4. RESULTS AND DISCUSSION

Breeding and selecting for better wheat yield in water limited environments which occurred by drought have been accomplished more successfully using traditional breeding methods in environments where water was not limited.

This has been due to mainly the contribution of dwarfing genes that are yield positive in dry environments as well as in the irrigated environments for which they were originally developed.

To identify ways to further improve yields in dry environments, two breeding approaches are discussed; the first is the traditional or empirical approach where selection is for yield, and the second, an analytical approach where selection is for a trait other than yield that may be advantageous under drought.

Griffing (1956) noted that parental and F1 data have distinct advantage over data from segregation generation in studying quantitative genetic systems because, being unaffected by genetic segregation and linkage, the former data require relatively few individuals for estimating genetic parameters. Hence, more parents and wider range of germplasm can be included. Diallel analysis for estimating certain genetic parameters in terms of gene models have been developed and extensively used plant breeders.

Data were recorded on all genotypes for growth, yield, yield components, susceptibility index, and physiological and chemical measurements for drought.

For better representation and discussion of the results obtained herein, results were grouped into three parts. The first growth, yield and its components, the second physiological and chemical traits (Drought measurements) and third susceptibility index.

V.1 Growth, yield and yield components:

V.1.1. Analysis of variance, means and heterosis

The analysis of variance for each of the stress and normal environments as well as the combined analysis for growth yield and yield components is presented in Table (8). The error variance for the two environments were homogeneous for all the studied traits, consequently the combined analysis was valid

Results indicated that environment mean squares were significant for all traits, indicating overall differences between the two environments (stress and normal irrigation treatments.

Results in Table (9) presented the average of the studied traits at both two irrigation treatments. It is clear that all studied traits increased significantly with normal irrigation treatments compared to stress ones, except 1000-kernel weight where the opposite trend was obtained.

Significant genotypes mean squares were obtained for all traits except no. of spikes / plant in both environments as well the combined analysis (Table 8). This indicates that wide diversity between the parental materials used in the present study. Significant genotype X environment mean squares were obtained for no. of grains / spike, maturity date, harvest index, grain, straw and biological yields, revealing that

Table (8): Observed mean squares from ordinary analysis and combining ability for agronomical traits from F1 generation.

S.O.V	D.F		Heading (days)			Plant height PH (cm)			Flag leaf area FLA (cm2)		
	S	C	N	D	Comb.	N	D	Comb	N	D	Comb
Irrig..(I)		1			353.34**			685.53**			9944.89**
Rep x I.	2	4	2.40	6.54	4.47	10.64	4.41	7.53	56.04	207.91**	131.98**
Genotypes(G)	20	20	42.89**	34.00**	75.23**	106.55**	69.85**	158.01**	137.91**	99.61**	203.50**
Parents (P)	5	5	84.86**	63.79**	147.20**	169.55**	97.98**	245.78**	269.07**	134.23**	372.23**
Crosses (F1)	14	14	22.88**	18.41**	39.45**	63.40**	54.69**	101.87**	91.08**	79.36*	133.20**
P vs. F1	1	1	113.16**	103.21**	216.26**	395.56**	141.43**	505.02**	137.76*	209.96*	343.94**
G x Irrig.		20			1.66			18.39			34.02
P x Irrig.		5			1.44			21.75			31.06
F1 x Irrig.		14			1.84			16.22			37.24
P vs.F1 x I.		1			0.11			31.97			3.79
Error	40	80	2.31	2.32	2.32	13.27	17.25	15.26	24.59	37.84	31.22

*and** indicates significant at 0.05and 0.01 levels of probability, respectively.

N= Normal irrigation D = Stress C= Combined

Table (8): Cont

S.O.V	D.F		Maturity (days)			No. of grains /spike			No. of spikes /plant		
	S	C	N	D	Comb.	N	D	Comb	N	D	Comb
Irrig.. (I)		1			1200.96**			9780.33**			2749.60**
Rep x I.	2	4	3.44	7.00	5.22	168.08*	4.67	86.38	12.44	32.71*	22.58
Genotypes(G)	20	20	30.65**	33.54**	57.73**	125.97**	87.80**	177.56**	13.75	8.22	14.83
Parents (P)	5	5	75.17**	89.82**	161.96**	206.51**	145.61**	319.49**	9.81	8.00	15.16
Crosses (F1)	14	14	13.55**	15.83**	23.09**	106.20*	72.32*	138.12**	15.66	8.78	15.27
P vs. F1	1	1	47.51**	0.10	21.61**	0.02	16.74	8.95	6.83	1.37	7.16
G x Irrig.		20			6.46**			36.21			7.14
P x Irrig.		5			3.03			32.63			2.65
F1 x Irrig.		14			6.29*			3951			9.18
P vs.F1 x I.		1			26.**			7.81			1.04
Error	40	80	2.61	3.30	2.96	47.09	30.86	38.98	12.32	7.55	9.94

*and ** indicates significant at 0.05 and 0.01 levels of probability, respectively.

N= Normal irrigation D= Stress C = Combined

Table (8): Cont

S.O.V	D.F		Weight 1000-kernel (g)			Grain yield / plant (g)			Straw yield / plant (g)		
	S	C	N	D	Comb.	N	D	Comb	N	D	Comb
Irrig.. (I)		1			467.29**			31751.75**			9867.22**
Rep x I.	2	4	4.70	41.18**	22.94**	59.48	170.43	114.96	587.96*	139.37	363.67
Genotypes(G)	20	20	27.39**	20.17**	42.82**	292.89*	138.28*	262.51**	937.71**	505.58**	1219.11**
Parents (P)	5	5	38.26**	31.07**	66.88**	232.14	96.28	137.91	2132.18**	1135.06**	3095.19**
Crosses (F1)	14	14	23.37**	13.97**	31.57**	271.63	134.09	236.21	574.06 **	313.93*	636.12*
P vs. F1	1	1	29.25*	52.46**	80.03**	844.29*	406.89*	1253.81**	56.34	41.30	0.58
G x Irrig.		20			4.74			168.66			224.18
P x Irrig.		5			2.45			190.51			172.05
F1 x Irrig.		14			5.77			169.52			251.87
P vs.F1 x I.		1			1.68			47.37			97.06
Error	40	80	4.36	3.36	3.86	146.29	72.29	109.45	148.19	140.30	146.25

*and ** indicates significant at 0.05 and 0.01 levels of probability, respectively.

N =Normal irrigation D= Stress C= Combined

Table (8): Cont.

S.O.V	D.F		Biological yield / plant (g)			Harvest index H.I%		
	S	C	N	D	Comb.	N	D	Comb
Irrig.. (I)		1			77019.61**			1078.48**
Rep x I.	2	4	386.90	617.88	502.39	29.46**	4.70	17.08*
Genotypes(G)	20	20	1932.44**	795.56**	2006.74**	12.75**	18.91**	27.64**
Parents (P)	5	5	3577.43**	1194.45**	4090.35**	18.60**	41.73**	52.78**
Crosses (F1)	14	14	1383.01**	696.44*	1312.47**	9.41	8.99	15.40**
P vs. F1	1	1	1399.56	188.93	1308.46*	30.23*	43.63**	73.25**
G x Irrig.		20			721.27*			4.02
P x Irrig.		5			681.53			7.55
F1 x Irrig.		14			766.98*			3.01
P vs.F1 x I.		1			280.03			0.61
Error	40	80	488.85	319.32	404.09	5.05	6.05	5.55

*and ** indicates significant at 0.05 and 0.01 levels probability, respectively.

N= Normal irrigation D = Stress C= Combined

Table (9): The genotypes mean performance for the agronomical traits from the F_1 generation

Genotypes	Heading (days)			Plant height (cm)			Flag leaf area (cm2)		
	N	D	Comb	N	D	comb	N	D	comb
Sids1 p1	94.67	92.33	93.50	114.93	115.17	115.05	58.40	40.13	49.27
Line2 D p2	92.00	88.33	90.17	102.93	102.93	102.93	61.30	44.60	52.95
Line3 D p3	93.33	91.00	92.17	103.67	101.93	102.80	45.50.	33.90	39.70
Gemmiza9 P4	104.67	100.33	102.50	113.87	112.40	113.13	65.40	40.03	52.72
Giza 168 p5	98.33	95.00	96.67	112.93	106.67	109.80	62.37	45.00	53.68
Sham6 p6	103.33	98.67	101.00	122.87	113.67	118.27	74.43	53.83	64.13
P1xP2	92.33	89.67	91.00	122.00	113.47	117.73	70.73	53.80	62.27
P1xP3	94.33	90.33	92.33	115.27	110.07	112.67	64.97	45.50	55.23
P1xP4	97.00	94.00	95.50	125.33	118.40	121.87	75.53	48.50	62.02
P1xP5	95.33	90.00	92.67	120.07	110.07	115.07	69.13	59.20	64.17
P1xP6	97.67	94.33	96.00	122.53	119.47	121.00	68.27	49.23	58.75
P2xP3	90.00	88.00	89.00	118.80	107.13	112.97	57.80	47.30	52.55
P2xP4	94.67	90.67	92.67	117.00	110.87	113.93	65.47	48.97	57.22
P2xP5	91.67	89.67	90.67	112.27	110.00	111.13	65.40	47.53	56.47
P2xP6	89.67	87.67	88.67	117.47	115.80	116.63	60.70	49.13	54.92
P3xP4	97.67	95.33	96.50	114.13	111.13	112.63	55.37	43.17	49.27
P3xP5	95.67	92.33	94.00	107.67	103.33	105.50	63.17	41.37	52.27
P3xP6	94.00	90.67	92.33	114.13	109.33	111.73	55.67	39.50	47.58
P4xP5	98.33	95.67	97.00	118.7	116.53	117.30	65.87	42.83	54.35
P4xP6	96.67	91.33	94.00	121.93	113.07	117.50	63.70	40.93	52.32
P5xP6	96.33	92.00	94.17	114.53	113.00	113.77	65.83	47.40	56.62
Mean of the parents	97.72	94.28	96.00	111.86	108.80	110.33	61.23	42.92	52.08
Mean of the crosses	94.76	91.44	93.10	117.45	112.11	114.76	64.51	46.95	55.74
Mean of the genotypecs	95.59	92.25	93.93	115.83	111.16	113.50	63.57	45.80	54.69
L.S.D .5%	2.51	2.50	2.50	6.01	6.95	6.35	8.18	10.30	9.08
L.S.D.1%	3.36	3.40	3.40	8.04	9.17	8.39	10.95	13.58	12.00

N= Normal irrigation D =Stress C = Combined

Table (9): Cont.

