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SCHEDULING IRRIGATION FOR SOME WHEAT CULTIVARS UNDER UPPER EGYPT CONDITIONS

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ABSTRACT

Two field experiments were conducted at Shandaweel Agricultural Research Station, during 2002/03 and 2003/04 seasons. Three irrigation regime treatments, i.e., 0.8, 1.0 and 1.2 evaporation pan coefficients with four bread wheat cultivars, Sakha 93, Giza 168, Gemmeiza 7 and Gemmeiza 9 to find out the specific pan-coefficient needed for scheduling irrigation of wheat using class A pan evaporation records under different wheat cultivars at Upper Egypt region.

The results revealed significant differences among studied cultivars and irrigation treatments in all studied traits in the second season. The irrigation treatment at 1.2 evaporation pan coefficient gave the best results with Gammeiza 7 regarding to vegetative growth traits, grain yield and its components. The irrigation at 1.2 evaporation pan coefficient with Gammeiza7 cultivar produced the highest grain yield (26.66 and 26.10 Ardab/fed) for the first and second seasons, respectively.

The irrigation treatment at 1.2 evaporation pan coefficient recoded the highest amount of water consumed more than the other two treatments. Water consumptive uses by wheat were 1582.4, 1796.9 and 2215.9 m^3/fed, for irrigation treatments at 0.8, 1.0 and 1.2 evaporation pan coefficients, respectively. The irrigation at 0.8 evaporation pan coefficient gave the highest value of water use efficiency. From these results, it could be concluded that the application of irrigation water at 1.2 evaporation pan coefficient could be recommended with wheat cultivar Gammeiza7 for high production under Upper Egypt conditions.

INTRODUCTION

The increasing pressure of over growing population particularly in the developing countries call for problem oriented agricultural research mostly directed to alleviate the problem of food shortages. In Egypt, wheat is one of the most important crops with respect to value and area, because its national production is not sufficient to supply the annual demand of the increasing population. This caused a gap between production and consumption, Egypt has become the world largest importer of wheat world-wide after the former USSR and China. (Miseha *et al.,* 1984 and Abdel-Ghani *et al.,* 1994). El-Sayed (1982) stated that exposing wheat plants to high moisture stress depressed seasonal consumptive use, grain and straw yields. Khater *et al.*, (1997) found that number of spikes/m^2, 1000 grain weight, straw and grain yield/fed were significantly decreased with decreasing available soil moisture content. Rayan *et al.*, (1999) indicated that seasonal wheat water consumptive use at Shandaweel region (Upper Egypt) was differed between 1883 and 1930 m^3/fed. El-Kolla *et al.,* (1994) and Mohamed and Tammam (1999) stated that decreasing available soil moisture content caused a significant decrease in plant height, number of tillers, spikes/m^2, number of grains/spike, 1000 grains weight, straw and grain yields/fed. Increasing soil moisture content by using the higher irrigation levels treatments (100 and 80 %) increased all these traits. Rayan *et al.,* (2000) found that exposing wheat plants to irrigation regime treatments at 0.6 evaporation pan coefficient gave the highest values of water use efficiency, while the highest values of grain yield were obtained when irrigation at 1.0 accumulation pan evaporation. Sidrak (2003) found out that irrigation regime (0.6, 0.8, 1.0 and 1.2 EP) had a significant effect on plant height, spike length, number of spikes/, number of grain/ spike, 1000 grain weight and grain yield (kg/fed). The main objective for this study is to determine the best irrigation interval by using class A pan method with wheat cultivars at Upper Egypt region .

MATERIALS AND METHODS

Experiments were undertaken at Shandaweel Agric. Res. Station, Sohag Governorate, Upper Egypt during 2002/03 and 2003/04 growing seasons, to study the response of irrigation scheduling of new wheat cultivars with high yield potential by using evaporation pan coefficients on growth, yield, yield components and some of water relations. The experiment was laid out in split plots with four replicates. The main plots were devoted to irrigation pan coefficient as assigned for irrigation scheduling treatments and the split plots were assigned to wheat cultivars. The description of the experimental factors and treatments was as follows:-

A-Irrigation pan coefficients

1- 0.8 evaporation pan coefficient, EP (I_1)
2- 1.0 evaporation pan coefficient, EP (I_2)
3- 1.2 evaporation pan coefficient, EP (I_3)

