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EVALUATION OF SOME NEW BREAD WHEAT GENOTYPES UNDER DIFFERENT IRRIGATION INTERVALS AND N-FERTILIZATION LEVELS IN SANDY SOILS.

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ABSTRACT

Two field experiments were conducted at El-Bustan region (EL-Behaira Governorate) in 1998/1999 and 1999/2000 seasons to evaluate three new wheat genotypes of bread wheat (*Triticum aestivum,* L.) namely; Gemmeiza 5,Sakha 93 and Giza 168 compared to the two commercial cultivars Sakha 69 and Sids 1 in the sandy soils at three different nitrogen rates (72, 144 and 216 kg N/ha) with four sprinkler irrigation treatments viz., irrigation at 7-day intervals throughout the growing season + increasing the intervals from 7 to 14 days only at either of the three stages of crop growth i.e., from planting to booting, from booting to milk stage and from milk stage to maturity.

Obtained results indicated that irrigation every seven days through the season resulted in the highest grain yield from all tested genotypes. Elongating the interval of irrigation from 7 to 14 days at any of the three growth stages resulted in significant reductions estimated by 19.6, 13.4 and 9.8%, respectively, indicating that the first stage from planting to booting was the most sensitive period for water stress. Yield components; number of spikes/m², number of kernels/spike and 1000-kernel weight were also depressed by elongating the irrigation intervals with reductions being more at the first stage.

Grain yield and yield components of the different genotypes were significantly increased with each successive level of nitrogen application. In addition, differences in grain yield among the tested genotypes were significant. Gemmeiza 5 gave the highest grain yield (5.81 t/ha) but was not significantly different from that produced by Sakha 93. Giza 168 and Sids1 were next to follow whereas, Sakha 69 gave the lowest grain yield (4.61 t/ha).The interactions between the different treatments were significant and the highest yields were produced from cultivars Gemmeiza 5 and Sids 1 irrigated every 7 days throughout the season and fertilized with 216 kgN/ha.

In addition, substantial difference among the genotypes in their response to increasing N fertilizer level was observed. Grain yield response index (GYRI) was highest for cultivar Gemmeiza 5 and lowest for Sakha69. Furthermore, GYRI and water-use efficiency(WUE) were highest when the shortest irrigation interval of 7 days was followed at both the first and the second growth stages and were declined with elongating the intervals at either one of them, particularly in the first stage. Likewise, WUE significantly increased with increasing N application.

Moreover, significant genotypic variation for WUE was obtained and the highest values were achieved from the high-yielding genotypes.

In conclusion, the new cultivars; Gemmeiza 5 followed by Sakha 93 and Giza168 along with the commercial cultivar Sids 1 are highly recommended to be grown in the sandy soil of new reclaimed area of El-Bustan region (El-Behaira Governorate) and for maximum yield, irrigation should be practiced every 7 days and N fertilizer should be applied at a rate of 216 kgN/ha.

INTRODUCTION

Extensive studies on fertilizing and irrigating wheat (*Triticum aestivum,* L.) revealed that both applied N and water are required for substantial yield increases from either variable .For the most efficient use of both of them, the supply of one should be adjusted to that of the other. Mishra *et al.* (1998)reported that plant biomass increased with increasing N rate and irrigation frequency. Also, Singh and Srivastava (1996),Oweis *et al.* (1998) and Ehdaie *et al.* (1999) reported that wheat yield increased by nitrogen application and that the response to N varied with the different genotypes. Meanwhile, Eck (1988), Singh *et al.* (1996), Garabet *et al.* (1998) and Oweis *et al.* (1998) observed increases in yield response to applied N proportional to available soil moisture, whereas Nielsen and Halvorson (1991), Sharma *et al.* (1992) and Sharma and Acharya (1996) showed that sensitivity of wheat grain yield to water uptake was higher at higher N application rates. Also, Ismail and Shehab-El-Din (1992) reported that wheat response to applied water depends on the nitrogen fertilization level..

Nevertheless, there are periods of wheat life cycle during which more frequent irrigation is required (Slatyer, 1969). Rajki (1982) reported that spring wheat plants were extremely sensitive to water stress during tillering and ear formation stages. While, Sharma *et al.* (1992) found that the sensitivity factor for water uptake was higher at the reproductive stage than at the vegetative and maturation stages. Farah (1986) showed that wheat grain yield was highest when irrigation intervals were shortened in all the three growth stages, while increasing the intervals during the second stage (from booting to milk stage) had a more adverse effect on yield . Ravichandran and Mungse (1997), also showed that flowering was the most sensitive growth stage to moisture stress. Whereas, Hassan *et al.* (1987) reported that regular irrigation at 10- days interval produced the highest grain yield as well as number of spikes/m², while moisture stress during crown root initiation and jointing stages reduced the wheat grain yield and was also detrimental to spike number and number of kernels/spike . Eck (1988) also showed that under limited irrigation, preventing stress during tillering and jointing is the best strategy for yield sustainability. It was also indicated that number of seeds/m² was reduced by water stress with reduction being greater at tillering and jointing than at heading and grain filling stages. Mosaad *et al.* (1995) found that number of spikes/plant was decreased significantly with increasing water stress during the pre-heading stages. However, Ahmed (1993) and Ibrahim (1995) reported that wheat could tolerate long irrigation intervals up to 28 days during the vegetative growth stage, and that reasonable grain yields could be obtained if moisture stress is avoided by shorter intervals during the reproductive stages.

In Egypt, there is lack of information about the most efficient combination of irrigation water and fertilizer on growth stages of wheat in the new reclaimed areas. Therefore, this study was undertaken to find out the optimum schedule of watering in relation to N levels for obtaining higher grain yield of wheat in sandy soil.