Genotypes	Maturity (days)			No. of grains / spike			No. of spikes / plant		
	N	D	Comb	N	D	Comb	N	D	Comb
Sids 1 P1	141.00	134.67	137.83	84.33	64.00	74.17	29.27	21.93	25.60
Line 2D P2	140.67	131.33	136.00	81.00	65.17	73.08	27.67	18.47	23.07
Line3D P3	141.00	132.33	136.67	75.33	62.83	69.08	32.13	23.27	27.70
Gemmiza9 P4	151.67	144.33	148.00	87.17	76.50	81.83	31.20	20.27	25.73
Giza168 P5	146.33	140.67	143.50	98.50	79.50	89.00	31.27	21.20	26.23
Sham 6 P6	150.33	142.00	146.17	92.83	70.17	81.50	28.33	20.40	24.37
P1xp2	141.00	133.67	137.33	96.50	71.67	84.08	29.00	23.40	26.20
P1xp3	144.33	134.67	139.50	79.67	61.00	70.33	35.33	21.93	28.63
P1xp4	147.67	139.67	143.67	91.67	64.40	78.03	29.00	20.47	24.73
P1xp5	143.67	135.67	139.67	88.17	74.03	81.10	29.00	20.00	24.50
P1xp6	145.67	140.00	142.83	91.33	75.67	83.50	33.07	24.27	28.67
P2xp3	138.33	134.67	136.50	81.17	66.33	73.75	27.20	21.27	24.23
P2xp4	143.33	138.67	141.00	83.67	71.67	77.67	28.13	21.67	24.90
P2xp5	141.33	137.67	139.50	83.00	66.50	74.75	30.53	18.53	24.53
P2xp6	143.33	136.67	140.00	77.67	67.57	72.62	30.00	19.53	24.77
P3xp4	143.67	141.00	142.33	86.00	65.17	75.58	31.60	23.77	27.68
P3xp5	142.33	137.67	140.00	79.83	63.17	71.50	30.27	21.33	25.80
P3xp6	143.33	136.33	139..83	89.83	63.57	76.70	32.80	22.33	27.57
P4x5	144.00	139.67	141.83	82.33	68.83	75.58	33.53	19.70	26.62
P4XP6	142.33	138.33	140.33	91.67	71.23	81.45	29.07	19.20	24.13
P5XP6	144.33	140.33	142.33	94.83	77.50	86.17	32.07	21.33	26.70
Mean of the parents	145.17	137.56	141.36	86.53	69.70	78.11	29.98	20.92	25.45
Mean of the crosses	143.24	137.65	140.45	86.49	68.55	77.52	30.71	21.26	25.97
Mean of the genotypes	143.79	137.62	140.71	86.50	68.88	77.69	30.50	21.16	25.83
L.S.D 5%	2.67	3.04	2.79	11.32	12.36	11.58	NS	NS	NS
L.S.D1%	3.57	4.01	3.69	15.15	16.29	15.30	NS	NS	NS

N= Normal irrigation D =Stress C = Combined

Table (9): Cont.

Genotypes	Weight 1000- kernel (g)			Grain yield /plant (g)			Straw yield /plant (g)		
	N	D	Comb.	N	D	Comb	N	D	
Sids1 P1	49.27	52.47	50.87	94.26	65.07	79.66	154.07	135.60	144.84
Line 2D P2	55.47	56.97	56.22	92.63	60.30	76.47	125.37	115.30	120.33
Line 3D P3	49.05	54.23	51.64	87.97	64.53	74.58	121.37	108.47	114.92
Gemmiza9 P4	48.53	52.33	50.43	110.37	59.50	84.93	195.30	160.83	178.07
Giza168 P5	44.30	47.17	45.73	99.20	74.83	87.02	140.80	130.83	135.82
Sham6 P6	49.00	53.37	51.18	90.53	68.53	79.53	150.47	146.80	148.63
P1XP2	51.93	55.60	53.77	104.0310	64.80	84.42	164.30	141.53	152.92
P1XP3	50.87	56.73	53.80	120.43	69.47	94.95	160.57	127.87	144.22
P1XP4	53.17	55.60	54.38	105.87	81.73	93.80	160.13	151.93	156.03
P1XP5	48.87	53.40	51.13	95.03	80.67	87.85	136.30	129.33	132.82
P1XP6	50.37	53.40	51.88	110.00	81.33	95.67	146.67	139.00	142.83
P2XP3	53.13	54.60	53.87	83.70	66.60	75.15	129.63	122.73	126.18
P2XP4	48.70	52.20	50.45	93.10	72.83	82.97	143.90	136.17	140.03
P2XP5	50.43	52.63	51.53	103.03	59.93	81.48	152.63	115.73	134.18
P2XP6	51.23	54.90	53.07	94.07	67.03	80.55	132.93	119.30	126.12
P3XP4	56.30	60.40	58.35	112.17	77.37	94.77	144.83	134.97	139.90
P3XP5	47.97	55.53	51.75	98.37	65.23	81.80	134.97	123.43	129.20
P3XP6	47.73	55.13	51.43	107.10	71.30	89.20	141.90	120.03	130.97
P4XP5	50.60	54.70	52.56	113.40	66.60	90.00	175.60	126.07	150.83
P4XP6	54.63	55.50	55.07	111.17	73.47	92.32	160.17	140.87	150.52
P5XP6	45.73	51.30	48.52	102.70	67.93	85.32	165.30	138.73	152.02
Mean of the parents	49.27	52.76	51.01	95.82	65.46	80.37	147.89	132.97	140.44
Mean of the crosses	50.78	54.77	52.77	103.61	71.09	87.34	149.99	131.18	140.58
Mean of the genotypes	50.35	54.20	52.27	101.23	69.48	85.35	149.39	131.69	140.54
L.s.D5%	3.45	3.07	3.19	19.96	14.27	17.00	20.09	20.12	19.65
L.S.D1%	4.61	4.05	4.22	26.70	18.81	22.47	26.88	26.52	25.97

N= Normal irrigation D =Stress C = Combined

Table (9): Cont.

Genotypes	Biological yield/plant (g)			Harvest index H.I %		
	N	D	Comb	N	D	Comb
Sids1 P1	248.33	200.67	224.50	37.96	32.39	35.18
Line 2D P2	218.00	175.60	196.80	42.56	34.31	38.44
Line 3D P3	206.00	173.00	189.50	40.48	37.45	38.97
Gemmiza9 P4	305.67	220.33	263.00	36.19	27.06	31.63
Giza168 P5	240.00	205.67	222.83	41.29	36.38	38.84
Sham 6 P6	241.00	215.33	228.17	37.42	31.86	34.64
P1XP2	268.33	206.33	237.33	38.71	31.39	35.05
P1XP3	281.00	197.33	239.17	42.82	35.21	39.03
P1XP4	266.00	233.67	249.83	39.77	34.83	37.30
P1XP5	231.33	210.00	220.67	41.08	38.38	39.73
P1XP6	256.67	220.33	238.50	42.85	36.86	39.86
P2XP3	213.33	189.33	201.33	39.16	35.05	37.10
P2XP4	237.00	209.00	223.00	39.26	34.82	37.04
P2XP5	255.67	175.67	215.67	40.34	34.19	37.27
P2XP6	227.00	186.33	206.67	41.48	35.70	38.59
P3XP4	257.00	212.33	234.67	43.80	36.60	40.20
P3XP5	233.00	188.67	211.00	42.12	34.55	38.34
P3XP6	249.00	191.33	220.17	43.00	37.08	40.04
P4XP5	289.00	192.67	240.83	39.37	34.72	37.05
P4XP6	271.33	214.33	242.83	40.71	34.12	37.41
P5XP6	268.00	206.67	237.33	38.23	32.78	35.50
Mean of the parents	243.17	198.43	220.80	39.31	33.24	36.28
Mean of the crosses	253.57	202.26	227.88	40.85	35.08	37.97
Mean of the genotypes	250.62	201.17	225.90	40.41	34.56	37.49
L.S.D 5%	36.48	29.93	32.66	3.71	4.12	3.83
L.S.D 1%	48.81	39.45	43.17	4.96	5.43	5.06

N= Normal irrigation D=Stress C = Combined

the performance of genotypes differed from environment to another for these traits.

Also, results showed that mean squares due to parents were significant for all studied traits except no. of spikes / plant in both irrigation treatments as well as the combined analysis. Significant mean squares due to interaction between parental varieties and irrigation treatments were detected for all traits except heading date, plant height no. of spikes/plant, maturity date, flag leaf area, biological and straw yields. Such result revealed that the parents varied in their response to environments in these traits.

The mean performance of the six parental varieties / or lines of wheat at separate environments as well as the combined analysis are presented in (Table9).

The parental variety Sids1 (P1) gave the desirable values for maturity date and grain yield/plant. It gave, moderate values for other traits

The parental Line 2D (P2) ranked the first earlier for heading and maturity date, and lower values for plant height biological and straw yields. While, it gave the highest values for 1000- kernel weight. However, it gave the moderate value for other traits.

The parental Line3D (P3) gave the lowest values for plant height, grain yield / plant, flag leaf area, biological and straw yields /plant; and heading and maturity dates. Meanwhile, it almost expressed moderate values for the most of other traits.

The parental variety Gemmeiza9 (P4) exhibited the highest mean values for heading and maturity dates (late of maturity), biological and straw yields, and harvest index.While, it ranked the third of the tested parent for highest of plants. However, it gave moderate values for the most of other traits.

The parental variety Giza168 (P5) expressed the highest values for no. of grains /spike, and grain yield/plan. While, it ranked the second of the tested parents for high flag leaf area. However, it gave moderate values for the most of other traites.

The parental variety Sham 6 (P6) expressed the highest values for heading date, plant height, flag leaf area and straw yield. While, it ranked the second 1000- kernel weight of the tested parents for ; grain yield, no. of grains/spike, date of maturity, and biological yield. Meanwhile, it almost expressed moderate values for the most other traits.

Data presented in table (8) showed that crosses mean squares were significant for all traits under both environments as well as the combined analysis except no. of spikes/plant in both environments as well as the combined data and harvest index in the normal irrigation, revealing an over all difference between these hybrids. Significant mean squares due to interaction between crosses and irrigation treatments were detected for no. of grains / spike, maturity date, grain, straw and biological yields. Such results indicate that these hybrids varied in their response to environmental fluctuations.

The mean performance of F1 hybrids in each irrigation treatment as well as the combined analysis over them are presented in Table(9).

For heading date, plant height, flag leaf area, maturity date,1000-kernel weight, no. of grains /spike, no. of spikes /plant, straw yield and harvest, index, the hybrids were within the range of the performance of the parents. For grain yield /plant, the mean values for crosses ranged from 75.15g. for cross P1xP3 to 95.67g for cross P1xP6 in the combined analysis .The two crosses Sids1 (P1)x line3D(P3) and Sids1(P1) x Sham6(P6) in the combined analysis had the highest grain yield /plant. The high grain yield in both crosses could be attributed to high no. of grains / spike, 1000-kernel weight and harvest index .It could be concluded that these crosses would be efficient and promising in wheat breeding programs for improving grain yield .

V.1.2.Heterosis

Mean squares for parents vs. crosses as an indication to average heterosis overall crosses was significant for all traits in both treatments as well as the combined analysis, except no. of grains/spike, no. of spikes / plant and straw yield / plant in both irrigation treatments as well as the combined analysis, biological yield / plant in both irrigation treatments, and maturity date in stress irrigation treatment (Table 10). F1`s mean performance were significantly higher than parental means for all traits under study except heading and maturity dates.

Insignificant mean squares due to interaction between parents vs. crosses and environments were detected for all traits

Table (10): Percentage of heterosis in the F1 generation over both mid-parent(mp)and better-parent (BP)for the agronomical traits

Crosses	Heading (days)						Plant height (cm)					
	N		D		Comb		N		D		Comb	
	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP
P1xp2	-1.07	0.36	- 0.74	1.51	- 0.91	0.93	12.00**	6.15**	4.05	1.48	-8.02**	2.33
P1xp3	0.35	1.07	-1.46	- 0.74	- 0.54	0.17	5.46*	0.29	1.40	- 4.42	3.44	-2.07
P1xp4	-2.68 *	2.46	-2.42*	1.81	-2.55*	2.14	9.56**	9.05**	4.06	2.81	6.81	5.93*
P1xp5	-1.21	0.70	-3.91**	-2.52*	2.54*	0.91	5.38*	4.47	- 0.77	- 4.43	2.35	0.02
P1xp6	-1.35	3.16*	-1.22	2.17	1.29	-2.67*	3.06	- 0.28	4.41	3.73	3.72	2.31
P2xp3	-2.88*	-2.17	-1.86	- 0.37	-2.38*	-1.29	15.00**	14.59**	4.59	4.08	9.82**	9.34**
P2xp4	-3.73 **	2.90*	-3.89**	2.64*	-3.81**	2.77*	7.93**	2.74	2.97	-1.37	5.46*	0.70
P2xp5	-3.68**	- 0.36	-2.18	1.51	-2.94*	0.55	4.01	- 0.58	4.96	3.13	4.48	1.28
P2xp6	- 8.19**	-2.53*	- 6.24**	- 0.76	-7.24**	-1.66	4.04	- 4.55	6.93*	1.88	5.46*	-1.34
P3xp4	-1.35	4.65**	- 0.35	- 4.76**	- 0.86	4.71**	4.93*	0.22	3.70	-1.13	4.32	- 0.46
P3xp5	-0.17	2.51	0.72	1.46	- 0.44	1.99	- 0.58	- 4.66	- 0.93	-3.12	- 0.75	-3.89
P3xp6	- 4.41 **	0.72	- 4.39**	- 0.37	- 4.40**	0.18	0.77	-7.11**	-1.42	-3.81	1.09	-5.46*
P4xp5	-3.12*	0.00	- 2.05	0.69	-2.59*	0.35	4.12	3.69	6.39*	3.67	5.23*	3.68
P4xp6	-7.05**	-6.45**	- 8.21**	-7.34**	-7.62**	-6.93**	3.01	- 0.77	0.03	0.53	1.56	- 0.65
P5xp6	- 4.46*	-2.03	- 4.99**	-3.16*	- 4.72**	2.59*	-2.86	- 6.78**	2.57	0.53	- 0.23	-3.68

*and ** indicates significant at 0.05 and 0.01 levels of probability, respectively. P= Sids1 P2= Line2D P3= Line3D P4= Gemmiza9
P5= Giza168 P6=Sham6

Table(10): cont.

