Annals Agric. Sci., Ain Shams Univ., Cairo, 48(1), 131-146, 2003

GENE EFFECTS FOR SOME AGRONOMIC TRAITS IN THREE BREAD WHEAT CROSSES

[10]

Hamada[1], **A.A.**

ABSTRACT

Six populations (P_1, P_2 ,F_1,F_2, $Bc_1$and Bc_2) of three bread wheat *Tritium aestivum* L. crosses of namely Sids 8 x Dorghal (crossI) ,Giza 170 x SD8036(cross II) and Sudan # 8 x tast/ Toria (cross III), were studied for earliness ,plant height, yield and yield components. Highly significant positive heterotic effects relative to mid parent and /or better parent values were obtained for spike length , number of spikes /plant, number of kernels/ spike, 1000 kernel weight and grain yield/ plant in the three crosses and grain filling period in the first cross. Significant negative heterotic effects relative to mid parent and /or better parent were detected for heading date in the first cross. Also similar effects were detected for maturity date, grain filling period and plant height in the second and third crosses. High values of Genetic Coefficient of Variation (G.C.V.) were detected for spike length in the three crosses and for number of spikes /plant in the second and third crosses. Moderate G.C.V. values were obtained for grain yield/plant, number of kernels / spike and 1000- kernel weight in the three crosses, heading date, maturity date and plant height in the first cross, and grain filling period in the first and second crosses. The additive genetic estimates were highly significant for all traits in the three crosses except number of spikes /plant in the second cross . The estimates of dominance effects were significant for all traits except heading date in the first and second crosses, maturity date in the third cross , spike length in the second and third crosses, number of spikes / plant and number of kernels / spike in the second cross . Significant estimates for epistatic gene effects for one or more of the three types of epistatsis were obtained in the three crosses for all the studied traits. High to moderate values of heritability (broad and narrow sense) and the predicted genetic gain for most traits were detected.

Key words: Breed wheat, Yield components, Gene action, Heritability

INTRODUCTION

The Egyptian wheat cultivars have narrow genetic background, Selection among 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. Quantitative economic traits

---

1- National Wheat Research Program, Field Crops Research Institute, ARC, Giza, Egypt.

(Received February 15, 2003)
(Accepted April 14, 2003)

in wheat are highly influenced by environmental conditions .To overcome this problem variation is partitioned the to heritable and non heritable components is made with the help of suitable genetic parameters such as genetic coefficients of variation, heritability estimates and gene action.

Assessment and quantifying the type of gene action in wheat were detected by many investigators .**Mosaad *et al* (1990)** and **El-Seidy and Hamada (1997)** found that additive genetic variance was the prevalent type controlling days to heading plant height and spike length . Moreover, **Al-Kaddoussi (1996)** and **Moustafa (2002)**, reported that dominance component played an important role in genetic control for number of spikes/ plant, number of kernels/spike, 100-kernel weight and grain yield/plant. On the other hand **El-Hosary *et al* (2000)** and **Morad (2001)** found that grain yield and its components in wheat genotypes were controlled by both additive and non-additive gene effects. In addition, **Przulj and Mladenov (1999 a)** indicated that heritability estimates ranged from 0.35 to 0.73 for grain filling .Meanwhile, **Morad (2001)** and **Ashoush *et al* (2001)** reported that heritability estimates for plant height, heading date and yield components were medium to high (more than 50 %).

The present work was carried out to study genetic variance, gene action, heritability, and predicted genetic gain for yield and yield components in wheat using the three crosses Sids 8 x Dorghal, Giza 170 x SD8036 and Sudan 8 x Tast /Toria .The ultimate goal of this study is to elucidate the breeding value of crosses that could be utilized in a breeding program to improve wheat yield .

MATERIAL AND METHODS

The field experiments were carried out at El-Gemmeiza Agricultural Research Station during three successive seasons (1999/2000,2000/2001 and 2001/2002). Six bread wheat *Triticum aestivum* L. cultivars and lines were chosen for this investigation on the basis origin diversity (Table 1).

In the 1999/2000 season, the parent genotypes were sown at three planting dates to secure enough hybrid seeds of three crosses made among the parents to produce F_1 hybrid designated as follows:

I - cross 1 : Sids 8 x Dorghal
II - cross 2 : Giza 170 x SD8036
III- cross 3 : Sudan# 8 x Tast/Toria

In the 2000/2001 season, 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. Some of F_1 hybrid plants were selfed to produce the F_2 grains and some parental spikes were also selfed to maintain the parental purity.

In the 2001/2002 season, 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 with three replicates. Each replicate consisted of four rows from each of the parents, F_1 hybrid and back-crosses and six rows from the F_2 populations .Rows were 4 m long and 30 cm apart and 10 cm between plants within the row. Recommended field practices for wheat production were adopted allover the growing season.

Data were recorded on individual guarded plants for the following characters

1- Heading date; number of days from planting to the time of the emergence of the first spike.

