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GENETIC ANALYSIS FOR YIELD AND ITS ATTRIBUTES IN BREAD WHEAT

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ABSTRACT

This investigation was carried out at the farm of El-Gemmeiza Agricultural Research Station, Agricultural Research Center, Egypt, during 2002/2003 and 2003/2004 seasons. Six parental lines of bread wheat were used in a half-diallel cross to produce F_1, crosses. Combining ability, heterosis, type of gene action and heritability,were estimated for days to heading, plant height, spike length, number of headed tillers/plant, number of kernels/spike, 1000-kernel weight and grain yield/plant .Griffing, Mather and Jinks and Hayman methods were used to estimate these parameters. Significant mean squares were obtained for genotypes, parents, crosses for all traits studied. Karwan-2 and Sakha 69 were at the top of the tested parents in grain yield/plant. The two crosses(Sakha 69 x Sids 7) and (Sakha 69 x Giza 170) gave the highest values of grain yield/plant. The mean squares due to general combining ability (GCA) and specific combining ability (SCA) were significant, for all traits studied which indicated the presence of both additive and non-additive types of gene action including dominance. The ratios of GCA/SCA were more than unity in all traits which indicated that additive gene effects were more important than dominance in the performance of these traits.

The estimates of heterosis for grain yield/plant indicated that twelve out of fifteen crosses exhibited positive and significant heterosis relatively to mid parents, while five crosses out of fifteen crosses exhibited positive and significant heterosis relatively to better parent. All H_2 (the component of variation due to the dominance portion associated with gene distribution values were smaller than H_1 (the dominance component of variation) values for all the studied traits, indicating unequal allele frequency. Values of $(H_1/D)^{½}$ were higher than units for most traits indicating over dominance. However spike length exhibited $(H_1/D)^{½}$ was less than unity suggesting the existence of partial dominance effect. The values of $H_2/4H_1$ for all traits were less than 0.25 for all the studied traits, indicating unequal distribution of dominant and recessive alleles among the parents. Narrow sense heritability was high for days to heading, spike length, moderate for number of headed tillers, number of kernels spike and 1000-kernel weight and low for plant height and grain yield/plant.

INTRODUCTION

The genetic analysis of any breeding materials is essential before the initiation of any breeding program for choosing efficient breeding method leading to rapid genetic improvement that gives maximum combinations of earliness and yield genes. Information about general and specific combining ability, heterosis and type of gene effects of wheat yield and its contributing characters for considerable lines are the important in wheat breeding.

In this respect, both general and specific combining ability as well as heterotic effects for wheat yield and its attributes had been estimated by many investigators (Singh *et al.*, 1982; Hassan, 1990; Hassan and Abd El-Moniem, 1991; Darwish, 1992; Mohammed, 1999; El-Beially and El-Sayed, 2002 and Hamada and El-Beially, 2003).

In wheat, days to heading, plant height and spike characters are important plant attributes that determine the desirability of progeny of any cross. The appropriate selection of these traits may greatly contribute towards enhancement in the yielding ability.

Various degrees of dominant were studied by several investigators among Singh *et al.* (1983), Abdel-Sabour *et al.* (1996), Awaad (1996) and Hamada and El-Beially (2003).

Various values of heritability in narrow sense estimates for wheat yield and its contributing characters were reported for days to heading (24.70 – 48.0), spike length (43.0 – 83.0), number of spikes/plant (11.4-88.37), number of Kernel (20.49 – 76.41), 1000-kernel weight (12.77 – 67.88) and grain yield/plant (16.0-66.57) by many researchers (Dawam and Hendawy, 1990; Shafey *et al.*, 1993; Afaf, 1994; Abd El-Magied, 1995; Mohammed, 1999; El-Sayed *et al.*, 2000 and Hamada and El-Beially, 2003).

The present investigation was aimed to study the genetic behavior of several agronomic characters in six bread wheat half diallel cross to give more breeding information about the parental genotypes and their crosses for exploiting in wheat breeding programs.

MATERIALS AND METHODS

The present investigation was performed at El-Gemmeiza Agricultural Research Station,A.R.C, Egypt during 2002/2003 and 2003/2004 seasons.

