J. Agric. Sci. Mansoura Univ., 28(12): 8507 - 8520, 2003

INFLUENCE OF DIFFERENT IRRIGATION REGIME AND POTASSIUM FERTILIZATION LEVELS ON YIELD AND COMPONENTS OF FOUR WHEAT CULTIVARS.

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ABSTRACT

Two field trails were conducted at the experimental farm of Sakha Agric. Res. Station to study the influence of three irrigation regime treatments, full irrigation (W_1) which received planting plus five irrigations, withholding one irrigation at late season (W_2) which received planting plus four irrigations, withholding two irrigations at late season (W_3) which received planting plus three irrigations and two levels of potassium fertilization (24 and 48 kg K_2O/fed.) on yield and components of four wheat cultivars; Sakha 8 (V_1), Sakha 69 (V_2), Sakha 92 (V_3) and Giza 163 (V_4). It aimed at maximizing wheat production and water use efficiency, at the same time to select the suitable cultivar adopted for this condition of drought. The experiments were conducted in split- split plot design with four replicates.

The observed results can be summarized as follows:

- The yield and yield components of studied wheat cultivars were generally affected significantly by irrigation regime treatments, potassium fertilization rates and wheat cultivars. Sakha 69 cultivar generally gave the highest values of grain yield, weight and number of kernels per spike and number of heads/m^2 under irrigation treatments W_1 and W_2. While Sakha 8 cultivar was more tolerate to drought condition than the other cultivars which gave the highest values of grain yield, weight of kernels per spike and the 100-grain weight under irrigation treatment W_3 in the presence of high rate of potassium.
- The water consumptive use was highest with full irrigation treatment W_1 where it was 35.97 and 37.79 cm in 2002 and 2003. While it was lowest 26.82 and 26.88 cm in 2002 and 2003 with the drought condition; W_3 treatment. The daily consumptive use gradually increased to reach its maximum at Apr. 0.32 and 0.33 cm/day in 2002 and 2003 were obtained with full irrigation treatment W_1.
- The highest values of W.U.E. 1.85 and 1.80-kg grain/m^3 water in 2002 and 2003 were obtained with Sakha 69 cultivar under irrigation treatment W_1 and by application of 48 kg K_2O/fed in the two seasons.

Keywords:wheat cultivars, irrigation regime, potassium.

INTRODUCTION

Wheat is considered as one of the main cereal crops cultivated to face the great demands for human food and the straw of wheat is considered an important feed for livestock in Egypt Nowadays-great efforts are exerted in order to increase the amount of food in Egypt by increasing its agricultural production mainly wheat production to minimize the gap between production and consumption. One way of increasing production of wheat is by utilization of irrigation water and increasing the efficiency of added NPK fertilizers. The total annual production of wheat also can be increased by introducing high yielding varieties. Increasing the K nutrition to an adequate level is generally accompanied by an increase in yield and yield components of wheat crop. El-Yamani (1994) recorded that potassium fertilization was a factor contributing

in the increase of the efficiency of nitrogen uptake from soil and its utilization by wheat plant, he added that maximum grain yield of wheat was obtained at optimum soil moisture content and was significantly higher in the presence of potassium than in its absence. Singh *et al* (1980) recorded that maximum grain yield was obtained with irrigation at 50% depletion of available soil moisture.

The objective of the present investigation was to study the influence of different irrigation regime and potassium fertilization rates on yield and yield components of four wheat cultivars.

MATERIALS AND METHODS

Two field trails were conducted at the experimental farm of Sakha Agric. Res. Station during two successive seasons of 2001/2002 and 2002/2003. The aim of this study was to obtain the influence of three irrigation regimes; full irrigation (W_1) which received planting plus five irrigations (the common practics in the area is to give six irrigation for wheat), withholding one irrigation at late season (W_2) which received planting plus four irrigations, withholding two irrigations at late season (W_3) which received planting plus three irrigations and two levels of potassium fertilization 24 (K_1) and 48 kg K_2O/fed (K_2)on yield and yield components of four wheat cutivars; Sakha 8 (V_1), Sakha 69(V_2), Sakha 92 (V_3) and Giza 163 (V_4) the more common cultivars in the Nile Delta. Also some water relations of wheat crop were studied. The experiments were conducted in a split split plot design with four replicates. The main plots were randomly assigned to irrigation regime treatments, the sub plot to two levels of potassium fertilization and the sub-sub plot to four wheat cultivars. The area of each plot was (2.4 × 3.5) square meter. All plots of the experiment were treated with 15.5 kg P_2O/fed. as super phosphate fertilizer (15.5% P_2O_5) and 70 kg N/fed in the form of urea (46% N) splitted in three doses. The first dose (14 kg N/fed) was broadcasted together with P-fertilizer and potassium fertilizer treatments at sowing. The second and the third doses of urea 28 kg N/fed. were applied at tillering and booting stages respectively. Wheat grains at rate of 60 kg/fed were sowing at 10th and 8th of Dec. 2001 and 2002. The wheat plants were harvested at 20th May 2002 and 2003. The grain and straw yields were determined after maturity and weighed at 15% moisture content. Harvest index were also recorded (total grain: total dry matter ratio).

