ESTIMATION OF GENETIC PARAMETERS FOR GRAIN YIELD AND ITS COMPONENTS IN THREE BREAD WHEAT CROSSES UNDER LOW INPUT OF NITROGEN FERTILIZER

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Abstract

Six populations (P_1, P_2, F_1, F_2, BC_1 and BC_2) of three bread wheat(*Triticum aestivum* L.) crosses, mamely Gemmeiza 9 x Mayon"S"//Crow"S"/Vee"S" (cross I), Attila/Sids 1 x Sakha 94 (cross II) and Mayon "S"//Crow "S"/Vee"S" x Attila /Sids 1 (cross III) were used to estimate genetic parameters for grain yield/plant and certain related characters under two nitrogen fertilizer levels; (40 Kg N/Fed [low level] and 75 Kg N/Fed (recommended level]). Results revealed that heterosis values were positive and significant relative to better-parent in the three crosses under the two nitrogen levels for most of the studied characters. Meanwhile, heterosis values were negative and significant for number of kernels/spike in the first and the third crosses under low level of nitrogen N_1, and the third cross under recommended level N_2 and for kernel weight in the second cross under N_1. In the second and third crosses under N_2, positive and significant inbreeding depression values were recorded for all studied characters in the first cross except for kernels/spike under both N_1 and N_2, for kernels/spike in the second cross under both N_1 and N_2, for spikes/plant and grain yield in the third cross under N_1 and N_2, whereas negative significant values were obtained for kernels/spike in the third cross and for kernel weight in the second and third ones under both levels of nitrogen. Over-dominance above the higher parent was detected for spikes/plant and grain yield in all crosses under the two levels of nitrogen, for kernels/spike in the first cross under N_2 as well as in the second cross under N_1 and N_2 and for kernel weight in the first cross under two levels. The other types of dominance were also studied. Scaling tests (A, B, C and D) indicated the presence of non-allelic gene interactions for all studied characters in all crosses under both levels of nitrogen. Additive genetic variance was highly significant for all traits in the three crosses under N_1 and N_2. Dominance variance was significant for all characters in all crosses, except for kernels/spike and kernel weight in the second cross under N_1 and for all characters except for kernels/spike in the first cross, for kernel weight in the second cross and for all characters except for kernel weight in the third one under N_2. Epistasis effects were present for most studied traits in the three crosses under both levels of nitrogen. F_2 deviations (E_1) was significant for kernel weight in all crosses, spikes/plant in the second and third crosses and grain yield in the second cross under N_1 as well as for spikes/plant and kernel weight in all crosses and grain yield in the first and second crosses under N_2. Back-cross deviations (E_2) were significant for kernel/spike and grain yield in the first cross, for kernel weight in the second cross and for all characters in the third cross under N_1 as well as for spikes/plant and grain yield in the first cross, for kernels/spike and kernels weight in the second cross and for all characters except for spikes/plant in the third cross under N_2. Broad sense heritability estimates were relatively high under both N_1 and N_2. Selection in segregating generation could be effective to produce lines that have high yielding ability under low level of nitrogen fertilizer (40 kg N/fed).

Key words: *Wheat, Genetic component, Heterosis, Inbreeding depression , Scaling test, Heritability, Six parameters model, Nitrogen fertilizer.*

INTRODUCTION

The Egyptian wheat cultivars have narrow genetic background. Selection within these cultivars for increasing grain yield and its components would not be effective. Hybridization between the Egyptian wheat cultivars and exotic materials was carried out to increase genetic variability. Moreover the quantitative economic character in wheat are highly influenced by environment conditions. Variation is partitioned into heritable and non heritable components order to estimate suitable genetic parameters such as genetic coefficients of variation, heritability estimates and gene action. The improvement of wheat yield is dependent upon a better understanding of the type of gene action underlying the inheritance of yield and its contributing characters. Genotype by environment interaction is often described as inconsistent differences from one environment to another (Yang and Baker 1991).

The increase in grain yield by increasing N-levels may be due to the improved growth which may account for the superiority of yield components and grain yield. In most of the wheat breeding programmes, the materials in the segregating generations are grown under high fertility conditions till homozygosity is nearly attained and progenies are ready for bulking.

Soil fertility as an environmental factor may differ from soil to another and might affect the assessment of characters in breeding programmes programs, especially nitrogen levels.

Assessment and quantifying the type of gene action in wheat were studied by many investigators using many techniques to obtain genetic information for yield and its components in wheat under various nitrogen levels. El-Nagar (2003), Allam (2005), and Swelam and Hassan (2007), and Abd El-Aty and Hamad (2006) reported that additive and non-additive gene action played a great role in controlling yield and yield components under various environments. Meanwhile, Swelam and Hassan (2007) showed that dominance gene effects played a great role in the genetics of yield and yield components. Heritability values and various distribution of positive and negative alleles were investigated under various environmental conditions. In addition, concerning the heritability estimates, Abdel-Nour (2006), and Abdel-Nour and Hassan (2009) reported that narrow sense heritability estimates for yield and its components were medium to high.

Grain yield is a quantitatively inherited character and highly affected by environmental fluctuations. Thus, direct selection for yield is misleading. Assessment and quantifying the types of gene action for yield attributes under different environments may help breeder for choosing the appropriate one to improve grain yield indirectly. Several studies were employed to ascertain the mode of gene action. In this respect, Ketata *et. al.,* (1976) reported that additive and non-additive gene effects in bread wheat governed the inheritance of grain yield and its components. Patel and Bains (1984) indicated the role of non-allelic interaction of duplicate types for grain yield/plant.