Table 1. Pedigree and origin for the parental wheat genotypes

Entry	Cultivar or cross and pedigree	Origin
1	Sids8=Maya's'/Mon's'//CMH74A.592/3/Sakha 8^{*2}SD 10002 -8SDr-1SD-1SD-OSD	Egypt
2	Dorghal=CM73861-O3AP-300AP-5AP-3AP-300L-OAP	Syria
3	Giza 170 = Kauz/Altar 84//Aso	Egypt
4	SD8036	Moracco
5	Sudan # 8	Sudan
6	Tast /Toria Swm 754397-O2P-3H-1H-OP	Mexico

2- Maturity date; number of days from planting to the beginning of change in green color of the main stem to yellow color (Physiological maturity).
3- Grain filling period , number of days from anthesis to maturity.
4- Plant height (cm) measured from soil surface to the top of the spike on the tallest culm (without awn).
5- Spike length (cm).
6- Number of fertile spikes per plant.
7- Number of kernels/ spike; average number of kernels from 10 main spikes.
8- 1000- Kernel weight in grams.
9- Grain yield per plant in grams.

Statistical and genetic analysis

To determine the presence or absence of non-allalic 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 adequancy of the additive – dominance model in each case where :

$$A = 2\,\overline{Bc1} - \overline{P1} - \overline{F1}$$

$$B = 2\,\overline{Bc2} - \overline{P2} - \overline{F1}$$

$$C = 4\,\overline{F2} - 2\,\overline{F1} - \overline{P1} - \overline{P2}$$

$$D = 2\,\overline{F2} - \overline{Bc1} - \overline{Bc2}\ \text{, and}$$

$$V(A) = 4\,V\,(\overline{Bc1}\,) + V\,(\overline{P1}\,) + V\,(\overline{F1}\,)$$

$$V(B) = 4\,V\,(\overline{Bc2}\,) + V\,(\overline{P2}\,) + V\,(\overline{F1}\,)$$

$$V(C) = 16\,V\,(\overline{F2}\,) + 4\,V\,(\overline{F1}\,) + V\,(\overline{P1}$$

$$V\,(\overline{P2}\,)$$

$$V(D) = 4\,V\,(\overline{F2}\,) + V\,(\overline{Bc1}\,) + V\,(\overline{Bc2}$$

The standard error of A,B,C and D is 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 are calculated upon dividing the effects of a, d, aa, ad and dd by their respective standard error.

$$m = \overline{F2}$$

$$a = \overline{Bc1} - \overline{Bc2}$$

$$d = \overline{F1} - 4\,\overline{F2} - \frac{1}{2}(\overline{P1}) - \frac{1}{2}(\overline{P2}) + 2(\overline{Bc1}) + 2(\overline{Bc2})$$

$$aa = 2(\overline{Bc1}) + 2(\overline{Bc2}) - 4\,\overline{F2}$$

$$ad = \overline{Bc1} - \frac{1}{2}\overline{P1} - \overline{Bc2} + \frac{1}{2}\overline{P2}$$

$$dd = \overline{P1} + \overline{P2} - 2\overline{F1} + 4\overline{F2} - 4(\overline{Bc1}) - 4(\overline{Bc2}),$$

$$\text{and } Vm = V\,\overline{F2}$$

$$Va = V(\overline{Bc1}) + V(\overline{Bc2})$$

$$Vd = V\,\overline{F1} + 16\,V\,\overline{F2} + \frac{1}{4}V(\overline{P1}) + \frac{1}{4}V(\overline{P2}) + 4\,V(\overline{Bc1}) + 4\,V(\overline{Bc2})$$

$$Vaa = 4\,V(\overline{Bc1}) + 4\,V(\overline{Bc2}) + 16\,V(\overline{F2})$$

$$Vad = V(\overline{Bc1}) + \frac{1}{4}V(\overline{P1}) + V(\overline{Bc2}) + \frac{1}{4}V(\overline{P2})$$

$$Vdd = V(\overline{P1}) + V(\overline{P2}) + 4\,V(\overline{F1}) + 16\,V(\overline{F2}) + 16\,V(\overline{Bc1}) + 16\,V(\overline{Bc2})$$

The amount of heterosis was expressed as the percentage deviation of F_1 mean performance from mid and better parent values. Inbreeding depression was calculated as the difference between the F_1 and F_2 means expressed as a 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 mid parent heterosis

$$(\overline{F1} - \overline{MP}) = (V\,\overline{F1} + \frac{1}{4}V\,\overline{P1} + \frac{1}{4}V\,\overline{P2})^{1/2}$$

S.E for better parent heterosis

$$(\overline{F1} - \overline{BP}) = (V\,\overline{F1} + V\,\overline{BP})^{1/2}$$

and S.E for inbreeding deperession

$$(\overline{F1} - \overline{F2}) = (V\,\overline{F1} + V\,\overline{F2})^{1/2}$$

The studied parameters were heritability in broad and narrow sense according **Mather (1949)**; predicted genetic gain from selection (Δ g) **Johanson *et al* (1955)** and genetic coefficient of variation (G.C.V %) **Burton (1952).**

RESULTS AND DISCUSSION

Significant genetic variance was detected for all studied traits in the three crosses, therefore other genetical parameters were estimated (Table, 2). Also, differences between the two parents in each cross were significant for all studied traits. The existence of significant genetic variability in spite of the significant differences between the parents, obtained herein in most traits, may suggest that the genes of like effects were not completely associated in the parents, i.e., these genes are dispersed (**Mather and Jinks 1971**).