Water consumptive use (C.U.) by wheat plant in each irrigation was calculated according to (Israelson and Hansen, 1962) as follows:

$$\text{C.U.} = \sum_{i=1}^{i=n} \frac{Pw_2 - Pw_1}{100} \times D_{bi} \times D_i$$

Where:

C.U. = Water consumptive use in cm.
Pw_2 = Soil moisture percent after irrigation in the ith layer.
Pw_1 = Soil moisture percent before next irrigation in the ith layer.
D_{bi} = Bulk density in g/cm^3 of the ith layer of soil.
D_i = Depth of the ith layer of soil, cm.
i = Number of soil layer sampled in the rate zone depth (D).

Water consumptive use was computed for all irrigation from sowing until harvesting. Water use efficiency (W.U.E.) was calculated according to (Doorenbos and Pruitt, 1977) as follows:

$$\text{W.U.E.} = \frac{grain\ yield(kg/fed)}{Actual\ evapotranspiration(M^3/fed)}$$

Statistical analysis: Data were subjected to statistical analysis according to Snedecor and Cochran (1980).

Soil surface samples (0 - 30 cm) were taken from the experimental sites and analyzed before planting. Available nitrogen was extracted by K-sulfate and determined using the microkjeldahl method according to Jackson (1958). Available phosphorus was extracted as described by Olsen *et al* (1954) and then determined spectro photometrically accoding to Jackson (1958). Available potassium was determined by flame photmeter in the ammonium acetate extract, according to Jackson (1958). The soil characteristics of the experimental sites are presented in Table 1.

Field capacity, wilting point, available soil moisture and bulk density for the experimental sites are presented in Table 2. The irrigation water schedule for the two experiments are presented in Table 3.

RESULTS AND DISCUSSION

1- Soil analysis:

Data in Table 1 showed that soils of the experimental sites were non-saline soils, i.e., EC dS/m 2.32 and 2.22 in 2001 and 2002 with pH 7.9 and 8.0, clayey (50.57 and 51.88 % clay in 2001 and 2002). Low in organic matter (1.35 and 1.28 %) and low in available nitrogen (28 and 24 mg N/kg soil). The soil contents of available phosphorus were low (8.0 and 7.8 mg/kg soil in 2001 and 2002 seasons). Their K contents were medium (370 and 385 mg/kg soil in 2001 and 2002 seasons).

2- Yield and yield components as affected by irrigation water regime, potassium fertilization levels and wheat cultivars:

Grain Yield: The results in Table 4 and Fig. 1 show that with two years experiment grain yield of wheat was affected significantly by different irrigation regime, potassium fertilization levels and wheat cultivars. Sakha 69 cultivar (V_2) gave the highest values of grain yield under optimum and medium soil moisture content (full irrigation W1 and withholding one irrigation at late season W2). While Sakha 8 cultivar (V_1) gave the highest values under drought condition (withholding two irrigations at late season W_3). In this regard, such differences might be due to variability among wheat varieties genotypes (Essam *et al*, 1993). The maximum grain yield (2.80 and 2.86 ton/fed in 2002 and 2003) were obtained under full irrigation treatment, when the potassium was applied at 48 kg K_2O/fed with Sakha69 Cultivar (V_2)

Table (1): Some chemical and physical properties of the soil surface layer (0-30 cm) before sowing.

Year	Soil pH* 1:2.5 susp.	EC** dS/m at 25C°	Soluble cations me/L				Soluble anions me/L				Available nutrients mg/kg soil			O.M. %	Total carbonate %	Particle size %			Texture grade.
			Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$CO_3^{=}$	HCO_3^{-}	Cl^{-}	$SO_4^{=}$	N	P	K			Clay %	Silt%	Sand%	
2001/2002	7.9	2.32	7.84	5.36	9.58	0.42	-	1.96	13.44	7.80	28.0	8.0	370	1.35	2.78	50.57	24.33	25.10	Clayey
2002/2003	8 0	2.22	6.37	5.15	10.36	0.32	-	2 21	13 92	6.07	24.0	7.8	385	1.28	3.00	51.68	23.87	24 25	clayey

*1:2.5 soil: water suspension.
** Soil paste extract.

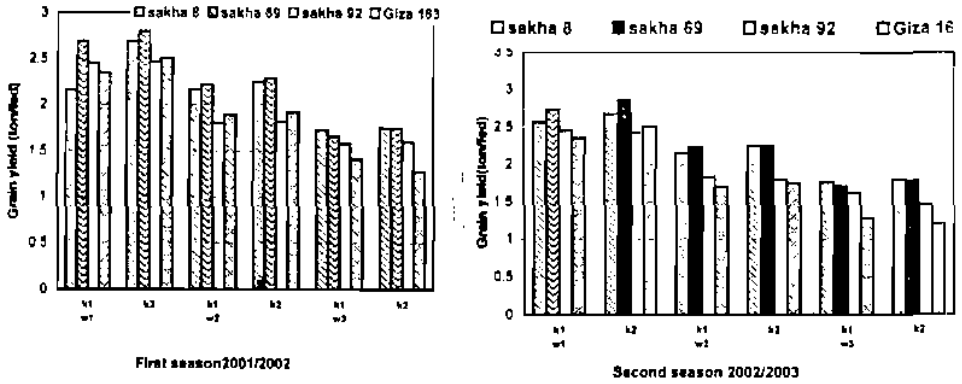

Fig. 1: Effect of irrigation water regime and potassium levelsK1 24, K2 48 kg K2O/fed on grain yield of four wheat cultivars

