The 10th Plant Breeding international Conference September 2016　　*Egypt. J. Plant Breed. 20 (4):128 -156. 2016 Special Issue*

HETEROSIS AND COMBINING ABILITY ANALYSIS OFF1 BREAD WHEAT UNDER STRESS AND NORMAL IRRIGATION TREATMENTS

EL HosaryA.A., M. EL. M.Badawy,S. A. Mehasen,A.A.A. El HosaryandE. H. Abd El Hady
Agronomy.Dep, Fac. of Agric, Moshtohor, Egypt

ABSTRACT

Eight bread wheat genotypes were crossed in a8x8half diallelscheme in 2012/2013.Parents and their 28 F1 crosses were evaluated under normal and stress conditions during 2013/2014 in two field experiments. The results of analysis of variance were significant for all studied traits. The highest mean values were detected by parents P6, P5,P5,P3,P5 and p4 for plant height, spike length, no of spike/ plant, 1000-kernel weight, biological yield/ plant and grain yield/ plant in the combined analysis, respectively. While, the highest mean values were recorded under combined analysis with crosses P1×P4,P1×P3, P2×P6, P2×P3, P4×P5 and P2×P4grain yield/ plant. Mean squares for both general (GCA) and specific (SCA) combining ability estimates were highly significant for all studied traits. The ratios between GCA and SCA exceeded the unity for all studied traits except for plant height at normal irrigation and biological yield plant-1 in the combined analysis, revealing that additive and additive x additive types of gene action are more important than non-additive gene action in controlling these traits.The parental P2 exhibited significant and positive ĝi effects for plant height, no of spike/ plant, 1000-kernel weight, and grain yield.

The highest desirable SCA effects were obtained with P4 x P5 and P4xP6 for grain yield/ plant.P7 and the cross P2xP6exhibited the desirable susceptibility index (SI)for grain yield/ plant.

Key words: Wheat,heterosis, combining ability, drought stress, GCA and SCA..

INTRODUCTION

Drought is a major limiting factor in the production of wheat in many areas of the world and there is considerable interest in trying to increase drought tolerance in wheat. Drought can cause substantial losses in total yield. In some areas, crop losses due to an extended drought can amount to many million dollars.

Heterosis is a complex phenomenon, which depends on the balance of different combinations of gene effects as well as on the distribution of plus and minus alleles in the parents of a mating system. In self-pollinated crops, like wheat, the scope for utilization of heterosis depends mainly upon the direction and magnitude of heterosis. Heterosis over better parent may be useful in identifying the best crosses but these hybrids can be of immense practical value if they involve the best cultivars of the area.

According to Arunachalam (1976), Baker (1978), Esmail (2002), Joshi *et al* (2004), Hasnain*et al* (2006) andFarooq*et al* (2010), the combining ability is a most reliable biometrical tool to circumvent plant breeding programs.

In general, screening and discovering drought tolerant gene resources are urgently needed for creating productive breeding materials with improved drought tolerance. Diallel cross technique is a good tool for the identification of hybrid combination that have the maximum improvement and identifying superior lines among the progenies in early segregations.

Therefore, the major objectives of this work were:

1-Evaluating performance of eight parents of bread wheat and their F1 crosses to identify the best performing genotypes.

2-Estimating heterosis, general and specific combining ability to identify the best combiner parents and its crosses for grain yield and its components

MATERIALS AND METHODS

Eight parents of bread wheat were used for this study. The parental Names, origin and pedigree of these genotypes are presented in Table (1).

Table (1): The name pedigree and source of the parental varieties and lines.

NO	genotypes name	Pedigree	Source
1	Ib. 4	Landraces	Egypt
2	Ib. 2	Landraces	Egypt
3	9	Landraces	Egypt
4	22	Landraces	Egypt
5	Sakha 93	S 92/TR 810328 S8871-1S-2S-1S-0S	Egypt
6	M 37	Landraces	Egypt
7	M45	Landraces	Egypt
8	Giza 168	MRl/BUG/SEPICM933046-8M-OY-OM•2Y-O3-OGZ.	Egypt

The experimental field work was carried out at Agricultural Research Station,Fac. of Agric. Moshtohor, Benha University, Kalubia Governorate, Egypt during the two successive seasons 2012/2013 and 2013/2014. The parents were crossed in a8x8diallel cross excluding reciprocals in 2012/2013 growing season. In 2013/2014 two adjacent experiments using randomized complete block design with three replications were carried out. Each experiment contained the eight parents and their resulting 28 F1's. The sowing date was on 25th Nov. 2013. The first experiment was irrigated only once after planting irrigation and the second one was normally irrigated. Plots of parents and F1's consisted of one row, 3 m-long, with spacing of 30 cm between rows and 20 cm between plants. The dry method of planting was used in this study. The other cultural practices of growing wheat were practiced. The amount of total rainfall during the growing season were recorded in Table (2).

Table 2. Monthly averages of temperature, relative humidity (R.H.) and total rain fall during 2013/2014 season at Kalubia (Moshtohor).

Months	Temperature C		R.H. (%)	Rain fall mm/month
	Min.	Max.		
Nov.2013	27.1	14.6	51.6	0.2
Dec.2013	20.1	8.5	54.7	0.7
Jan.2014	19.7	7	55.8	1.2
Feb.2014	22.4	8.4	46.2	0.4
Mar.2014	27.8	11.0	37.3	0.1
Apr.2014	29.1	12.4	38.9	0.2
May.2014	35.5	18.0	32.1	----

Ten guarded plants from parents and the F1's were selected randomly from each plot for recording observations on different characters.The characters studied were,Plant height(cm), No .of spikes /plant, No .of kernels/ spike,1000- kernel weight (g), biological yield/ plant andgrain yield/ plant (g). A stress susceptibility index (s) was used to characterize relative stress resistance of all genotypes.For each genotype drought susceptibility index (DSI) was calculated using formula given by **Saulescu*et al.* (1995)**

$$DSI = S/NS$$

Where: Ns and S character with normal irrigated and stress conditions, respectively.

Heterosis for each trait was computed as parents vs. hybrids sum of squares was obtained by partitioning the genotypes sum of square to its components. Analysis of variance was conducted as outlined by Steel and Torrie (1980) for all characters. The analysis of GCA and SCA was done following the procedure given by Griffing (1956) using Method II Model I. The combined analysis of the two experiments was carried out whenever homogeneity of mean squares was detected (Gomez and Gomez 1984). Percentages of heterosis relative to mid (MP) and better (BP) parents were calculated according to Fonsecca and Patterson (1968) as follows:

MP= (value of F1- mean of the two parents/mean of the two parents)×100.

BP= (value of F1- value of the best parent/value of the best parent)×100.

RESULTS AND DISCUSSION

Analyses of variance for yield and its components under drought and normal irrigation as well as combined analysis are presented in Table 3. Results indicated that mean squares due to irrigation treatments (Environments) were highly significant for all studied traits indicating overall differences between the two environments of study.