Heterosis

Highly significant positive heterotic effects relative to mid parent and /or better parent values were obtained for spike length, number of spikes/plant, number of kernels/spike, 1000 kernel weight and grain yield /plant in the three crosses. for grain filling period in the first

Table 2. Means and variances of six populations for nine traits in three wheat crosses

Trait	Statistics	Cross 1					
		$\overline{P1}$	$\overline{P2}$	$\overline{F1}$	$\overline{Bc1}$	$\overline{Bc2}$	$\overline{F2}$
No. of plants	N	300	300	300	400	400	500
Heading date	$\overline{X}$	83.45	98	81.23	81.25	91.23	83.85
	S^2	2.46	2.71	4.51	10.24	8.64	15.64
Maturity date	$\overline{X}$	140.25	147.51	148.65	138.90	142.35	135.34
	S^2	2.35	3.10	6.54	18.94	19.87	22.34
Grain filling	$\overline{X}$	56.81	49.51	67.42	57.56	51.12	51.49
	S^2	2.87	2.89	6.34	13.25	12.89	20.23
Plant height	$\overline{X}$	98.25	115.95	105.63	90.54	105.67	101.54
	S^2	8.95	10.23	18.94	34.58	30.24	44.56
Spike length	$\overline{X}$	14.78	11.30	15.46	13.78	11.51	16.35
	S^2	1.98	2.13	1.89	3.56	3.12	4.23
No. of	$\overline{X}$	4.58	8.46	10.24	6.54	10.24	12.35
spikes/plant	S^2	8.79	10.23	12.36	23.67	25.64	37.89
No. of ker-	$\overline{X}$	87.96	56.48	102.23	86.95	54.87	103.56
nels/spike	S^2	10.24	8.96	12.35	25.46	23.54	29.65
1000-kernel	$\overline{X}$	47.56	43.27	48.96	46.8	44.12	45.68
weight	S^2	5.62	4.56	8.57	14.56	13.54	20.35
Grain	$\overline{X}$	19.96	17.23	25.63	18.65	17.85	28.69
yield/plant	S^2	10.87	11.23	14.56	26.87	28.49	37.89

Cross I: Sids 8 x Dorghal

Table 2. Cont.

Trait	Statistics	Cross II					
		$\overline{P1}$	$\overline{P2}$	$\overline{F1}$	$\overline{Bc1}$	$\overline{Bc2}$	$\overline{F2}$
No. of plants	N	200	200	200	350	350	450
Heading date	$\overline{X}$	95.32	121.54	105.64	90.25	107.58	98.65
	S^2	3.25	2.91	4.56	25.68	30.25	37.36
Maturity date	$\overline{X}$	144.36	152.78	143.57	142.65	146.35	140.23
	S^2	1.57	2.34	4.53	18.95	20.36	27.89
Grain filling	$\overline{X}$	49.04	31.24	38.06	52.40	38.77	41.58
	S^2	2.56	1.87	3.25	20.41	17.84	25.36
Plant height	$\overline{X}$	118.36	110.56	109.65	108.56	102.34	103.24
	S^2	8.96	7.45	12.35	38.65	33.47	55.65
Spike length	$\overline{X}$	11.32	12.34	14.24	10.98	11.95	12.12
	S^2	1.45	0.98	2.34	10.24	8.56	13.54
No. of spikes/plant	$\overline{X}$	9.42	11.56	14.23	10.89	10.56	11.89
	S^2	2.35	1.53	3.24	13.54	12.34	17.65
No. of kernels/spike	$\overline{X}$	58.69	51.23	61.35	54.68	52.36	55.36
	S^2	5.61	7.89	10.23	25.64	27.84	35.60
1000-kernel weight	$\overline{X}$	44.58	39.54	46.32	40.24	41.28	40.18
	S^2	1.32	1.24	3.14	24.35	17.58	16.42
Grain yield/plant	$\overline{X}$	26.84	21.35	32.45	23.54	21.36	27.81
	S^2	5.63	7.84	11.24	25.64	22.34	31.24

Cross II: Giza 170 x SD 8036

Table 2. Cont.