B-Wheat cultivars

V_1=Sakha 93
V_2=Giza 168
V_3=Gemmeiza 7
V_4=Gemmeiza 9

Irrigation was applied according to the daily record of the evaporation pan and the crop was irrigated when the water balance reached zero. Application of irrigation regime treatments started after life watering. All other agricultural practices were carried out as a recommended. Each sub-plot was 6 meters in length and 7 meters in width (42 m^2) and surrounded by ditches to avoid the effect of lateral movement of water. Sowing was done at the 24th of November for the two growing seasons, whereas harvest took place at the 5th of May for the same respective seasons. The soil moisture constants of the experimental field i.e. field capacity; wilting point and available soil moisture were 28.3%, 11.9% and 16.4%, respectively. The soil was silty loamy in texture and pH ranged between 7.9-8.0. Soil samples were taken from each 15 cm depth up to 60 cm from the ground surface. The amount of water consumed during each irrigation period was obtained from the difference between soil moisture content before the following irrigation and that of the preceding one according to the following formula as described by Israelsen and Hansen (1962):

$$CU = \frac{(\square_2 - \square_1) * Bd * 60 * 4200}{100 * 100}$$

Where:
CU=the amount of consumptive use in m^3/fed.
$\square_2$=soil moisture percentage after irrigation.
$\square_1$=soil moisture percentage before next irrigation.
Bd=bulk density in gm/cm^3

Water use efficiency values (WUE, kg/m^3) were calculated according to the following equation (Vites, 1965):

$$WUE = \frac{\text{Grain yield (kg/fed)}}{\text{Consumptive use } (m^3/\text{fed})}$$

Vegetative, yield and its components:

At harvest time, the following characters were measured:
1-Plant height (cm).
2-Spike length (cm).
3-Number of spike/m^2
4-1000-grain weight (gm).
5-Number of grains/spike.
6-Grain yield (Ardab /Fed).

The obtained data was subjected to statistical analysis according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

1. Growth characters

1.1. Plant height (cm)

1.1.1. Effect of irrigation regimes

The mean values of plant height as affected by irrigation regime and wheat cultivars in 2002/03 and 2003/04 seasons is presented in Table (1). Results in the first season showed that plant height was not significantly affected by irrigation regime. The highest values of 111.0 and 118.4 cm. were obtained when plants received irrigation at 1.2 evaporation pan coefficient for the two seasons, respectively. The lowest values of 86.3 and 98.4 cm were obtained when plants received irrigation at 0.8 accumulative pan evaporation for the same respective seasons. It could be concluded that plant height was increased with increasing available soil moisture level of irrigation at 1.2 evaporation pan coefficient. These results may be attributed to the increase in the length of internodes and/or the number of internodes per stem. These results were in agreement with those obtained by Reddy and Bhardwaj (1982), El-Kalla *et al.* (1994)

1.1.2. Effect of wheat cultivars:

Data presented in Table (1) show that plant height was significantly affected by wheat cultivars in the two growing seasons. The highest values of 108.8 and 114.5 cm. were obtaind for Gemmeiza 7 in the first and second season, respectively. While the lowest values of plant height 89.1 and 99.8 cm. were gained for the Sakha93 and Giza168 for the same respective, seasons. These results may be due to the differences in genetic coefficient. This findings was in harmony with results obtained by El–Kalla *et al.* (1994), Mohamed and Tammam (1999) and Tawfiles *et al.* (2001).

1.1.3. Effect of the interaction

In the two seasons, results reveal that the interaction between irrigation and wheat cultivars was significant. The maximum values of plant height were 111.0 and 118.4 cm. for irrigation at 1.2 and Gemmieza 7 cultivar in the first and second seasons, respectively. The lowest values were obtained from the interaction between irrigation at 0.8 X Sakha93 and 1.0 X Giza168 for the same respective seasons.

Table (1): Effect of irrigation regimes and wheat cultivars on plant height in the two growing seasons.

