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RESPONSE OF SOME WHEAT CULTIVARS TO IRRIGATION IN NORTH NILE DELTA.

BY

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ABSTRACT

Two field experiments were carried out at Sakha Agricultral Research Station, Kafr El-Sheikh Governorate, North Nile Delta region during the two growing seasons (2004/2005 and 2005/2006) to find out the response of some wheat cultivars to different irrigation levels. Six wheat cultivars were subjected to 2 irrigation amounts computed on 2 basis (1)on soil moisture depletion (SMD) in effective root zone and (2) on Ibrahim's equation.[ET p = 0.1642 +0.8 Ep] The wheat cultivars were; Sakha 61, Sakha 93, Gemmeiza 7, Gemmeiza 9, Sids 1 and Giza 168. The results revealed significant differences among the cultivars and irrigation levels regarding grain and straw yields as well as 1000-grain weight and harvest index. The highest grain yield 3119.92 kg/ fed. (7.4 "mega grams Mg" metric tons/ ha) was given by Giza 168 under SMD. Under Ibrahim equation, the highest yield was 2944.27 kg/ fed. (7.0 Mg/ ha) was recorded. Treatment F_1 i.e Giza 168 which irrigated depending upon SMD gave the highest mean values of 2.02 and 1.98 kg/ m^3 as water utilization (W.Ut.E) and use efficiency (W.U.E.) respectively.

INTRODUCTION

Wheat is the main cereal crop in Egypt. Efforts have been made to minimize the gap between the national consumption and production in wheat. Productivity of wheat is affected by several factors such as water and high yielding cultivars. Effective irrigation management is essential for up-grading the productivity of each unit of applied water. The deficit in wheat production is in the range of about 50% of national consumption. Water is one of the most important factors in crop production. The shortage of water in Egypt continuously increases as a result of the fixed water share of Egypt and the rapid increase in water demand. To evaluate the most common wheat cultivars widely cultivated from irrigation productivity point of view, six bread wheat cultivars were subjected to two irrigation levels. One is irrigation water equal to the actual extracted water from the effective root zone or so-called soil moisture depletion SMD, while the other was based on Ibrahim method which is mainly computed from pan evaporation (Ep). The wheat-irrigation parameters were studied widely in Egypt and world wide.

Metwally *et al.* (1984) revealed that the mean values of seasonal consumptive use by wheat were 40.97, 35.23 and 31.62 cm at Sakha for irrigation at 25, 50 and 75% soil moisture depletion (SMD). They added that higher yields of grains and straw were obtained with *irrigation* at 25 and 50 % SMD. Sharma *et al.* (1990) reported that water use efficiency of winter wheat was highest under sufficient irrigation condition compared with stress conditions. Ibrahim and Walker (1993) found that dead level has a higher value of crop-water productivity, in terms of water utilization efficiency (W Ut E) in relation to the soil slope. Value of water use efficiency WUE ranged between 0.70- 0.82 Kg grains /m^3 with an overall average of 0.75 Kg grains/m^3 water.

Yousef and Eid (1999) concluded that irrigation at 30 % available soil moisture depletion gave highest WUE of 1.004 and 0.998 kg grain/m^3 water consumed two successive season. Abul-Naas *et al.* (2000) indicated that wheat plants which received 4 irrigations significantly out yielded those which received 1, 2 or 3 irrigations. Khater *et al.*(1997) found that number of spikes/ m^2, 1000 grain weight, straw and grain yield decreased with decreasing available soil moisture. Abo Warda(2002) found that at El Bustan area (western Nile Delta), irrigation of wheat plants at 458 mm and 333 mm of water increased yield and yield components compared to 208 mm; and that WUE progressively decreased with increasing irrigation.

Hefnawy and Wahba (2003) stated that WUE for wheat increased due to reducing the number of irrigations. Other investigations were done by other researchers such as, Singh and Patel (1995). Armstrong *et al.* (1996). Garabet *et al.*, (1998) Reynolds *et al.* (1999). and Nabipour *et al.* (2002) indicating lower yields due to lower irrigation.

To evaluate the most common wheat cultivars widely cultivated from irrigation productivity point of view, six wheat bread cultivars were subjected to two irrigation levels. One was irrigation water equal to the actual extracted water from the effective root zone or so-called soil moisture depletion SMD, while the other level was implemented based on Ibrahim method which is mainly computed from pan evaporation (Ep).

