IRRIGATION WATER MANAGEMENT FOR COTTON YIELD IN NORTH DELTA

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ABSTRACT

Field experiments were conducted at the experimental farm of El-Karada water management research station, Kafr El-Sheikh Governorate during 2008 and 2009 summer seasons to study the impact of farm water management on the cotton yield and economic benefit for irrigation water unit. To attain this goal, different methods of planting and different irrigation treatments were investigated on the Giza 86 v. cotton. A split – plot design with four replicates were used, the main – plots were furrow and bed (ridge) planting methods. While , four irrigation treatments were allocated in the sub-plots , which were irrigation at FC % ,90 % FC ,85 % FC and 80 % FC . The main results in this study can be summarized as follows: -

The bed planting method had the minimum values of water applied and water consumptive use compared with the furrow planting method for all irrigation treatments. Using the bed planting method instead of furrow planting method saved about 396 m3 per fed (15.6%) with irrigation at 80 % FC.

The maximum values of crop coefficient crop and field water use efficiencies, seed cotton yield and net profit for water unit had been obtained with the bed planting method for all irrigation treatments and two growing seasons. But, the minimum values had been given with the furrow planting method for all different irrigation treatments.

The data also indicated that irrigation treatments had significant effect on the traits under study , where 80 % FC irrigation treatment gave the minimum values of water applied , water consumptive use and net profit for water applied unit compared with the other different irrigation treatment for two planting methods .

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Respecting the crop and field water use efficiencies in addition to crop coefficient, the irrigation at 80 % FC recorded the maximum values compared with the other irrigation treatments for two different planting methods.

Interactions between planting methods and water applied treatments were significantly. Where as the minimum values of water applied 2151.2 m3/fed, water consumptive use 1576 m3/feddan and cost of water applied unit (0.34 LE/m3 and 1314 LE/Fed) had been obtained with the bed planting method and irrigation at 80 % FC. On the other hand, the maximum values of crop coefficient (0.67), field and crop water efficiencies (0.52 and 0.72 kg/m3) had been achieved with the bed planting method and irrigation at 80 % FC.

INTRODUCTION

Productivity of cotton plant depends on a large number of environmental effects as well as crop management. Water management is one of the factors affecting the productivity of cotton. An amount of cotton irrigation water of 3400 and 4700 m3/fed. has been recommended by Ministry of water resources and irrigation for lower and upper Egypt, respectively. On the other hand, Ministry of Agriculture in their publications (1961 up till now**)** devoted farmers to schedule cotton irrigation to be

every 15 and 10 days for lower and upper Egypt, respectively. Nile water of Irrigation purposes became more available after constructing the high dam. Taking into consideration insufficient and inefficient drainage systems the situation has become more difficult where high ground water babble has been established. This, resulting in increasing the salt affected soils area from one side and creates poor soil aeration condition from the other side by which the other side by which cotton yield has been negatively affected cotton yield. Cotton yield is dependent upon the production and retention of bolls, both of which can be decreased by water stress ***(Guanine and Money, 1984).*** Additionally, income produced by cotton depends on yield and its value based on fiber physical properties. However, even short periods of water stress during susceptible stages could cause shorter and less-developed cell walls in bolls (Ramey, 1986). Under weather conditions of Middle Egypt, water

uses for cotton were reported to be 73-80, 81 and 98.8 cm ***(El-shal, 1966, Khalil et al. 1969 and Chaudry, 1969).***

The number of open bolls per plant and seed cotton yield per feddan were reported to decrease by delaying the sowing date ***(Ragab, 1985). Yasean et al. (1989)*** reported that highest number of open bolls per plant and seed cotton yield per fed. were obtained by 21-28 days as time of first post sowing irrigation.

Mohamed el. al. (1994) indicate that highest seed cotton yield for Dandarah cotton variety grown in upper Egypt is to be achieved by applying irrigation at 10 days apart till flower stage and then at 20 days apart till harvesting . This treatment is followed by 10 days interval all over the cotton growing season. From the economic point of view the best irrigation regime may be achieved by applying the irrigation every 10 days till flowering and than 20 days until harvesting due to its maximum water use efficiency.

