Zagazig J.Agric. Res., Vol . 29 No.(5) 2002 **1411-1427**

EFFECT OF AMOUNT OF IRRIGATION WATER CALCULATED FROM CLASS A PAN ON GROWTH AND YIELD OF WHEAT AND SOME RELATED WATER RELATIONS

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Received 15 / 9 / 2002 *Accepted 5 / 10 / 2002*

ABSTRACT: Two field experiments were carried out during 2000/2001, and 2001/2002 seasons to study the effect of the amount of irrigation water on wheat (Gemmiza 7 CV) growth, yield, water requirement, water consumptive use and water use efficiency. The amount of water was determined based on Class A pan method. These amounts were equal to 100 (2425m^3/fed), 80(2040m^3/fed), 60% (1660m^3/fed) of Class A pan evaporation given on four monthly irrigations. The experiments were carried out at Zankalon Water Requirement Research Station, Sharkia Governorate, Egypt. Results indicated that there were no significant differences between the effect of treatment T1 which received 2425 m^3/fed and treatment T2 which received 2040 m^3/fed for plant height, grain weight/ spike, 1000 grain weight, and grain and straw yields/fed. However, T1 and T2 treatments were superior to treatment T3, which received 1660m^3/fed. The amounts of applied water as averages of two the seasons were 57.74, 48.59 and 39.44 cm and the seasonal water consumptive use values were 39.54, 37.41, and 34.49 cm when plants were irrigated with quantities of water equal to 100%, 80%, and 60% of Class A pan evaporation, respectively. The average seasonal crop coefficient (K_c) for the two seasons was 0.75, which could be used to predict the water consumptive use of wheat crop. Water use efficiency (W.U.E.) was increased from 1.70 to 1.75 when 80% of class A pan evaporation was applied in T2, but was thereafter decreased to 1.67 kg/m^3 as average when 60% of class A pan evaporation was given as in treatment T3. The results of the

experiments indicated that 33.5%, 25.3% and 15.4% of each m^3 of applied irrigation water were not used by crop and returned to the system downstream via drainage or groundwater for the three treatments T1, T2, T3 respectively. The results also indicated the possibility of saving about 16% of the amount of irrigation water, as in treatment (T2) which received 2040 m^3/fed and produced as much grain and straw yields/fed as T1 which received 2425 m^3/fed, therefore 385m^3/fed could be saved.

INTRODUCTION

Recent studies indicated that by year 2025 one-third of the population in developing countries will be exposed to absolute water scarcity, in the sense that they will not have sufficient water resources to meet their agricultural, domestic, industrial and environmental needs. One of the ways of alleviating water scarcity is by increasing the efficiency of water use especially in the irrigation sector. Water use efficiency can be improved without additional costs to the farmers through better timing of irrigation and controlling amounts applied. As population in Egypt continues to increase, demands for water including irrigation will also increase. Hence, irrigation system planners and water resources managers will continue conducting studies of system and management alternatives and evaluating their probable effects on water supplies in river basins. Wheat is one of the most important cereal crops in Egypt and its production is based upon irrigation water from the Nile. Farmers got used to over irrigate their fields, where losses of water are great. Hence, scheduling irrigation for wheat through its growing season using the optimum amount of water is considered a very important process for increasing productivity of wheat crop. On the other hand, water use efficiency will be improved without additional costs to the farmers. Hence, better timing of irrigation and controlling amounts could achieve managers' goal of better utilization of water, where the strategy of irrigation policy in Egypt aims at optimizing the use of irritation water. Many investigators studied the effect of irrigation treatments on wheat growth, and yield, as well as water requirements, water consumptive use and water use efficiency.

Regarding that, Abd El-Rasool *et al* (1976), found that at Sakha (Northern delta) the water consumptive use ranged form 21.3 to 43.0 cm for wheat crop.

Metwally *et al* (1984), found that at Gemmeiza (Middle Delta) the mean values of water consumptive use by wheat were 47.65, 41.71 and 36.3 cm when irrigation was scheduled after the depletion of 25, 50and 75% soil moisture, respectively.

