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COMBINING ABILITY AND HETEROSIS ESTIMATES FOR AGRONOMIC TRAITS IN BREAD WHEAT USING HALF DIALLEL ANALYSIS

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ABSTRACT

Combining ability and heterosis for grain yield and yield components traits, were studied in a six-parent diallel cross without reciprocals. The 15 F_1 hybrids and the six parental cultivars were grown at 2009/2010 season at the Experimental Farm of Faculty of Agriculture, Al-Azhar University, Assiut Branch. Seeds were planted in a randomized complete block design with three replications. The data showed that, the mean squares of the genotypes (six parents and 15 F_1 hybrids), GCA and SCA were highly significant for all studied traits except SCA for plant height which was insignificant. The effects of general combining ability (GCA) were highly significant for all the traits measured with the exception of 1000-grain weight trait, while the specific combining ability (SCA) effects were statistically significant for studies traits. The GCA effects clarified that, the parents P_1, P_3 and P_5 were the good general combiners for most studied traits. On the other hand, the estimates of SCA effects exhibited the highest SCA values regarding the cross $P_3 \times P_6$ for days to 50% blooming, the cross $P_3 \times P_5$ for plant height, the cross $P_2 \times P_6$ for number of spikes/plant, number of grains/ spikelet and grain yield/plant, the cross $P_2 \times P_4$ for number of spikelets/ spike and the cross $P_5 \times P_6$ for 1000-grains weight. The heterosis versus mid-parents and better-parent elicited highly significant or significant and positive or negative for days to 50% blooming, number of spikes/plant, number of spikelets/spike, 1000-grain weight, number of grains /spikelet and grain yield/plant. The best crosses for these traits in ranking were $P_1 \times P_2$, $P_3 \times P_5$, $P_2 \times P_6$, $P_2 \times P_4$, $P_5 \times P_6$, $P_2 \times P_6$ and $P_2 \times P_6$. Generally, it could be concluded that the best promising combinations were the previous crosses.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the most important grain crop and a staple food for a large part of the world population. It is a dietary mainstay for millions of people as it provides 50% caloric and protein requirements to a major population of the world. It also plays a significant role in critical areas of food security and economic stability of most countries of the world. The types and varieties of wheat are exceedingly diverse in crop traits, Farooq *et al.* (2010). The diallel cross technique is widely used for the evaluation of combining ability. Estimation of G.C.A and S.C.A are indicators for the nature of gene action. G.C.A is due to genes which are additive in nature, while S.C.A is due to genes with non-additive effect (dominance or epistatic effects).Akram *et al.* (2009) reported that the different related yield traits estimated were number of spikelets/ spike, number of grains per spike, 1000 grain weight and grain yield per plant. Some varieties are good parents when crossed in a series of crosses according to good combining ability or by their ability to transmit good characters to their progeny. When tests for general combining ability are significantly important, selected varieties or inbreds having higher combining ability values should prove to be superior parents in crosses.The results indicated that the differences among parents and hybrid progenies were highly significant for all characters. Therefore, it becomes possible to proceed in conducting the different comparisons between parents and their F1 hybrids. Partitioning of the genetic variance indicated that both G.C.A and S.C.A were highly significant in all the studied traits. This result indicates that there is an importance of both additive and non-additive genetic effects in controlling the inheritance of all the studied characters.(Peng *et al.* 2009;Subhashchandra et al. 2009; Kumar and Gupta 2010; Padhar *et al.* 2010 and Sener 2009).

Knowledge on the expression levels of heterosis are useful to help breeders to choose the best hybrid combinations which will serve as the basis for the selection of superior genotypes. (Abdel-Moneam (2009); Peng *et al.* (2009) and Subhashchandra *et al.* (2009).

In the present work, Griffing,s (1956) method II model I mating system was used for analysis and partition the total genetic variance among six bread wheat cultivars and their F1 hybrids in order to evaluate these parents. The aim of this work was to determine the best parents and the best crosses according to the agronomic traits and studying G.C.A, S.C.A and heterosis.