MATERIALS AND METHODS

A field experiment was conducted in 1998/1999 and repeated in 1999/2000 wheat growing seasons in the new reclaimed area at El-Bustan region, Behaira Governorate to study the response of the following bread wheat genotypes; the two commercial cultivars Sakha 69 and Sids1 and the three newly released cultivars Gemmeiza 5, Sakha 93 and Giza 168 to three different levels of N fertilization with four irrigation intervals. The N levels used were 72, 144 and 216 kg /ha and the four irrigation treatments are listed below as follows:

Irrigation treatments	Irrigation intervals (days) planting to booting stage	booting to milking stage	milking to maturity
I-1	7	7	7
I-2	14	7	7
I-3	7	14	7
I-4	7	7	14

The split-split block design with four replications was used. In this design irrigation treatments were assigned to the main blocks and nitrogen levels to the sub-plot, while the wheat genotypes occupied the sub-sub-plot. The plot size was 4.5 m². The soil of the experimental site is classified as sandy in texture, having low available nitrogen as well as phosphorus and organic matters with pH of 8.2 (Table 1).

The preceding crop was maize in both seasons. During land preparation, 72 kg P_2O_5/ha in the form of mono-ammonium phosphate (15% P_2O_5) and 57 kg K_2O as potassium sulphate (48% K_2O) were broadcasted. Additional dose of 57 kg K_2O/ha was applied at booting stage. Nitrogen fertilizer in the form of ammonium nitrate (33% N) was used. Planting dates were 20 Nov. 1998, and 22 Nov. 1999 in rows spacing 15 cm using 400 seeds/m².

Fixed sprinkler irrigation system was used. After sowing, irrigation was taken place for 2 hrs/day in the first three days to ensure good emergence and plant stand. Afterwards, irrigation treatments were practiced and a measured amount of water was applied at each of subsequent irrigation. The wheat crop was harvested on May 1st, in each season. Yield attributing characters viz., number of spikes/m², number of kernels/spike and 1000 kernel weight, were also investigated along with the grain yield. In addition, water use efficiency (WUE) was worked out as a ratio of produced grain yield (GY) to the total water applied according to Ehdaie and Waines, (1993). Grain yield response index (GYRI) was also calculated as outlined by Fageria and Barbosa Filho (1981):

$$GYRI = \frac{\text{Yield under high N} - \text{yield under low N}}{\text{High N} - \text{low N}}$$

All obtained data were subjected to statistical analyses of variance for each season and to combined analysis for the two seasons according to Steel and Torrie (1980),and treatment means were statistically compared using the test of least significant difference (LSD) .

Table 1: Soil analyses of the experimental sites.

Analysis	Season	
	1998/1999	**1999/2000**
EC mmhos/cm	0.14	0.14
pH	8.2	8.0
ESP	2.52	2.50
CaCO3 %	5.6	5.4
OM %	0.5	0.5
N (ppm)	16.3	16.0
P (ppm)	15.0	16.0
K (ppm)	87.7	89.0
Sand %	89.4	89.0
Silt %	1.1	1.2
Clay %	9.5	9.8
Texture	Sandy	Sandy

RESULTS AND DISCUSSION

The combined analysis for the collected data in the two seasons showed no significant effect for season on all studied traits except number of kernels/spike. Therefore, the average of the two seasons for all studied characters will be discussed.

Irrigation intervals

The results revealed that grain yield of the different genotypes were significantly affected by irrigation treatments in both seasons. Combined analysis showed that irrigation at 7-days interval treatment (I-1) throughout the growing season gave significantly the highest average yield (6.12t/ha), while increasing the intervals of irrigation up to 14 days during the first stage; from planting to booting (I-2) caused the greatest grain yield reduction (19.6%) compared with treatment (I-1), indicating that this stage of crop growth was the most sensitive period for water stress (Tables 2 & 3). This could be expected since that period of growth coincides with the time of initiation of reproductive tillers and spikelet development.

Moreover, Increasing the intervals during the second stage from booting to milk stage (I-3) had a more adverse effect on yield than during the third stage from milk stage to maturity (I-4). However, the differences between the two treatments were not significant in both seasons and combined analysis as well. Based on pooled data, the reductions were 13.4 and 9.8% for the two treatments, respectively as compared with treatment(I-1). This result was in agreement with the findings of Slatyer (1969), Rajki (1982), Farah (1986), Hassan *et al.* (1987) and Mishra *et al.* (1998).

Table (2): Grain yield and other agronomic traits of five wheat cultivars as affected by variation in the irrigation intervals and N fertilization levels at El-Bustan region combined over 1998/1999 and 1999/2000 growing seasons .

Treat.	Grain yield (t/ha)	Spikes no./m²	Kernels no./spike	1000-kernel weight (gm)	WUE (kg/ha/mm)
Irrigation (I)*					
I-1	6.12	470	49.2	50.9	13.0
I-2	4.92	387	44.1	47.0	12.0
I-3	5.30	432	46.2	48.7	12.3
I-4	5.52	442	46.3	48.0	13.1
LSD at 0.05 level	0.28	26.7	1.8	1.6	0.7
Nitrogen (N)					
72 kg N/ha	4.85	388	42.4	45.6	11.2
144 kg N/ha	5.50	435	46.5	48.8	12.7
216 kg N/ha	6.04	475	50.5	51.6	14.0
LSD at 0.05 level	0.08	7.7	1.0	0.7	0.2
Cultivras (C)					
Sids 1	5.58	437	48.2	49.2	12.9
Sakha 69	4.61	384	43.7	45.7	10.7
Sakha 93	5.70	454	44.4	50.9	13.2
Gemmeiza 5	5.81	449	48.5	49.8	13.4
Giza 168	5.62	439	47.5	47.7	13.0
LSD at 0.05 level	0.14	13.9	1.2	1.1	0.3
Interactions					
season	NS	NS	*	NS	NS
I x N	*	*	NS	*	*
I x C	*	*	*	*	*
N x C	NS	NS	*	NS	NS
I x N x C	*	NS	*	NS	*

*** I-1 = Irrigated at 7-day intervals throughout the season, I-2, I-3 and I-4: increasing the intervals only at the first or the second or the third stage of crop growth, respectively.**

The direct depressive effects of increasing the intervals of irrigation at the different growth stages on the yield components could explain the effect of this treatment on grain yield. For instance, number of spikes/m² was markedly reduced with increasing irrigation intervals from 7 to 14 days at the three growth stages; (I-2), (I-3) and (I-4), although, the difference between the two treatments (I-3) and (I-4) was not significant. These reductions were

Table 3: Grain yield of five wheat cultivars (t/ha) as affected by variation in the irrigation intervals and N fertilization levels at El-Bustan region .

