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GENETIC ANALYSIS OF SOME BREAD WHEAT CROSSES UNDER NORMAL AND WATER STRESS CONDITIONS

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ABSTRACT

Six bread wheat genotypes representing different agronomic characters were crossed in a half-diallel model in 2003/2004 season. The six parents and their 15 F_1 hybrids were evaluated under normal and water stress conditions during 2004/2005 . Irrigation mean squares were significant for all studied traits except days to heading, grain filling period, number of kernels/spike and 100-kernels weight. General (GCA) and sepecific (SCA) combining ability mean squares were significant for all studied traits at both conditions, except SCA for days to heading, days to maturity, grain filling period and number of spikes/plant under water stress conditions. GCA/SCA ratio were more than unity for all traits at both conditions, except grain filling rate, flag leaf area, number of kernels/spike under water stress condition, number of spikes/plant at normal condition, total chlorophyll content, 100-kernels weight and grain yield/plant under both conditions. Suggesting that additive genetic effects were more important in controlling these traits. The genetic component i.e. additive and dominance were highly significant for most studied traits. The results showed the role of partial dominance gene effects in controlling all traits under both conditions, except number of spikes/ plant at normal condition, grain filling rate, number of kernels/spike,grain yield at water stress condition, total chlorophyll content and 100-kernels weight at both conditions. which controlled by over dominance gene effects. the results clearly showed that each one of studied characters were governed at least by one gene group, except days to maturity at normal condition, plant height , grain yield /plant at water stress condition which were governed at least by two gene groups. Plant height at normal condition and 100-kernels weight at both conditions were governed by at least by three gene group.

The parents Line 1 and Sakha 94 could be used in breeding for drought tolerance. Selection for days to heading, days to maturity, grain filling period, plant height at both conditions may be practiced in early segregating generations to improved bread wheat.

Key words : ***Wheat, Crosses, GCA, SCA, Water stress***

INTRODUCTION

Selection among Egyptian wheat cultivars for increasing grain yield and its components may not be effective. Hybridization between the local cultivars and exotic materials was carried out to increase genetic variability. Quantitative economic traits in wheat are highly influenced by environmental conditions.

Assessment and quantifying the type of gene action in wheat were detected by some investigators. El-Hosary *et al* (2000) found that grain yield and its components in wheat genotypes were controlled by both additive and non additive gene effects. In addition Ashoush *et al* (2001) reported that heritability estimates for plant height, days to heading and yield components were medium to high (more than 50%). Moreover, Farhat (2005) reported that additive gene effects were more important for days to heading, grain filling period, total chlorophyll content, plant height and 100-kernels weight at normal and water stress conditions. While dominance gene effects were more important for days to maturity, grain filling rate and grain yield/ plant.

Information on the relative importance of general and specific combining ability is important in the development of efficient wheat breeding programs. It is very essential that the breeder evaluated the available germplasm per se and in crosses. In this regard, several studies have been reported in wheat, Mohamed (2004) reported that mean squares due to general and specific combining ability were highly significant for plant height and grain yield/plant at normal and water stress conditions. El-Danasory (2005) reported that GCA/SCA ratio was more than unity for days to heading at normal and water stress conditions, number of kernels/spike and days to maturity at normal and water stress conditions, respectively.

MATERIALS AND METHODS

The genetic materials used in this investigation as parents included six bread wheat genotypes, representing a wide range of diversity for several agronomic characters. The parents names and pedigree are presented in Table (1). In 2003/2004 season, the parental genotypes were sown at various dates in order to overcome the differences in flowering time. All possible cross combinations excluding reciprocals were made among the six genotypes, giving 15 crosses.

Table 1. Parents names and pedigree

No	Genotype	Pedigree
1	Line # 1 (P1)	Giza158/5/CFN/CNO"S"//RON/3/BB/NOR67/4/TL/3/ FN/TH//NAR59*2 S.10232-3S-2S-4S-5S-0S
2	Sakha 61 (P2)	INIA/RL4220//7C/Yr"S" CM15430-2S-5S-0S
3	Sakha 93 (P3)	Sakha 92/TR8 10328 S.8871-1S-2S-1S-0S
4	Sakha 94 (P4)	Opata / Rayon // Kauz CMBW90Y3180-0TOPM-3Y-010M-010M-010Y-10M-015Y-0Y-0AP-0S.
5	Gemmeiza 9 (P5)	Ald"S"/Huac//Cmh74A.630/Sx CGM4583-5GM-1GM-0GM
6	Gemmeiza 10(P6)	Maya74"S"/ON//1160-147/3/BB/GLL/4/chat"s"/5/ Crow"s" CGM5820-3GM-1GM-2GM-0GM

The monthly average amount of rainfall of experimental area is presented in Table (2).

Table 2. Monthly average of total rainfall during (2004/2005) at Sakha Agri. Res. St., Kafer El-sheikh.