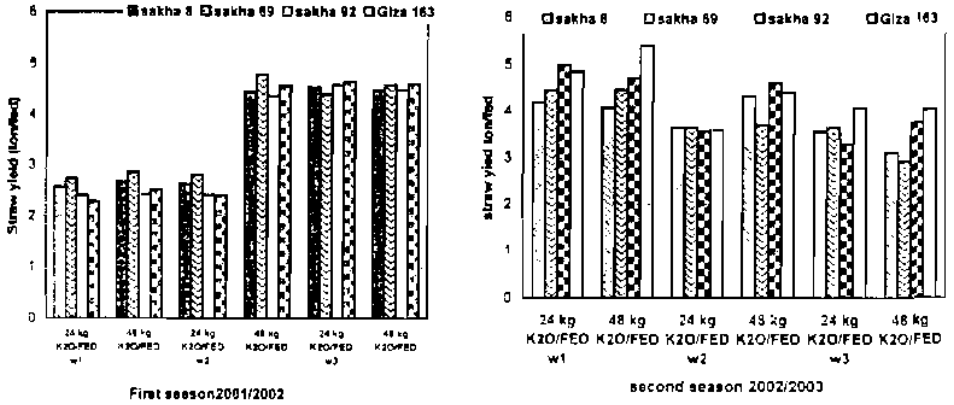

Fig. 2: Effect of Irrigation water regime and potassium levels K1 24, K2 48 kg K2O/fed on straw yield of four wheat cultivars

Table 2: Field capacity, wilting point, available soil moisture and bulk density for the soil of the experiment field.

Season	Soil layer (cm)	Field capacity (%)	Wilting point (%)	Available moisture (%)	Bulk density (g/cm)
2001/2002	0-15	43.76	23.78	19.98	1.15
	15-30	41.79	22.71	19.08	1.22
	30-45	40.39	21.95	18.44	1.30
	45-60	38.68	21.02	17.66	1.36
	Average	41.16	22.37	18.79	1.27
2002/2003	0-15	43.66	23.64	20.02	1.12
	15-30	42.83	23.28	19.55	1.20
	30-45	40.90	22.23	18.67	1.29
	45-60	39.82	21.64	18.18	1.34
	Average	41.85	22.75	19.10	1.24

Table 3: The irrigation water schedule from sowing to harvesting for the different irrigation regime treatments.

Irrigation No.	Full irrigation (W_1)		Drought after the fifth irrigation (W_2)		Drought after the fourth irrigation (W_3)	
	Date of irrigation	Period (days)	Date of irrigation	Period (days)	Date of irrigation	Period (days)
2001/2002 season						
Planting	10/12 to 15/1/2002	36	10/12 to 15/1/2002	36	10/12 to 15/1/2002	36
First	15/1 to 3/3/2002	47	15/1 to 3/3/2002	47	15/1 to 3/3/2002	47
Second	3/3 to 23/3/2002	20	3/3/ to 23/3/2002	20	3/3/ to 23/3/2002	20
Third	23/3 to 12/4/2002	20	23/3 to 12/4/2002	20	23/3 to 20/5/2002	58
Fourth	12/4 to 2/5/2002	20	12/4 to 20/5/2002	38		
Fifth	2/5 to 20/5/2002	18				
	6	161	5	161	4	161
2002/2003 season						
Planting	8/12 to16/1/2003	39	8/12 to16/1/2003	39	8/12 to16/1/2003	39
First	16/1 to 5/3/2003	48	16/1 to 5/3/2003	48	16/1 to 5/3/2003	48
Second	5/3 to 25/3/2003	20	5/3 to 25/3/2003	20	5/3 to 25/3/2003	20
Third	25/3 to14/4/2003	20	25/3 to14/4/2003	20	25/3 to 20/5/2003	56
Fourth	14/4 to 2/5/2003	20	14/4 to 20/5/2003	38		
Fifth	2/5 to 20/5/2003	18				
	6	163	5	163	4	163

These results indicate that the effect of high rate of potassium (48 kg K_2O/fed) on grain yield of wheat was more pronounced under optimum and medium soil moisture conditions (W_1 and W_2 treatments) with Sakha 69 cultivar (V_2) while under Drought condition (withholding two irrigations at late season W_3), Sakha 8 cultivar (V_1) gave the highest value. These results were supported the data obtained by El-Yamani (1994) who found that maximum grain yield of wheat was obtained at optimum soil moisture content (irrigation at 50% depletion of available soil moisture), he added that the response of wheat was much higher in the presence of potassium (60 kg K_2O/fed) than in its absence. The increase in grain yield under high rate of potassium may be

explained by the fact that K improves the activity of the enzymes in the plant leading to a more intensive assimilation and translocation of the assimilates from the leaf to the grain thus leading to a higher yield. Regarding the effect of irrigation regime on grain yield an increase in grain yield under optimum soil moisture condition (full irrigation) was observed, these increments may be due to the fact that the response of wheat plant to plant nutrition very much related to the soil moisture content of the soil.