Bishr et al. (1994) found that in the case of absence of the ground water table (Free of water table) the higher seed cotton yield was observed from the shorter irrigation intervals. Cotton water consumptive use was found to be higher at more frequent irrigation (shorter irrigation intervals). They also added that delaying to be 21 days apart caused 90% higher in water use efficiency than that scheduled every 14 days. This was due to the higher yield and less irrigation requirements resulted in irrigating cotton every 21 day in 60 to 70 cm (ground water table) field.

The aim of the present investigation was to study the impact of farm water management on cotton yield and benefit for irrigation water unit to introduce the most suitable planting method and water treatment to optimize water use and cotton yield.

MATERIALS AND METHODS

The present investigation was conducted at EL-Karada Agricultural Research Station, Kafer El-sheikh, Governorate Egypt, during 2008 and 2009 seasons.

The soil texture of the experimental area is clay loam. Mechanical and chemical analysis of soil samples were determined according to the standard methods that outlined by ***Black (1983), Klute (1986) and Westerman (1990)*** are given in Table (1).

Table (1): Chemical analysis of the tested soil

Soil depth, cm	PH 1:2.5	Ec mmhos/cm	Cations, mg/L				Anions, mg/L			
			Ca^{++}	Mg^{++}	Na^{+}	K^{+}	Co_3^{-}	Hco_3^{-}	Cl^{-}	So_4^{--}
0-40	8.0	1.90	6.4	5.3	9.0	0.34	-	3.5	10.4	7.14
40-80	8.1	2.10	5.2	4.1	12.4	0.35	-	5.6	11.6	4.85
80-120	8.1	2.30	5.0	5.5	12.7	0.34	-	5.2	12.4	5.94

Monitoring soil moisture:

Soil samples were collected before and two days after each irrigation from 3 layers (40 cm each) to determine soil moisture content which presented in Table (2).

Table (2): Soil moisture content of the experimental site

Soil depth, cm	Field capacity (FC),%	Permanent wilting point (PWP),%	Available water (AW), cm	Bulk density(d.b.) , g/cm^3
0 - 40	45.00	24.30	20.70	1.08
40 - 80	37.20	21.20	16.00	1.20
80- 120	34.10	18.50	15.00	1.31

Egyptian cotton Giza variety (Gossypium L.) was planted on March 21, 2008and on March 26, 2009 seasons. The land was ridged at 60 cm spacing. Four seeds were planted in each hill and the hills were spaced 20 cm a part. The first irrigation was after 35 days from planting. The hills were thinned to the desired stand before the second irrigation. Nitrogen was applied with the second irrigation after 17 days from the first. The experiment was arranged in split-plot design with 4 replicates .The main- plots represented planting methods; furrow and bed while, the sub-plots represented irrigation applied treatments:

1. Irrigated at F.C % (A)
2. Irrigated at 90 % FC (B)
3- Irrigated at 85 % FC (C)
4- Irrigated at 80 % FC (D)

Meteorological elements:

Values of the Meteorological elements in Table (3) were obtained from the meteorological station at El-Karada, Kafer El-sheish, Governorate, situated at 30° 47 N Fatitude and 31° E longitude and 15 m altitude. It

represents the circumstances and conditions of the North Delta. Average values of temperature, air relative humidity (RH%) and wind speed (m/S) were recorded daily during the two years.

Table (3) Average meteorological data for two seasons.

Month	Ave. of air Tem. °C	Ave. of RH, %	Ave. of wind speed, Km/day
March	16.20	63.6	89.50
April	19.20	60.00	106.9
May	20.8	58.00	108.00
June	24.3	65.30	119.00
July	25.8	67.00	103.00
August	26.7	67.70	86.10
Sept.	25.10	96.49	99.60
Oct.	26.30	72.00	90.20

Measurements and calculations:

1- Estimation of the potential evapotranspiration (ET_P):

ETP was estimated simultaneously for a period of about 8 months from March until October in both seasons by using the modified penman equation ***(FAO-24 Method, 1977)*** as follows:

$$ET_p = c \{W. R_n + (1-w). f(u). (ea - ed)\}$$

Where:

ETp = potential crop evapotranspiration , mm/day,.

W = temperature related weighting factor,.

Rn = net radiation in equivalent evaporation , mm/day,.

f (u) = wind related function,

ea = saturation vapor pressure (ea) at mean air temperature, mbar,

ed =mean actual vapor pressure (ea) of the air, mbar , and

c = adjustment factor to account for day and night weather conditions.