The main objective of the current study was to evaluate some different wheat irrigation efficiency parameters for a number of wheat cultivars which are of a great importance in Egypt.

Specific goals were:

1- To compute irrigation water and the water consumed by plant.
2- To evaluate the most proper method in computing irrigation water in North Nile Delta region where the study took place.
3- To find out the most suitable cultivar (s) to be grown in the area in connection with maximizing crop-water productivity.

MATERIALS AND METHODS

This study was carried out at the Crops Water Requirement Research field, Sakha Agricultural Research Station, Kafr El-Sheikh Governorate (Middle North Nile Delta) Egypt during the two winter seasons 2004/2005 and 2005/2006 of wheat. Soil of the field was a clay loam. (Table, 1) The plot area was 52.5 m^2(1/80 fed.) and the experimental design was a split plot involving two factors; main treatment (wheat varieties) and sub treatment (irrigation level)

I- Main-treatments (wheat cultivars) were as follow:

A: Sakha 61	**B:** Sakha 93	**C:** Gemmeiza 7
D: Gemmeiza 9	**E:** Sids 1	**F:** Giza 168

II- Sub treatments(irrigation amount):

1-Soil moisture depletion SMD (direct method)
2-Ibrahim equation (1981) [Indirect method]:

Codes denoting treatment combinations are represented by: the letter denoting the cultivar followed by the number denoting irrigation amount (e.g. E1= Sids 1-SMD)

Details of irrigation treatments:

The computation of irrigation water was based (in the two methods) as follows:

1- Soil moisture depletion SMD (direct method)

Irrigation water was equal to the water needed to replenish the extracted moisture consumed before each irrigation plus 10% (leaching factor)

$$SMD = \frac{Fc - \emptyset_i}{100} \times D_b \times d \times A$$

Where:

SMD = Soil moisture depletion in the effective root zone (60 cm),
Fc = Field capacity, %,
$\emptyset_i$ = Soil moisture percentage on w/w basis, before irrigation,
D_b = Soil bulk density, Mg/m^3,
d = Soil wetting depth (effective root zone of 60 cm)
A = Irrigation area.
Then irrigation water (IW) was equal to SMD +10 %

2-Ibrahim equation (1981) [Indirect method]:

ET p = 0.1642 +0.8 Ep
where:
ETp = potential evapotranspiration, (cm/day)
Ep = pan evaporation, (cm/day)

The applied irrigation water (IW) was equal to crop-evapotranspiration (ETc), which was calculated as follows:

ETc = ETp * Kc
Which was:
ETc = water consumed by crop i.e. crop evapotranspiration (cm/day)
Kc = crop coefficient of wheat during the period of a specified irrigation interval.

Treatments were executed in 3 replicates.

Table (1): Mechanical analysis and soil water parameters of the experimental field

Soil depth (cm)	Physical properties								
	Particle size distribution, %			Texture Class	Bulk Density (Mg/m³)	Total Porosity %	Field Capacity %	PWP	A.W.
	Sand	Silt	Clay						
0-15	12.3	33.3	54.4	Clay	1.26	52.45	47.50	25.69	21.81
15-30	20.2	34.2	45.6	Clay	1.30	50.94	39.87	21.66	18.21
30-45	20.4	41.4	38.2	Clay loam	1.29	51.32	38.40	20.86	17.54
45-60	21.1	41.5	37.4	Clay loam	1.38	47.92	36.39	19.78	16.61
Mean	18.5	37.6	43.92		1.31	50.66	40.54	22.00	18.51

* PWP: Permanent wilting point, AW: Available water, ** Mg: megagram i.e. 10^6 g

Data collected

1- Irrigation water (IW):

Irrigation water was determined by a constructed rectangular weir in the experimental field with a discharge rate of 0.1654 m^3/sec at 10 cm as effective head over the crest.