MATERIALS AND METHODS

The six commercial cultivars of bread wheat were chosen as representing a fixed sample of the best germplasm available for a range of characters of commercial importance, including yield and yield components. The parents involved Sids1(P1), Sakha 94 (P2), Gemmeiza 10 (P3), Giza 164 (P4), Gemmeiza 9 (P5), and Sakha93 (P6). The seeds were sown and at heading crosses were made handily in 6 × 6 half diallel cross to produce the 15 possible F1 hybrids in 2008/2009 growing season at Farm of Faculty of Agriculture, Al-Azhar University, Assiut Branch. The 6 parents and their 15 F1s were sown on 15th of November 2009 in randomized complete block design with three replications. One row plot was used with 3.0 m long and 0.40 m apart. The seeds were sown at a spacing of 20 cm within one row. The parents and F1s were randomly assigned to each plot. All the recommended cultural practices of wheat production in the province were done properly at the required time.

The recorded agronomic characters were recorded as follow:

1- Days to 50% blooming (days) for all plants in each plot.
2- Plant height (cm) from soil surface to the tip of main spike, excluding awns.
3- Number of spikes/ plant.
4- Number of spikelets/ spike
5- 1000-grains weight (g).
6- Number of grains/ spikelet
7- Grain yield/plant (g).

Statistical analysis:-

The plant material was evaluated by analysis of the data on heterosis and combining ability for the studied traits at the F1 generation. The genotypes are then analyzed according to Griffing's (1956) Method II (half-diallel set), Model I to estimate the analysis of variance and effects for general and specific combining ability for studied traits. The mathematical model for the combining ability analysis is:

$$Yij = \mu + g_i + g_j + S_{ij} + e_{ijk}$$

Where:

Y_{ij}: is the value of a cross between parents i and j.
μ: is the population mean.
g_i, g_j: are the general combining ability effects.
S_{ij}: is the specific combining ability effects.
$e_{ij}k$: is the mean error effect.

The analysis of variance for combining ability in diallel crosses mating design and the expectation of mean squares for single year are given in Table (1).

Table (1): The analysis of variance of F_1 in half diallel cross and xpectations of mean squares (E.M.S.) for one year.

S.O.V	d.f.	M.S.	E.M.S.
GCA	n – 1	M_g	$\sigma^2e + \sigma^2s + (n+2)\, \sigma^2g$
SCA	n(n – 1)/2	M_s	$\sigma^2e + \sigma^2s$
Error	(g – 1)(r – 1)	M_e	σ^2e /r

Where:

n: Number of parents.
g: Number of genotypes.
r: Number of replications.
M_g: Mean square of general combining ability (GCA).
M_s: Mean square of specific combining ability (SCA).
M_e: Mean square of error divided by number of replications.

The heterosis was estimated as percent increase (+) or decrease (–) over mid-parents ($H_{M.P}$.%) and better-parent ($H_{B.P}$.%). The heterosis measurements were calculated by the following equations:

$$H_{M.P}.\% = \frac{\overline{F_1} - \overline{M.P}}{\overline{M.P}} \times 100$$

$$H_{B.P}.\% = \frac{\overline{F_1} - \overline{B.P}}{\overline{B.P}} \times 100$$

RESULTS AND DISCUSSION

The mean performance of genotypes:

The mean performance of parents and F_1 crosses regarding above mentioned traits are presented in Table (2). The results revealed that, the mean values of parents developed differences with range of 94 (P_4) – 113

(P_3) for days to 50% blooming, 87.00 (P_3) – 120.00 (P_1) for plant height, 7.33 (P_2) – 17.33 (P_4) for number of spikes/plant, 19.33 (P_1) – 25.33 (P_3 and P_5) for number of spikelets/ spike, 43.10 (P_1) – 54.30 (P_2) for 1000-grain weight, 3.67 (P_2) – 4.33 (P_5) for number of grains/ spikelet and 10.82 (P_6) – 26.64 (P_5) for grain yield/plant traits. In the same time, the mean values of 15 F_1 hybrids displayed significantly differed and varied from 93.00 ($P_1 \times P_2$) to 105.00 ($P_2 \times P_3$), from 74.33 ($P_3 \times P_5$) to 112.67 ($P_1 \times P_2$), from 13 ($P_1 \times P_6$) to 24.33 ($P_2 \times P_6$), from 17.67 ($P_4 \times P_5$) to 27.00 ($P_2 \times P_4$), from 41.00 ($P_2 \times P_6$) to 59.00 ($P_5 \times P_6$), from 2.00 ($P_3 \times P_4$) to 5.00 ($P_1 \times P_3$, $P_1 \times P_5$ and $P_2 \times P_6$) and from 17.58 ($P_1 \times P_6$) to 38.25 ($P_2 \times P_6$) for the previous traits, respectively.