Table 4: Effect of irrigation water regime and potassium fertilization levels on grain and straw yields of four wheat cultivars.

Treatments		Grain yield (ton/fed)						Straw yield (ton/fed)					
		2001/2002			2002/2003			2001/2002			2002/2003		
Irrigation regime	Wheat cultivar	24 kg K_2O/fed	48 kg K_2O/fed	V- mean	24 kg K_2O/fed	48 kg K_2O/fed	V- mean	24 kg K_2O/fed	48 kg K_2O/fed	V- mean	24 kg K_2O/fed	48 kg K_2O/fed	V- mean
W_1	Sakha 8	2.61b	2.69b	2.65	2.56b	2.67b	2.62	4.43b c	4.53ab	4.48	4.18c	4.07c	4.12
	Sakha 69	2.69a	2.80a	2.75	2.73a	2.86a	2.80	4.78a	4.39b	4.58	4.45b	4.46b	4.46
	Sakha 92	2.45c	2.47c	2.46	2.40c	2.42d	2.41	4.36c	4.58a	4.47	4.99a	4.70b	4.85
	Giza 163	2.35c	2.51c	2.43	2.28d	2.52c	2.40	4.51b	4.65a	4.60	4.84ab	5.40a	5.12
W_2	Sakha 8	2.17a	2.25a	2.21	2.15a	2.25a	2.20	4.04b	4.37bc	4.20	3.84a	4.38a	4.01
	Sakha 69	2.22a	2.29a	2.25	2.23a	2.25a	2.24	3.94b	4.24c	4.09	3.65a	3.70b	3.67
	Sakha 92	1.80c	1.82c	1.81	1.83b	1.89b	1.86	3.62c	4.56b	4.09	3.56a	4.60a	4.08
	Giza 163	1.89b	1.92b	1.90	1.70c	1.75c	1.72	4.41a	5.19a	4.80	3.60a	4.44a	4.02
W_3	Sakha 8	1.73a	1.75a	1.74	1.76a	1.80a	1.78	3.39	3.06c	3.22	3.56b	3.11b	3.34
	Sakha 69	1.66b	1.75a	1.70	1.71a	1.77a	1.74	3.35b	2.94d	3.10	3.65b	2.92c	3.29
	Sakha 92	1.58c	1.60b	1.59	1.62b	1.46c	1.54	3.36b	3.91a	3.64	3.29c	3.76a	3.52
	Giza 163	1.41d	1.26c	1.43	1.26c	1.20d	1.24	4.22a	3.30b	3.76	4.06a	4.03a	4.04
Statistical analysis		W	V	K	W	V	K	W	V	K	W	V	K
LSD 5%		0.072	0.073	0.070	0.095	0.08	0.098	0.176	0.184	0.173	0.273	0.274	0.270
LSD 1%		0.099	0.098	0.094	0.134	0.112	0.131	0.236	0.245	0.233	0.372	0.365	0.365

W: Irrigation regime, V: Wheat cultivar K: Potassium levels

In a column under each W, means followed by a common letter are not significantly different at the 5% level by DMRT.

Straw Yield: The results in Table (4) and Fig (2) show that with two years experiment straw yield of wheat was affected significantly by irrigation regime, potassium application and wheat cultivars in the two seasons. Giza 163 cultivar gave the maximum values of straw yield under W_2 and W1 in 2002 and 2003 seasons. The maximum values of straw yield (5.19 and 5.40 ton/fed in 2002 and 2003) were obtained under W_2 in the first season and W1 in the second season by application of 48 kg K_2O/fed with Giza 163 cultivar in the two seasons. These results indicate that the effect of high rate of potassium on straw yield of wheat plant was more pronounced under optimum and medium soil moisture conditions with Giza 163 cultivar. It is important to note that, with Giza 163 cultivar the straw yield of wheat was increased in the two seasons under optimum and medium soil moisture

conditions by the application of 48 kg K_2O/fed, whereas, the grain yield was decreased. These results are in agreement with those published by El-Leithi *et al*, (1996).

Weight of Kernels Per Spike: The results in Table 5 show that weight of kernels was affected significantly under irrigation regime treatments and with wheat cultivars in the two seasons. the weight of kernels was not responded significantly to potassium fertilization levels in the first season, but it was responded in the second. The maximum values of weight of kernels per spike (2.03 and 2.15 g/spike in 2002 and 2003) were obtained under optimum soil moisture conditions (full irrigation treatment W_1) in the presence of 48 kg K_2O/fed with Sakha 69 cultivar. The increase in weight of kernels per spike under high rate of K may be explained by the fact that potassium increases the starch content of grains, making plump kernels with high weights. While the lowest values (1.20 and 1.18 g/spike in 2002 and 2003) were attained by Giza 163 under drought conditions (withholding two irrigations at late season W_3). These results indicate that optimum soil moisture conditions was found to increase the weight of kernels. Similar results were reported by Wright, (1972).

Table 5: Effect of irrigation water regime and potassium fertilization levels on weight and number of kernels per spike of four wheat cultivars.