Genotypes mean squares were significant for all studied traits except no of spikes plant^{-1} in drought environment indicating wide diversity between all genotypes used in this work. Moreover, significant mean squares between genotypes and environment interaction were detected for all studied traits. This result indicated that genotypes responded differently to different environments.

Mean squares due to parents were highly significant for all traits in drought stress, normal irrigation and combined across them except parents mean squares due to no of spike plant^{-1} and 1000-kernel weight in the drought environment as well as grain yield plant^{-1} in normal irrigation environment indicating that these parents are differently in the aforementioned significant traits. Moreover, mean squares due to the interaction between parents and environments were significant for all studied traits except number of spikes/ plant. Such result indicated that wheat parents responded differently to stress and non-stress conditions. For the exceptional traits, insignificant mean squares between parents and environments were detected indicating that parents behaved similarly in stress and non-stress conditions.

Table (3) Mean squares for yield and its components under normal irrigation and drought stress condition as well as the combined over them.

S.O.V.	d.f.	plant height	Spike length	No of spike/ plant	1000-kernel weight	biological yield/ plant	grain yield / plant
Normal environment							
Rep/ I	2	35.77	0.18	211.09**	25.34*	8296.37**	376.6*
Genotypes (G)	35	97.99**	1.23**	74.16**	56.98**	5300.77**	193.88**
Parent (P)	7	80.73**	0.85*	70.63**	70.52**	3534.62**	88.27
Cross (C)	27	104.57**	1.32**	77.81**	54.55**	5946.68**	225.94*
P vs C.	1	41.12	1.45*	0.53	27.78	224.2	67.42
Error	70	31.52	0.32	24.45	7.38	1046.37	81.82
GCA	7	24.96**	0.9	37.1**	32.61**	2306.31**	154.93**
SCA	28	34.59**	0.29	21.63**	15.59**	1632.08**	42.05**
Error	70	10.51	0.11	8.15	2.46	348.79	27.27
GCA/SCA		0.72	3.12	1.72	2.09	1.41	3.68
drought environment							
Rep/ I	2	16.1	0.78	8.87	1.45	2144.84	31.57
Genotypes (G)	35	111.36**	2.36**	26.41	39.04**	2786.42**	344.55**
Parent (P)	7	120.95**	3.4**	14.42	23.01	2416.33*	554.75**
Cross (C)	27	110.33**	2.07**	30.49*	44.59**	2984.9**	282.97**
P vs C.	1	72.32	2.91*	0.1	1.31	17.85	535.79**
Error	70	25.85	0.47	18.21	11.38	994.64	27.61
GCA	7	101.11**	1.92	10.22**	28.18**	1705.06**	228.04**
SCA	28	21.12**	0.5	8.45**	9.22**	734.74**	86.55**
Error	70	8.62	0.16	6.07	3.79	331.55	9.2
GCA/SCA		4.79	3.8	1.21	3.06	2.32	2.63

Table (3) Cont.

S.O.V.	d.f.	plant height	Spike length	No of spike/ plant	1000-kernel weight	biological yield/ plant	grain yield / plant
Combined analysis							
Irrigation (I)	1	5760.83**	87.64**	4968.45**	250.2**	302995.97**	7683.4**
Rep/ I	4	25.94	0.48	109.98**	13.4	5220.6**	204.08**
Genotypes (G)	35	140.58**	2.44**	63.06**	59.59**	3712.27**	423.68**
Parent (P)	7	98.52**	2.43**	45.17*	53.5**	3479.91**	395.99**
Cross (C)	27	156.6**	2.37**	70.01**	63.06**	3907.87**	428.34**
P vs C.	1	2.19	4.23**	0.54	8.5	57.76	491.67**
G x I	35	68.78**	1.16**	37.51*	36.43**	4374.91**	114.74**
p2 x I	7	103.15**	1.81**	39.88	40.03**	2471.04*	247.02**
C x I	27	58.3**	1.03**	38.28*	36.08**	5023.71**	80.57
P.vs.C x I	1	111.24	0.13	0.09	20.59	184.3	111.54
Error	140	28.68	0.39	21.33	9.38	1020.5	54.71
GCA	7	85.72**	2.06**	24.62**	44.9**	874.7*	333.91**
SCA	28	37.14**	0.5**	20.12**	13.6**	1328.1**	93.06**
GCA x L	7	40.35**	0.76**	22.71**	15.89**	3136.66**	49.06*
SCA x L	28	18.57**	0.29**	9.95	11.21**	1038.71**	35.55**
Error	140	9.56	0.13	7.11	3.13	340.17	18.24
GCA/SCA		2.31	4.12	1.22	3.3	0.66	3.59
GCA x L/GCA		0.47	0.37	0.92	0.35	3.59	0.15
SCA x L/SCA		0.5	0.58	0.49	0.82	0.78	0.38

* $p < 0.05$; ** $p < 0.01$

Mean performance

Results in Table (4) showed the average of plant height, yield and its components traits at the combined across irrigation treatments. Its clear that the parental line (P_1) gave the lowest mean value for plant height, the highest mean values for spike length. Also, this parent ranked the first one for biological yield/ plant. Parent No 3 (P_3) gave the highest mean values for 1000-kernel weight.Parental No 4 (P_4) gave the highest mean values for grain yield / plant.The parental variety No 5 (P_5) exhibited the highest mean values for spike length. Also, it gave the highest mean values for no of spike/ plant. Moreover it gave the highest parent for biological yield/ plant.The parental No 6 (P_6) gave the highest mean value for plant height. Parental No 7 (P_7) and No 8 (P8) ranked the first for grain yield / plant and biological yield/ plant, respectively.

Mean performance of F_1 crosses for all studied traits are presented in Table 4.Results indicate that the cross P_6 x P_7 exhibited the lowest mean values for plant height. Moreover, the cross P_1 x P_4 expressed the highest values for plant height. Some farmers usually prefer higher plant due to the high price of hay. On the other hand, this plant must be given high yield for grain and behave resistant to lodging

Table 4. Mean performance of the genotypes for yield and its components over the studied environments .