Six genotypes of wheat were used as parental lines in this study. The origin and pedigree of the studied parental wheat genotypes are given in Table 1. The parental wheat genotypes were chosen on the basis of their genetic diversity in yield and its attributes. A half diallel cross set involving the six parents was made in winter of 2002/2003 season. All possible combinations excluding reciprocals were hand crossed among these parents to produce 15 F_1 s seeds.

In 2003/2004 season, the six parents and their crosses were grown in a randomized complete blocks design with three replications. Each plot consisted single row of 4 meters in length spaced at 30 cm. Plant to plant distance was kept at 10 cm. The recommended agricultural practices for wheat production were applied from sowing to harvest.

Table (1): The origin and pedigree of the studied parental wheat genotypes:

No	Parent	Origin	Pedigree
P_1	Sakha 69	Egypt	Inia/RL 4220//7C/ yr's'
P_2	Gemmeiza 9	Egypt	Ald's'/Huac's'// CMH74.A.630/SX
P_3	Sids 7	Egypt	Maya's'/Mon's'/CMH74.A592/3/Sakh8
P_4	Giza 170	Egypt	Kauz//Altra 84/ Aos
P_5	Line	Mexico	Spri 82/4/SPN//MCD/CAMA/3/NZR
P_6	Karwan –2	ICARDA	SWM6828-6AP-2AP-1AP-2AP-1AP-0AP

Data were recorded on ten plants chosen at random from each plot for parents and F_1 crosses. The studied traits were days to heading, plant height (cm), spike length (cm), number of headed tillers/plant, number of kernels/spike, 1000-kernel weight (g) and grain yield / plant (g).

The obtained data were analyzed to estimate general and specific combining abilities according to method II model I by Griffing (1956).

The percentages of heterosis as proposed by Mather and Jinks (1971) were determined as deviation of the F_1 mean from mid-parent and better parent values and expressed in percentage as follows:

A- Heterosis relatively to mid parent = $[(\overline{F1} - \overline{M.P})/ \overline{M.P}] \times 100$

B- Heterosis relatively to better – parent = $[(\overline{F1} - \overline{B.P})/ \overline{B.P}] \times 100$

Where :

$\overline{F_1}$ = Mean of the F_1 crosses

$\overline{M.P}$ = Mean of the two parents

$\overline{B.P}$ = Mean of the better parent

Appropriate LSD values were calculated to test the significance of the heterotic effects according to the following formula suggested by Wynne *et al*.(1970) :

$$LSD = t \times \sqrt{S.E}$$

Where :

S.E For mid parent = $[3M.S.E/2R]^{1/2}$

S.E For better - parent = $[2M.S.E/2R]^{1/2}$

t = tabulated value at the degree of freedom for the error .

M.S.E = Mean squares for pooled error.

R = number of replications.

The components of genetic variance and heritability were computed using Hayman method(1954).

RESULTS AND DISCUSSION

1- Analysis of variance

Data presented in Table 2 show that the mean squares due to genotypes, parents, parents vs. crosses and crosses were highly significant for all traits studied, indicating that these genotypes were genetically different for genes controlling yield and its contributing characters.

In this connection highly significant differences between wheat genotypes, for yield and its contributing traits were also observed by Singh *et al.* (1987), Eissa (1993), El-Sayed *et al.* (2000), Mana (2001), El-Beially and El-Sayed (2002) and Hamada and El-Beially (2003).

Analysis of variance for combining ability are also presented in Table (2). The variances due to GCA (General combining ability) and SCA (Specific combining ability) were highly significant for all the studied traits, indicating that both additive and non-additive types of gene action were important.

Table (2): Mean squares from ordinary analysis of parents and F_1 cross diallel for the studied traits.

S.O.V	d.f	Days to heading	Plant height (cm)	Spike length (cm)	No. of headed tillers	No. of kernels/spike	1000 kernel weight (g)	Grain yield/ plant(g)
Genotypes	20	138.116**	163.906**	5.770**	33.386**	732.336**	111.707**	120.845**
Parents	5	128.528**	261.953**	11.713**	38.948**	1244.691**	84.427**	128.132**
Crosses	14	143.210**	128.205**	3.612**	29.575**	592.388**	116.632**	112.394**
P. VS. C	1	114.734**	173.484**	6.264**	58.931**	129.828**	179.160**	202.729**
GCA	5	116.769**	160.512**	6.439**	24.199**	428.522**	69.264**	56.605**
SCA	15	22.462**	19.343**	0.418**	6.772**	182.642**	26.560**	34.841**
Error	40	2.506	5.658	0.203	2.425	15.745	6.111	8.947
GCA / SCA		5.198	8.298	15.404	3.573	2.346	2.607	1.624