The present work was carried out to study genetic variance, gene action, heritability and predicated genetic gain for yield and its components in bread wheat using three crosses under low input level of nitrogen fertilizer. The ultimate goal of this study is to test the effect of two nitrogen levels i.e low (40 kg N/fed) and high (75 kg N/fed) level (recommended) on the different genetic components controlling grain yield and its components and identifying the most promising genotypes to be involved in breeding programs for tolerance low to level of nitrogen fertilizer to sustain clean environment and hoping high grain yield with less nitrogen fertilizer to decrease costs in farmers fields.

MATERIALS AND METHODS

Three crosses were used in the present study. They were derived from four widely diverse bread wheat genotypes. Names and pedigree of parental genotypes are given in Table (1). These genotypes were used to obtain the following three crosses: (1) Gemmeiza 9 x Mayon "S" // crow "S"/ vee "S", (2) Attila / Sids 1 x Sakha 94 and (3) Mayon "S"/ crow"S"/vee"S" x Attila /Sids 1 .

Table 1. The Name, pedigree and origin of four parental bread wheat genotypes.

S. No.	*Name*	*Pedigree*	*Origin*
P_1	*Gemmeiza 9*	Ald"S"/HUAC"S"//CMH74A630/Sx	Egypt
P_2	*Line 116*	Mayon "S" // crow "S"/ vee "S"	*CIMMYT*
P_3	*Promising Line 141*	Attila /Sids 1	Egypt
P_4	*Sakha 94*	Opta/Rayon // Kauz	Egypt

Cultivar Gemmeiza 9 is characterized by high yield , high number of spikes/plant and high number of kernels/spike, cultivar Sakha 94 by high yield, high number of spikes/plant and heavy kernel weight, Line# 116 from exotic materials by high yield, high number of spikes/plant and high number of kernels/spike and the promising line 141 by high yield, high number of spikes/plant and high number of kernels /spike. The two genotypes line 116 and line 141 they are good yielders under low level of nitrogen fertilizer.

This study was carried out at El-Giza Research Station of ARC during the two successive seasons 2007/2008 and 2008/2009. The final experiment (the third season in 2009/2010) was conducted at Kafer El-Hamam Research Station, El-Sharkia Governorate, Agriculture Research Center, ARC. In the first season (2007/2008), the parental genotypes were sown at three planting dates and the three crosses were made among the parents to produce F_1 hybrid seeds designed as follows:

1- Cross I : Gemmiza 9 x Line 116 (P_1 x P_2).
2- Cross II : Promising line 141 x Sakha 94 (P_3 x P_4).
3- Cross III : line 116 x Promising line 141 (P_2 x P_3).

In the second season (2008/2009), crosses were made between the F_1 hybrid of each cross and its two respective parents to produce the BC_1 and BC_2 populations. Crossing was repeated to ensure enough more fresh hybrid seeds, some of F_1 hybrid plants were selfed to produce the F_2 seeds and some parental spikes were also selfed to maintain the parental purity.

In the third season (2009/2010), the six populations including the two parents, the F_1 hybrids, F_2 populations and both back-crosses of each cross, were sown in a randomized complete block design (RCBD) with three replicates. Each replicate consisted of four rows from each of the parents and F_1 hybrid, six rows from the back-crosses and eight rows from the F_2 populations. Rows were 4 m long and 30 cm apart and 10 cm between plants within the row. Each of the two nitrogen levels i.e., 40 kg N/fed (low) and 75 kg N/fed (recommended) were applied and each nitrogen level represented a separate experiment. Soil characterization of the experimental site during 2009/2010 season are listed in Table (2). Phosphorous fertilizer (15 kg P_2O_5/ fed) as calcium super phosphate (15% P_2O_5) was added with land preparation. Recommended cultural practices for wheat were applied except for nitrogen levels. The preceding crop was cotton .

Table 2. Soil status at the experimental farm of Kafr El-Hamam Research station at Sharkia (Egypt).

Characteristics	2009 / 2010 season
Chemical analysis	
Ec	0.56
Ph	8.60
K ppm	62.5
P ppm	41
N ppm	14.5
Mechanical analysis	
Fine Sand %	26.90
Silt %	30.50
Clay %	40.91
Soil Texture	clay

Data were recorded on individual guarded plants from each plot (80 plants from F_2, 60 plants from back-crosses and 20 plants from each parents and F_1) for number of spikes/plant, number of kernels/spike, 100-kernel weight (g) and grain yield/plant (g). The proper cultural practices were applied as recommended for wheat production in both experiments.