2- Consumptive use (CU):

To compute the actual consumed water of the growing plants, soil moisture percentage was determined, (on weight basis) before and after each irrigation as well as at harvest. Soil samples were taken from successive layers of the effective root zone; (0-15, 15-30, 30-45 and 45-60 cm). This method is one of the direct methods of consumptive use which based on soil moisture depletion (SMD) or so called actual crop-water consumed (ETc) as stated by Hansen *et al.* (1979).

$$Cu = \sum_{i=1}^{i=4} \frac{\emptyset_2 - \emptyset_1}{100} \times D_{bi} \times D_i$$

Where:
Cu = water consumptive use (cm) in the effective root zone (of 60 cm depth),
i = number of soil layers (1-4),
D_i = soil layer thickness (15 cm),
D_{bi} = soil bulk density (Mg/m^3) of the concerned layer.
$\emptyset_1$ = soil moisture percentage before irrigation and
$\emptyset_1$ = soil moisture percentage, 48 hours after irrigation

3-Water efficiency for crop

Crop water efficiency was calculated according to Doorenbos and Pruitt, (1975), as follows:

$$(A)\ WUtE = \frac{Y}{I.W}$$

$$(B)\ WUE = \frac{Y}{Cu}$$

where,
WUtE = Water utilization efficiency (kg/m^3)
WUE = Water use efficiency (kg/m^3)
Y = Seasonal yield kg/ fed.,
I.W = Seasonal irrigation water applied and
Cu = Seasonal crop-water consumed.

Yield parameters:
- Grain yield
- 1000-grain weight
- Straw yield
- Biological yield (grains + straw)
- Harvest index

The obtained data of crop yield were subjected to statistical analysis according to Snedecor and Cochran (1980) and the mean values were compared by L.S.D. at 5 % and 1 % levels of probability.

RESULTS AND DISCUSSION

Applied irrigation water (I.W.):

Applied water consists of two components; irrigation water (IW) and rainfall (RF) as described in Table (2). Seasonal rainfall was 130 and 70 mm during the water growing seasons of 2004/2005 and 2005/2006 respectively. The mean values of applied irrigation water to different wheat cultivars can be arranged in a descending order as 1711.98> 1602.50> 1565.85> 1547.13> 1524.83> 1515.29 m^3/fed. for E_1, B_1, A_1, F_1, C_1 and D_1 treatments, respectively. These values are calculated on the basis of soil moisture depletion (SMD). On the other hand, the mean seasonal irrigation water applied to the crops (IW) for the two seasons as computed by Ibrahim's equation is 1640.42 m^3 /fed. or 39.06 cm (average for all cultivars).

The difference in IW values computed on basis of SMD. reflects the actual soil water extracted by different wheat varieties which differ from one variety to another. I.W. which is computed according to Ibrahim's method depends upon evaporation (Ep) and crop-coefficient (k_c), both are not affected by wheat varieties.

Irrigation water of E_1 treatment (Sids 1-SMD.) was the highest (1711.98 m^3/fed.,) while the lowest (1515.29 m^3 /fed.) was for D_1 treatment (Gemmeiza 9, SMD). Seasonal rainfall (RF) was 130 and 70 mm during the first and the second seasons, respectively. Thus, the mean total water applied for wheat cultivars (based on SMD.) can be arranged in descending order as 2131.98> 2022.5> 1985.85> 1967.13> 1944.83> 1935.29 m^3/fed. for E1, B1, A1, F1, C1 and D1 cultivars respectively. Mean total applied water (I.W.+ RF) equals 2060.42 m^3/fed. by Ibrahim equation. Sids 1 variety is initiated and developed in south Egypt by the Egyptian wheat programme, of the Agriculture Research Center (A.R.G.). The climatic conditions of

such area are high in both air temperature and evaporation losses which leads to a higher irrigation water demand. The two methods which are used in this study in calculating irrigation water gave comparable values.

Comparison between the two methods (of SMD. and Ibrahim) used in calculating applied IW show that the deviation between them is only 1.04%. Ibrahim method exceeds the SMD method by only about 1 %. In this regard, it is highly recommended to use Ibrahim method in computing IW for the following advantages:

- Easy in calculation.
- Avoiding the soil destructive effect due to soil sampling.
- Avoiding time lag between taking soil samples and getting the result (24 hrs).
- Saving labour, time and equipment needed for determination.

The average of total water applied for wheat in Middle North Nile Delta region is 2029.17 m^3/ fed. (48.31 cm) for the six cultivars calculated by the two methods of SMD and Ibrahim. The stated value consists of 420 m^3/ fed. (10 cm) or 20.70 % as rainfall and 1609.17 m^3/ fed 79.30 % as irrigation water. Irrigation water was applied through four waterings plus the sowing one. These results are in agreement with those reported by Metwally *et al.* (1984), Shahin and Mosa (1994), Khater *et al.* (1997) and Sidrak (2003).