Month	Nov. 2004	Dec. 2004	Jan. 2005	Feb. 2005	Mar. 2005	Apr. 2005	May. 2005
Rainfall (ml)	9.00	38.00	65.00	20.00	4.00	—	—

In 2004/2005 season, the twenty one entries (6 parents and 15 F_1) were evaluated in two separate irrigation regime experiments. The first experiment (normal conditions) was irrigated three times after planting irrigation i.e. four irrigation were given through the whole season . The second experiment (drought conditions) was given one surface-irrigation 27 days after the establishment (two irrigations were given through the whole season). Each of the two experiments was fertilized with 15 kg P_2O_5/fad , 24 kg K_2O/fad in one dose during soil preparing and 75kg N/fad was added in two equal doses. The first dose was 30% with sowing and the second was 70% with the first irrigation (after 27 days from sowing). The two experiments were designed in randomized complete block design with three replications in the Experimental Farm at Sakha Agric.Res.Station. Egypt.

Each replicate consisted of 21 rows (genotypes) as well as two rows (border) 4 m long and 25 cm apart with 20 cm between plants. Twenty grains were planted in each row and manually drilled in the rows. Each experiment was surrounded by a wide border (10 m) to minimize the underground water permeability. All other cultural practices, except irrigation, were applied as recommended for wheat cultivation. The two outside plants for each row and the two external rows of each plot were excluded to eliminate the border effect.

The studied characters were, days to heading, days to maturity, grain filling period, grain filling rate (gm/day), flag leaf area (cm^2), total chlorophyll content, plant height (cm), number of spikes/plant, number of

kernels/spike, 100-kernels weight (gm) and grain yield/plant (gm). Characters were determined from 10 plants per plot for all characters, except flag leaf area and total chlorophyll content were determined from 5 plant per plot.

Total chlorophyll content was determined with a portable chlorophyll meter (SPAD-502, Soil-Plant Analysis Development (SPAD) Section, Minolta Camera, Osaka, Japan) was used to measure flag leaf greenness in SPAD values according to Castelli *et al.* (1996).

The data obtained for each trait were analyzed on plot mean basis in both parents and F_1 generation. In order to test the significance among genotypes and irrigation treatments all obtained data were subjected to the statistical analysis of the randomized complete block design as described by Gomez and Gomez (1984). Combined analysis was performed between the two experiments (normal and water stress conditions) to indict the irrigation effects according to Snedecor and Cochran (1980). An ordinary analysis using Griffing (1956) method 2 model 1 was applied to estimate general combining ability (GCA) and specific combining ability (SCA) effects. The data were analysed using Hayman (1954 and 1958) to partition the total genetic variance to consistent parts; additive and dominance genetic effects.

RESULTS AND DISCUSSION

Analysis of variance and combined analysis for the studied traits are presented in Tables (3). Results indicated that irrigation mean squares were significant for all traits except days to heading, grain filling period, number of kernels per spike and 100-kernels weight. indicating significant differences between the normal and stress conditions for all studied characters except these four traits. The irrigation × genotypes interactions were found to be significant for days to maturity, flag leaf area , total chlorophyll content, number of kernels per spike and 100-kernels weight .

Analysis of variance for the studied traits presented in Table 4. The results indicated clearly that mean squares of genotypes, parents and crosses were significant for all traits under normal and water stress conditions. Mean squares for the interaction between parents and their F_1's were significant for all traits under both conditions except grain filling period, total chlorophyll content, number of kernels/spike at normal condition, days to maturity and number of spike/ plant at water stress condition. This results reflected in indication of heterosis for these characters. These results agree with those previously reported by Mohamed (2004) and Farhat (2005).

Table 3 . Combined analysis of variance for all characters over both conditions.

Source of Variation	d.f	Days to heading	Days to maturity	Grain filling period	Grain filling rate	Flag Leaf Area	Chlorophyll content	Plant height	No.of spikes/ plant	No.of kernels/ spike	100-kernels weight	Grain yield/ plant
Irrigations	1	47.792	101.162*	0.007	0.248*	336.012**	488.127**	5365.182**	185.058*	1.072	0.091	491.676*
Error	4	7.780	7.225	1.712	0.017	11.683	2.810	104.374	6.967	14.063	0.297	44.482
Genotypes	20	78.585**	25.205**	44.814**	0.078**	309.297**	16.875**	465.433**	17.066**	92.311**	0.513**	132.786**
Irri X Geno	20	1.424	3.581**	2.887	0.007	40.878**	7.298**	10.606	2.784	13.707**	0.059**	13.594
Error	80	1.519	1.333	2.478	0.008	5.644	1.757	6.815	2.608	6.023	0.026	15.946

* and ** = significant at 0.05 and 0.01 probability, respectively.

Table 4 . Mean squares from analysis of variance, for general and specific combining ability under normal and water stress conditions of all studied traits .