Statistical and genetic analysis

To determine the presence or absence of non-allelic interaction, scaling test as outlined by Mather (1949) was used. The quantities A, B, C and D and their variances have been calculated to test the adequacy of the additive-dominance model in each case where:

$A = 2\,\overline{BC_1} - \overline{P_1} - \overline{F_1}$

$B = 2\overline{BC_2} - \overline{P_2} - \overline{F_1}$

$C = 4\overline{F_2} - 2\,\overline{F_1} - \overline{P_1} - \overline{P_2}$

$D = 2\overline{F_2} - \overline{BC_1} - \overline{BC_2}$

And

$V(A) = 4V(\overline{BC_1}) + V(\overline{P_1}) + V(\overline{F_1})$

$V(B) = 4V(\overline{BC_2}) + V(\overline{P_2}) + V(\overline{F_1})$

$V(C) = 16V(\overline{F_1}) + 4V(\overline{F_1}) + V(\overline{P_1}) + V(\overline{P_2})$

$V(D) = 4V(\overline{F_2}) + V(\overline{BC_1}) + V(\overline{BC_2})$

The standard error of A, B, C and D was obtained by taking the square root of respective variances. T-Test values are calculated upon dividing the effects of A, B, C and D by their respective standard errors.

Type of gene effects were estimated according to Gamble (1962) as follows:

The standard error of a, d, aa, ad and dd is obtained by taking the square root of respective variances. T-Test values were calculated upon dividing the effects a, d, aa, ad and dd by their respective standard error.

$m = \bar{F}_2$

$a = \overline{BC}_1 - \overline{BC}_2$

$d = \bar{F}_1 - 4\bar{F}_2 - 1/2\ (\bar{P}_1) - 1/2\ (\bar{P}_2) + 2\ \overline{BC}_1 + (2\ \overline{BC}_2)$

$aa = 2(\overline{BC}_1) + 2\ (\overline{BC}_2) - 4\ \bar{F}_2$

$ad = \overline{BC}_1 - 1/2\ (\bar{P}_1) - \overline{BC}_2 + 1/2\ (\bar{P}_2)$

$dd = \bar{P}_1 - \bar{P}_2 - 2\bar{F}_1 + 4\bar{F}_2 - 4(\overline{BC}_1) - 4(\overline{BC}_2)$

and

$V(m) = V\ (\bar{F}_2)$

$V(a) = V(\overline{BC}_1) + V(\overline{BC}_2)$

$V(d) = V(\bar{F}_1) + 16V(\bar{F}_2) + 1/4V(\bar{P}_1) + 1/4V(\bar{P}_2) + 4V(\overline{BC}_1) + 4V(\overline{BC}_2)$

$V(aa) = 4V(\overline{BC}_1) + 4V(\overline{BC}_2) + 16\ V(\bar{F}_2)$

$V(ad) = V(\overline{BC}_1) + 1/4V\ (\bar{P}_1) + V\ (\overline{BC}_2) + 1/4\ V(\bar{P}_2)$

$V(dd) = V(\bar{P}_1) + V(\bar{P}_2) + 4V(\bar{F}_1) + 16V(\bar{F}_2) + 16V(\overline{BC}_1) + 16V(\overline{BC}_2)$

The amount of heterosis was expressed as the percentage increase of F_1 above better parent values. Inbreeding depression was calculated as the difference between the F_1 and F_2 means expressed as percentage of the F_1 mean. The T-test was used to determine the significance of these deviations where the standard error (S.E.) was calculated as follows:

S. E. for better parent heterosis

$\bar{F}_1 - \overline{BP} = (\ VF_1 + VBP)^{1/2}$

And S. E. for inbreeding depression :

$\bar{F}_1 - \bar{F}_2 = (V\bar{F}_1 + V\bar{F}_2)^{1/2}$

In addition F_2 deviation (E_1) and back-crosses deviation (E_2) were measured as suggested by Mather and Jinks (1971). Potence ratio (P) was also calculated according to Peter and Frey (1966).

Heritability in broad and narrow sense was calculated according to Mather (1949). Furthermore the predicated genetic advance (Δg) from selection was computed according to Johanson *et. al* (1955) using 5% selection intensity.

The genetic gain as percentage of the F_2 mean performance (Δg %) was computed using the method of Miller *et. al* (1958).

RESULTS AND DISCUSSION

Mean performance

Mean performance of different characters for all populations and their standard errors for the three bread wheat crosses under two levels of nitrogen fertilizer are illustrated in Table (3).

Mode of gene action

As shown in Table (4) the scaling test (A, B, C and D) for the studied characters indicated that at least one of the non-allelic interactions is significant for all the studied traits except No. of spikes/plant in cross 1 under the low level of nitrogen fertilizer, indicating the adequacy of the six parameters model to explain the type of gene action controlling the traits in the three crosses under two levels of nitrogen fertilizer. These results assured the contribution of epistatic gene effect in the performance of these traits. In all studied traits, the mean effects parameters (m) which reflect the contribution due to the overall mean plus the locus effects and interactions of the fixed loci, was highly significant, with the exception of grain yield/plant in the third cross under high level of nitrogen fertilizer; the additive genetic estimates was highly significant. These results indicate the potentiality of improving the performance of these traits by using a pedigree selection program. Similar results were obtained by Abdel-Nour, (2006), Abdel-Nour, and Hassan, (2009) and El-Gabery *et. al.,* (2009).

Table 3. Mean performance ($\bar{X}$) and variance (S^2) of P_1, P_2, F_1, F_2, BC_1 and BC_2 populations of the three bread wheat crosses under two nitrogen levels .