Crop consumptive use (CU):

Crop consumptive use (CU) was computed directly on the basis of water extracted by the growing plants (from the effective root zone (60 cm) depth) during the successive watering plus that withdrawn from the last one till harvesting. The actual soil moisture depleted is considered as a direct method for determination of crop water use "crop evapotranspiration, ETc". Mean values of CU in the two growing seasons (Table 3) for the cultivars based on SMD can be arranged in the descending order of: 38.82> 37.5> 36.70> 35.56> 34.63 and 33.69 cm for E_1, F_1, B_1, D_1, A_1 and C_1 respectively (Table, 3). For the same cultivars irrigated by Ibrahim equation, values are 42.15> 40.88> 40.35> 38.93> 38.35> 35.58 for F_2, E_2, D_2, A_2, B_2 and C_2 respectively.

Treatment E_1 (Sids-1- SMD) has the highest mean value of 38.82 cm with seasonal rate of 2.4 mm/day. For Ibrahim equation, treatment F_2 (Giza 168) has the highest mean value of 42.15 cm with a rate of 2.6 mm/ day. It is obvious from the same Table that the average seasonal value of CU rate for different cultivars irrigated based on SMD. is 2.2 mm/day. The corresponding value for the same cultivars irrigated with Ibrahim equation is 2.4 mm/day. The ratio between mean values of CU computed by the two methods is 1.2.

***Grain yield:**

Data in Table (4) reveal no significant effect of irrigation amount on wheat grain yield. Wheat cultivars have shown significant differences in grain yield in the two growing seasons. The maximum yield of 3119.92 kg (20.80 Ardab/ fed.) was scored from Giza 168 under SMD., while under Ibrahim method the maximum yield of 2944.27 kg/ fed (19.63 Ardab/fed.) was recorded for the same cultivar. There was a significant interaction effect between irrigation amount and wheat cultivar on grain yield in the first growing season.

Table (2): Seasonal water applied (I.W., irrigation water; RF, rainfall) for some varieties of wheat expressed in m^3/fed and cm as affected by irrigation treatments.

Water applied	Treatments											
	A_1	A_2	B_1	B_2	C_1	C_2	D_1	D_2	E_1	E_2	F_1	F_2
Season (2004-2005)												
I.W. m^3/ fed.	1530.15	1689.24	1580.2	1689.24	1560.18	1689.24	1535.10	1689.24	1706.94	1689.24	1565.85	1689.24
I.W. cm/ fed	36.43	40.22	37.62	40.22	37.15	40.22	36.55	40.22	40.64	40.22	37.28	40.22
RF, m^3/ fed.	→ 546 ←											
RFcm/ fed.	→ 13 ←											
Season (2005-2006)												
I.W. m^3/ fed	1601.54	1591.6	1624.80	1591.6	1489.49	1591.6	1495.47	1591.6	1717.01	1591.6	1523.41	1591.6
I.W. cm/ fed	38.13	37.89	38.68	37.89	35.46	37.89	35.61	37.89	40.88	37.89	36.39	37.89
RF, m^3/ fed.	→ 294 ←											
RF, cm/ fed.	→ 7 ←											
Mean of 2 season												
I.W. m^3/ fed	1565.85	1640.42	1602.50	1640.42	1524.83	1640.42	1515.29	1640.42	1711.98	1640.42	1547.13	1640.42
I.W. cm/ fed	37.28	39.06	38.15	39.06	36.31	39.06	36.07	39.06	40.76	39.06	36.84	39.06
RF, m^3/ fed.	→ 420 ←											
RF, cm/ fed.	→ 10 ←											

Table (3): Seasonal consumptive use (CU) as calculated by soil moisture depletion (SMD) and Ibrahim equation ET p = 0.1642 +0.8 Ep, for six wheat cultivars (CV) and their irrigation treatments in the two growing season.

(CU)	Cultivars and irrigation treatment											
	A_1	A_2	B_1	B_2	C_1	C_2	D_1	D_2	E_1	E_2	F_1	F_2
Season (2004-2005)												
cm	34.11	39.11	36.40	38.59	34.13	37.15	36.00	42.20	39.50	41.53	38.70	43.12
(mm /day)	2.1	2.4	2.2	2.4	2.1	2.3	2.2	2.6	2.4	2.6	2.4	2.7
Season (2005-2006)												
cm	35.15	38.75	37.00	38.11	33.25	34.02	35.12	38.50	38.13	40.23	36.30	41.17
(mm /day)	2.1	2.4	2.3	2.3	2.0	2.1	2.1	2.3	2.3	2.5	2.2	2.5
Mean of 2 season												
Cm	34.63	38.93	36.70	38.35	33.69	35.58	35.56	40.35	38.82	40.88	37.5	42.15
(mm /day)	2.1	2.4	2.2	2.3	2.1	2.2	2.2	2.5	2.4	2.5	2.3	2.6

* growing season 163 days,. A, B, C, D, E, F represent cultivars Sakha 61, Sakha 93, Gemmeiza7, Gemmeiza9, Sids 1 and Giza 168 respectively; 1 and 2 following CU letters denotes method of CU 1 = SMD, and 2 = Ibrahim equation.