	plant height	Spike length	no of spikes / plant	1000-kernels weight	biolodical yield/ plant	grain yield/ plant
1x1	97.63	13.6	28.1	47.2	257.34	64.12
2x2	98.78	13.26	26.94	46.73	215.86	85.17
3x3	102.44	13.43	23.15	54.23	202.39	78.57
4x4	105.5	11.85	26.53	47.8	216.04	89.48
5x5	106.89	13.43	32.58	45.64	271.25	87.19
6x6	108.61	12.39	29.32	48.81	255.36	80.63
7x7	99.76	13.01	26.18	48.02	231.93	85.58
8x8	100.44	12.38	26.32	44.08	242.26	76.26
1x2	103.58	13.28	32.51	49.42	259.65	83.7
1x3	104.28	14.69	28.35	49.61	258.89	80.73
1x4	111.83	13.47	32.72	51.19	278.6	74.88
1x5	106.04	14.24	23.78	50.31	220.82	74.41
1x6	108.46	13.15	29.89	52.54	247.47	74.51
1x7	96.21	13.15	26.63	49.22	216.16	74.41
1x8	98.13	13.4	33.56	47.38	257.19	79.98
2x3	106.33	13.76	26.68	53.47	234.04	86.94
2x4	106.74	12.9	32.01	49.17	271.53	87.62
2x5	110.06	13	28.36	49.7	243.96	88.38
2x6	106.88	13.33	34.24	50.62	242.79	92.63
2x7	100.13	13.5	27.53	49.37	218.39	97.4

Table 4. Con.

	plant height	Spike length	no of spikes / plant	1000-kernels weight	biolodical yield/ plant	grain yield/ plant
2x8	100.58	13.25	24.08	46.82	186.31	97.21
3x4	110.65	13.6	27.58	49.84	244.57	75.98
3x5	105.06	13.97	23.88	52.74	210.63	96.93
3x6	106.92	12.72	26.33	50.67	214.35	93.53
3x7	95.88	13.94	24.49	50.22	224.18	84.06
3x8	100.63	13.69	30.03	45.51	245.93	91.87
4x5	102.14	12.89	29.28	45.87	273.07	69.56
4x6	96.93	12.78	22.13	46.07	201.17	65.14
4x7	104.35	12.63	23.63	45.89	218.71	81.66
4x8	101.1	12.44	26.01	45.12	206.06	89.04
5x6	106.93	11.69	23	46.41	198.11	84.75
5x7	100.1	12.67	24.6	37.8	205.4	89.5
5x8	96.88	13.15	27.58	48.46	233.53	88.63
6x7	90.65	12.38	28.93	47.43	253.1	84.78
6x8	98.96	13.85	28.81	42.83	269.29	88.41
7x8	100.58	13.6	23.71	48.44	254.82	89.46
mean of parent	102.51	12.92	27.39	47.81	236.55	80.87
mean of cross	102.75	13.26	27.51	48.29	235.31	84.5
mean of Genotype	102.7	13.18	27.48	48.18	235.59	83.7
L.S.D 5%	8.57	1	7.39	4.9	51.12	11.84
L.S.D 1%	11.24	1.31	9.69	6.43	67.03	15.52

For spike length, the cross P_1 x P_3 expressed the highest means value being 14.69 cm. The highest no of spikes were detected by cross P_2 x P_6 (34.24). The parental combination P_2 x P_3gave the highest mean values for 1000-kernel weight.The highest mean values for biological yield / plant were detected for the cross P_1 x P_4 (278.60 g). For grain yield/ plant the cross P_3 x P_5 gave the highest values (107.58 g) under Normal condition. However, the highest mean values for grain yield/ plant (91.82) were detected by P_2 x P_6 and P_2 x P_7. Moreover the cross P_2 x P_7 exhibited the heavier grain yield plant in the combined analysis being 79.40.Therefore, these crosses could be efficient for prospective wheat breeding programs aiming at improving wheat grain yield.

Heterotic effects

Percentages of heterosis expressed as the percentage deviation of F1 mean performance from its mid- and better- parent for yield and its components are presented in Table(5).

For plant height non-cross expressed significant and negative heterotic effects relative to mid parent. However, two crosses manifested significant and negative heterotic effects relative to better parent. Whereas, the cross P_5 x P_7 expressed the highest significant and negative effects relative to better parent. Significant and negative heterotic effects relative to both mid parent and better parent were also reached by **El- Sayed (1997), Hamada and Taufelis (2001), Hamada et al., (2002), Bayoumi (2004), Abdel El-Aty et al., (2005), and Abdel- Monwam (2009).**

Table (5): Heterosis relative to mid and better parent for the studied traits in the combined analysis .

	plant height		Spike length		No of spike/ plant		1000-kernel weight		biological yield/ plant		grain yield / plant	
	M.P.	B.P	M.P.	B.P	M.P.	B.P	M.P.	B.P	M.P.	B.P	M.P.	B.P
1x2	3.20	2.68	-1.28	-1.84	7.26	4.35	0.1	-0.79	5.66	2.46	8.93*	-2.06
1x3	1.16	0.22	3.28	2.86	6.76	6.52	2.6	1.63	3.68	-0.17	11.08*	4.87
1x4	6.28**	3.42	2.56	-3.68	10.92	7.57	3.58	2.5	8.22	8.03	4.14	-6.85
1x5	3.07	0.58	0.41	-0.41	-6.07	-10.34	4.21	0.48	-9.75	-12.41*	3.23	-7.84
1x6	3.05	1.53	0.63	-1.43	0.95	-0.53	4.08	3.99	-0.01	-0.34	5.59	-4.01
1x7	0.53	0.30	0.31	-0.72	-6.06	-8.21	-2.9	-2.94	-5.44	-5.96	2.83	-8.38
1x8	0.49	-0.01	0.94	-0.01	4.18	0.00	2.03	0.01	-6.39	-0.1	12.83**	0.09
2x3	3.69	2.21	2.73	2.57	-4.26	-7.06	7.89**	5.92	-0.09	-0.82	5.33	0
2x4	1.09	-2.13	-0.22	-5.79*	-0.65	-0.98	3.03	1.06	-0.86	-3.7	0.25	-0.34
2x5	3.26	0.26	-1.71	-1.96	-0.69	-2.61	3.21	0.38	2.71	-3.24	0.02	-0.78
2x6	4.90*	2.83	2.57	1.03	12.76	11.31	-0.8	-1.56	1.92	-1.48	7.44	6.13
2x7	3.25	2.96	2.13	1.65	-2.18	-2.62	0.03	-0.9	-2.74	-6.19	5.03	3.95
2x8	5.04*	0.04	3.52	0.02	-4.34	-0.06	1.04	0.01	-6.53	-0.13*	14.14**	0.06
3x4	4.48	2.60	5.63**	-0.41	7.51	4.04	-0.9	-0.97	10.16	6.24	-5.92	-11.18*
3x5	2.13	0.58	4.14*	3.71	-3.28	-7.87	6.08*	1.35	0.31	-6.15	7.23	1.03
3x6	0.41	-0.15	-2.62	-4.22	-5.17	-6.77	-1.4	-2.4	-4.06	-7.92	5.04	0.89
3x7	-2.66	-3.78	2.49	1.85	-2.42	-4.86	-0.9	-1.83	-1.34	-5.5	2.56	-3.58
3x8	-0.22	-0.03	3.47	0.01	4.82	0.00	-3.2	-0.05	0.41	-0.07	18.47**	0.16**
4x5	-2.19	-2.48	5.87**	0.21	2.10	0.45	-7.71**	-11.90**	7.29	3.96	-17.79**	-17.97**