Crosses	Flag leaf area (cm2)						Maturity (days)					
	N		D		Comb		N		D		Comb	
	M p	B p	MP	BP	MP	B P	M P	Bp	MP	BP	MP	BP
P1xp2	18.18**	15.38*	26.99*	20.62	21.83**	18.00*	00.12	00.23	0.50	1.77	0.30	0.98
P1xp3	25.06**	11.25	22.92	13.88	24.17**	12.31	2.36**	2.36*	0 .87	1.76	1.64	2.57
P1xp4	22.02**	15.48**	21.00	20.85	21.62**	18.16*	0.91	4.16**	0.12	3.71**	0.52	4.23**
P1xp5	14.49**	- 10.83	39.08**	31.55**	24.66**	-19.52*	0.00	1.89*	-1.45	0.74	- 0.71	2.69
P1xp6	2.79	- 8.28	4.79	- 8.54	3.62	- 8.34	0.00	3.31**	1.20	3.96**	0.59	5.02**
P2xp3	8.24*	- 7.01	20.51	6.05	13.44	- 0.76	-1.78*	-1. 66	2.15*	2.54*	0.12	0.37
P2xp4	3.34	0.11	15.71	9.77	8.30	8.53	-1.94*	1.89*	0.60	5.58**	- 0.70	3.68**
P2xp5	5.77	4.85	6.10	5.62	5.91	5.17	-1.51	0.47	1.23	4.82**	- 0.18	2.57*
P2xp6	-10.56*	- 18.45**	- 0.17	- 8.73	- 6.19	- 14.37*	-1.49	1.89*	0.00	4.06**	- 0.77	2.94*
P3xp4	- 0.15	-15.34*	16.77	7.82	6.62	- 6.55	-1.82*	1.89*	1.93*	6.55**	00.00	4.15**
P3xp5	17.12*	1.28	4.86	- 8.08	11.94	- 2.65	- 0.93	0.94	0.85	4.03**	- 0.06	2.44*
P3xp6	-7.17	- 25.20**	- 9.95	- 26.62**	- 8.35	- 25.80*	-1.60*	1.65	- 0.61	3.02*	-1.12	2.31*
P4xp5	3.10	0.71	0.74	- 4.82	2.16	21.25	-3.36**	- 1.59	- 1.99*	- 0.71	-2.69**	-1.16
P4xp6	- 8.89	-14.41**	-12.78	- 23.96*	- 10.45	- 19.18*	-5.74**	-5.32**	-3.38**	- 2.58*	- 4.59**	-3.95**
P5xp6	- 3.75	- 11.55*	- 4.08	-11.94	- 3.89	-11.75	-2.70**	- 1.37	- 0.71	- 0.23	-1.73	- 0.82

*and ** indicates significant at 0.05 and 0.01 levels of probability, respectively. P= Sids1 P2= Line2D P3= Line3D P4= Gemmiza9 P5= Giza168 P 6= Sham6

Table (10): Cont.

Crosses	No. of grains / spike						No. of spikes / plant					
	N		D		Comb		N		D		Comb	
	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP
P1XP2	16.73**	14.43*	10.97	9.98	14.20*	13.38	1.87	0.92	15.84	6.70	7.67	1
P1xP3	- 0 .21	- 5.52	-3.81	- 4.69	- 1.80	- 5.16	15.09	9.96	- 2.95	- 5.72	7.44	3.36
P1xP4	6.90	5.16	- 8.33	-15.82*	0.04	- 4.64	- 4.08	- 7.05	-3.00	0.99	- 3.64	- 3.88
P1xP5	-3.56	-10.48	3.18	- 6.88	- 0.59	- 8.87	- 4.19	-7.26	-7.25	-5.68	-5.47	- 6.60
P1XP6	3.10	-1.62	12.80*	7.84	7.28	2.45	14.81	-12.98	14.65	10.62	14.74	11.95
P2XP3	3.84	0.21	3.65	1.80	3.75	0.92	- 9.03	- 15.34	1.92	- 8.59	- 4.53	-12.52
P2Xp4	- 0.50	-4.02	1.18	- 6.33	0.27	- 5.09	- 4.42	- 9.83	11.88	6.91	2.05	-3.23
P2Xp5	-7.52	-15.74**	- 8.06	- 16.35*	- 7.76	- 16.01*	3.62	- 2.37	- 6.55	-12.59	- 0.47	- 6.48
P2XP6	-10.64	-16.33**	- 0.15	-3.71	- 6.05	- 10.90	7.14	5.89	0.51	- 4.26	4.43	1.64
P3XP4	5.85	-1.34	- 6.46	- 14.82	0.17	- 7.64	- 0.21	- 1.65	9.19	2.14	3.62	- 0.07
P3XP5	-8.15	0.94	-11.24*	- 20.55**	- 9.54	- 19.66**	- 4.52	-5.78	- 4.05	- 8.29	- 4.33	- 6.86
P3XP6	6.84	-3.23	- 4.41	- 9.41	1.87	- 5.89	78.49	2.08	2.29	- 3.99	5.89	- 0.51
P4XP5	-11.31*	-16.42**	-11.75 *	-13.42	- 11.51*	- 15.07*	7.35	6.65	- 4.98	- 7.08	2.44	1.44
P4Xp6	1.85	1.25	- 2.86	- 6.88	- 0.27	- 0.46	- 2.35	- 6.82	-5.57	- 5.88	-3.66	- 6.22
P5XP6	-0.87	-3.73	3.56	- 2.52	1.08	- 3.19	7.61	2.56	2.56	0.61	5.53	1.79

*and ** indicates significant at 0.05 and 0.01 levels of probability, respectively.
P= Sids1 P2= Line2D P3= Line3D P4= Gemmiza9 P5= Giza168 P6= Sham6

Table (10): Cont.

Crosses	Weight 1000- kernel (g)						Grain yield / plant (g)					
	N		D		Comb		N		D		Comb	
	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP
P1xP2	- 083	- 6.38*	1.61	- 2.39	0.42	- 4.36	11.33	10.36	3.38	- 0.39	8.14	5.96
P1xP3	3.48	3.25	6.34*	4.61	4.97	4.18	34.64**	27.76*	7.20	6.76	23.11*	19.19
P1xP4	8.73**	7.92*	6.11*	5.99*	7.37*	6.92*	3.47	- 4.07	31.23**	25.62**	13.98	10.44
P1xP5	4.45	- 0.81	7.19*	1.79	5.87	0.53	- 1.75	- 4.20	15.32	7.79	5.41	0.97
P1xP6	2.51	2.23	- 0.91	0.07	1.68	1.36	19.05*	16.70	21.76*	18.67	20.19*	20.10*
P2xP3	1.67	- 4.22	- 1.80	- 4.14	- 0.12	- 4.18	- 5.57	9.64	6.70	3.21	- 0.50	- 1.71
P2xzP4	- 6.35*	- 12.20	- 4.48	- 8.36**	- 5.39*	- 10.25**	- 8.28	-15.64	21.59*	20.78	2.81	- 2.32
P2xP5	1.10	- 9.09**	1.09	- 7.60**	1.10	- 8.33**	7.42	3.86	- 11.30	-19.91*	- 0.32	- 6.36
P2xP6	- 1.91	- 7.65*	- 0.48	- 3.16	- 1.18	- 5.60	2.71	1.55	4.06	- 2.19	3.27	1.28
P3xP4	15.39**	14.78**	13.36**	11.38**	14.33**	12.99**	15.04	1.63	24.75*	19.88	18.82*	11.57
P3xP5	2.77	- 2.20	9.53**	2.40	6.29*	0.21	7.02	0.83	- 6.39	- 12.83	1.24	- 5.99
P3xP6	-2.63	- 2.69	2.48	1.66	0.04	- 0.41	22.28*	18.30	7.16	4.04	15.76	12.16
P4xP5	9.01**	4.27	9.95**	4.53	9.50**	4.40	8.22	2.75	- 0.84	- 10.99	4.68	3.44
P4xP6	12.56**	11.49**	5.01	4.01	8.38**	7.58*	10.67	0.72	14.66	7.11	12.26	8.70
P5xP6	- 1.96	- 6.67	-2.06	- 2.06	0.12	- 5.26	8.26	3.52	-5.23	- 5.23	2.45	- 1.96

*and ** indicates significant at 0.05 and 0.01 levels of probability, respectively.

P= Sids1 P2= Line2D P3= Line3D P4= Gemmiza9 P5= Giza168 P6= Sham6

Table (10):Cont.

Crosses	Straw yield / plant (g)						Biological yield / plant (g)					
	N		D		Comb		N		D		Comb	
	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP
P1xP2	17.59**	6.64	12.82	4.37	15.33*	5.58	15.08*	8.05	9.67	2.83	12.67	5.71
P1xP3	16.59*	4.22	4.78	- 5.70	11.04	- 0.43	23.70**	13.16	5.62	- 1.66	12.54*	6.53
P1xP4	- 8.33	- 18.01**	2.51	- 5.53	- 3.36	-12.38*	- 3.97	- 12.98*	11.01	6.05	2.50	- 5.01
P1xP5	-7.55	- 11.53	- 2.92	- 4.62	-5.35	- 8.30	- 5.26	- 6.84	3.36	2.11	- 1.34	-1.71
P1xP6	- 3.68	- 2.53	- 1.56	- 5.31	- 2.66	- 3.90	4.90	3.36	5.93	2.32	5.38	4.53
P2xP3	5.08	3.40	9.70	6.44	7.28	4.86	0.63	- 2.14	8.62	7.81	4.24	2.31
P2xP4	- 10.25	- 26.32**	- 1.38	- 15.33*	- 6.14	- 21.36**	- 9.48	- 22.46**	5.57	- 5.14	- 3.00	- 15.21**
P2xP5	14.69	- 8.40	- 5.96	- 11.54	4.77	- 1.21	11.64	6.63	-7.85	- 14.59	2.79	- 3.22
P2xP6	- 3.61	- 11.66	- 8.97	- 18.73**	- 6.22	- 15.14*	- 1.09	- 5.81	-4.67	-13.47	- 2.74	- 9.42
P3xP4	- 8.53	- 25.84**	0.24	- 16.08*	- 4.50	- 21.44**	0.46	- 15.92*	7.96	- 3.63	3.72	- 10.78
P3xP5	2.96	- 4.14	3.16	- 5.66	3.06	- 4.87	4.63	- 2.78	- 0.35	- 8.27	2.34	- 5.31
P3xP6	4.40	- 5.70	- 5.95	- 18.24*	-0.61	- 10.88	11.41	3.31	- 1.46	- 11.15	5.43	- 3.51
P4xP5	4.49	- 10.09*	- 13.55	- 21.62**	- 3.89	- 1530**	5.93	- 5.45	- 9.55	- 12.55	-0.86	- 8.43
P4xP6	- 7.36	- 17.99**	- 8.42	- 4.04	- 7.86	- 15.47**	- 0.73	- 11.23	- 1.61	- 0.46	- 1.12	- 7.67
P5xP6	13.50	9.86	- 0.06	- 5.50	6.88	2.28	11.43	11.20	-1.82	- 4.03	5.25	4.02

*and ** indicates significant at 0.05 and 0.01 levels of probability, respectively.
P= Sids1 P2= Line2D P3= Line3D P4= Gemmiza9 P5= Giza168 P6= Sham6

Table (10): Cont.