Grain yield for different cultivars can be arranged in descending order as: Giza 168, Gemmeiza 7, Sakha 93, Gemmeiza 9, Sakha 61, and Sids 1. The mean values are 3032.09, 2782.96, 2643.13, 2605.29, 2398.18 and 2252.85 kg/ fed. The relative values in percentage are: 100, 91.8, 87.2, 85.9, 79.1 and 74.3 % respectively. It might be stated that Giza 168 is the most proper cultivar cultivated in the area followed by Gemmiza 7 and Sakha 93. The yields obtained are 3032.09, 2782.96 and 2643.13 kg/ fed. Either SMD or Ibrahim method could be used in calculating irrigation water, since both methods yielded almost the same grain yield. These data are in agreement with Yousef and Eid (1994)

Crop-Water efficiencies:

Crop water efficiency is a parameter which indicates the crop water productivity. This function could be evaluated in the two terms of water utilization efficiency (W.Ut.E.) for water applied and water use efficiency (WUE) for water consumed. Regarding water utilization efficiency (W.Ut.E.), the mean values of the two seasons for different wheat cultivars irrigated on basis of SMD can be arranged in the descending order of 2.02> 1.85> 1.73> 1.69> 1.56> 1.35 kg/m^3 for F_1, C_1, D_1, B_1, A_1 and E_1 treatments, respectively (Table 5). The corresponding values of W.Ut.E. in descending order as computed by Ibrahim's equation is 1.80> 1.69> 1.58> 1.57> 1.44> 1.34 kg/m^3 for F_2, C_2, D_2, B_2, A_2 and E_2, respectively. Regarding watering by SMD, F_1 (Giza 168) has the highest mean value of 2.02 kg/m^3. Watering by Ibrhim's equation, F_2 (Giza 168) has the highest mean value of 1.80 kg/m^3. Therefore, one kg of grain wheat bread needs an average of 525 L water.

Table (4): Effect of irrigation level and wheat cultivars on grain yield in the two growing seasons.

Irrigation level (M)	Wheat cultivar(s)						Mean
	A	B	C	D	E	F	
Season (2004/2005)							
M1	2408.43	2662.37	2870.57	2703.97	2348.87	3175.83	2692.01
M2	2414.57	2647.27	2780.23	2627.77	2168.43	2988.13	2648.20
S. Mean	2411.50	2654.82	2825.40	2665.87	2258.65	3072.98	2648.21
LSD (5%) M x S 0.68 M: ns S: 0.85							
Season (2005/2006)							
M1	2460.53	2767.53	2750.87	2532.03	2264.07	3082.00	2642.87
M2	2309.00	2495.33	2730.17	2560.73	2230.03	2900.40	2537.61
S. Mean	2384.77	2631.43	2740.52	2546.38	2247.05	2991.20	2590.23
LSD (5%) M x S 1.01 M: 1.00 S: 0.74							
Mean of 2 Season							
M1	2434.48	2714.95	2810.72	2618.00	2306.47	3119.92	2667.42
M2	2361.79	2571.30	2755.20	2592.58	2199.23	2944.27	2571.56
S. Mean	2398.18	2643.13	2782.96	2605.29	2252.85	3032.09	2619.49
LSD (5%) M x S 0.74 M 0.83 S 0.32							

Irrigation level: M1: soil moisture depletion (SMD), M2: Ibrahim equation (ET_P=0.1642 + 0.8 Ep. see footnotes of Table 3.

