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EFFECT OF DROUGHT STRESS ON YIELD AND YIELD COMPONENTS OF SOME WHEAT AND TRITICALE GENOTYPES

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ABSTRACT

Two field experiments were conducted at the Experimental Farm of the Faculty of Agriculture, Ain Shams University, "Shalakan", Kalubia Governorate, during the two successive seasons 1997/98 and 1998/99. The study aimed to investigate the performance of twelve bread wheat (*Triticum aestivum,L.*) and triticale (*Triticale hexaoploid,Lart*) genotypes as affected by drought stress at booting stage (S-1) and at heading and early filling stage (S-2) by skipping the second and third irrigation. The results indicated that there were significant differences among all studied genotypes in their yield and yield components. Significant differences were found among the non-stress treatment (S-0) and the stress treatments (S-1 and S-2) for plant height, number of kernels/spike, 100-kernel weight, main spike yield and grain yield/m^2 in both seasons. Treatment S-1 led to decrease plant height, number of kernels/ spike, 100-kernel weight, main spike yield and grain yield/ m^2 by 7.66, 3.59, 8.47 and 13.43% in the first season and by 9.3, 9.59, 3.42, 4.97 and 15.86% in the second season as compared to treatment S-0, respectively. For treatment S-2, the reduction were 3.8, 10.58, 12.11, 14.58 and 25.22% in the first season compared to 4.35, 16.7, 10.09, 12.01 and 32.83% in the second season for the above mentioned traits, respectively. The triticale genotype Bahteem 2, Bahteem 10 and Line 1 as well as the wheat genotypes Giza 164 and Ekhwan surpassed the other genotypes in their grain yield/ m^2 under non-stress and stress treatments in both seasons. Mean values of stress susceptibility index(S) of wheat and triticale genotypes were 0.885 and 1.037, respectively, indicating that wheat genotypes had lower susceptibility to drought stress compared to triticale genotypes.

Key words: Drought stress, Yield and yield components, Wheat, Triticale, Stress susceptibility index

INTRODUCTION

Wheat production in many arid and semi-arid regions of the world depends on limited irrigation resources. Following suitable agricultural practices in addition to breeding new cultivars with less susceptibility to water stress can let wheat cropping sustainable in a such area. In Egypt, the area of cultivated land in the Nile Valley and Delta is very limited. Therefore, it is necessary to increase

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acreage of wheat in newly reclaimed land, since the production of wheat is not enough for human consumption. Under these conditions, drought accompanied by high temperatures occurs frequently later in growth and drastically reduces grain yield.

Relative yield performance of genotypes in drought stressed and more favorable environments seems to be a common starting point in identification of traits related to drought tolerance and selection of genotypes for use in breeding for dry environment. **(Clarke *et al* 1992).**

Water deficits around anthesis may lead to a loss in yield. The effect of drought stress on wheat grain yield may be analyzed in terms of yield components, some of which can assume more importance than others, depending upon the stress intensity and growth stage at which it develops **(Giunta *et al* 1993).** Grain weight is among the most adversely affected traits by post-anthesis drought presumably by reducing assimilate supply to developing grains **(Saadalla, 1994).** Yield in stress environments is dependent upon stress susceptibility, yield potential and stress escape. The susceptibility of a plant genotype to stress is the product of many physiological and morphological characters for which effective selection criteria have not yet been developed **(Fischer and Maurer, 1978).** Therefore, grain yield and its components remain a major selection criterion for improving adaptation to stress environments in many breeding programs **(Ehdaie *et al* 1988). Laing and Fischer (1979)** reported that semi dwarf wheat lines selected under optimal conditions also yield well under moderate stress.

The objectives of this work were a) to detect the effect of drought stress on yield and yield components of a set of wheat and triticale genotypes, b) to define and compare the stress susceptibility index of the different genotypes.