Treatment	2002 / 2003				2003 / 2004			
	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean
V_1	86.3	91.4	89.7	89.1	98.5	105.5	105.4	103.1
V_2	86.7	92.2	96.7	91.9	98.4	96.3	104.7	99.8
V_3	106.7	108.6	111.0	108.8	111.7	113.3	118.4	114.5
V_4	96.4	103.1	96.2	98.6	102.9	102.2	113.3	106.1
Mean	94.0	98.8	98.4	97.1	102.9	104.3	110.5	105.9
L.S.D.	I V IxV			N.S. 2.47 4.27				3.67 2.51 4.34

I_1 = Irrigation at 0.8 evaporation pan coefficient
I_2 = Irrigation at 1.0 evaporations pan coefficient
I_3 = Irrigation at 1.2 evaporations pan coefficient
V_1 = Sakha 93 V_2 = Giza 168
V_3 = Gemmeiza 7 V_4 = Gemmeiza 9

2. Yield and yield components

2.1. Spikes length (cm)

2.1.1. Effect of irrigation regimes

Results of the first season in (Table 2) showed that spike length was not significantly affected by irrigation treatments, while in the second season reached to the significant level. In the second season the maximum and lowest values of spikes length 10.4 and 9.7 cm were gained under irrigation at 1.0 and 0.8 accumulative pan evaporation, respectively. Whereas, no significant differences between irrigation at 1.0 and 1.2 evaporation pan coefficient on spike length. These results may be due to the number of tillering and the moderate status of the available soil moisture. These results were in agreement with the results obtained by Agrawal (1997) and Mohamed and Tammam (1999).

2.1.2 Effect of wheat cultivars

Results in Table (2) indicated that length of spikes was significantly affected by wheat cultivars in both seasons, Gemmeiza 7 cultivar gave the highest values of spike length (10.7 and 11 cm.) in the first and second season, respectively. While, Sakha 93 gave the shortest spike length (9.4 and 8.9 cm.) for the same respective seasons. On the other hand no significant differences between Gemmeiza 7 and Gemmeiza 9 cultivars on spike length in both seasons. These finding may be attributed to the differences in genetic coefficient.

2.1.3 Effect of the interaction

The data presented in Table (2) pointed out that the interaction between irrigation and wheat cultivars on spike length was significantly in the second season only. The maximum values were 11.2 cm obtained from the interaction between I_1 X V_3 in the first growing season, while in the second season the value was 11.6 cm obtained from I_3 X V_4. Whereas, the lowest values 9.2 and 8.7 were gained from the interaction between I_2 X V_1 and I_1 X V_1 for the same respective seasons.

Table (2): Effect of irrigation regimes and wheat cultivars on spike length in the two growing seasons.

Treatment	2002 / 2003				2003 / 2004			
	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean
V_1	9.5	9.2	9.4	9.4	8.7	9.2	8.9	8.9
V_2	10.8	9.6	10.0	10.1	9.0	10.7	9.9	9.8
V_3	11.2	10.1	10.7	10.7	11.2	11.1	10.9	11.0
V_4	9.7	10.3	10.7	10.2	9.9	10.6	11.6	10.7
Mean	10.3	9.8	10.2	10.1	9.7	10.4	10.3	10.1
L.S.D.	I V I X V			N.S. 0.57 N.S.				0.47 0.47 0.82

I_1 = Irrigation at 0.8 evaporation pan coefficient
I_2 = Irrigation at 1.0 evaporations pan coefficient
I_3 = Irrigation at 1.2 evaporations pan coefficient
V_1 = Sakha 93 V_2 = Giza 168
V_3 = Gemmeiza 7 V_4 = Gemmeiza 9

2.2. Number of spikes/m^2

2.2.1. Effect of irrigation

In the two seasons, (Table 3) results indicated that number of spikes/m^2 was not significantly affected by irrigation regimes. The highest number was 431 and 481, obtained when plants received irrigation at 1.2 accumulative pan evaporation in the first and second seasons, respectively. These results may be due to the increasing of the available soil moisture level with irrigation at (1.2). These results are in agreement with that obtained by Sidrak (2003) who reported that the number of spikes/m^2 increased by increasing the available soil moisture.

2.2.2. Effect of wheat cultivars

The results in Table (3) indicated that number of spikes/m^2 was not affected by wheat cultivars in the first and second seasons, respectively.