Concerning, water use efficiency (WUE) which indicates t ıe capability of one unit of consumed water in crop production, values are tabulated in Table 6. Under SMD., values of WUE for different wheat cultivars can be arranged in descending order as 1.98> 1.98> 1.76> 1.76> 1.67> 1.42 kg/m^3 for F_1, C_1, D_1, B_1, A_1 and E_1, respectively. On the other hand, under Ibrahim method the values on the descending order can be arranged as 1.84> 1.67> 1.60> 1.53> 1.45> 1.28 for C_2, F_2, B_2, D_2, A_2 and E_2 treatment, respectively. The highest values of WUE are 1.98 and 1.84 kg/m^3 on basis of SMD. and Ibrahim methods respectively. This gives an average 1.91 kg/m^3 which means that one kg of grain wheat bread needs 523.6 L of consumed water in Middle North Nile Delta region. This finding are in good agreement with those obtained by Shahin and Mosa (1994) and Abo-warda (2002).

*** Straw yield:**

Data in Table (7) reveal that irrigation amount has no effect on straw yield. Wheat cultivars showed differences in their yield. The highest mean values of 6783.72 and 6517.0 kg/fed are obtained from Sakha 61 and Gemmeiza 9 under Ibrahim method and SMD method respectively. The effect of the interaction between irrigation and cultivars was not significant in both seasons.

Table (5): Water utilization efficiency for some varieties of wheat as affected by irrigation treatments, expressed in kg/m^3

Water utilization efficiency	Treatments											
	A_1	A_2	B_1	B_2	C_1	C_2	D_1	D_2	E_1	E_2	F_1	F_2
Season (2004-2005)												
WUt E kg/m^3	1.57	1.43	1.68	1.57	1.84	1.65	1.76	1.55	1.38	1.28	2.02	1.77
Season (2005-2006)												
WUt E kg/m^3	1.54	1.45	1.70	1.57	1.85	1.72	1.69	1.61	1.32	1.40	2.02	1.82
Mean of 2 season												
WUt E kg/m^3	1.56	1.44	1.69	1.57	1.85	1.69	1.73	1.58	1.35	1.34	2.02	1.80

See footnotes of Table 3.

Table (6): Water use efficiency for some varieties of wheat as affected by irrigation treatments, expressed in kg/m^3

Water use efficiency	Treatments											
	A_1	A_2	B_1	B_2	C_1	C_2	D_1	D_2	E_1	E_2	F_1	F_2
Season (2004-2005)												
WUE kg/m^3	1.68	1.47	1.74	1.63	2.00	1.78	1.79	1.48	1.42	1.24	1.94	1.65
Season (2005-2006)												
WUE kg/m^3	1.67	1.42	1.78	1.56	1.97	1.91	1.72	1.58	1.41	1.32	2.02	1.68
Mean of 2 season												
WUE kg/m^3	1.67	1.45	1.76	1.60	1.98	1.84	1.76	1.53	1.42	1.28	1.98	1.67

See footnotes of Table 3.

Data in Table (8) show no significant differences between the two methods on Biological yields. Differences between wheat cultivars show significant effect on this trait in the two seasons. The highest mean values of 9537.5 and 9159.5 kg/fed were obtained by Giza 168 under Ibrhim and SMD. method respectively. On the other hand, the lowest mean values 8120.0 of and 8099.0 were obtained by Sids 1 under SMD. and Ibrahim methods respectively. The effect of interaction between irrigation and cultivars was not significant in both seasons. Results show that both SMD and Ibrahim methods, resulted in similar yields. Giza 168 has the highest value of grain followed by Gemmeiza 7. Regarding both straw and biological yields Giza 168 has the highest value followed by Gemmeiza 9.

*** 1000-Grain weight (gm):**

As concerns irrigation level, Table 9 shows that, on average, the 1000-grain weight was not significantly affected by irrigation methods. However differences between cultivars were significant. The highest mean values of 55.90 and 54.89 g for the 2 seasonswere obtained by Sakha 61 under Ibrahim method and

SMD, respectively. The lowest mean values of 45.15 and 46.14 g were obtained by Sids 1 under SMD and Ibrahim methods, respectively. The effect of the interaction between irrigation methods and wheat cultivars was not significant regarding the average of the 2 seasons.

Table (7): Effect of irrigation level and wheat cultivars on straw yield in the two growing seasons.

