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ESTIMATION OF GENETIC PARAMETERS USING SIX POPULATIONS OF DIFFERENT WHEAT CROSSES

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ABSTRACT

The present experiment was conducted at the Experimental Farm of Faculty of Agriculture Kafr El-Sheikh, Tanta University, during the three successive growing seasons of 2001/2002, 2002/2003 and 2003/2004, to determine the types of gene effects and to develop new genetic combinations, using the six populations (P_1, P_2, F_1, BC_1, BC_2 and F_2) of four wheat crosses, Sakha 61 x Sids 7, Gemmeiza 9 x Sids 1, Sakha 93 x Sakha 61 and Sids 1 x Sids 7.

The results indicated that:

1. *The F_1 mean values exceeded the mid-parent for all studied traits in the four crosses except for days to heading which was earlier than the mid-parent, indicating partial dominance.*
2. *The F_2 mean values were approximately equal to the mid parent values and less than the F_1 mean values, indicating that inbreeding depression has occurred.*
3. *BC_1 and BC_2 mean values varied according to the trait itself, it was in the direction of their respective recurrent parents for the studied characters with some exceptions.*
4. *Positive heterotic effects relative to the mid-parent were found for most of the traits in the four crosses, except for heading and maturity dates, also positive heterotic effects relative to the better parent were found for plant height in the second and third crosses.*
5. *The additive effect was more important and greater than the dominance effect for most traits.*
6. *Among the epistatic components, the dominance x dominance was greater in magnitudes than additive x additive and additive x dominance in most studied traits.*
7. *Heritability estimates in narrow sense were low to moderate for all the studied characters in all crosses, ranged from 25% for 1000 grains weight in the second cross to 57.5% for plant height in the first cross and spike weight in the third cross.*
8. *The predicted genetic advance was low in all the studied traits except for spike weight which was moderate.*
9. *The crosses Sakha 93 x Sakha 61 and Sids 1 × Sids 7 would be of interest in a breeding program, for improving characters of earliness, yield and its components.*

Key words: ***Wheat, Crosses, Heterosis, Inbreeding depression, Heritability, Gene effects, Genetic advance, Scaling tests***

INTRODUCTION

Wheat (*Triticum aestivum*, L.) is the most important crop all over the world, and in Egypt. National wheat production is insufficient to meet the local consumption according to the higher increase of population especially in the recent years. The domestic wheat production is about six million tons from 2.5 million fed., while the imports totaled about six million tons of wheat grains.

Wheat breeders are always looking for means and sources of genetic improvement for grain yield, its components and other agronomic characters. Genetic diversity is the main tool for the breeders to have better recombinants by creating heritable variability upon which selection can be practiced.

Information on the genetics and gene effect of breeding materials could ensure long-term selection and better genetic improvements. The maximum progress in improving any character would be expected in a selection program when the additive gene action was the main component of genetic variance, whereas, the presence of non-additive gene action might suggest the use of hybridization program for achieving this goal, many genetic models were proposed by Mather (1949), Gamble (1962), Hayman and Mather (1955) and Mather and Jinkes (1971).

The present investigation was planned to determine the type of gene action and to estimate some genetic parameters in the four wheat crosses derived from five parental wheat genotypes using the six populations of each cross.

MATERIALS AND METHODS

The present study was carried out at the Farm of Faculty of Agriculture Kafr El-Sheikh, Tanta University during three winter successive growing seasons i.e., 2001/2002, 2002/2003 and 2003/2004. In the first season the five parental wheat genotypes shown in Table 1 were grown and four crosses were chosen and crossing was made by hand. i.e. Sakha 61 x Sids 7 (cross 1), Gemmeiza 9 x Sids 1 (Cross 2), Sakha 93 x Sakha 61 (Cross 3) and Sids 1 x Sids 7 (cross 4). In the second season seeds of four F_1's were sown to produce F_1 plants. Each of F_1 plants were crossed back to their respective parent to produce first backcross (BC_1) and second back cross (BC_2) in the same time, also the four crosses were recrossed again in the same season to produce their F_1's seeds, the F_1 plants were selfed to produce F_2 seeds. In 2003/2004 season the obtained seeds of the six populations P_1, P_2, F_1, BC_1, BC_2 and F_2 of the four crosses were evaluated using a randomized complete block design with four replications. All field plots consist of eight rows, 3.0 m long, spaced 25 cm apart and seeds were spaced 15 cm within each row. So, all the P_1, P_2, F_1, BC_1, BC_2 and F_2 generations each has the same field plot size to satisfy the equality of the field plot in each replicate for all the treatments which is required in the randomized complete block design (RCBD).