In general, the means found that there was no specific parent and single cross, which were superior or inferior for these traits. However, the data indicated that, the best parents were the parent P4 for days to 50% blooming and number of spikes/ plant traits, the parent P_3 for plant height and number of spikelets/ spike traits, the parent P_2 for 1000-grain weight trait and the parent P_5 for number of grains/ spikelet and grain yield/plant traits. Also, the results elicited that the better crosses were ($P_1 \times P_2$) for days to 50% blooming and plant height, ($P_1 \times P_3$) for number of grains/spikelet, ($P_2 \times P_4$) for number of spikelets/ spike, ($P_2 \times P_6$) for number of spikes/ plant and grain yield /plant, and ($P_5 \times P_6$) for 1000 grain weight in studied traits. In addition, the superiority of some single crosses, with respect to their corresponding parents would indicate the presence of heterosis.

Table (2): Means estimation of six parents and their 15 F_1 hybrids for studied traits of bread wheat in a diallel cross.

Genotypes		Days to 50% blooming	Plant height (cm)	No. of spikes/ plant	No. of spikelets/ spike	1000-grain weight (gm)	No. of grains/ spikelet	Grain yield/plant (gm)
P_1		97	120.00	15	19.33	43.1	4.00	15.82
P_2		102	101.00	7.33	24.67	54.3	3.67	11.15
P_3		113	87.00	15	25.33	45.3	4.00	22.16
P_4		94	117.33	17.33	23.67	44	4.00	25.69
P_5		107	111.33	12	25.33	49	4.33	26.64
P_6		102	111.00	10.33	22.67	48.6	3.67	10.82
$P_1 \times P_2$		93	112.67	17.33	24.00	42	4.33	26.00
$P_1 \times P_3$		95	103.67	14.33	24.00	44.6	5.00	27.18
$P_1 \times P_4$		97	108.33	18.33	23.00	42.3	4.67	28.33
$P_1 \times P_5$		97	108.67	19	24.33	42.4	5.00	28.42
$P_1 \times P_6$		98	96.00	13	21.00	44.4	4.67	17.58
$P_2 \times P_3$		105	102.33	20.67	23.67	45.3	4.67	29.11
$P_2 \times P_4$		94	110.67	19.33	27.00	46.4	4.67	27.22
$P_2 \times P_5$		100	110.67	22	24.00	45.7	4.00	22.95
$P_2 \times P_6$		94	103.00	24.33	24.33	41	5.00	38.25
$P_3 \times P_4$		102	109.67	22.33	24.67	41.9	2.00	20.44
$P_3 \times P_5$		102	74.33	20.2	26.67	45.8	4.00	27.95
$P_3 \times P_6$		95	110.67	19.55	23.67	48.2	4.00	26.48
$P_4 \times P_5$		101	106.33	18	17.67	46.9	3.67	21.55
$P_4 \times P_6$		95	100.00	17.33	22.33	47.9	4.00	18.11
$P_5 \times P_6$		96	100.00	20.38	23.33	59	4.00	36.22
L.S.D	**5%**	2.41	12.18	1.17	1.22	4.05	0.55	1.47
	1%	3.22	16.27	1.56	1.63	5.41	0.73	1.96

Combining Ability
Analysis of variance

The mean squares obtained from analysis of variance for studied traits are presented in Table (3). The results demonstrated that, the mean squares of the genotypes (six parents and 15 F_1 hybrids) were highly significant for all studied traits. Rasul *et al.*., (2002) reported that, the analysis of variance for spike length, number of grains per spike, 1000-grain weight and grain yield per plant manifested highly significant differences between genotypes. Inamullah *et al.*., (2006) showed that, highly significant differences among the genotypes for all the traits studied. Character wise discussion of the results is summarized below. Akinci (2009) mentioned that, the analysis of variance showed significant differences among genotypes for heading time, thousand kernels weight and grain yield/plant traits. Generally, the analysis of variance for genotypes reflected the presence of adequate genetic variability which could be exploited in different crossing programs.

Table (3):Mean square due to genotypes, general combining ability (GCA) and specific combining ability (SCA) for studied traits of bread wheat in diallel cross.

