Shoker, El−S ,M.H ; El−hosary,A.A ; Salwau,M.I.M and Hanem,E.A.El - Nady(2009) Breeding wheat for tolerance to drough stress .Annala of Agric.Sci.,Moshtohor ,47(4)235-253

ABSTRACT:

Seven drought measurements, i.e relative water content(RWC), osmotic pressure (OP), membrane integrity (MI), total sugaers (TS), total amino acids (TAA), potassium content(K^+) and protein content were estimated for six parental varieties or lines and their hybrids under two irrigation treatments (two experiments). The first experiment was irrigated once after planting irrigation and the second one was normally irrigated.

Irrigation mean squares were significant for all the traits studied. Mean squares for genotypes, parents, crosses and parent vs.crosses were significant for most traits in both environments as well as the combined data. Genotypes x irrgation, parent x irrigation, F1 x irrigation and parent vs. crosses x irrigation were significant for all traits except F1x irrigation for K^+, parent vs. cresses x environments for MI and parent x environment and parents vs cresses x environment for OP. Line 3D (P3), Line2D (P2) ,and Line 3D (P3) for OP, Line 3D (P3), Giza168 (P5) and Giza 168(P5) for MI, expressed the highest mean values at normal, stress irrigation treatments as well as the combined analysis respectively. Also, the parents; Sids1 (P1), Line2D (P2), and Sham6 (P6) expressed the highest value for K^+ in the same order. The parental variety Gemmiza 9 (P4) expressed the hightest value of TS in stress condition. While, Giza 168 (P5) gave the highest protien content in stress irrigation as well as the combined analysis and TAA in stress condition. Mean squares for parent vs. crosses as an indication to average heterosis over all crosses were significant for all drought measurements in both irrigation treatments as well as the combinrd analysis except MI in both irrigation treatments and the combined analysis and TAA in the combined analysis. The cross P4xP6 for OP, P1xP2 for (K^+) and TS, P2xP5 forTAA, and P1xP3 for protein content gave the most desirable heterotic effetics

Mean squares associated with general combining ability (GCA) and spicific combining ability (SCA) were significant for all drought measurements in both irrigation treatments as well as the combined analysis except GCA for K^+ in stress irrigation, OP in normal and the combined analysis and MI in stress condition and the combined analysis and SCA for MI in normal irrigation. For most crosses, low GCA /SCA ratios of less than unity were detected. The interaction between both general and specific combining ability and irrigation treatments was significant for all the studied traits except K^+ content.

The parental variety Sids1(P1) for protien content, Line2D (P2) for protien content and RWC, Line 3D (P3) for TAA, Gemm.9 (P4) for RWC and TS , Giza168 (P5) for RWC and OP and Sham6 (P6) for TAA and OP gave significant desirable $\hat{g}i$ effects for these measurements.

The most desirable S_{ij} effects were recorded by crosses P4xP6 for OP, P1xP2 and P1xP3 for protein content, P3x P6 for TS in both irrigation treatments as well asthe combined analysis ; by P2x P5 and P2x P6 for K^+ by P1x P3, P2x P5, and P3x P4 for TAA, and P1 x P4 and,P1x P3 for MI% in stress irrigation and the combined analysis.

INTRODUCTION

Plant breeders and physiologists have been concerned with drought resistance for many years. Various mechanisms by which crops, including wheat, may resist drought have been reported. Nowadays, it is well understood that drought resistance comprises avoidance and /or tolerance , but not scape (**Fisher and Maurer, 1978; Clarke and Townley – Smith, and Green1984).**

Drought avoidance consists of mechanisms that reduce water loss from the plant and the mechanisms that manitain water uptake . Drought tolerance refers to the ability of the plant to withstand with low tissue water potentials.

Today, the world`s agriculture is seriously affected by drought. In particular, drought is the number one environmental limitation to many crops . It was predicted that drought is becoming the largest constraint to productions of some water-consuming crops such as wheat in the new contury. 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.

The main objectives of the present investigation are to assess the variations amongst a few wheat genotypes and available crosses for several drought tolerance characters, to estimate the magnitude of heterosis, general combining ability (GCA) and specific combining ability (SCA) to improve wheat under drought conditions and to determine suitable measurements for druoght resistance in wheat genotypes.

MATERIALS AND METHODS

Half diallel cross set involving six parents was made in winter of 2004/2005 in Agric. Research Station at Kafer El-Hamam Al- Sharkya Governorate Egypt, to produce the F1-generation.The parental genotypes used in this study were; Sids1 (P), Line 2D(P2) Line 3D(P3), Gemmiza 9 (P4), Giza 168 (P5) and Sham6 (P6). In 2005 /2006 growing season; two experiments were conducted. Each experiment included the six parents and their fifteen possible crosses, which were sown on 26th Nov. in a randomized complete bloks design with three replications.The first experiment was irrigated only once after planting irrigation and the second one was normally irrigated. Each plot consisted of two rows, each row was two meters long and 30 cm. apart. Plants within row were 20cm. apart. Dry method of planting was used in this concern. The other cultural practices of growing wheat were properly practiced The drought measurements were determined. The relative water content (RWC) was dermined.

The relative water content (RWC) was dermined by method of **Barrs and Weather (1962),** Osmotic pressure (OP) by **Gosey (1960),** Membrane integrity (MI) by **Leopold et al (1981**), Total sugers (TS), by **Dubois et al (1956),** Total free amino acids by **Rosen (1957**), Potassuim

K^+ by **Walkley (1942)and protein content by A. O.A.C.,(1990).** Heterosis for each trait

computed as parents vs. hybrids sums of squares was obtained by partitioning the genotypes sums of squares to its components. Heterosis was also determind according to **Pachal and Wilcox (1975)** for individual crosses as the percentage deviation of F1 mean performance from either the mid- parent value (MP)or to better parent mean (BP) for each experiment as well as the combined. General and specific combining ability estimates were obtained by employing **Griffing`s (1956)** diallel cross analysis designated as a model -1 method 2.

RESULTS AND DISCSSION

Analysis of variance, means and heterosis:

Mean squares for relative water content (R.W.C), membrane integrity (M.I),osmotic pressure, potassium content (k+), total sugars (TS), for each of the two irrigation treatments (normal and stress irrigation) as well as the combined analysis are presented in Table (1).

Results indicated that irrigation mean squares were significant for all the traits studied, indicating over all differences between normal and stress condition. With the exception of (W.R.C) mean values of stress condition for all drought measurements were higher than those of normal irrigation, indicating that selection for stress tolerance should give a positive yield response under stress . Also, the results indicated that selection under irrigation environments would be less effective for improving grain yield under drought stress than direct selection in the stress condition. **Altin and Frey (1989)** demonstrated that grain yield in stress or low-productivity environments were not controlled by the same genes ,making indirect selection unattractive.