Table 1.Name and pedigree of the studied parental bread wheat cultivars.

Parent	Name	Pedigree
1	Gemmeiza 9	Ald "S"/Huac//cmh74A.630/Sx cGM4583-5 GM-1-OGM
2	Sids 1	HD2172/Pavon "s"//1158 571 Maya74"S" SD 46-45D-25D-15D-05D
3	Sids 7	Maya "S" MON "S"//cMH 74 A, 292/3/Sakha 8*2
4	Sakha 61	Inia/RL 4220172/Yr
5	Sakha 93	Sakha 92/TR 810328 S 887-1-15-25-15-05

To satisfy the analysis of variance of the characters recorded, 150 individual plants from each field plot were chosen at random from the six populations and all chosen characters were recorded.

All the recommended agricultural practices for wheat production were applied at the proper time.

Data were recorded on the chosen plants of the six populations in each cross for days to heading, days to maturity, plant height (cm), spike length (cm), number of grains/spike, 1000-grain weight (gm), spike grain weight (gm), grain yield/plant (gm) and grain yield/plot (kg).

Heterosis was determined as the percent of the deviation of F_1 hybrids over its mid-parent (MP) or its better parent (BP) values. Inbreeding depression was estimated as the average percentage decrease of the F_2 from the F_1. Potence ratio (P) was also calculated according to Peter and Frey (1966).

The population means and the variances were used to compute the scaling tests A, B and C and to estimate the type of gene effects according to Mather (1949) and Hayman and Mather (1955).

The six parameters model proposed by Gamble (1962) was used to estimate different gene effects. Heritability in broad and narrow senses were calculated according to Mather's (1949) and the predicted genetic advance under selection was computed according to Johanson *et al* (1955).

RESULTS AND DISCUSSION

1. Mean performance

Mean and standard error of the six populations (P_1, P_2, F_1, BC_1, BC_2 and F_2) of the four wheat crosses for the studied characters are given in Table (2).

Table 2. Means ± standard error of the six populations (P_1, P_2, F_1, BC_1 and BC_2) for all the studied characters in the four crosses.