Source of Variation	d.f	Days to heading		Days to maturity		Grain filling period		Grain filling rate		Flag leaf area		Chlorophyll content	
		Normal	Stress	Normal	Stress	Normal	Stress	Normal	Stress	Normal	Stress	Normal	Stress
Genotypes	20	43.04**	36.95**	19.28**	9.17**	23.57**	24.13**	0.05**	0.03**	131.62**	218.56**	8.77**	15.41**
Rep	2	1.07	14.38	4.64	9.43**	2.14	1.29	0.02	0.02	1.66	21.71*	5.07	0.55
Parents	5	73.86**	57.94**	23.01**	12.53**	30.67**	32.93**	0.09**	0.05**	265.18**	523.62**	18.17**	23.90**
F1's	14	34.66**	31.09**	17.87**	8.59**	22.69**	21.81**	0.03**	0.03*	88.57**	96.68**	5.98**	10.28**
P. vs F1's	1	6.16*	13.94**	20.27**	0.49	0.07	12.74*	0.39**	0.04*	66.45**	399.53**	0.80	44.69**
GCA	5	165.43**	138.03**	64.94**	31.84**	76.34**	81.48**	0.13**	0.08**	375.35**	547.34**	11.07**	25.57**
SCA	15	2.24*	3.25	4.07**	1.62	5.98**	5.14	0.02**	0.29**	50.37**	108.96**	7.99**	12.02**
Error	40	1.05	1.99	1.48	1.11	2.04	2.91	0.01	0.01	6.93	4.36	1.76	1.75
GCA/SCA	-	17.27	13.50	3.06	7.53	2.36	4.40	1.50	0.03	1.06	0.65	0.19	0.29

Table 4 . continued

Source of Variation	d.f	Plant height (cm)		No.of spikes/plant		No.of kernels/spike		100-kernels weight		Grain yield/ plant	
		Normal	Stress	Normal	Stress	Normal	Stress	Normal	Stress	Normal	Stress
Genotypes	20	261.79**	215.28**	10.05**	9.79**	61.12**	44.90**	0.26**	0.31**	82.25**	64.13**
Blocks	2	181.59**	28.58	3.49	10.44*	20.96*	7.17	0.12**	0.48**	50.96*	38.00
Parents	5	166.16**	442.57**	14.18**	11.03*	112.16**	84.49**	0.26**	0.28**	139.18**	76.33**
F1's	14	161.39**	140.21**	8.49**	9.97**	47.03**	28.76**	0.15**	0.16**	55.31**	48.83*
P. vs F1's	1	324.29**	129.93**	11.23*	1.14	3.21	72.88**	1.77**	2.57**	174.79**	217.42**
GCA	5	933.82**	775.68**	23.85**	29.66**	180.87**	78.96**	0.47**	0.53**	142.34**	109.51**
SCA	15	37.79**	28.48**	5.45*	3.17	21.20**	33.55**	0.19**	0.24**	62.22**	49.00**
Error	40	3.16	10.51	2.61	2.59	5.20	6.84	0.02	0.03	13.65	18.24
GCA/SCA	-	3.36	5.32	0.93	5.83	1.37	0.34	0.33	0.30	0.33	0.37

General and Specific combining ability mean squares presented in Table (4) were highly significant for all studied traits at normal and water stress conditions, except specific combining ability for days to heading, days to maturity, grain filling period and number of spikes per plant at water stress condition. The GCA/SCA ratio was more than unity for most traits at both conditions. This means that studied traits are predominantly controlled by additive gene action . It therefore could be concluded that selection. procedures based on the accumulation of additive effect would be more effective in the early segregating generations. On the other hand, grain filling rate, flag leaf area, no. of kernels per spike at water stress condition; number of spikes per plant at normal condition; 100-kernels weight and grain yield/plant at both conditions were mainly controlled by non-additive gene action. These results are in general agreement with those previously reported by Mohamed (2004) and El-Danasory (2005).

Estimates of GCA effects for parents genotypes for all traits at both conditions were presented in Table (5) . Significant positive GCA effects were found for all studied traits except days to heading, days to maturity and grain filling period.

Based on GCA estimates, it could be concluded that the best combiners at both environmental conditions for days to heading were Line 1, Sakha 61 and Sakha 93; for days to maturity Line 1 and Sakha 61; for grain filling period Sakha 94, Gemmeiza 9 and Gemmeiza 10; for grain filling rate Line 1 and Sakha 94; for flag leaf area Line 1 and Sakha 61; for total chlorophyll content Sakha 61; for plant height Line1 ,Sakha 94 and Gemmeiza 9; for no.spike / plant Sakha 61 and Sakha 94;for no. of kernels / spike Line1 and Sakha 94; for 100-kernels weight was Line 1 ; for grain yield per plant Line 1 and Sakha 94. These results indicated that these genotypes could be considered as good combiners for improving these traits.

Estimates of SCA effects of crosses for all studied traits at both conditions are presented in Table 6 . Significant positive SCA effects were found for all studied traits except days to heading, days to maturity and grain filling period.

Based on SCA estimates, it could be concluded that the best crosses for days to heading was Sakha 94×Gemmeiza 10 at water stress conditions; for days to maturity was Line 1×Sakha 94 at normal conditions; for grain filling period was Sakha 94 × Gemmeiza 10 at both conditions; for grain filling rate was Line1 × Sakha 61 at normal condition; for flag leaf area were Sakha 61×Gemmeiza 9, Sakha 93×Gemmeiza 10 and Sakha 94 ×

Table 5. Estimates of general combining ability effects for all parental studied at both conditions.