MATERIAL AND METHODS

Two field experiments were conducted at the Experimental Farm of the Faculty of Agriculture, Ain Shams University, "Shalakan", Kalubia Governorate during the two successive seasons 1997/98 and 1998/99, in which drought stress was induced by skipping irrigation at different phenological stages simulating to drought condition that may occur frequently later in growth in newly reclaimed land. The soil texture of the experimental farm was clay loam. The soil contained 1.58 and 1.47% organic matter, 2.9 and 2.7% total nitrogen and 1.18 and 1.19% total phosphorus in 1997/98 and 1998/99 seasons, respectively. Four genotypes of bread wheat (*Triticum aestivum*, L.); i.e. Sakha-8,Gemmeiza-1, Ekhwan and Giza 164 along with eight genotypes of triticale (*Triticale hexaploid*, Lart) ;i.e. Bahteem2 , Line 12, Line 4, Juana, Bahteem 10, Line 1, Line 2 and Line 6 were used in this study. The triticale genotypes, Line 12, Line 1, line 2 and Line 6 were released as new lines selected from two hexaploid triticale crosses which were previously undertaken in the Agronomy Department, Faculty of Agriculture, Ain-Shams University through the pedigree method. The wheat genotypes, Sakha-8, Gemmeiza-1, Ekhwan and Giza 164 as well as the triticale genotypes. Bahteem 2, Line 4, Juana and Bahteem 10 were provided from Agricultural Research Center (ARC, Egypt).

Irrigation treatments were applied or withheld to allow the plants to be non-stressed (S-0) i.e. normal irrigations, stressed during booting stage (S-1) i.e. skipping the second irrigation by witholding irrigation from 60 to 90 days after sowing and stressed during heading and grain filling stage (S-2) i.e. skipping the third irrigation by withholding irrigation from 90-120 days after sowing. The first irrigation in all treatments was practiced 30 days after sowing. The treatments were arranged in a split plot design with three replicates for both wheat and triticale genotypes. The irrigation treatments were distributed in the main plots while the genotypes were arranged in the sub-plots. The experimental unit was 8.75 m^2, consisting of 10 rows each of 20 cm apart and 3.5 m length. To avoid the effect of lateral movement of irrigation water, plots were isolated by leaving 1.5 m wide. Calcium superphosphate (15.5% P_2O_5) was added before sowing. Seeds were sown in hills 20 cm apart on December 3rd and 4th in 1997 and 1998, respectively. Thinning to one plant per hill was practiced after full germination. Nitrogen fertilizer, in the form of urea (46% N), was added before the first irrigation at a rate of 70 Kg N per feddan as a single basal dose. All the other cultural treatments of wheat were followed as usual in the production area.

Observations were recorded at harvest on seven characters, namely plant height, number of spikes/plant, number of spikelets/spike, number of kernels/spike, 100-kernel weight, main spike yield on the basis of 10 randomly chosen plants per plot as well as grain yield/m^2.

The standard analysis of variance procedure of split plot design described by **Snedecor and Cochran (1981)** was followed. The treatment means were compared according to L.S.D test at 5% level of significance.

Stress susceptibility index (S) calculated by the following relationship **(Fischer and Maurer, 1978):**

$y = y_p$ (1-SD) thus $S = (1-y/y_p)/D$.

Where Y is the drought yield ,

y_p is the yield potential (yield in the absence of drought)

and D is the stress or drought intensity ($D = 1 - X/X_p$) where X is the mean stress treatment grain yield and X_p is the mean irrigated grain yield of all the genotypes. The lower the value of S, the greater was its stress resistance.

RESULTS AND DISCUSSION

Response of grain yield and its components

The stress intensities (D) based on relative mean grain yield in stressed treatments compared with non-stressed treatment were 0.135 and 0.254 in the first growing season, 1997/98 compared to 0.153 and 0.332 in the second growing season, 1998/99, respectively.

Analysis of variance for first and second growing seasons indicated significant genotypic differences for all characters measured (Table 1). The genotype, Bahteem 2, of triticale surpassed the other triticale genotypes in grain yield/ m^2 (355.25 g) in the first growing season while the genotype, Line 4 showed the highest grain yield/ m^2 (587.42 g) in the second growing season. Similar results were obtained by **Ehdaie *et al* (1988). Dencie *et al* (2000), Desalegn *et al* (2001) and Merah (2001)** who found significant genotypic differences in grain yield of wheat and triticale genotypes.