Characters	Cross	P_1	P_2	F_1	BC_1	BC_2	F_2
Days to heading (day)	1	87.05±0.75	91.93±0.81	88.65±0.93	89.0±0.14	92.29±0.98	89.00±1.05
	2	107.00±0.74	104.93±0.56	105.20±0.90	107.65±0.98	104.50±0.94	106.70±1.04
	3	94.95±0.73	87.04±0.75	89.00±0.83	95.25±0.44	87.95±0.96	90.73±1.03
	4	104.93±0.63	91.93±0.61	95.93±0.94	104.45±1.04	93.00±1.08	97.76±1.26
Days to maturity (day)	1	140.9±0.33	142.7±0.34	141.00±0.38	140.1±0.98	142.4±0.95	142.7±1.09
	2	161.20±0.62	155.13±0.62	151.90±0.91	157.35±0.97	154.04±0.98	153.50±1.10
	3	145.20±0.21	140.95±0.70	140.20±0.77	145.10±1.04	139.75±1.00	143.66±1.19
	4	155.13±0.83	142.7±0.74	144.37±1.09	154.10±1.19	142.09±1.18	147.43±1.30
Plant height (cm)	1	92.10±0.33	115.26±0.34	110.9±0.37	101.0±0.53	115.45±0.54	105.85±0.63
	2	113.30±0.54	123.20±0.44	126.20±0.64	115.20±0.77	125.00±0.77	125.40±0.88
	3	96.95±0.72	92.10±0.82	101.00±0.83	95.40±1.09	92.80±1.09	95.27±1.3
	4	123.20±0.89	115.26±0.88	125.00±0.82	123.90±1.33	116.10±1.31	119.80±1.41
Spike length (cm)	1	12.43±0.40	15.27±0.40	13.64±0.50	12.69±0.62	13.73±0.63	13.64±0.74
	2	11.60±0.29	12.58±0.36	12.58±0.40	11.22±0.56	12.55±0.39	12.26±0.55
	3	12.55±039	12.43±0.33	12.62±0.54	12.49±0.63	12.04±0.55	12.43±0.67
	4	12.58±0.36	15.26±0.40	14.42±0.54	12.57±0.62	14.14±0.62	14.27±0.72
No. of grains/ spike	1	51.95±0.62	62.13±0.59	58.50±0.89	52.05±0.92	58.55±0.91	57.29±1.0
	2	59.00±0.54	50.74±0.62	59.95±0.99	59.10±0.91	51.65±0.98	58.10±1.04
	3	56.95±0.78	51.95±0.82	58.65±1.09	54.95±1.14	52.95±1.04	52.53±1.20
	4	50.74±0.63	62.13±0.74	58.18±0.90	50.05±1.01	61.30±1.14	56.60±1.22
1000 grains weight (g)	1	50.29±0.86	58.73±0.79	57.50±0.20	50.12±0.97	57.25±0.95	56.23± 1.00
	2	45.10±0.78	47.80±0.62	49.54±086	44.65±0.98	48.15±0.87	46.55±1.00
	3	46.00±0.57	50.29±0.63	49.15±0.92	45.15±0.97	51.45±0.97	47.03±1.14
	4	47.80±0.62	58.73±0.74	55.00±0.81	48.07±1.09	57.85±1.08	52.80±1.30
Spike weight (g)	1	2.247±0.13	2.954±0.10	2.770±0.17	2.390±0.22	2.805±0.23	2.670±0.24
	2	2.18±0.11	2.240±0.10	2.280±0.17	2.228±0.19	2.410±0.18	2.13±0.21
	3	2.17±0.10	2.248±0.10	2.270±0.12	2.41±0.17	2.33±0.16	2.34±0.20
	4	2.24±0.11	2.954±0.12	2.77±0.17	2.18±0.22	2.55±0.23	2.68±0.27
Grain yield/plant (g)	1	22.50±0.32	20.045±0.36	22.380±0.44	22.550±0.71	19.730±071	21.070±0.77
	2	26.38±0.54	22.860±0.84	25.80±0.88	25.490±0.83	22.520±0.76	25.00±0.98
	3	26.33±0.33	22.500±0.48	24.24±0.83	25.94±0.98	22.88±0.99	23.47±1.09
	4	22.86±0.42	20.045±0.41	23.96±0.48	23.06±0.54	20.15±0.54	21.65±0.63
Grain yield/plot (kg)	1	0.899±0.04	0.754±0.05	0.898±0.05	0.888±0.07	0.826±0.07	0.835±0.08
	2	0.989±0.04	0.892±0.04	1.018±0.05	1.043±0.06	0.894±0.06	1.009±0.05
	3	1.033±0.01	0.899±0.01	0.981±0.04	1.034±0.05	0.930±0.03	0.962±0.06
	4	0.892±0.03	0.754±0.02	0.895±0.05	0.896±0.05	0.821±0.04	0.881±0.05

*, ** Significant at 0.05 and 0.01 levels, respectively.

The F_1 mean values exceeded the mid-values of the two parental means for all the studied traits in the four crosses except that of heading date which was earlier than the mid-parent indicating the presence of partial dominance.

Regarding F_2 mean, the values were intermediate between the two parents and less than the F_1 mean values, indicating the importance of non-additive components of genetic variance for the studied crosses.

However, both BC_1 and BC_2 mean values varied according to the trait itself, it was tended toward the mean of recurrent parent for the studied traits with some exceptions.

2. Heterosis, inbreeding depression and degree of dominance

Heterosis, inbreeding depression and degree of dominance in the four crosses for the studied traits are given in Table 3. Significant negative heterotic effects relative to mid parent obtained for days to heading in the third and fourth crosses, while high significant negative heterotic effects were found for days to maturity in the second, third and fourth crosses. The results are in harmony with those of Khalifa *et al* 1998 and El-Sherbeny *et al* (2000).

Table 3.Estimates of heterosis, inbreeding depression percentages (ID%) and degree of dominance for the four crosses.