El-Refaie *et al* (1988-a), reported that the monthly rates of water consumptive use at Middle Delta were 22.4, 55.28, 53.48, 90.07, 85.26 and 70.7mm, from December to May, respectively. They found that W.U.E. values were 1.98, 2.15 and 2.39Kg wheat grain per cubic meters of water consumed for 25, 50 and 75% depletion from available soil moisture, respectively.

El-Refaie *et al* (1988-b), found that the water consumptive use values at Gemmeiza (Middle Delta) were 42.03, 37.58 and 28.40cm, respectively for wheat irrigation after the depletion of 25%, 50% and 75% of available soil moisture, respectively.

Ibrahim *et al* (1988), found that the irrigation at 50% of field capacity was most convention for wheat regarding its water relations. Values of water consumptive use ranged between 39.96 to 49.10cm. Daily ranged of evapotranspiration (ET) were from 0.22 to 0.27cm water utilization efficiency reached 0.89 Kg/m^3 and seasonal K_c for wheat was 0.6.

El-Mowelhi *et al* (1990), calculated the mean value of actual evapotranspiration at North Delta by 3.4 mm/day during winter season.

Amer *et al* (1990), and Omar and Eid (1999), recommended the pan-evaporation method as an easier and more reliable method for calculating the potential evapotranspiration in comparison with Pennman, Thornthwaite and Blaney-Criddle equations.

Ibrahim *et al* (1996), found that the calculated values of water consumptive use by different methods for wheat using saline water under desert conditions were as follows: 43.2-55.4 cm by Penman, 42.3-53.2 cm by Pan, 35.1-41.8 cm by Blaney – criddle methods.

Khater *et al* (1997), studied the response of some wheat cultivars to different irrigation levels(40, 60, 80, 100%)of field capacity at Gemmieza (Middle Delta). Thesy found that, the irrigation levels 100% and 80% of field capacity increased, grain and straw yields/fed, and yield components. The crop coefficient was 0.70. Water use efficiency was the highest in treatment 80% of field capacity (1.93 Kg/m^3 as average). The seasonal water consumptive use values were 34.43, and 34.07 cm for treatment 80% of field capacity as best irrigation level in the study.

Sobh (1997), studied at Northern Delta region the effect of four different water regimes (W), W_1= conventional water requirement (C_{wr}) which comes to be 1950 m^3/fed, W_2= 80% of W_1, W_3= 120% of W_1, and W_4= 140% of W_1. He found that the best grain and straw yields/fed were obtained at water regime of 80% of (C_{wr}) and increasing the amount of the applied water had increased the seasonal water consumptive use of while water use efficiency values had decreased.

El-Sabbagh (1998), found that water requirements of 2485 m^3/fed (59.17cm) at Sakha (Northern Delta), produced the highest grain yield where evapotranspiration rates ranged from 35.72 to 43.12 cm. The water use efficiency ranged between 40.23 to 58.51 kg/cm of water consumed and the seasonal value for crop coefficient K_c using Blaney-Criddle formula was 0.85.

Rayan *et al* (2000), reported that the effective evaporation pan coefficient of 1.0 was the best one among 0.6, 0.8, and 1.2 at Shandaweel region (Upper Egypt), as its use produced the maximum grain yield, where the water consumptive use as average of two seasons for wheat was 37.74 cm (1581 m^3/fed).

Hayam ., and Sayed (2001), studied at El-Bustan area El-Behairah Governorate (West Delta) the effect of three irrigation water treatments, T1 received 0.4 (760, 748m^3), T2 received 0.5 (1500, 1480m^3), and T3 received 0.6 (2400, 2355m^3) of class A pan evaporation in the two seasons.

Abbas *et al* (2001), found that at the new reclaimed area of Ismailia Governorate, applying irrigation after the depletion of 25% of the available soil moisture produced the highest grain and straw yields as compared to watering after 50% or 75% depletion. The average values of water consumptive use were 54.63, 46.08 and 38.29cm, respectively for plants irrigated after the depletion of 25, 50 and 75% from available soil moisture.