Populations	Characters	Cross 1 (Gemmeiza 9 x Mayon"S"// crow"S"/vee"S")								Cross 2 (Attila /Sids1 x Sakha 94)								Cross 3 (Mayon"S"//crow"S"/vee"S" x Attila/Sids 1)							
		Spikes/plant		Kernels/spike		100-kernel weight(g)		Grain yield / plant (g)		Spikes/plant		Kernels/spike		100-kernel weight(g)		Grain yield / plant (g)		Spikes/plant		Kernels/spike		100-kernel weight(g)		Grain yield / plant (g)	
		$\bar{X}$	S^2	$\bar{X}$	S^2	$\bar{X}$	S^2	$\bar{X}$	S^2	$\bar{X}$	S^2	$\bar{X}$	S^2	$\bar{X}$	S^2	$\bar{X}$	S^2	$\bar{X}$	S^2	$\bar{X}$	S^2	$\bar{X}$	S^2	$\bar{X}$	S^2
40 kg N/ fed (low level)	P_1	7.33	5.2	58.72	30.37	4.54	0.091	18.60	14.34	10.29	1.87	52.50	11.02	4.65	0.064	22.13	5.52	11.27	3.95	51.69	24.37	4.03	0.073	26.10	15.96
	P_2	11.27	3.95	51.69	24.37	4.03	0.073	26.10	15.96	8.23	2.42	49.75	9.37	5.043	0.041	19.78	5.01	10.29	1.87	52.50	11.02	4.65	0.064	22.13	5.20
	F_1	13.27	4.35	54.93	23.06	4.66	0.11	36.47	13.60	11.45	1.08	64.93	14.15	4.343	0.022	31.75	4.93	17.40	1.93	48.97	9.41	4.685	0.082	35.76	3.12
	F_2	11.64	18.18	56.48	123.74	4.30	0.529	28.23	94.04	11.57	9.14	57.85	170.90	4.788	0.485	30.63	98.33	10.90	27.88	51.22	134.42	5.166	0.516	30.27	80.69
	BC_1	10.73	13.75	60.88	87.62	4.23	0.379	25.04	69.67	10.67	5.94	56.44	124.50	5.071	0.285	29.24	48.46	12.50	18.95	41.90	95.67	5.035	0.30	32.02	54.15
	BC_2	12.00	11.84	56.21	99.98	4.54	0.414	28.85	61.56	10.08	6.52	50.90	104.50	4.591	0.279	22.14	85.38	14.40	19.93	56.35	93.66	4.66	0.38	34.10	53.17
75 kg N/ fed (recommended level)	P_1	9.10	2.62	55.72	18.13	4.73	0.081	22.60	12.69	9.90	1.30	57.06	16.65	4.625	0.071	23.18	4.85	11.90	2.52	54.53	16.57	4.25	0.091	31.15	10.29
	P_2	11.90	2.52	54.53	16.57	4.25	0.091	31.15	10.29	8.60	0.85	53.50	17.14	4.903	0.051	21.97	8.40	9.90	1.30	57.06	16.65	4.625	0.071	23.18	7.85
	F_1	14.30	2.43	57.48	8.57	5.06	0.08	44.00	12.51	12.00	1.96	64.84	17.50	4.291	0.038	33.01	10.94	17.89	1.36	50.56	10.72	4.58	0.077	36.91	4.58
	F_2	11.60	17.62	57.01	120.62	4.32	0.62	30.18	83.33	11.92	8.74	58.31	175.10	4.794	0.432	32.01	92.12	11.11	28.22	51.53	145.08	5.16	0.571	31.13	92.20
	BC_1	12.00	13.33	57.15	70.36	4.58	0.396	29.57	58.23	11.40	4.27	57.22	107.69	4.838	0.270	30.93	45.35	13.20	17.70	43.05	106.99	5.344	0.318	34.12	62.23
	BC_2	13.90	11.21	53.50	83.95	4.87	0.456	34.29	60.57	10.30	8.09	51.44	125.27	4.72	0.276	25.32	73.43	14.78	19.73	56.50	103.96	4.754	0.446	35.32	66.29

Also, the major contribution by dominance gene effects to variation in these crosses under the two levels of nitrogen fertilizer for most traits is indicated by relative magnitude of the parameter dominance (d) to the parameter (m). In addition, the estimates of dominance effects were significant except for kernels/spike and kernel weight in the second cross under low level of nitrogen, and also were significant under recommended level except for spikes/plant in the second cross, kernels/spike in the first and second crosses and kernel weight in the third cross, indicating the importance of dominance gene effects in the inheritance of all traits under both levels of nitrogen fertilizer.

Significant additive (a) and dominance (d) components indicated that both additive and dominance effects were important for these traits under study and the selection should be achieved in advanced generations as homozygosity become fixable. Similar conclusion was obtained by Abdel-Nour, (2006), Abdel-Nour, and Hassan, (2009) and El-Gabery *et. al.,* (2009).

Significant estimates for epistatic gene effects for one or more of the three epistasis types were exhibited in the three crosses for all studied traits under both levels of nitrogen fertilizer, except additive x additive, additive x dominance and dominance x dominance in the first cross and additive x dominance in the second cross for spikes/plant, additive x dominance in the first cross for kernels /spike, additive x additive in the first and second crosses, and dominance x dominance in the first and third crosses for kernel weight and additive x additive and additive x dominance in first cross for grain yield/plant under low level of nitrogen fertilizer. Also additive x dominance in the first and second crosses for spikes/plant, additive x additive in the first and third crosses for kernels/spike, additive x additive in the second and third crosses for kernel weight and additive x dominance and dominance x dominance in the first cross for grain yield/plant under recommended level of nitrogen fertilizer.