S.O.V	d.f	M.S						
		Days to 50% blooming	Plant height	No. of Spikes/ plant	No. of Spikelets /spike	1000-grain weight	No. of Grains / spikelet	Grain yield/ plant
Genotypes	20	67.7 **	312.12**	53.05**	14.1**	62**	1.32**	164.52**
G.C.A	5	51.5**	165.24*	6.14**	6.51**	26.29**	0.354*	18.09**
S.C.A	15	17.37**	81.58	21.53**	4.09**	15.59*	0.49**	59.09**
Error	40	2.14	54.5	0.5	0.55	6.03	0.11	0.79

The mean squares for GCA and SCA were observed to be highly significant or significant for all the traits like, days to 50% blooming, plant height, number of spikes/ plant, number of spikelets/ spike, 1000-grain weight, number of grains/ spikelet and grain yield/plant except SCA for plant height was insignificant (Table 3). The out put of data of component of variance elucidated that, the variance due to GCA was much higher in scale and very important than SCA for days to 50% blooming, plant height, number of spikelets/ spike and 1000-grain weight traits, showing in that way the predominance of additive type of gene action for the inheritance of these imperative traits. Similarly the estimates of components of variance clarified that the variance due to SCA was much higher in magnitude and more important than GCA for the traits like, number of spikes/plant, number of grains/ spikelet and grain yield/plant, reflecting the predominance of non additive type of gene action in the inheritance of these traits. This exposed that the major portion of genetic variance (in percentage) for these characters is owing to non additive type of gene action with (dominance or epistatic effects). These results in common agreement with many authors among them Peng *et al.* (2009), Subhashchandra *et al.* (2009) and, Kumar and Gupta (2010).Variance due to S.C.A was greater than that of the variance due to G.C.A regarding spikes number/plant and grains number/spikelet, as found by Padhar *et al.* (2010). On the other hand, Sener (2009) stated that number of spikelets in spike was determined by non-additive genes. Ojaghi and Akhundova (2010) noted that additive type of gene action was found for number of grains per spike and number of spikes/ plant. Sharma and Chaudhary (2009) mentioned that genetic studies revealed the preponderance of additive gene action for days to flowering, and non-additive gene action for the remaining yield components traits.

General combining ability effects:

General combining abilities estimated for the parents of studied traits were given in Table (4). The results claimed that, the six parents were elicited highly significant for studied traits. The parents P_1, P_4 and P_6 (earlier) for days to 50% blooming, the parent P_3 (negative or desirable) for plant height, the parent P_4 for number of spikes/plant, the parents P_3 and P_2 for number of spikelets/spike, the parents P_5 and P_6 for 1000-grain weight, the parent P_1 for number of grains/spikelet and the parent P_5 for grain yield/plant. Therefore, the best yielding parents for quantitative and those parents reflecting attractive qualitative performance might be exploited separately for varietal improvement for different cross combinations. Peng *et al.* (2009**)** reported that some parents had high value of general combining ability (G.C.A) for certain specific traits and can be used as parents in hybrid wheat breeding.

Table (4):Estimates of general combining ability effects for various traits of bread wheat in a 6 x 6 diallel cross experiment.

Characters / Genotypes	Days to 50% blooming	Plant height	No. of Spikes /plant	No. of Spikelets /spike	1000-seeds weight	No. of Grains /spikelet	Grain yield/ plant
P_1	-2.38**	4.68	-1.13**	-1.24**	-2.6*	0.31**	-1.28**
P_2	-0.38	1.18	-0.34	0.93**	0.79	0.10	-0.44
P_3	4.00**	-7.15**	0.76	1.06**	-0.79	-0.19	0.77*
P_4	-2.00**	4.72	1.12**	-0.36	-1.16	-0.28*	-0.29
P_5	2.13**	-1.15	0.32	0.22	1.89*	0.05	2.63**
P_6	-1.38**	-2.28	-0.72	-0.61	1.88*	0.01	-1.38**
L.S.D 5%	0.95	4.82	0.46	0.48	1.60	0.22	0.58
L.S.D 1%	1.28	6.44	0.62	0.65	2.14	0.29	0.78

Specific combining ability effects:

The SCA effects of yield components for crosses among six bread wheat genotypes are given in Table (5) which reveals that, the crosses (P_3 × P_6) and (P_1 × P_3) were exhibited highly significant negative (desirable) SCA effects and the crosses (P_5 × P_6), (P_1 × P_2), (P_2× P_6) and (P_2 × P_4) had negative and significant SCA effects for days to 50% blooming. For plant height the only cross (P_3× P_5) which denoted negative (useful) and highly significant SCA effects. However number of spikes/ plant, 8 crosses from 15 F_1 hybrids have positive and highly significant or significant SCA effects varied from 1.84 for the cross (P_3 × P_5) to 8.10 for the cross (P_2 × P_6). As for number of spikelets/ spike, the two cross (P_2 × P_4) noticed positive and highly significant SCA effects, while the two crosses (P_3 × P_5) and (P_1 × P_5) were positive and significant. The cross (P_5 × P_6) displayed highly significant positive SCA effects for 1000-grains weight. Concerning, the crosses (P_1 × P_3), (P_2 × P_6), (P_2 × P_4) and (P_2 × P_3) manifested positive and significant SCA effects for number of grains/ spikelet. Regarding grain yield/plant, 8 out of 15 F_1 hybrids developed highly significant positive SCA effects values, which ranged from 2.91 for the cross (P_3 × P_6) to 15.88 for the cross (P_2 ×P_6). In general, the parents with best general combining ability on their utilization in cross combination as one of the parents produced good hybrid combinations. This type of disagreement may be due to different germplasm materials exploited and the divergent climatic conditions under which these workers initiated their experiments. It can be say that significant of S.C.A effects indicate that probability of heterosis presence, greatly.

Table (5): Specific combining ability effects estimates for studied traits of 15 F1 hybrids in bread wheat.

Characters / Genotypes	Days to 50% blooming	Plant height	No. of Spikes /plant	No .of Spikelets /spike	1000- seeds weight	No. of Grains /spikelet	Grain yield/ plant
P_1×P_2	-3.250*	2.252	1.51	0.75	-2.288	-0.249	3.52**
P_1×P_3	-5.625**	1.586	-2.59**	0.63	1.888	0.714*	3.50**
P_1×P_4	2.375	-5.628	1.05	1.04	-0.038	0.466	5.70**
P_1×P_5	-1.750	0.587	2.52**	1.79*	-2.988	0.465	2.88
P_1×P_6	2.750	-10.96	-2.44**	-0.71	-0.975	0.175	-3.95**
P_2×P_3	2.375	3.746	2.96**	-1.87**	-0.800	0.591*	4.59**
P_2×P_4	-2.625*	0.212	1.26	2.87**	0.675	0.674*	3.76**
P_2×P_5	-0.750	6.087	4.73**	-0.71	-3.075	-0.327	-3.43**
P_2×P_6	-3.25*	-0.459	8.10**	0.45	-7.763**	0.713*	15.88**
P_3×P_4	1.000	7.546	3.17**	0.42	-2.250	-1.704**	-4.23**
P_3×P_5	-3.125	-21.92**	1.84*	1.84*	-1.400	-0.035	0.36
P_3×P_6	-6.625**	15.544**	2.23**	-0.33	1.013	0.005	2.91**
P_4×P_5	1.875	-1.793	-0.73	-5.75**	0.075	-0.282	-4.98**
P_4×P_6	-0.625	-6.999	-0.36	-0.25	1.088	0.088	-4.41**
P_5×P_6	-3.750*	-1.124	3.49**	0.16	9.138**	0.086	10.78**
L.S.D 5%	2.619	13.225	1.27	1.330	4.400	0.584	1.59
L.S.D 1%	3.504	17.695	1.69	1.779	5.887	0.781	2.13

Heterosis:

Heterosis values estimated for investigated traits in F1 hybrids were given at Table (6). The studied traits showed positive and negative significant or highly significant MP and BP heterosis in all the hybrids. The results denoted that of 15 crosses, $H_{M.P.}$% and $H_{B.P.}$% were found to be increasing effects in 11 crosses and no cross for early days to 50% blooming, in 3 crosses and 1 cross short plant height, 14 crosses and 11 crosses high number of spikes/plant, in 7 crosses and 2 crosses high number of spikelets/ spike, in one cross and 1 cross high 1000- grains weight, in 10 crosses and 7 crosses high number of grains/ spikelet and in 12 crosses and 8 crosses high grain yield/plant, respectively.