The aim of this study was to detect the effect of different irrigation levels on growth, yield, some yield attributes, water requirements, water consumptive use and water use efficiency of Gemmiza 7 wheat cultivar. Determining the potential evapo-transpiratian, and crop coefficient were also under investigation. This study aimed also, at getting the highest level of water productivity by reducing or eliminating the non-beneficial water use through reducing water losses.

MATERIALS AND METHODS

Two field experiments were conducted at the Water-Management Research Institute (National Water Research Center), Zankalon Station, Sharkia Governorate during two successive seasons of (2000/2001 and 2001/2002). The textural class of the soil was clay (43.75%) with pH of 8.1, and organic matter of 1.96%. Soil moisture constants are shown in Table (1) and the meteorological data are shown in Table (2).

Table (1): Soil moisture constants at the experimental site.

Depth (cm)	Field capacity (%)	Wilting point (%)	Available water (%)	Bulk density (gm/cm^3)
0-20	43.51	23.55	19.96	1.25
20-40	38.0	18.56	19.44	1.30
40-60	36.25	16.62	19.63	1.40
Average	39.25	19.57	19.67	1.32

A complete blocks randomized design with four replicates was used. The total number of plots was 12. Area of each plot was 150m^2 (12 x 12.5m) included 60 rows 20 cm apart with a border of 1.5m between plots. Irrigation treatments were as follows:

T1: irrigation with a quantity of water equals to 100% of Class A pan.

T2: irrigation with a quantity of water equals to 80 % of Class A pan.

T3: irrigation with a quantity of water equals to 60 % of Class A pan.

Table (2): Meteorological data for Zankalon Water Requirement Research Station during the two seasons.

Season	2000/2001					2001/2002				
Month	Temp. C°		Relative humidity (%)	Evaporation mm/day	Rainfall (mm)	Temp. C°		Relative humidity (%)	Evaporation mm/day	Rainfall (mm)
	Max.	Min.				Max.	Min.			
Nov.	25.5	11.7	60.6	3.38	-	25.5	10.7	66.90	3.10	1.00
Dec.	20.8	7.7	74.9	2.28	1.4	20.8	6.7	65.80	2.50	5.00
Jan.	20.3	4.6	69.5	2.39	1.6	17.4	3.7	78.70	2.21	1.60
Feb.	20.1	4.4	58.1	3.16	4.2	20.1	6.8	75.50	3.42	4.00
Mar.	24.2	8.7	55.6	4.58	1.0	19.4	8.7	64.80	4.31	1.00
Apr.	28.0	10.4	54.86	5.97	-	28.0	10.4	54.85	5.76	1.60
May	32.9	15.1	54.4	8.94	-	30.5	14.1	60.8	8.2	-

Four monthly irrigations were applied, in addition to the seeding irrigation. In the seeding irrigation all plots were given equal quantities of added water by rising the soil moisture content to its field capacity. Thereafter, the irrigation treatments were tried. A rectangular weir was used for measuring the amount of added irrigation water. The normal practices for wheat were followed as recommended for the region.

Sowing dates were 19th and 18th November in the first and second seasons, respectively. Phosphorus fertilizer was added to all plots at a rate of 15kg P_2O_5 during seedbed preparation. Nitrogen (ammonium nitrate) was added at the rate of 70 kgN/fed, as two equal doses before the first and the third irrigation.

Soil moisture contents were determined gravimetrically as average of three samples per plot taken at 0-20, 20-40 and 40-60 cm depth just before and two days after each irrigation to determine actual evapotranspiration (ETa) of wheat plant.

Water consumptive use (Actual evapotranspiration, ETa)

Water consumptive use (ETa) and the depth of irrigation water were calculated according to equation (1) and (2) given by Israelsen and Hansen (1962) as follows,

$$D_{aiw} = (F.C. - \theta_1/100) * Db * d \ldots\ldots (1)$$

$$W_c = (\theta_2 - \theta_1/100) * D_b * d \ldots\ldots\ldots (2)$$

Where,

D_{aiw} = depth of applied irrigation water (cm),

W_c = water consumptive use (cm),

F.C. = soil moisture content at field capacity (%),

θ_1 = soil moisture content before irrigation (%),

θ_2 = soil moisture content after irrigation (%),

D_b = bulk density (gm/cm^3), and

d = soil depth (cm).