2- Estimation of crop coefficient (KC):

Crop coefficient was estimated by ***(FAO, 1990)*** as Follows

$$ETc = ETp \times KC$$

Where:

ETc = actual evapotranspiration, mm/day,

ETp = potential evapotranspiration calculated by the modified penman equation, mm/day, and

KC= crop coefficient, dimensionless

3- Soil – Water relationships:

a- Amount of water applied:

The amount of water applied has calculated by using the following equation ***(Masoud, 1967)***

$$Q = CLH^{3/2}$$

Q = the discharge, m3/s,

L = the length of the crest, m.

H = the head, m and.

C = an empirical coefficient that must be determined from discharge measurements.

b- Water consumptive use:

Soil moisture content was determined before and after each irrigation to calculate water consumptive use according to ***Iseraelson and Hansen (1962)***

$$Cu = \frac{\theta_2 - \theta_1}{100} \times Bd \times D \times A$$

Where:

Cu = water consumptive use in each irrigation (cm3),

θ_2 = soil moisture percent after irrigation. (%, d.b),

θ_1 = soil moisture percent before irrigation. (%, d.b),

Bd = soil Bulk density in g /cm3,

D = depth of soil layer (cm) and.

A = irrigation area (cm^2).

C- Water saving (m^3/fed):

The water saving has been calculated according to the difference between the water applied in furrow and bed planting methods.

d- Crop water use efficiency, (CWUE)

Crop water use efficiency was calculated according to ***Hansen et al. (1980)*** by the following equation:

$$\text{CWUE}, (\text{Kg}/m^3) = \frac{\text{Yield (Kg/fed)}}{\text{Water consumptive use } (m^3/\text{fed})}$$

e- Field water use efficiency, (FWUE):

Field water use efficiency was calculated by ***(Michael,1978)*** the following equation:

$$\text{FWUE}, (\text{Kg}/m^3) = \frac{\text{Yield (Kg/fed)}}{\text{Water applied } (m^3/\text{fed})}$$

2- Crop yield of irrigation water unit

$$\text{Crop yield of irrigation water unit} = \frac{\text{seed cotton yield (Kentar/fed)}}{\text{Water applied } (cm^3/\text{fed})}$$

Data of the two seasons were statistically analyzed using the IRRISTAT computer program ***(IRRI, 1991),*** and the treatment means were compared according to Duncans multiple range test ***(Duncan, 1955).***

RESULTS AND DISCUSSIONS

1- Amount of water applied and water consumptive use :

Data presented in table(4) indicated that there was a significant effect of both planting method and irrigation treatment on the amount of water applied and water consumptive use for cotton plants during the two growing seasons of 2008 and 2009 . It is cleared that the bed planting method consumed the minimum amount of water applied (2151.2 m3/ fed) and water consumptive use (1578.3 m3/ fed) compared with the furrow planting method with 80 % FC irrigation treatment. The other irrigation treatments had the same previous trend. Generally , the maximum amounts of water applied and water consumptive use were recorded by using the furrow planting method for all irrigation treatments

during the two growing seasons of 2008 and 2009 . These results indicated that, amount of water applied was related with seedbed methods. Finding reported by (Ragab, 1985).Regarding to irrigation treatment, it can be seen that the FC % irrigation treatment recorded the maximum amounts of water applied and water consumptive use followed by 90 % FC irrigation treatments while, the minimum values were achieved with the 80 % FC and 85 % FC irrigation treatments for the two different planting methods during the two growing seasons of 2008 and 2009. The maximum value of water applied and water consumptive use were 3009 and 2299.1 m3/ fed respectively with FC % irrigation treatment using the furrow irrigation method while , the minimum values were 2151.2 and 1578.3 m3 / fed with 80 % FC irrigation treatment using the bed planting method.

2- Water saving (m^3 /fed):

Water saving of cotton yield as influenced by planting method and irrigation treatment is presented in Table (5). It is noticed that the bed planting method gave the highest values of water saving at all the irrigation treatments compared with the furrow planting method. The maximum value of water saving was 396 m3/fed (18.41%) which recorded with bed planting method and 80 % FC irrigation treatment.

However, no significant differences were obtained among the irrigation treatments for the two planting methods.