Trait	Statistics	Cross III					
		$\overline{P1}$	$\overline{P2}$	$\overline{F1}$	$\overline{Bc1}$	$\overline{Bc2}$	$\overline{F2}$
No. of plants	N	250	250	250	350	350	400
Heading date	$\overline{X}$	99.31	91.24	92.35	93.54	90.12	90.21
	S^2	1.24	1.62	2.41	16.45	18.54	21.36
Maturity date	$\overline{X}$	159.36	144.24	143.56	148.96	140.24	142.32
	S^2	3.54	2.54	3.98	28.94	28.16	36.45
Grain filling	$\overline{X}$	60.05	53	51.21	55.42	50.12	52.11
	S^2	2.31	1.78	2.67	13.21	12.34	17.61
Plant height	$\overline{X}$	126.32	103.45	101.23	120.36	101.24	110.23
	S^2	7.25	8.10	11.25	35.64	38.91	45.63
Spike length	$\overline{X}$	11.10	11.63	12.40	11.46	10.52	11.27
	S^2	1.11	1.63	2.14	9.86	10.17	16.82
No. of spikes/plant	$\overline{X}$	8.74	15.23	19.23	12.23	7.23	13.24
	S^2	1.58	1.62	2.71	13.64	15.60	17.81
No. of kernels/spike	$\overline{X}$	58.35	71.23	74.23	64.53	58.24	65.43
	S^2	6.84	5.34	10.23	25.31	27.65	39.65
1000-kernel weight	$\overline{X}$	49.21	45.21	51.23	47.54	40.12	42.36
	S^2	2.32	1.54	3.47	25.64	22.13	28.16
Grain yield/plant	$\overline{X}$	26.54	36.54	39.45	30.25	32.35	34.65
	S^2	8.45	10.23	15.36	44.63	41.25	56.32

Cross III: Sudan 8 x Tast /Toria

cross. Significant negative heterotic effects relative to mid parent and /or better parent were detected for heading date in the first cross; for maturity date, grain filling period and plant height in the second and third crosses. Also significant negative heterotic effects relative to mid parent value were obtained for plant height in he first cross Table (4).

Earliness, if found in wheat is favourable for escaping destructive injuries caused by stress conditions .Both second and third crosses ,as previously mentioned ,expressed significant negative heterosis for maturity date. Hence, it could be concluded that both populations are valuable in breeding for earliness. Similar results were reported by **Abd El-Aty (2000)**; **Ashoush *et al* (2001)** and **Awaad (2001)**. Highly significant negative heterosis for plant height was found in both second and third crosses .This result is important to obtain short plants. This result is in agreement with that obtained by **El-Seidy and Hamada (2000)** and **Hamada and Tawfelis (2001)**. Significant positive heterotic effects were obtained for yield and yield components, in the three crosses. This result indicated the large diversity of parents genetic constitution .Similar results were reported by **El-Seidy and Hamada (1997), Darwish (1998)**, **El-Hosary *et al* (2000)** and **El-Morshidy *et al* (2001)**

Inbreeding depression

Significant positive values were obtained for inbreeding depression of maturity date and 1000 kernel weight in the three crosses. Significant positive results showed for heading date, spike length, number of spikes/plant, number of kernels/spike and grain yield/plant in the second and third crosses. Also significant positive values were detected for grain filling period in the first cross and plant height in the first and second crosses (Table, 4). On the other hand, significant negative values were obtained for other traits. Significant effects for both heterosis and inbreeding depression were associated for all cases except maturity date in the first cross (Table, 4). 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 expectation which was also reached by **El-Seidy and Hamada (1997)**, **Khalifa *et al* (1997)** and **Kheiralla *et al* (2001)**.

Insignificant heterosis and significant inbreeding depression values were obtained for maturity date in the first cross (Table, 3).**Van der Veen (1959)** pointed out that the presence of linkage causes some bias in estimates of parameters that are derived from the F_2 and backcross generations. Also, **Marani (1968)** reported that the reduction in the values of non additive genetic components is caused by means of inbreeding depression.

Genetic coefficient of variability

Table (4) shows high genetic coefficient of variation for spike length in the three crosses; for number of spikes /plant in the second and third crosses. However moderate values were obtained for grain yield /plant, number of kernels /spike and 1000 kernel weight in the three crosses. Also moderate values were obtained for heading date, maturity date and plant height in the first cross, for grain filling period in the first and second crosses. The

Table 3. Estimates of scaling test, types of gene action using generation means of the three crosses for nine traits of wheat

Trait	Cross	Scaling test			
		A	B	C	D
Heading date	I	-2.18**	3.23**	-8.51**	-13.75**
	II	-20.46**	-12.02**	-33.54**	-19.56**
	III	-4.58**	-3.35**	-14.41**	-10.13**
Maturity date	I	-11.10**	-11.46**	-43.70**	-17.08**
	II	-2.63**	-3.65**	-23.36**	-16.68**
	III	-5.00**	-7.32**	-21.44**	-18.96**
Grain filling	I	-8.93**	-14.69**	-35.20**	-3.34**
	II	17.70**	8.24**	9.92**	2.88**
	III	-0.42$^{N.S.}$	-3.97**	-7.03**	-8.83**
Plant height	I	-22.80**	-10.24**	-19.30**	-11.12**
	II	-10.89**	-15.53**	-35.26**	-22.44**
	III	13.17**	-2.20*	8.69**	-9.31**
Spike length	I	-2.69**	-3.74**	8.40**	6.62**
	II	-3.60**	-2.68**	-3.66**	0.58
	III	-0.58$^{N.S.}$	-2.99**	-2.45**	-0.19
Number of spikes/plant	I	-1.74**	1.78**	15.88**	11.66**
	II	-1.87**	-4.67**	-1.88*	2.80**
	III	-3.51**	-20.0**	-9.47**	2.51**
Number of kernels/spike	I	-16.29**	-48.97**	65.34**	62.68**
	II	-10.68**	-7.86**	-11.18**	0.80
	III	-3.52**	-28.98**	-16.32**	1.28
1000-kernel weight	I	-2.92**	-3.99**	-6.03**	0.53
	II	-8.34**	-5.50**	-15.80**	-3.64**
	III	-5.36**	-16.20**	-27.44**	-9.70**
Grain yield/plant	I	-8.29**	-7.16**	26.31**	20.19**
	II	-12.21**	-11.08**	-1.85$^{N.S}$	7.43**
	III	-1.29**	-15.49**	-3.38*	6.22**

Table 3. Cont.