Mean squares for genotypes, parents, crosses and parents vs crosses were significant for all traits in both environments as well as the combined analysis, except parent mean squares for OP in both environments and the combined analysis, crosses mean squears for MI in the combined analysis and parent vs crosses for MI in both environments as well as the combined analysis, k+ in stress irrigation and the combined analysis, TAA in the combined analysis, and RWC in normal irrigation indicating wide diversity between the parents used in the present study for these traits.

Genotypes x irrigation, parent x irrigation, F1 x irrigation and parent vs crosses x irrigation were significant for all traits except F1 x irrigation for K+, parent vs crosses x environments for MI% and parent x environment and parent vs crosses x environment for OP. Such results indicated that the tested genotypes varied from each other and ranked differently from normal to stress irrigation treatments.

The mean performance of the six parents and fifteen hybrids of wheat at stress and normal irrigation are presented in Table (2). Data in Table (2) indicate that generally there was a gradual decrease in RWC with increasing water stress condition in root media of parents and their crosses. The minimum reduction was obtained in Sids1 (P1), Line 2D (P2), Line3D(P3), Giza168 (P5), Sham6 (P6), and crosses P1xP2, P3xP6, P2xP4 and P4xP5. Meanwhile, the maximum reduction was in Gemmiza9 (P4),P1xP5, P3xP4, P3xP5.

Table (1) Observed mean squares from ordinary analysis and combining ability for drought measurements studied in F1 generation.

S.O.V	DF		Relative water content (RWC)%			Membrane integrity M.I %			Osmotic Pressure O.P		
	S	C	N	D	Comb.	N	D	Comb	N	D	Comb
Irrig..		1			484.00**			8129.73**			56.43**
Rep x I.	2	4	0.00	72.43**	36.22*	2.04	291.95	147.00	0.24	0.11	0.18
Genotypes(G)	20	20	32.82**	211.43**	138.00**	206.44*	431.01**	225.14*	1.25**	2.30**	2.42**
Parnts (P)	14	14	34.17**	195.01**	53.21**	289.00	536.47**	343.93*	0.49	0.29	0.31
Crosses (F1)	5	5	35.38*	211.89**	169.19**	190.94*	423.53**	198.79	1.47**	2.87**	2.92**
P vs. F1	1	1	1.24	287.11**	125.28**	10.70	8.41	0.07	1.95*	4.34*	6.06**
G x Irrig.		20			106.26**			412.31**			1.12**
P x Irrig.		5			177.18**			481.54**			0.47
F1 x Irrig.		14			76.87**			415.68**			1.42**
P vs.F1 x I..		1			163.08**			19.04			0.24

Error	40	80	11.99	13.76	12.87	95.55	133.25	114.40	0.33	0.59	0.46

*and ** indicates significant at 0.05 and 0.01 levels of probability, respectively.
N= Normal irrigation D= Stress C = Combined

Table (1): Cont.

S.O.V	D.F		Potassium content K. p.pmN			Protein Content g/kg (PC)			Total amino acid (TAA)		
	S	C	N	D	Comb.	N	D	Comb	N	D	Comb
Irrig. (I)		1			7110786.08**			14283.57**			1726.05*
Rep x I.	2	4	3288069.15**	107689.27	1697879.21**	149.47	776.29**	463.13**	10.50	0.80	5.65
Genotypes(G)	20	20	1599252.90**	1483557.90**	1823192.57**	2707.39**	13434.39**	7052.48**	157.41**	138.43**	117.23**
Parents (P)	5	5	4373164.77**	1052560.61	3935301.59**	3682.13**	574.16**	790.42**	175.57**	237.88**	200.65**
Crosses (F1)	14	14	173022.90	1675370.98**	1083634.65*	2007.62**	6557.46**	5908.22**	104.52**	54.81**	95.82**
P vs. F1	1	1	7696913.51**	953161.26	1616458.46	7630.60**	174012.40**	54382.26**	807.19**	811.92**	0.00
G x Irrig.		20			1259618.22**			9089.30**			178.61**
P x Irrig.		5			1490423.80*			3465.87**			212.80**
F1 x Irrig.		14			764759.23			2656.86**			63.51**
P vs.F1 x I..		1			7033616.31**			127260.74**			1619.08**
Error	80	80	377432.92	567693.89	472563.41	63.35	94.95	79.15	11.10	11.10	8.47

*and ** indicates significant at 0.05 and 0.01 levels of probability, respectively.
N= Normal irrigation D= Stress C = Combined

Table (1): cont.

SOV	D F		Total Sugars (TS)		
	S	C	N	D	Comb.
Irrig.. (I)		1			47590.29**
Rep x I.	2	4	12.11**	6.63**	9.37**
Genotypes (G)	5	5	3247.19**	6372.14**	5256.33**
Parents (P)	20	20	969.45**	8906.29**	3762.99**
Crosses (F1)	14	4	3676.80**	3068.24**	3123.03**
P vs. F1	1	1	8621.37**	39956.03**	42848.75**
G x Irrig.		20			4362.99**
P x Irrig.		5			6164.64**
F1 x Irrig.		14			3622.01**
P vs.F1 x I..		1			5728.64**
Error	40	80	063	0.52	0.57

*and ** indicates significant at 0.05 and 0.01 levels of probability, respectively.
N= Normal irrigation D= Stress C = Combined

Table (2):The genotypes mean performance for drought measurements studied in F_1 generation.

Genotypes	Relative water content R.W.C%			Membrane integrity M.I%			Osmotic Pressure O.P		
	N	D	Comb	N	D	Comb	N	D	Comb
Sids 1 P1	88.40	88.97	88.68	15.40	26.40	20.90	4.35	5.35	4.85
Line 2D P2	85.87	88.27	87.07	32.67	37.70	35.18	3.95	5.77	4.86
Line 3D P3	83.80	90.40	87.10	35.30	26.40	30.85	4.75	5.16	4.96
Gemmiza9 P5	92.50	70.47	81.48	15.80	51.70	33.75	4.16	4.94	4.55
Giza168 p5	83.20	89.03	86.12	24.50	59.40	41.95	3.95	5.57	4.76
Sham6 P6	87.90	92.60	90.25	11.77	37.60	24.68	3.56	5.14	4.35
P1Xp2	86.37	88.10	87.23	15.93	28.17	22.05	4.35	4.87	4.61
P1xp3	93.10	89.30	91.20	15.75	56.57	36.16	5.97	5.78	5.88
P1XP4	88.67	86.10	87.38	17.40	71.67	44.53	4.87	5.16	5.01
P1Xp5	83.20	63.67	73.43	16.10	32.30	24.20	4.16	6.98	5.57
P1xp6	91.13	87.50	89.32	29.87	35.30	32.58	3.56	5.14	4.35
P2xP3	84.17	76.77	80.47	25.80	41.77	33.78	4.08	4.35	4.22
P2Xp4	85.67	86.50	86.08	40.60	25.70	33.15	3.96	4.75	4.35
P2xP5	85.30	79.80	82.55	30.17	29.90	30.03	4.75	5.57	5.16
P2xp6	90.00	89.05	89.53	29.67	39.60	34.63	4.75	6.58	5.67
P3xP4	87.20	72.20	79.70	32.40	30.27	31.33	4.75	6.28	5.51
P3XP5	83.70	66.27	74.98	14.65	32.40	23.53	3.95	6.87	5.41
P3xp6	82.67	88.67	85.62	17.50	36.30	26.90	3.95	5.97	4.96
P4xp5	86.67	85.57	86.12	17.07	40.77	28.92	4.35	5.59	4.97
P4xP6	88.00	83.87	85.93	28.10	43.37	35.73	5.98	7.79	6.88
P5xp6	93.00	85.20	89.10	21.27	41.80	31.53	4.22	6.87	5.54
Meanof the Parents	86.94	86.62	86.7	22.60	39.90	31.3	4.1	5.3	4.8
Mean of the crosses	86.9	81.9	84.4	2350	39.10	31.3	4.5	5.9	5.2
Mean of the genotypes	.86.9	83.3	58.1	23.10	39.30	31.3	4.4	5.7	5.1
L.D.S 5%	5.71	6.21	5.83	16.37	19.05	17.38	1.28	1.70	1.46
L.S.D 1%	7.65	8.19	8.19	21.58	25.49	22.97	0.95	1.29	1.11