Characters	Cross	Heterosis		ID %	Degree of dominance
		M.P.	B.P		
Days to heading (day)	1	-0.93	1.83	-0.39	0.81
	2	-0.72	0.26	-1.43	0.82
	3	-2.19*	2.24	-1.94	0.58
	4	-2.53**	4.35**	-1.91	0.39
Days to maturity (day)	1	-0.59	3.54	-1.21	1.03
	2	-3.96**	-2.08*	-1.05	0.76
	3	-2.01*	-0.53**	-2.46	0.47
	4	-3.06**	1.14	-2.12	0.73
Plant height (cm)	1	6.96**	-3.78**	4.55	0.44
	2	6.72**	2.43**	0.63	0.57
	3	6.85**	6.31**	4.68	0.42
	4	4.84	8.45	4.16	0.97
Spike length (cm)	1	-1.52	-10.67*	0.01	0.42
	2	4.05	0.00	2.55	0.68
	3	1.04**	0.56	1.51	0.68
	4	3.59**	-5.56	1.04	0.58
No. of grains/ spike	1	2.56	-5.84*	2.06	0.80
	2	9.26**	1.61	3.08	0.74
	3	7.71*	2.98	10.43	0.53
	4	3.08**	-6.37**	2.72	0.93
1000 grains weight (g)	1	5.49**	-2.09	2.21	1.07
	2	6.87*	3.64	6.22	0.66
	3	2.09**	-2.27	4.31	0.44
	4	3.26**	-6.35**	4.00	0.75
Spike weight (g)	1	6.53	-6.10	3.61	1.00
	2	3.21	1.79	6.57	0.61
	3	2.79**	1.02	3.08	0.46
	4	6.66**	-6.10	3.25	0.69
Grain yield/plant (g)	1	5.22	-0.53	5.85	1.18
	2	4.79	-2.01	3.10	0.30
	3	-0.70**	-7.93*	3.18	1.09
	4	11.70	4.81	9.64	0.60
Grain yield/plot (kg)	1	8.65	-0.11	7.02	0.83
	2	8.24	2.93	0.88	0.48
	3	1.55**	-5.03	1.94	1.41
	4	8.74**	0.34	1.56	0.94

*, ** Significant at 0.05 and 0.01 levels, respectively.

Highly significant positive heterotic effects relative to mid parent were found for plant height in the first, second and third cross, spike length in the third and fourth cross, number of grains/spike in the second, third and fourth cross, 1000 grains weight in all crosses, spike grain weight in the third and fourth cross, grain yield/plot in the third and fourth cross. On the other hand, there was highly significant negative heterotic effect in the third cross for grain yield/plant.

The pronounced heterotic effect detected for most of the studied traits in the third and fourth cross would indicate that these crosses would be of interest in a breeding program for high yielding ability.

These results are in close harmony with those recorded by El-Shami *et al* (1996), Khalifa *et al* (1998), El-Sherbeny *et al* (2000), Abd El-Aty (2002), Esmail and Khattab (2002) and Darwish and Ashoush (2003).

With respect to heterotic effects relative to the better parent, the heterotic magnitude, differed according to the trait and cross, significant or highly significant positive heterotic effects were found for days to heading in the fourth cross and plant height in the second and third cross. On the contrary, significant or highly significant negative heterotic effects relative to the better parent were found for days to maturity in the second and third cross, plant height in the first cross, spike length in the first cross, number of grains/spike in the first cross and fourth cross, 1000 grains weight in the fourth cross and grain yield/plant in the third cross.

On the other hand, significant negative heterotic effects relative to high parent were found for grain yield/plant in the second and third crosses, while highly significant negative heterotic effects were obtained for days to maturity in the third cross, plant height, spike length and number of grains per spike in the first cross and 1000 grains weight in the fourth cross. These results are in close agreement with those of Abd El-Aty 2000 and 2002.

Positive values of inbreeding depression were obtained for all traits in all studied crosses except for days to heading and days to maturity, which had negative values (Table 3). Significant heterosis and insignificant inbreeding depression were obtained for most characters. This was logical, since the expression of heterosis in F_1 will be followed by considerable reduction in F_2 performance. The obtained results for most cases were in harmony with that reached by Abd El-Aty (2002) with some exceptions.

The average degree of dominance indicated the over dominance towards the higher parent for days to maturity, 1000 grains weight and grain yield/plant in the first cross as well as grain yield/plant and grain yield/plot in the third cross.

A complete dominance was found for spike weight toward the higher parent in the first cross.

A partial dominance towards lower or higher parent in the remaining traits for all the studied crosses (Table 3) was obtained.

These results were in close agreement with those of Salem and Hassan (1991), Shehab El-Din (1997), Hagras (1999), Darwish and Ashoush (2003).

3.Estimation of type of gene action

Testing for non-allelic interaction (A, B, and C) together with the six parameters model and type of epistasis are given in Table (4). The results revealed the presence of non allelic interaction for all studied characters in all the studied crosses. It is worthy to mention that at least one of the A, B and C tests was significant for the previous characters, indicating the adequacy of the six-parameter model to explain the type of gene action controlling the trait in these crosses.

The estimated mean effect parameter (m) was found to be highly significant Initially, it is clear that all studied traits were quantitatively inherited.

The additive gene effects were found to be highly significant positive for grain yield/plant and grain yield/plot in the first cross, days to heading, days to maturity, number of grains per spike, grain yield/plant in the second cross, 1000 grains weight and spike weight in the third cross, days to heading, days to maturity, plant height, grain yield/plant and grain yield/plot in the fourth cross, suggesting the potential for obtaining further improvements of these traits by using pedigree selection program. These results are in close agreement with those of Hendawy (1998), Afiah (1999) and El-Hosary *et al* (2000).