Parents	Days to heading		Days to maturity		Grain filling period		Grain filling rate		Flag Leaf Area		Chlorophyll content	
	Normal	Stress	Normal	Stress	Normal	Stress	Normal	Stress	Normal	Stress	Normal	Stress
L 1 (P1)	-1.38**	-1.00*	-1.49**	-1.17**	0.24	0.66	0.06**	0.05*	6.45**	5.19**	0.05	-0.08
Skh.61 (P2)	-2.98**	-2.70**	-1.61**	-1.14**	1.12**	1.50**	-0.05*	-0.05*	2.55**	4.22**	1.02**	1.45**
Skh.93 (P3)	-2.54**	-2.38**	0.16	-0.29	2.92**	2.39**	-0.10**	-0.07*	0.01	3.27**	-0.81*	0.94*
Skh.94 (P4)	1.48**	0.96*	-0.97**	-0.17	-1.36**	-0.97*	0.09**	0.07**	-4.1**	-5.33**	0.54	-0.16
Gem.9 (P5)	3.04**	3.16**	2.16**	1.41**	-1.46**	-2.57**	0.03	0.03	-3.23**	-4.94**	-0.47	-1.04**
Gem.10 (P6)	2.39**	1.9**	1.75**	1.37**	-1.45**	-1.01*	-0.03	-0.03	-1.69*	-2.41**	-0.33	-1.11**
0.05	0.49	0.68	0.58	0.51	0.69	0.82	0.04	0.04	1.26	1.00	0.64	0.63
LSD (gi) 0.01	0.77	1.06	0.92	0.79	1.07	1.28	0.06	0.07	1.98	1.57	0.99	0.99
0.05	0.76	1.05	0.90	0.78	1.06	1.27	0.06	0.07	1.95	1.55	0.98	0.98
LSD (gi-gj) 0.01	1.19	1.65	1.42	1.23	1.66	1.99	0.09	0.11	3.06	2.43	1.54	1.54

Table 5. continued

Parents	Plant height (cm)		No.of spikes/plant		No.of kernels/spike		100-kernels weight		Grain yield/plant	
	Normal	Stress	Normal	Stress	Normal	Stress	Normal	Stress	Normal	Stress
L. 1 (P1)	7.49**	7.03**	-0.64	-0.57	1.42*	2.32**	0.19**	0.22**	2.99**	3.11*
Skh.61 (P2)	-3.21**	-3.72**	1.12*	1.52*	-3.20**	-1.46*	-0.18**	-0.10*	-1.23	-1.05
Skh.93 (P3)	-7.19**	-6.52**	0.18	-0.39	-3.32**	-1.77*	0.06	0.13*	-2.00*	-1.43
Skh.94 (P4)	4.24**	4.79**	1.04*	1.29*	3.33**	2.06**	0.08*	-0.06	2.91**	2.24*
Gem.9 (P5)	4.69**	3.19**	-1.46**	-0.81	1.82**	0.08	0.11*	-0.01	-0.08	0.79
Gem.10 (P6)	-6.03**	-4.77**	-0.23	-1.04*	-0.05	-1.23	-0.07*	-0.18**	-2.59*	-2.08*
0.05	0.85	1.55	0.77	0.99	1.09	1.25	0.07	0.09	1.77	2.05
LSD (gi) 0.01	1.33	2.44	1.23	1.56	1.71	1.96	0.11	0.13	2.78	3.21
0.05	1.31	2.41	1.20	1.54	1.41	1.62	0.11	0.13	2.74	3.17
LSD (gi-gj) 0.01	2.06	3.77	1.88	2.41	1.96	2.25	0.17	0.21	4.30	4.97

Table 6 : Estimates of specific combining ability effects for all crosses at both conditions.

Table 6 . Estimates of specific combining ability effects for all crosses at both conditions.