Table 4. Estimates of scaling tests and gene effects of the studied characteristics, using six populations data in the three bread wheat crosses for low input (nitrogen fertilizer).

Characters	crosses	Scaling test								Gene effect (Gamble's procedure)											
		40 kg N/ fed (low level)				75 kg N/ fed (recommended level)				40 kg N/ fed (low level)						75 kg N/ fed (recommended level)					
		A	B	C	D	A	B	C	D	m	a	d	aa	ad	dd	m	a	d	aa	ad	dd
Spikes / plant	I	0.86	-0.45	1.42	0.55	0.60	1.60**	-3.20*	-2.70**	11.64**	-1.27**	2.87*	-1.1	0.70	-0.78	11.60**	-1.90**	9.20**	5.40**	-050	-7.60**
	II	-0.40	-.048	4.86**	2.39**	0.90*	0.00	5.18**	2.14**	11.57**	0.59*	-2.59*	-4.78**	-0.44	4.70**	11.92**	1.10**	-1.53	-4.28**	0.45	3.38
	III	-3.67**	1.11	-12.76**	-5.10**	-3.39**	1.77*	-13.14**	-5.76**	10.90**	-1.90**	16.82**	10.2**	-2.39**	-7.64**	11.11**	-1.58**	18.51**	11.52**	-2.58**	-9.90**
Kernels / spike	I	8.11**	5.80**	5.65	-4.13*	1.10	-5.01**	2.83	3.37*	56.48**	4.67**	7.985*	8.26*	1.155	-22.17**	57.01**	3.65**	-4.385	-6.74	3.055*	10.55*
	II	-4.55*	-12.88**	-0.71	8.36**	-7.46**	-15.46**	-7.00	7.96**	57.85**	5.54**	-2.915	-16.72**	4.165**	34.14**	58.31**	5.78**	-6.36	-15.92**	4.00**	38.84**
	III	-16.86**	11.23**	2.75	4.19*	-18.99**	5.38**	-6.59	3.51	51.22**	-14.45**	-11.505**	-8.38*	-14.045**	14.01*	51.53**	-13.45**	-12.255**	-7.02	-12.185**	20.63**
100-kernel weight (g)	I	-0.74**	0.39**	-0.69**	-0.17	-0.63**	0.43**	-1.82**	-0.81**	4.30**	-0.31**	0.715**	0.34	-0.565**	-0.01	4.32**	-0.29**	2.19**	1.62**	-0.53**	-1.42**
	II	1.149**	-0.204*	0.773**	-0.086	0.76**	0.246*	1.066**	0.03	4.788**	0.48**	-0.332	0.172	0.677**	-1.117**	4.794**	0.118*	-0.533*	-0.06	0.257**	-0.946**
	III	1.355**	-0.015	2.614**	0.637**	1.858**	0.303*	2.605**	0.222	5.166**	0.375**	-0.929**	-1.274**	0.685**	-0.066	5.16**	0.59**	-0.302	-0.444	0.778**	-1.717**
Grain yield / plant (g)	I	-4.99**	-4.87**	-4.72	2.57	-7.46**	-6.57**	-21.03**	-3.50*	28.23**	-3.81**	8.98*	-5.14	0.06	15.00**	30.18**	-4.72**	24.125**	7.00*	-0.445	7.03
	II	4.60**	-7.25**	17.11**	9.88**	5.67**	-4.34**	16.87**	7.77*	30.63**	7.10**	-8.965*	-19.76**	5.925**	22.41**	32.01**	5.61**	-5.105	-15.54**	5.005**	14.21**
	III	2.18	10.31**	1.33	-5.58**	0.18	10.55**	-3.63	-7.18**	30.27**	-2.08*	22.805**	11.16**	-4.065**	-23.65**	31.13**	-1.20	24.105**	14.36**	-5.185**	25.09**

Generally, the absolute magnitudes of the epistatic effects were larger than the additive or dominance gene effects in the most cases. Therefore, it could be concluded that epistatic effect was important as a major contributor in the performance of these cases. These results agree with the idea that the inheritance of qualitative characters is generally more complex than single quantitative characters. Similar results were obtained by Abdel-Nour, (2006).

Heterosis relative to the better parent, inbreeding depression percentage, potence ratio (P), F_2 deviation (E_1), back-crosses deviation (E_2), heritability and genetic advace estimates in each cross under both levels of nitrogen fertilizer for the studied characters are given in Table (5).

Significant positive heterosis was found for spikes/plant and grain yield/plant in the three crosses under the two levels of nitrogen and kernels/spike in the second cross under low level of nitrogen and meantime, heterosis percentage was highly significant for kernels/spike in the first and second crosses and kernel weight in the first cross under recommended level of nitrogen fertilizer. On the other side, negative significant heterosis values were revealed for kernels/spike in the first and third crosses and kernels weight in the second cross under 40kg N/fed and kernels/spike in the third cross and kernel weight in the second cross under 75 kg N/fed. Significant positive hetrotic effects were obtained for yield and yield components, in the three crosses under both levels of nitrogen fertilizer. These results indicated the large diversity of parents in their genetic constitution. Similar findings were reported by Abdel-Nour, (2006), Abdel-Nour, and Hassan, (2009) and El-Gabry *et. al.,* (2009).