On the other hand, highly significant negative additive effects were obtained for days to heading, days to maturity, plant height, spike length, number of grains/spike, 1000 grains weight and spike weight in the first cross, plant height, spike length, 1000 grains weight and spike weight in the second cross, days to heading, days to maturity, plant height, spike length number of grains/spike, grain yield/plant and grain yield/plot in the third cross, spike length, number of grains/spike, 1000 grains weight and spike weight in the fourth cross, indicating that the additive effects were less important in the inheritance of these traits.

Table 4. Estimates of scaling tests and gene effects for all the studied characters in the four crosses.

Characters	Crosse	Scaling test					Genetic components				
		A	B	C	m	a	d	aa	ad	dd	
Days to heading (day)	1	2.350**	4.00**	-0.230	89.00**	-3.20**	5.765**	6.580**	-0.825*	-12.93**	Duplicate
	2	5.170**	-3.20**	-4.470**	106.70**	3.15**	-3.265**	-2.500**	4.185**	0.530	Duplicate
	3	0.100*	7.01**	3.430*	90.73**	-7.30**	1.735	3.480**	-3.555**	-10.390**	Duplicate
	4	8.040**	-3.280**	2.320	97.76**	12.16**	-0.060	2.440	5.660**	-7.200**	Comp.
Days to maturity (day)	1	-1.750**	1.170**	5.120**	142.70**	-2.35**	-6.540**	-5.70**	-1.460**	6.28**	Duplicate
	2	7.670**	-5.00**	-6.130**	153.50**	3.30**	2.535*	8.80**	6.335**	-11.470**	Duplicate
	3	-1.650**	4.80**	8.090**	143.66**	-5.35**	-7.815**	-4.94**	-3.225**	1.790	Duplicate
	4	8.700**	-2.200**	3.120*	147.43**	11.65**	-1.180	3.38*	5.450**	-9.880**	Comp.
Plant height (cm)	1	-1.00**	4.740**	-5.76**	105.85**	-14.45**	16.720**	9.50**	-2.870**	-13.24**	Duplicate
	2	-19.00**	10.50**	12.70**	125.40**	-9.80**	-13.250**	-21.20**	-14.750**	29.70**	Duplicate
	3	-7.500**	-7.15**	-5.970**	96.27**	-2.60**	-2.205	-8.68**	-0.175	23.33**	Duplicate
	4	-1.400*	-9.360**	-9.260**	119.80**	7.95**	4.270**	-1.50	3.980**	12.26**	Comp.
Spike length (cm)	1	-0.690*	-1.450**	-0.420	13.64**	-1.04**	-1.930**	-1.720*	0.380	3.86**	Duplicate
	2	-2.720**	0.920*	-0.300	12.26**	-1.33**	-1.010	-1.50*	-1.820**	3.30**	Duplicate
	3	-0.970**	-0.190	-0.5000	12.43**	-0.45*	-0.530	0.66	-0.390*	1.82	Comp.
	4	-1.860**	-2.230**	0.390	14.27**	-1.16**	-3.985**	-4.48**	0.185	8.57**	Duplicate
No. of grains/ spike	1	-6.350**	-3.530**	-1.920*	57.29**	-6.50**	-6.50**	-7.96**	-1.710**	17.84**	Duplicate
	2	7.510**	-15.65**	2.760**	58.10**	7.45**	-5.82**	-10.90**	11.580**	19.04**	Duplicate
	3	-4.700**	-5.700**	-16.80**	52.53**	-2.00**	9.880**	5.68**	0.500	4.72**	Comp.
	4	-8.820**	-3.210**	-6.830**	55.60**	-8.50**	-3.455*	-5.20**	-2.805**	17.23**	Duplicate
1000 grains weight (g)	1	-7.550**	-2.480**	0.150	56.23**	-7.13**	-7.57**	-10.18**	-2.535**	20.21**	Duplicate
	2	-8.140**	1.560**	-5.980**	46.55**	-3.50**	2.59**	-0.60	-4.850**	7.18**	Duplicate
	3	3.460**	-4.850**	-6.458**	47.03**	6.30**	6.073**	5.06**	4.155**	-3.67*	Duplicate
	4	-6.660**	0.020	-8.960**	52.08**	-9.18**	3.680*	2.32	-3.340**	4.32*	Comp.
Spike weight (g)	1	-0.237*	-0.110	-0.057	2.67**	-0.415**	-0.119	-0.290	-0.063	0.637	Duplicate
	2	-0.064	0.362**	-0.458**	2.13**	-0.182*	0.827**	0.756**	-0.213**	-1.054**	Duplicate
	3	-0.043	-0.366**	0.403*	2.34**	0.200**	-0.751*	-0.812**	0.162*	1.22**	Duplicate
	4	-0.650**	-0.110	-0.010	2.68**	-0.625**	-0.575*	-0.750**	-0.270**	1.51**	Duplicate
Grain yield/plant (g)	1	0.220	-2.960**	-3.020**	21.07**	2.820**	1.390	0.280	1.590**	2.460*	Comp.
	2	4.320**	-7.140**	-0.840	25.00**	.970**	-0.800	-1.980*	5.730**	4.800**	Duplicate
	3	-0.980	1.310**	-3.430**	23.47**	-3.06**	3.585**	3.760**	-1.145**	-4.09*	Duplicate
	4	-0.700*	-4.540**	-4.220**	21.65	3.330**	1.490*	-1.02	1.920**	6.26**	Duplicate
Grain yield/plot (kg)	1	-0.021	0.001**	-0.109*	0.835**	0.062**	0.159**	0.088	-0.011	-0.067	Duplicate
	2	-0.050	-0.187	-0.077	0.950**	0.020	-0.013	-0.160*	0.068**	0.397	Duplicate
	3	-0.020	0.054*	-0.046	0.962**	0.104**	0.095	0.080	-0.037*	-0.114	Duplicate
	4	0.005	0.003	0.088*	0.881**	0.070**	-0.008	-0.081	0.001	0.072	Duplicate