Crosses	Days to heading		Days to maturity		Grain filling period		Grain filling rate		Flag Leaf Area		Chlorophyll content	
	Normal	Stress	Normal	Stress	Normal	Stress	Normal	Stress	Normal	Stress	Normal	Stress
L.1 X SKH.61	-1.12	-0.97	-0.38	-1.11	-0.41	0.68	0.17**	0.08	-2.99*	-3.66**	-2.90**	-0.65
L.1 X SKH.93	0.37	0.47	-0.49	0.32	-0.77	0.65	0.01	-0.05	-0.92	-1.71	0.19	-2.04**
L.1 X SKH.94	-0.65	-1.01	-2.12**	-0.04	-0.64	0.78	0.07	0.09	5.09**	1.79	-2.03**	-0.74
L.1 X GEM.9	-0.32	-0.97	0.18	0.21	0.66	0.98	-0.03	0.03	-0.42	4.26**	2.01*	0.87
L.1 X GEM.10	-1.57**	0.16	-0.47	0.82	0.81	0.25	-0.04	-0.08	0.15	-8.17**	0.21	2.38**
SKH.61 X SKH.93	-0.86	-1.00	-0.13	-0.15	-1.34	-1.69	-0.02	-0.00	-3.62*	-2.29	-0.98	-1.66**
SKH.61 X SKH.94	-0.01	-0.31	-0.39	-0.87	1.12	0.47	-0.02	0.06	-2.85	4.91**	2.07**	3.59**
SKH.61 X GEM.9	0.45	0.32	-1.23	0.61	-0.89	0.84	0.04	0.10*	5.98**	8.83**	-1.09	0.18
SKH.61 X GEM.10	0.57	0.06	0.12	1.06	0.87	0.98	0.07	-0.01	-0.32	0.64	0.44	-0.71
SKH.93 X SKH.94	-0.05	-0.80	-0.37	-0.34	1.26	0.35	-0.01	0.07	0.59	-1.54	-0.60	3.25**
SKH.93 X GEM.9	-1.02	-0.74	1.53*	-0.12	3.28**	2.18*	0.09	-0.02	-0.18	2.52*	1.04	1.69**
SKH.93 X GEM.10	0.43	0.07	-0.39	-0.28	0.54	0.95	0.02	0.04	8.29**	9.99**	2.59**	0.67
SKH.94 X GEM.9	0.83	1.62*	-1.47*	0.35	-2.64**	-1.96*	-0.04	-0.09	-3.97*	2.42*	-0.21	-0.01
SKH.94 X GEM.10	0.31	-1.74*	0.04	1.23	-0.62	0.82	-0.11*	-0.06	4.44**	5.39**	0.48	0.09
GEM.9 X GEM.10	-0.33	0.39	0.21	-0.86	-0.34	-1.72	0.13**	0.15	0.46	0.49	-0.15	1.07
LSD (Sij) 0.05	1.13	1.55	1.34	1.16	1.57	1.87	0.09	0.09	2.89	2.29	1.46	1.45
LSD (Sij) 0.01	1.54	2.15	1.86	1.61	2.18	2.60	0.13	0.13	4.01	3.18	2.02	2.02
LSD (Sij-Sik) 0.05	1.68	2.32	1.99	1.73	2.34	2.79	0.13	0.16	4.31	3.42	2.17	2.17
LSD (Sij-Sik) 0.01	2.33	3.21	2.77	2.39	3.25	3.88	0.19	0.23	5.98	4.75	3.02	3.01
LSD (Sij-Skl) 0.05	1.56	2.14	1.85	1.59	2.17	2.59	0.13	0.15	3.99	3.17	2.01	2.01
LSD (Sij-Skl) 0.01	2.16	2.98	2.56	2.22	3.01	3.59	0.17	0.21	5.54	4.39	2.79	2.79

Table 6 . continued

Crosses	Plant height (cm)		No.of spikes/plant		No.of kernels/spike		100-kernels weight		Grain yield/plant	
	Normal	Stress	Normal	Stress	Normal	Stress	Normal	Stress	Normal	Stress
L.1 X SKH.61	1.10	0.70	1.82*	-0.29	1.45	1.45	-0.10	0.30**	7.72**	4.23**
L.1 X SKH.93	3.57**	-2.76	-1.91*	-0.46	-0.62	-0.62	0.01	-0.02	-0.19	-2.68
L.1 X SKH.94	2.48*	2.66	-0.71	1.22	0.68	0.68	0.06	0.07	2.11	3.96
L.1 X GEM.9	-1.99*	-1.67	-0.07	-0.14	-0.21	-0.21	0.29**	0.03	-0.89	1.35
L.1 X GEM.10	0.27	2.09	-1.16	-1.11	2.57*	2.57*	0.09	0.24*	-1.13	-3.60
SKH.61 X SKH.93	0.46	3.52*	0.17	0.59	-1.92	-1.92	-0.14	-0.01	-2.52	-1.93
SKH.61 X SKH.94	3.17**	1.21	0.24	1.31	0.41	0.41	0.12	0.05	0.59	3.37
SKH.61 X GEM.9	3.59**	0.27	-1.82*	-0.59	2.54*	2.54*	0.35**	0.12	1.02	5.10*
SKH.61 X GEM.10	3.41**	2.40	-0.66	1.41	-0.45	-0.45	0.23*	0.34**	3.95	1.05
SKH.93 X SKH.94	-1.37	-3.93*	0.44	0.39	-0.49	-0.49	0.10	0.16	1.01	4.42*
SKH.93 X GEM.9	-1.95*	-0.46	1.08	0.76	-3.07*	-3.07*	0.21*	0.44**	7.61**	1.88
SKH.93 X GEM.10	4.67**	3.87*	0.15	0.12	1.74	1.74	0.14	0.04	1.39	3.86
SKH.94 X GEM.9	2.47*	4.47**	-1.78*	-1.59	-4.59**	-4.59**	0.22**	0.20*	-4.75*	-5.45**
SKH.94 X GEM.10	-1.12	0.06	-1.55	-1.47	-0.51	-0.51	0.07	0.03	-5.14*	-1.53
GEM.9 X GEM.10	2.47	1.19	1.76	0.87	4.62**	4.62**	-0.07	-0.09	5.01*	3.61
LSD (sij) 0.05	1.95	3.56	1.78	2.27	2.50	2.50	0.16	0.19	4.06	4.69
LSD (sij) 0.01	2.71	4.94	2.46	3.16	3.48	3.48	0.22	0.27	5.63	6.51
LSD (Sij-Sik) 0.05	2.91	5.31	2.65	3.39	3.74	3.74	0.24	0.29	6.05	6.99
LSD (Sij-Sik) 0.01	4.04	7.37	3.68	4.71	5.19	5.19	0.33	0.40	8.40	9.71
LSD (Sij-Skj) 0.05	2.69	4.92	2.45	3.14	3.46	3.46	0.22	0.27	5.60	6.48
LSD (Sij-Skj) 0.01	3.74	6.83	3.40	4.36	4.80	4.80	0.31	0.37	7.78	8.99