3- Actual evapotranspiration (ET_c, mm/ day):

Actual evapo-transpiration (ETc) for cotton at different treatments of irrigation were presented in Table (6) the values of ETc indicated that the irrigation treatments had significant effect on her during the two growing seasons of 2008 and 2009 . The minimum values of ETc were reached in March and April months, then increased in June and July months but, it decreased in the end of the growing season.

The maximum values of ETc were 3.14 and 4.90 mm/day in June and July months, respectively for the growing season of 2008.

4- Potential evapotranspiration (ET_P, mm/ day):

Data in Table (6) obtained that the ETp values (mm/day) was decreased in emergence stage, while, it increased gradually with increase age of plant and decrease with before harvest period at October, after that Etp was increased in June, July and August months.

5- Crop coefficient (KC):

The data presented in table (8) observed that the highest values of Kc had been accomplished with the bed planting method compared with the furrow planting method for all irrigation treatments during the two growing seasons of 2008 and 2009. The average values of KC were 0.53 and 0.67 for the furrow and bed planting methods respectively during growing seasons of 2008 and 2009. On the other hand, the irrigation treatments had significant effect on the KC of cotton for two different methods of panting during the two growing seasons.

6- Seed cotton yield (Kentar/fed) : -

Total seed cotton yield in Kentar/fed under different methods of planting and different treatments of irrigation during the two growing seasons were presented in Table (9). The bed planting method resulted in higher cotton yield comparing with the furrow planting method for all irrigation treatment. The obtained values of cotton yield were 7.34 and 8.17 kantar/fed for furrow and bed planting methods respectively, at FC % irrigation treatment. The other irrigation treatments had the same trend. It is clear that using the bed planting method increased the cotton yield by about 11.3% comparing with the furrow planting method.

The presented data in Table (9) showed that the cotton yield were positively with irrigation treatments for two planting methods during two growing seasons of 2008 and 2009. Significant differences were observed on cotton yield between different irrigation treatments for two different planting methods and growing seasons.

The highest yield of cotton (7.98 kentar/ fed) was achieved with FC % irrigation treatment but , the lowest mean value of cotton yield (6.89

kentar/fed) was recorded with 80 % FC irrigation treatment at using the bed planting method and the furrow planting method had the same trend .

Generally, it is clear that, the bed planting method in addition to using the FC % irrigation treatment could be recommended to obtain the best result. This result will be fact in case of obtaining the maximum number of stand plants /fed at harvesting and the highest value of boll weight (gm) .These results were close to those found by **Mohamed et al (1994) and Bisher et al (1994).**

7- Crop and field water use efficiencies, Kg/m^3:

Crop water use efficiency (CWUE) and field water use efficiency (FWUE) for cotton at different methods of planting and different treatments of irrigation were presented in Table (10). The results indicated that the planting method had significant effect on both crop and field water use efficiencies under different treatments of irrigation during the two growing seasons of 2008 and 2009. It could be noticed that the bed planting method gave the maximum values of CWUE and FWUE comparing with the furrow planting method for all irrigation treatments. The obtained values of CWUE and FWUE were (0.544 and 0.686 kg/m3) and (0.401 and 0.503 kg / m3) .For furrow and bed planting methods respectively with 80 % FC irrigation treatment. The other irrigation treatments had the same trend. It is obvious that using the bed planting method increased the CWUE and FWUE about 26.1 and 25.4% comparing with the furrow planting method at 80 % FC irrigation treatment.

The results also indicated that the obtained values of CWUE and FWUE were (0.602 , 0.617 , 0.648 and 0.686 Kg/ m3) and (0.448 , 0.463 , 0.484 and 0.503) for FC %, 90 %FC, 85 % FC and80 % FC irrigation treatments, respectively by using the bed planting method. The furrow planting method had the same trend. It is evident that the maximum values of CWUE and FWUE had been found with the 80 % FC and 85 % FC irrigation treatments for two planting methods and growing seasons while, the minimum values of CWUE and FWUE had been achieved with the FC % irrigation treatment .

Generally, the highest values of crop water use efficiency and field water use efficiency had been achieved by using the bed planting method with the 80% FC irrigation treatment.