Season (2004/2005)							
Irrigation level (M)	Varieties (S)						M. mean
	A	B	C	D	E	F	
1	6341.57	5429.63	5634.43	6256.03	5841.13	6292.17	5965.83
2	7014.43	5787.73	6277.77	7175.57	5993.57	6731.87	6496.82
S. Mean	6678.00	5608.68	5956.10	6715.80	5917.35	5353.39	6038.22
LSD (5%) M x S ns		M ns	S ns				
Season (2005/2006)							
1	6310.47	5513.47	5789.13	6777.97	5785.60	5787.00	5993.99
2	6553.00	5911.67	5284.83	5944.27	5805.97	6444.60	5990.72
S. Mean	6931.73	5712.57	5536.98	6361.12	5791.28	6115.80	5991.58
LSD (5%) M x S ns		M ns	S 0.61				
Mean of 2 Season							
1	6326.02	5471.55	5711.78	6517.00	5813.53	6039.59	5979.91
2	6783.72	5849.70	5781.30	6559.92	5899.70	6588.24	6243.76
S. Mean	6554.87	5660.63	5746.54	6538.46	5856.62	6313.92	6111.84
LSD (5%) M x S 0.35		M 0.22	S 1.11				

Table (8): Effect of irrigation level and wheat cultivars on biological yield in the two growing seasons.

Season (2004/2005)							
Irrigation level (M)	Varieties (S)						M. mean
	A	B	C	D	E	F	
1	8750.0	8092.0	8505.0	8960.0	8190.0	9450.0	8657.8
2	9429.0	8435.0	9058.0	9800.0	8162.0	9730.0	9102.3
S. Mean	9089.5	8263.5	8781.5	9380.0	8176.0	9590.0	8880.05
LSD (5%) M x S ns		M ns	S 0.78				
Season (2005/2006)							
1	8771.0	8281.0	8540.0	9310.0	8050.0	8869.0	8581.28
2	8862.0	8407.0	8015.0	8505.0	8036.0	9345.0	8528.33
S. Mean	8816.5	8344.0	8277.5	8907.5	8043.0	9107.0	8582.58
LSD (5%) M x S ns		M ns	S 0.85				
Mean of 2 Season							
1	8760.5	8186.5	8622.5	8976.67	8120.0	9159.0	8647.33
2	9145.5	8421.0	8536.5	9152.5	8099.0	9537.5	8815.33
S. Mean	8953.0	8303.75	8579.5	9143.75	8109.50	9348.50	8739.67
LSD (5%) M x S ns		M ns	S 1.20				

* **Biological yield (yield of grains + straw), see footnotes of Table 3.**

Table (9): Effect of irrigation level and wheat cultivars on 1000-grain weight in the two growing seasons.

Irrigation level (M)	Varieties (S)						M. mean
	A	B	C	D	E	F	
Season (2004/2005)							
1	55.27	53.43	52.40	51.63	45.90	48.17	51.13
2	56.43	54.53	53.17	52.27	46.87	49.30	52.09
S. Mean	55.85	53.98	52.78	51.95	46.38	48.73	51.61
LSD (5%) M x S 0.12		M ns		S 2.02			
Season (2005/2006)							
1	54.50	52.57	52.17	50.73	44.40	47.73	50.35
2	55.37	53.57	53.37	51.83	45.40	49.07	51.43
S. Mean	54.93	53.07	52.77	51.28	44.90	48.40	50.89
LSD (5%) M x S ns		M ns		S 2.20			
Mean of 2 Season							
1	54.89	53.00	52.28	51.18	45.15	47.95	50.74
2	55.90	54.05	53.27	52.05	46.14	49.18	51.77
S. Mean	55.39	53.52	52.78	51.61	45.64	48.57	51.25
LSD (5%) M x S ns		M ns		S 1.95			

see footnotes of Table 3.

*** Harvest index:**

Irrigation level has no effect on harvest index (Table 10). However, the effect of wheat cultivars was significant on this trait in both seasons of study. The highest mean values of 34.17 and 32.40 % were obtained by Giza 168 and Gemmeiza 7 under SMD and Ibrahim methods, respectively. The effect of interaction between irrigation methods and wheat cultivars on harvesting index was not significant.

CONCLUSIONS

- For grain yield, the tested wheat cultivars could be arranged in the following order for adoption in the area: Giza 168 > Gemmeiza 7 > Sakha 93 > Gemmeiza 9 > sakha 61 > Sids 1.
- For straw yield, the arrangement is as follows: sakha 61 > Gemmeiza 9 > Giza 168 > Sids 1 > Gemmeiza 7 > Sakha 93.
- WUT which assesses productivity per m^3 of applied water could be arranged as follows: Giza 168 > Gemmeiza 7 > Gemmeiza 9 > sakha 61 > Sids 1.
- There is no pronounced differences in the calculated irrigation water (IW) based on the two methods of soil moisture depletion in the effective root zone (S M D) which depends on the acual water withdrawn by the growing plants and Ibrahim's method which uses Pan evaporation (Ep) in the area. Thus each one of the two methods is suitable for calculating IW in the area.