Gemmeiza 10 at both conditions; for total chlorophyll content was Sakha 61×Sakha 94 at both conditions; for plant height were Sakha 93×Gemmeiza 10 and Sakha 94×Gemmeiza 9 at both conditions; for no.of spikes per plant was Line1×Sakha 61 at normal condition; for no.of kernels /spike were Line1×Gemmeiza 10, Sakha 61×Gemmeiza 9 and Gemmeiza 9 ×Gemmeiza 10 at both conditions; for 100-kernel weight were Sakha 93×Gemmeiza9 and Sakha 94×Gemmeiza 9 at both conditions; for grain yield per plant was Line1×Sakha 61 at both conditions. These crosses could be selected and used in breeding programs to improving these traits. These results are in general agreement with those previously reported by Afiah (1999),Mohamed(2004) and El-Danasory (2005).

Results presented in Table (7) indicated that the major assumptions postulated for diallel analysis appeared to be valid for all traits at both studied conditions, except days to heading at water stress condition and grain yield at normal condition.

Table 7. Values of t^2. regression coefficient of covariance (Wr) on variance (Vr) and t value for b=0 and b=1.

Characters	Cond.	t^2	Regression coefficient	t value for b=0	t value for b=1
Days to heading	N	0.01	0.99±0.10	9.59**	0.11
	S	12.57**	0.73±0.06	11.72**	4.23
Days to maturity	N	1.25	0.60±0.21	2.91*	1.91
	S	1.33	0.83±0.11	7.52**	1.50
Grain filling period	N	1.80	0.70±0.15	4.54*	1.94
	S	1.74	0.85±0.09	9.10**	1.63
Grain filling rate	N	0.22	0.97±0.28	3.44*	0.10
	S	2.72	1.21±0.17	6.91**	-1.18
Flag Leaf Area	N	0.14	0.94±0.30	3.17*	0.22
	S	1.95	1.19±0.22	5.38**	-0.87
Chlorophyll content	N	0.15	0.75±0.44	1.69	0.56
	S	0.03	0.85±0.31	2.76	0.47
Plant height	N	0.12	0.97±0.06	15.44**	0.48
	S	1.59	1.11±0.11	9.78**	-0.98
No.of spikes/plant	N	2.25	1.17±0.15	7.55**	-1.10
	S	0.71	0.71±0.20	3.56*	1.45
No.of kernels/spike	N	1.43	0.88±0.68	1.29	0.18
	S	0.65	0.72±60	1.20	0.46
100-kernels weight	N	2.41	0.16±0.24	0.66	3.51*
	S	2.40	0.14±0.24	0.56	3.58*
Grain yield plant	N	6.14**	1.44±0.28	5.15**	-1.57
	S	0.01	0.93±0.20	4.73**	0.33

Both additive (D) and dominance (H_1 and H_2) gene effects as presented in Table (8) were significant for most traits at both conditions except dominance gene effects for days to maturity, no. of spikes/plant at water stress condition, grain filling period and (H_2) for number of kernels/ spike at normal condition.

The additive gene effects were more important than dominance for all traits at normal and water stress conditions, except grain filling rate, number of kernels/spike and grain yield/plant at water stress condition, number of spikes/ plant at normal condition, total chlorophyll content and 100-kernels weight at both conditions.

The dominance effect (h^2), were significant or highly significant for all traits at both conditions. except, grain filling period, flag leaf area, total chlorophyll content at normal condition, number of kernels/spike at water stress condition and number of spikes/plant at both conditions. The observed positive and significant dominance effect values indicated that the dominant genes of these characters were due to heterozygosity and dominance seemed to be acting in positive direction. On the contrary, the remaining dominance effect values were not significant.

The results showed that the relative frequency of dominance and recessive alleles in parents under study revealed significantly negative (F) values for days to heading at normal condition, grain filling period and number of spikes/plant at water stress condition, days to maturity at both conditions. indicating excess of recessive alleles among the parents. However, positive and significant or insignificant values were recorded for other traits at both studied conditions, indicating excess of dominant alleles in the parents.

Several ratios and proportions were obtained in Table (9). The mean degree of dominance $(H_1/D)^{1/2}$ is less than one for all traits under both water studied conditions which confirms the role of partial dominance gene effects in controlling these traits, except number of spikes per plant at normal condition, grain filling rate, number of kernels/spike, grain yield at water stress condition, total chlorophyll content and 100-kernels weight at both conditions which controlled by over dominance gene effects. The proportion of genes with positive and negative effects in parents ($H_2/4H_1$) was nearly equal to the ratio 0.25 for plant height at normal condition, days to maturity , grain filling rate, grain yield/plant at water stress, grain filling period, number of spikes/plant at both conditions. indicating that the positive and negative alleles were equally distributed among the parents. The other traits at both conditions were not nearly equal to the ratio 0.25,

Table 8. Estimates of genetic components of variance for the studied traits at both conditions