2.2.3 Effect of the interaction

Data presented in Table (3) pointed out that the interaction between irrigation regimes X wheat cultivars on number of spike/m^2 was significant in the first season, whereas it was not significant in the second season. The maximum number 448 and 496 spike/m^2 was obtained from (I_3 X V_4) and (I_3 X

V_2) in the first and second seasons, respectively. The lowest number 406 and 463 spike/m^2 was obtained from I_3 X V_1 and I_1 X V_1 for the same respective seasons.

Table (3): Effect of irrigation regimes and wheat cultivars on number of spike/m^2 in the two growing seasons.

Treatment	2002 / 2003				2003 / 2004			
	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean
V_1	441	425	406	424	463	478	465	469
V_2	424	422	442	429	476	475	496	482
V_3	412	421	428	420	482	467	488	479
V_4	433	438	448	440	480	494	473	482
Mean	428	427	431	428	475	479	481	478
L.S.D.	I			N.S.				N.S.
	V			N.S.				N.S.
	I X V			21.22				N.S.

I_1 = Irrigation at 0.8 evaporation pan coefficient
I_2 = Irrigation at 1.0 evaporations pan coefficient
I_3 = Irrigation at 1.2 evaporations pan coefficient
V_1 = Sakha 93 V_2 = Giza 168
V_3 = Gemmeiza 7 V_4 = Gemmeiza 9

2.3 1000-grain weight (gm)

2.3.1. Effect of irrigation regimes

Table (4) show that the average of 1000-grain weight was not significantly affected by irrigation treatments in the first season. While in the second season the results was significantly affected by irrigation regimes. The highest values 51.47 and 51.62 gm obtained from irrigation at 1.2 evaporation pan coefficient in the first and second seasons, respectively Whereas, the lowest one was 47.69 and 45.77 gm. obtained from irrigation at 0.8 evaporation pan coefficient for the same respective seasons. It could be concluded that frequent irrigation caused an increase in 1000 grain weight. This might be attributed to positive effect of more available moisture at grain filling which increase the starch content and organic compounds in wheat plants. These results go parallel with those obtained by Rayan *et al.*, (2000) and Sidrak (2003).

2.3.2. Effect of wheat cultivars

Data recorded in Table (4) indicate that 1000-grain weight was significantly affected by wheat cultivars in the first and second seasons. The highest values 52.62 and 49.96 gm were gained from Gemmeiza7 and Giza168 cultivars in the first and second seasons, respectively. While the lowest values 48.01 and 45.97 gm were obtained for V_2 and V_4 for the same respective seasons. These results may be due to the effect of meteorological factors in the two seasons.

2.3.3. Effect of the interaction

Results in Table (4) pointed out that the interaction between irrigation regime and wheat cultivars was not significant in both seasons.

Table (4): Effect of irrigation regimes and wheat cultivars on 1000-grain weight in the two growing seasons.

Treatment	2002 / 2003				2003 / 2004			
	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean
V_1	47.72	47.83	49.18	48.24	47.15	47.77	52.00	48.97
V_2	47.45	46.84	49.75	48.01	47.42	49.00	52.86	49.96
V_3	48.69	52.27	56.90	52.62	44.83	49.00	51.63	48.49
V_4	46.89	49.16	50.05	48.70	43.67	44.24	50.00	45.97
Mean	47.69	49.03	51.47	49.39	45.77	47.50	51.62	48.30
L.S.D.	I			N.S.				1.47
	V			0.45				1.20
	IxV			N.S.				N.S.

I_1 = Irrigation at 0.8 evaporation pan coefficient
I_2 = Irrigation at 1.0 evaporations pan coefficient
I_3 = Irrigation at 1.2 evaporations pan coefficient
V_1 = Sakha 93 V_2 = Giza 168
V_3 = Gemmeiza 7 V_4 = Gemmeiza 9

2.4. Number of grains/spike

2.4.1. Effect of irrigation regime

Number of grain/spike as affected by irrigation regimes in the two growing seasons shown in Table (5). Results in the first season showed that the average of number of this trait was not significant in the first season, while in the second season the effect of irrigation regime on the number of grains/spike was significant. The highest number of grain/ spike 48.8 and 47.0 was obtained from irrigation at 1.0 and 1.2 evaporation pan coefficient in both seasons, respectively. The lowest number of grains/spike 46.5 and 42.8 was obtained by irrigation at 0.8 accumulative pan evaporation for the same respective seasons. These results may be due to the increasing in the available soil moisture and/or the number of spike/m^2. These findings go parallel with the results obtained by Amin (2003) and Sidrak (2003).