Table 1. Average of yield and yield components of wheat and triticale as affected by genotypes (G), stress treatments (ST) and their interaction in 1997/98 season

Genotype	Stress treatment	Plant height (cm)	Number of spikes/ plant	Number of spikelets/ spike	Number of kernels spike	100-kernel weight (g)	Main spike yield (g)	Grain yield/ m^2 (g)
	S-0	118.33	10.0	22.67	71.6	3.66	2.76	344.75
Sakha-8	S-1	107-67	8.67	22.0	65.7	3.55	2.51	289.0
	S-2	109.0	9.0	21.33	55.33	3.41	2.38	230.75
Mean		111.66	9.22	22.0	64.2	3.54	2.55	288.17
	S-0	129.33	11.0	24.33	59.7	3.57	2.54	266.75
Gemmeiza-1	S-1	116.33	8.33	23.0	57.0	3.54	2.50	240.0
	S-2	117.00	10.67	22.33	53.3	3.28	2.32	192.5
Mean		120.88	10.33	23.22	56.7	3.46	2.45	233.10
	S-0	136.33	11.67	28.33	64.7	4.85	2.66	368.5
Ekhwan	S-1	120.67	9.0	28.0	64.0	4.60	2.45	330.75
	S-2	129.67	9.0	28.07	62.3	4.32	2.35	302.5
Mean		128.89	9.89	28.13	63.7	4.59	2.48	333.92
	S-0	137.33	9.33	22.67	63.0	5.12	2.48	365.25
Giza 164	S-1	130.33	8.67	22.67	60.33	5.04	2.30	336.0
	S-2	131.0	8.67	22.67	60.60	4.97	2.20	313.75
Mean		132.88	8.89	22.67	61.33	5.04	2.33	338.38
	S-0	135.0	10.67	34.33	66.0	3.93	2.75	426.5
Bahteem 2	S-1	130.0	8.67	33.0	63.3	3.65	2.53	346.25
	S-2	132.0	8.33	32.67	61.3	3.46	2.21	293.0
Mean		132.33	9.22	33.33	63.53	3.68	2.49	355.25
	S-0	122.33	9.67	24.67	77.6	4.92	2.59	334.25
Line 12	S-1	110.66	8.67	24.67	64.3	4.75	2.39	271.75
	S-2	119.33	8.67	24.66	63.7	4.55	2.37	236.75
Mean		117.44	9.00	24.67	68.5	4.74	2.45	280.92
	S-0	137.33	9.0	34.0	66.0	4.83	2.73	258.25
Line 4	S-1	124.0	8.0	32.0	65.0	4.67	2.55	230.5
	S-2	129.33	8.76	32.67	62.6	3.54	2.38	213.5
Mean		130.22	8.58	32.89	64.53	4.34	2.55	234.10
	S-0	133.67	10.0	29.33	68.36	4.35	3.75	316.75
Juana	S-1	125.67	9.0	29.33	69.0	4.12	3.46	235.75
	S-2	131.67	9.3	27.33	61.3	3.91	3.22	220.50
Mean		130.33	9.43	28.67	66.20	4.13	3.48	257.66

Table 1. Cont.

Genotype	Stress treatment	Plant height (cm)	Number of spikes/ plant	Number of spikelets/ spike	Number of kernels spike	100-kernel weight (g)	Main spike yield (g)	Grain yield/ m^2 (g)
	S-0	133.0	9.0	33.33	66.7	4.67	3.34	384.25
Bahteem 10	S-1	126.0	7.66	32.67	66.7	4.58	2.89	350.75
	S-2	127.67	8.67	32.33	65.3	3.42	2.46	284.50
Mean		128.89	8.44	32.77	66.2	4.22	2.93	339.83
	S-0	136.0	8.33	32.67	76.0	4.69	3.51	371.5
Line 1	S-1	122.0	7.67	30.33	67.33	4.48	3.07	335.5
	S-2	134.00	7.67	31.00	62.7	4.06	3.06	305.0
Mean		130.66	7.89	31.33	68.7	4.41	3.22	337.33
	S-0	119.3	8.67	34.76	67.33	3.97	3.30	224.5
Line 2	S-1	109.3	7.67	30.0	63.6	3.82	3.10	185.75
	S-2	119.0	8.67	32.0	62.0	3.72	2.96	160.0
Mean		115.86	8.33	32.25	64.3	3.83	3.12	190.08
	S-0	109.6	9.3	23.33	75.33	4.94	2.90	240.75
Line 6	S-1	106.6	8.6	23.33	67.33	4.83	2.63	216.75
	S-2	109.0	9.0	23.33	61.90	4.37	2.42	157.5
Mean		108.40	8.96	23.33	68.18	4.71	2.65	205.0
Mean of	S-0	128.97	9.72	28.70	68.47	4.46	2.95	324.33
stress	S-1	119.09	8.38	27.58	64.32	4.30	2.70	280.73
treatments	S-2	124.07	8.86	27.52	61.23	3.92	2.52	242.52
L.S.D. 0.05	ST	1.37	NS	NS	3.20	0.07	0.06	9.5
	G	2.34	0.946	0.77	3.64	0.02	0.22	8.0
	STxG	4.07	1.63	1.32	6.31	0.04	0.23	13.75