The Maximum over the mid parent were recorded by the crosses P_3 x P_6 (-11.62), P_3 × P5 (-25.04), P_2 × P_6 (175.54), P_2 × P_4 (11.71), P_5 × P_6 (20.90), P_2 × P_6 (36.24) and P_2 × P_6 (248.20) for days to 50% blooming, plant height, number of spikes/plant, number of spikelets/ spike, 1000-grain weight, number of grains/ spikelet and grain yield/plant traits, respectively. However, the maximum heterosis over better parent were recorded by the crosses P_1 x P_2 (-1.06), P_3 x P_5 (-14.56), P_2 × P_6 (40.39), P_2× P_4 (6.59), P_5 × P_6 (8.66), P_2

× P_6 (15.47) and P_2 × P_6 (43.58) for these same previous traits. These results are in harmony with those obtained by Abdel-Moneam (2009),Peng *et al.* (2009), Subhashchandra *et al.* (2009). Significant of heterosis indicates that group of useful genes in the cross were collected from both of two parents, this means that the breeder can be select a good lines in later generations.

Table (6): Heterosis relative to the mid-parents (M.P.) and better parent (B.P.) estimates of 15 F1 hybrids for studied traits in bread wheat.

Characters / Genotypes		Days to 50% blooming		Plant height		No. of Spikes/plant		No. of Spikelets / spike	
		$\overline{M.P}$	$\overline{B.P}$	$\overline{M.P}$	$\overline{B.P}$	$\overline{M.P}$	$\overline{B.P}$	$\overline{M.P}$	$\overline{B.P}$
P_1×P_2		-6.53**	-1.06	1.96	29.51**	55.22**	0.00	9.09**	-5.25**
P_1×P_3		-9.52**	1.06	0.16	19.16**	-4.47**	-17.31**	7.48**	-5.25**
P_1×P_4		1.57	3.19**	-8.71	24.52**	13.39**	5.77**	6.98**	-9.20**
P_1×P_5		-4.90**	3.19**	-6.05	24.91**	40.74**	9.64**	8.96**	-3.95**
P_1×P_6		-1.50	4.25**	-16.88**	10.34	2.65**	-24.99**	0.00	-17.09**
P_2×P_3		-2.32*	11.70**	8.86	17.62**	85.13**	19.27**	-5.32**	-6.55**
P_2×P_4		-4.08**	0.00	1.38	27.21**	56.77**	11.54**	11.71**	6.59**
P_2×P_5		-4.30**	6.38**	4.24	27.21**	127.63**	26.95**	-4.00**	-5.25**
P_2×P_6		-7.84**	0.00	-2.83	18.39**	175.54**	40.39**	2.79**	-3.95**
P_3×P_4		-1.44	8.51**	7.35	26.06**	38.14**	28.85**	0.69	-2.61**
P_3×P_5		-7.23**	8.51**	-25.04**	-14.56*	49.63**	16.56**	5.29**	5.29**
P_3×P_6		-11.62**	1.06	11.79*	27.21**	54.36**	12.81**	-1.37*	-6.55**
P_4×P_5		0.49	7.44**	-7.00	22.22**	22.74**	3.87**	-27.88**	-30.24**
P_4×P_6		-3.06**	1.06	-12.41*	14.94*	25.31**	0.00	-3.63**	-11.84**
P_5×P_6		-8.13**	2.12	-10.04	14.94*	82.53**	17.60**	-2.79**	-7.90**
L.S.D	**5%**	2.09	2.41	10.54	12.18	1.01	1.17	1.06	1.22
	1%	2.79	3.22	14.09	16.27	1.35	1.56	1.42	1.63

Con. Table (6): Heterosis relative to the mid-parents (M.P.) and better parent (B.P.) estimates of 15 F1 hybrids for studied traits in bread wheat.