Irri. Treat.	N level Kg/ha	Sids 1	Sakha 69	Sakha 93	Gemm. 5	Giza 168	Average	Sids 1	Sakha 69	Sakha 93	Gemm. 5	Giza 168	Average
		1998/1999						**1999/2000**					
I-1	72	5.72	5.06	5.58	6.01	5.84	5.64	5.25	4.39	5.33	5.32	5.78	5.21
	144	5.96	5.78	6.72	7.25	6.27	6.40	5.72	4.75	5.44	6.80	6.41	5.82
	216	6.88	6.44	6.81	7.91	6.68	6.95	7.46	5.18	6.51	7.19	7.07	6.68
Average		6.19	5.76	6.37	7.06	6.26	6.33	6.14	4.77	5.76	6.44	6.42	5.91
I-2	72	4.15	4.76	4.51	4.34	4.10	4.37	3.86	3.61	4.57	5.09	4.74	4.37
	144	5.12	4.67	5.00	4.67	5.33	4.96	4.71	4.00	5.76	6.00	4.93	5.08
	216	5.64	4.51	5.60	5.74	5.14	5.33	5.09	4.14	5.88	6.33	5.52	5.39
Average		4.97	4.64	5.04	4.92	4.86	4.89	4.56	3.92	5.40	5.81	5.06	4.95
I-3	72	5.43	4.27	5.12	4.78	5.29	4.98	4.73	3.07	4.93	5.55	4.45	4.55
	144	5.97	4.77	5.69	5.24	5.48	5.43	5.64	3.27	5.21	6.19	5.62	5.19
	216	6.20	5.26	6.32	5.76	5.46	5.80	6.14	4.11	6.29	6.31	6.41	5.85
Average		5.87	4.77	5.71	5.26	5.41	5.40	5.51	3.48	5.48	6.01	5.49	5.19
I-4	72	5.55	4.41	5.52	4.57	4.82	4.97	5.02	3.54	5.09	4.62	5.33	4.72
	144	5.76	5.31	6.40	5.94	5.22	5.73	5.54	4.54	5.69	5.07	5.96	5.36
	216	6.11	5.94	6.41	6.42	6.31	6.24	6.14	4.89	6.31	6.40	6.79	6.11
Average		5.81	5.22	6.11	5.64	5.45	5.65	5.57	4.32	5.70	5.36	6.03	5.39
	72	5.21	4.63	5.18	4.92	5.01	4.99	4.71	3.65	4.98	5.15	5.07	4.71
	144	5.70	5.13	5.95	5.78	5.58	5.63	5.40	4.14	5.53	6.02	5.73	5.36
	216	6.21	5.54	6.29	6.46	5.90	6.08	6.21	4.58	6.25	6.56	6.45	6.01
Average		5.71	5.10	5.81	5.72	5.50	5.57	5.44	4.12	5.58	5.91	5.75	5.36
CV%		7.12						10.5					
LSD at 0.05 level for													
Irrigation (I)			0.35							0.48			
Nitrogen (N)			0.14							0.09			
I x N			NS							0.17			
Cultivars (C)			0.16							0.22			
I x C			0.32							0.45			
N x C			0.27							NS			
I x C x N			0.55							NS			
		Combined						**GYRI**					
I-1	72	5.48	4.73	5.45	5.67	5.81	5.43						
	144	5.84	5.26	6.08	7.02	6.34	6.11						
	216	7.17	5.81	6.66	7.55	6.88	6.81						
Average		6.17	5.27	6.06	6.75	6.34	6.12	11.7	7.5	8.4	13.1	7.4	9.6
I-2	72	4.00	4.19	4.54	4.72	4.42	4.37						
	144	4.92	4.33	5.38	5.34	5.13	5.02						
	216	5.37	4.32	5.74	6.03	5.33	5.36						
Average		4.76	4.28	5.22	5.36	4.96	4.92	9.5	0.9	8.3	9.1	6.3	6.9
I-3	72	5.08	3.67	5.02	5.16	4.87	4.76						
	144	5.81	4.02	5.45	5.71	5.55	5.31						
	216	6.17	4.68	6.30	6.03	5.93	5.83						
Average		5.69	4.13	5.59	5.64	5.45	5.30	7.6	7.0	8.9	6.0	7.4	7.4
I-4	72	5.29	3.97	5.31	4.59	5.07	4.84						
	144	5.65	4.92	6.04	5.01	5.59	5.54						
	216	6.13	5.42	6.34	6.41	6.55	6.17						
Average		5.69	4.77	5.90	5.50	5.74	5.52	5.8	10.1	7.2	12.6	10.3	9.2
	72	4.96	4.14	5.08	5.03	5.04	4.85						
	144	5.55	4.64	5.74	5.90	5.65	5.50						
	216	6.21	5.06	6.27	6.51	6.17	6.04						
Average		5.58	4.61	5.70	5.81	5.62	5.46	8.7	6.4	8.3	10.3	7.8	8.3
CV%		8.9											
LSD at 0.05 level for													
Season (S)			NS										
Irrigation (I)			0.28										
Nitrogen (N)			0.08										
I x N			0.17										
Cultivars (C)			0.14										
I x C			0.27										
N x C			NS										
I x C x N			0.48										

I-1 = Irrigated at 7-days interval throughout the season, I-2, I-3 and I-4: increasing the intervals only at the first or the second or the third stage of crop growth, respectively.

estimated by 17.7, 8.1 and 6.0% for the three stages, respectively, comparing to that obtained at 7-day intervals (I-1) which had significantly the highest average number of spikes/m² (Tables 2 & 3a). Logically, treatment (I-2) would have the reduced number of spikes due to plants being stressed during tillering, while treatments (I-3) and (I-4) had statistically similar spike numbers since irrigation intervals being the same during that period. This result was in harmony with the findings obtained by Hassan *et al.* (1987) and Mosaad *et al*. (1995).