N= Normal irrigation D=Stress C = Combined

Table (2): Cont.

Genotypes	Potassium Content K.ppmN			Protein Content g/kg PC			Total amino acid. T.A.A		
	N	D	Comb	N	D	Comb	N	D	C
Sids1 P1	13816.32	12769.04	13292.68	111.15	268.76	189.95	36.00	32.15	34.08
Line2D P2	10744.95	12694.63	11719.79	109.73	280.44	195.08	47.55	27.30	37.43
Line3D P3	13403.14	13820.49	13611.81	105.74	273.60	189.67	42.70	42.90	42.80
Gemmiza9 P4	13784.28	13629.02	13706.65	168.44	251.09	209.76	45.00	36.75	40.88
Giza168 P5	13786.66	13699.24	13742.95	180.96	253.65	217.30	34.10	50.05	42.08
Sham 6 P6	13594.34	14149.42	13871.88	167.01	246.24	206.63	54.85	47.45	51.15
P1XP2	13898.50	14105.55	14002.02	153.05	232.85	192.95	35.60	48.50	42.05
P1XP3	13902.06	13076.74	13489.40	222.02	263.34	242.68	38.30	50.10	44.20
P1XP4	14283.49	13337.53	13810.51	166.16	158.75	162.45	40.85	42.45	41.65
P1XP5	13916.36	12934.06	13425.21	171.00	140.79	155.90	25.10	44.15	34.63
P1XP6	13924.31	13370.60	13647.45	134.52	104.60	119.56	39.60	47.95	43.78
P2XP3	14149.77	12644.93	13397.35	160.46	108.02	134.24	29.70	47.05	38.38
P2XP4	13944.83	13500.30	13722.56	143.64	172.71	158.18	23.30	48.55	35.95
P2XP5	13876.55	13480.53	13678.54	163.02	146.49	154.76	38.65	59.20	48.93
P2XP6	14447.49	13433.62	13940.55	152.48	110.30	131.39	38.80	48.30	43.55
P3XP4	14232.41	13679.40	13955.90	222.30	132.81	177.56	38.40	51.15	44.78
P3XP5	13496.06	13232.66	13364.36	154.47	107.16	130.82	43.30	47.45	45.38
P3XP6	13849.95	13503.40	13676.67	147.92	109.44	128.68	31.85	42.30	37.08
P4XP5	13783.93	13220.91	13502.42	162.17	151.62	156.89	33.45	42.65	38.05
P4XP6	14035.40	13529.78	13782.59	142.22	120.56	131.39	33.55	45.75	39.65
P5XP6	13689.00	10770.41	12229.71	177.56	129.96	153.76	41.20	45.15	43.18
Mean of the Parents	13188.28	13460.30	13324.29	140.50	262.29	201.39	43.36	39.43	41.40
Mean of the Crosses	13796	13188.02	13575.02	164.86	145.96	155.41	35.44	47.38	41.41
Mean of the genotypes	13740.94	13265.82	13503.38	157.9	179.20	168.54	37.70	45.11	41.40
L.S.D 5%	1013.8	1243.3	1116.9	13.13	16.32	14.46	5.58	3.99	4.73

L.S.D 1%	1356.4	1663.5	1476.2	17.6	21.5	19.2	7.36	5.33	6.25

N= Normal irrigation D=Stress C = Combined

Table (2): Cont.

Genotypes	**Total sugars (T S)**		
	N	**D**	**Comb.**
Sids1 P1	164.10	186.00	175.05
Line 2D P2	172.50	216.20	194.35
Line 3D P3	185.25	292.30	238.78
Gemmiza9 P4	139.95	296.85	218.40
Giza168 P5	189.00	164.05	176.53
Sham6 P6	179.85	236.40	208.13
P1XP2	106.55	224.30	165.43
P1XP3	194.00	177.05	185.53
P1XP4	112.85	217.75	165.30
P1XP5	128.05	155.10	141.58
P1XP6	185.60	145.25	165.43
P2XP3	117.50	193.10	155.30
P2XP4	195.40	161.10	178.25
P2XP5	121.55	152.05	136.80
P2XP6	185.35	159.10	172.23
P3XP4	139.00	145.05	142.03
P3XP5	127.60	139.15	133.38
P3XP6	197.20	227.20	212.20
P4XP5	127.85	206.95	167.40
P4XP6	106.45	142.50	124.48
P5XP6	143.25	197.65	170.45
Mean of theParents	171.77	231.96	201.87
Mean of theCrosses	145.88	191.74	161.05
Mean of the Genotypes	153.28	192.15	172.71
L.S.D 5%	1.31	1.21	1.23
L.S.D 1%	1.75	1.60	1.63

N= Normal irrigation D=Stress C = Combined

The reduction in RWC under water stress condition was explained by **Gawish (1992)** who reported that, the RWC in bean leaves decreased as the level of soil moisture decreased and this may be due to relatively low root ability to absorbe water from the soil or decreased hydraulic conductively of soil under drought condition, which reflected reduction in plant growth **(Kramer and Boyer, 1995, Collinson et al 1997).** Moreover, **Sinclair and Ludlow, (1995**) reported that**,**

plant metabolism is dependant on leaf water status, and RWC has been proposed as a selection criteria for drought tolerance in many crops as reported by **Schonfeld et al (1988) in barley and (Martin et al 1989)** in wheat.

For OP, the parental sham6 (P6), Gemmiza 9 (P4) and Sham 6 (P6) expressed the lowest values for this trait in normal, stress conditions as well as the combined data, respectively. However, line3D(P3), line 2D (P2) and line 3D (P3) exhibited the highest OP in the same order. On the other hand, the mean values ranged from 4.35 (P2xP3) to7.79 (P4xP6) in stress irrigation treatment, from 3.56 (P1xP6) to 5.98 (P4xP6) in normal irrigation and from 4.22 (P2xP3) to 6.88(P4xP6) in the combined analysis. The increase in osmotic pressure under water stress condition was explained by **Hammad (1991)** who reported that, there was a decrease in sugar concentration which were related to OP increase.