NS, not significant at 0.05 level.

Significant differences were found among the non-stress (S-0) and the stress treatments (S-1 and S-2) for plant height, number of kernels/ spike, 100-kernel weight, main spike yield and grain yield/ m^2 in both seasons (Table 1 & 2). Differences in number of day to beginning of heading between wheat and triticale genotypes were 4 and 6 days in season 1 and 2, respectively. Differences between the stress treatments S-1 and S-2 were significant for plant height, 100-kernel weight, main spike yield and grain yield/ m^2 in the first season and for number of kernels/spike, main spike yield and grain yield/ m^2 in the second one. Treatment S-1 led to decrease plant height, number of kernels/spike, 100-kernel weight, main spike yield and grain yield/ m^2 by 7.66, 3.59, 8.47 and 13.43%, in the first season, and by 9.3, 9.59, 3.42, 4.97 and 15.86%, in the second one, lower than those of

Table 2. Average of yield and yield components of wheat and triticale as affected by genotypes (G), stress treatments (ST) and their interaction in 1998/99 season

Genotype	Stress treatment	Plant height (cm)	Number of spikes/ plant	Number of spikelets/ spike	Number of kernels spike	100-kernel weight (g)	Main spike yield (g)	Grain yield/ m² (g)
	S-0	118.33	10.0	22.33	73.3	5.74	3.92	580.25
Sakha-8	S-1	110.0	7.42	20.67	68.7	5.68	3.63	480.0
	S-2	111.7	7.67	21.0	63.7	4.95	3.56	440.25
Mean		113.3	8.36	31.32	68.5	5.45	3.71	500.17
	S-0	121.7	9.0	24.67	87.33	4.78	4.37	593.25
Gemmeiza-1	S-1	111.7	7.0	22.0	78.70	4.65	4.24	551.0
	S-2	116.7	7.17	22.67	70.7	4.24	4.14	427.75
Mean		116.70	7.72	23.11	78.9	4.58	4.25	524.0
	S-0	137.7	7.47	32.73	92.33	6.22	5.72	575.0
Ekhwan	S-1	125.1	6.0	30.0	75.0	5.86	5.29	528.75
	S-2	125.3	6.47	30.0	66.7	4.94	5.13	350.0
Mean		129.6	6.63	30.89	78.0	5.68	5.38	484.58
	S-0	131.0	7.46	22.67	75.33	5.18	3.95	641.75
Giza 164	S-1	123.0	7.16	20.0	64.7	5.04	3.76	527.0
	S-2	122.0	7.38	22.0	62.0	4.97	3.56	352.0
Mean		125.3	7.33	21.56	67.3	5.06	3.76	507.08
	S-0	141.0	7.58	34.67	100.0	5.96	5.83	652.75
Bahteem 2	S-1	127.3	6.33	32.0	93.3	5.54	5.22	503.0
	S-2	140.7	6.67	31.3	91.3	5.24	4.43	476.25
Mean		136.3	6.86	32.65	94.8	5.58	5.16	544.0
	S-0	129.0	7.92	24.67	87.7	5.92	4.87	629.25
Line 12	S-1	119.3	6.53	24.0	76.3	5.72	4.67	485.50
	S-2	123.0	6.67	24.0	66.7	5.41	3.56	434.50
Mean		123.8	7.04	24.22	76.9	5.68	4.36	516.42
	S-0	143.7	8.67	35.0	102.7	4.50	4.73	633.25
Line 4	S-1	122.7	6.83	34.0	94.3	4.29	4.60	598.50
	S-2	141.3	7.17	34.67	71.7	4.13	4.45	538.50
Mean		135.9	7.55	34.55	89.5	4.31	4.59	587.42
	S-0	137.3	8.00	30.67	100.0	5.92	4.71	449.5
Juana	S-1	124.0	7.00	28.67	94.0	5.93	4.44	410.0
	S-2	131.7	7.00	28.67	76.0	4.90	4.24	337.0
Mean		131.0	7.33	29.33	90.0	5.48	4.46	398.83