8- Cotton production cost and net profit:

Tables (11 and 12) indicate cotton production cost, net profit in LE/fed and net profit for water unit in LE/m3 under different methods of planting and different treatments of irrigation during two growing seasons of 2008 and 2009. The total cost of cotton production without soil rent was about 1850 LE/fed. The mean obtained values of net profit for yield and water unit were (4438.3 and 4926.1 LE / fed) and (1.55 and 1.94 LE/m3) for furrow and bed planting method respectively. It can be noticed that the bed planting method accomplished the maximum values of net profit for yield and water unit with all the irrigation treatments. The net profit of cotton yield and water unit increased by 11.0 and 25.2% respectively, when the bed planting method was used instead of the furrow planting method.

On the other hand , the mean obtained values of net profit for cotton yield were 5327.5 , 4886.5 , 4544.5 and 4351.0 LE/fed with FC % , 90% FC, 85% FC and 80% irrigation treatments respectively by using the bed planting method. The furrow planting method had the same trend. It can be concluded the maximum net profit for cotton product had been achieved with the FC % irrigation treatments for two different plating methods and growing seasons.

Generally , it can be concluded from the results that the bed planting method with the FC % gave the maximum values of net profit for cotton production and water unit in addition to total cotton yield comparing with the furrow planting method and other irrigation treatments during two growing seasons 2008 and 2009 .

CONCLUSIONS

- The results can be summarized under the following items:

1- The bed planting method consumed the lowest amounts of applied water and water consumptive use (2151.2 and 1758.3m3/ fed)

respectively, comparing with the furrow planting method for all irrigation treatments and growing seasons. Using the bed planting method saved amount of water about 396m3/fed (15.6%) compared with the furrow planting method with 80% FC irrigation treatment.

2- The maximum mean values of crop coefficient (0.67) , crop water use efficiency (0.628Kg/m3) and field water use efficiency (0.466 kg/m3) had been achieved by using the bed planting method compared with the furrow planting method for all irrigation treatments and growing seasons .

3- The irrigation treatments of FC%, 90% FC, 85% FC and 80% FC had significant effect on both water consumptive use, crop coefficient (Kc),crop water use efficiency (CWUE) and field water use efficiency (FWUE) for all two planting methods. The maximum values of KC, CWUE and FWUE had been achieved with 80% F.C irrigation treatment for two planting methods and growing seasons .

4- The bed planting method had been recorded the highest values of cotton yield (8.19Kentar/fed) , net profit for yield (5521.0 LE/fed) and net profit for water unit (2.02 LE/m3) with the 80% FC irrigation treatment during two growing seasons of 2008 and 2009 comparing with the furrow planting method. The net profit of cotton yield increased by 11.0% while, the net profit per water unit increased by25-2% when the bed planting method was used instead of the furrow planting method.

5- The maximum yield of cotton, net profit per yield and net profit per water unit had been given with irrigating at FC% irrigation treatment comparing with the other irrigation treatments for two planting methods and growing seasons.

6- It can be concluded that the bed planting method with irrigating at FC % produced the highest yield and net profit of cotton in addition to increase water use efficiency and decrease the water applied.

Table (4): Water applied, m/fed and water consumptive use, m^3/fed as affected by different treatments in 2008 and 2009 seasons.

treatments	Water applied, m/fed			Water consumptive use, m^3/fed		
	2008	2009	mean	2008	2009	mean
Furrow						
FC%	3034.2	2983.8	3009.0	2316.2	2281.9	2299.1
90% FC	2832.6	2850.2	2841.4	2126.6	2154.2	2140.4
85% FC	2679.7	2710.7	2695.2	1987.7	2005.1	1996.4
80% FC	2608.5	2485.8	2547.2	1868.8	1835.0	1851.9
mean	2788.8	2757.6	2773.2	2074.8	2069.1	2072.0
LSD at 5%				1.77	9.50	
Significant				*	**	
Bed						
FC%	2808.0	2788.5	2798.3	2095.1	2065.5	2080.3
90% FC	2584.2	2493.1	2538.7	1903.8	1906.9	1905.4
85% FC	2329.8	2285.0	2307.4	1716.0	1725.2	1720.7
80% FC	2175.3	2127.1	2151.2	1586.5	1570.0	1578.3
mean	2474.3	2423.5	2448.9	1825.4	1816.9	1821.2
LSD at 5%				5.10	3.60	
Significant				**	**	
Interactions				*	*	

Table (5): Average Water saving m3/fed. And % as affected by different treatment in 2008 and 2009 Seasons.