*, ** Significant at 0.05 and 0.01 levels, respectively.
Comp. = Complimentary

The estimates of dominance effects were highly significant for all the studied traits except for spike weight and grain yield/plant in the first cross, spike length, grain yield/plant and grain yield/plot in the second cross, days to heading, plant height, spike length and grain yield/plot in the third cross, days to heading, days to maturity and grain yield/plot in the fourth cross, indicating the importance of dominance gene effects in the inheritance of these traits.

Highly significant positive additive x additive types of epistasis was detected for days to heading and plant height in the first cross, days to maturity in the second cross, days to heading, number of grains/spike, 1000 grains weight and grain yield/plant in the third cross, days to heading and days to maturity in the fourth cross.

Highly significant negative additive x additive was found for days to maturity, spike length, number of grains/spike and 1000 grains weight in the first cross, days to heading, plant height, spike length and number of grains/spike in the second cross, days to maturity, plant height and spike weight in the third cross, spike length, number of grains/spike and spike weight in the fourth cross.

Highly significant positive additive x dominance types of epistasis was found for grain yield/plant only in the first cross, days to heading, days to maturity, number of grains/spike, grain yield/plant and grain yield/plot in the second cross, 1000 grains weight and spike weight in the third cross, days to heading, days to maturity, plant height and grain yield/plant in the fourth cross. While highly significant negative additive x dominance types of gene action were found for days to heading, days to maturity, plant height, number of grains/spike and 1000 grain weights in the first cross, plant height, spike length, 1000 grains weight and spike weight in the second cross, days to maturity, spike length and grain yield/plant in the third cross, number of grains/spike, 1000 grains weight and spike weight in the fourth cross.

Dominance x dominance epistatic types were significant or highly significant positive for most traits in all crosses except for days to heading and plant height in the first cross, days to maturity and spike length in the second cross, days to heading and grain yield/plant in the third cross, as well as days to heading and days to maturity in the fourth cross.

Among the epistatic components, the dominance x dominance was greater in magnitudes than additive x additive and additive x dominance in most studied traits.

Duplicate epistasis was observed, as revealed by differences in signs of (d) and (dd) in crosses which exhibited significant epistasis, while similar signs of (d) and (dd) in complementary epistasis. These findings illustrated that duplicate epistasis was prevailing for most traits in the first, second and third crosses, while complementary epistasis was prevailing for days to heading, days to maturity, plant height, and 1000 grain weight in the fourth cross. This indicated that duplicate epistasis was greater and important when compared with complementary epistasis for most studied traits.

4.Components of variance, heritability and % of genetic advance

Components of variance (σ^2A, σ^2D and σ^2E), heritability in both broad and narrow senses and % of genetic advance under selection are presented in Table (5).

Table 5. Estimates of additive (σ^2A), dominance (σ^2D), environmental (σ^2E) variances, heritability and percentage of genetic advance for all studied characters for the four crosses.