Table 2. Cont.

Genotype	Stress treatment	Plant height (cm)	Number of spikes/ plant	Number of spikelets/ spike	Number of kernels spike	100-kernel weight (g)	Main spike yield (g)	Grain yield/ m^2 (g)
	S-0	136.0	7.67	34.67	92.0	5.56	5.71	770.0
Bahteem 10	S-1	129.0	6.33	34.0	85.0	5.47	5.73	645.5
	S-2	131.3	6.67	34.0	81.7	5.08	4.83	316.75
Mean		132.1	6.89	34.22	86.23	5.37	5.30	577.41
	S-0	122.7	8.25	33.67	70.33	7.75	4.67	396.0
Line 1	S-1	115.0	6.42	32.33	67.3	5.61	4.47	307.5
	S-2	119.7	7.33	32.67	65.7	5.44	4.28	255.5
Mean		119.0	7.33	32.89	67.8	5.60	4.47	319.66
	S-0	142.3	6.25	32.67	74.33	5.52	4.63	660.5
Line 2	S-1	121.0	6.13	30.0	70.0	5.37	4.48	525.0
	S-2	129.7	6.25	30.66	64.3	5.18	4.33	429.0
Mean		131.0	6.21	31.11	69.5	5.35	4.48	538.17
	S-0	120.7	6.53	24.67	80.0	5.64	4.83	558.0
Line 6	S-1	106.0	5.23	24.00	77.0	5.46	4.62	525.0
	S-2	119.6	6.30	24.29	73.0	5.30	4.35	438.25
Mean		115.4	6.02	24.31	76.8	5.47	4.60	507.08
Mean of	S-0	131.78	7.89	29.17	86.27	5.55	4.83	594.96
stress	S-1	119.52	6.55	27.65	78.00	5.36	4.59	506.56
treatments	S-2	126.05	6.88	27.98	71.86	4.99	4.24	399.64
L.S.D. 0.05	ST	5.87	NS	NS	1.72	1.82	0.28	33.75
	G	3.63	0.53	1.54	2.77	0.09	0.23	25.50
	STxG	6.29	0.92	2.67	4.80	0.17	0.32	48.75

NS, not significant at 0.05 level.

treatment S-0 (non-stressed), respectively. Concerning treatment S-2, the reduction in these characters were 3.8, 10.58, 12.11, 14.58 and 25.22% in the first season compared to 4.35, 16.7, 10.09, 12.01 and 32.83% lower than those on treatment S-0 in the second one (data not shown in tables). Stress during vegetative growth terminating at flowering (S-1) reduced both plant height and grain yield/ m^2 but grain yield/ m^2 was reduced more than plant height. Stress during flowering and filling (S-2) had little effect on plant height but caused grain yield reduction by reducing number of kernels/spike, 100-kernel weight and main spike yield. **Frank *et al* (1987)** found that the number of spikelets/spike was reduced by water stress during development of the juvenile inflorescence.

Since the number of spikes/plant and number of spikelets/spike are the first phenological yield components of wheat and triticale, stress treatments (S-1 and S-2) initiated during the mid plant life cycle would not affect these yield components. Hence, reduction in number of spikes / plant and number of spikelets / spike was not significant in both seasons. This result is in agreement with that obtained by **Eck (1988)** who mentioned that head size was less sensitive to water stress during heading and grain filling. Also, **Shpiler and Blum (1986) and Ehdaie** ***et al*** **(1988)** observed that number of heads/plant was affected least by stress and number of grains/head was affected most. **Fischer and Maurer (1978) and Giunta** ***et al*** **(1993)** also reported that grain number/head was reduced more relative to other yield components as stress severity increased. **Dencie** ***et al*** **(2000)** also found that number of kernels/spike, 1000-kernel weight and especially yield were more sensitive to drought stress in wheat cultivars than plant height and number of spikelets / spike.