Irrigation treatments	water applied, m3/fed		Water saving	
	Furrow	Bed	m^3/fed.	%
FC%	3009.0	2798.3	210.7	7.0
90% FC	2841.4	2538.7	302.7	10.65
85% FC	2695.2	2307.4	387.8	14.39
80% FC	2547.2	2151.2	396.0	15.55

Table (6): Monthly and average actual water consumptive use mm/day for different treatments during 2008 and 2009 seasons.

Months	ETc, mm/day									
	2008					2009				
	A	B	C	D	Ave.	A	B	C	D	Ave.
March	1.1	1.1	1.1	1.1	1.1	1.08	1.08	1.08	1.08	1.08
April	1.92	1.70	1.60	1.40	1.65	1.90	1.68	1.58	1.39	1.630
May	3.1	2.6	2.50	2.30	2.62	3.07	2.57	2.48	2.27	2.56
June	3.6	3.1	3.00	2.80	3.12	3.56	3.07	2.97	2.77	3.09
July	5.2	4.90	4.80	4.60	4.87	5.14	4.85	4.75	4.55	4.82
Agust.	3.0	2.60	2.50	2.40	2.62	2.97	2.57	2.48	2.37	2.59
Sept.	2.3	1.85	1.80	1.60	1.88	2.28	1.83	1.78	1.58	1.86
Oct.	1.7	1.20	1.1	1.00	1.25	1.68	1.19	1.08	0.99	1.23

Table (7): Monthly and Average Potential evapotranspiration, mm/day for different Treatments during 2008 and 2009.

Months	Potential evapotranspiration, mm/day							
	2008				2009			
	A	B	C	D	A	B	C	D
Furrow								
March	3.00	2.70	4.00	2.59	2.97	2.67	3.96	2.56
April	4.10	4.00	5.20	3.84	4.06	3.96	5.15	3.80
May	4.90	4.60	6.10	4.32	4.85	4.55	6.04	4.28
June	5.40	5.60	6.60	4.97	5.35	5.54	6.53	4.92
July	5.60	5.70	6.80	4.91	5.54	5.64	6.73	4.86
Agust.	5.20	5.40	6.40	4.56	5.15	5.35	6.34	4.51
Sept.	4.26	4.75	5.32	4.04	4.22	4.70	5.26	3.99
Oct.	3.30	4.50	3.90	2.86	3.27	4.45	3.86	2.83
Bed								
March	2.00	1.97	3.00	1.50	1.96	1.93	2.94	1.47
April	3.14	3.00	4.20	2.80	3.08	2.94	4.12	2.74
May	3.30	3.80	5.00	3.30	3.23	3.72	4.90	3.23
June	4.00	4.60	5.60	3.97	3.92	4.51	5.89	3.89
July	4.50	4.80	5.80	3.90	4.41	4.70	5.68	3.82
Agust.	4.00	4.30	5.00	7.60	3.92	4.21	4.90	3.53
Sept.	3.10	3.75	4.30	4.00	3.04	3.67	4.21	3.92
Oct.	2.10	3.50	2.80	2.80	2.06	3.43	2.74	2.74

Table (8):Crop Coefficient KC, % as affected by different Treatments during 2008 and 2009.