Results in Table (2) show that exposing plants to drought condition increase gradually in membrane integrity with increasing water stress .The highest mean values were obtained by P5 (Giza168) 59.4%, P3 (line 3D) 35.3% and P5 (Giza168) 41.95% in drought condition, normal and the combined analysis, respectively. On the other hand, the lowest values were obtained by Sids1 (P1),in stress irrigation as well the combined analysis and P6 (Sham6) in the normal irrigation treatment.

Also, the mean values for crosses ranged from 25.70 (P2xP4) to 71.67 (P1xP4) from 14.66 (P3xP5) to 40.50 (P2xP4) and from 22.06 (P1xP2) to 44.53 (P1xP4) in stress, normal irrigation treatments as well as the combined analysis respectively. The effect of water stress on membrane integrity was explained by **Vieira De Silva (1976),** who stated that, the primary stress injury is in membrane systems. The desiccation tolerance differences have also been assessed based on the extend of leakage of solutes in dehydration medium, often in excised tissues subjected to rapid wilting. The lower injury can be explained by the protecting effect of minerals accumulated inside the cells **(Tal and Shannon, 1983).** Membrane destabilization caused by high drought stress was greatly reduced in the presence of proline. These solute provide protection against destabilization of proteins and membrane **(Jolivet *et al.* 1982 and Gadallah, 1995).**

The parental variety Sids1 (P1) gave the highest mean values for K+ in stress condition, lowest values for TAA and TS in the combined analysis. While, it gave the moderate values for other cases. The parental line 2D (P2) ranked the first of the tested parents for k+ in both irrigation treatments and the combined analysis and protein content in stress condition. However, it gave the lowest value for TAA in drought condition. While, it almost expressed moderate values for other chemical traits. The parental vatiety line 3D (P3) expressed the lowest values of protein content in normal and the combined analysis, while, it gave the highest value of TS in the combined analysis. However, it gave moderate values for the other traits. The parental variety Gemmiza9 (P4) expressed the highest value of TS in stress condition and ranked the second for this trait in the combined analysis. However, it gave the lowest value for TS in normal irrigation. Meanwhile, it almost expressed moderate values for other traits. The parental variety Giza168 (P5) gave the highest protein content in stress irrigation as well as the combined analysis, and TAA in stress condition. However, it expressed the lowest value for TAA in normal irrigation. Meanwhile, it expressed moderate values for other traits.

The parental Sham 6 (P6) expressed the highest values for k+ and TAA in normal irrigation and the combined analysis. However, it gave the lowest value of protein content in stress condition. Meanwhile, it gave moderate values for other cases.

The mean performance of F1 hybrids in each treatment as well as the combined over them are presented in Table (2). For k+ in both irrigation treatments as well as the combined, protein content in drought condition, and TAA in normal irrigation and the combined analysis, the hybrids were within the range of the performance for parents.

For protein content, the mean values for crosses ranged from 134.52 for P1xP6 to 222.30 for P3xP4, in the normal irrigation and for 119.56 for P1xP6 to 242.66 for cross P1xP3 in the combined analysis.

As for TAA, the cross P2xP3, P2xP4, line 2D P2xP5 (Giza168) had the highest mean value in stress condition , while the crosses P3xP6, P1xP4, P1xP5, P4xP5, P4xP6, and P4xP6 gave the lowest one value for this trait. Regarding TS, the cross P3xP6 had the highest mean values, while, the cross P4xP6 exhibited the lowest one in normal, stress irrigation treatments as well as the combined analysis .

It can be noticed from the above results, that there was a significant increase exhibited in water stress. In this respect **Kramer**

(1983), and Abd El-Hady (1988) revealed that, carbohydrate and protein metabolism are disturbed under water deficit and this often leads to accumulation of sugars and amino acids. Moreover, **Hammad (1991) and Abo El-Seoud and Hashim (1994)** reported that, the increase soluble sugars by decreasing water supply may due to the increase of chlorophyll and photosynthesis rate.

Values of stress condition for all traits were higher than those of normal irrigation. These results may be due to that soil water deficit increased carbohydrate leaf content of winter wheat **(Bobenko and Gevorkyam, 1969),** and affected total free and bound water leaves **(Fischer, 1973)**. Also, soil water deficit increased free and bound sugars in plant leaves. This could be due to the relationship of free sugars and osmotic pressure of the cell sap which enable the plant to absorb more water of high suction potential **(Moursi *et al*., 1978).** Moreover**, Dhingara Varghese (1985)**, on maize and **Premachandra *et al*., (1995),** on sorghum reported that, the increase in total free amino acid under water stress may be due to incomplete utilization of amino acids in protein synthesis.

Heterosis :

Mean squares for parent vs. crosses as indication to average heterosis overall crosses were found to be significant for all drought and chemical measurements in both irrigation treatments as well as the combined analysis except MI in both irrigation treatments and the combined analysis, K+ in normal irrigation and the combined analysis and total amino acid in the combined analysis (Table 1). The F1 mean performances were significantly higher than parental means for total sugars in both irrigation treatments and the combined analysis and K+ in stress irrigation and the combined analysis (Table 2). Significant mean squares due to interaction between parents vs. crosses and environments were detected for drought measurements (Table 1).

Heterosis expressed as the percentage deviation of F1 mean performance from either mid- parent or better parent for all the studied measurements at both irrigation treatments as well as the combined analysis are presented in Table (3).

With regard to relative water content (RWC), the two crosses P1xP3 and P5xP6 in normal irrigation, and three crosses; P1xP5, P1xP4 and P2xP4 in stress irrigation treatment expressed significant positive heterotic effects relative to mid- parent value. On the other hand, significant negative or insignificant heterotic effects relative to better parent were detected for this trait.

For M.I two, three and one hybrids exhibited significant positive heterotic effects relative to mid –parent value in normal, stress irrigation treatments as well as the combined analysis, respectively. However, the two crosses P1xP3 andP1xP4 in normal irrigation treatment expressed significant positive heterotic effects relative to better parent. The other crosses exhibited either significant negative or insignificant heterotic effects relative to better parent in both irrigation treatments and the combined analysis.

With regard to O.P, three, four and three crosses expressed significant positive heterotic effects relative to mid- parent value at normal, stress irrigation treatments and the combined analysis, respectively. Meanwhile, two, four and one crosses exhibited significant positive heterotic effects relative to better parent in the same order. It is clear that the cross P4xP6 had the highest heterotic effects for O.P in both irrigation treatments as well as the combined analysis .

Osmotic pressure allows further reduction of leaf water potential against the evapotranspirational demand before zero turgor (wilting) is reached. Genetic variation in osmotic adjustment was found in wheat **(Fischer and Sanchez 1979).** Also, **Nicolas <u>et</u> <u>al.</u> (1985)** suggested that osmotic adjustment in mature leaves and roots may be to of important for the maintenance of vital processes and for recovery after drought.