Number of spikes/plant, number of kernels/spike and kernel weight are the main components of grain yield/plant. Hence, heterotic increase if found in one or more attributes with other attributes being constant would lead to favorable yield increase in hybrids. The lack of significance in heterosis of kernel weight in the first and third crosses under low level of nitrogen and third cross alone under recommended level of nitrogen could be due to the lower magnitude of the non-additive gene action. These results are in agreement with Ketata *et. al.,* (1976).

The recommended heterosis effects estimated for the most studied characters indicated the importance of such crosses in wheat breeding programs for improving grain yield/plant and its main components.

Significant inbreeding depression was found for all characters except kernels/spike in the first cross; spikes/plant and grain yield/plant in the second cross and kernels/spike and kernel weight in the third one under both levels of nitrogen fertilizer. However, significant negative inbreeding depression (inbreeding gain) was detected for kernels/spike in the third cross and kernel weight in the second and third ones under both levels of nitrogen fertilizer. This is a positive result, since the expression of heterosis in F_1 may be followed by a considerable reduction in F_2 performance.

The information about inbreeding depression is useful to test the potentiality of F_2 seeds after reducing the heterosis in F_2 generation due to the reduction of heterozygousity caused by inbreeding. Thus, it is logical expectation that the expression of heterosis in F_1 may be followed by reduction in F_2 performance for some of the studied traits especially these having high heterosis values.

The obtained results for most cases were in harmony with those obtained by Abdel-Nour, (2006) and El-Gabry *et. al*.,(2009).

Significant heterosis and insignificant inbreeding depression were obtained for spikes/plant and grain yield/plant in the second cross under both levels of nitrogen fertilizer and kernels/spike alone in the first cross under recommended level of nitrogen. The contradiction between heterosis and inbreeding depression estimates could be due to the presence of linkage between genes in these materials (Van der Veen 1959).

Table 5. Estimates of better parent heterosis (%), inbreeding depression (I. D%), potence ration (P), F_2 deviation (E_1), Backcrosses deviation (E_2), heritability in broad (B. S) and narrow sense (N. S) and genetic advance from selection (in absolute units and percentage) of the studied characteristics, using the six populations data in three bread wheat crosses under two nitrogen levels .

Characters	crosses	Heterosis % over B.P		Inbreeding depression		Potence ratio (P)		F_2 deviation (E_1)		Back-crosses deviation (E_2)		Heritability %				40 kg N/ fed		75 kg N/ fed	
												40 kg N/ fed		75 kg N/ fed					
		40 kg N/ fed	75 kg N/ fed	40 kg N/ fed	75 kg N/ fed	40 kg N/ fed	75 kg N/ fed	40 kg N/ fed	75 kg N/ fed	40 kg N/ fed	75 kg N/ fed	Broad sence	Narrow sence	Broad sence	Narrow sence	Genetic absolute	Advance %	Genetic absolute	Advance %
Spikes / plant	I	17.75**	20.17**	12.28**	18.88**	2.015	2.714	10.38	-0.80*	0.16	1.10*	75.25	59.24	85.68	60.75	5.203	44.70	5.25	45.27
	II	11.27**	21.21**	-1.05	0.667	2.126	4.231	1.215**	1.295**	0.04	0.45	80.42	63.68	84.32	58.58	3.966	34.28	3.568	29.93
	III	54.39**	33.48**	37.35**	37.89**	13.51	6.99	3.19**	-3.285**	-1.28*	-0.81	90.74	60.55	93.88	67.36	6.586	60.42	7.37	66.35
Kernels / spike	I	-6.45*	3.16*	-2.82	0.82	-0.078	3.958	1.413	0.708	6.955**	1.955	79.04	48.39	88.05	72.07	11.09	19.63	16.31	28.60
	II	23.68**	13.63**	10.90**	10.07**	10.04	5.371	-0.178	-1.75	-8.715	-11.46**	93.26	66.00	90.24	66.96	17.774	30.72	18.25	31.30
	III	-6.72**	-11.39**	-4.59*	-1.92*	-7.716	-4.138	0.688	-1.648	-2.815*	-6.805**	88.89	59.15	89.90	54.60	14.127	27.58	13.55	26.29
100-kernel weight (g)	I	2.64	6.98**	7.73**	14.62**	1.47	2.375	-0.173*	-0.455**	-0.175	-0.10	82.80	50.10	86.45	62.58	0.751	17.46	1.015	23.50
	II	-13.88**	-12.48**	-10.25**	-11.72**	-2.562	-3.403	0.193**	-0.267**	0.473**	0.503**	91.28	83.71	87.73	73.61	1.201	25.08	0.997	20.79
	III	0.753	-0.97	-10.267**	-12.66**	1.113	0.76	0.654**	0.651**	0.67**	11.081**	85.85	68.22	85.99	66.20	1.009	19.54	1.03	19.97
Grain yield / plant (g)	I	39.73**	41.25**	22.62**	31.41**	3.765	4.01	-1.18	5.258**	-4.93**	-7.015**	84.44	60.45	85.80	57.43	12.08	42.78	10.80	35.78
	II	43.47**	42.41**	3.53	3.029	9.187	17.248	4.278**	4.218**	-1.325	0.665	94.76	63.89	91.25	71.06	13.051	42.61	14.05	43.89
	III	37.01**	18.49**	15.35**	15.66**	5.866	2.445	0.333	-0.908	6.245**	5.365**	89.79	67.00	91.79	60.61	12.398	40.96	11.989	38.51

* and ** indicate significance at 0.05 and 0.01 levels of probability levels, respectively.