Characters	Cond.	D	F	H_1	H_2	h^2	E
Days to heading	N	24.25** ±0.20	-3.92**±0.50	2.16**±0.52	1.71**±0.46	1.19**±0.31	0.35**±0.08
	S	—	—	—	—	—	—
Days to maturity	N	7.12**±0.57	-3.92 **±1.40	3.87**±1.45	2.89*±1.30	4.02**±0.87	0.54*±0.22
	S	3.72**±0.29	-1.91**±0.71	0.99±0.74	0.96±0.66	-1.67**±0.45	0.50**±0.11
Grain filling period	N	9.54**±1.43	-3.41±3.49	6.69±3.62	6.03±3.24	-0.29±2.18	0.68±0.54
	S	9.97**±0.55	-4.32**±1.34	4.00**±1.40	4.01**±1.25	2.591*±0.84	0.95**±0.21
Grain filling rate	N	0.029**±0.003	0.016*±0.007	0.026**±0.007	0.021**±0.006	0.014**±0.004	0.002*±0.001
	S	0.015**±0.001	0.004±0.001	0.016**±0.001	0.016**±0.001	0.012**±0.001	0.003**±0.001
Flag leaf area	N	86.17**±6.06	41.69**±14.81	65.57**±15.39	53.44**±13.75	13.12±9.25	2.23±2.29
	S	172.81**±11.9	133.89**±29.06	142.61**±30.20	110.29**±26.98	85.36**±18.16	1.73±4.49
Chlorophyll content	N	5.42**±0.98	6.90**±2.39	10.36**±2.48	7.93**±2.22	-0.18±1.49	0.64±0.37
	S	7.40**±1.68	5.96±4.11	14.05**±4.27	12.05**±3.82	9.34**±2.57	0.57±0.64
Plant height	N	172.89**±1.47	25.97**±3.59	29.931**±3.73	28.59**±3.33	67.93**±2.24	3.90**±0.56
	S	144.03 **±2.81	24.32**±6.87	26.25**±7.14	22.52**±6.37	26.03**±4.29	3.79**±1.06
No.of spikes/plant	N	3.81**±0.40	0.31±0.98	4.81**±1.02	4.73**±0.91	1.90**±0.61	0.89**±0.15
	S	2.69**±0.50	-2.43*±1.23	1.95±1.28	1.86±1.14	-0.40±0.77	0.99**±0.19
No.of kernels/spike	N	35.39**±4.65	14.96±11.36	28.17*±11.81	18.89±10.55	-0.411±7.10	1.98±1.76
	S	25.89**±5.65	27.13*±13.81	42.72**±14.35	30.69*±12.82	14.48±8.63	2.29±2.14
100-kernels weight	N	0.08**±0.02	0.02±0.04	0.18**±0.04	0.16**±0.04	0.38**±0.03	0.01±0.01
	S	0.07**±0.02	-0.02±0.04	0.17**±0.04	0.15**±0.04	0.38**±0.03	0.01*±0.01
Grain yield plant	N	—	—	—	—	—	—
	S	19.04**±2.76	4.39±6.75	42.46**±7.02	42.27**±6.27	43.39**±4.22	6.40**±1.05

N= normal irrigation, S=Stress

Table 9 . Proportions of genetic components for the studied traits

Characters	Cond.	$(H_1/D)^{1/2}$	$H_2/4H_1$	K_D/K_R	h^2/H_2	h^2(n.s)	h^2(b.s)
Days to heading	N	0.30	0.20	0.57	0.70	0.95	0.98
	S	—	—	—	—	—	—
Days to maturity	N	0.74	0.19	0.46	1.39	0.83	0.93
	S	0.52	0.24	0.34	-0.17	0.79	0.86
Grain filling period	N	0.84	0.23	0.65	-0.05	0.76	0.92
	S	0.63	0.25	0.49	0.65	0.79	0.90
Grain filling rate	N	0.94	0.20	1.82	0.68	0.55	0.86
	S	1.04	0.23	1.30	0.74	0.46	0.77
Flag Leaf Area	N	0.87	0.20	1.77	0.25	0.65	0.95
	S	0.91	0.19	2.49	0.77	0.55	0.97
Chlorophyll content	N	1.38	0.19	2.71	-0.02	0.15	0.79
	S	1.38	0.22	1.83	0.78	0.32	0.89
Plant height	N	0.42	0.24	1.44	2.38	0.87	0.95
	S	0.43	0.21	1.49	1.13	0.87	0.95
No.of spikes/plant	N	1.12	0.25	1.08	0.40	0.46	0.77
	S	0.82	0.24	0.31	-0.22	0.64	0.76
No.of kernels/spike	N	0.89	0.17	1.62	-0.02	0.69	0.91
	S	1.28	0.18	2.38	0.47	0.35	0.85
100-kernels weight	N	1.53	0.22	1.20	2.39	0.45	0.90
	S	1.53	0.22	1.15	2.53	0.43	0.84
Grain yield plant	N	—	—	—	—		—
	S	1.49	0.25	1.17	1.02	0.30	0.74

N= normal irrigation, S=Stress

indicating that the positive and negative alleles were unequally distributed among the parents.