Crosses	Harvest index H.I %					
	N		D		Comb	
	MP	BP	MP	BP	MP	BP
P1xP2	- 3.85	-9.05*	- 5.88	-8.51	- 4.77	- 8.82
P1xP3	9.25*	5.85	0.82	- 5.98	5.28	0.15
P1xP4	7.28	4.77	17.18*	7.53	11.69*	6.03
P1xP5	3.66	- 0.51	11.62	5.50	7.36	2.29
P1xP6	13.70**	12.88**	14.75*	13.80*	14.19*	13.30*
P2xP3	- 5.69	- 7.99	- 2.33	- 6.41	- 4.13	- 4.80
P2xP4	- 0.28	-7.75	13.46*	1.49	5.74	- 3.64
P2xP5	- 3.77	- 5.22	- 3.27	- 6.02	- 3.54	- 4.04
P2xP6	3.74	- 2.54	7.90	4.05	5.62	0.39
P3xP4	14.27**	8.20	13.47*	- 2.27	13.90*	3.16
P3xP5	3.02	2.01	- 6.41	- 7.74	- 1.45	- 1.62
P3xP6	10.40*	6.23	7.00	- 0.10	8.80	2.75
P4xP5	1.63	- 4.65	9.45	- 4.56	5.15	- 4.61
P4xP6	10.52*	8.79	15.80*	7.09	12.92*	8.00
P5xP6	- 2.87	-7 .41	- 3.95	- 9.90	- 3.37	- 8.60

*and ** indicates significant at 0.05 and 0.01 levels of probability, respectively.

P= Sids1 P2= Line2D P3= Line3D P4= Gemmiza9 P5= Giza168 P6= Sham6

except maturity date. These results indicated that heterotic effects were not affected by environmental changes under study.The results agree with the results reported by **Mani and Rao (1975),El- Marakby _et al._ (1993), El–Hennawy (1996), Saad _et_ *al.*(1997), EL –Borhamy (2000), Hamada and Tawfelis (2001), Awaad (2002), Abd EL-Aty and Katta (2002), Darwish and Ashoush (2003), Abd EL Aty and EL Borhamy (2007) and El-Marakby _et al._ (2007)**

Heteosis expressed as the percentage deviation of F1 mean performance from its mid- and better parent values for all the studied traits at both environments as well as the combined analysis are presented in table (10)

For heading date, nine, six and nine hybrids expressed significant negative heterotic effects relative to mid- parent in normal, stress irrigation treatments as well as the combined analysis, respectively. However, two, three and two hybrids expressed significant negative heterotic effects relative to better parent in the same order. The single cross P4xP6 (Gemmiza9 x Sham6) expressed the most desirable heterotic effects for earliness relative to mid – parent -7.05, -8.21 and – 7.62%) and better parent (-6.48, - 7.34 and – 6.93 in normal, stress irrigation treatments as well as the combined analysis, respectively. Significant negative heterotic effects for earliness was previously reported by **Darwish (1992) and El- Menofy (2007).** However, little or no heterotic effects for earliness were previously found by **Mani and Rao (1975), Mitkees (1981), Mekhamer (1995) and Zaied (1995).**

While, the highest heterotic effects were found by **Tamam and Abdel- Gawad (1999), Ashoush *et al.* (2001) Darwish and Ashoush (2003), and Darwishe *et al* .(2006).**

Earliness if found in wheat is a favorable for escaping destructive injuries by stress conditions. Hence, it could be concluded that the previous cross is valuable in breeding for earliness.

Concerning plant height, significant and positive mid-parent heterotic effects were detected by seven, two and three hybrids in normal stress irrigation treatments and the combined analysis, respectively. The cross P2xP3 in normal irrigation and the combined analysis and P2xP6 in stress irrigation gave the highest positive heterotic effects for this trait.

While, three, zero, and two hybrids exhibited significant positive heterotic effects relative to better parent in the same order. While, the cross P5xP6 and P2xP3 expressed significant positive heterotic effects relative to better parent in normal and the combined analysis, respectively. Also, the cross P1xP2 gave significant negative to mid- parent in the combined analysis.

Several investigators reported positive and significant heterotic effects for plant height. Among those are **Ghanem (2001)and Safan (2001) .**

Regarding flag leaf area, six, two and four hybrids expressed significant positive heterotic effects relative to mid-parent in normal, stress irrigation treatments as well as the combined analysis, respectively. The two crosses P1xP2and P1xP4 expressed significant positive heterotic effects relative to better parent in normal treatment and the combined analysis.On the other side, two, one, and two, crosses expressed significant positive heterotic effects relative to better parent in the same order.

The cross P1xP2 had the highest desirable positive heterotic effects in both environments and the combined analysis.

Awaad (2002) and El-Hosary *et al* (2009a). reported that heterosis values were positive and significant for FLA in most studied hybrids .

For maturity date, six, two and two hybrids exhibited significant negative heterotic effects relative to mid- parent in normal, stress irrigation treatments as well as the combined analysis, respectively. While, the cross P4xP6 expressed significant negative heterotic effects relative to better parent in both irrigation treatments and the combined analysis . Several investigators reported significant negative heterotic effects for maturity date.

For number of grains /spike, the cross P1xP2 in normal irrigation and the combined analysis and P1xP6 in stress irrigation expressed significant positive heterotic effects relative to mid- parent. However, the cross P1xP2 gave significant positive heterotic effects relative to better parent in normal irrigation. Significant positive heterotic effects for number of kernels per spike were reached by **Darwish (1992), Ashoush (1996), Ashoush *et al* (2001) Safan (2001), Ashoush (2006) and Darwish *et al* (2006), El-Hosary *et al* (2000)and El-Hosary *et al* (2009a).** However, no heterotic effects for no. of grains per spike were found by **Hendawy (1990) Abdel-Wahed (2001),Ghanem(2001), and Darwish and Ashoush (2003) .**

Concerning thousand kernel weight , four, six and six hybrids expressed significant positive heterotic effects relative to mid parent in the normal , stress irrigation treatments as well as the combined analysis ,respectively. While, three, two and three crosses from the previous hybrids exhibited significant positive heterotic effects relative to better parent in the same order. The most desirable heterotic effects relative to better parent were detected for the cross P3xP4 (Line3D xGemmiza9) followed by cross P4xP6 in the combined analysis. In this connection **El- Hosary *et al* (2000), Hamada and Tawfelis (2001), Abd El –Aty and Katta (2002), Darwish and Ashoush (2003), Ashoush (2006) and Darwish *et al.* (2006),and El-Hosary *et al* (2009a)**

Regarding grain yield/plant, three, four and three crosses exhibited significant positive heterotic effects relative to mid – parent in the normal, stress irrigation treatments as well as the combined analysis, respectively. Also, the cross P1xP3, P1xP4, and P1xP6 expressed significant positive heterotic effects relative to better parent and gave the highest desirable heterotic effects in the same order. The previous crosses exhibited one or more of trait contributing yield. Several investigators reported significant positive heterotic effects for grain yield/plant. Among those are **El–Marakby *et al* (1993) El-Hosary *et al* (2000) Hamada and Tawfelis (2001), Abd – El-Aty and Katta (2002), Awaad (2002) Darwish and Ashoush (2003), El-Menofy (2007) and El- Hosary *et al* (2009a).**

Regarding straw yield / plant, the two cresses P1xP2 and P1xP3 in normal irrigation treatment and P1 xP2 in the combined data expressed significant positive heteroic effects relative to mid – parent. However, none of the studied hybrids gave significant positive heterotic effects relative to better – parent in both irriation treatments as well as the combined analysis in this trait.

Also, for biological yield / plant, the two crosses P1xP2 in normal irrigation treatment and P1xP3 in the combined analysis exhibited significant positive heterotic effects relative to mid-parent. However, none of the studied hybrids showed significant positive heterotic effects relative to better parent in both irrigation treatments and the combined analysis in this trait.

Concerning harvest index, five, five and four hybrids expressed significant positive heterotic effects relative to mid-parent in the normal ,stress irrigation treatments and the combined data, respectively .The cross P1xP6 (Sids1 xSham6) exhibited significant positive heterotic effects relative to either mid- parent or better parent in both irrigation treatments as well as the combined analysis.

From such results it could be concluded that crossP1xP6 exhibited a great potential for commercial hybrid wheat production

Significant positive heterotic effects to higher yielding relative to either better or mid- parent values were also reached before by **Darwish (1992) Mekhamer (1995), El –Hosary *et al* (2000),Ghanem (2001), Abd –El- Hameed (2002), Darwish**

and Ashoush (2003), Ashoush (2006), El-Menofy (2007) and El-Hosary et *al* (2009a).

V.1.3 Combining ability:

Analysis of variance for combining ability as outlined by **Griffing's (1956)** method 2 model 1 in each environments and their combined data for all the studied traits are shown in Table (11).

Significant general combining ability (GCA) mean squares were detected for all the studied traits in both irrigation treatments as well as the combined analysis except for harvest index in normal irrigation. Whereas significant mean squares for specific combining ability (SCA) were obtained for all traits in both irrigation treatments and the combined analysis, except for plant height ,no. of grains/spike and straw yield /plant in stress condition and biological yield /plant in stress condition and the combined analysis.

It is evident that non additive type of gene action was the more important part of the total genetic variability for plant height and straw yield /plant in stress condition and biological yield /plant in stress condition and the combined analysis. On the other hand, the additive types of gene action was the more important port of the total genetic variability for harvest index in normal irrigation. For the other studied traits, 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 grain yield/plant and harvest index in the combined data and normal irrigation, respectively exhibited low GCA/SCA ratios of less than unity, indicating the

Table (11):Observed mean squares of general and specific combining ability for F1 crosses in diallel analysis for the agronomical traits

S.o.v	D.F		Heading (days)			Plant height (cm)			Flag leaf area (cm 2)		
	S	C	N	D	Comb	N	D	Comb	N	D	Comb
GCA	5	5	40.28**	28.98**	68.61**	74.88**	67.63**	141.89**	105.55**	56.94**	142.78**
SCA	15	15	5.64**	5.45**	10.56**	22.39**	8.50	22.93**	26.11**	25.29*	42.85**
GCAxI		5			0.64			0.61			19.71
SCA xI		15			0.52			7.97			8.55
Error	40	80	0.77	0.77	0.77	4.42	5.75	5.09	8.20	12.61	10.41
GCA/SCA			7.15	5.32	6.50	3.34	7.95	6.19	4.04	2.25	3.33
GCAxI/GCA					0.01			0.00			0.14
SCAx I/SCA					0.05			0.35			0.20
GCAxI/SCAxI					1.23			0.08			2.30

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

Table (11): Cont.

S.o.v	D.F		Maturity (days)			No. of grains /spike			No .of spikes / plant		
	S	C	N	D	Comb	N	D	Comb	N	D	Comb
GCA	5	5	24.34**	35.82**	58.32**	77.41**	64.15**	132.11**	6.51	4.83	9.24
SCA	15	15	5.51**	2.97**	6.22**	30.18*	17.62	34.88**	3.94	2.04	3.51
GCAxI		5			1.85			9.44			2.10
SCAxI		15			2.26*			12.94			2.47
Error		80	0.87	1.10	0.99	15.70	10.29	12.99	4.11	2.52	3.31
GCA/SCA			4.42	12.07	9.38	2.56	3.64	3.79	1.65	2.36	2.63
GCAxI/GCA					0.03			0.07			0.23
SCAxI/SCA					0.36			0.37			0.70
GCAxI/SCAxI					0.82			0.73			0.85

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

Table (11):Cont.