Table (5): cont.

	plant height		Spike length		No of spike/ plant		1000-kernel weight		biological yield/ plant		grain yield / plant	
	M.P.	B.P	M.P.	B.P	M.P.	B.P	M.P.	B.P	M.P.	B.P	M.P.	B.P
4x6	-3.92	-5.13*	4.84*	0.43	-1.20	-2.79	-6.61*	-7.66*	1.16	0.65	-16.11**	-17.61**
4x7	0.93	-2.02	3.13	-2.19	-2.04	-2.79	-6.5	-7.47*	9.35	8.57	-5.86	-6.28
4x8	-0.67	-0.02	2.73	0.01	-3.87	-0.06	-4.1	-0.07*	-0.49	0.01	11.07**	-0.05
5x6	-2.33	-3.28	-7.05**	-8.20**	-4.25	-7.28	-2.2	-5.64	-2.92	-5.48	2.04	0
5x7	-3.39	-5.94*	-2.91	-3.12	-9.83	-11.96	-2.9	-6.45*	-6.87	-9.13	-0.03	-0.25
5x8	-0.87	-0.05*	-0.63	-0.02	-1.96	-0.02	2.66	0	-2.69	-0.04	7.42	-0.01
6x7	-3.34	-4.98	-1.58	-2.61	3.57	2.69	-3.4	-3.54	7.94	7.71	-2.27	-4.43
6x8	2.53	-0.01	6.73**	0.06**	6.93	0.04	-6.39*	-0.07*	9.41	0.05	11.25**	0.05
7x8	0.66	-0.01	2.96	0.02	-3.60	-0.06	1.33	0	-5.75	-0.09	8.90**	0

* $p< 0.05$; ** $p< 0.01$

For spike length, five crosses exhibited positive and significant heterotic effects relative to mid parents. The cross P_6 x P_8 expressed the highest significant and positive heterosis across environments, whereas, one crosses give positive and significant heterotic effects relative to better parent. The cross P_5 x P_6 gave the high significant and positive hetertotic effects relative to better parent. Significant and positive mid- parent and better- parent heterosis for spike length was reported by **Zaied (1995), El- Seidy and Hamada (2000), Hamada et al., (2002) and El- Borhamy et al., (2008) .**

For 1000 kernel weight, two crosses expressed significant and positive mid parent heterosis. However, the highest significant and positive mid parent heterosis was recorded for the crosses P_2 x P_3 . However, the most desirable heterotic effects relative to better parent were detected for the crosses P_2 x P_3 and P_3 x P_5. Significant and positive heterosis effects for 100 kernel weight were detected **by El- Sayed (1997), Hamada et al., (2002), El- Borhamy et al., (2008) and Abdel- Moneam (2009).**

Regarding grain yield/ plant, eight crosses exhibited significant and positive mid parent heterosis. Also, one cross expressed significant and positive heterosis in the same order. However, the most desirable heterotic effects relative to both mid- and better- parent were detected for the cross P_3 x P_8. This cross (P_4 x P_5) recorded the highest significant and positive heterosis relative to mid parent and better parent. Significant and positive heterosis effects relative to mid parent and better parent for grain yield/ plant were reported by**Zaied (1995), Hamada et al., (2002), Bayoumi (2004),Abde El- Aty et al. (2005) and Abde El- Aty et al. (2007)**

Combining ability

The analysis of variance for combining ability for plant height, spike length, number of spikes/ plant, 1000-kernel weight, biological yield, and grain yield/ plant, under drought treatment, normal irrigation and combined analysis is presented in Table 3. General (GCA) and specific (SCA) combining ability mean squares were highly significant for all studied traits in both environments as well as combined analysis except for spike length under drought and normal conditions. Such results indicated that both types of combining ability are important in the inheritance of these traits. Moreover, the ratios between GCA and SCA exceeded the unity for all studied traits except for plant height at normal irrigation and biological yield plant^{-1} in the combined analysis, revealing that additive and additive x additive types of gene action are more important than non-additive gene action in controlling these traits. The genetic variance was previously reported to be mostly due to additive effects for plant height by **Menshawy (2004) and El Hosary*et al* (2009)**; for spikes/ plant by **El Seidy and Hamada (1997), El Borhamy (2000), Gomaa*et al* (2014)**; for 1000-grain weight by **El Seidy and Hamada (1997), El Borhamy (2000),** and for grain yield/ plant by **El Seidy and Hamada (1997), El Seidy and Hamada (2000), El Borhamy (2000), Abd El-Aty and Katta (2002), El Hosary*et al* (2012), Gomaa*et al* (2014).**

The mean squares of the interaction between GCA, SCA and irrigation treatments were significant for all studied traits except SCA x E for no of spike / plant. Such result indicated that the additive type of gene action differed significantly from one environment to another for these traits. For the exceptional case the additive gene action was more infulenced across different environments. Similar results were reported by **El-Seidy and Hamada (1997), El-Seidy and Hamada (2000).**

The ratio SCA x environment/ SCA was much higher that of GCA x irrigation/ GCA treatments for all traits except biological yield/ plant indicating that non additive effects were much more influenced by environments than additive genetic one. Such results are in harmony with those obtained by **El Hosary and Nour El Deen (2015).**

General Combing Ability (GCA) effects

Test of homogeneity revealed the validity of the combined analysis for the data of the two irrigation treatments. The general combining ability effects $\hat{g}_i$ of each parent for all studied measurements at the combined analysis are presented in Table (6). Such results are being used to compare the average performance of each parent with other genotype and facilitate selection of parents for further improvement to drought resistance. Results indicate that the parental P_1 gave significant and positive ĝi effects for spike length, no of spike/ plant , biological yield/ plant and 1000-kernels weight. P_2 exhibited significant and positive ĝi effects for plant height, No of spike/ plant, 1000-kernel weight, and grain yield.The parent $P_3$is considered the best combiner for grain yield/ plant. Also, P3 gave significant and positive ĝi effects for spike length and 1000-kernel weight.P_4 expressed significant and positive ĝi effects for plant height in the combined analysis, biological yield/ plant in drought stress environment. P_5 seemed to be the best general combiner for plant height and grain.

Table 6. Estimates of general combining ability effects for yield and its components at the combined analysis.