Osmotic pressure is time dependent. Progression of water stress has to sufficiently slow to allow solutes to accumulate. It is value as a drought –resistance mechanisms is excepted to be limited under the rapid desiccation typical in crops growing on shallow sandy soils.

For potassium (K+) content, one, four and one crosses exhibited significant positive heterotic effects relative to mid- parent value in normal, stress irrigation treatments and the combined analysis, respectively. The most desirable heterotic effects were recorded in cross (P1)Sids1 x (P2) Line 2D. Also, the crossP1xP2 expressed significant positive heterotic effects relative to better parent in normal irrigation only. The other crosses, exhibited either significant negative or insignificant heterotic effects.

For total amino acid (TAA), ten and four crosses surpassed the mid- parent value in stress irrigation treatment and the combined analysis, respectively. Also, six and one crosses from the previous hybrids expressed significant positive heterotic effects relative to better parent in the same order. The most desirable heterotic effects was recorded by cross P2xP5 in stress treatment and the combined analysis. While, the most desirable heterotic effects was recorded by cross P1xP2 followed by the cross P2xP4 and than by the cross P2xP5 in stress condition.

For total sugars, five and one crosses exhibited significant positive heterotic effects relative to either mid- parent or better parent value in normal and stress irrigation treatments, respectively. The cross P1xP2 expressed significant positive heterotic effects relative to better parent and mid-parent in stress condition. However, no desirable heterotic effects were detected for this trait in the combined analysis .

With respect to protein content, ten and one crosses exhibited significant positive heterotic effects relative to mid-parent value in normal and the combined analysis, respectively. While, four and one crosses expressed significant positive heterotic effects relative to better parent in the same order. The most desirable positive heterotic effects were recorded in cross P1xP3 followed by cross P3xP4.

In all drought measurements, the values of heterosis were mostly differed from irrigation treatment to another. This finding coincided with that reached above where significant genotypes by environment were detected (Table1).

Combining ability:

The analysis of variance for combining ability as outlined by **Grifing`s (1956)** method 2 model 1 in each environment and their combined data for all the traits studied are shown in Table (4). The mean squares associated with general combining ability (GCA) and specific combining ability (SCA) were significant for all drought measurements in both irrigation treatments as well as the combined analysis except GCA for K+ in stress irrigation, for OP in normal and the combined analysis and MI in stress condition and the combined analysis, and SCA for MI in normal irrigation.

It is evident that non additive type of gene action was the more important part of the total genetic variability for k+ in stress irrigation, OP in normal irrigation and the combined analysis and MI in stress condition. On the other hand, the additive type of gene action was the more important part of the total genetic variability for MI in normal irrigation. For the other studied drought measurements, both additive and non additive gene effects were involving in determining the performance of single cross progeny. Also, when GCA /SCA ratio was used, it was found that OP, protein content and TS in both environments and the combined analysis, k+ in normal irrigation and the combined analysis, TAA in normal and stress irrigation and MI in stress irrigation and the combined analysis, exhibited GCA / SCA ratio of less than unity, indicating the predominance of non-additive gene action in the inheritance of such traits. While, the magnitudes of additive and non-additive types of gene action were similar for TAA in the combined analysis .On the other hand , high GCA/SCA ratio, which exceeded than the unity was obtained for other cases. Such results indicate that additive and additive by additive gene action were more important than non-additive gene effects in controlling these cases.

These results were along the same line of **El-Marakby *et al.*, (1993a) and Darwish (1998)** who found equal importance of additive and non-additive effects for most traits. Also **El–Borhamy (2000) and El-Gamal (2002),** reveled that high ratios of GCA/SCA mean squares were obtained for almost traits, indicating that dominant role of additive gene action in the inheritance of these traits

The interaction between both general and specific combining ability and irrigation treatments was significant for all the studied traits except K+ content, indicating that the magnitude of GCA and SCA varied from environment to another. It is fairly evidents that ratios of SCAxI/SCA were higher than ratios of GCAxI/ GCA for TAA, RWC. Such results indicated that non-additive effects were much more influenced by the environmental conditions than additive genetic ones. Specific combining ability was stated by **Gilbert, (1958)** to be more sensitive to environmental chances than GCA. **El-Gamal (2002)** found that the mean squares of interaction between irrigation and both types of combining ability were significant for RWC.; **Hassan (2007),** found that non-additive types of gene action was much more influenced by the environmental condition than additive genetic ones for K+ and RWC.

Table (4): Observed mean squares of general and specific combining ability for F1 crosses in diallel analysis for drought measurements studied

S.O.V	D.F		Relative water content R.W.C%			Membrane integrity M.I%			Osm0tic Pressure O.P		
	S	**C**	**N**	**D**	**Comb**	**N**	**D**	**Comb**	**N**	**D**	**Comb**
GCA	5	5	16.02**	76.48**	57.80**	98.81*	96.90	46.89	0.23	0.59*	0.22
SCA	15	15	9..25*	68.48**	42.07**	58.81	159.26**	84.43*	0.48**	0.82**	1.01**
GCAxI		5			34.70**			184.83**			0.61**
SCAxI		15			35.66**			133.64**			0.30*
Error	40	80	4.00	4.59	4.29	31.85	44.42	38.13	0.11	0.20	0.15
GCA/SCA			1.73	1.12	1.37	1.68	0.61	0.56	0.49	0.72	0.22
GCAxI/GCA					0.60			3.17			2.79
SCAxI/SCA					0.85			1.58			0.29
GCAxI/SCAxI					0.97			1.11			2.06

*and ** indicates significant at 0.05 and 0.01 levels of probability, respectively.
N = Normal irrigation D =Stress C = Combined GCA and SCA indicates general and specific combined ability

Table (4):Cont.

S.O.V	D.F		Potassium content K.p.p.m.N			Protein content g/Kg P.C			Total amino acid T.A.A		
	S	C	N	D	Comb	N	D	Comb	N	D	Comb
GCA	5	5	620138.08**	182115.42	486852.91*	660.26**	2000.78**	851.34**	33.39**	30.73**	38.89**
SCA	15	15	504066.37**	598653.93**	648023.51**	983.20**	5303.91**	2850.65**	58.83**	51.28**	39.14**
GCAxI		5			3145400.59			2809.69**			25.23**
SCAxI		15			454696.79**			3436.46**			70.97**
Error	40	80	125810.97	189231.30	157221.14	21.12	31.65	26.38	3.90	1.95	2.82
GCA/SCA			1.23	0.30	0.75	0.67	0.38	0.30	0.57	0.60	0.99
GCAxI/GCA					0.65			2.13			0.65
SCAxI/SCA					0.70			1.21			1.81
GCAxI/SCAxI					0.69			0.53			0.36

*and ** indicates significant at 0.05 and 0.01 levels of probability, respectively.
N= Normal irrigation D=Stress C = Combined GCA and SCA indicates general and specific combined ability

Table (4):Cont.