Trait	Cross	Six parameters (Gamble's procedure)					
		m	a	d	aa	ad	dd
Heading date	I	83.85**	-9.98**	0.065	9.56**	-2.705**	-10.61**
	II	98.68**	-17.33**	-1.73	1.06	-4.22**	31.42**
	III	90.21**	3.42**	3.55**	6.48**	-0.615	1.45
Maturity date	I	135.34**	-3.45**	25.91	21.14**	0.18	1.42
	II	140.23**	-3.70**	12.08**	17.08**	0.51	-10.8**
	III	142.32**	8.72**	0.88	9.12**	1.16**	3.20
Grain filling	I	51.49**	6.53**	25.84**	11.58**	2.88**	12.04**
	II	41.58**	13.63**	13.94**	16.02**	4.73**	-41.96**
	III	52.11**	5.3**	-2.675**	2.64**	1.775**	1.75
Plant height	I	101.54**	-15.13**	-15.21**	-13.74**	-6.28**	46.78**
	II	103.25**	6.22**	4.03*	8.84**	2.32**	17.58**
	III	110.23**	19.12**	-11.375**	2.28	7.685**	-13.25**
Spike length	I	16.35**	2.27**	-12.40**	-14.82*	0.53**	21.24**
	II	12.12**	-0.97**	-0.21	-2.62**	-0.46	8.9**
	III	11.27**	0.94**	-0.085	-1.12	1.205**	4.69**
Number of spikes/plant	I	12.35**	-3.70**	-12.12**	-15.84**	-1.76**	15.80**
	II	11.89**	0.33	-0.92	-4.66**	1.40**	11.20**
	III	13.24**	5.00**	-6.795**	-14.04**	8.245**	37.55**
Number of kernels/spike	I	103.56**	32.08**	-100.59**	-130.6**	16.34**	195.86**
	II	55.36**	2.32**	-0.97	-7.36**	-1.41**	25.9**
	III	65.43**	6.29**	-6.74**	-16.18**	12.73**	48.68**
1000-kernel weight	I	45.68**	2.68**	2.66**	-0.88	0.535	7.79**
	II	40.24**	1.10**	6.22**	1.96	-1.42**	11.88**
	III	42.36**	7.42**	9.90**	5.88**	5.42**	15.68**
Grain yield/plant	I	28.69**	0.80*	-34.725**	-41.76**	-0.565	57.21**
	II	27.81**	2.18*	-13.085**	-21.44**	-0.565	44.73**
	III	34.65**	2.10**	-5.49**	-13.4**	7.10**	30.18**

Cross I: Sids 8 x Dorghal, cross II: Giza 170 x SD8036 Cross III Sudan 8 x Tast / Toria
*, ** Verify the significant at 0.05 and 0.01 levels of probability, respectively

Table 4. Estimates of heterosis, inbreeding depression (ID%), heritability in broad (B.S) and narrow sense (N.S) and genetic advance (Δ g) for nine traits in the three wheat crosses

Trait	Crosses	Heterosis %		ID%	Heritability%		Δ g%	Δ g	G.C.V%
		$\overline{MP}$	$\overline{BP}$		Broad	Narrow			
Heading date	I	-10.465**	-2.66**	-3.225**	79.369	79.283	7.703	6.459	22.527
	II	-2.573**	10.826**	6.616**	90.435	50.294	6.332	6.419	5.892
	III	-3.070**	1.216	2.317**	91.775	36.189	3.819	3.445	4.908
Maturity date	I	3.315	5.989	8.953**	82.109	26.275	1.890	2.558	19.171
	II	-3.365**	-0.547**	2.326**	89.876	59.053	4.581	6.424	3.570
	III	-5.428**	-0.471**	0.863**	90.800	43.347	3.787	5.391	4.042
Grain filling	I	26.824**	18.676**	23.628**	80.062	70.785	12.737	6.558	19.893
	II	-5.181**	-22.38**	-9.248**	89.905	49.171	12.268	5.101	11.483
	III	-9.402**	-14.721**	-1.757**	87.204	54.911	9.109	4.746	7.520
Plant height	I	-1.372**	7.511	3.872**	71.484	54.533	7.385	7.498	12.665
	II	-4.202**	-0.823**	5.845**	82.773	70.404	10.479	10.819	6.573
	III	-11.885**	-2.145**	-8.890**	80.568	36.620	4.622	5.095	5.501
Spike length	I	18.558**	4.601**	-5.756**	52.718	42.080	10.904	1.782	35.303
	II	20.371**	15.397**	14.887**	88.257	61.152	38.245	4.635	28.522
	III	9.106**	6.620**	9.113**	90.328	80.915	60.656	6.836	34.586
Number of spikes/plant	I	57.055**	21.040**	-20.605**	72.393	69.860	71.728	8.858	13.822
	II	35.653**	23.096**	16.444**	86.553	53.371	38.847	4.618	32.872
	III	60.450**	26.263**	31.149**	88.938	35.822	23.521	3.114	30.060
Number of kernels/spike	I	41.553**	16.223**	-1.300**	64.530	34.738	3.762	3.896	14.752
	II	11.626**	4.532**	9.763**	77.780	49.775	11.051	6.117	9.505
	III	14.570**	4.211**	11.855**	81.160	66.431	13.169	8.617	8.669
1000-kernel weight	I	7.805**	2.943**	6.699**	69.302	61.984	12.612	5.761	18.449
	II	10.128**	3.903**	13.126**	92.197	60.369	15.250	6.136	11.774
	III	8.515**	4.104**	17.314**	91.323	30.362	7.835	3.319	11.971
Grain yield/plant	I	37.832**	28.406**	-11.939**	67.748	53.892	23.819	6.833	13.371
	II	34.675**	20.901**	14.298**	73.634	46.414	19.216	5.344	17.246
	III	25.079	7.963**	12.167	79.853	47.514	21.199	7.345	19.354