Potential evapo-transpiration (ETp)

Potential evapotranspiration (ETp) was obtained from the Class A pan evaporimeter where it is extensively used to calculate potential evapo-transpiration and hence identify water requirements of crops.

ETp = Kpan x Epan (Doorenbos and Pruitt, 1984).

Where,

Epan = evaporation in mm/day.

Kpan = pan coefficient (0.7).

Crop coefficient (K.c)

K_c was calculated as follows:

K_c = ETa / ETp.

Water use efficiency (W.U.E.)

(W.U.E.) was calculated according to Jensen (1983),

$$W.U.E. = \frac{Grainyield(Kg/fed)}{Waterconsumptiveuse(m3/fed)} \quad (Kg/m^3)$$

Irrigation efficiency (Ea)

Irrigation application efficiency (Ea) was calculated according to ICID Bulletin (1978) and expressed as

$$Ea\ (\%) = \frac{CU}{AW} * 100$$

Where,

CU : Water consumptive use (cm).

AW: Added irrigation water (cm).

Growth, yield and some yield attributes:

1- Plant height at harvest (cm).
2- 1000-grain weight (gm).
3- Grains weight per spike (gm).
4- Grains yield (ardab/fed.).
5- Straw yield (ton/fed.).

Data were statistically analyzed using least significant difference (L.S.D.) test according to Steel and Torri (1980).

RESULTS AND DISCUSSION

1- Wheat Growth :

The data presented in Table (3) show clearly that irrigation treatments had significant effect on growth of wheat as expressed herein in plant height in the two seasons and combined. The data also, indicate that plant height was not significantly decreased, unless the amount of water was decreased to an amount equal to 60% of class A pan evaporation (T3). Such decrease may be attributed to the decrease in the activity of meristematic tissues responsible for elongation. In this respect, no significant differences were detected in plant height between T1 and T2 in both seasons and combined. These results are in agreement with those obtained by El-kalla *et al* (1994), Khater *et al* (1997), and Rayan *et al* (2000).

Table (3): Plant height, grain weight/ spike and 1000 grain weight as affected by different irrigation treatments for wheat in the two seasons and combined.

Treatment*	Plant height (cm)			Grain weight/spike (gm)			1000 Grain weight (gm)		
	2000/2001	2001/2002	Combined	2000/2001	2001/2002	Combined	2000/2001	2001/2002	Combined
T1	118.8	121.50	120.15	2.34	2.42	2.38	53.85	54.62	54.23
T2	117.0	119.25	118.13	2.20	2.25	2.23	52.40	53.91	53.16
T3	113.5	115.40	114.45	1.95	1.98	1.96	50.95	51.45	51.2
L.S.D. 1%	2.01	3.43	2.49	0.24	0.35	0.27	1.61	0.85	0.79

*T1: irrigation with a quantity of water equals to 100% of Class A pan evaporimeter.

T2: irrigation with a quantity of water equals to 80 % of Class A pan evaporimeter.

T3: irrigation with a quantity of water equals to 60 % of Class A pan evaporimeter.

2- Yield and yield attributes :

The statistical analysis revealed that the different irrigation treatments had a significant effects on all studied traits in the two seasons. The average values are presented in Table (3) and Table (4). Grain weight / spike, 1000 grains weight, straw yield, and grain yield / fed were significantly affected by irrigation treatments in both seasons and combined. Applying amount of water equal to 60% of Class A pan (T3) caused a significant reduction for all studied traits in the two seasons and combined. Applying T2 reduced the grain and straw yields but differences with T1 did not reach the level of significance. These results go parallel with those obtained by El-kalla *et al* (1994), Khater *et al* (1997), Rayan *et al* (2000), and Abbas *et al* (2001).

Table (4): Grain and straw yields as affected by different irrigation treatments for wheat crop in the two seasons and combined.