The ratio of dominant and recessive genes in the parents (K_D/K_R) was more than one for all traits at both conditions , suggesting the preponderance of dominance alleles. except, days to heading at normal condition, days to maturity and grain filling period at both conditions which were less than one. showing an excess of recessive alleles among parents.

Regarding the number of gene groups (h^2/H_2), the results clearly showed that each one of studied characters were governed at least by one gene group, except days to maturity at normal condition. Plant height , grain yield per plant at water stress condition which were governed at least by two gene groups. Plant height at normal condition and 100-kernels weight at both conditions were governed by at least by three gene group.

Heritability in narrow sense ($h_{(n.s)}$) estimates were moderate or high for all traits at both conditions, except total chlorophyll content at both conditions and grain yield at water stress condition which had low values of heritability in narrow sense. reflecting the role of additive gene action in governing these traits, Therefore selection for these traits could be applied in early segregating generations. except total chlorophyll content at both conditions and grain yield at water stress condition which had low values of heritability in narrow sense. Heritability in broad sense ($h_{(b.s)}$)estimates had moderate or high values for all traits at both conditions, These results are in general agreement with those previously reported by Mohamed (2004) and Farhat (2005).

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التحليل الوراثي لبعض هجن قمح الخبز تحت ظروف الري الطبيعي و الإجهاد المائي

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أجريت هذه الدراسة في المزرعة البحثية بمحطة البحوث الزراعية بسخا محافظة كفر الشيخ خلال الموسمين ٢٠٠٣/٢٠٠٤ و ٢٠٠٤/٢٠٠٥ و قد استخدمت خمسة أصناف وسلالة من قمح الخبز المختلفة في صفاتها الوراثية . أجريت كل التهجينات الممكنة بين الآباء للحصول علي ١٥ هجينا فيما عدا الهجن العكسية في العام ٢٠٠٣/٢٠٠٤ وتم زراعة الست أباء و ١٥ هجين في تجربتين بنظام القطاعات الكاملة العشوائية تحت الظروف الطبيعية (٤ريات بالموسم) وظروف الجفاف (ريتين بالموسم) في العام ٢٠٠٤/٢٠٠٥ وفيما يلي ملخص لأهم النتائج .

١-أوضح التحليل التجميعي للتجربتين وجود فرق معنوي بين معاملتي الري لكل الصفات المدروسة ماعدا عدد الأيام حتى الطرد، فترة الامتلاء ، عدد حبوب السنبلة و وزن ١٠٠حبة.

٢ - أشارت النتائج إلي أن متوسطات مربعات التباين الراجع إلي القدرة العامة و القدرة الخاصة علي التالف كانت معنوية لكل الصفات تحت الظروف الطبيعية وظروف الجفاف ماعدا القدرة الخاصة علي التالف لعدد الأيام حتى الطرد، عدد الأيام حتى النضج ، فترة الامتلاء و عدد السنابل بالنبات تحت ظروف الجفاف. كانت نسبة القدرة العامة/القدرة الخاصة اعلي من واحد لكل الصفات ماعدا ، عدد السنابل للنبات تحت الظروف الطبيعية، معدل الامتلاء، مساحة ورقة العلم، عدد حبوب السنبلة تحت ظروف الجفاف المحتوي الكلي للكلوروفيل، وزن ١٠٠ حبة ومحصول النبات تحت الظروف الطبيعية وظروف الجفاف مما يشير إلي أن الفعل الجيني المضيف أكثر أهمية في التحكم في هذه الصفات.

٣ - أظهرت النتائج أهمية كل من الفعل الجيني المضيف والسيادي في وراثة معظم الصفات المدروسة تحت الظروف الطبيعية وظروف الجفاف. وقد لوحظ أن السيادة الجزئية تتحكم في وراثة كل الصفات المدروسة تحت الظروف الطبيعية وظروف الجفاف ماعدا عدد السنابل للنبات، محصول النبات تحت الظروف الطبيعية، معدل الامتلاء، عدد الحبوب بالسنبلة تحت ظروف الجفاف، المحتوي الكلي

للكلوروفـــيل، وزن ١٠٠ حـــبة تحت الظروف الطبيعة وظروف الجفاف و كان المتحكم فيها السيادة الفائقة.

٤-أظهـــرت النتائج أن معظم الصفات المدروسة يتحكم بها مجموعة واحدة من العوامل الوراثية ماعدا عـــدد الأيام حتى النضج تحت الظروف الطبيعية وطول النبات ومحصول النبات تحت ظروف الجفاف والتـــي يتحكم بها زوجين من العوامل الوراثية بينما طول النبات في الظروف الطبيعية ووزن ١٠٠ حبة تحت الظروف الطبيعية وظروف الجفاف يتحكم بها ثلاث أزواج من العوامل الوراثية.

توصي الدراسة باستخدام السلالة ١ والصنف سخا ٩٤ في برامج التربية لتحمل الجفاف حيث كان لهما قدرة عامة علي التالف لمعظم الصفات تحت الدراسة. كذلك توصي الدراسة بالانتخاب لصفات عـــدد الأيـــام حـــتى الطـــرد، عدد الأيام حتى النضج، فترة الامتلاء،طول النبات تحت الظروف الطبيعية وظروف الجفاف في الأجيال الانعزالية المبكرة .