The same trend was observed with respect to number of kernels/spike. Increasing the intervals of irrigation at the different growth stages reduced kernel numbers in both years. Averaged over the two years data, treatments (I-3) and (I-4) resulted in producing statistically similar numbers of kernels/spike with reductions being less than that from treatment (I-2) as compared to treatment (I-1)where the highest number of kernels was obtained (Tables 2 & 3b). These results are confirmed by those obtained by Hassan *et al.* (1987) and Eck (1988).

Significant differences among the different irrigation treatments with respect to 1000-kernel weight were also indicated in both seasons. Regular irrigation at 7-day intervals throughout the season gave significantly the heaviest 1000-kernel weight. Elongation of irrigation intervals, at the first stage resulted in remarkable reduction in kernel weight comparing to the reduction caused by the water stress in the second or the third growth stage (Tables 2 & 3c). Similar results were obtained by Hassan *et al.* (1987).

Nitrogen levels

The mean grain yield of the different genotypes significantly increased with each successive level of N applied, as it was 4.85, 5.50 and 6.04 t/ha for the three N levels (72, 144 and 216 kg/ha), respectively. The grain yield increment was estimated by 13.4 and 9.8% for the two high nitrogen levels, respectively, (Tables 2 & 3). This might be attributed to increased values of yield components; number of spikes/m², number of kernels/spike and 1000-kernel weight as indicated from Tables (2, 3-a, b and c.)

The respective average increase for those characters due to the increased N levels were 12.1 & 9.2%; 9.7 &8.6 % and 7.0 & 5.7%, respectively. These findings are supported by the results of Eck (1988), Nielsen and Halvorson (1991), Shehab El-Din (1993), Mishra *et al.* (1998), Oweis *et al.* (1998) and Ehdaie *et al.* (1999).

Substantial difference among the tested genotypes in their response to increasing N fertilizer levels was also observed. Gemmeiza 5 recorded the highest grain yield response index value (10.3), while Sakha 69 gave the lowest value (6.4) with increasing nitrogen level from 72 to 216 kg /ha, (Table 3). Singh and Srivastava (1996), Oweis *et al.* (1998)and Ehdaie *et al.*.(1999) came to the same conclusion.

Table 3a: Means of number of spikes/m² of five wheat cultivars as affected by variation in the irrigation intervals and N fertilization levels at El-Bustan region.

Irri. Treat.	N level Kg/ha	Sids 1	Sakha 69	Sakha 93	Gemm. 5	Giza 168	Average	Sids 1	Sakha 69	Sakha 93	Gemm. 5	Giza 168	Average
				1998/1999						**1999/2000**			
I-1	72	419	379	508	428	431	433	443	398	434	430	425	428
	144	462	422	504	509	500	479	493	435	479	479	443	466
	216	495	430	522	563	523	507	529	452	533	520	493	505
Average		459	410	511	500	485	473	488	429	482	479	454	466
I-2	72	367	331	349	345	375	353	316	283	407	398	353	351
	144	375	385	396	367	403	385	390	305	428	416	426	393
	216	462	391	406	394	399	410	431	308	449	486	471	429
Average		401	369	383	369	392	383	379	299	428	433	417	391
I-3	72	374	367	403	411	433	398	339	260	438	411	416	373
	144	481	416	471	402	461	446	398	314	475	470	438	411
	216	478	503	500	487	415	476	448	342	542	574	493	480
Average		444	428	458	433	436	440	395	305	485	485	449	424
I-4	72	383	366	369	349	407	375	416	345	384	448	362	391
	144	495	465	469	354	442	445	461	398	429	511	438	448
	216	512	499	522	470	478	496	524	421	488	533	515	496
Average		463	443	453	391	442	439	467	388	434	497	438	445
	72	386	361	407	384	411	390	378	321	416	424	389	386
	144	453	422	460	408	452	439	436	363	453	469	437	431
	216	487	456	487	478	454	472	483	381	503	528	493	478
Average		442	413	451	423	439	434	433	355	457	474	439	432
CV%		8.5						13.7					
LSD at 0.05 level for													
Irrigation (I)			18.6							54.4			
Nitrogen (N)			10.8							11.1			
I x N			21.8							NS			
Cultivars (C)			14.7							23.6			
I x C			29.4							47.3			
N x C			25.4							NS			
I x C x N			50.1							NS			
				Combined									
I-1	72	431	389	471	433	428	430						
	144	477	429	491	494	472	473						
	216	512	441	527	541	509	506						
Average		473	420	496	490	469	470						
I-2	72	341	307	378	372	364	352						
	144	383	345	412	391	415	389						
	216	446	349	427	440	435	420						
Average		390	334	406	401	405	387						
I-3	72	357	314	421	411	424	385						
	144	439	365	473	436	450	433						
	216	463	422	521	530	454	478						
Average		420	367	472	459	443	432						
I-4	72	399	355	376	398	384	383						
	144	478	432	449	433	440	446						
	216	518	460	505	502	496	496						
Average		465	416	444	444	440	442						
	72	382	341	411	404	400	388						
	144	444	392	456	438	444	435						
	216	485	418	495	503	474	475						
Average		437	384	454	449	439	433						
CV%		11.0											
LSD at 0.05 level for													
Season (S)			NS										
Irrigation (I)			26.7										
Nitrogen (N)			7.7										
I x N			15.3										
Cultivars (C)			13.9										
I x C			27.9										
N x C			NS										
I x C x N			NS										

I-1 = Irrigated at 7-day intervals throughout the season, I-2, I-3 and I-4: increasing the intervals only at the first or the second or the third stage of crop growth, respectively.

Table 3b. Means of number of kernels/spike of five wheat cultivars as affected by variation in the irrigation intervals and N fertilization levels at El-Bustan region.