Potence ratio given in Table (5), indicated that over-dominance towards the higher parent for all characters except kernels/spike in the first and the third crosses under 40kg N/fed, and in the third one under 75 Kg N /fed; and kernel weight in the second and the third crosses under 40 and 75 Kg N/fed. Meantime over-dominance towards the lower parent was found for kernels/spike in the third cross and kernel weight in the second cross under both 40 and 75Kg N/fed. Complete dominance was found for kernels weight in the third cross. Meanwhile, partial dominance towards the higher parent was detected for kernel weight in the third cross under 75 kg N/fed. These results are in harmony with those obtained by Ketata *et. al.,* (1976), Abdel-Nour, (2006), El-Gabery *et. al.,* (2009) and Abdel-Nour, and Hassan, (2009).

Significant positive F_2 deviations (E_1) were indicated for spikes/plant and kernel weight in the second and the third crosses and grain yield/plant in the second cross under low level of nitrogen fertilizer; and for spikes/plant in the second cross, kernel weight in the third cross and for grain yield/plant in the first and the second crosses under recommended level of nitrogen fertilizer. Meanwhile, significant negative (E_1) values were obtained for kernel weight in the first cross under low level of nitrogen fertilizer, for spikes/plant in the first and the third crosses, kernel weight in the first and the second crosses under recommended level of nitrogen fertilizer. These results may refer to the contribution of epistatic gene effects in the performance of these characters.

On the other hand, insignificant F_2 deviations were detected for spikes/plant in the first cross, kernels /spike in all crosses and grain yield/plant in the first and the third crosses under low level of nitrogen fertilizer; for kernels/spike in all crosses and grain yield/plant in the third one under recommended level of nitrogen fertilizer. This may indicate that the epistatic gene effects have a minor contribution in the inheritance of these characters.

Backcross deviation (E_2) was significant for all characters in all crosses except for spikes/plant in the first and the second crosses, kernels/spike and grain yield/plant in the second cross and kernel weight in the first cross under low level of nitrogen fertilizer; for spikes/plant in the second and the third crosses, kernels/spike and kernel weight in the first cross and grain yield/plant in the second one under recommended level of nitrogen fertilizer. These results would ascertain the presence of epistasis in a such large magnitude as to warrant great deal of attention in breeding programs.

Heritability estimates in both broad and narrow sense are presented in Table (5). High heritability values in broad sense were detected for all studied characters in the three crosses under both low and recommended levels of nitrogen fertilizer.

High to moderate estimates of narrow sense heritability were found for all studied characters in all crosses under both low and recommended levels of nitrogen fertilizer. The differences in magnitude between broad and narrow sense heritability estimates of all studied characters would ascertain the presence of both additive and non-additive gene effects in the inheritance of these characters. This conclusion was also confirmed by estimates of gene action parameters. Similar results were obtained by Abdel-Nour, (2006), Abdel-Nour, and Hassan (2009) and El-Gabery *et. al.,* (2009).

The values of expected genetic advance (Δg) reported in Table (5) show the possible gain from selection as percent increase in the F_3 families over their selected F_2 plants. Genetic gain was rather moderate to high for spikes/plant, low to moderate for kernels/spike and kernel weight and moderate for grain yield/plant in all crosses under the two levels of nitrogen fertilizer. These results indicate the possibility of practicing selection in early segregating generation to enhance these characters and hence selecting high yielding genotypes. Similar results were obtained by Abdel-Nour, (2006) and El-Gabery *et. al.,* (2009).

Johanson *et. al.*, (1955) reported that heritability estimates along with genetic gain upon selection are more variable than the former alone in predicting the effect of selection. On the other hand, Dixit *et. al.,* (1970) pointed out that high heritability is not always associated with high genetic advance, but in order to make effective selection, high heritability should be associated with high genetic gain.

Quantitative characters having high heritability values may be of great importance for selection on the basis of phenotypic performance, in most traits under study.

The results of this study indicated that selection could be effective in early generation when the additive gene effects play an important role in the inheritance of the characters under study while the selection will be more effective in the late segregating generation if the dominance gene effects have the greatest contribution in the inheritance of the desired characters and the selection procedure based on the accumulation of additive effects may be very successful in improving of these characters.

In general, the most of biometrical parameters resulted from the first cross were higher in magnitude under the recommended level of nitrogen fertilizer than those obtained under the low level of nitrogen fertilizer, but in the second and third crosses were high under both low and recommended levels of nitrogen and would be of interest in breeding programmes under these conditions.

Generally, most biometrical parameters resulted from the first cross was higher in magnitude under recommended level of nitrogen fertilizer than those obtained from the low level of nitrogen fertilizer, but the second and third crosses high under both low and recommended levels of nitrogen and would be of interest in breeding programmes under these conditions.

Consequently, it could be concluded that the Line 141 (Attila/Sids 1), the second and the third crosses (Attila /Sids1 x Sakha 94) and (Mayon "S" // Crow"S" / Vre"S" x Attila /Sids 1) would be of interst in breeding programs under low input of nitrogen fertilizer for brining about the maximum genetic improvement.