Treatment	Grain yield (ardab/fed)*			Straw yield (ton/fed)		
	2000/2001	2001/2002	Combined	2000/2001	2001/2002	Combined
T 1	18.20	19.40	18.80	4.91	5.20	5.06
T 2	17.96	18.6	18.28	4.60	4.91	4.76
T 3	15.80	16.49	16.15	4.08	4.45	4.26
L.S.D 1%	1.56	2.06	2.08	0.52	0.35	0.37

* 1 ardab = 150 kg.

3- Water Relations:

3.a. Amounts of applied water:

The amount of irrigation water was calculated by the summation of the daily records of Class A pan evaporation for each treatment from sowing date up to the fourth irrigation. The total amounts of applied irrigation water for the two growing seasons as averages are presented in Table (5). The results showed that, for each irrigation treatment, the data for both seasons were almost the same. The average amounts of the applied water for both seasons were 57.74, 48.59, and 39.44 cm for the T1, T2, and T3 irrigation treatments, respectively, which agree with those reported by El-Sabagh (1998).

3.b. Water consumptive use (Actual evapotranspiration, ETa):

Actual evapotranspiration (ETa) for wheat crop as calculated for the three irrigation treatments during the two growing seasons is presented in Table (5). It is evident that the highest value of water consumptive use was obtained with T1 irrigation treatment in both seasons. It is clear that ETa was increased as soil moisture content was increased.

Concerning daily and monthly consumptive use, data in Table (6) reveal that (ETa) was low at the beginning of the growing season and was gradually increased as the plant growth developed to reach its maximum values in March due to the increase in the vegetative growth of the plants. Thereafter, it began to decrease reaching its lowest value before harvest.

The complete cover of wheat canopy to soil surface, as well as, the advanced growth of wheat could account for the gradual decrease of ETa after reaching its maximum in March.

These results are in agreement with those of Abd El-Rasol (1976), Ibrahim *et al* (1988), El-sabagh (1998).

Table (5): Amounts of added irrigation water, actual consumptive use, water use efficiency, and irrigation application efficiency for wheat crop.

Treatments	Amount of added irrigation water (cm)*			Actual consumptive use (cm)			Irrigation efficiency (%)	Water use efficiency (kg/m3)		
	2000/2001	2001/2002	Average	2000/2001	2001/2002	Average		2000/2001	2001/2002	Average
T 1	57.14	58.34	57.74	37.16	41.92	39.54	66.5	1.74	1.65	1.70
T 2	48.11	49.07	48.59	36.20	38.62	37.41	74.7	1.77	1.72	1.75
T 3	39.08	39.80	39.44	33.44	35.54	34.49	84.6	1.59	1.66	1.67

* Including the sowing irrigation.

Table (6): Monthly and daily consumptive use (mm) as affected by the three irrigation treatments for wheat crop (average of the two seasons).

Treatment	November		December		January		February		March		April		May		Seasonal consumptive	
	Monthly	Daily	Monthly	Daily	Monthly	Daily	Monthly	Daily	Monthly	Daily	Monthly	Daily	Monthly	Daily	(mm)	(m3/fed)
T1	16.3	0.82	33.69	1.08	60.12	2.00	80.32	2.86	103.10	3.32	79.77	2.66	22.10	2.21	395.4	1660.68
T2	16.3	0.92	33.69	1.08	57.99	1.87	75.90	2.71	94.69	3.05	74.40	2.48	21.13	2.11	374.1	1571.22
T3	16.3	0.82	33.69	1.08	54.35	1.75	63.96	2.28	84.19	2.72	71.81	2.39	20.64	2.06	344.9	1448.28

3.c. Potential evapotransiration (ETp)

Table (7) shows the values of the average monthly potential evapotronsiration (ETp) The monthly ETp was 2.27mm in November then decreased to 1.67mm and 1.6mm in December and January, respectively. This value was increased to reach its maximum (5.99mm) in May, due to the increase in evapotranspiration and temperature during May. However, the monthly ETa increased from 0.82 in November and reached a maximum of 3.05 in March, but thereafter decreased to reach 2.11mm in May, Table (7).