Parent	plant height	Spike length	No of spike/ plant	1000- kernel weight	biological yield/ plant	grain yield / plant
g1	-0.05	0.4**	1.63**	1.04**	13.32**	-8.24**
g2	0.76*	0.09*	1.19**	0.84**	-3.19	5.09**
g3	1.04**	0.46**	-1.37**	2.69**	-8.29**	1.39**
g4	2.05**	-0.42**	-0.09	-0.49*	0.55	-3.04**
g5	1.67**	-0.01	-0.17	-1.11**	0.77	1.33**
g6	0.87*	-0.39**	0.46	0.05	1.67	-0.83
g7	-3.68**	-0.07	-1.55**	-0.93**	-6.57**	1.92**
g8	-2.65**	-0.05	-0.09	-2.09**	1.74	2.38**
L.S.D(0.05) gi	0.71	0.08	0.62	0.41	4.26	0.99
L.S.D(0.01) gi	0.94	0.11	0.81	0.54	5.59	1.29
L.S.D(0.05) gi-gj	1.36	0.16	1.17	0.77	8.08	1.87
L.S.D(0.01) gi-gj	1.78	0.21	1.53	1.02	10.6	2.45

* $p< 0.05$; ** $p< 0.01$

yield/ plant. P_6 expressed significant and positive ĝi effects for plant height. P_7 exhibited significant and negative ĝi effects for plant height. Also, this parent considered best combiner for grain yield/ plant.P_8 seemed to be the best general combiner for plant height. Also, it ranked the second best general combiner for grain yield/ plant.

Specific combining ability (SCA) effects

Specific combining ability effects $\hat{s}_{ij}$ for the F_1 crosses for the studied traits in the combined analysis are presented in (Table 7).

For plant height, five cross combinations expressed significant and positive ŝij effects. Moreover, the cross P_1 x P_4 gave the most desirable ŝij effects for plant height. However, the cross combination P_4 x P_6 gave significant and negative ŝij effects for plant height. For spike length, four cross in the combined analysis expressed significant and positive ŝij effects. Moreover, the cross P_6 x P_8 gave the most desirable ŝij effects for this trait. For number of spikes/ plant, five crosses expressed significant and positive ŝij effects. However, the best ŝij effects (5.10**) were detected for the cross P_2 x P_6.Regarding 1000-kernel weight, five cross combinations expressed significant and positive ŝij effects. The cross P5xP8 being 3.47**.Five crossescombinations (P_2 x P_4, P_6 x P_8 and P_2 x $P_{4)}$ exhibited significant and positive ŝij effects for biological yield/ plant. The best positive ŝij effects were the crosses P_2 x P_7, P_2 x P_8 , P_3 x P_5, P_3 x P_6, and P_4 x P_8 in the combined analysis (Table 7).

It could be concluded that the previous cross combinations might be of interest in breeding programs towards the development of pure lines varieties for high biological, and grain yields/ plant under drought conditions.

Table 7. Estimates of specific combining ability effects for yield and its components 'at the combined analysis .

Cross	plant height	Spike length	No of spike/ plant	1000-kernel weight	biological yield/ plant	grain yield / plant
P1xP2	0.18	-0.39	2.21	-0.64	13.94	3.15
P1xP3	0.59	0.66**	0.61	-2.3*	18.28	3.89
P1xP4	7.14**	0.32	3.71*	2.46*	29.14**	2.47
P1xP5	1.72	0.67**	-5.16**	2.19	-28.86*	-2.37
P1xP6	4.94*	-0.03	0.32	3.26**	-3.1	-0.12
P1xP7	-2.75	-0.35	-0.94	0.92	-26.18*	-2.96
P1xP8	-1.87	-0.13	4.54**	0.25	6.55	2.14
P2xP3	1.84	0.03	-0.63	1.76	9.94	-3.24
P2xP4	1.23	0.05	3.43*	0.64	38.58**	1.87
P2xP5	4.93*	-0.26	-0.15	1.79	10.79	-1.74
P2xP6	2.55	0.45	5.1**	1.54	8.72	4.66
P2xP7	0.35	0.3	0.4	1.28	-7.44	6.69*
P2xP8	-0.22	0.02	-4.5**	-0.11	-47.83**	6.04*
P3xP4	4.87*	0.38	1.57	-0.54	16.72	-6.06*
P3xP5	-0.35	0.34	-2.07	2.98**	-17.44	10.51**
P3xP6	2.32	-0.53*	-0.24	-0.25	-14.62	9.27**
P3xP7	-4.17*	0.37	-0.08	0.27	3.45	-2.94
P3xP8	-0.45	0.1	4.01*	-3.27**	16.9	4.39
P4xP5	-4.28*	0.15	2.06	-0.71	36.16**	-12.42**
P4xP6	-8.68**	0.41	-5.73**	-1.67	-36.64**	-14.68**
P4xP7	3.29	-0.06	-2.22	-0.88	-10.86	-0.91

Table 7. Con.

Cross	plant height	Spike length	No of spike/ plant	1000-kernel weight	biological yield/ plant	grain yield / plant
P4xP8	-0.99	-0.27	-1.28	-0.48	-31.82**	6.01*
P5xP6	1.7	-1.08**	-4.77**	-0.72	-39.92**	0.56
P5xP7	-0.59	-0.43	-1.17	-8.35**	-24.39*	2.56
P5xP8	-4.84*	0.04	0.36	3.47**	-4.57	1.23
P6xP7	-9.23**	-0.34	2.54	0.11	22.41	-0.01
P6xP8	-1.95	1.11**	0.96	-3.31**	30.3*	3.16
P7xP8	4.22*	0.54*	-2.13	3.27**	24.07*	1.46
LSD5%(sij)	3.89	0.45	3.35	2.22	23.18	5.37
LSD1%(sij)	5.1	0.6	4.39	2.91	30.39	7.04
LSD5%(sij-sik)	5.75	0.67	4.96	3.29	34.29	7.94
LSD1%(sij-sik)	7.54	0.88	6.5	4.31	44.97	10.41
LSD5%(sij-ski)	1.92	0.22	1.65	1.1	11.43	2.65
LSD1%(sij-ski)	2.51	0.29	2.17	1.44	14.99	3.47

* $p < 0.05$; ** $p < 0.01$

Drought susceptibility index (DSI)

The analysis of variance for susceptibility index (SI) of yield and yield components are presented in Table 8. Highly significant mean squares due to genotypes, parents and crosses were detected for all studied traits except for, parents mean square for biological yield/ plant. Such results indicate the wide diversity among all wheat genotypes of this study.

Mean performance of the eight parents along with their crosses of wheat of SI are presented in Table 9.

Results indicate that (P_4) gave the desirable susceptibility index (SI) for plant height. Parent (P_5) seemed to be the best parent for number of 1000-kernel weight. P_6 gave the desirable SI for spike length. P_7 was the best parent for grain yield/ plant. P_8 gave the desirable SI for no of spikes/ plant and biological yield. The mean performance of susceptibility index for studied hybrids are presented inTable 9.

Regarding plant height, the crosses P_1 x P_4, P_3 x P_4, and P_3 x P_5 had the best susceptibility index of stress irrigation. However, the crosses P_7 x P_8 had low SI of stress irrigation. For spike length, the crosses P_2 x P_8 and P_3 x P_5 seemed to be the best cross combinations since they had the highest SI for this trait. However, the crosses P_2 x P_4 had low SI of stress irrigation.