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تقدير بعض الثوابت الوراثية لمحصول الحبوب ومكوناته في ثلاثة هجن من قمح الخبز للمدخلات الأقل من السماد الأزوتي

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أُجرى هذا البحث في محطة بحوث الجيزة في موسمي ٢٠٠٧/٢٠٠٨ إلى ٢٠٠٨/٢٠٠٩م ، ثم أجريت تجربة التقييم النهائي في محطة البحوث الزراعية بكفر الحمام – محافظة الشرقية ، في موسم ٢٠٠٩/٢٠١٠ على ثلاثة هجن من قمح الخبز (كل من الأبوين والجيلين الأول والثاني والجيلين الرجعيين الأول والثاني) لكل من الهجن الثلاثة وهي:

1-Gemmeiza 9 x Mayon"S"//Crow"S"/Vee"S".

2- Attila/Sids1 x Sakha 94.

3- Mayon"S" // Crow "S"/Vee"S" x Attila / Sids 1

تحت معدلين من التسميد الأزوتي الأول ٤٠ كجم أزوت/فدان وهو معدل أقل من التسميد الموصى به ، أما المعدل الثاني الموصى به وهو ٧٥ كجم أزوت/فدان وذلك بهدف دراسة قوة الهجين والانخفاض الناشئ عن التربية الذاتية ونوع ودرجة السيادة مع تحديد طبيعة الفعل الجيني للعوامل الوراثية المتحكمة في وراثة صفة محصول الحبوب للقمح ومكوناته وبعض الصفات المؤثرة عليه مع تقدير المكافئ الوراثي والتقدم الوراثي المتوقع بالانتخاب.

- كانت قوة الهجين في F_1 بالنسبة للأب الأفضل معنوية وموجبة لحبوب النبات وعدد السنابل/ النبات في الثلاثة هجن لكل من معدلي التسميد الأزوتي وكذلك بالنسبة لصفة عدد الحبوب/ نبات للهجين الثاني تحت معدل التسميد الأقل . أما بالنسبة لمعدل التسميد الموصى به فكانت قوة الهجين موجبة ومعنوية لصفة عدد الحبوب/سنبلة للهجينين الأول والثاني وبالنسبة لصفة وزن المائة حبة فكانت للهجين الأول وذلك تحت معدل التسميد الموصى به.
- كما أشارت النتائج أيضاً إلى وجود نقص ناتج عن التربية الذاتية في صفة عدد السنابل/نبات و وزن حبوب النبات في كل من الهجين الأول والثالث وكذلك لصفة عدد الحبوب / سنبلة بالنسبة للهجين الثاني وصفة وزن المائة حبة في الهجين الأول لكل من معدلي التسميد الأزوتي ، بينما كان تأثير التربية الذاتية سالباً ومعنوياً لصفة وزن المائة حبة للهجينين الثاني والثالث لكل من معدلي التسميد الأزوتي .
- أوضحت دراسة طبيعة التوارث أن درجة السيادة كانت فائقة تجاه الأب الأعلى لجميع الصفات تحت معدلي التسميد الأزوتي ما عدا صفة عدد الحبوب/سنبلة في الهجين الأول تحت معدل التسميد الأقل وكذلك عدد الحبوب / سنبلة للهجين الثالث ووزن المائة حبة للهجين الثاني في كل من معدلي التسميد الأزوتي.

- كما أظهرت النتائج وجود سيادة كاملة تجاه الأب الأعلى لصفة وزن المائة حبة للهجين الثالث تحت معدل التسميد الأقل ، بينما أظهرت وجود سيادة جزئية للأب الأعلى لنفس الهجين تحت معدل التسميد الأزوتي الموصى به .
- كانت انحرافات الجيل الثاني (E_1) وانحرافات الجيلين الرجعيين (E_2) معنوية لمعظم الصفات في الهجن تحت الدراسة لمعدلي التسميد الأزوتي مما يوضح أهمية الفعل الجيني التفوقي في وراثة الصفات .
- أظهرت النتائج وجود تفاعل غير أليلي في معظم الصفات تحت الدراسة مما يدل على أن النموذج الوراثي ذو الستة مقاييس كانت لحساب تباين العشائر الستة .
- أظهرت التأثيرات الوراثية المضيفة وكذلك الفعل الجيني غير المضيف(السيادة والتفوق) دوراً هاماً في وراثة معظم الصفات المدروسة لكل من معدلي التسميد الأزوتي .
- أظهرت كفاءة التوريث بمعناها الواسع قيماً عالية لكل الصفات ، كما أظهرت كفاءة التوريث بمعناها الضيق قيماً متوسطة إلى عالية مرتبطة بنسبة تحسين وراثي متوسط في معظم الصفات المدروسة لكل من معدلي التسميد الأزوتي .

والخلاصة أنه يمكن الاستفادة من الهجن الثلاثة في برامج تربية القمح للحصول على سلالات جيدة ومتفوقة في المحصول سواء تحت معدل التسميد الأزوتي الموصى به أو تحت التسميد الأزوتي المنخفض.

أما بالنسبة للهجينين الثاني والثالث فيمكن الاستفادة منهما تحت ظروف مدخلات أقل من التسميد الأزوتي فقط ، كما أن النتائج المتحصل عليها تدل على أن الانتخاب في الأجيال الانعزالية المبكرة قد يكون مفيداً في الهجين الثاني فقط ولكن سوف يكون أكثر كفاءة إذا تم تأجيله إلى الأجيال الانعزالية المتأخرة وخاصة بالنسبة للهجينين الأول والثالث .