S.O.V	DF		Total Sugars T.S		
	S	C	N	D	Comb
GCA	5	5	779.32**	1513.10**	1243.54**
SCA	15	15	1183.42**	2327.70**	1921.63**
GCAxI		5			1048.87**
SCAxI		15			1589.49**
Error	40	80	0.21	0.17	0.19
GCA/SCA			0.66	0.65	0.65
GCAxI/GCA					0.84
SCAxI/SCA					0.83
GCAxI/SCAxI					0.66

*and ** indicates significant at 0.05 and 0.01 levels of probability, respectively.
N= Normal irrigation D =Stress C = Combined GCA and SCA indicates general and specific combined ability

However, the ratio of GCA x I /GCA was higher than SCA x I /SCA for protein content, MI%, OP and TS, indicating that additive and additive by additive genetic effects were mach more influenced by different irrigation treatments than additive gene effects. Significant SCA x irr. and insignificant GCA x irr. was detected for K+ content ,indicating that nonadditive genetic effects only were inflnenced by different irrigation treatments.

General combining ability effects (ĝi):

General combining ability effects (ĝi) of each parent for all drought measurements; (physiological traits i.e RWC, MI and OP and chemical traits ie(K+ content, protein content, TAA and TSS) at stress and normal irrigation treatments as well as the combined analysis are presented in Table (5). Such effects are being used to compare the average performance of each parent with other parents and facilitate selection of parents for further improvement to drought resistance. Genera**l** combining ability effects in this study were found to be different significantly from zero in all the measurements except MI in stress irrigation treatment and the combined analysis and k+ in normal irrigation treatment as well as the combined data and OP in stress irrigation treatment. High positive values would be of interest under all the studied drought measurements in question except RWC. where high negative ones would be useful from the breeders point of view.

The parental variety Sids1(P1)exhibited significant positive ĝi effects for protein content in stress condition and the combined analysis. However, it gave either significant in desirable or insignificant ĝi effects for other traits. The parental line 2D (P2) expressed significant positive ĝi effect for protein content and RWC in stress irrigation, and MI in normal irrigation. While, it gave either significant negative or insignificant ĝi effect for other drought measurements. The parental line 3D (P3) expressed significant desirable ĝi effects for TAA in stress condition and the combined analysis, TS in both irrigation treatments as well as the combined data, and RWC in normal irrigation and the combined analysis. While, it gave insignificant ĝi effects for other cases.

The parental variety Gemmiza9 (P4) gave significant desirable ĝi effect for k+ in the combined analysis, protein content in normal irrigation and the combined analysis, RWC and TS in stress condition and the combined analysis. However, it gave either significant undesirable or insignificant ĝi effect for other traits. The parental variety Giza168 (P5) seemed to be the best general combiner for WRC in both irrigation treatments as well as the combined data, protein content under normal irrigation and OP under stress irrigation, revealing that this parent was the best combiner for these traits. The parental variety Sham6 (P6) seemed to be the best general combiner for TAA in both irrigation treatments as well as the combined analysis, TSS in normal irrigation and the combined analysis, and OP in stress irrigation treatment .While, it gave significant in desireble or insignificant for other cases.

Specific combining ability effects(S_{ij}):

Specific combining ability effects of the parental combinations were computed for all drought measurments in both irrigation tratments as well as the combined analysis are presented in Table (6).

Table (5): Estimates of general combining ability effects for the drought measurements studied in F1 generation.

Parents Variety or line	Relative water content R.W.C %			Membrane integrity M.I%			Osmotic Pressure O.P		
	N	D	Comb	N	D	Comb	N	D	Comb
Sids 1 P1	1.14	1.23	1.19**	- 4.59	0.22	- 2.18	0.10	- 0.19	- 0.04
Line 2 D P2	- 0.87	1.75*	0.44	5.62**	- 4.31	0.65	- 0.13	- 0.31*	- 0.22
Line 3 D P3	- 1.47*	- 1.10	- 1.29**	1.77	-3.12	- 0.67	0.18	- 0.07	0.05
Gemmiza9 P4	1.38*	- 3.45**	- 1.03**	0.58	5.02	2.80	0.18	- 0.09	0.04
Giza 168 P5	- 1.49*	- 3.02**	- 2.25**	-1.79	2.62	0.41	-.018	0.36*	0.09
Sham 6 P6	1.30*	4.58**	2.94**	- 1.58	- 0.43	- 1.01	- 0.15	0.31*	0.08
L.S.D gi 5%	1.30	2.46	0.92	3.68	4.35	1.90	0.22	0.29	0.12
L.S.D gi 1%	1.74	3.29	1.24	4.93	5.82	2.52	0.29	0.39	0.16
L.S.D gi-gi 5%	2.02	3.81	1.51	5.7	6.73	3.07	0.34	0.45	0.20
L.S.D gi-gi1%	2.70	5.11	2.03	7.63	9.01	4.08	0.45	0.60	0.26

*and ** indicates significant at 0.05 and 0.01 levels of probability, respectively.
N= Normal irrigation D =Stress C = Combined

Table (5): Cont.

Parental Variety or Line	Potassium content K.ppm .N			Protein Content g/kg P.C			Total Amino Acid T.A.A		
	N	D	Comb	N	D	Comb	N	D	Comb
Sids1 P1	171.35	-62.27	54.54	- 4.54**	22.93**	9.20**	- 1.56*	-2.29**	- 1.93**
Line2 D P2	- 547.45**	-38.32	- 292.88*	- 14.15**	9.61**	- 2.27**	- 053	- 1.20*	- 0.77**
Line3 D P3	31.24	114.67	72.96	1.66	1.70	1.68*	0.38	1.01*	0.69**
Gemmiza9 P4	207.75	208.15	207.95**	8.50**	- 1.97	3.27**	- 055	-1.46**	- 1.01**
Giza 168 P5	18.58	-227.96	- 104.96	10.60**	- 8.88**	0.86	-1.76**	2.87**	0.56*
Sham6 P6	118.53	5.74	62.13	- 2.08	- 23.38	- 12.73**	3.84**	1.07*	2.64**
L.S.Dgi 5%	231.36	NS	121.87	3.00	3.67	1.58	1.25	0.91	0.52
L.S.Dgi 1%	309.55	NS	161.68	4.01	4.91	2.09	1.68	1.22	0.68
L.S.Dgi-gi 5%	358.42	NS	197.45	6.64	5.68	2.56	1.94	1.41	0.84
L.S.Dgi-gi 1%	479.55	NS	261.95	6.21	7.61	3.39	2.60	1.89	1.11

*and ** indicates significant at 0.05 and 0.01 levels of probability, respectively.
N= Normal irrigation D=Stress C = Combined

Table (5):Cont.