For number of spikes/ plant, the cross combinations P_4 x P_6 had the highest tolerance for stress irrigation. However, the crosses P_1 x P_7 had low SI of stress irrigation.Regarding 1000-kernel/plant, four crosses namely P_1 x P_2, P_2 x P_7, P_3 x P_7 and P_6 x P_8 had the best susceptibility index of stress irrigation. For biological yield/ plant the two crosses i.e. P5xP6 and P6xP8 were the Most cross gave desirable susceptibility index (Table 9).

Analysis of variance for combining ability for SI in yield and yield components is presented in Table 8.

The variances associated with general and specific combining ability were highly significant for SI in all studied traits except SCA for no of spikes / plant. Such results indicated that both types of gene action namely, additive and non-additive are important in the inheritance of susceptibility index for yield and yield components.

Large GCA/ SCA ratio which was over one was detected for all traits indicating the predominance of additive type of gen action in controlling such traits. Similar results were reported by **El- Borhamy (2000), and El- Gamal (2001).**

Table (8) Mean squares of yield and yield component for susceptibility index (SI) under normal irrigation (N) and drought stress (D).

SOV	df	plant height	spike length	no of spike / plant	1000-kernel weight	biolodical yield/ plant	grain yield/ plant
replication	2	0.008	0.008	0.736**	0.014	0.593**	0.032
Genotypes	35	0.017**	0.021**	0.214**	0.032**	0.314**	0.075**
parent	7	0.028**	0.042**	0.212	0.033**	0.156	0.174**
Cross	27	0.013*	0.016**	0.222**	0.032**	0.366**	0.047*
Par.vs.cr.	1	0.027	0.008	0.009	0.022	0.001	0.125*
Error	70	0.007	0.006	0.109	0.008	0.093	0.024
GCA	7	0.011	0.015	0.124	0.014	0.216	0.028
SCA	28	0.004	0.005	0.058	0.01	0.077	0.024
Error	70	0.002	0.002	0.036	0.003	0.031	0.008
GCA/SCA		2.483	2.869	2.14	1.352	2.815	1.19

* p< 0.05; ** p< 0.01

Table (9) Mean performance of susceptibility index (SI) for yield and its component.

genotypes	plant height	spike length	no of spike / plant	1000-kernel weight	biological yield	grain yield / plant
P1	1.09	1.07	1.91	0.88	1.64	1.59
P2	1.16	1.07	1.33	0.92	1.67	1.08
P3	1.11	1.10	1.38	1.08	1.57	1.40
P4	1.02	1.41	1.25	0.83	1.24	1.13
P5	1.07	1.12	1.58	1.10	1.40	1.07
P6	1.18	1.06	1.72	0.95	1.58	1.07
P7	1.15	1.07	1.36	0.91	1.36	1.01
P8	1.34	1.09	1.10	0.82	1.00	1.57
1x2	1.10	1.10	1.54	1.00	1.51	1.13
1x3	1.14	1.12	1.43	0.85	1.69	1.24
1x4	1.00	1.22	1.36	0.87	1.37	1.06
1x5	1.03	1.19	1.51	0.98	1.81	1.07
1x6	1.12	1.06	1.82	0.98	1.54	1.08
1x7	1.06	1.03	2.01	1.07	1.55	1.08
1x8	1.17	1.11	1.74	0.85	1.89	1.23
2x3	1.09	1.02	1.87	0.85	1.95	1.12
2x4	1.13	1.29	1.94	0.85	2.19	1.10
2x5	1.12	1.11	1.39	1.03	1.35	1.12

Table (9). Con.

genotypes	plant height	spike length	no of spike / plant	1000-kernel weight	biological yield	grain yield / plant
2x6	1.03	1.03	1.49	1.08	1.61	1.02
2x7	1.04	1.03	1.55	0.99	1.59	1.12
2x8	1.15	1.01	1.34	0.88	1.67	1.13
3x4	1.01	1.12	1.14	0.94	1.18	1.33
3x5	1.01	1.01	1.34	0.98	1.17	1.25
3x6	1.16	1.16	1.98	1.04	1.73	1.36
3x7	1.13	1.08	1.52	1.00	1.67	1.12
3x8	1.21	1.06	1.38	0.92	1.46	1.07
4x5	1.05	1.02	1.27	1.25	1.20	1.55
4x6	1.10	1.11	1.00	1.06	1.06	1.39
4x7	1.08	1.11	1.22	1.04	0.78	1.20
4x8	1.15	1.16	1.42	0.94	0.92	1.02
5x6	1.21	1.23	1.23	1.07	1.03	1.01
5x7	1.20	1.14	1.76	0.71	1.34	1.11
5x8	1.08	1.18	1.29	1.00	1.15	1.13
6x7	1.03	1.08	1.39	1.02	1.10	1.17
6x8	1.03	1.02	1.13	0.99	0.99	1.07
7x8	1.22	1.10	1.22	0.91	1.83	1.09
mean of parents	1.14	1.12	1.45	0.94	1.43	1.24
mean of crosses	1.10	1.10	1.47	0.97	1.44	1.16
mean of Genotypes	1.11	1.11	1.47	0.96	1.44	1.17
L.S.D 5%	0.13	0.12	0.54	0.15	0.50	0.25
L.S.D 1%	0.18	0.16	0.71	0.20	0.66	0.34

General combining ability effects (ĝi):

Estimations of G.C.A effects (ĝi) for individual parental genotypes for SI in yield and yield components are presented in Table 10.

P_1 expressed the highest significant and positive (ĝi) effects for number of spikes / plant and biological yield/ plant. P_2 exhibited significant desirable (ĝi) effects spikes/ plant biological yield/ plant and undesirable (ĝi) effects for other studied traits (Table 10).P_3 exhibited positive and significant general combiner for grain yield/ plant and biological yield.P_4 expressed significant and negative (ĝi) effects for plant height. Also, it gave significant and positive effects for spike length. Therefore, it seemed to be the best general combiner for those two traits. P_5 and P6 was the best general combiners for 1000 kernel weight since it exhibited significant and positive (ĝi) effects for this trait.

Table (10) Estimates of general combining ability effects for susceptibility index (SI) of yield and its component .

parents	plant height	spike length	no of spike / plant	1000-kernel weight	biological yield	grain yield / plant
P1	-0.02	0.00	0.20**	-0.03	0.17**	0.05
P2	0.00	-0.02	0.06	-0.01	0.23**	-0.07*
P3	0.00	-0.02	0.02	0.01	0.10*	0.07**
P4	-0.04**	0.09**	-0.14*	-0.01	-0.18**	0.03
P5	-0.02	0.01	-0.03	0.06**	-0.11*	-0.02
P6	0.01	-0.02	0.03	0.05**	-0.07	-0.03
P7	0.01	-0.03	0.02	-0.01	-0.04	-0.07*
P8	0.07**	-0.02	-0.15**	-0.05**	-0.10*	0.03
L.S.D(0.05) gi	0.03	0.03	0.11	0.03	0.10	0.05
L.S.D(0.01) gi	0.04	0.03	0.15	0.04	0.14	0.07
L.S.D(0.05) gi-gj	0.04	0.04	0.17	0.05	0.16	0.08
L.S.D(0.01) gi-gj	0.06	0.05	0.22	0.06	0.21	0.11

* $p< 0.05$; ** $p< 0.01$

Specific combining ability effects (ŝij):

Specific combining ability effects for SI in yield and yield components are presented in Table 11.