Table (5): Effect of irrigation regimes and wheat cultivars on number of grains/spike in the two growing seasons.

Treatment	2002 / 2003				2003 / 2004			
	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean
V_1	44.0	46.5	45.5	45.3	42.0	43.0	46.5	43.8
V_2	52.3	56.0	48.3	52.2	44.0	45.0	49.0	46.0
V_3	47.8	50.0	48.5	48.8	42.3	44.3	47.3	44.6
V_4	41.8	42.8	45.0	43.2	42.8	44.8	45.3	44.3
Mean	46.5	48.8	46.8	47.4	42.8	44.3	47.0	44.7
L.S.D.	I			N.S.				1.41
	V			2.50				1.29
	I X V			N.S.				N.S.

I_1 = Irrigation at 0.8 evaporation pan coefficient
I_2 = Irrigation at 1.0 evaporations pan coefficient
I_3 = Irrigation at 1.2 evaporations pan coefficient
V_1 = Sakha 93 V_2 = Giza 168
V_3 = Gemmeiza 7 V_4 = Gemmeiza 9

2.4.2. Effect of wheat cultivars

In both seasons the results presented in Table (5) show that the average number of grains/spike was significantly affected by wheat cultivars.

The highest values 52.2 and 46.0 were obtained from Giza168 cultivar in the first and second seasons, respectively. On the other hand, the lowest number of grains/spike was 43.2 and 43.8 produced from Gemmeiza9 and Sakha93 cultivars in the first and second seasons, respectively. Also, no significant difference was obtained from Sakha93 and Gemmeiza7 in number of grains/ spike in both seasons. These results may be due to the differences in genetic coefficient.

2.4.3. Effect of the interaction

Results in Table (5) showed that the interaction between irrigation regimes and wheat cultivars was not reach to the significant level.

2.5. Grain yield (Ardab/fed.)

2.5.1. Effect of irrigation regimes

With regard to the effect of water regime on grain yield, results in Table (6) revealed that it had a significant effect. The values of the first seasons were 23.09, 24.27 and 24.92 Ardab/fed. For treatment irrigated at 0.8, 1.0 and 1.2 evaporation pan coefficient, respectively. The corresponding values for the second season were 21.89, 24.26 and 25.06 Ardab/fed. This trend revealed that the highest yield of grains was produced from frequent irrigation (1.2 EP) level. Whereas, no significant difference between irrigation at 1.0 and 1.2 on grain yield in both seasons. This trend may prove the importance of soil water for the production of wheat grain yield. These results are in agreement with that obtained by Amin (2003) and sidrak (2003) which stated that grain yield increased as increasing the available soil moisture.

Table (6): Effect of irrigation regimes and wheat cultivars on yield (Ardab/fed) in the two growing seasons.

Treatment	2002 / 2003				2003 / 2004			
	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean
V_1	22.11	22.91	23.41	22.81	19.79	24.24	24.85	22.96
V_2	23.28	24.50	25.48	24.42	22.89	23.92	24.90	23.90
V_3	23.26	24.79	26.66	24.90	21.47	24.92	26.10	24.16
V_4	23.72	24.87	24.12	24.24	23.41	23.95	24.37	23.91
Mean	23.09	24.27	24.92	24.01	21.89	24.26	25.06	23.73
L.S.D.	I			0.81				1.11
	V			0.20				0.76
	I X V			0.85				1.31

I_1 = Irrigation at 0.8 evaporation pan coefficient
I_2 = Irrigation at 1.0 evaporations pan coefficient
I_3 = Irrigation at 1.2 evaporations pan coefficient
V_1 = Sakha 93 V_2 = Giza 168
V_3 = Gemmeiza 7 V_4 = Gemmeiza 9

2.5.2. Effect of wheat cultivars

Yield of wheat grains expressed as Ardab/fed as influenced by wheat cultivars is shown in Table (6). Statistical analysis of the variance showed that wheat cultivars had a significant effect on grain yield in the two growing seasons. The maximum yield was scored from Gemmeiza7 in the two seasons, respectively. This trend may be explained the differences between the cultivars which may be due to the genetic coefficients.