Characters / Genotypes		1000-seeds weight		No. of grains/spikelet		Grain yield/plant	
		$\overline{M.P}$	$\overline{B.P}$	$\overline{M.P}$	$\overline{B.P}$	$\overline{M.P}$	$\overline{B.P}$
P_1×P_2		-13.76**	-22.65**	12.91**	0.00	92.81**	-2.40**
P_1×P_3		0.90	-17.86**	25.00**	15.47**	43.13**	2.03**
P_1×P_4		-2.87	-22.10**	16.75**	7.85**	36.50**	6.34**
P_1×P_5		-7.93**	-21.92**	20.05**	15.47**	33.87**	6.68**
P_1×P_6		-3.16	-18.23**	21.77**	7.85**	31.98**	-34.01**
P_2×P_3		-9.04**	-16.57**	21.77**	7.85**	74.78**	9.27**
P_2×P_4		-5.60**	-14.55**	21.77**	7.85**	47.77**	2.18**
P_2×P_5		-11.52**	-15.84**	0.00	-7.62**	21.46**	-13.85**
P_2×P_6		-20.31**	-24.49**	36.24**	15.47**	248.20**	43.58**
P_3×P_4		-6.16**	-22.84**	-50.00**	-53.81**	-14.57**	-23.27**
P_3×P_5		-2.86	-15.65**	-3.96**	-7.62**	14.55**	4.92**
P_3×P_6		2.66	-11.23**	4.30**	-7.62**	60.58**	-0.60
P_4×P_5		0.86	-13.63**	-11.88**	-15.24**	-17.64**	-19.11**
P_4×P_6		3.46	-11.79**	4.30**	-7.62**	-0.79	-32.02**
P_5×P_6		20.90**	8.66**	0.00	-7.62**	93.38**	35.96**
L.S.D	**5%**	3.51	4.05	0.47	0.55	1.27	1.47
	1%	4.69	5.41	0.63	0.73	1.70	1.96

Theses results indicated that, high heterosis of hybrids for the traits suggested the possible exploration of bread wheat hybrids to raise grain yield potential within the existing genetic variation. Also, some hybrids can be successfully designed to capitalize on contrasting heterotic groups present in less adapted parents carrying alien substitution and translocations, for example, or in genotypes with a more extreme expression of yield components.

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تقدير القدرة على التآلف وقوة الهجين للصفات الزراعية في قمح الخبز باستخدام الهجن نصف التبادلية

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إن الهدف من هذه الدراسة هو تقييم ستة أصناف من قمح الخبز المحلية فيما يتعلق بكمية المحصول من الحبوب لتحديد أنسب الآباء لعمل أفضل توليفة من الهجن المبشرة. التقييم يشمل دراسة القدرة على التآلف ودراسة قوة الهجين. وقد أجريت التجارب خلال موسمي ٢٠٠٨ و٢٠٠٩م بمزرعة كلية زراعة الأزهر بأسيوط حيث تم التهجين في اتجاه واحد في الموسم الأول للحصول على الهجن وتمت زراعة الهجن والآباء في الموسم الثاني في ثلاث مكررات في قطاعات كاملة عشوائية وتم أخذ البيانات وتحليلها على صفات مكونات المحصول الأساسية وكانت أهم النتائج تتمثل في الآتي:

١- أن تباينات التراكيب الوراثية والقدرة العامة والخاصة على التالف كانت عالية المعنوية في كل الصفات المدروسة ما عدا القدرة الخاصة على التالف لصفة طول النبات والتي كانت غير معنوية

٢- أشارت النتائج إلى أن تأثيرات القدرة العامة على التالف كانت عالية المعنوية في كل الصفات المقاسة ما عدا وزن الألف حبة والتي كانت غير معنوية، بينما أظهرت النتائج إلى أن تأثيرات القدرة الخاصة على التالف كانت معنوية في كل الصفات محل الدراسة.

٣- أوضحت نتائج تأثيرات القدرة العامة على التالف أن الآباء سدس١ – جميزة ١٠ – جميزة ٩ كانت الأفضل في القدرة على التالف في معظم الصفات محل الدراسة. من ناحية أخرى أشارت بيانات تقديرات القدرة الخاصة على التالف إلى أن أعلى قيم للقدرة الخاصة على التالف كانت: الهجين جميزة ١٠ × سخا ٩٣ لصفة التزهير – والهجين جميزة ١٠ × جميزة ٩ لصفة طول النبات – والهجين سخا ٩٤ × سخا ٩٣ لصفات عدد السنابل/نبات و عدد الحبوب/سنيبلة و محصول الحبوب/نبات – والهجين سخا ٩٤× جيزة ١٦٤ لصفة عدد السنيبلات/سنبلة – الهجين جميزة ٩ × سخا ٩٣ لصفة وزن الألف حبة.

٤- أما بالنسبة لقوة الهجين فى حالة متوسط الأبوين و أفضل الآباء كانت عالية المعنوية أو معنوية وموجبة أو سالبة لكل الصفات المدروسة.

٥- أشارت البيانات الناتجة عن قوة الهجين إلى وجود توليفة من الهجن يمكن استخدامها كبدايات لبرامج التحسين والإنتاج في القمح، وكان أفضل هجين أو توليفة مبشرة هسخا٩٤ × سخا٩٣ لزيادة كمية المحصول في القمح.

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