* GCA, General combining ability

* SCE, Specific combining ability

However, GCA variances were higher than SCA for all the studied traits, indicating the predominance of additive gene action in the expression of these traits, resulting from GCA/SCA ratios which were more than unity. Such results agree with those obtained by Eissa (1993), El-Hennawy (1996), Ismail *et al.* (2000) and Hamada and El-Beially (2003).

2- Mean performance, GCA and SCA effects:

The mean performance of the six parents and their F_1 s of wheat genotypes are presented in Table 3. It revealed that the parental cultivar P_3 (Sids 7) gave the lowest value for days to heading.

Table (3): Mean Performance for the studied traits of parent and their F1 crosses

Genot.	Days to heading	Plant height (cm)	Spike length (cm)	No. of headed tillers	No. of kernels/spike	1000-kernel weight (g)	Grain yield plant (g)
P_1	89.667	118.520	11.710	11.467	59.903	36.973	26.210
P_2	99.800	116.473	13.900	13.280	89.660	47.067	34.453
P_3	80.800	98.187	16.520	4.213	117.747	51.653	16.970
P_4	92.333	103.853	12.080	12.660	76.997	39.547	30.333
P_5	91.600	95.710	11.707	10.900	80.997	42.680	25.533
P_6	96.733	106.187	11.520	14.283	67.043	41.800	33.963
$P_1 x P_2$	95.067	114.900	12.853	13.237	68.760	46.947	33.67
$P_1 x P_3$	88.467	113.850	14.330	16.027	93.600	44.013	39.413
$P_1 x P_4$	90.600	107.850	12.423	16.140	74.867	39.777	42.380
$P_1 x P_5$	96.000	107.520	13.140	14.477	88.710	45.960	29.453
$P_1 x P_6$	91.800	116.187	12.993	13.970	74.780	45.653	33.327
$P_2 x P_3$	98.533	121.090	14.710	12.557	79.233	43.520	29.443
$P_2 x P_4$	113.600	114.187	13.327	13.090	73.330	44.920	23.150
$P_2 x P_5$	95.733	107.093	12.807	13.950	70.330	44.627	33.080
$P_2 x P_6$	98.333	116.280	12.853	17.147	96.013	48.133	37.723
$P_3 x P_4$	87.200	107.380	15.137	8.717	106.617	54.00	30.847
$P_3 x P_5$	88.400	103.900	14.747	7.897	68.993	60.453	20.577
$P_3 x P_6$	85.467	115.897	16.043	7.077	113.043	57.640	24.577
$P_4 x P_5$	95.233	96.043	12.567	16.870	98.443	36.587	29.493
$P_4 x P_6$	98.533	104.420	13.187	12.923	87.970	48.093	32.903
$P_5 x P_6$	99.200	105.803	12.950	15.047	83.853	44.973	37.987
L S D 5%	2.612	3.925	0.744	2.569	6.547	4.079	4.935
1%	3.495	5.251	0.995	3.438	6.707	5.457	6.603

The most promising genotypes were P_5 (Line) and P_3 (Sids 7) for plant height, P_3 (Sids 7) for spike length and P_6 (Karawan-2) for number of headed tillers, P_3 (Sids 7) for number of kernels/ spike and 1000-kernel weight and P_2 (Gemmeiza 9) had the highest grain yield/plant.

Table 3 show that cross(P_3 x P_6) gave good levels for days to heading, spike length, number of kernels/spike and 1000- kernel weight, (P_4 x P_5) was the shortest cross in plant height while(P_2 x P_3) the tallest plant height.(P_2 x P_6) gave the highest number of headed tillers. The maximum value of grain yield/plant was obtained by the cross (P_1 x P_4).

Estimates of GCA effects of the individual parental lines for each studied traits are presented in Table 4.

Data revealed that parental lines exhibited highly significant values for the most studied traits in all cases with either positive or negative significance.