Irri. Treat.	N level Kg/ha	Sids 1	Sakha 69	Sakha 93	Gemm. 5	Giza 168	Average	Sids 1	Sakha 69	Sakha 93	Gemm. 5	Giza 168	Average
				1998/1999						**1999/2000**			
I-1	72	46.8	48.0	49.2	42.3	37.8	44.8	44.8	48.0	41.5	42.8	47.0	44.8
	144	45.0	47.1	49.5	48.3	48.6	47.7	48.0	49.3	46.0	47.8	55.3	49.3
	216	55.5	48.0	51.9	59.1	54.6	53.8	53.5	52.5	50.3	55.8	61.0	53.6
Average		49.1	47.7	50.2	49.9	47.0	48.8	48.8	49.9	45.9	48.8	54.4	50.0
I-2	72	45.0	39.0	43.5	44.4	45.0	43.4	41.5	30.0	39.0	39.0	40.0	37.9
	144	52.2	39.6	49.5	51.6	45.0	47.6	46.5	30.8	42.5	41.3	46.8	41.6
	216	52.2	41.1	48.0	53.1	46.8	48.2	51.0	34.3	48.8	45.3	55.0	46.9
Average		49.8	39.9	47.0	49.7	45.6	46.4	46.3	31.8	43.4	41.8	47.3	42.1
I-3	72	46.5	45.6	39.6	48.0	43.8	44.7	42.3	38.5	38.8	44.8	39.5	40.8
	144	48.9	45.6	42.0	54.6	43.8	47.0	49.0	43.8	41.5	49.0	49.3	46.1
	216	48.0	49.5	43.8	52.8	43.5	47.5	53.3	46.5	51.0	53.3	50.5	50.9
Average		47.8	46.9	41.8	51.8	43.7	46.4	48.2	42.9	43.8	49.0	45.8	45.9
I-4	72	41.4	42.6	42.6	45.0	41.4	42.6	44.0	40.5	33.5	39.8	43.0	40.2
	144	42.6	49.5	46.8	54.0	46.8	47.9	45.5	44.3	37.5	47.5	51.3	45.2
	216	60.6	48.3	46.2	55.2	54.3	52.9	52.0	45.8	43.5	49.5	53.0	48.8
Average		48.2	46.8	45.2	51.4	47.5	47.8	47.2	43.5	38.2	45.6	49.1	44.7
	72	44.9	43.8	43.7	44.9	42.0	43.9	43.1	39.3	38.2	41.6	42.4	40.9
	144	47.2	45.5	47.0	52.1	46.1	47.6	47.3	42.0	41.9	46.4	50.1	45.5
	216	54.1	46.7	47.5	55.1	49.8	50.6	52.4	44.8	48.4	50.9	54.9	50.3
Average		48.7	45.3	46.1	50.7	46.0	47.4	47.6	42.0	42.8	46.3	49.1	45.6
CV%		9.0						9.4					
LSD at 0.05 level for													
Irrigation (I)			NS							3.2			
Nitrogen (N)			1.1							0.7			
I x N			2.2							NS			
Cultivars (C)			1.3							1.7			
I x C			2.6							3.4			
N x C			3.0							NS			
I x C x N			5.8							NS			
				Combined									
I-1	72	45.8	48.0	45.4	42.5	42.4	44.8						
	144	46.5	48.2	47.8	48.0	51.2	48.5						
	216	54.5	50.3	51.1	57.4	57.8	54.2						
Average		48.9	48.8	48.1	49.3	50.7	49.2						
I-2	72	43.3	34.5	41.3	41.7	42.5	40.6						
	144	49.4	35.2	46.0	46.4	45.9	44.6						
	216	51.6	37.7	48.4	49.2	50.9	47.5						
Average		48.1	35.8	45.2	45.8	46.4	44.1						
I-3	72	44.4	42.1	39.2	46.4	41.7	42.7						
	144	49.0	44.7	41.8	51.8	45.5	46.5						
	216	50.6	48.0	47.4	53.0	47.0	49.2						
Average		48.0	44.9	42.8	50.4	44.7	46.2						
I-4	72	42.7	41.6	38.1	42.4	42.2	41.4						
	144	44.1	46.9	42.2	50.8	49.0	46.6						
	216	56.3	47.0	44.9	52.4	53.7	50.8						
Average		47.7	45.2	41.7	48.5	48.3	46.3						
	72	44.0	41.5	41.0	43.2	42.2	42.4						
	144	47.2	43.7	44.4	49.3	48.1	46.5						
	216	53.3	45.7	47.9	53.0	52.3	50.5						
Average		48.2	43.7	44.4	48.5	47.5	46.4						
CV%		9.2											
LSD at 0.05 level for													
Season (S)			0.06										
Irrigation (I)			1.8										
Nitrogen (N)			1.0										
I x N			NS										
Cultivars (C)			1.2										
I x C			2.4										
N x C			2.1										
I x C x N			4.2										

I-1 = Irrigated at 7-days interval throughout the season, I-2, I-3 and I-4: increasing the intervals only at the first or the second or the third stage of crop growth, respectively.

Table 3c: Means of 1000-kernel weight (gm) of five wheat cultivars as affected by variation in the irrigation intervals and N fertilization levels at El-Bustan region.

