣-٣٩ % ، ١٤-٢٢ % ، ٢٣-٦٢ % ، ٢٢-٥٤ % لصفات عدد السنابل للنبات ، عدد حبوب السنبلة ، وزن المائة حبة ، محصـول حبـوب النبـات ، ووزن النبات الكلى بالمقارنة بصفة طول النبات التي تراوحت من٧- ١٨ % .