The results also revealed that P_1 and P_3 could be considered as good general combines for developing early genotypes, while P_4 and P_5 for plant shortness. On the other hand, P_1 and P_2 gave positive GCA effects for plant tallness. For spike length, number of kernels/spike and 1000-kernel weight,P_3 expressed positive and significant general combining ability effects for these traits. For number of headed tillers P_1 and P_2 showed desirable GCA effects for this trait. It is worth to note that P_1, P_2 and P_6 were good combiners for grain yield/plant.

Estimates of the SCA effects of the F_1 crosses for the studied traits are presented in Table 5. Negative and significant SCA effects were detected for days to heading in six crosses (P_1xP_2, P_1xP_4, P_2xP_5, P_2xP_6, P_3xP_4, and P_3xP_6). Concerning plant height the two crosses (P_1xP_2 and P_4xP_5) exhibited negative and highly significant SCA effects, while three crosses (P_2xP_3, P_2xP_4 and P_3xP_6) exhibited positive and highly significant SCA effects. As for spike length, the four crosses (P_1xP_5, P1xP_6, P_3xP_6 and P_4xP_6) exhibited positive and significant SCA effects.

Table (4): Estimation of general combining ability (GCA) effects for the parental varieties.

Genot.	Days to heading	Plant height (cm)	Spike length (cm)	No. of headed tillers	No. of kernels/spike	1000-kernel weight (g)	Grain yield plant (g)
P_1	-2.054**	4.196**	-0.584**	1.018**	-8.722**	-3.172**	1.929**
P_2	5.396**	5.340**	0.064	0.987**	-2.914**	0.076	1.368*
P_3	-6.004**	-0.661	1.772**	-3.493**	13.335**	5.158**	-4.554**
P_4	1.517**	-3.274**	-0.379**	0.552	0.615	-2.400**	0.526
P_5	0.008	-6.500**	-0.526**	0.175	-2.247**	-0.464	-1.697**
P_6	1.137	0.898*	-0.346**	0.761*	-0.069	0.803	2.427**
L.S.D 5%	0.596	0.895	0.169	0.586	1.494	0.930	1.126
1%	0.797	1.198	0.227	0.784	1.530	1.245	1.507

Regarding number of headed tillers the five crosses (P_1xP_3, P_1xP_4, P_2xP_3, P_2xP_6 and P_4xP_5) exhibited positive and significant SCA effects. For number of kernels/spike, the six crosses (P_1xP_3, P_1xP_5, P_2xP_6, P_3xP_4, P_3xP_6, and P_4xP_5) exhibited positive and significant SCA effects. With regard to the 1000-kernel weight, the six crosses (P_1xP_2, P_1xP_5, P_3xP_4, P_3xP_5, P_3xP_6, and P_4xP_6) exhibited positive and significant SCA effects. Furthermore for grain yield/plant, the five crosses (P_1xP_3, P_1xP_4, P_2xP_6 , P_3xP_4, and P_5xP_6) have positive and significant SCA effects.

3- Heterosis

Heterosis percentages calculated for each cross are shown in Table 6. The high positive and highly significant percentages of heterosis would be of interest in most traits under investigation, however for days to heading, plant height, high negative percentags would be useful from the breeders point of view. Cross P_3xP_6 for days to heading and cross (P_4xP_5) for plant height expressed negative and significant heterotic effects relatively to mid parent.

Table (5): Specific combining ability effects (SCA) for fifteen crosses of the studied characters .