Irri. Treat.	N level Kg/ha	Sids 1	Sakha 69	Sakha 93	Gemm. 5	Giza 168	Average	Sids 1	Sakha 69	Sakha 93	Gemm. 5	Giza 168	Average
				1998/1999						**1999/2000**			
I-1	72	49.0	51.5	51.3	50.5	50.8	50.6	46.5	47.7	45.0	48.3	47.4	47.0
	144	48.3	51.5	53.0	52.5	51.0	51.3	51.0	48.3	48.3	51.9	49.2	50.0
	216	51.3	53.3	56.0	53.0	50.8	52.9	53.7	50.4	56.4	53.1	55.2	53.8
Average		49.5	52.1	53.4	52.0	50.8	51.6	50.4	48.8	49.9	51.1	50.6	50.2
I-2	72	45.3	48.3	48.5	47.5	43.0	46.5	44.1	33.9	43.5	44.7	39.0	41.0
	144	47.3	51.8	52.0	49.3	44.5	49.0	50.1	37.8	46.2	49.2	43.8	45.4
	216	50.3	52.0	55.0	48.3	54.3	52.0	53.4	39.3	50.4	51.9	46.8	48.4
Average		47.6	50.7	51.8	48.3	47.3	49.1	49.2	37.0	46.7	48.6	43.2	44.9
I-3	72	47.0	45.5	50.0	48.5	45.5	47.3	41.1	36.0	43.8	44.7	41.1	41.3
	144	58.5	46.5	54.3	51.0	46.5	51.4	49.5	42.3	49.8	50.4	45.6	47.5
	216	57.5	54.0	54.3	47.3	47.3	52.1	54.3	47.1	58.8	51.6	52.5	52.9
Average		54.3	48.7	52.8	48.9	46.4	50.2	48.3	41.8	50.8	48.9	46.4	47.2
I-4	72	44.5	44.5	47.5	49.3	46.3	46.4	44.7	39.0	47.4	45.3	45.6	44.4
	144	51.3	45.0	53.0	50.5	48.5	49.7	48.6	38.1	49.2	49.2	47.7	46.6
	216	44.3	48.5	55.0	54.0	49.3	50.2	50.4	45.3	52.2	53.4	52.5	50.8
Average		46.7	46.0	51.8	51.3	48.0	48.8	47.9	40.8	49.6	49.3	48.6	47.2
	72	46.4	47.4	49.3	48.9	46.4	47.7	44.1	39.2	44.9	45.8	43.3	43.4
	144	51.3	48.7	53.1	50.8	47.6	50.3	49.8	41.6	48.4	50.2	46.6	47.3
	216	50.8	51.9	55.1	50.6	50.4	51.8	53.0	45.5	54.5	52.5	51.8	51.4
Average		49.5	49.4	52.5	50.1	48.1	50.0	49.0	42.1	49.3	49.5	47.2	47.4
CV%		7.2						9.4					
LSD at 0.05 level for													
Irrigation (I)			0.9								3.3		
Nitrogen (N)			1.4								1.1		
I x N			2.8								2.2		
Cultivars (C)			1.1								1.8		
I x C			NS								3.6		
N x C			NS								NS		
I x C x N			5.0								NS		
				Combined									
I-1	72	47.8	49.6	48.1	49.4	49.1	48.8						
	144	49.6	49.9	50.7	52.2	50.1	50.5						
	216	52.5	51.8	56.2	53.1	53.0	53.3						
Average		50.0	50.4	51.7	51.6	50.7	50.9						
I-2	72	44.7	41.1	46.0	46.1	41.0	43.8						
	144	48.7	44.8	49.1	49.2	44.2	47.2						
	216	51.8	45.7	52.7	50.1	50.5	50.2						
Average		48.4	43.8	49.3	48.5	45.2	47.0						
I-3	72	44.1	40.8	46.9	46.6	43.3	44.3						
	144	54.0	44.4	52.0	50.7	46.1	49.4						
	216	55.9	50.6	56.5	49.4	49.9	52.5						
Average		51.3	45.2	51.8	48.9	46.4	48.7						
I-4	72	44.6	41.8	47.5	47.3	45.9	45.4						
	144	49.9	41.6	51.1	49.9	48.1	48.1						
	216	47.3	46.9	53.6	53.7	50.9	50.5						
Average		47.3	43.8	50.7	50.3	48.3	48.0						
	72	45.3	43.3	47.1	47.3	44.8	45.6						
	144	50.6	45.2	50.7	50.5	47.1	48.8						
	216	51.9	48.7	54.8	51.6	51.1	51.6						
Average		49.2	45.7	50.9	49.8	47.7	48.7						
CV%		8.3											
LSD at 0.05 level for													
Season (S)			NS										
Irrigation (I)			1.6										
Nitrogen (N)			0.7										
I x N			1.4										
Cultivars (C)			1.1										
I x C			2.3										
N x C			NS										
I x C x N			NS										

I-1 = Irrigated at 7-days interval throughout the season, I-2, I-3 and I-4: increasing the intervals only at the first or the second or the third stage of crop growth, respectively.

Genotypes

Significant differences in grain yield among the tested wheat genotypes were also observed. Gemmeiza 5 produced the highest grain yield (5.81 t/ha), being at par with Sakha 93 (5.70 t/ha) and was significantly more than the other genotypes, (Tables 2 & 3). This might be attributed to their higher values of number of spikes/m², kernels/spike and 1000-kernel weight. Giza 168 and Sids 1 ranked the third and fourth with a non-significant difference between their grain yields being 5.62 and 5.58 t/ha receptively. While, Sakha 69 produced the lowest grain yield, (4.61t/ha)which might be due to its lowest yield attributing characters; number of spikes/m², number of kernels/spike and 1000-kernel weight as compared with the other genotypes Tables 2, 3-a, b and c.

Concerning the significance of the interaction among the studied treatments (INC), the highest yields were achieved from cultivars Gemmeiza 5 and Sids 1 by irrigation at 7-day intervals and fertilized with 216 kg N/ha. This result was in agreement with those obtained by Ahmed (1993), El-Naggar (1997), Singh and Sharma (1997) and Singh *et al.* (1998).

Regarding the grain yield response index (GYRI), the results showed that the highest value (9.6) was obtained with the regular irrigation at 7-day intervals (I-1), whereas the lowest value of (6.9) was obtained with increasing the irrigation intervals during the first stage of crop growth (I-2) . Treatments (I-1 and I-4) had almost equal values of GYRI as they were 9.6 and 9.2 for the two treatments, respectively, while that of treatment (I-3), was 7.4 (Table 3). Garabet *et al.* (1998) found that nitrogen fertilizer use efficiency (NFUE) was highest before anthesis, and it was increased by higher rainfall and irrigation. This might explain the obtained results regarding the decline in GYRI values with increasing the irrigation intervals either at the first stage (I-2) or at the second one(I-3), while the higher values were obtained with the treatments where the shortest intervals of 7 days were followed at both stages (I-1 and I-4).