Characters	Crosses	σ^2A	σ^2D	σ^2E	Heritability		Δg %
					Broad sense	Narrow sense	
Days to heading (day)	1	0.334	0.221	0.206	72.93	43.88	0.73
	2	0.332	0.224	0.521	51.62	30.82	0.61
	3	0.669	0.228	0.603	60.00	44.60	1.32
	4	0.928	0.145	0.588	64.59	55.86	1.54
Days to maturity (day)	1	0.520	0.555	0.124	89.53	43.33	0.69
	2	0.445	0.257	0.498	58.53	37.08	0.55
	3	0.752	0.169	0.508	64.41	52.62	0.90
	4	0.580	0.310	0.810	52.35	34.11	0.62
Plant height (cm)	1	0.230	0.046	0.124	69.01	57.50	0.71
	2	0.370	0.119	0.291	62.71	47.44	0.69
	3	0.910	0.164	0.626	63.16	53.52	1.55
	4	0.504	0.176	0.542	64.39	33.11	0.62
Spike length (cm)	1	0.310	0.055	0.185	66.38	56.36	6.31
	2	0.121	0.057	0.122	59.39	40.33	3.71
	3	0.190	0.089	0.170	62.13	42.22	4.69
	4	0.250	0.086	0.184	64.51	48.08	5.00
No. of grains/ spike	1	0.317	0.205	0.478	52.20	31.70	1.13
	2	0.393	0.216	0.491	55.39	35.73	1.32
	3	0.510	0.147	0.793	45.32	35.17	1.66
	4	0.500	0.435	0.565	62.30	33.33	1.48
1000 grains weight (g)	1	0.401	0.467	0.266	76.51	35.36	1.37
	2	0.259	0.171	0.570	43.00	25.90	1.15
	3	0.630	0.127	0.482	61.09	50.84	2.85
	4	0.830	0.468	0.552	70.16	44.86	2.38
Spike weight (g)	1	0.021	0.021	0.018	70.00	35.00	6.51
	2	0.021	0.008	0.016	64.44	46.67	9.57
	3	0.023	0.005	0.012	70.00	57.50	10.12
	4	0.039	0.019	0.017	77.33	52.00	10.54
Grain yield/plant (g)	1	0.190	0.268	0.142	76.32	31.66	2.40
	2	0.480	0.046	0.454	53.67	48.98	3.99
	3	0.430	0.511	0.260	78.38	35.83	3.44
	4	0.150	0.054	0.196	51.00	37.50	2.26
Grain yield/plot (kg)	1	0.0020	0.0014	0.0034	50.00	29.41	6.37
	2	0.0013	0.0003	0.0020	44.44	36.00	4.25
	3	0.0011	0.0020	0.0008	79.49	28.21	3.98
	4	0.0010	0.0009	0.0011	63.33	33.00	4.26

Additive genetic variance (σ^2A) were greater than that of dominance variance (σ^2D) for all the studied traits except that of days to maturity, 1000 grains weight and grain yield/plant in the first cross, grain yield/plant and grain yield/plot in the third cross, indicating that the selection for these traits might be more effective in early generations for improving such traits in the four studied crosses, however, it would be better if it was delayed to later generations.

Heritability estimates in broad sense were moderate to relatively high for all the studied traits in all crosses, ranged from 43% for 1000 grains weight in the second cross to 89.53% for days to maturity in the first cross, according to the cross and/or trait itself as shown in Table 5. Similar results were obtained by El-Shamy (1978), Shehab El-Dein (1997), Hagras (1999) and Abd El-Aty (2002).

Heritability estimates in narrow sense were low to moderate for all the studied characters in all crosses, ranged from 25% for 1000 grains weight in the second cross to 57.5% for plant height in the first cross and spike weight in the third cross, indicating that these characters greatly affected by non-additive and environmental effects. These results were coincident with those reported by Kheiralla and Tahany (1992), May and Van Sanford (1992), Shehab El-Dein (1997), Abd El-Aty (2002) and Salama (2002).

The expected genetic advance as percent of F_2 mean ($\Delta g\%$) was calculated and the results are presented in Table (5).

The predicted genetic advance was low in all studied traits except for spike length and grain yield/plot in the first cross and spike weight for all crosses which were moderate. These values depend on narrow sense heritability values, standard deviation of F_2 and the character under study. Similar results were obtained by Abd El-Aty (2002).