Treatments		Weight of kernels per spike (g)						Number of kernels per spike					
Irrigation regime	Wheat cultivars	2001/2002		V- mean	2002/2003		V- mean	2001/2002		V- mean	2002/2003		V- mean
		24 kg K_2O/fed	48 kg K_2O/fed		24 kg K_2O/fed	48 kg K_2O/fed		24 kg K_2O/fed	48 kg K_2O/fed		24 kg K_2O/fed	48 kg K_2O/fed	
W1	Sakha 8	1.60b	1.73b	1.66	1.76a	1.73b	1.71	37.25a	38.75b	38.0	38.25a	37.5b	37.88
	Sakha 69	1.73a	2.03a	1.88	1.77a	2.15a	1.96	37.75a	41.25a	39.5	37.5ab	44.25a	40.88
	Sakha 92	1.55b	1.52c	1.53	1.38c	1.40d	1.39	39.0a	37.0b	38.0	38.25bc	35.75c	36.0
	Giza 163	1.42c	1.71b	1.56	1.49b	1.66c	1.58	37.5a	38.25b	37.88	36.0c	37.25b	36.63
W2	Sakha 8	1.79a	1.60b	1.65	1.72a	1.82b	1.77	38.25a	38.25b	38.25	36.5bc	38.75b	37.13
	Sakha 69	1.79a	1.85a	1.82	1.76a	1.98a	1.87	38.5a	38.5a	38.5	38.0a	40.75a	39.38
	Sakha 92	1.42b	1.25c	1.33	1.35c	1.36d	1.35	36.25b	36.50b	36.38	35.0c	35.75c	35.38
	Giza 163	1.48b	1.22c	1.35	1.55b	1.43c	1.49	36.25b	36.02b	36.20	36.75ab	36.75c	36.25
W3	Sakha 8	1.96a	1.75a	1.71	1.61a	1.65a	1.63	38.25a	37.0ab	37.63	38.25a	36.75b	37.5
	Sakha 69	1.49b	1.72a	1.61	1.57b	1.61a	1.59	38.50a	38.5a	38.50	37.5a	38.25a	37.88
	Sakha 92	1.31c	1.33b	1.35	1.26c	1.32b	1.29	37.0ab	36.50b	36.76	35.75b	36.25b	36.0
	Giza 163	1.26c	1.20c	1.23	1.16d	1.22c	1.20	36.25b	36.50b	36.38	35.25b	34.75c	35.0
Statistical analysis		W	V	K	W	V	K	W	V	K	W	V	K
LSD 5%		0.104	0.092	ns	0.06	0.06	0.06	1.77	1.70	Ns	1.55	1.32	1.35
LSD 1%		0.143	0.136	ns	0.08	0.08	0.08	2.42	2.27	Ns	2.16	1.76	1.84

W: Irrigation regime, V: Wheat Cultivar, K: Potassium levels

In a column under each W, means followed by a common letter are not significantly different at the 5% level by DTIRT.

Number of Kernels Per Spike: The results in Table (5) also show that number of kernels per spike was affected significantly under different irrigation regime treatments and with wheat cultivars but was not responded significantly to potassium fertilization levels in the two seasons. The highest values of member of kernels per spike (41.25 and 44.25 kernels/spike in 2002 and 2003) were obtained under full irrigation treatment, when the potassium was applied at 48 kg K_2O/fed with Sakha 69 cultivar. While the lowest values were found under drought condition (withholding two irrigations at late season W_3) with Giza 163 cultivar in the two seasons. These results agree with Abd El-Wahab (2002), who showed that the irrigation at 50% depletion of available soil moisture gave the highest number of grains per spike, whereas, the lowest one was produced by irrigation at depletion 90% of available soil moisture. In general the results indicate that Sakha 69 cultivar gave the maximum values of number of kernels/spike under all irrigation regime treatments in the presence of high rate of potassium fertilization. While the lowest one was produced under drought condition (withholding two irrigations at late season) at the low rate of potassium fertilization with Gisa 163 cultivar.

100-grain weight: The results in Table 6 show that 100-grain weight was affected significantly under irrigation regime treatments and wheat cultivars in the two seasons. The 100-grain weight was not responded significantly to potassium fertilization levels in the first season, but it was responded in the second.

Table 6: **Effect of irrigation water regime and potassium fertilization levels on the 100-grain weight (g) and number of heads per square meter of four wheat cultivars.**