Months	KC, %									
	2008					2009				
	A	B	C	D	av	A	B	C	D	av
Furrow										
March	0.37	0.41	0.28	0.42	0.37	0.36	0.40	0.27	0.42	0.36
April	0.47	0.43	0.31	0.36	0.39	0.47	0.42	0.31	0.39	0.39
May	0.63	0.65	0.41	0.53	0.55	0.63	0.56	0.41	0.53	0.53
June	0.67	0.67	0.45	0.56	0.58	0.67	0.55	0.45	0.56	0.55
July	0.93	0.88	0.91	0.94	0.91	0.88	0.94	0.71	0.94	0.86
August	0.54	0.48	0.39	0.34	0.43	0.58	0.48	0.39	0.53	0.49
Sep.	0.54	0.39	0.34	0.40	0.41	0.54	0.39	0.34	0.40	0.41
Oct.	0.52	0.27	0.28	0.35	0.35	0.51	0.27	0.28	0.44	0.37
Mean	0.58	0.52	0.42	0.48	0.50	0.58	0.50	0.39	0.52	0.49
L.S.D at 5%	0.17	0.29	0.11	0.15		0.10	0.14	0.11	0.15	
Significant	**	**	**	**		**	**	**	**	
Bed										
March	0.55	0.56	0.37	0.73	0.55	0.55	0.56	0.37	0.73	0.55
April	0.61	0.57	0.38	0.50	0.51	0.62	0.57	0.38	0.58	0.53
May	0.94	0.68	0.50	0.70	0.70	0.95	0.69	0.51	0.70	0.71
June	0.90	0.67	0.54	0.71	0.70	0.91	0.68	0.52	0.71	0.70
July	1.16	1.02	0.96	1.17	1.07	1.16	1.03	0.84	1.19	1.05
August	0.75	0.60	0.50	0.67	0.63	0.76	0.61	0.51	0.67	0.63
Sep.	0.74	0.49	0.42	0.40	0.51	0.75	0.50	0.42	0.40	0.51
Oct.	0.81	0.34	0.39	0.36	0.47	0.82	0.35	0.39	0.36	0.48
Mean	0.80	0.61	0.50	0.65	0.64	0.81	0.62	0.49	0.66	0.64
L.S.D at 5%	0.15	0.34	0.25	0.19		0.16	0.30	0.23	0.20	
Significant	**	**	**	**	**	**	**	**	**	**
Interaction	**	**	**	**	**	**	**	**	**	**

Table (9): Seed Cotton Yield (kentar/Fed.) as affected by different treatments during 2005 and 2006 seasons.

Treatments	Seed cotton Yield (Kentar/fed.)		
	2008	2009	Mean
furrow			
FC%	7.17	7.34	7.25
90% FC	6.82	7.08	6.95
85% FC	6.52	6.82	6.67
80% FC	6.38	6.46	6.42
Mean	6.72	7.92	6.82
L.S.D at 5%	0.29	0.34	
Significant	**	**	
Interaction	**	**	
Bed			
FC%	7.78	8.17	7.97
90% FC	7.30	7.67	7.48
85% FC	6.93	7.28	7.10
80% FC	6.72	7.06	6.89
Mean	7.18	7.54	7.36
L.S.D at 5%	0.34	0.36	
Significant	**	**	

Table (10): Crop and field water use efficiency for different during 2008 and 2009 seasons.

Treatments	Crop water use efficiency, Kg/m^3			Field water use efficiency ,Kg/m^3		
	2008	2009	Mean	2008	2009	Mean
Furrow						
FC%	48.60	50.00	49.3	37.10	38.20	37.65
90% FC	50.35	50.60	50.47	37.80	39.00	38.4
85% FC	51.50	53.40	52.45	38.20	39.50	38.85
80% FC	53.60	55.27	54.43	39.40	40.80	40.10
Mean	51.01	52.31	51.66	38.12	39.37	38.75
L.S.D at 5%	0.09	0.09		0.01	0.02	
Significant	*	*		ns	ns	
Bed						
FC%	58.30	62.10	60.20	43.500	46.00	44.75
90% FC	60.22	63.15	61.68	44.35	48.30	46.32
85% FC	63.40	66.25	64.82	46.70	50.02	48.36
80% FC	66,50	70.60	68.55	48.50	52.11	50.30
Mean	62.10	65.52	63.81	45.76	49.10	47.43
L.S.D at 5%	0.05	0.10		0.01	0.03	
Significant	*	**		*	**	
Interaction	*	*		*	*	

Table (11): Crop budget of Cotton (Giza 86) in North Delta

Items	Unit	No. of Units	Price of unit, LE/Unit	Total Cost , LE/Fad
Product income	kintar		900.0	
Production Costs				
-Seeds	Kg	30	1.5	45.0
-Super phosphate	Kg	100		90.0
-Ammonium Nitrate	Kg	150		225.0
-Irrigation	m^3/fed	7 Irrigations	20	140.0
-Pesticides	kg/fed			350.0
- Labors and Equipment	man-hour/fed	50	20	1000.0
Total variable costs	-	-	-	1850.0

Table (12): Effect of irrigation treatments on net income for irrigation water unit and net income for yield per fad during 2008 and 2009 seasons.