*and ** Significant at 0.05 and 0.01 level of probability, respectively.

other cases had low values of G.C.V.. alone, however, it is imposable to estimate the magnitude of heritable variation. The heritable portion of the variation could be found out with the help of heritability estimates and genetic gain under selection **(Al-Kaddoussi (1996), El-Seidy and Hamada** (1997) and **Awaad** (2001).

Heritability estimates

Heritability in broad sence for the studied traits were estimated and the obtained values are presented in Table (4). High heritability values were detected for all studied traits in the three crosses. Similar results had been reported by **El-Seidy and Hamada (1997)** for plant height, heading date, spike length, **Khalifa *et al* (1997)** for plant height, spike length; heading and maturity dates; **Przulj and Mladenov (1999 a)** for grain filling period and **Morad (2001)** for number of spikes/plant, 1000-kernel weight and grain yield /plant .

Heritability in narrow sense was estimated using F_2 and backcrosses data, and the obtained results are presented in Table (4). Moderate values were estimated for grain yield /plant in the three crosses, heading date, plant height ,number of spikes /plant and 1000 kernel weight in the third cross, maturity date in the first and third crosses, for grain filling period in the second cross ,spike length in the first cross and number of kernels /spike in the first and second crosses.

Heritability values in narrow sense were high in magnitude and nearly equal its corresponding value in broad sense for heading date, grain filling period, number of spikes /plant, 1000-kernel weight and grain yield /plant in the first cross and plant height ,spike length and 1000 kernel Using the genetic coefficient of variation weight in the second cross. This revealed that the genetic variance was mostly attributed to the additive effects of genes for those traits . These findings are in line with those previously found by means of gene action estimates of additive genetic portion which was mostly predominant. Similar results were obtained by **Al-Kaddoussi** (1996), **El-Hosary *et al* (2000), Awaad (2001), Ashoush *et al* (2001)** and **Moustafa (2002)**

Expected genetic gain

The values for expected genetic advance (Δ g) reported in Table (4) show the possible gain from selection as percent increase in the F_3 families over their selected F_2 plants.

Genetic gain was rather higher for spike length in the three crosses; number of spikes /plant in the second and third crosses, for heading date in the first cross. Moderate gain was estimated for grain yield /plant and 1000 kernel weight in the three crosses; grain filling period in the first and second crosses, for maturity date, number of spikes/plant and number of kernels /spike in the first cross. Relatively low gain was estimated for other cases (Table, 4). Similar results were obtained by **Mosaad *et al* (1990),Khalifa *et al* (1997)** and **Przulj and Mladenov (1999 b) Johanson *et al* (1955)** reported that heritability estimates along with the genetic gain upon selection are more valuable than the formar alone in predicting the effect of selection .On the other hand, **Dixit *et al* (1970)** reported that high genetic coefficient of variation (G.C.V.) and high heritability were not always associated with high genetic advance for the trait. But to make effective selection, high heritability should be associated with high genetic advance.

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

Gene action

Nature of gene action was also studied according to relationships illustrated by **Gamble (1962)** All traits under study were significant for scaling tests A, B, C and D in the three crosses except scaling test A for grain filling period and spike length in the third cross scaling test C for grain yield/plant in the second cross and scaling test D for spike length and number of kernels /spike in second and third crosses and 1000- kernel weight in the first cross. These results assured the contribution of epistatic gene effect in the performance of these traits. The estimates of the various types of gene effects contributing to the genetic variability are presented in Table (3) .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 number of spikes/plant in the second cross, the additive genetic estimates were highly significant. These results indicate the potentiality of improving the performance of these traits by using pedigree selection program. Similar results were obtained by **Mosaad *et al* (1990), Khalifa *et al* (1997) El-Seidy and Hamada (1997), Przulj and Mladenov (1999 a)**