Water use efficiency

The results revealed that water use efficiency (WUE) was influenced by the different treatments of irrigation intervals although the differences were not significant in the second season of the study. The highest WUE values were obtained when the shortest intervals was followed at the first two stages, while a significant reduction occurred with increasing the irrigation intervals at either one of them, more so at the first stage than at the second one (Table 4). The lowest WUE value was obtained from the treatment (I-2), which also resulted in the lowest grain yield. Similar results were also reported by Eck (1988) and Ahmed (1993).

Table 4: Water-use efficiency (kg/ha/mm) of five wheat cultivars as affected by variation in the irrigation intervals and N fertilization levels at El-Bustan region.

Irri. Treat.	N level Kg/ha	Sids 1	Sakha 69	Sakha 93	Gemm. 5	Giza 168	Average	Sids 1	Sakha 69	Sakha 93	Gemm. 5	Giza 168	Average
		1998/1999						**1999/2000**					
I-1	72	12.2	10.8	11.9	12.8	12.4	12.0	11.2	9.3	11.3	11.3	12.3	11.1
	144	12.7	12.3	14.3	15.4	13.3	13.6	12.2	10.1	11.6	14.5	13.6	12.4
	216	14.6	13.7	14.5	16.8	14.2	14.8	15.9	11.0	13.8	15.3	15.0	14.2
Average		13.2	12.3	13.5	15.0	13.3	13.5	13.1	10.2	12.3	13.7	13.7	12.6
I-2	72	10.1	11.6	11.0	10.6	10.0	10.7	9.4	8.8	11.2	12.4	11.6	10.7
	144	12.5	11.4	12.2	11.4	13.0	12.1	11.5	9.8	14.1	14.6	12.0	12.4
	216	13.8	11.0	13.7	14.0	12.5	13.0	12.4	10.1	14.3	15.4	13.5	13.2
Average		12.1	11.3	12.3	12.0	11.8	11.9	11.1	9.6	13.2	14.2	12.3	12.1
I-3	72	12.6	9.9	11.9	11.1	12.3	11.6	11.0	7.1	11.5	12.9	10.3	10.6
	144	13.9	11.1	13.2	12.2	12.7	12.6	13.1	7.6	12.1	14.4	13.1	12.1
	216	14.4	12.2	14.7	13.4	12.7	13.5	14.3	9.6	14.6	14.7	14.9	13.6
Average		13.6	11.1	13.3	12.2	12.6	12.6	12.8	8.1	12.7	14.0	12.8	12.1
I-4	72	13.2	10.5	13.2	10.9	11.5	11.8	12.0	8.4	12.1	11.0	12.7	11.2
	144	13.7	12.6	15.2	14.1	12.4	13.6	13.2	10.8	13.5	12.1	14.2	12.8
	216	14.5	14.1	15.3	15.3	15.0	14.9	14.6	11.7	15.0	15.2	16.2	14.5
Average		13.8	12.4	14.5	13.4	13.0	13.4	13.3	10.3	13.6	12.8	14.3	12.8
	72	12.0	10.7	12.0	11.3	11.5	11.5	10.9	8.4	11.5	11.9	11.7	10.9
	144	13.2	11.9	13.7	13.3	12.9	13.0	12.5	9.6	12.8	13.9	13.2	12.4
	216	14.3	12.8	14.5	14.9	13.6	14.0	14.3	10.6	14.5	15.2	14.9	13.9
Average		13.2	11.8	13.4	13.2	12.7	12.8	12.6	9.5	12.9	13.7	13.3	12.4
CV%		7.2						10.7					
LSD at 0.05 level for													
Irrigation (I)			0.9							NS			
Nitrogen (N)			0.3							0.20			
I x N			NS							0.40			
Cultivars (C)			0.4							0.53			
I x C			0.7							1.06			
N x C			NS							NS			
I x C x N			1.3							NS			
		Combined											
I-1	72	11.7	10.1	11.6	12.1	12.4	11.5						
	144	12.4	11.2	12.9	14.9	13.4	13.0						
	216	15.3	12.4	12.2	16.1	14.6	14.5						
Average		13.1	11.2	12.9	14.4	13.5	13.0						
I-2	72	9.8	10.2	11.1	11.5	10.8	10.7						
	144	12.0	10.6	13.1	13.0	12.5	12.2						
	216	13.1	10.5	14.0	14.7	13.0	13.1						
Average		11.6	10.4	12.7	13.1	12.1	12.0						
I-3	72	11.8	8.5	11.7	12.0	11.3	11.1						
	144	13.5	9.4	12.7	13.3	12.9	12.3						
	216	14.4	10.9	14.7	14.0	13.8	13.5						
Average		13.2	9.6	13.0	13.1	12.7	12.3						
I-4	72	12.6	9.5	12.6	10.9	12.1	11.5						
	144	13.5	11.7	14.4	13.1	13.3	13.2						
	216	14.6	12.9	15.1	15.3	15.6	14.7						
Average		13.5	11.4	14.1	13.1	13.7	13.1						
	72	11.5	9.6	11.8	11.6	11.6	11.2						
	144	12.8	10.7	13.3	13.6	13.1	12.7						
	216	14.3	11.7	14.5	15.0	14.3	14.0						
Average		12.9	10.7	13.2	13.4	13.0	12.6						
CV%		9.1											
LSD at 0.05 level for													
Season (S)			NS										
Irrigation (I)			0.7										
Nitrogen (N)			0.2										
I x N			0.4										
Cultivars (C)			0.3										
I x C			0.6										
N x C			NS										
I x C x N			1.1										

I-1 = Irrigated at 7-days interval throughout the season, I-2, I-3 and I-4: increasing the intervals only at the first or the second or the third stage of crop growth, respectively.