Table (10): Effect of irrigation level and wheat cultivars on harvesting index in the two growing seasons.

Irrigation level (M)	Varieties (S)						M. mean
	A	B	C	D	E	F	
Season (2004/2005)							
1	27.53	32.97	33.80	30.20	28.70	33.53	31.12
2	25.60	31.43	30.73	26.80	26.57	30.83	28.66
S. Mean	26.57	32.20	32.27	28.50	27.63	32.18	29.89
LSD (5%) M x S 0.08		M 0.38		S 3.02			
Season (2005/2006)							
1	28.13	33.40	32.23	27.13	28.23	34.80	30.66
2	26.23	29.77	34.07	30.17	27.80	31.10	29.86
S. Mean	27.18	31.58	33.15	28.65	28.02	32.95	30.26
LSD (5%) M x S 0.93		M ns		S 1.85			
Mean of 2 Season							
1	27.83	33.19	33.02	28.67	28.47	34.17	30.89
2	25.92	30.60	32.40	28.48	27.19	30.97	29.26
S. Mean	26.87	31.89	32.71	28.58	27.83	32.57	30.07
LSD (5%) M x S ns		M ns		S 3.55			

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استجابة بعض اصناف القمح للري في شمال دلتا النيل

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أقيمت تجربتان حقليتان بمحطة البحوث الزراعية بسخا- كفر الشيخ بشمال وسط الدلتا خلال موسمي ٢٠٠٤/٢٠٠٥ & ٢٠٠٥/ ٢٠٠٦ وذلك لدراسة استجابة بعض أصناف القمح لمستويات ري مختلفة حيث كانت الأصناف المنزرعة هي:-

سخا ٦١ & سخا ٩٣ & جميزة ٧ & جميزة ٩ & سدس ١ و جيزة ١٦٨ ومستويات الري هي:-

١- الري حسب الاستنفاذ الرطوبي في منطقة الجذور

٢- الري حسب معادلة إبراهيم والخاصة بالمنطقة، وقد أوضحت النتائج أن:-

- هناك اختلا فات معنوية بين الأصناف المروية بمستويات مختلفة من المياه علي كل من محصول الحبوب و محصول التبن بالإضافة إلي المحصول البيولوجي (محصول الحبوب + التبن) ووزن ١٠٠٠ حبه ومعامل الحصاد.
- صنف جيزة ١٦٨ تحت SMD أعطى أعلي محصول ٣١١٩,٩٢ كجم/فدان (٧,٤ طن/هكتار) وكذا محصول نفس الصنف تحت معادلة إبراهيم كان الاعلي بما قيمته ٢٩٤٤,٢٧ كجم/فدان (٧,٠ طن/هكتار).
- اعلي كفاءة استخدام لوحدة مياه الري المستهلكة كفاءة استهلاك الري W.U.E بواسطة النبات (٢,٠٢ كجم/م^3) من الصنف جيزة ١٦٨ تحت مستوى الري (SMD) بينما كانت اعلي كفاءة استعمال لوحدة مياه الري (W.Ut.E) بواسطة النبات (١,٩٨ كجم/م^3) لنفس الصنف جيزة ١٦٨ تحت نفس مستوى الري SMD.
- كما أنة لا توجد فروق جوهرية بين استخدام كل من طرق حساب كمية مياه الري، بناء علي الاستنفاذ الرطوبي بمنطقة الجذور أو تطبيق معادلة إبراهيم التي تعتمد علي بيانات وعاء البخر بالمنطقة و عليه فيمكن ترتيب أصناف القمح من ناحية أنتاج محصول الحبوب بالمنطقة كما يلي:-

جيزة ١٦٨- جميزة ٧- سخا ٩٣ - جميزة ٩ - سخا ٦١ - سدس ١، بينما بالنسبة للتبن يمكن ترتيبها كما يلي:-

سخا ٦١ - جميزة ٩ - جيزة ١٦٨ - سدس ١ - جميزة ٧ - سخا ٩٣، في حين أن إنتاجية وحدة المياه المضافة يمكن ترتيبها كما يلي:-

جيزة ١٦٨ -- جميزة ٧ - جميزة ٩- سخا ٩٣- سخا ٦١ - سدس ١