Also, the major contribution by dominance gene effects to variation in these crosses for most traits is indicated by the relative magnitude of the parameter dominance (d) to the parameter (m) .In addition, the estimates of dominance effects were significant except for heading date in the first and second crosses, maturity date in the third cross, spike length in the second and third crosses, and number of spikes /plant and number of kernels /spike in the second cross, indicating the importance of dominance gene effects in the inheritance of all traits .Significant additive (a) and dominance(d) components indicated that both additive and dominance effects were important for these traits .Similar conclusion was obtained by **Mosaad *et al* (1990), Khalifa *et al* (1997) El-Seidy and Hamada (1997), Przulj and Mladenov (1999 b)**

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, except additive x additive in the second cross, additive x dominance and dominance x dominance in the third cross for heading date; additive x dominance and dominance x dominance in the first cross; additive x dominance and dominance x dominance in the second and third crosses, respectively for maturity date; dominance x dominance in the third cross for grain filling period , additive x additive in the third cross for plant height; additive x dominance and additive x additive gene effects in the second and third crosses, respectively for spike length; additive x additive in the first and second cross and additive x dominance in the first cross for 1000 kernel weight; and additive x dominance in the first and second cross for grain yield /plant. Generally, the absolute magnitudes of the epistatic effects were larger than the additive or dominance gene effects in 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 a quantitative characters is generally more complex than single qualitative characters .Similar results were obtained by **Ronga** *et al* (1995); **Przulj and Mladenov (1999 a); Awaad (2001); El-Morshidy** *et al* (2001), **Kheirall** *et al* (2001) and **Moustafa (2002)**.

REFERENCES

Abd El-Aty, M.S.M. (2000). Estimates of heterosis and combining ability in diallel wheat crosses (*T. aestivum* L.). *J. Agric. Res. Tanta Univ., 26(3): 486-498.*

Al-Kaddoussi, A.R. (1996). Using genetic components for predicting new r combinant lines in some crosses of Egyptian wheat (*Triticum aestivum* L.). **Zagazig J. Agric. Res. 23:** 463 - 475.

Ashoush, H.A.; A.A. Hamada and I.H. Darwish (2001). Heterosis and combining ability in F_1 and F_2 diallel croses of wheat (*Triticum aestivum* L.). *J. Agric. Sci. Mansoura Univ., 26(5): 2579-2592.*

Awaad, H.A. (2001). The relative importance and inheritance of grain filling rate and period and some related characters to grain yield of bread wheat (*Triticum aestivum* L.). *2nd Pl. Breed. Conf., Fac. of Agric., Assiut Univ., Egypt. (2): 181-198.*

Burton, G.W. (1952). Quantitative inheritance in grasses. *Proc. 6th Int. Grassid Congr. 1: 277- 283.*

Darwish, I.H.I. (1998). *Breeding Wheat for Tolerance to Some Environmental Stresses.* **pp. 77-81.** Ph.D. Thesis Fac. of Agric. Minufiya Univ., Egypt.

Dixit, P.K.; P.D. Saxena and L.K. Bhatia (1970). Estimation of genotypic variability of some quantitative characters in groundnut. *Indian J. Agric. Sci., 40: 197-201.*

El-Hosary, A.A.; M.E. Riad and N.R.Abd El-Fattah (2000). Heterosis and combining ability in durum wheat. *Proc. 9th Conf. Agron., Minufiya Univ.: 101-117.*

El-Morshidy, M.A.; K.A.A. Kheiralla and M.M. Zakaria (2001). Studies on grain filling under different planting dates in wheat. *2nd Pl. Breed. Conf., Fac. of Agric., Assiut Univ., Egypt. (2): 241-263.*

El-Seidy, E.H. and A.A. Hamada, (1997). Genetical studies on some economic characters in some "wheat crosses". *Annals of Agric. Sci., Moshtohor, 35 (1): 49-62.*

El-Seidy, E.H. and A.A. Hamada (2000). Interaction of wheat genotypes x water sources. *Proc. 9th Conf., Agron., Minufiya Univ., 17-34.*

Gamble, E.E. (1962). Gene effects in corn (*Zea mays* L.) 1- separation and relative importance of gene effects for yield. *Can. J. of Plant Sci. 42: 339 - 348.*

Hamada, A.A. and M.B. Tawfelis (2001). Genetic and graphical analysis of diallel crosses of some bread wheat (*Triticum aestivum* L.). *J. Agric. Res. Tanta. Univ., 27(4): 633-647.*

Johanson, H.W.; H.F. Robinson and R.E. Comstock (1955). Estimates of genetic and environmental variability in soybean. *Agron. J. 47: 314-322.*

Khalifa, M.A; E.M.Salaby; A.A. Ali and M.B. Tawfelis (1997). Inheritance of some physiological traits ,yield and its components in durum wheat. *Assiut J. Agricultural Sci., 28 (4): 143-162.*

Kheiralla, K.A.; M.A. El-Morshidy and M.M. Zakeria (2001). Inheritance of earliness and yield in bread wheat under favourable and late sowing dates.**2nd Pl.** *Breed. Conf., Fac. of Agric., Assiut Univ., Egypt. (2): 219-239.*

Marani, A. (1968). Heterosis and inheritance of quantitative characters in interspecific crosses of cotton *Crop Sci., 8: 299-300.*

Mather, (1949). Biometrical Genetics. 1st **Ed., p. 162. Metheum and Co., London,**

Mather, K. and J.L. Jinks (1971). *Biometrical Genetics.* 2nd **Ed., p. 382.** Chapman and Hill Ltd., London.