2.5.3. Effect of the interaction

Results in Table (6) showed that the interaction between irrigation regimes and wheat cultivars on grain yield was significant in both seasons. The highest grain yield (Ardab/fed) was obtained from Treatment which irrigate at 1.2 X gemmaize7 in the first and second season, respectively. These results are in agreement with the results obtained by Sidrak (2003).

3. Water – Relations

3.1. Water consumptive use (WCU, m^3/fed)

Seasonal water consumptive use (WCU) as affected by irrigation regimes and wheat cultivars and their interaction are recorded in Table (7). With respect to irrigation regimes, WCU values in the first season were 1691.9, 1845.0 and 2292.7 m^3/fed for irrigation treatment I_1, I_2 and I_3, respectively. The same respective values in the second season were 1472.9, 1748.7 and 2139.0 m^3/fed. These results show that water consumptive use increased as the available soil moisture increased in the root zone of plants (i.e. irrigation wheat plants at ferquent irrigation intervals). While, subjecting wheat plants to soil water deficit caused decrease in WCU. The results indicate that the average of water consumptive use was high in the first season compared with the second season. These finding may be due to the variation in the weather conditions, in special temperature. This higher temperature would automatically resulted in higher WCU. For wheat cultivars WCU in the first season were 1952.9, 1993.6, 1904.9 and 1921.4 m^3/fed for V_1, V_2, V_3 and V_4, respectively.

Table (7): Water consumptive use (WCU m^3/fed) as affect by irrigation regimes and wheat cultivars in 2002/03 and 2003/04 growing seasons.

Irrigation	Cultivars	WCU (m^3/fed)		
		2002/03	2003/04	Mean
I_1	V_1	1663.3	1429.2	1546.3
	V_2	1704.3	1457.1	1580.7
	V_3	1695.9	1485.2	1590.6
	V_4	1704.9	1520.1	1612.2
Average		1691.9	1472.9	1582.4
I_2	V_1	1879.7	1781.8	1830.8
	V_2	1922.9	1719.3	1821.1
	V_3	1779.9	1765.8	1772.9
	V_4	1797.6	1727.7	1762.7
Average		1845.0	1748.7	1796.9
I_3	V_1	2315.9	2117.9	2216.9
	V_2	2353.6	2131.2	2242.4
	V_3	2238.9	2157.1	2198.0
	V_4	2262.2	2149.9	2206.1
Average		2292.7	2139.0	2215.9
Average for all cultivars	V_1	1952.9	1776.3	1864.6
	V_2	1993.6	1769.2	1881.4
	V_3	1904.9	1802.7	1853.8
	V_4	1921.4	1799.2	1860.3
Average		1943.2	1786.9	1865.1

I_1 = Irrigation at 0.8 evaporation pan coefficient
I_2 = Irrigation at 1.0 evaporations pan coefficient
I_3 = Irrigation at 1.2 evaporations pan coefficient
V_1 = Sakha 93 V_2 = Giza 168
V_3 = Gemmeiza 7 V_4 = Gemmeiza 9

Values in the second season were 1776.3, 1769.2, 1802.7 and 1799.2 m^3/fed for the same respective cultivars. These results indicate that the higher water consumptive used obtained by V_2, V_1, V_4 and V_3, gradually. These differences may be due to maturity stage for each variety. These results are in agreement with those obtained by Khater *et al.*, (1997), Rayan *et al.*, (1999) and Sidrak (2003).

The stated values of water consumptive use were obtained according the different factors of evaporation pan (EP), which resulted from different irrigation intervals. Therefore, in the same direction number of irrigations was 3, 4 and 5 for treatments I1, I2 and I3, respectively. So, this technique of using the evaporation pan (EP) could be used as a practical tool to obtain effective way for determining the suitable irrigation interval of the irrigated crop.

The interaction between irrigation regimes and wheat cultivars as shown in Table (7) pointed out that water consumptive use was increasing by short irrigation intervals (I_3) with cultivar (V_2).

3.2. Water use efficiency (WUE kg/m^3)

Results of water use efficiency are recorded in Table (8). Such results indicated that irrigation at 0.8 evaporation pan coefficient gave the maximum water use efficiency 2.14 kg/m^3. This may be due to the lower seasonal water consumption and numbers of irrigation for 0.8 treatment.