S.O.V	D.F		Weight 1000- kernel (g)			Grain yield/plant (g)			Straw yield/plant (g)		
	S	C	N	D	Comb	N	D	Comb	N	D	Comb
GCA	5	5	17.73**	11.93**	26.57**	122.58**	47.39**	140.77**	778.10**	501.58**	1234.09**
SCA	15	15	6.38**	4.99**	10.18**	89.32**	45.65** -63-	69.74**	157.39**	57.51	130.46**
GCAxI		5			2.73			29.20**			45.59
SCAxI		15			1.19			65.22**			84.44*
Error	40	80	1.45	1.12	1.29	48.76	24.19	36.48	49.40	48.10	48.75
GCA/ SCA			2.72	2.39	2.61	1.40	1.04	2.02	4.94	8.72	9.46
GCAx I/GCA					0.10			0.21			0.04
SCA XI /SCA					0.12			0.94			0.65
GCAxI/SCA xI					2.29			0.45			0.54

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

Table(11): Cont.

S.O.V	D.F		Biological yield/plant (g)			Harvest index (H. I) %		
	S	C	N	D	Comb	N	D	Comb
GCA	5	5	1475.98**	749.02**	2088.88**	3.68	8.26**	11.11**
SCA	15	15	366.87*	103.91	195.59	4.44**	5.65**	8.58**
GCAxI		5			136.12			0.83
SCAxI		15			275.19 *			1.51
Error	40	80	162.95	106.44	134.70	1.68	2.02	1.85
GCA/SCA			4.02	7.21	10.68	0.83	1.46	1.29
GCAxI/GCA					0.07			0.07
SCAxI/SCA					1.41			0.18
GCAxI/SCAxI					0.49			0.55

*and ** indicates significant at 0.05 and 0.01 levels of probability, respectively.

N=Normal irrigation D= Stress C = Combined

predominance of non-additive gene action in the inheritance of such traits.

However, high GCA/SCA ratio, which exceeded more 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 controlling these cases. The genetic variance was previously reported by **El-Marakby *et al* (1993), El-Hennawy (1996), Darwish (1998), El-Borhamy (2000) and El-Gamal (2002).**

The interaction between both general and specific combining ability and irrigation treatments was significant for number of grains/spike, grain yield /plant and harvest index, indicating that the magnitude of GCA and SCA varied from environment to another. It is fairly evident that ratio of SCA x I /SCA higher than ratio of GCA x I/GCA for number of grains/spike and harvest index. Such results indicated that non-additive type of gene action was more influenced by the irrigation treatments than additive genetic effects. These conclusions are in well agreement with those reported by **Gilbert (1958)**.However, the ratio of GCA x I /GCA was higher than SCA x I/SCA for grain yield/plant, indicating that additive and additive by additive genetic effect were much more influenced by different irrigation treatments than non additive gene effects.

Significant SCA x irrigation and insignificant GCA x irrigation interaction was detected for maturity date, biological and straw yields/plant indicating that non additive genetic effects only were influenced by different irrigation treatments.

Insignificant interactions between irrigation treatments and both types of combining ability were obtained for other traits indicating that all types of gene action were stable over the two irrigation treatments.

General combining ability effects (ĝi):

Estimates of GCA effect (ĝi) for individual parental genotypes in each trait in both irrigation treatments as well as the combined analysis are presented in Table (12).

General combining ability effects computed herein were found to differ significant from zero in all cases. High positive values would be interest under all trait in question except heading and maturity dates where high negative effects would be useful from the breeder point of view.

The parental variety Sids1(P1) exhibited significantly positive (ĝi) effects for; plant height, straw and biological yield in both irrigation treatments as well as the combined analysis, grain yield and flag leaf area in normal irrigation and the combined analysis and number of grains/spike in the combined data. Also, it gave significant negative ĝi effects for heading date in the combined analysis and maturity date in stress condition as well as the combined analysis, revealing that this parent was best combiner for these traits. However, it expressed either significant negative or insignificant ĝi effects for other cases.

The parental line 2D (P2) seemed to be good combiner for heading and maturity dates (earliness) and it ranked the second best combiner for short plant height in both irrigation

Table (12):Estimates of general combining ability effects for all parents in the agronomical traits in the F1 generation

Parental Variety Or Line	Heading (days)			Plant height (cm)			Flag leaf Area (cm2)		
	N	D	Comb	N	D	Comb	N	D	Comb
Sids1 P1	- 0.40	- 0.35	- 0. 37 **	3.03**	2.96**	3.00**	2.55**	1.98	2.27**
Line2 D P2	- 3.36**	-2.93**	- 3.15**	- 2.18**	- 1.88*	- 2.03**	- 0.29	1.91	0.81
Line3 D P3	1.36**	- 0.89**	-1.12**	- 4.18**	- 4.16**	- 4.17**	-7.13**	- 4.50**	- 5.81**
Gemmiza9 P4	3.06**	2.74**	2.90**	1.67*	2.08*	1.88**	1.47	- 2.02	- 0.28
Giza 168 P5	0.60*	0.49	0.54**	- 1.54*	- 1.48	- 1.51**	1.14	0.96	1.05*
Sham6 P6	1.47**	0.94**	1.21**	3.19**	2.48**	2.84**	2.25*	1.66	1.95**
LSD gi 5%	0.57	0.57	0.27	1.37	1.56	0.69	1.87	2.32	0.99
LSD gi 1%	0.77	0.77	0.36	1.84	2.09	0.92	2.50	3.10	1.31
LSD gi-gi 5%	0.89	0.89	0.44	2.13	2.42	1.12	2.89	3.59	1.60
L.S.D gi-gi 1%	1.19	1.19	0.58	2.84	3.24	1.49	3.87	4.80	2.13

*and ** indicates significant at 0.05 and 0.01 levels of probability, respectively.

N=Normal irrigation D= Stress C = Combined

Table (12): Cont.

Parental Variety Or Line	Maturity (days)			No. of grains / spike			No. of spikes / plant		
	N	D	Comb	N	D	Comb	N	D	Comb
Sids1 P1	- 0.28	- 1.29**	- 0.78**	1.31	0.92	0.19	0.06	0.73	0.39
Line2 D P2	- 2.24**	- 2.42**	- 2.33**	- 2.69*	-1.01	- 1.85**	- 1.66	- 0.84	-1.25
Line3 D P3	- 1.57**	- 1.79**	- 1.68**	- 4.79**	- 4.66**	- 4.72**	1.00	1.13	1.07
Gemmiza9 P4	2.22**	2.83**	2.53**	0.52	1.52	1.02	0.03	- 0.34	- 0.16
Giza 168 P5	0.22	1.12**	0.67**	2.46	- 3.36**	2.91**	0.56	- 0.60	- 0.02
Sham6 P6	1.64**	1.54**	1.59**	3.19*	1.71	2.45**	0.02	- 0.08	- 0.03
LSD gi 5%	0.61	0.68	0.30	2.58	2.09	1.11	NS	NS	NS
LSD gi 1%	0.81	0.92	0.40	3.46	2.79	1.47	NS	NS	NS
LSD gi-gi 5%	0.94	1.06	0.49	4.00	3.24	1.79	NS	NS	NS
LSD gi-gi 1%	1.26	1.42	0.66	5.35	4.34	2.38	NS	NS	NS

*and ** indicates significant at 0.05 and 0.01 levels of probability, respectively.

N=Normal irrigation D= Stress C = Combined

Table (12): Cont.

Parental Variety Or Line	Weight 1000- kernel (g)			Grain yield / plant (g)			Straw yield / plant (g)		
	N	D	Comb	N	D	Comb	N	D	Comb
Sids1 p1	0.16	0.03	0.10	1.91*	2.72	2.32*	3.80**	4.88**	4.34**
Line2 D P2	1.74**	0.56	1.15**	- 5.67**	- 4.32**	- 4.99**	- 8.95**	- 6.97**	- 7.96**
Line3 D P3	0.21	1.43**	0.82**	- 2.20	- 0.92	- 1.56	- 10.39**	- 9.48**	- 10.44**
Gemmiza9 p4	1.00*	0.46	0.73**	5.98**	0.58	3.28**	16.19**	11.22**	13.71**
Giza 168 P5	- 2.53**	- 2.19**	- 2.36**	0.29	- 0.46	0.38	0.08	- 3.36	- 1.64
Sham6 P6	- 0.59	- 0.30	- 0.45*	- 0.31	1.47	0.58	0.27	3.71	1.99
LSD gi 5%	0.79	0.69	0.35	4.54	3.21	1.85	4.38	4.52	2.13
LSD gi 1%	1.05	0.92	0.46	6.08	4.29	2.46	5.86	6.05	2.82
LSD gi-gi 5%	1.22	1.07	0.56	7.05	4.96	3.00	6.79	7.00	3.46
LSD gi-gi 1%	1.63	1.43	0.75	9.44	6.65	3.98	9.08	9.37	4.59

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

Table (12): Cont.

Parental Variety Or Line	Biological yield / plant (g)			Harvest index H.I%		
	N	D	Comb	N	D	Comb
Sids1 P1	5.71	7.60*	6.65**	- 0.21	- 0.06	- 0.13
Line2 D P2	- 14.63**	- 11.29**	- 12.96**	0.15	- 0.27*	- 0.06
Line3 D P3	- 13.58**	- 10.40**	- 11.99**	1.13	1.43*	1.28**
Gemmiza9 P4	22.17**	11.81	16.99**	- 0.95	- 1.59**	- 1.27**
Giza 168 P5	0.38	- 2.90	- 1.26	0.10	0.68*	0.39
Sham6 P6	- 0.04	5.18	2.57	0.24	0.21	0.21
LSD gi 5%	8.33	6.73	3.36	NS	0.93	0.42
LSD gi 1%	11.14	9.00	4.73	NS	1.24	0.55
LSD gi-gi 5%	12.90	10.43	5.77	NS	1.43	0.68
LSD gi-gi 1%	17.26	13.95	7.66	NS	1.92	0.90

*and ** indicates significant at 0.05 and 0.01 levels of probability, respectively

N= Normal irrigation D= Stress C = Combined

treatments as well as the combined analysis. Also, it expressed significant positive ĝi effects for number of grains/spike and grain yield /plant in stress irrigation treatment, and 1000-kerenl weight in normal irrigation treatment as well as the combined data. Moreover, it gave either significant negative or insignificant ĝi effects for other cases.

The parental line 3D (P3) expressed significant desirable ĝi effects for earliness (heading and maturity dates) and short plant in both irrigation treatments as well as the combined data, harvest index and 1000- kernel weight in stress condition as well as the combined analysis. However, it poor combiner for other cases.

The parental variety Gemmiza9 (P4) seemed to be good combiner for biological and straw yields in both irrigation treatments and the combined data, grain yield and 1000-kernel weight in normal irrigation and the combined analysis. Also, it gave significant positive ĝi effect for plant height in both irrigation treatments and the combined analysis. However, it gave undesirable ĝi effect for other traits.

The parental variety Giza168 (P5) exhibited significant positive ĝi effect for no. of grains /spike in normal irrigation treatment, flag leaf area in the combined analysis and harvest index in stress irrigation treatment as well as the combined analysis. However, it gave undesirable ĝi effects for other traits.

The parental variety Sham6 (P6) expressed significant positive ĝi effects for; plant height and no. of grains/spike in both irrigation treatments as well as the combined analysis, harvest index and grain yield /plant in stress condition and the combined analysis and flag leaf area in normal irrigation and the combined analysis. Moreover, it gave either significant undesirable or insignificant ĝi effect for other cases.

Specific combining ability effects(S_{ij}):

Specific combining ability effects of the parental combinatios computed for all traits in both irrigation treatments as well as the combined analysis are presented in Table (13).