Relative productivity (%) was used in this study to detect the differences exist among wheat and triticale genotypes under stress treatments S -1 and S -2 (Table 3). In the first season, the wheat genotype Giza 164 gave the highest relative productivity at S -1 and S -2 (91.99 and 85.90%) indicating its drought tolerance. Whereas, the triticale genotypes line 6 (at S-2) and Juana (at S-1) showed the lowest relative productivity of 65.42 and 74.43%, respectively. For the second season, the triticale genotype line 4 revealed the highest relative productivity at S-1 and S-2 (94.51 and 85.04%) indicating its drought tolerance. On the other hand, the triticale genotypes Bahteem 10 (at S-2) and Bahteem 2 (at S-1) exhibited the lowest relative productivity 41.14 and 77.06%, respectively. These results indicate that, the genotypes Giza 164 and line 4 are more suitable under drought condition and are promising for production under limited irrigation resources.

The interaction between genotypes and stress treatments was significant for all studied characters as shown in Tables (1 & 2). All genotypes exhibited highest grain yield/ m^2 (yield potential) in the non-stress treatment as compared to stress treatments (Tables 1, 2 & 4). Among all genotypes, the triticale genotypes Bahteem 2, Bahteem 10 and Line 1 as well as wheat genotypes, Giza 164 and Ekhwan surpassed the other genotypes in their grain yield/ m^2 under non-stress and stress treatments in both growing seasons, but they differed in their relative ranking (Table 1 & 2). The superiority of these genotypes could be attributed to high 100-kernel weight and/or high main spike yield.

The combined data of the two seasons shown in Table (4) revealed that the grain yield/ m^2 of wheat genotypes as a group, was higher than triticale genotypes under both non-stress and stress treatments. **Sinha** ***et al*** **(1986)** also observed that in irrigated environment (D=O) grain yield of *T. durum* cultivars, as a group, was higher than *T. aestivum*. The latter, in turn had higher yield than triticales. However, in unirrigated environments (D>O), the grain yield of the *durums* was reduced more than the *aestivums* and *triticales*. They also added that *T. aestivum* cultivars at all levels of drought (D>O) maintained the highest grain yield. However, within each group there was considerable variation in yield response.

Table 3. Relative productivity (R.P%) of wheat and triticale genotypes at the stress treatments, S -1 and S-2 in the two growing seasons, 1997/98 and 1998/99.

Genotype	1997/98		1998/99	
	S-1	S-2	S-1	S-2
Sakha-8	83.83	66.93	82.72	75.87
Gemmeiza-1	89.97	72.16	92.88	72.10
Ekhwan	89.75	82.09	91.96	60.87
Giza 164	91.99	85.90	82.12	54.85
Bahteem 2	81.18	68.70	77.06	72.96
Line 12	81.30	70.83	77.16	69.05
Line 4	89.25	82.67	94.51	85.04
Juana	74.43	69.61	91.21	74.97
Bahteem 10	91.28	74.04	83.83	41.14
Line 1	90.31	82.10	77.65	64.52
Line 2	82.74	71.27	79.48	64.95
Line 6	90.03	65.42	94.09	78.54

R.P%, Calculated using the following relationship: R.P%=(Ys/Y) x100 where Ys and Y are stressed and irrigated genotype yield, respectively.

Stress-susceptibility index

A grain yield-based, stress-susceptibility index(S) was used to estimate relative susceptibility to stress because it adjusts for variation in yield due to differences in genotypic yield potential and environmental stress intensity. Low stress susceptibility ($S<1$) is synonymous with higher stress resistance. The S values calculated separately for stress treatments in season 1 and 2, were similar for some genotypes, but quite different for others (Table 4). **Fischer and Maurer (1978), Ehdaie *et al* (1988) and Saadalla (2001)** found reasonable agreement among S values across different experiments in all but a few genotypes. However, **Clarke *et al* (1984)** and **Bruckner and Frohberg (1987)** reported large shifts in the S values across stress environments. They associated this variation with differing genotype maturities and/or genotype x environment interactions.