The most desirable ŝij effects were detected for the cross combination P_6 x P_7 and P6xP8 for plant height; the cross P_2 x P_4 for spike length; the crosses P1 x P7 and P4xP5 for 1000-kernel weight; the crosses P_1 x P_8 , P2xP4 and P7xP8 for biological yield / plant; the cross P_4 x P_5 and P4xP6 for grain yield/ plant. It could be concluded that stress tolerant genotypes, as defined by SI values, need not have a high yield potential since SI provides a measure of tolerance based on minimization of yield loss under stress rather than non-stress yield.

Table (11) Estimates of specific combining ability effects for susceptibility index.

	plant height	spike length	no of spike / plant	1000-kernel weight	biological yield	grain yield / plant
P1xP2	0.01	0.02	-0.18	0.08	-0.32*	-0.03
P1xP3	0.06	0.03	-0.26	-0.09	-0.03	-0.06
P1xP4	-0.04	0.03	-0.17	-0.05	-0.06	-0.20*
P1xP5	-0.05	0.07	-0.14	-0.01	0.31	-0.13
P1xP6	0.02	-0.03	0.12	0.00	0.00	-0.11
P1xP7	-0.04	-0.05	0.32	0.15**	-0.02	-0.08
P1xP8	0.01	0.01	0.22	-0.03	0.39*	-0.03
P2xP3	-0.01	-0.04	0.33	-0.10*	0.18	-0.06
P2xP4	0.07	0.12**	0.55	-0.10*	0.71**	-0.04
P2xP5	0.02	0.02	-0.10	0.03	-0.21	0.03
P2xP6	-0.08	-0.04	-0.07	0.08	0.02	-0.05
P2xP7	-0.08	-0.02	0.01	0.06	-0.04	0.08
P2xP8	-0.03	-0.06	-0.04	-0.01	0.11	-0.01
P3xP4	-0.05	-0.05	-0.21	-0.02	-0.18	0.05
P3xP5	-0.08	-0.09*	-0.12	-0.05	-0.26	0.02
P3xP6	0.04	0.09*	0.47**	0.02	0.26	0.15
P3xP7	0.01	0.02	0.01	0.04	0.16	-0.06
P3xP8	0.03	-0.01	0.04	0.00	0.02	-0.20*
P4xP5	0.00	-0.19**	-0.04	0.24**	0.05	0.36**

Table (11). Con.

	plant height	spike length	no of spike / plant	1000-kernel weight	biological yield	grain yield / plant
P4xP6	0.02	-0.08	-0.36*	0.05	-0.13	0.21*
P4xP7	0.00	-0.06	-0.12	0.09	-0.44**	0.06
P4xP8	0.02	-0.02	0.24	0.04	-0.24	-0.22**
P5xP6	0.11*	0.12**	-0.24	0.01	-0.22	-0.11
P5xP7	0.10*	0.04	0.31	-0.30**	0.05	0.02
P5xP8	-0.08	0.07	0.00	0.04	-0.08	-0.05
P6xP7	-0.09*	0.02	-0.12	0.02	-0.23	0.10
P6xP8	-0.16**	-0.05	-0.21	0.03	-0.27	-0.10
P7xP8	0.04	0.03	-0.12	0.01	0.53**	-0.05
LSD5%(sij)	0.09	0.08	Ns	0.10	0.32	0.16
LSD1%(sij)	0.11	0.10	Ns	0.13	0.42	0.22
LSD5%(sij-sik)	0.13	0.12	Ns	0.14	0.47	0.24
LSD1%(sij-sik)	0.17	0.16	Ns	0.19	0.62	0.32
LSD5%(sij-ski)	0.12	0.11	Ns	0.13	0.44	0.23
LSD1%(sij-ski)	0.16	0.15	Ns	0.18	0.59	0.30

* $p < 0.05$; ** $p < 0.01$

REFERENCES

Abd El- Aty, M. S. M.; Y. S. Katta and M. A. El – Hity (2005). Estimation of genetic parameters using six population of different wheat crosses. Egypt J. plant Breed., 9 (1): 17-30.

Abd El- Aty, M. S. M. and H. S. El – Borhamy (2007). Estimates of combining ability and susceptibility index in wheat diallel crosses under stress and normal irrigation treatments .Zagazig J. Agric. Res. 31 (2): 435-455.

Abd El-Aty, M.A. and Y. S. Katta (2002). Genetic analysis and heterosis of grain yield and related traits in bread wheat (Triticumaestivum L.). J. Agric. Res. Tanta Univ., 28 (2): 287-300.

Abdel- Moneam, M. A. (2009). Heterosis in some crosses of bread wheat under irrigation and drought conditions . Pak. J. of Biol. Sci., 12 (6): 486-491.

Arunachalam, V. (1976). Evaluation of diallel crosses by graphical and combining ability methods. Indian J. Genet. 36: 358-366.

Baker, R.J. (1978). Issues in diallel analysis. Crop Sci. 18: 533-536.

Bayoumi, T. Y. (2004). Diallel cross analysis for bread wheat under stress and normal irrigation treatments .Zagazig J. Agric. Res., 31 (2): 435-455 .

El- Borhamy, H. S. (2000). Genetic studies on some quantitative characters in bread wheat (*Triticumaestivum* L.). Ph. D. Thesis Fac. Agric., Moshtohor, Benha Univ.,

El- Borhamy, H. S.;M.A. El-Maghraby and A. M. Gadallah (2008). Genetic behavior of yield and its components in three bread wheat crosses .Egypt . J. Agric. Res., 86 (3) : 973-984.

El-Gamal, A. A. (2001). Studies on drought tolerance in wheat . M. Sc. Thesis , Fac. of Agric., Minufiya Univ., Egypt.

El-Hosary A.A., S.A. Omar and A.H.Wafaa (2009). Improving wheat production under drought conditions by using diallel crossing system. In: 6th International Plant Breeding Conference, Ismailia (Egypt).

El-Hosary A.A.A. and Gehan A. Nour El Deen (2015) Genetic analysis in the F1 and F2 wheat generations of diallel crosses. Egypt. J. Plant Breed. 19 (2): 355-373.

EL-Hosary, A.A.; M. E. M. EL-Badawy; A. K. Mustafa and M. H. EL-Shal (2012). Evaluation of diallel wheat crosses under drought tolerance . Egypt. J. Plant Breed. 16 (1): 19-40.