For heading date, three, four and five crosses exhibited significant negative (S_{ij}) effects in normal, stress irrigation treatment as well as the combined analysis, respectively. Results indicated that the three crosses P2xP6, P3xP6and P4xP6 had desirable (S_{ij}) effects for this trait in both irrigation treatments as well as the combined analysis.

For maturity date, the two crosses Gemmiza9 (P4) x Giza168 (P5) and Gemmiza9 (P4)x Sham6 (P6) expressed significantly negative (S_{ij}) effects in both irrigation treatments as well as the combined analysis. The cross P4xP6 had the highest earliness, for maturity and heading date.

Earliness, if found in wheat is favorable for escaping destructive injuries by stress conditions and intensive production. Both crosses P4xP5 and P4xP6 as previously mentioned, expressed significant negative (S_{ij}) effects of maturity date. In addition, the cross P4xP5gave significant positive (S_{ij}) effects for grain yield /plant. Hence, it could be concluded that this cross is valuable in breeding for earliness and yield potentiality.

Table (13): Estimates of specific combining ability effects for the agronomical at traits from the F1 generation

Crosses	Heading (days)			Plant height (cm)			Flag leaf area (cm2)		
	N	D	Comb	N	D	Comb	N	D	Comb
P1xP2	0.49	0.69	0.59	5.31**	1.22	3.27*	4.90	4.10	4.50*
P1xP3	0.49	- 0.68	- 0.10	0.59	0.11	0.35	5.97*	2.21	4.09*
P1xP4	- 1.26	- 0.64	- 0.95	4.80*	2.20	3.50*	7.94**	3.73	5.34*
P1xP5	- 0.46	- 2.39**	- 1.43*	2.75	- 2.57	0.09	1.87	10.45**	6.16**
P1xP6	0.99	1.48	1.24*	0.48	2.86	1.67	- 0.11	- 0.21	- 0.16
P2xP3	- 0.88	- 0.43	- 0.66	9.33**	2.01	5.67**	1.65	4.08	2.86
P2xP4	- 0.63	-1.39	-1.01	1.67	- 0.50	0.58	0.72	3.27	1.99
P2xP5	- 1.17	- 0.14	- 0.66	0.15	2.20	1.18	0.97	- 1.15	- 0.09
P2xP6	- 4.05**	- 2.60**	- 3.32**	0.62	4.03	2.33	- 4.84	- 0.24	- 2.54
P3xP4	0.37	1.23	0.80	0.81	2.05	1.43	- 2.54	3.88	0.67
P3xP5	0.83	0.48	0.65	- 2.44	- 2.19	- 2.31	5.58*	- 0.90	2.34
P3xP6	- 1.71*	-1.64*	- 1.68**	- 0.70	- 0.15	- 0.43	- 3.03	- 3.46	- 3.24
P4xP5	- 0.92	0.19	- 0.37	2.10	4.77	3.44*	- 0.31	- 1.91	- 1.11
P4xP6	- 3.46**	- 4.60**	- 4.03**	1.24	- 2.66	- 0.71	- 3.59	- 4.51	-4.05*
P5xP6	- 1.34	- 1.68*	- 1.51**	- 2.95	0.84	-1.05	- 1.13	- 1.02	- 1.08
LSD Sij 5%	1.57	1.58	1.10	3.77	NS	2.81	5.13	6.36	4.02
LSD Sij 1%	2.10	2.11	1.45	5.04	NS	3.73	6.86	8.51	5.34
LSD sij-sik 5%	2.35	2.35	1.64	5.62	NS	4.20	7.66	9.50	6.00
LSD sij-sik 1%	3.14	3.15	2.17	7.52	NS	5.57	10.24	12.70	7.97
LSD sij-skl 5%	2.17	2.18	0.62	5.21	NS	1.59	7.09	8.79	2.27
LSD sij-skl 1%	2.91	2.91	0.82	6.97	NS	2.10	9.48	11.76	3.01

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

Table(13):Cont.

Crosses	Maturity (days)			No. of grains / spike			No. of spikes / plant		
	N	D	Comb	N	D	Comb	N	D	Comb
P1xP2	- 0.28	0.24	- 0.26	11.38* *	4.72	8.05**	0.11	2.36	1.23
P1xP3	2.39**	0.13	1.26*	- 3.36	- 2.30	- 2.83	3.78	- 1.09	1.35
P1xP4	1.93*	0.51	1.22	3.33	-5.07	- 0. 87	- 1.58	-1.08	- 1.33
P1xP5	- 0.07	- 1.79	- 0.93	- 2.10	2.72	0.31	- 2.11	- 1.29	1.70
P1xP6	0.51	2.13*	1.32*	0.33	5.99	3.17	2.49	2.46	2.47*
P2xP3	- 1.65	1.26	-0.20	2.15	3.12	2.63	- 2.63	- 0.18	- 1.41
P2xP4	- 0.45	0.63	0.09	-0.67	2.28	0.81	- 0.73	1.70	0.48
P2xP5	- 0.45	1.34	0.45	- 3.27	- 4.73	- 3.99	1.14	- 1.18	- 0.02
P2xP6	0.14	- 0.08	0.03	- 9.33*	- 2.02	-5.67*	1.14	- 0.70	0.22
P3xP4	- 0.78	2.34*	0.78	3.77	- 0.57	1.60	0.07	1.82	0.95
P3xP5	- 0.11	0.71	0.30	- 4.33	- 4.42	- 4.37	- 1.78	- 0.36	- 1.07
P3xP6	- 0.53	- 1.04	- 0.78	4.94	- 2.37	1.28	1.28	0.12	0.70
P4xP5	- 2.24**	-1.91*	- 2.07**	- 7.15**	- 4.92	- 6.03**	2.45	- 0.51	0.97
P4xP6	- 5.32**	- 3.66**	- 4.49**	1.46	- 0.87	0.29	- 1.48	- 1.53	- 1.51
P5xP6	- 1.32	0.05	- 0.64	2.69	3.55	3.12	0.99	0.85	0.92
LSD Sij 5%	1.67	1.88	1.24	7.09	NS	4.49	NS	NS	NS
LSD Sij 1%	2.24	2.51	1.64	9.49	NS	5.96	NS	NS	NS
LSD sij-sik 5%	2.49	2.80	1.85	10.58	NS	6.70	NS	NS	NS
LSD sij-sik 5%	3.34	3.75	2.45	14.17	NS	8.90	NS	NS	NS
LSD sij-skl 5%	2.31	2.60	0.70	9.80	NS	2.54	NS	NS	NS
LSD sik-skl 1%	3.09	3.47	0.93	13.11	NS	3.36	NS	NS	NS

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

Table (13):Cont.

Crosses	Weight 1000- kernel (g)			Grain yield / plant (g)			Straw yield / plant (g)		
	N	D	Comb	N	D	Comb	N	D	Comb
P1XP2	- 0.32	0.81	0.24	6.57	- 3.08	1.74	20.06**	11.94	15.99**
P1XP3	0.15	1.07	0.61	19.49**	- 1.82	8.83*	18.77**	0.78	9.77*
P1XP4	1.65	0.91	1.28	- 3.25	8.95*	2.85	- 9.24	4.14	- 2.55
P1XP5	0.89	1.35	1.12	- 8.40	8.01	- 0.20	- 16.97**	- 3.88	- 10.42**
P1XP6	0.45	- 0.53	- 0.04	7.17	7.66	7.42	- 6.97	- 1.28	- 4.04
P2XP3	0.84	- 1.59	- 0.38	- 9.66	2.36	- 3.65	0.58	7.50	4.04
P2XP4	- 4.39**	- 3.02**	- 3.71**	- 8.43	7.09	- 0.67	- 12.73*	0.22	- 6.25
P2XP5	0.87	0.06	0.47	7.19	- 5.69	0.75	12.11	- 5.63	3.24
P2XP6	- 0.26	0.44	0.09	- 1.17	0.40	- 0.39	- 7.78	- 9.13	- 8.45
P3XP4	4.74**	4.31**	4.52**	7.15	8.22	7.69*	- 9.36	1.53	- 3.91
P3XP5	- 0.06	2.09*	1.01	- 0.96	-3.79	- 2.37	- 3.12	4.59	0.73
P3XP6	- 2.23*	- 0.20	- 1.21	8.38	1.26	4.82	3.63	- 5.88	- 1.13
P4XP5	1.78	2.23*	2.00**	5.90	- 3.92	0.99	9.94	- 13.49	- 1.78
P4XP6	3.87**	1.14	2.51**	4.27	1.93	3.10	- 5.68	- 5.76	- 5.72
P5XP6	- 1.49	- 0.41	- 0.95	1.49	- 3.48	- 0.99	15.56*	6.69	11.12*
LSD Sij 5%	2.16	1.90	1.42	12.50	8.81	7.51	12.58	NS	8.69
LSD Sij 1%	2.89	2.54	1.88	16.74	11.79	9.97	16.85	NS	11.53
LSD sij-sik 5%	3.22	2.83	2.11	18.66	13.12	11.22	18.79	NS	12.99
LSD sij-sik 1%	4.31	3.79	2.80	24.98	17.58	14.88	25.15	NS	17.22
LSD sij-skl 5%	2.99	2.62	0.80	17.27	12.16	4.24	17.39	NS	4.91
LSD sij-skl 1%	3.99	3.51	1.06	23.12	16.28	5.62	23.28	NS	6.51

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

Table(13):Cont.

Crosses	Biological yield / plant (g)			Harvest index H.I%		
	N	D	Comb	N	D	Comb
P1XP2	-26.63*	8.85	17.74	-1.64	2.84*	-2.24**
P1XP3	38.26**	- 1.04	18.61	1.52	- 0.73	0.40
P1XP4	- 12.49	13.09	0.30	0.52	1.92	1.22
P1XP5	- 25.37*	4.13	- 10.62	0.77	3.20*	1.98*
P1XP6	0.38	6.38	3.38	2.88*	2.57 *	2.72**
P2XP3	- 9.08	9.85	0.39	- 2.53*	- 0.68	- 1.60
P2XP4	- 21.16	7.31	- 6.92	- 0.35	2.11	0.88
P2XP5	19.30	- 11.31	3.99	- 0.32	-0.78	- 0.55
P2XP6	- 8.95	- 8.73	- 8.84	1.14	1.62	1.38
P3XP4	- 2.20	9.75	3.78	3.21**	2.19	2.70
P3XP5	- 4.08	0.80	- 1.64	0.48	- 2.13	- 0.82
P3XP6	12.01	- 4.62	3.69	1.68	1.29	1.48
P4XP5	15.84	- 17.41	- 0.79	- 0.20	1.06	0.43
P4XP6	- 1.41	- 3.83	- 2.62	1.47	1.35	1.41
P5XP6	17.05	3.21	10.13	- 2.07	- 2.26	- 2.16*
LSD Sij 5%	22.87	NS	NS	2.33	2.54	1.69
LSD Sij 1%	30.60	NS	NS	3.11	3.41	2.24
LSD sij-sik 5%	34.13	NS	NS	3.47	3.80	2.53
LSD sij-sik 1%	45.66	NS	NS	4.65	5.08	3.35
LSD sij-skl 5%	31.60	NS	NS	3.21	3.51	1.59
LSD sij-skl 1%	42.27	NS	NS	4.30	4.70	2.09

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

Regarding plant height, the three crosses Sids1 (P1)x Line2D(P2), Sids1(P1) x Gemmiza9 (P4) and Line2D(P2) x Line3D(P3) expressed significant positive (S_{ij}) effect in normal irrigation and the combined data. None of the hybrids showed significant negative sij effect for this trait.

For flag leaf area, three, one and four crosses exhibited significant positive S_{ij} effects in normal and stress irrigation treatments and the combined analysis, respectively. The highest positive S_{ij} effects were obtained by cross P1xP4 in normal irrigation and P1xP5 in stress irrigation treatment and the combined analysis. For this trait, it is clear that the previous two crosses are the promising in practical breeding programs to produce broader flag leaf area genotypes. However, the cross P4xP6 in the combined analysis expressed the negative S_{ij} effects for this trait.