Table (8): Water use efficiency (WUE kg/m^3) as affect by irrigation regimes and wheat cultivars in 2002/03 and 2003/04 growing seasons.

Irrigation	Cultivars	WUE (kg grains / m^3) water consumed		
		2002/03	2003/04	Mean
I_1	V_1	1.99	2.08	2.04
	V_2	2.05	2.36	2.21
	V_3	2.06	2.17	2.12
	V_4	2.09	2.31	2.20
Average		2.05	2.23	2.14
I_2	V_1	1.83	2.04	1.94
	V_2	1.91	2.09	2.09
	V_3	2.09	2.12	2.11
	V_4	2.08	2.11	2.10
Average		1.98	2.09	2.06
I_3	V_1	1.52	1.76	1.64
	V_2	1.62	1.75	1.79
	V_3	1.79	1.81	1.80
	V_4	1.60	1.70	1.65
Average		1.63	1.76	1.70
Average for all cultivars	V_1	1.81	1.96	1.89
	V_2	1.86	2.07	2.00
	V_3	1.95	2.03	1.97
	V_4	1.92	2.04	1.98
Average		1.89	2.03	1.96

i_1 = irrigation at 0.8 evaporation pan coefficient
I_2 = Irrigation at 1.0 evaporation pan coefficient
I_3 = Irrigation at 1.2 evaporation pan coefficient
V_1 = Sakha 93 V_2 = Giza 168
V_3 = Gemmeiza 7 V_4 = Gemmeiza 9

The values of water use efficiency were 1.81, 1.86, 1.95 and 1.92 kg/m^3 for V_1, V_2, V_3, and V_4 in the first season, respectively. While in the second season, the values were 1.96, 2.07, 2.03 and 2.04 for the same respective cultivars. These differences may be due to the irrigation numbers and the value of water consumptive use.

The interaction between irrigation treatments and wheat cultivars as listed in the Table (8), showing that water use efficiency reached to its maximum 2.21 kg/m^3 by irrigation at 0.8 evaporation pan coefficient with cultivar (V_2) average of two growing seasons.

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جدولة الرى لبعض اصناف قمح الخبز تحت ظروف مصر العليا

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اقيمت تجربتان حقليتان بمحطة بحوث جزيرة شندويل خلال موسمى ٢٠٠٢ / ٢٠٠٣ م ، ٢٠٠٣ /٢٠٠٤ م وذلك لدراسة جدولة الرى لاربعة اصناف من قمح الخبز(سخا ٩٣ و جيزه ١٦٨ وجميزه ٧ و جميزه ٩) باستخدام ثلاثة معاملات بخر الوعاء القياسى (٨, & ١,٠ & ١,٢ معامل بخر الوعاء)، وتاثير المعاملات المذكورة على العلاقات المائية و المحصول ومكوناته .

أوضحت النتائج أن هناك اختلافات معنوية بين الأصناف و الرى وذلك لجميع الصفات تحت الدراسة في الموسم الثاني ، كما أوضحت النتائج أن معامل البخر ١,٢ أعطى احسن النتائج في كل من طول النبات ومحصول الحبوب ومكوناته، فالرى عند معامل البخر ١,٢ مع الصنف جميزه ٧ أعطى أعلى قيمة محصولية وهى ٢٦,٦٦ ، ٢٦,١٠ إردب/فدان في الموسم الأول والثاني على الترتيب.

أعطى الرى عند معامل بخر ١,٢ أعلى استهلاك مائي لمحصول القمح بالمقارنة بمعاملات وعاء البخر الأخرى ، و بلغ الاستهلاك المائي لمحصول القمح ١٥٨٢,٤ ، ١٧٩٦,٩ ، ٢٢١٥,٩ متر مكعب للفدان لمعاملات الرى عند معامل بخر ٠,٨ ، ١,٠ ، ١,٢ على الترتيب.

أعطي الرى عند معامل بخر ٠,٨ اعلى قيمة للكفاءة الاستعمالية لمياه الرى ٢,١٤كج/م٣(متوسط الموسمين).

من هذه النتائج نستنتج انه يمكن تنظيم ري محصول القمح في مصر العليا باستخدام معامل بخر قدره ١,٢ وذلك للحصول على افضل النتائج واعلى محصول حبوب مع دراسة صنف جميزة ٧.