Genot.	Days to heading	Plant height (cm)	Spike length(cm)	No. of headed tillers	No. of kernels/spike	1000- kernel weight (g)	Grain yield plant(g)
$P_1 x P_2$	-2.232**	-3.747**	-0.032	-1.431	-3.933	4.089**	-0.374
$P_1 x P_3$	2.568**	1.204	-0.262	5.839**	4.658**	-3.926**	11.291**
$P_1 x P_4$	-2.820**	-2.183	-0.018	1.907*	-1.355	-0.604	9.177**
$P_1 x P_5$	4.089**	0.712	0.846**	0.621	15.350**	3.643**	-1.526
$P_1 x P_6$	-1.240	1.982	0.519*	-0.472	-0.578	2.069	-1.776
$P_2 x P_3$	5.185**	7.300**	-0.531*	2.399**	-15516.**	-7.667**	1.882
$P_2 x P_4$	12.730**	3.009*	0.237	-1.113	-8.700**	1.291	-9.491**
$P_2 x P_5$	-3.628**	-0.858	-0.136	0.125	-8.838**	-0.938	2.661
$P_2 x P_6$	-2.157*	0.931	-0.270	2.735**	14.668**	1.302	3.881*
$P_3 x P_4$	-2.270**	2.204	0.340	-1.006	8.338**	5.289**	4.127*
$P_3 x P_5$	0.439	1.949	0.097	-1.448	-26.424**	9.807**	-3.920*
$P_3 x P_6$	-3.624**	6.549**	1.213**	-2.855**	15.449**	5.727**	-4.043*
$P_4 x P_5$	-0.249	-3.294**	0.067	3.480**	15.746**	-6.502**	-0.084
$P_4 x P_6$	1.922*	-2.315	0.507*	-1.053	3.095	3.738**	-0.797
$P_5 x P_6$	4.097**	2.294	0.417	1.448	1.841	-1.318	6.509**
L.S.D 5%	1.637	2.460	0.466	1.610	4.103	2.556	3.093
1%	2.190	3.291	0.623	2.155	4.204	3.420	4.139

In this respect, significant heterotic effects less the mid parent and/or the better parent values were reported by Patwary *et al.* (1986), Koumber (1997), Tammam and Abd El-Gawad (1999), Manah (2001), El-Beially and El-Sayed (2002) and Hamada and El-Beially (2003).

Positive and significant heterotic effects relatively to mid parent had been recorded for spike length (12 cross), number of headed tillers/plant (12 cross), number of kernels/spike (9 cross), 1000-kernel weight (11 cross) and grain yield/plant (12 cross).

Positive and significant heterotic effects relatively to mid-parent and/or better parent were also recorded by Abd El-Aty (2000), Manah (2001), Morad (2001) and Hamada and El-Beially (2003).

According to the better parent, five crosses exhibited negative and significant heterosis for days to heading and five crosses expressed negative and significant heterotic effects for plant height. These result are in harmony with those reported by El-Hosary *et al.* (2000), Ashoush *et al.* (2001), Manah (2001), Morad (2001) and Hamada and El-Beially (2003).

Moreover positive and significant better parent heterosis were recorded for spike length (6 cross), number of headed tillers/plant (7 cross) number of kernels/spike (5 cross), 1000-kernel weight (7 cross) and grain yield/plant

(5 cross). These results are in the same line with those recorded by Afaf (1994), Koumber (1997). Manah (2001) as well as Hamada and El-Beially (2003).

4- Genetic components of variance and heritability.

Data presented in Table 7 revealed that the additive genetic variances (D) was significant for all the studied traits except plant height and 1000-kernel weight indicating that the additive gene action played a major role in the inheritance of the most studied traits.

The dominance component of variation (H_1) was significant for all the studied traits except plant height and greater than respective (D) one, except for spike length.

The component of variation due to the dominance portion associated with gene distribution (H_2) was significant for all the studied traits except plant height. All (H_2) values were smaller than (H_1) values for all the studied traits which agreed with the theoretical assumption of Hayman (1954) and could be a further proof for the unequal proportions of positive and negative alleles in the parent at all loci for these traits indicating unequal allele frequency. The overall dominance effects of heterozygous loci (h_2) were significant for spike length and number of headed tillers/plant. These results indicate that the effect of dominance was due to heterozygosity. These results are in agreement with those obtained by El-Sayed *et al.* (2000), Morad (2001) and Hamada and El-Beially (2003).

The covariance of additive and dominance (F) was not significant for all traits except spike length. These results are in harmony with those obtained by Abdel-Sabour *et al.* (1996). Values of $(H_1/D)^{½}$ were higher than unity for all traits except spike length indicating over dominance effect. However spike length exhibited $(H1/D)^{½}$ was less than unity (0.617) suggesting the existence of partial dominance effect.

Table (6): Heterosis percentages of mid parent (M.P) and better parent (B.P) for the studied traits in wheat .