Morad A.A. (2001). *Genetic Performance of Yield and Its Attributes in Some Wheat Genotypes Under Nitrogen Rates.* **pp. 57-64 & 90-95.** M.Sc. Thesis, Faculty of Agric., Al-Azhar. Univ., Egypt.

Mosaad, M.G.; M.A. El-Morshidy; B.R. Bakheit and A.M. Tamam (1990). Genetical studies of some morpho-physiological traits in durum wheat crosses. *Assiut J. Agric. Sci. 21(1):79-94.*

Moustafa, M.A. (2002) Gene effect for yield and 0yield component for four durum wheat crosses. *J. Agric. Sci. Mansoura Univ., 27 (1): 47 -60.*

Przulj, N. and N. Mladenov, (1999 a). Inheritance of grain filling rate in wheat. *Cereal, Res. Communications. 27(3): 259-266.*

Przulj, N. and N. Mladenov, (1999 b) Inheritance of grain filling duration in spring wheat. *Plant Breeding, 118(6): 517-521.*

Ronga, G.; M. de. Ninno and N. di Fonzo (1995). Combining ability as a criterion for the choice of parents for pedigree selection programs in durum wheat. *Agriculture Mediterranea, 125 (4): 387-394.*

Van der Veen, J.H. (1959). Test of non-allelic interaction and linkage for quantitative characters in generations derived from two diploid pure lines. *Genetica 30: 201-204.*

مجلة حوليات العلوم الزراعية ، كلية الزراعة ، جامعة عين شمس ، القاهرة ، م٤٨ ، ع(١) ، ١٣١-١٤٦، ٢٠٠٣

التأثيرات الجينية لبعض الصفات الزراعية فى ثلاث هجن من قمح الخبز

[١٠]

أسعد أحمد حمادة[١]

١– البرنامج القومي لبحوث القمح – معهد بحوث المحاصيل الحقلية–مركز البحوث الزراعية – الجيزة–مصر

استخدم ثلاثة هجن من قمح الخبز وهم سدس ٨ × درغال ، جبزة ١٧٠× اسدى ٨٠٣٦ والهجين الثالث سودان٨ × تاستتورى واختبر لكل هجين العشائر الستة وهى الآباء والجيل الأول والجيل الثاني والهجين الرجعى الأول والثاني لصفات التبكير وارتفاع النبات والمحصول ومكوناته للنبات الفردى.

أظهرت النتائج قوة هجين معنوية وموجبة لمتوسط الأبوين أو الأب الأفضل لطول السنبلة وعدد السنابل في النبات وعدد الحبوب في السنبلة ووزن ألف حبة ومحصول النبات فى الثلاث هجن وفترة امتلاء الحبوب في الهجين الأول بينما لوحظ قوة هجين معنوية وسالبة لمتوسط الأبوين أو الأب الأفضل لصفة ميعاد طرد السنابل للهجين الأول وميعاد النضج وفترة امتلاء الحبوب وارتفاع النبات فى الهجين الثاني والثالث.

لوحظ ارتفاع معامل التباين الوراثي لصفات طول السنبلة في الثلاث هجن وعدد السنابل في النبات للهجين الثاني والثالث وكانت قيم معامل التباين الوراثي متوسطة لصفة محصول الحبوب للنبات وعدد حبوب السنبلة ووزن ألف حبة فى الثلاث هجن وميعادى الطرد والنضج وارتفاع النبات في الهجين الأول وفترة امتلاء الحبوب في الهجين الأول والثاني بينما كانت قيمته منخفضة لباقي الحالات.

كانت قيم الفعل الجينى المضيف عالية المعنوية لكل الصفات في الثلاث هجن ماعدا عدد السنابل فى النبات فى الهجين الثانى• كانت قيم الفعل الجينى من النوع السيادى معنوية لكل الصفات تحت الدراسة ماعدا طرد السنابل فى الهجين الأول والثاني وميعاد النضج فى الهجين الثالث وطول السنبلة في الهجين الثاني والثالث وعدد السنابل فى النبات وعدد حبوب السنبلة في الهجين الثالث. كانت قيم الفعل الجينى من النوع التفوقى معنوية لواحد أو أكثر من طرز التفوق فى كل الصفات لكل الهجن.

أظهرت النتائج أن قيم معامل التوريث بمعناها الضيق والواسع والتحسين الوراثي المتوقع للانتخاب كانت عالية إلى متوسطة لمعظم الصفات تحت الدراسة وبناءا على ذلك يمكن تحسين هذه الصفات باستخدام طرق التربية العادية أو التقليدية مع اتباع الإنتخاب المنسب كوسيلة فعالة فى هذا انمجال.

تحكيم : أ.د حامد عبد الرؤوف خليل أ.د سامى رضا صبرى