3.d. Crop coefficient (K_c)

The values of crop coefficient Kc of wheat are listed in Table (7), which calculated according to daily actual evapotransiration (ETa) derived from T2 irrigation treatment (which produced the highest wheat yield) and potential evapotranspiration (ETp). The average value for (k_c) in the two growing seasons was 0.75. It could be noticed that K_c was low at the beginning of the growing season, then the values increased and reached its maximum value in January, February and March, then tended to decrease with advancing of the crop to the maturity stage. Similar results were obtained by Doorenbos and Kassem (1986), and El-Sabagh (1998), who found that the seasonal (K_c) was 0.80 and 0.85 respectively,

3.e. Water use efficiency (W.U.E.)

Values of water use efficiency (W.U.E.) expressed as kg of wheat crop grain yield per cubic meter of water consumed as affected by irrigation treatments in the two seasons are presented in Table (5). Comparing the values of water use efficiency under different irrigation treatments reveals that maximum value of W.U.E. was scored from T2, irrigation treatment, i.e when irrigated with amount of applied water equal 80% of Class A pan and followed by T1, irrigation treatment, i.e when irrigated with amount of water equal 100% of Class A pan, in two seasons compared with T3 which irrigated with amount of water equal 60% of Class A pan. The highest values of W.U.E. were 1.77 and 1.72 kg/m^3, while the lowest values were 1.59 and 1.66 kg/m^3 in the first and second seasons, respectively. It decreased with decreasing or increasing of the amount of applied irrigation than that of T2 (80% of Class A pan) where it can be recommended treatment.

3.f. Irrigation Efficiency

Values of irrigation application efficiency (Ea) expressed in percent (%) as affected by irrigation treatments as average of the two seasons are presented in Table (5). The results indicated that 33.5%, 25.3% and 15.4% of each m^3 of added irrigation water were not used by crop and returned to the system downstream via drainage or groundwater as a losses for the three treatments T1, T2, T3 respectively. The increase of Ea could be mainly due to the decrease of water losses.

Table (7): Monthly potential evapotranspiration (ETp), actual evapotranspiration (ETa), evaporation, and crop coefficient for wheat crop (averages of the two seasons).

Month	Average evaporation (mm/day)	Potential evapotranspiration (mm/day)	Actual consumptive use (mm/day)	Crop coefficient (K_c)
November	3.24	2.27	0.82	0.36
December	2.39	1.67	1.08	0.64
January	2.3	1.60	1.87	1.17
February	3.29	2.30	2.71	1.18
March	4.45	3.12	3.05	0.98
April	5.87	4.10	2.48	0.60
May	8.57	5.99	2.11	0.35
Average	-	-	-	0.75

Conclusion and recommendation

From the two experiments carried out at Zankalon region (Eastern Delta), it can be concluded that adding 2040 m^3/fed of irrigation water which equal to 80 % of Class A pan saved about 16% of the amount of the irrigation water of the control treatment received (2425m^3/fed) and hence about 385m3/fed could be saved. Maximum value of water use efficiency (1.75kg/m^3) was achieved in the second treatment. This amount of water (2040 m^3/fed) produced as much grain and straw yields/fed, so it seems to be better adapted and could be recommended to produce a high grain and straw yields/fed with high water use efficiency and more crop per drop of water could be achieved at Zankalon region (Eastern Delta) under clayey soil conditions. The results, also, indicated that limiting water applications that create more plant stress and reduced ET leads to some reduction in plant height, grain weight/spike, 1000-grain weight and grain and straw yields/fed.

REFERENCES

Abbas, F. A. H., S. A. Abd El-Hafez, I. S. Bengmen and N. N. El-Mowelhi (2001), Influence of water regime, Phosphorous and potassium fertilization on wheat production under sprinkler irrigation in Ismailia, Egypt, J. Appl. Sci., 16 (8).

Abd El-Rasool, S. F, H. W. Tawadros, W. I. Miseha, and F. N. Mahrous (1976), Effect of irrigation and fertilization on water use efficiency by wheat Fertilization conf., Held at Ain Shams Univ., Egypt.