Treatments		100-grain weight (g)						Number of heads per square meter					
		2001/2002			2002/2003			2001/2002			2002/2003		
Irrigation regime	Wheat cultivar	24 kg K_2O/fed	48 kg K_2O/fed	V- mean	24 kg K_2O/fed	48 kg K_2O/fed	V- mean	24 kg K_2O/fed	48 kg K_2O/fed	V- mean	24 kg K_2O/fed	48 kg K_2O/fed	V- mean
W_1	Sakha 8	4.45a	4.56b	4.50	4.56a	4.60b	4.58	361ab	376a	369	312b	385a	349
	Sakha 69	4.60a	4.87a	4.73	4.64a	4.85a	4.75	370a	380a	375	350a	388a	369
	Sakha 92	3.78b	4.10c	3.94	3.82c	3.93c	3.88	350b	370a	360	338ab	382a	360
	Giza 163	3.91b	4.47b	4.19	4.14b	4.49b	4.32	320c	326b	323	325ab	312b	319
W_2	Sakha 8	4.66a	4.14b	4.40	4.81a	4.72a	4.76	294c	327b	311	288c	333a	311
	Sakha 69	4.64a	4.76a	4.70	4.63a	4.84a	4.74	352a	360a	356	367a	283b	325
	Sakha 92	3.90b	3.45c	3.68	3.85b	3.80c	3.82	321b	341b	331	334b	288b	311
	Giza 163	4.05b	3.27c	3.66	4.27c	4.01b	4.14	277d	299c	288	287c	347a	317
W_3	Sakha 8	4.33a	4.56a	4.44	4.39a	4.25a	4.32	296a	320a	308	269c	362a	315
	Sakha 69	3.87b	4.47a	4.17	4.17b	4.25a	4.21	273bc	297b	285	235d	285c	261
	Sakha 92	3.54c	3.83b	3.69	3.54c	3.62b	3.58	270c	300a	285	335a	355ab	345
	Giza 163	3.53c	3.12c	3.32	3.36d	3.48b	3.42	288ab	319a	304	300b	330b	315
Statistical analysis		W	V	K	W	V	K	W	V	K	W	V	K
LSD 5%		0.196	0.205	ns	0.162	0.154	ns	14.54	16.75	14.54	26.51	27.32	25.71
LSD 1%		0.266	0.273	ns	0.223	0.205	ns	19.36	22.31	19.37	36.04	36.38	34.61

W: Irrigation regime, V: Wheat Cultivar, K: Potassium levels

In a column under each W, means followed by a common letter are not significantly different at the 5% level by DMRT.

The maximum values of 100-grain weight 4.87 and 4.85g/100 grain in 2002 and 2003 were obtained under full irrigation treatment (W_1), in the presence of 48 kg K_2O/fed and for Sakha 69 cultivar. While the lowest values 3.12 and 3.36 g/100 grain in 2002 and 2003 were obtained under drought

condition (W_3) for Giza 163 cultivar. These results indicate that the optimum soil moisture conditions was found to increase the 100-grain weight this increase was more pronounced in the presence of 48 kg K_2O/fed and for Sakha 69 cultivar. These results are in agreement with those obtained by EL-Yamani (1994), Sonia *et al* (1996) and Abd El-Wahab (2002).

Number of Heads Per Square Meter: The results in Table 6 also show that the number of heads per square meter was affected significantly under irrigation regime treatments, potassium fertilization levels and with wheat cultivars in the two seasons. The highest values of number of heads/m^2 (380 and 388 heads/m^2 in 2002 and 2003) were obtained under full irrigation treatment (W_1), in the presence of 48 kg K_2O/fed for Sakha 69 cultivar in the two seasons. While the lowest values (270 and 235 heads/m^2 in 2002 and 2003) were obtained under drought condition (withholding two irrigations at late season W_3) with Sakha 92 in the first season and with Sakha 69 in the second. These results indicate that the optimum irrigation conditions were found to increase the number of heads/m^2 this increase was more pronounced in the presence of 48 kg K_2O/fed with Sakha 69 cultivar. These are in agreement with those obtained by Abd El-Wahab (2002) who indicated that irrigation at 50% depletion of available soil moisture gave the higher number of spike/m^2 and it was significantly affected by wheat varieties. Jack and Major (1994) concluded that number of spike per plant was the most important yield component determining final yield.

Harvest Index (Total Grain: Total Dry Matter Ratio): The results in Table 7 indicate that the harvest index was affected significantly under irrigation regime treatments, wheat cultivars and was not respond significantly by potassium fertilization levels in the two seasons.

Table 7: Effect of irrigation water regime and potassium fertilization levels on harvest index of four wheat cultivars.

Treatments		Harvest index					
Irrigation regime	Wheat	2001/2002		v-mean	2002/2003		V-mean
		24 kg K_2O/fed	48 kg K_2O/fed		24 kg K_2O/fed	48 kg K_2O/fed	
W_1	Sakha 8	0.372a	0.372ab	0.372	0.378a	0.384a	0.381
	Sakha 69	0.363a	0.385a	0.374	0.380a	0.388a	0.384
	Sakha 92	0.355ab	0.350b	0.353	0.323b	0.338b	0.330
	Giza 163	0.330b	0.303c	0.316	0.325b	0.278c	0.302
W_2	Sakha 8	0.384a	0.343a	0.364	0.371a	0.340b	0.355
	Sakha 69	0.355a	0.353a	0.354	0.379a	0.378a	0.379
	Sakha 92	0.332a	0.285b	0.309	0.343b	0.283c	0.313
	Giza 163	0.303b	0.268b	0.285	0.320c	0.275c	0.298
W_3	Sakha 8	0.343a	0.364a	0.354	0.330a	0.370b	0.350
	Sakha 69	0.325a	0.373a	0.349	0.319a	0.377a	0.343
	Sakha 92	0.320a	0.290b	0.305	0.333a	0.285c	0.309
	Giza 163	0.248b	0.275b	0.261	0.243b	0.220d	0.231
Statistical analysis		W	V	K	W	V	K
LSD 5%		0.030	0.027	0.032	0.024	0.022	ns
LSD 1%		0.041	0.036	0.044	0.033	0.029	ns

W: Irrigation regime, V: Wheat Cultivar, and K: Potassium levels

In a column under each W, means followed by a common letter are not significantly different at the 5% level by DMRT.