Water-use efficiency of the different genotypes was significantly increased with increments of N-level in all irrigation treatments (Table 4). WUE was 11.2 and 14.0 kg/ha/mm for the lowest and highest N-levels, respectively. The increase in WUE due to nitrogen application was probably because nitrogen fertilization increase proportionately much more leaf area, and photosynthetic activity of plants than water loss. Similar results were obtained by Eck (1988), Nielsen and Halvorson (1991) and Singh *et al.* (1996). The results also showed that there was significant difference among the tested genotypes for WUE. Gemmeiza 5 recorded the highest WUE value, which was not significantly different from that obtained for Sakha 93. Moreover, Giza 168 and Sids 1 were statistically at par and were next to follow, whereas Sakha 69 gave the lowest WUE value (Table 4). Significant genotypic variation for WUE was also reported by Ahmed (1993), Ehdaie (1995) and Oweis *et al.* (1998).

Based on these results, the new cultivars, Gemmeiza 5 followed by Sakha 93 and Giza 168 along with the commercial cultivar Sids 1 are highly recommended to be grown in the sandy soil of new reclaimed area of El-Bustan region (El-Behaira Governorate) and for maximum, yield irrigation should be practiced every 7 days and N fertilizer should be applied at a rate of 216 kg N/ha.

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تقييم بعض التراكيب الوراثية الجديدة لقمح الخبز تحت فترات مختلفة من الرى ومعدلات التسميد النتروجيين فى الأراضى الرملية .

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أقيمت تجربتان فى الأراضى الرملية بمنطقة البستان بمحافظة البحيرة خلال موسمى ١٩٩٨/١٩٩٩ و ٢٠٠٠/١٩٩٩ بهدف تقييم ثلاثة تراكيب وراثية جديده من قمح الخبز وهى جميزة ٥ وسخا ٩٣ وجيزة ١٦٨ بالمقارنة مع الصنفين التجاريين سخا ٦٩ وسدس ١ تحت ثلاثة مستويات من التسميد النيتروجينى (٧٢, ١٤٤, ٢١٦ كجم/ن/هكتار) وأربع معاملات لفترات الرى وذلك بالرى كل ٧ أيام طوال موسم النمو فى احداها وزيادة فترات الرى الى ١٤ يوماً خلال أىّ من مراحل النمو التالية على الترتيب وهى من الزراعة الى طور الحمل، ومن الحمل الى الطور اللبنى، ومن الطور اللبنى حتى النضج .

ولقد أشارت نتائج الدراسة الى وجود تأثير معنوى لمعاملات الرى على محصول الحبوب ومكوناته , كما تبين بالتحليل التجميعى للبيانات أن الرى كل ٧ أيام خلال موسم النمو قد أعطى أعلى محصول لجميع التراكيب الوراثية المختبرة وأن إطالة فترات الرى من ٧ الى ١٤ يوماً فى أىّ من مراحل النمو الثلاث المذكورة قد نتج عنه نقص معنوى فى محصول الحبوب وذلك بنسبة ١٩,٦ , ١٣,٤ , ٩,٨ % لتلك المراحل على الترتيب بما يشير الى أن المرحلة الأولى من مراحل نمو النبات (من الزراعة حتى طور الحمل) هى الأكثر تأثراً بإطالة فترات الرى. كما تبين أيضا تناقص مكونات المحصول (عدد السنابل /م٢ , عدد الحبوب / سنبلة ووزن الألف حبه) بإطالة فترات الرى وبنسبة أكبر فى المرحلة الأولى .

كذلك أوضحت النتائج زيادة معنوية فى محصول الحبوب ومكوناته الثلاثة للأصناف المختبرة بزيادة معدلات التسميد النيتروجينى. كما كانت الفروق معنويه بين تلك الأصناف المختبره بالنسبة لكمية المحصول حيث أعطى الصنف جميزة ٥ أعلى محصول (٥,٨١ طن/هكتار) وذلك بفرق معنوى عن بقية الأصناف بأستثناء سخا ٩٣ حيث لم يكن الفرق بينهما معنوياً , يليهما جيزة ١٦٨ وسدس ١ فى حين أعطى سخا ٦٩ أقل محصول (٤,٦١ طن/هكتار) وذلك بفرق معنوى عن بقية الأصناف , كما كان التفاعل بين المعاملات المختلفة معنوياً وقد حقق الصنف جميزة ٥ وسدس ١ أعلى محصول وذلك بالرى كل ٧ أيام خلال موسم النمو مع التسميد بمعدل (٢١٦ كجم /ن/هكتار)

كما أشارت الدراسة الى وجود فروق جوهرية بين التراكيب الوراثية المختبرة فى استجابتها لزيادة معدلات التسميد النيتروجينى، وقد حقق الصنف جميزة ٥ أعلى معامل استجابة(GYRI) بينما كان الصنف سخا ٦٩ أقلها فى ذلك . كما تبين إرتفاع كل من معامل الإستجابة للتسميد(GYRI) , وكفاءة استخدام المياه(WUE) باتباع فترة الرى القصيرة (٧ أيام) خلال المرحلتين الأولى والثانية من مراحل نموالنبات المذكورة وأنخفاضهما بإطالة فترة الرى خلال إىّ من تلك المرحلتين وعلى الأخص خلال المرحلة الأولى . وكذلك اشارت النتائج أيضاً الى إرتفاع كفاءة استخدام مياه الرى (WUE) بزيادة معدلات التسميد النيتروجينى والى وجود فروق معنوية بين التراكيب الوراثية المختبرة بالنسبة لكفاءة استخدام المياه. وكانت اعلاها تلك التراكيب الوراثية ذات أعلى محصول.

وبذلك يوصى للأراضى الرملية فى المناطق المستصلحة بمنطقة البستان فى محافظة البحيرة بزراعة الأصناف الجديدة جميزة ٥ وسخا ٩٣ وجيزة ١٦٨ وكذا الصنف التجارى سدس ١ مع الرى كل ٧ أيام طوال موسم النمو وبمعدل تسميد ٢١٦ كجم ن/هكتار للحصول على أعلى محصول منها.