Amer, M. H., I. M. El-Nagar and H. H. Abdel-Maksoud (1990), Evaluative study for some empirical formula applied for crop water requirements estimation, Egypt, J. Appl. Sci., 5(2) 202-214.

Doorenbos, J. and H. A., Kassem (1986): Yield response to water, FAO Irrigation Drainage Paper 33, P. 193, FAO, Rome, Italy.

Doorenbos J. and W. O. Pruitt (1984): Crop water Requirements Irrigation and drainage, paper No. 24, FAO. Rome, Italy.

El-Mowelhi, N. M., S. A. Abdel-Hafez, M. S., M. Abo-Soliman and W. S. El-Sabry (1990), water budget calculations of the main crops at North Delta using the cropwat program, Proc. of Soil fertility and foliar fertilization conference 14-15 Jan., Giza, Egypt.

El-Kalla, S. E., A. A. Leilah, A. H. Basiony, and Samira M. Hussien (1994), Effect of irrigation and foliar nutrition treatments on growth and yield of some wheat cultivars under El-Aish conditions, Sixth Conf. Agron., Fac. Agric., Al-Azhar Univ., Egypt.

El-Refaie, M. M. A., H. H. Abdel-Maksoud, and A. A. Abdel-hafi (1988a), Comparison of basin, sprinkler and drip irrigation methods for wheat crop Conf. of Field irrigation and agroclimatology. Soil and water Res. Inst. ARC., Ministry of Agric and land Reclamation, Giza, June 20-23, 1988.

El-Refaie, M. M. A., H. H. Abdel Maksoud and M.M.A. El-Menoufi (1988b), effect of soil moisture levels on wheat-water relations under trickle irrigation method in the Delta soils, Conf. of field irrigation and Agroclimatology. Soil and water Res. Inst. ARC, Ministry of Agric and land reclamation, Giza, June 20-23, 1988.

El-Sabbagh A. A. (1998) Effect of soil Moisture deficits at different stages of plant growth on wheat production, Menofiya J. Agric-Res. Vol 23 No. 2: 415-426.

Ibrahim, M. A. M., M. A. Sherif, and M. A. Metwally (1988), Some water relations for wheat under the interaction between irrigation regime and nitrogen rate. Conf. of Field Irrigation and Agroclimatology, 20-23 June, SWRI, ARC, Egypt, Paper No. 30.

Ibrahim A. H, M. N. Khalil; M.H.-El Dosouky and S. H. Seidhom (1996) Water consumptive use by wheat using saline water under Desert conditions, Zagazig J. Agric Res-Vol. 23 No. (1) 179-186.

ICID Cmmuinttee (1978), On Assembling irrigation efficiency data standards for the calculation of irrigation efficiencies, ICID Bukk. Vol. 27(1).

Israelsen, O. W., and V. E. Hansen (1962), Irrigation principles and practices, 3rd Ed. John Wiley and Sons Inc., New York, U. S. A. Jensen M. E. (1983), "Design and operation of farm irrigation systems", Amer. Soc. Agric. Eng., Mitchigen, U. S. A.

Jensen, M. E., (1983), Design and operation of farm irrigation systems, Amer. Soc. Agric. Eng., Michigan, U.S.A.

Khater, A. N., H. H. Abd El-Maksoud and H.M. Eid (1997) Response of some wheat cultivars and their water relation to different irrgation levels in Middle Delta, Egypt, J. Appl. Sci; 12 (5) 142-158.

Hayam S., Mahgoub, and M. A. Sayed (2001), Response of two wheat cultivars to irrigation amount and nitrogen level in sandy soil, J. Agric. Sci., Mansoura Univ., 26(4): 1863-1873.

Metwally, M. A., M. N. Sief El-Yazal, A. Y. Badawi; H. W. Tawadros and A. Serry (1984), Effect of soil moisture stress on some wheat varieties, Proceedings of the 2nd General conference, Agric. Res. Center, Giza, April 8-11, 1984.

Omar, M.H., and H.M. Eid (1999), Comparative study on ETo estimated with different methods in South Delta, Proc. of the third Conference of On-Farm Irrigation and Agrocilmatology, Giza, Egypt, 25-27 Jan. 1999.