Generally, the most biometrical parameters resulted form the third and fourth cross (Sakha 93 x Sakha 61 and Sids 1 x Sids 7, respectively) were found to be higher in magnitude in comparison with those from other crosses. Consequently, it could be concluded that the above-mentioned crosses would be of interest in breeding programmes for improving traits for earliness, yield and its components.

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تقدير الثوابت الوراثية باستخدام العشائر الستة فى هجن مختلفة لقمح الخبز

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أجريت هذه الدراسة بمزرعة كلية الزراعة بكفرالشيخ خلال ثلاثة مواسم ابتداء من ٢٠٠٢/٢٠٠١ وإلى عام ٢٠٠٤/٢٠٠٣ بهدف تقدير طبيعة التأثير الجينى ومحاولة الحصول على تراكيب وراثية جديدة يمكن الانتخاب من خلالها فى الأجيال الانعزالية التالية للحصول على سلالات (تراكيب) جديدة من القمح متفوقة فى صفاتها المحصولية على الأصناف التجارية المنزرعة.

وقد استخدم لذلك خمسة أباء متباينة فى صفاتها وهى (سدس١ ، سدس٧ ، سخا٦١ ، سخا٩٣ ، جميزه٩) وتم عمل أربعة هجن من هذه الأباء وهى (سخا٦١ × سدس٧) ، (جيمزه٩ × سدس١) ، (سخا٩٣ × سخا٦١) ، (سدس١ × سدس٧) ، والحصول على العشائر الستة من كل هجين (الأب الأول والثانى والجيلين الأول والثانى والهجينين الرجعيين الأول والثانى) لكل هجين منهم وزرعت جميعها فى تجربة قطاعات كاملة العشوائية ذو أربعة مكررات فى الموسم الأخير ، وتمت دراسة كل من الصفات الآتية: عدد الأيام حتى طرد السنابل ، عدد الأيام حتى النضج ، ارتفاع النبات ، طول السنبلة ووزن السنبلة ، وزن الألف حبة ، عدد حبوب السنبلة ، محصول النبات الفردى ، بالإضافة إلى محصول القطعة التجريبية.

ويمكن تلخيص أهم النتائج المتحصل عليها فى النقاط الآتية:

١.- تفوقت قيم متوسطات الجيل الأول على قيم متوسطي الأباء لجميع الصفات المدروسة فى جميع الهجن وكانت كل من صفتى التزهير والنضج أبكر من متوسطى الأباء مما يعنى وجود سيادة جزئية فى جميع الهجن تحت الدراسة.

٢.- كانت قيم متوسطات الجيل الثانى وسط بين الأبوين إلا أنها كانت أقل من قيـــم متوســطات الجيــل الأول بســبب الانخفاض الراجع للتربية الداخلية للصفات المختلفة.

٣. اختلفت قيم الهجن الرجعية تبعا للصفات المختلفة إلا أنها كانت معظمها فى اتجــاه قيــم الأب الرجعــى للصفــات المدروسة.

٤. كانت تأثيرات قوة الهجين موجبة ومعنوية بالنسبه لمتوسط الأبوين لمعظم الصفات فى جميـــع الـــهجن المدروسة فيما عدا صفتى التزهير والطرد. كذلك كانت تأثيرات قوة الـــهجين موجبـــة لـــلأب الأفضـــل لصفات ارتفاع النبات فى الهجينين الثالث و الرابع..

٥. كان تأثير الفعل الجينى المضيف أكثر أهمية من تأثير الفعل الجينى السيادى لمعظم الصفات المدروسة.

٦. دلت النتائج على أهمية التأثير (السيادى × السيادى) عن التأثيرات (المضيف × المضيف) ، (المضيف × السيادى) لمعظم الصفات.

٧. كانت قيم معامل التوريث بمعناه الضيق منخفضة إلى متوسطه للصفات المدروسة فى كل الهجن وتراوحـــت مـــا بيـــن ٢٥% لصفة وزن الألف حبة فى الهجين الثانى إلى ٥٧,٥% لصفتى ارتفاع النبات فـــى الـــهجين الأول وطـــول السنبلة فى الهجين الثالث.

٨- أظهرت النتائج أن قيم النسب المئوية للتحسين الوراثى المتوقع فى الانتخاب كانت منخفضة لمعظم الصفات فيمـــا عدا صفة وزن السنبلة فكانت متوسطة لجميع الهجن المدروسة.

٩- من محصلة نتائج هذه الدراسة يمكن لمربى القمح الاستفادة بالهجينين (سخا ٩٣×سخا ٦١) و(سدس ١× سدس ٧) لتحسين صفات كل من التبكير والمحصول ومكوناته.