The highest values of harvest index (0.385 and 0.388 in 2002 and 2003) were obtained under full irrigation regime treatment (W_1) in the presence of 48 kg K_2O/fed for Sakha 69 cultivar in the two seasons. While the lowest values (0.248 and 0.220 in 2002 and 2003) were attained by Giza 163 under drought conditions (withholding two irrigations at late season) in the two seasons. These results indicate that a pronounced increase in harvest index was observed under optimum irrigation conditions this increase was significantly higher for Sakha 69 Cultivar.

3- IRRIGATION WATER RELATIONS:

Water Consumptive Use by Wheat Plant: monthly and seasonal water consumptive use data as affected by irrigation regime treatments, K fertilization levels and with wheat cultivars are presented in Table 8. The results show that for both seasons, consumptive use of water was highest under full irrigation regime (6 irrigations), and it was found to be 35.97 and 37.79 cm, in 2002 and 2003. While it was lowest under withholding two irrigations at late season (4 irrigations) which found to be 26.82 and 26.88 cm, in 2002 and 2003. Whereas medium values; 31.28 and 32.65 cm, in 2002 and 2003 were attained withholding one irrigation at late season (5 irrigations). From data obtained it was obvious that water consumptive use of wheat crop was increased with increasing the number of irrigations during the growing season of wheat crop. These results were supported by the data obtained by Abd El-Hafez *et al* (1992).

Daily and Monthly Water Consumptive Use (cm) for Wheat Plants: The average values of seasonal water consumptive use (cm/day) for wheat plant in the two growing seasons were 0.22, 0.19 and 0.17 cm/day in 2001/2002 and 0.23, 0.20 and 0.16 cm/day in 2002/2003, for treatments W_1, W_2 and W_3, respectively.

Table 8: Daily and monthly water consumptive use (cm) for studied wheat cultivars under three irrigation regime treatments.

Irrigation regime	Rate	Dec.	Jan.	Feb.	Mar.	Apr.	May	Seasonal C.u.	
								Cm	M^3/fed
		2001/2002 eeason							
W_1	Monthly	2.94	4.34	5.04	9.30	9.60	5.20	35.97	1511
	Daily	0.14	0.14	0.18	0.30	0.32	0.26	0.22	9.39
W_2	Monthly	2.94	4.34	5.04	8.06	6.90	4.00	31.28	1314
	Daily	0.14	0.14	0.18	0.26	0.23	0.20	0.19	8.16
W_3	Monthly	2.94	4.34	5.04	6.20	5.10	3.20	26.82	1126
	Daily	0.14	0.14	0.18	0.20	0.17	0.16	0 17	6.99
		2002/2003 season							
W_1	Monthly	3.22	4.34	5.32	9.61	9.90	5.40	37.79	1587
	Daily	0.14	0.14	0.19	0.31	0.33	0.27	0 23	9.74
W_2	Monthly	3.22	4.34	5.32	8.37	7.20	4.20	32 65	1370
	Daily	0 14	0 14	0 19	0.27	0.24	0.21	0.20	8.40
W_3	Monthly	3.22	4.34	5.32	6.20	4.80	3 00	26.88	1129
	Daily	0.14	0.14	0.19	0.20	0.16	0.15	0.16	6 93

* Date of planting 10/12/2001 and 8/12/2002.

** Date of harvesting 20/5/2002 and 2003.

The results show that the daily consumptive use by wheat plant was low during the beginning season as a result of small vegetative growth of wheat cultivars,then increased during crop development (mid-season) and arrived its maximum at Apr. 0.32 and 0.33 cm/day in 2002 and 2003 for W_1 treatment and at Mar. 0.26 and 0.27 cm/day in 2002 and 2003 for W_2 treatment, while it was observed to be 0.20 cm/day in the two seasons for W_3 treatment, which consider the criticai period in the demand of water by wheat cultivars, then it is followed by droping during ripening period (May).

Water Use Efficiency (W.U.E.): water use efficiency values of wheat crop kg/m^3 of water consumed as influenced by irrigations regime, K fertilization levels and wheat cultivars are listed in Table (9). Results reveal that, the maximum values of W.U.E. 1.85 and 1.80 kg grain /m^3 in 2002 and 2003 were obtained under full irrigation treatment by application of 48 kg K_2O/fed with Sakha 69 cultivar. The results indicate that W.U.E. for wheat crop were more efficiency under optimum soil moisture contition. These results were supported by data obtained by El-Yamani (1994).

Table 9: Water use efficiency (W.U.E.*) as affected by irrigation regime, potassium fertilization and four wheat cultivars.