Rayan, A. A., S. M. El-Marsafawy, N. G. Aimer, and S. E. Soliman (2000), Scheduling irrigation of wheat crop in upper Egypt under some sowing dates, Egypt, J. appl. Sci. 15(1).

Sobh, M. M. (1997), Water response to nitrogen and Zn-application and different water regimes in Northern Delta soils, Zagazig J. Agric. Res., Vol. 24, No. 5, P. 905-913.

Steel, R. G. D. and J. H. Torri (1980) Principals and procedures of statistics, 2nd ed. McGraw Hill Co., New York, U. S. A.

تأثير كمية مياه الري المحسوبة من وعاء البخر المفتوح على نمو و محصول القمح و بعض العلاقات المائية

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أجريت تجربتان حقليتان بمحطة بحوث و تجارب المقننات المائية بالزنكلون محافظة الشرقية خلال الموسمين (٢٠٠٠ / ٢٠٠١) و (٢٠٠١ / ٢٠٠٢) لدراسة تأثير كمية مياه الري على نمو و محصول و الاحتياجات المائية و الاستهلاك المائي و كفاءة استخدام المياه و معامل المحصول (k_c) لمحصول القمح صنف (جميزه ٧) حيث تم حساب كمية المياه للرية الواحدة لأربع ريات شهرية باستخدام وعاء البخر القياسي (Class A pan) و كانت المعاملات كالأتي:

المعاملة الأولى (T1): أعطيت كمية مياه تساوي ١٠٠ % من إجمالي كمية البخر.
المعاملة الثانية (T2): أعطيت كمية مياه تساوي ٨٠ % من إجمالي كمية البخر.
المعاملة الثالثة (T2): أعطيت كمية مياه تساوي ٦٠ % من إجمالي كمية البخر.

يمكن تلخيص أهم النتائج التي تم الحصول عليها على النحو التالي:

لم يكن هناك فروق معنوية بين المعاملة الأولى (T1) و التي أعطيت كمية مياه حوالي (٢٤٢٥ م٣/ف) و المعاملة الثانية (T2) و التي أعطيت كمية مياه حوالي (٢٠٤٠ م٣/ف) على صفات طول النبات و وزن حبوب السنبلة و وزن ١٠٠٠ حبة و كذلك محصول الحبوب و القش/الفدان حيث سجلت تلك المعاملتين متوسطات أعلى من المعاملة الثالثة (T3) و التي أعطيت كمية مياه حوالي (١٦٦٠ م٣/ف). أظهرت النتائج أن متوسط الاستهلاك المائي كان ٣٩,٥٤ و ٣٧,٤١ و ٣٤,٣٩ سم/ف للمعاملات (T1) و (T2) و (T3) على التوالي و متوسط معامل المحصول لموسمي النمو كان (٠.٧٥) و الذي يمكن استخدامه في التنبؤ بالاستهلاك المائي لمحصول القمح في منطقة الزنكلون (شرق الدلتا) و كان متوسط كفاءة استخدام المياه (١,٧ و ١,٧٥ و ١,٦٧ كجم/م٣)للمعاملات (T1) و (T2) و (T3) على التوالي بما يوضح أن أعلى قيمة كانت للمعاملة (T2). كما تشير النتائج إلى إمكانية توفير حوالي ١٦% من كمية المياه (٣٨٥ م٣/ف) حيث أنة باستخدام المعاملة (T2) (٢٠٤٠ م٣/ف) أمكن الحصول على محصول أعلى من الحبوب و القش/الفدان بدون نقص معنوي عند استخدام المعاملة (T1) (٢٤٢٥م٣/ف) و كذلك أعلى كفاءة استخدام للمياه لمحصول القمح صنف (جميزة ٧) المنزرع في الأراضي الطينية تحت ظروف منطقة شرق الدلتا (الزنكلون) و تنظيم ريه باستخدام وعاء البخر القياسي (الري عند نسبة ٨٠% من كميات البخر المجمعة على أربع ريات شهرية).