Regarding no. of grains/spike the cross P1xP3 expressed significant positive S_{ij} effects in the normal, stress irrigation treatment and the combined over them, respectively. Results indicates that the cross P1xP2 in normal irrigation and the combined analysis had best desirable S_{ij} effects for this trait.

For 1000-kerenl weight, the cross P3xP4 was the best followed by cross P4xP6 in normal irrigation, cross P3xP4 followed by cross P4xP5 and than by cross P3xP5 in stress irrigation, and cross P3xP4 followed by crossP4xP6 and than by cross P3xP5 in the combined analysis, expressed significantly positive S_{ij} effects. The best cross was P3xP4 for this trait in both irrigation treatments as well as the combined data.

Seven, four and four crosses expressed significant positive S_{ij} effects for grain yield/plant in normal, stress irrigation treatment as well as the combined analysis, respectively. Meanwhile, the most desirable S_{ij} effects were recorded for the crosses P1xP3 followed by cross P4xP5 in both irrigation treatments as well as the combined data for this traits

The three crosses P1xP2, P1xP3 and P5xP6 exhibited significant positive S_{ij} effect for straw yield /plant in normal irrigation and the combined analysis. Also, the first two crosses exhibited significant positive S_{ij} effects for biological yield/plant in normal irrigation treatment. In addition, the two crosses P1xP6, P3xP4in normal irrigation, the three crosses P3xP6,P4xP5 and P4xP6 in stress irrigation treatment and the three crosses P1xP6, P3xP6, and P4xP6 in the combined analysis expressed significant positive S_{ij} effect for harvest index

In most traits, the values of S_{ij} effect were mostly differed from irrigation treatment to another. This finding coincided with that reached above where significant SCA by irrigation treatment mean squares was detected Table (11).

The previous parental combinations might be of interest in breeding programs aimead at producing pure line varieties for high, biological, grain and straw yields/plant and some of its components as most combinations involved at least one good combiner for most previous trait.

If crosses showing high specific combining ability effects involving only one good combiner, such combinations would throw out desirable transgressive segregates, proving that the additive genetic system present in the good combiner and complementary and epistatic effects present in the crosses, act in the some direction to reduce undesirable plant characteristics and maximize the character in view. Therefore the most previous crosses might be of prime importance in breeding program to drought tolerance varieties by using traditional breeding procedures.

V.2- Drought measurements :

V.2.1- 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 (14).

Results indicated that irrigation mean squares were significant for all the studied traits, indicating over all differences between normal and stress condition. With the exception of (R.W.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 Fery (1989)** demonstrated that grain yield in stress or low-productivity environments were not controlled by the same genes, making indirect selection unattractive. Also, results

Table (14) Observed mean squares from ordinary analysis and combining ability for drought measurements studied on 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 (14): 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 (14): 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

indicated that mean values of normal environment for yield and its components were higher than these of stress condition.

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 (15).

Relative water content. (RWC)

Data in Table (15) indicate that generally there was a gradual decrease in relative water content (RWC) with increasing water stress condition in root media of parents and

Table (15): The genotypes mean performance for drought measurements studied on 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
Mean of 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 (15): 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 (15): 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 the parents	171.77	231.96	201.87
Mean of the crosses	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

their crosses. The minimum reduction was in Sids1 (P1), Line 2D (P2), Line 3D(P3), Giza168 (P5), Sham6 (P6), and crosses P1xP2, P3xP6, P2xP4 and P4xP5. Meanwhile, the maximum reduction was in Gemmiza9 (P4), P1xP5, P3xP4, P3xP5.

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 absorbed 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, (1985**) 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), Gemmiza9 (P4) and Sham6 (P6) expressed the lowest values for this trait in normal, stress condition 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 (15) 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 Sham6 P6 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 22.06 (P1xP2) to and 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 wiiting. 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 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, TAA in stress condition However, expressed the lowest value for TAA in normal irrigation. Meanwhile, 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 (15). 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 crosses 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 ones 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 treatment as well as the combined analysis .

It can be noticed from the above results, that there was significant increase exhibited in water stress. In this respect **Kramer (1983), 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 (chemical 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 and Stankova, 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 and 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.

A.2.1.3. Heterosis :

Mean squares for parent vs. crosses as indication to average heterosis overall crosses were 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 (Table14). 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 15).

Significant mean squares due to interaction between parents vs. crosses and environments were detected for drought measurements (Table14)

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 (16).

Table (16): Percentage of heterosisin the F1 generation over both mid –parent(MP)and better –parent (BP)for drought measurements studied.

Crosses	Relative water content R.W.C %						Membrane integrity M.I %					
	N		D		Comb		N		D		Comb	
	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP
P1xP2	-.88	- 2.29	- 0.58	- 0.97	- 0.73	-1.64	-33.70	- 51.22	-12.12	-25.28	- 21.37	- 37.23
P1xP3	8.13*	5.32	- 0.43	-1.21	3.76	2.84	-37.87	55.38*	-114.27**	114.28**	39.74	17.18
P1xP4	-1.97	- 4.14	8.01*	- 3.21	2.70	-1.47	11.54	10.13*	38.63*	38.63**	62.98*	31.94
P1xP5'	- 3.03	- 5.88	28.46**	- 28.49**	-15.98**	-17.19**	-19.30	- 34.29	- 45.62	- 45.62	- 23.00	- 42.31*
P1xP6	3.38	3.09	- 3.62	- 5.51	- 0.17	-1.04	119.88*	93.89	10.31	- 6.12	42.96	32.01
P2xp3	- 0.79	-1.98	-14.07**	-15.08**	-7.60*	-7.62	-24.08	-26.91	30.32	10.80	2.32	-3.98
P2xp4	- 3.94	-7.38*	8.99*	-1.99	2.15	-1.13	- 67.54*	24.31	- 42.51*	-50.29**	- 3.82	- 5.77
P2xp5	0.91	- 0.66	-9.98**	-10.37	- 4.67	- 5.18	-5.54	-7.65	-38.41*	-49.66**	- 22.13	- 28.41
P2xp6	3.59	2.39	-1.53	- 3.83	0.98	- 0.81	33.53	-9.19	5.18	5.04	15.70	-1.56
P3xp4	-1.08	- 5.73	-10.24**	- 20.13**	- 5.45	- 8.50	26.81	-8.21	-22.49	-41.45*	- 3.00	-7.17
P3xp5	0.24	- 0.11	- 26.14**	- 26.70**	-13.42**	-13.92**	- 51.00*	-58.50*	- 24.48	- 45.45**	- 35.37	- 43.93*
P3xp6	- 3.71	- 5.95	- 3.21	- 4.36	- 3.45	- 5.14	-25.64	50.42	13.44	-3.46	- 3.12	-12.80
P4xp5	-1.35	- 6.30*	7.29	- 3.89	2.76	0.00	- 15.30	- 30.37	26.61	- 31.36	- 23.60	- 31.08
P4xp6	- 2.44	- 4.86	2.86	- 9.44	0.08	- 4.78	103.87*	-77.84	-2.87	-16.11	22.30	5.86
P5xp6	8.71*	5.80	- 6.18	-7.99	1.04	-1.27	17.28	- 13.22	-13.81	-29.63	- 5.35	- 24.83

*and ** indicates significant at 0.05 and 0.01 levels of probability, respectively.

P1=Sids1 P =Line 2D P3= Line 3D P4 = Gemmiza9 P5 = Giza168 P6 = Sham6

Table (16): Cont..

Crosses	Osmotic Pressure O.P						Potassum Content K.p.p.m.N					
	N		D		Comb		N		D		Comb	
	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP
P1xP2	4.78	0.00	-12.52	-15.77	-.5.13	- 5.35	13.17**	059	10.79*	10.47*	11.96**	5.34
P1xP3	31.33**	25.68**	9.89	7.85	19.84	18.57	2.15	0.62	1.05	-5.40	0.28	0.89
P1xP4	14.38	11.95	0.32	- 3.55	6.69	3.30	3.50	3.38	-2.27	-2.14	2.30	0.76
P1xP5	0.36	- 4.36	27.86*	25.31*	15.99	14.85	0.83	072	- 0.66	-5.59	- 0.69	-2.31
P1xP6	- 9.95	-18.16	- 2.03	- 3.93	- .5.43	- 10.31	1.60	0.78	-0.66	-5.50	0.48	-1.61
P2xP3	- 6.13	-14.11	- 20.49	- 24.97*	-14.13	-14.93**	17.99**	5.57	-4.62	- 8.51	5.78	- 1.58
P2xP4	- 2.47	- 4.80	-11.27	- 17.68	- 7.47	- 10.49	13.70**	1.16	2.57	- 0.94	7.94	0.12
P2xP5	20.25	20.25	- 1.79	- 3.47	7.26	6.17	13.13**	0.65	2.15	-1.60	7.44	-0.47
P2xP6	26.50*	20.25	20.65	14.04	23.03*	16.46	18.72**	6.28	0.09	-5.06	8.95	0.50
P3xP4	5.58	0.00	24.37	21.51	16.03	11.31	4.70	3.25	- 033	-1.02	2.17	1.82
P3xP5	- 9.20	16.84	27.87	23.16*	11.39	9.09	- 0.73	- 2.11	- 3.83	- 4.25	- 2.29	- 2.75
P3xP6	- 4.93	16.84	15.99	15.70	6.65	0.20	2.60	1.88	-3.44	- 4.57	- 0.47	- 1.41
P4xP5	7.15	4.56	6.44	0.36	6.75	4.20	- 0.01	- 0.02	-3.24	- 3.49	-1.62	-1.75
P4xP6	54.77**	43.75**	54.71**	51.56**	54.78**	51.54**	- 2.53	1.82	- 2.59	- 4.38	- 0.05	- 0.64
P5xP6	12.38	6.84	28.23*	23.15*	21.70*	16.39	- 0.01	- 0.71	- 22.65**	- 23.88**	-11.43**	- 11.83**

*and ** indicates significant at 0.05 and 0.01 levels of probability, respectively.

P1=Sids1 P=Line 2D P3= Line 3D P4=Gemmiza9 P5= Giza168 P6= Sham6

Table (16):Cont.

Crosses	Protein Content g/kg P.C						Total .amino acid T.A.A					
	N		D		Comb		N		D		Comb	
	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP
P1xP2	38.58**	37.69**	-15.20**	-16.97**	022	- 1.09	14.78*	-25.13**	63.16**	50.85**	17.62**	12.36
P1x3	104.74**	99.74**	- 2.89	- 3.75	27.85**	27.75**	-2.67	-10.13	33.51**	16.78**	14.99**	- 3.27
P1xP4	18.86**	- 1.35	-38.93**	- 40.93**	- 18.72**	- 22.55**	0.86	-9.22	23.22**	15.51**	11.14	1.89
P1xP5	17.08**	- 5.50	- 46.09**	-47.61**	- 23.44**	- 28.26**	-28.39**	-32.27**	7.42	-11.78**	- 9.06	-17.71**
P1xP6	- 3.28	- 19.45**	- 59.38**	- 61.08**	-39.71**	- 42.14**	-12.82	-27.80**	20.48**	1.05	2.73	- 14.41**
P2xP3	48.94**	46.23**	- 61.01**	-61.48**	- 30.22**	- 31.19**	-34.1 8**	-37.53**	34.05**	9.67*	- 4.33	- 10.35
P2xP4	3.28	-14.72**	- 35.01**	- 38.41**	- 21.86**	- 24.44**	-49.65**	-50.99**	51.60**	32.11**	- 8.23	-12.11*
P2xP5	12.16**	-9.91*	- 45.14**	-47.76**	- 24.95**	- 28.78**	-5.33	-18.72**	-53.07**	-18.28**	23.08**	16.28**
P2xP6	10.20*	- 8.70*	- 58.12**	- 60.66**	- 34.59**	- 36.41**	-24.22**	-29.26**	29.23**	1.79	- 1.66	-14.85**
P3xP4	62.16**	31.98**	- 49.37**	- 51.46**	- 11.10**	-15.35**	-12.43	- 14.67*	28.44**	--19.23**	7.02	4.60
P3xP5	7.76	- 14.64**	- 59.35**	- 60.83**	- 35.71**	- 39.79**	12.76	1.41	2.10	-5.19	6.92	6.00
P3xP6	8.46*	- 11.43**	- 57.89**	- 60.00**	-35.06**	- 37.73**	-34.70**	-41.93**	- 6.36	-10.85*	- 21.08**	- 27.51**
P4xP5	- 7.17*	-10.38**	- 39.92**	- 40.22**	- 26.52**	- 27.80**	-15.42*	- 25.67**	- 1.73	-14.78**	- 8.26	-9.56
P4xP6	- 15.21**	- 15.57**	-51.51**	- 51.98**	- 36.89**	- 37.36**	-32.80**	-38.83**	8.68	-3.58	- 13.83**	-22.48**
P5xP6	2.05	- 1.88	- 48.00**	- 48.76**	27.46**	- 29.24**	-7.36	-24.89	-7.38	-9.79*	- 7.37	-15.60**

*and ** indicates significant at 0.05 and 0.01 levels of probability, respectively.