Bruckner and Frohberg (1987) suggested that the stress-susceptibility index should be calculated separately in different stress environments, and the mean S value be used for differentiating the overall stress resistance of genotypes. They added that genotypes with low values of S are presumed to be drought resistant or tolerant, because they exhibit smaller reductions in yield in stress environment compared with non-stress environment (irrigated conditions) than the mean of all

Table 4. Stress susceptibility index (S) at stress intensity D1 and D2 in the two growing seasons. 1997/98 and 1998/99 as well as mean productivity of wheat and triticale genotypes under non-stressed, stressed, and overall treatments (combined data of season 1 and 2)

Genotype	S					Mean productivity		
	1997/98		1998/99					
	D_1	D_2	D_1	D_2	Mean	Non-stressed	Stressed	Overall
Wheat :								
Sakha-8	1.198	1.302	1.129	0.727	1.089	462.5	360.0	394.17
Gemmeiza-1	0.743	1.069	0.465	0.840	0.786	430.0	352.81	378.54
Ekhwan	0.579	0.705	0.526	1.178	0.747	471.75	778.0	409.25
Giza 164	0.593	0.555	1.169	1.360	0.919	503.5	382.25	422.67
Mean	0.778	0.915	0.822	1.026	0.885	466.94	368.27	401.16
Triticale :								
Bahteem 2	1.394	1.232	1.499	0.814	1.230	539.63	404.63	449.63
Line 12	1.385	1.148	1.493	0.932	1.240	481.75	357.13	398.67
Line 4	0.796	0.682	0.441	0.451	0.593	445.75	393.25	410.75
Juana	1.894	1.196	0.574	0.754	1.105	383.13	300.81	328.25
Bahteem 10	0.646	1.022	1.057	1.773	1.125	577.13	399.38	458.63
Line 1	0.718	0.705	1.461	1.071	0.988	383.75	300.88	328.50
Line 2	1.279	1.131	1.341	1.056	1.202	442.5	324.94	364.12
Line 6	0.738	1.361	0.386	0.646	0.783	399.38	334.36	356.03
Mean	1.106	1.060	1.032	0.937	1.033	456.63	351.92	386.82

D_1= 0.135 and D_2=0.254 in season 1, D_1=o.153 and D_2= 0.332 in season 2 genotypes. The mean S value ranged from 0.593 for the genotype Line 4 to 1.24 for line 12 (Table 4). Mean S values of wheat and triticale genotypes were 0.885 and 1.033, respectively, indicating that wheat genotypes had low susceptibility to stress, while triticale genotypes were relatively stress susceptible. The two genotypes that were least susceptible to stress were triticale genotype Line 4 and wheat genotype Ekhwan, with a mean S values of 0.593 and 0.747, respectively. Similar results were reported by **Sinha *et al* (1986)** who found differences among *aestivums,durums* and *triticales* varieties in respect to drought susceptibility indices and mentioned that *aestivums* (S=0.84) were the most drought resistant followed by *triticales* (S=1.02) with *durums* (S=1.15) the least. They also added that some of the studied varieties showed greatest drought resistance and the other had moderate drought resistance and the remainder were relatively drought susceptible

The association of S with a mean of all studied characters based on combined data of the first and second season either in stress or non-stress treatments were examined and showing non-significant relationships between them (data not shown). On the other hand, the correlation coefficient between mean productivity in non-stress treatment and mean productivity in stress treatment (Table 4) was positive and significant (0.852^{**}), indicating that the relative ranking of genotypes in stress-treatment was similar to that in non-stress treatment with little change in rank order. The stress-susceptibility index and mean productivity was not correlated, indicating that they may be independent components that contribute to adaptation to stress environments. **Ehdaie *et al* (1988)** also found that stress susceptibility was not correlated with non-stressed yield. However, **Fischer and Wood (1979)** mentioned that stress susceptibility was positively correlated with non-stressed yield. This indicates that some characteristics that contribute to yield potential may act to increase susceptibility to stress, and that selection for both S and yield potential (Y_p) may counteract with each other. These differing observations concerning relationship between Y_p and S probably result from the different genotypes that were used and from differences in timing and intensity of stress **(Ehdaie *et al* 1988).**