Planting methods	Irrigation Treatments	Net income for yield, LE/fad			Net income for irrigation water unit, LE/m^3		
		2008	2009	Mean	2008	2009	Mean
Furrow	FC%	4603	4756	4679.5	1.52	1.59	1.55
	90 %FC	4288	4522	4405	1.51	1.59	1.55
	85% FC	4018	4288	4153	1.50	1.58	1.54
	80% FC	3892	3964	3928	1.49	1.59	1.54
	Mean	4200.25	4382.5	4291.3	1.50	1.58	1.54
Bed	FC%	5152	5503	5327.5	1.83	1.99	1.91
	90 %FC	4720	5053	4886.5	1.83	2.03	1.93
	85% FC	4387	4702	4544.5	1.88	2.06	1.97
	80% FC	4198	4504	4351.0	1.93	2.11	2.02
	Mean	4614.2	4940.5	4777.3	1.85	2.04	1.95

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الملخص العربى

إدارة مياه الري لمحصول القطن بشمال الدلتا

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أجري هذا البحث بالمزرعة البحثية بمحطة بحوث إدارة المياه بالقرضا – محافظة كفر الشيخ خلال الموسمين الزراعيين ٢٠٠٨ ، ٢٠٠٩ م لدراسة تأثير إدارة مياه الري على الإنتاجية والعائد النهائي وكذلك عائد وحدة المياه الري لمحصول القطن وقد صممت التجربة بنظام القطاعات المنشقة في أربع مكررات ، وكانت معاملات التجربة :

طرق مختلفة للزراعة .

- الزراعة على خطوط (خط فردي)
- الزراعة على مصاطب (خط مزدوج)

معاملات مختلفة للري.

- الري عند السعة الحقلية .
- الري عند ٩٠% من السعة الحقلية.
- الري عند ٨٥% من السعة الحقلية.
- الري عند ٨٠% من السعة الحقلية .

وتضمنت أهم نتائج الدراسة الآتي :

- أوضحت النتائج أن استخدام طريقة الزراعة بالمساطب (الخط المزدوج) أعطت أقل القيم لكميات المياه المضافة والاستهلاك المائي (٢١٥١.٢ ، ١٥٧٨.٣ م ٣ / فدان على الترتيب) مقارنة بطريقة الزراعة على خطوط مما أدى إلى توفير كمية من المياه مقدارها ٣٩٦ م ^{٣} / فدان بنسبة ١٥.٦% عند الري عند ٨٠% من السعة الحقلية.

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- كما أشارت النتائج أيضاً إلى أن أقصى قيمة لمعامل المحصول ، كفاءة استخدام المحصول لمياه الري ، كفاءة استخدام المياه بلغت ٠.٦٧ ، ٠.٦٢٨ كجم /م٣ ، ٠.٤٦٦ كجم/م٣ على الترتيب قد تم الحصول عليها باستخدام طريقة الزراعة على مصاطب (الخط المزدوج).
- كما أظهرت النتائج التأثير المعنوي لمعاملات الري المختلفة تحت الدراسة على كل من الاستهلاك المائي ، كفاءة استفادة المحصول ، كفاءة استفادة المحصول لمياه الري وكفاءة استخدام المياه وتم الحصول على أقصى القيم مع الري عند ٨٠%من السعة الحقلية.
- وقد أمكن الحصول على أعلى القيم لإنتاجية محصول القطن (٨.١٩ قنطار /فدان) ، صافي العائد للمحصول (٥٥٢١ جنية / فدان) والعائد النهائي لوحدة المياه المضافة (٢.٠٢ جنية / م٣) باستخدام طريقة الزراعة على مصاطب (الخط المزدوج) والذي أدى إلى زيادة صافي العائد للمحصول بنسبة ١١% وصافي وحدة المياه بمقدار ٢٥.٢% .
- كانت جميع معاملات الري المستخدمة فعالة في تحسين الإنتاجية وصافي العائد لمحصول القطن وتم الحصول على أعلى القيم عند الري عند ٨٠ % من السعة الحقلية مقارنة بمعاملات الري الأخرى .
- يوصي حسب هذه الدراسة باستخدام طريقة الزراعة على مصاطب (الخط المزدوج) مع الري عند السعة الحقلية.