P1=Sids1 P =Line 2D P3= Line 3D P4 = Gemmiza9 P5 = Giza168

Table(16):cont.

Crosses	Total Sugars (TS)					
	N		D		Comb	
	MP	BP	MP	BP	MP	BP
P1xP2	- 36.69**	-38.23**	11.54**	3.75**	-10.44**	-14.88**
P1xP3	11.06**	4.72**	- 25.97**	- 39.43**	-010.34**	- 22.30**
P1xP4	- 25.77**	-31.23**	- 9.81**	- 26.65**	-15.97**	24.31**
P1xP5	- 27.47**	-32.25**	-11.38**	-16.61**	-19.46**	- 19.80**
P1xP6	7.92**	3.20**	- 31.23**	- 38.56**	-13.65**	- 20.51**
P2xP3	- 34.31**	-36.57**	- 24.05**	- 33.94**	- 28.29**	-34.96**
P2xP4	25.08**	13.28***	- 37.20**	- 45.73**	- 13.63**	-18.38**
P2xP5	- 32.75**	-35.69**	- 20.03**	- 29.67**	- 26.23**	-29.61**
P2xP6	5.21**	3.06**	- 29.70**	- 32.70**	- 14.42**	- 17.25**
P3xP4	-14.51**	- 24.97**	-50.76**	-51.14**	- 37.87**	- 40.52**
P3xP5	- 31.81**	-32.48**	-39.02**	- 52.39**	- 35.77**	- 44.14**
P3xP6	8.03**	6.45**	- 14.05**	- 22.27**	- 5.03**	-11.13**
P4xP5	- 22.27**	-32.35**	- 10.02**	- 30.28**	- 15.22**	- 23.35**
P4xP6	-33.43**	-40.81**	- 46.55**	-51.99**	- 41.63**	- 43.01**
P5xP6	- 22.33**	-24.21**	-1.29	-16.39**	- 11.37**	- 18.10**

*and ** indicates significant at 0.05 and 0.01 levels of probability, respectively.

P1=Sids1 P =Line 2D P3= Line 3D P4 = Gemmiza9 P5 = Giza168 P6 = Sham6

With regard relative water content (RWC), the two crosses P1xP3 and P5xP6 in normal irrigation, and three crosses; P1xP5, P1xP4 and P2xP4 in stress irrigation treatments expressed significant positive heterotic effects relative to mid-parent value. On the other hand, significant negative or insignificant heterotic effects relative 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. 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 Wood 1979).** Also, **Nicolas *et al.* (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 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 combined analysis, respectively. Also, six and one cross 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 (Table 14).

B-1-2 Combining ability:

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 studied traits are shown in Table (17). 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

Table (17): 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 (17):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 (17):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 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 controlling in these cases.

These results were along the same line of **El-Marakby *et al.* (1993) 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. Also, **Abd El-Aty and Katta (2000)** found that additive gene effect were larger in magnitude than those of dominant ones for yield and its components.

The interaction between both general and specific combining ability and irrigatio 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.; **El-Hosary *et al.*(2009)** found that non-additive types of gene action was much more influenced by the environmental condition than additive genetic ones for K+. and RWC.

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.

B.2 .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 (18).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. General 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.

Table (18): Estimates of general combining ability effects for all parents in the drought measurements studied on 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 (18): 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 (18):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

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 treatment as well as the combined data, protein content under normal irrigation and OP under stress irrigation, revealing that this parent was 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 desirable or insignificant for other cases.

Specific combining ability effects(S_{ij}):

Specific combining ability effects of the parental combinations were computed for all drought measurements in both irrigation treatments as well as the combined analysis are presented in Table (19).

Table (19):Estimates of specific combining ability effects for drought measurements studied on F1 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(19):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 (19):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 sij effects in normal, stress irrigation treatments as well as the combined analysis, respectively. The most desirable Sij effect 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 amid at producing pure line varieties as most combinations involved at least one good combiner.

V. 3. Susceptibility index (DSI):

V.3.1.Analysis of variance, means and heterosis:

Mean squares for drought susceptibility index (DSI) of straw, grain and biological yields are presented in Table (20).

Mean squares for genotypes (DSI) were significant for the three yields. While, mean square for (DSI) due to parent was

Table (20):Observed mean squares from ordinary analysis of variance for susceptibility index (SI) of yield and yield components in F1generation.

S.O.V	d.f	Straw yield/plant(g)	Grain yield /plant (g)	Biological yield /plant(g)
Replication	2	0.008	0.030	0.002
Genotypes(G)	20	0.013 *	0.022*	0.014*
Parents(P)	5	0.003	0.030*	0.011
Crosses (Cr	14	0.016 **	0.021	0.016*
P.vs.F1	1	0.016	0.001	0.005
Error	40	0.006	0.011	0.006

*and ** indicates significant at 0.05 and0.01 levels of probability, respectively significant for grain yield / plant. Also, significant mean square for crosses (DSI) was detected for straw and biological yields.

The parental variety Sham6 (P6) seemed to be the best parent for (DSI) of straw yield / plant , but without significant superiority than these of the other parents .Also, the parental combinations P1xP4 gave the desirable (DSI) for stress yield / plant but without significant superiority over these of other crosses except P1xP3 ,P2xP5 P4xP5.(Table 21)

For grain yield / plant, the parental Line 3D (P3) was the high tolerant for stress irrigation but without significant superiority over these of P6 and P5. While, the cross P1xP5 had the high tolerance for stress irrigation treatments for this trait. With the exception of P1xP2, P2xP3, P2xP5, P3xP5, P3xP6, P4xP5, P4xP6 and P5xP6, the other crosses gave the same tolerant for stress irrigation treatment for grain yield / plant (Table 21).

For biological yield / plant, the parental variety P6 had high tolerant to irrigation stress followed by (P5) Gemmiza9 and then by (P3) Line 3D .While, the cross P1xP5 had tolerant to irrigation treatment for this measurement but without significantly superiority over these crosses: P1xP4, P1xP6, P2xP3, P2xP4, P2xP6, P3xP4, P3xP5, and P4xP5.

Combining ability:

Analysis of variance for combining ability for DSI of straw, grain and biological yields is presented in Table (22).

The mean squares associated with general combining ability were insignificant along with significant of specific combining ability for the three DSI measurements of straw,

Table (21): The genotypes mean performance for susceptibility index (SI) of yield and yield components in F1 generation

Genotypes	Straw yield /plant (g)	Grain yield /plant (g)	Biological yield/ plant(g)
P1	0.09	0.30	0.19
P2	0.08	0.35	0.20
P3	0.11	0.19	0.15
P4	0.10	0.46	0.28
P5	0.07	0.24	0.14
P6	0.02	0.23	0.10
P1xP2	0.14	0.37	0.23
P1xP2	0.23	0.42	0.29
P1xP4	0.03	0.23	0.12
P1xP5	0.05	0.15	0.09
P1xP6	0.05	0.26	0.14
P2xP3	0.05	0.20	0.11
P2xP4	0.06	0.22	0.12
P2xP5	0.22	0.41	0.30
P2xP6	0.10	0.29	0.18
P3xP4	0.08	0.31	0.18
P3xP5	0.08	0.34	0.19
P3xP6	0.13	0.33	0.23
P4xP5	0.27	0.41	0.33
P4xP6	0.08	0.33	0.21
P5xP6	0.14	0.33	0.22
Mean parents	0.08	0.30	0.18
Mean crosses	011	0.31	0.20
Mean genotypes	0.10	0.30	0.19
L.S.D 5 %	0.13	0.17	0.13
L.S.D 1 %	0.18	0.23	0.18

N= Normal irrigation D=Stress C = Combined

Table (22):Observed mean squares of general and specific combining ability for susceptibility index (SI) of yield and components in F1 generation.

SOV	Straw yield /plant (g)	Grain yield /plant (g)	Biological yield/ plant(g)
GCA	0.002	0.004	0.002
SCA	0.005*	0.009*	0.006**
Error	0.002	0.004	0.002
G.C.A/S.C.A	0.315	0.414	0.298

*and ** indicates significant at 0.05 and 0.01 levels probability, respectively .

GCA and SCA indicates general and specific combining ability grain and biological yields. It is evident that non –additive of gene action was the more important part of the total genetic variability for these measurements. The genetic variance was previously reported to be mostly due to non additive type of gene action by **El-Borhamy (2000) and El-Gamal (2002).**

General combining ability effects:

Insignificant mean squares GCA for DSI for the three measurements. Consequently, the data were excluded.

Specific combining ability effects:

Specific combining ability effects sij of the parental combinations, computed for drought susceptibility index (DSI) for straw grain and biological yields are presented in Table (23).

For DSI of straw yield / plant, none of the hybrids showed desirable sij effects. Meanwhile, the two crosses P1xP5 and P2xP4 had significant negative (sij) desirable effects for DSI of grain and biological yields. However, the other crosses gave significant positive or insignificant sij effects of DSI for both traits. The previous two crosses were important for breeding, programs for drought resistance.

A stress tolerant genotypes, as defined by DSI values, need not_have a high yield potential sine DSI provides a measure of tolerance based on minimization of yield loss under stress rather than on stress yield per se.

Genotypes identified as stress tolerant using DSI should possess tolerance mechanisms, which may need to be incorporated into germplasm with higher yield potential for development of high yielding and stress tolerant cultivars.

Table (23): Estimates of specific combining ability effects for susceptibility index (SI) of yield and yield components in F1 generation.

Crosses	Straw yield /plant(g)	Grain yield /plant (g)	Biological yield /plant (g)
P1xP2	0.04	0.07	0.05
P1xP3	0.013**	0.14**	0.12 **
P1xP4	- 0.07	- 0.10	- 0. 08
P1xP5	- 0.07	- 0.14*	- 0.10 *
P1xP6	- 0.02	- 0.02	- 0.02
P2xP3	- 0.06	- 0.10	- 0.08
P2xP4	0.05	- 0.13*	- 0.09 *
P2xP5	0.10*	0.10	0.10 *
P2xP6	-0.02	0.00	0.01
P3xP4	- 0.03	- 0.01	- 0.03
P3xP5	0.05	0.05	0.00
P3xP6	0.04	0.06	0.06
P4xP5	0.14**	0.07	0.10 *
P4xP6	0.00	0.00	0.01
P5xP6	0.04	0.04	0.04
LSD5%sij	0.08	0.11	0.08
LSD1% sij	0.11	0.14	0.11
LSD5%sij-sik	0.12	0.16	0.12
LSDs1% sij-sik	0.16	0.22	0.16
LSD5%sij-skI	0.11	0.15	0.11
LSD1%sij-skI	0.15	0.20	0.15

*and ** indicates significant at 0.05 and 0.01 levels of probability, respectively