Stress resistance could be due to high yield potential and/or low susceptibility to stress. Of the eight diverse triticale genotypes examined, Bahteem 2 and Line 12 produced relatively high yield in stress treatment due to high mean productivity (overall treatments) rather than having low susceptibility to stress. In contrast, wheat genotype Gemmeiza-1 had low susceptibility to stress, but did not posses high mean productivity. Among all genotypes, only Giza 164 and Line 4 had both high mean productivity and low stress susceptibility. These results are in similar trend of those obtained using data of relative productivity summarized in Table (3), which confirm that the genotypes Giza 164 and Line 4 are more drought tolerance and could be used as sources of drought stress tolerance in breeding programs and/ or factors increasing general adaptation.

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مجلة حوليات العلوم الزراعية ، كلية الزراعة ، جامعة عين شمس ، القاهرة ، م٤٨ ، ع(١) ، ١١٧-١٢٩، ٢٠٠٣

تأثير الإجهاد الجفافى على المحصول ومكوناته لبعض التراكيب الوراثية من القمح والترتيكال

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أقيمت تجربتان حقليتان بمزرعة كلية الزراعة جامعة عين شمس بشلقان بمحافظة القليوبية خلال موسمى الزراعة ١٩٩٨/٩٧، ١٩٩٩/٩٨ وذلك بهدف دراسة سلوك ٤ تراكيب وراثية من القمح وثمانية تراكيب وراثية من الترتيكال من حيث تأثرها بالإجهاد الجفافى ،عند مرحلة ما قبل طرد السنابل، ومرحلة ما بعد الإزهار، وذلك بتفويت الرية الثانية والثالثة عند هذه المراحل . وقد أوضحت النتائج وجود فروق معنوية بين جميع التراكيب الوراثية تحت الدراسة وذلك لصفات كمية المحصول ومكوناته . كما أظهرت النتائج فروق معنوية بين معاملة الرى العادى (بدون إجهاد) ومعاملات الإجهاد من حيث تأثيرها على صفات ارتفاع النبات، وعدد الحبوب بالسنبلة، ووزن الـ ١٠٠ حبه، ومحصول السنبلة الرئيسية، ومحصول الحبوب للمتر المربع فى الموسمين .

أدت معاملة الإجهاد عند مرحلة ما قبل طرد السنابل الى خفض ارتفاع النبات، وعدد الحبوب بالسنبلة، ووزن الـ ١٠٠ حبة، ومحصول السنبلة الرئيسية، ومحصول النبات للمتر المربع بمقدار ٧,٦٦ ، ٣,٥٩ ، ٨,٤٧ ، ١٣,٤٣% فى الموسم الأول وبمقدار ٩,٣ ، ٩,٥٩ ، ٣,٤٢، ٤,٩٧ ، ١٥,٨٧% فى الموسم الثانى على الترتيب بالمقارنة بمعاملة الرى العادى (بدون إجهاد) ،وقد أدت معاملة الإجهاد عند مرحلة ما بعد الازهار الى خفض هذه الصفات السابقة بمقدار ٣,٨ ، ١٠,٥٨ ، ١٢,١١ ، ١٤.٥٨، ٢٥,٢٢% فى الموسم الأول وبمقدار ٤,٣٥، ١٦,٧ ، ١٠,٠٩ ، ١٢,٠١ ، ٣٢,٨٤% فى الموسم الثانى على الترتيب بالمقارنة بمعاملة الرى العادى . وقد تفوقت التراكيب الوراثية بهتيم ٢ ، وبهتيم ١٠ والسلالة ١٠ من الترتيكال والتراكيب الوراثية جيزة ١٦٤ وأخوان من القمح على التراكيب الوراثية الأخرى فى صفة كمية محصول الحبوب للمتر المربع . كان متوسط قيم دليل الحساسية للعطش ٠,٨٨٥ و ١,٠٣٧ لكل من التراكيب الوراثية للقمح والترتيكال على الترتيب مما يدل على أن التراكيب الوراثية للقمح كانت أقل حساسية للعطش مقارنة بالتراكيب الوراثية للترتيكال .

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