Parental variety or line	Total Sugar T.S		
	N	D	Comb
Sids1 P1	- 2.21**	- 6.70**	- 4.46**
Line 2D P2	- 0.20	-2.87**	-1.54**
Line 3D P3	9.11**	15.14**	12.12**
Gemmiza9 P4	-13.94**	15.25**	0.66**
Giza168 P5	-5.83 **	- 20.75**	-13.29**
Sham 6 P6	13.08**	- 0.07	6.50**
LSD gi (5%)	0.30	0.27	0.13
LSD gi (1%)	0.40	0.36	0.18
LSD gi-gi (5%)	0.46	0.42	0.22
LSD gi-gi 1%	0.62	0.56	0.29

*and ** indicates significant at 0.05 and 0.01 levels of probability, respectively.
N= Normal irrigation D =Stress C = Combined

Table (6):Estimates of specific combining ability effects for drought measurements studied in 1 generation

Crosses	Relative water content R.W.C%			Membrane integrity (M.I)%			Osmotic Pressure (O.P)		
	N	D	Comb	N	D	Comb	N	D	Comb
P1XP2	-1.07	1.87	0.40	- 8.32	-7.03	- 7.68	- 0.03	- 0.37	- 0.20
P1XP3	6.26**	5.92**	6.09**	- 4.65	20.17**	7.76*	1.30**	0.31	0.80
P1XP4	-1.02	5.06*	2.02	1.81	27.14**	12.66**	0.19	- 0.30	- 0.05
P1XP5	- 3.62*	- 17.79**	- 10.71**	- 0.74	-9.83	- 5.29	- 0.15	1.08**	0.46
P1XP6	1.52	- 1.56	- 0.02	12.81	-3.78	4.52	- 0.79*	- 0.72	- 0.75**
P2XP3	- 0.67	- 7.13**	- 3.90	-4.81	9.90	2.55	- 0.37	- 1.00*	- 0.69**
P2XP4	- 2.01	4.95*	1.47	11.18	-14.30*	- 1.56	- 0.50	- 0.58	- 0.54*
P2XP5	0.49	- 2.18	- 0.85	3.12	-7.70	- 2.29	0.66*	- 0.21	0.22
P2XP6	2.40	- 0.53	0.93	2.41	5.05	3.73	0.63*	0.85*	0.74**
P3XP4	0.12	- 6.50**	- 3.19*	6.83	-10.93	- 2.05	- 0.01	0.70	0.35
P3XP5	-0.51	- 12.86	- 6.68**	- 8.55	- 6.39	- 7.47	- 0.44	0.85*	0.20
P3XP6	- 4.34*	1.84	- 1.25	-5.91	0.56	- 2.68	- 0.47	0.00	- 0.24
P4XP5	- 0.39	8.79**	4.20**	- 4.94	- 6.16	- 5.55	- 0.05	- 0.41	- 0.23
P4XP6	- 1.85	- 0.52	- 1.18	5.88	- 0.51	2.69	1.55**	1.83**	1.69**
P5XP6	6.02**	0.39	3.20*	1.41	033	0.87	0.16	0.46	0.31
LSD Sij 5%	3.58	6.78	3.83	10.11	11.94	7.70	0.60	0.80	0.49
LSD Sij 1%	4.79	9.08	5.13	13.53	15.97	10.22	0.80	1.07	0.65
LSD sij-sik 5%	5.33	10.14	5.71	15.09	17.82	11.50	0.89	1.19	0.73
LSD sij-sik 1%	7.14	13.57	7.65	20.19	23.84	15.25	1.19	1.59	0.97
LSD sij-skl 5%	4.95	9.37	2.16	13.97	16.50	4.34	0.83	1.10	0.28
LSD sij-skl 1%	6.62	12.55	2.89	18.69	22.07	5.76	1.11	1.47	0.37

*and ** indicates significant at 0.05 and 0.01 levels of probability, respectively.
N= Normal irrigation D =Stress C = Combined

Table(6):Cont.

Crosses	Potassium content K.ppm.N			Protein content g/ kg P .C			Total Amino Acid (T.A.A)		
	N	D	Comb	N	D	Comb	N	D	Comb
P1XP2	533.65	940.32	736.99**	13.88**	21.11**	17.47**	- 0.19	6.88**	3.34**
P1XP3	- 41.47	- 241.48	- 141.47	66.99**	59.51**	63.25**	1.78	6.27**	4.03**
P1XP4	163.45	- 74.17	44.64	4.28	- 41.41**	- 18.56**	5.26**	1.09	3.18**
P1XP5	- 14.50	- 41.52	- 28.01	7.03	- 52.46**	- 22.71**	-9.29**	- 1.54	- 5.41**
P1XP6	-106.51	161.31	27.40	- 16.77**	- 74.15**	- 45.46**	-0.39	4.06	1.83
P2XP3	- 925.03**	- 697.24	113.90	15.04**	- 82.49**	- 33.72**	-8.03**	2.13	- 2.95**
P2XP4	543.58	64.65	304.11	- 8.61*	- 14.12**	- 11.37**	-13.51**	6.10**	- 3.70**
P2XP5	664.47*	480.99	572.73*	8.67*	- 33.43**	- 12.38**	3.05	12.42**	7.73**
P2XP6	1135.46**	200.38	667.92**	10.80*	- 55.13**	- 22.16**	-2.40	3.31	0.46
P3XP4	252.47	90.76	171.61	54.23**	- 46.11**	4.06	0.87	6.49**	3.68**
P3XP5	-294.70	80.13	- 107.28	- 15.70**	- 64.85**	- 40.27**	6.97**	-1.54	2.72*
P3XP6	- 40.77	117.17	38.20	- 9.57*	- 48.07**	- 28.82**	- 10.08**	-4.89**	- 7.48**
P4XP5	- 183.34	- 25.10	- 104.22	- 14.84**	- 16.72	- 15.78**	- 1.95	-3.86**	- 2.91**
P4XP6	- 31.82	50.07	9.12	- 22.11**	- 33.29	- 27.70**	-7.45	1.03	- 3.21**
P5XP6	-189.05	-2273.18	- 1231.11**	11.13**	- 16.97**	- 2.92	1.41	-3.90**	- 1.25
LSD Sij 5%	635.42	779. 28	495.04	8.23	10.08	6.41	3.45	2.50	2.10
LSD Sij 1%	850.16	1042.64	656.74	11.01	13.48	8.50	4.61	3.34	2.78
LSD sij-sik 5%	948.30	1163.01	738.80	12.29	15.04	9.56	5.14	3.73	3.13
LSD sij-sik 1%	1268.78	1556.05	980.12	16.44	20.12	12.68	6.88	4.99	4.15
LSD sij-skl 5%	877.95	1076.73	279.24	11.37	13.92	3.61	4.76	3.45	1.18

LSD sij-skl 1%	1174.66	1440.62	370.45	15.22	18.63	4.79	6.37	4.62	1.57

*and ** indicates significant at 0.05 and 0.01 levels of probability, respectively. N= Normal irrigation D =Stress C = Combined

Table (6):Cont.