Treatments		Water use efficiency (*W.U.E.) kg grain/m^3 water					
Irrigation regime	Wheat cultivars	2001/2002		2002/2003		Mean of two seasons	
		24 kg K_2O/fed	48 kg K_2O/fed	24 kg K_2O/fed	48 kg K_2O/fed	24 kg K_2O/fed	48 kg K_2O/fed
W_1	Sakha 8 (V_1)	1.73	1.78	1.61	1.68	1.67	1.73
	Sakha 69 (V_2)	1.78	1.85	1.72	1.80	1.75	1.82
	Sakha 92 (V_3)	1.62	1.63	1.51	1.52	1.57	1.58
	Giza 163 (V_4)	1.56	1.66	1.44	1.58	1.50	1.62
W_2	Sakha 8 (V_1)	1.71	1.68	1.57	1.64	1.67	1.66
	Sakha 69 (V_2)	1.74	1.71	1.63	1.64	1.66	1.68
	Sakha 92 (V_3)	1.39	1.38	1.34	1.38	1.37	1.38
	Giza 163 (V_4)	1.46	1.45	1.24	1.28	1.35	1.35
W_3	Sakha 8 (V_1)	1.54	1.55	1.56	1.59	1.55	1.57
	Sakha 69 (V_2)	1.47	1.55	1.51	1.57	1.49	1.56
	Sakha 92 (V_3)	1.40	1.42	1.43	1.29	1.42	1.36
	Giza 163 (V_4)	1.25	1.14	1.13	1.06	1.19	1.10

* W.U.E. = kg Grain yield/m^3 water.

It can be concluded that the optimum irrigation conditions (full irrigation) and adequate potassium for wheat crop during the last weeks of growth period resulted in higher grain yield, weight and number of kernels per spike, 100-grain weight, number of heads per square meter and harvest index. These main yield components were more pronounced with Sakha 69 cultivar which gave the highest grain yield associated with maximum weight and number of kernels per spike, 100-grain weight, number of heads per square meter and harvest index. Whereas Sakha 8 cultivar gave the maximum grain yield, weight of kernels spike, 100-grain weight and number of heads per square meter under drought condition (withholding two irrigations at late season). The results indicate that Sakha 8 cultivar at 48 kg K2O/fed was mcre tolaerate to drought conditions than the other studied cultivars under the experiment condition.

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تأثير نظم الرى المختلفة و مستويات التسميد البوتاسى على المحصول و مكوناته لأربعة أصناف من القمح

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أجريت تجربتين حقليتين فى المزرعة البحثية – محطة البحوث الزراعية بسخا لدراسه تأثير ثلاثة معاملات نظم الرى، رى كامل (W_1) تشمل ريه الزراعة بالاضافة الى ٥ ريات، تعطيش ريه واحدة فى نهايه الموسم (W_2) تشمل ريه الزراعة بالاضافة الى ٤ ريات، تعطيش ريتين فى نهايه الموسم (W_3) تشمل رية الزراعة بالاضافة الى ٣ ريات، مستويين من التسميد البوتاسى ٢٤، ٤٨ كجم بو٢أ /فدان على المحصول و مكوناته لاربعة أصناف من القمح: سخا ٨(V_1)، سخا ٦٩ (V_2)، سخا ٩٢ (V_3) و جيزة ١٦٣ (V_4) و ذلك لتعظيم انتاج القمح و الكفاءة الاستعماليه لمياه الرى.

أقيمت التجربتين فى تصميم قطع منشقة مرتين مع اربع مكررا.

و يمكن تلخيص النتائج المتحصل عليها كما يلي:

- المحصول و مكوناته لاصناف القمح عموما تأثر معنويا بمعاملات نظم الرى، معدلات التسميد البوتاسى و أصناف القمح. الصنف سخا ٦٩ أعطى أعلى قيم لمحصول الحبوب، وزن و عدد الحبوب فى السنبله و عدد السنابل فى المتر المربع تحت معاملى الرى W_1، W_2. بينما الصنف سخا ٨ هو أكثر الأصناف مقاومة للجفاف أعطى أعلى قيم لمحصول الحبوب، وزن الحبوب فى السنبله، وزن المائة حبه تحت معاملة الرى W_3 فى ظروف التسميد البوتاسى المرتفع.
- كان أعلى استهلاك مائى تم الحصول عليه تحت المعامله رى كامل W_1 و كان ٣٥,٩٧، ٣٧,٧٩ سم فى عامى ٢٠٠٢، ٢٠٠٣، بينما أقل قيمة استهلاك مائى كانت ٢٦,٨٢، ٢٦,٨٨ سم فى عامى ٢٠٠٢، ٢٠٠٣ كانت تحت المعامله تعطيش ريتين فى نهايه الموسم W_3.
- زاد الاستهلاك المائى اليومى تدريجيا حتى وصل أعلى قيمة فى شهر أبريل ٠,٣٢، ٠,٣٣ سم/يوم فى عامى ٢٠٠٢، ٢٠٠٣ تم الحصول عليها تحت المعامله رى كامل W_1.
- أعلى كفاءة استعماليه لمياه الرى ١,٨٥، ١,٨٠ كجم حبوب/م٣ مياه فى عامى ٢٠٠٢، ٢٠٠٣ تم الحصول عليها مع الصنف سخا ٦٩ تحت المعامله W_1 و باضافة ٤٨ كجم بو٢ أ/فدان خلال الموسمين.