El-Sayed, R. M. A. (1997). Quantitative inheritance of yield and some of its contributory characters in common wheat . M. Sc. Thesis, Faculty of Agric. Minufiya Univ. Egypt .

El-Seidy, E. H. and A. A. Hamada (1997). Genetic analysis of diallel crosses in wheat under normal irrigation and drainage water conditions. Annals of Agric. Sc., Moshtohor , 35 (4) : 1915-1932.

El-Seidy, E. H. and A. A. Hamada (2000). Interaction of wheat genotypes × Water sources .Proc . 9 th conf. Agron. 1-2 Sept. Minufiya Univ., 17-34.

Esmail, R.M. (2002). Estimation of genetic parameters in the F1 and F2 generation of diallel crosses of bread wheat *(Triticumaestivum L.).* Bull. NRC, Egypt. 27(1) 85-106.

Farooq, J., I. Khaliq, A.S. Khan and M.A. Pervez (2010). Studding the genetic mechanism of some yield contributing traits in wheat.(*Triticumaestivum*). Int. J. Agri. Biol. 12:241-246.

Fonsecca, S. and F. L. Patterson (1968). Hybrid vigour in seven-parent diallelcross in common wheat *(Triticumaestivum L.)*. Crop Sci. 2: 85-88.

Gomaa, M. A.; M. N. M. El-Banna ; A. M.Gadalla ; E.E. Kandil and A.R.H. Ibrahim (2014). Heterosis, combining ability and drought susceptibility index in some crosses of bread wheat (*Triticumaestivum* L.)under water stress conditions . Middle- East j. Agric. Res., 3(2): 338-345.

Gomez, K.N. and A.A. Gomez (1984).Statistical Procedures for Agricultural Research.John.Wiley and Sons. Inc., New York, 2nd ed.

Griffing, B. (1956). Concept of general and specific combining ability in relation to diallel crossing system. Aust. J. Biol. Sci.9**:** 463-493.

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

Hamada, A. A.; E. H. El-Seidy and H. I. Hendawy (2002). Breeding measurements for heading date, yield and yield components in wheat using line × tester analysis . Annals Agric. Sci., Ain Shams Univ., Cairo , 47 (2) : 587-609.

Hasnain Z., G. Abbas, A. Saeed, A. Shakeel, A. Muhammad and M.A. Rahim (2006). Combining ability for plant height and yield related traits in wheat *(Triticumaestivum L.).* J. Agric. Res. 44:167-175.

Joshi, S.K., S. N. Sharma, D. L. Sinnghania and R. S. Sain (2004). Combining ability in the F1 and F2 generations of diallel cross in hexaploid wheat (Triticumaestivum L. Em.Thell). Hereditas.141:115-121.

Prasad, K.D., M.F. Haque and D.K. Ganguli (1998). Heterosis studies for yield and its components in bread wheat *(Triticumaestivum L.)*. Indian J. Genet. 58: 97-100.

Saulescu N.N., W.E. Kronstad and D.M. Moss (1995). Detection of genotypic differences in early growth response to water stress in wheat using the Snow and Tingey system. Crop Science ;35:928-931.

Steel, R. G. D. and J. H. Torrie (1980). Principles and Procedures of Statistics: A Biometrical Approach. McGraw Hill Book Co., Inc., New York, USA.

Zaied, H. M. M. (1995). Combining ability in adiallel cross of wheat . Ph. D. Thesis, Fac. of Agric., El – Minufya Univ., Egypt.

تحليل قوة الهجين والقدرة علي التآلف فى الجيل الاول لقمح الخبز تحت ظروف الإجهاد والري الطبيعي

علي عبد المقصود الحصري، محمود الزعبلاوى البدوى ، صديق عبد العزيز صديق ، احمد على الحصرى و عمارة حسن عبد الهادى

قسم المحاصيل - كلية الزراعة - جامعة بنها - مصر.

لدراسة قوة الهجين والقدرة علي التآلف ومعامل الحساسية للجفاف لصفات المحصول ومكوناته لثمانية آباء من القمح بالأضافة إلي 28 هجين ناتجة منها بنظام Half diallel وذلك في محطة تجارب بحوث كلية زراعة مشتهر جامعة بنها، حيث تم عمل تجربتين بمزرعة الكلية. في التجربة الأولي تم الري مرة واحدة بعد رية الزراعة بينما التجربة الثانية تم إجراء معاملات الري الطبيعية ، دونت البيانات علي عشرة نباتات فردية أخذت عشوائيا من كل قطعة تجريبية وقدرت قوة الهجين لكافة الصفات المدروسة كنسبة مئوية لإنحراف قيمة الهجين عن قيمة متوسط الأبوين أو قيمة الأب الأفضل. وتم تحليل البيانات باستخدام طريقة الهجن التبادلية (جرفنج 1956) الطريقة الثانية الموديل الأول.أيضا تم تقدير معامل الحساسية للجفاف من البيانات الأساسية للتجربتين باستخدام معادلة (Saulescu et al 1995) . وكانت الصفات المدروسة هي : طول النبات (سم) – طول السنبلة - عدد سنابل النبات - وزن 1000 حبه – المحصول البيولوجى –محصول الحبوب/ نبات (جم) – معامل الحساسية للجفاف لهذه الصفات .كان التباين الراجع للتراكيب الوراثية الآباء والهجن والتفاعل بين الآباء والهجن معنويا لمعظم الصفات المدروسة تحت ظروف التحليل المشترك. أظهرت كلا من الآباءP4, P5,P3,P5,P5,P6أعلي قيم لصفات طول النبات ، طول السنبلة، عدد السنابل / النبات ، وزن الـ1000 حبة ، المحصول البيولوجى/ نبات ومحصول حبوب النبات الفردي علي التوالي .كما أظهرت الهجن P4×P2, P4×P5,P4×P2,P3×P2,P6×P1P3×P1أعلي قيم للصفات المذكوره انفا على التوالى.كان التباين الراجع للقدرة العامة والخاصة علي التآلف معنويا للصفات تحت الدراسة . كانت النسبة بين القدرة العامة/القدرة الخاصة أعلي من الوحدة للصفات تحت الدراسة عدا طول النبات فى كل من معاملة الرى العادى و المحصول البيولوجى للنبات فى التحليل الضام. وأظهرت السلالة P2 قدرة عامة علي التآلف طول النبات و عدد السنابل للنبات ووزن 1000- حبة و محصول حبوب النبات.أظهرت كل من الهجين P4×P5,P4×P6 بالنسبة لصفة محصول النبات الفردي قدرة خاصة علي التآلف معنوية.كان أحسن الأصناف بالنسبة لمعامل الحساسية للجفاف هوP7 لصفة محصول الحبوب . كان أفضل الهجن لمعامل الحساسية للجفاف هو الهجين P2×P6 بالنسبة لمحصول الحبوب.