Genot.	Days to heading		Plant height(cm)		Spike length(cm)		No. of headed tillers		No. of kernels/spike		1000- kernel weight (g)		Grain yield plant(g)	
	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
$P_1 x P_2$	0.353	4.742**	-2.209	-3054	0.375	-7.529**	6.974**	-0.326	-8.051**	-23.310**	11.725**	-0.255	11.005**	-2.274
$P_1 x P_3$	3.794**	-1.338	5.073**	-3.940*	1.523**	-13.256**	104.426**	39.767**	5.376	-20.507**	-0.677	-14.790**	82.552**	50.375**
$P_1 x P_4$	-0.440	-1.877	-3.001	-9.281**	4.439**	2.842**	33.786**	27.488**	9.375**	-2.766	3.965*	0.581	49.906**	39.714**
$P_1 x P_5$	5.922**	4.803**	0.378	-9.281**	12.231**	12.211**	29.444**	26.242**	25.920**	9.523**	15.399**	7.685**	13.841**	12.374**
$P_1 x P_6$	-1.502	-5.099**	3.412*	-1.969	11.864**	10.959**	8.505**	-2.193	17.814**	11.539**	15.908**	9.218**	10.772**	-1.875
$P_2 x P_3$	15.604**	-1.269	12.820**	3.964*	-3.287**	-10.956**	43.558**	-5.446**	-23.590**	-32.709**	-11.831**	-15.746**	14.511**	-14.541**
$P_2 x P_4$	18.252**	13.827**	3.653*	-1.963	2.594**	-4.124**	0.925	-1.430	-9.999**	-18.213**	3.725*	-4.561*	28.534**	-32.807**
$P_2 x P_5$	0.034	--4.075**	0.944	-8.053**	0.031	-7.866**	15.385**	5.045**	-17.578**	-21.560**	-0.550	-5.184*	10.292**	-3.96
$P_2 x P_6$	0.065	-1.469	4.446*	-.166	1.125**	-7.529**	24.416**	20.047**	22.541**	7.086**	8.325**	2.266	10.860**	10.071**
$P_3 x P_4$	0.732	-5.560**	6.296**	3.396	5.853**	-8.373**	3.331**	-31.148**	9.494**	-9.452**	18.421**	4.543*	30.42**	1.692
$P_3 x P_5$	2.552	-3.493**	7.169**	5.819**	4.485**	-10.73**	4.499**	-27.553**	-30.541**	-41.405**	28.168**	17.036**	-3.176	-19.412**
$P_3 x P_6$	-3.717**	-11.647**	13.416**	9.144**	4.430**	-2.885**	-23.475**	-50.455**	22.348**	-3.994	23.355**	11.590**	-3.495	-27.637**
$P_4 x P_5$	3.552**	3.140**	-3.747*	-7.520**	5.658**	4.028**	43.209**	33.254**	24.616**	21.539**	-11.011**	-14.277**	5.585*	-2.769
$P_4 x P_6$	4.231**	1.860	-0.571	-1.663	11.754**	9.161**	-4.075**	-9.521**	22.146**	14.252**	18.371**	15.055**	2.351	-3.121
$P_5 x P_6$	5.346**	2.549	4.807**	-0.361	11.503**	10.620**	19.497**	5.344**	13.284**	3.526	6.470**	5.373**	27.696**	11.846**

Table (7): Genetic components in F1 generation of 6 x 6 half diallel cross of wheat.

Components of variance	Days to heading	Plant height(cm)	Spike length (cm)	No. of headed tillers	No. of kernels/ spike	1000-Kernal weight(g)	Grain yield/ plant(g)
D	41.838**	0.000 $^{N.S}$	3.827**	12.184**	409.447**	25.033 $^{N.S}$	39.887*
H_1	87.560*	586.561 $^{N.S}$	1.458**	23.862**	810.184**	98.733**	135.137**
H_2	78.959*	530.621 $^{N.S}$	1.060*	22.225**	615.923*	90.041**	118.769**
h^2	24.257 $^{N.S}$	61.812 $^{N.S}$	1.311**	12.287*	25.034 $^{N.S}$	35.227 $^{N.S}$	42.253 $^{N.S}$
F	-15.107 $^{N.S}$	-155.359 $^{N.S}$	1.146*	1.741 $^{N.S}$	408.669 $^{N.S}$	-4.355 $^{N.S}$	30.831 $^{N.S}$
E	1.0039 $^{N.S}$	212.706 $^{N.S}$	0.77 $^{N.S}$	0.798 $^{N.S}$	5.451 $^{N.S}$	2.185 $^{N.S}$	.2.823 $^{N.S}$
$(H_1 / D)^{1/2}$	1.446	1.304	0.617	1.399	1.406	1.985	1.840
$H_2 / 4H_1$	0.225	0.226	0.181	0.2328	0.190	0.227	0.219
Heritability N. S	61.2	23.4	81.7	48.7	37.9	43.5	28.10

The values of $H_2/4H_1$ for all traits were less than 0.25 for all the studied traits, indicating unequal distribution of dominant and recessive alleles among the patents. These results are in agreement with those recorded by Singh (1990), Abdel-Sabour *et al.* (1996) and Hamada and El-Beially (2003).