Crosses	**Total sugars (T.S)**		
	N	**D**	**Comb**
P1XP2	- 44.32**	41.72**	- 1.30**
P1XP3	33.83**	- 23.54**	5.14**
P1XP4	- 24.28**	17.05**	- 3.62**
P1XP5	- 17.18**	- 9.60**	- 13.39**
P1XP6	21.46**	- 40.13**	- 9.34**
P2XP3	- 44.68**	- 11.31**	-28.00**
P2XP4	56.26**	- 43.43**	6.42**
P2XP5	- 25.70**	- 16.47**	- 21.08**
P2XP6	-19.20**	- 30.11**	- 5.46**
P3XP4	- 9.45**	- 77.49**	- 43.47**
P3XP5	-28.95**	- 47.38**	- 38.17**
P3XP6	21.74**	-19.98**	20.86**
P4XP5	- 5.66**	20.30**	7.32**
P4XP6	- 45.47**	- 64.83**	- 55.40**
P5XP6	-17.27**	26.32**	4.53**
LSD Sij 5%	0.82	0.75	0.55
LSD Sij 1%	1.10	1.00	0.72
LSD sij-sik 5%	1.22	1.12	0.81
LSD sij-sik 1%	1.63	1.49	1.08
LSD sij-skl 5%	1.13	1.03	0.31
LSD sij-skl 1%	1.51	1.38	0.41

*and ** indicates significant at 0.05 and 0.01 levels of probability, respectively.
N= Normal irrigation D=Stress C = Combined

Four, four and three crosses for OP, zero, two, and two crosses for M I, two, four and four, crosses for RWC, one, three and three crosses for k+, seven, two and two crosses for protein content, two, seven and seven crosses for TAA, and five, five and five crosses for TS expressed significant desirable (S_{ij}) effects in normal, stress irrigation treatments as well as the combined analysis, respectively. The most desirable(S_{ij}) effects were recorded by crosses namely Gemmiza9 P4 x Sham6 P6 for osmotic pressure (OP), Sids1 P1 x Line2D (P2) and Sids1 (P1)x Line3D (P3) for protein content, Line3D (P3)x Sham6 (P6) for TS in both irrigation treatments as well as the combined analysis; by two crosses Line2D (P2)x Giza168 (P5) and line 2D(P2)xSham6(P6) for k+, by crosses Sids1(P1) x line 3D (P3), line2D (P2)xGiza168(P5) and line3D (P3) x Gemmiza 9 (P4) for TAA and both crosses Sids1 (P1) x Gemmiza9 (P4) and Sids1 (P1)xline3D (P3)for MI in stress irrigation treatment as well as the combined analysis. The mentioned combinations might be of interest in breeding programs aimed at producing pure line varieties as most combinations involved at least one good combiner.

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تربية القمح لتحمل شدة الجفاف

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الملخص العربى

أجرى البحث بهدف دراسة امكانية التربية لتحمل ظروف الإجهاد المائى باستخدام بعض الدلائل الفسيولوجية المرتبطة بتحمل النباتات للجفاف وتفاعلها مع البيئة- ايضا دراسة القدرة على التالف وقوة الهجين لهذه الصفات . استخدم لهذا الغرض ستة تراكيب وراثية ذات اصول وراثية متباعدة هى (سدس١ ،سلالةد٢ ،سلالةد٣ ، جميزة ٩ ، جيزة ١٦٨ ، شام٦) وقد اجرى هذا البحث خلال موسم ٢٠٠٤ /٢٠٠٥ ،٢٠٠٥/ ٢٠٠٦ حيث تم عمل جميع الهجن الممكنة بين الاباء الستة دون العكسية (half diallel crosses) وتم التقييم للآباء والهجن الناتجة تحت معاملتين للرى كل معاملة فى تجربة مستقلة التجربة الأولى الرى المعتاد والثانية رية واحدة بعد رية الزراعة وتم قياس الصفات المرتبطة بتحمل الجفاف وهى:

١- المحتوى المائى للورقة ٢- نفاذية الغشاء ٣- الضغط الاسموزى

٤- محتوى البوتاسيوم للأوراق ٥- محتوى البروتين ٦- الأحماض الامينية الكلية ٧- السكريات الكلية .

قدرت قوة الهجين لكافة الصفات المدروسة كنسبة مئوية لانحراف قيمة الهجن عن متوسط الابوين او قيمة الأب الأفضل وقدرت قيم القدرة العامة والخاصة على التالف بتطبيق ما اقترحه جريفنج١٩٥٦ حسب النموذج الأول للطريقة الثانية . كان التباين الراجع لمعاملات الرى معنوية لكل الصفات . كان التباين الراجع الى التراكيب الوراثية والآباء والهجن وقوة الهجين معنويا عدا تباين الاباء للضغط الاسموزى لمعاملتى الرى والتحليل المشترك، تباين الهجن لنفاذية الغشاء فى التحليل المشترك ، وقوة الهجين لنفاذية الغشاء لمعاملتى الري والتحليل المشترك ومحتوى البوتاسيوم في معاملة الجفاف والتحليل المشترك والأحماض الأمينية الكلية في التحليل المشترك والمحتوى المائي للورقة في الرىالمعتاد .

أظهرت السلالة د٣ والسلالةد٢ والسلالة د٣ للضغط الاسموزى والسلالة د٣ ،جيزة ١٦٨ ، جيزة ١٦٨ لنفاذية الغشاء وسدس١ ، السلالة د٢ ،شام٦ لمحتوى البوتاسيوم أعلى قيمة تحت الري العادي والجفاف والتحليل المشترك على الترتيب أعطى الصنف جميزة ٩ايضا أعلى قيمة من

السكريات الكلية تحت الجفاف. بينما أعطى الصنف جيزة ١٦٨اعلى من محتــوى البــروتين تحــت الجفاف والتحليل المشترك والأحماض الامينية الكلية تحت الجفاف .

وأعطت الهجن٤x٦للضغط الاسموزى، ١ x٢لمحتوى البوتاسيوم والسكريات الكلية ،٢ x٥للأحماض الامينية ،الهجين ١ x ٣ لمحتوى البروتين قوة هجن مرغوبة . كان التباين الراجع للقدرة العامة والخاصة على التالف معنويا لمعظم الصفات تحت الدراسة . كانت النسبة بين القدرة العامة والخاصة على التالف اقل عن الوحدة لمعظم الصفات. أعطى الصنف سدس ١ لمحتوى البروتين ، السلالة د٢ لمحتوى البروتين والمحتوى المائى للورقة والضغط الاسموزى وشام ٦ للأحماض الامينية الكلية والضغط الاسموزى قدرة عامة مرغوبةومعنوية. أعطت الهجن ٤ x٦للضغط الاسموزى ، ١x ٢، ١x٣ لمحتوى البروتين ٣ x٦ للسكريات الكلية لمعاملتى الرى والتحليل المشترك وهجن ٢x٥، ٢ x٦لمحتوى البوتاسيوم ، والهجن ١ x٣، ٢x٥ ٣ x٤ للأحماض الامينية الكلية ، ١ x ٤ ،١ x٣ لنفاذية الغشاءاعلى قيمة للقدرة الخاصة على

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