The heritability in narrow sense estimates were high (more than 50%) for days to heading and spike length, moderate (30-50) for number of headed tillers/plant, number of kernels/spike and 1000-kernel weight and low for plant height and grain yield/plant. These results are in harmony with those obtained by Eissa (1989), Hassan and Abd-El-Moniem (1991), Abdel Sabour *et al.* (1996) and Hamada and El-Beially (2003).

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التحليل الوراثي للمحصول ومكوناته في قمح الخبز

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أجريت هذه الدراسة في محطة بحوث الجميزة خلال موسمي 2002/2003 و 2003/2004، وذلك بهدف دراسة القدرة على الائتلاف، قوة الهجين، نوع الفعل الجيني ودرجة التوريث لمجموعة من الهجن التبادلية بين ستة آباء ودونت البيانات على صفات عدد الأيام حتى طرد السنابل، طول النبات، طول السنبلة، عدد الأفرع الحاملة للسنابل/نبات ، عدد حبوب السنبلة، وزن الألف حبة ومحصول حبوب النبات .وقد حللت النتائج تبعا للموديل الأول للطريقة الثانية لجرفينج 1956 وهايمان 1954 وقوة الهجين بطريقة ماذر وجينكس 1971. وتم تقييم الهجن الناتجة وعددها 15 هجين بالإضافة إلي الستة آباء وقد تم زراعتها فى تجربة قطاعات كاملة عشوائية فى ثلاث مكررات وتتلخص أهم النتائج فيما يلي :

1– أوضح تحليل التباين وجود فروق عالية المعنوية في كل الصفات المدروسة بين كل من الآباء والهجن.

2– كان التباين الراجع لكل من القدرة العامة والخاصة على الائتلاف معنوياً لكل الصفات وكانت النسبة بين تباين القدرة العامة وتباين القدرة الخاصة على الائتلاف أكبر من الوحدة لكل الصفات مما يدل على أن الجزء الأكبر من الاختلافات الوراثية المرتبطة بهذه الصفات ترجع إلي الفعل الجيني من النوع المضيف .

أوضحت النتائج أن الأب السادس (كروان 2) والأب الأول (سخا 69) كانا على قمة الآباء المختبرة في محصول حبوب النبات ، وكذلك الهجن بين الأب الأول (سخا 69) × الأب الثالث (سدس 7) وبين الأب الأول (سخا 69) × الأب الرابع (جيزة 170) حيث أعطيا أعلى محصول حبوب للنبات.

4– أظهرت تقديرات قوة الهجين بالنسبة لمحصول حبوب النبات أن 12 هجين من بين 15 هجين أظهرت تفوق معنوي موجب بالنسبة إلي متوسط الأبوين تراوح من 5.585 % إلي 82% أما بالنسبة لقوة الهجين نسبة إلي أعلى الآباء فقد تفوق 5 هجن في محصول حبوب النبات بنسبة تراوحت من 10.071% إلي 50.375%.

5– كانت السيادة التامة تحكم توارث كل الصفات فيما عدا صفة طول السنبلة حيث كانت السيادة جزئية .

6– أظهرت كفاءة التوريث بمعناها المحدود قيما عالية لصفتي عدد الأيام حتى طرد السنابل وطول السنبلة وكانت متوسطة لصفات عدد الأفرع الحاملة للسنابل/نبات ، عدد حبوب السنبلة ووزن الألف حبة ، بينما كانت منخفضة لصفتي طول النبات ومحصول حبوب النبات.

هذه النتائج تؤكد أهمية استخدام هذه الأصناف لإنتاج وعزل تراكيب وراثية جديدة متفوقة في المحصول ومكوناته فى برامج تحسين وإنتاج القمح .