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YIELD AND WATER CONSUMPTIVE USE IN NORMAL AND LATE PLANTED COTTON

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ABSTRACT

Two field experiments were carried out at Shalakan Exp. Sta., National research Center NRC in 1994 and 1995 season on Giza 75 cotton variety. The tested factors were irrigation (I) at 3 depletion levels of available soil moisture viz. at 40, 60, and 80 % SMD and two Planting date (PD), viz. 31 march (Normal) and 30 April (Late). A split plot design with 3 replicates was used. The studied topics included growth traits, yield attributes yield and water relationship. The results showed that irrigation 40% SMD gave significant increase in leaf area index, leaves dry weight and total plant dry weight. Leaf weight ratio was not significantly affected by irrigation.

Normal planting date (PD_1) significantly exceeded the late one (PD_2) regarding wit all studied growth traits. The combination between the two factors significantly affected all the growth attributes where early planting along with frequent irrigation at 40% SMD promoted cotton plant growth. For yield and its attributes, irrigation at 40% SMD.

The 40 % SMD significantly surpassed the other two treatments with respect of plant height, boll weight and seed index. However, irrigation at 60% SMD produced higher seed cotton yield either per plant or per fed. Late planting showed significant and negative effect on No. of bolls/plant, boll weight and seed index. Where, normal planting resulted in significant increments in seed cotton yield/plant and per fed as well as lint yield/fed. The interaction between the two factors gave different results between the two seasons. In the first season irrigation at 60% SMD x normal planting significantly achieved the highest seed cotton ant lint yields/fed. Where, as the combination 80 % SMD x PD_1 gave the higher yields/fed in the two seasons. The water consumptive use ranged from 3266.0 and 3290.0 m^3/fed, given in 8 irrigations in each season. Water use efficiency WUE ranged between 0.03 and 0.25 Kg/m^3. The highest water use efficiency was recorded for early planting and irrigation at 80 % SMD.

INTRODUCTION

Egyptian cultivated area by cotton has been declined to about 25% of the area in the golden era of cotton, when it was usually seeded in about two millions fed. Many reasons tightly stand one beside one as a back bone supporting the previous appearance. One of those reasons lies in the fact that cotton is a summer and long growing season crop, cusuming a relatively high amount of water. Elgibali and Badaawi (1978) reported that water requirements for cotton ranged from 2927.4 and 3070.2 m^2/fed.

Many investigators reported that cotton growth was significantly decreased as soil water stress was increasd, of them Kandil (1990), who added that leaf area seemed to be smaller due to water deficit. Abd El-Haleem (1995) assured the previous trends on leaf area index and leaf dry weight. Yield and yield components were also declared to be affected by

watering. However, Abd Allah (1987) found that the final No. of bolls/plant was inversely related to the applied amount of water. Moursi et. al. (1990-a) reported that plant height tended to decrease by irrigation, especially after severe depletion of available soil moisture. Alvarez-Reyna (1991) found no effect of watering on lint yield, but water stress increased lint %. Nemat Nour El-Din et. al. (1990) concluded that increase irrigation quantity promoted the production of maximum seed cotton yield.

The agricultural map in Egypt was widely changed in the last years. A think that cotton could be seeded after winter crops occupies a great area of consideration. To translate such think to a reality, trends of some works dealt with late seeding of cotton. Some growth traits were positively responded to late planting, Abou-Zaid (1991). Selim (1984) reported that leaf area index was decreased due to late planting. Some yield attributers tended to increase in early sowings, Helal (1986) on boll weight, Shahine (1986) and Arfa (2004) on plant height, Shafshak et. al. (1987) on No. of bolls/plant, Nagib (1990) and Abd El-Kareem (2003) on seed index. Gad Allah (2002), El-Said (2005) and Hamoda (2006) on seed cotton yield. However, some found different results, of them El-Zaree (1981) on boll weight, Wahdan (1981) on lint %. Abbas (1985) as well as Ali and El-Said (2001-a) found no effect due to sowing date on some yield components.

Water relationships were deeply studied by many workers in Egypt. Eid and Hosny (1995-a) reported that the optium water requirements for cotton could be ranged between 3969.0 and 4851.0 m^3/fed. Moreover, Ibrahim (1995) decleared that water use efficiency WUE was not affected by soil moisture.

Therefore, the present study was planned to investigate the effect of irrigation amount, planting date and their interactions on the growth, yield attributers and seed cotton yield.

MATERIALS AND METHODS

1- Experiment and environment

Two field experiments were carried out during 1994 and 1995, in the experimental farm of National Research Center NRC, at Shalakan, Kalubia Governorate, to study of the effect of irrigation amount and planting dates and their interactions on Giza 75 cotton cultivar. The soil was clay loam, containing a mean of 52.7%, clay, 20.5% silt and 26.9%, sand. It contained 1.8 % organic matter with a ph of 7.1 and available content of 50.1, p 15.5 and 370.0 ppm of N, P and K, respectively. The meteorological data at the site are summarized in Table 1

2- Treatments and experimental design :

Irrigation (I) was carried out at three levels of depletion of available soil moisture MSD, viz. 40, 60 and 80%. Two the planting date PD, viz. normal, 31 March PD_1 and late, 30 April, PD_2. A split plot design with three replicates was used. Irrigation treatments occupied the main plots, while the sub ones were devoted to the two sowing dates. Randomization was considered with all respects. The experimental plot area was 42 m^2 7 m. length x 6 width. Each plot included 10 rows, 60 cm apart. Spaces between

hills were 20 cm. Thinning secured two plants/hill, after 30-day from planting. The borders among main plots as well as among replications were wided to 1.50 m, to avoid water secpage effects. All the agricultural practices from sowing to picking, except the tested ones, were carried out as usual.

Table 1 : Monthly mean of air temperature (temp. C°) and actual sun shine duration ASSD hr/day), at Shalakan, in 1994 and 1995 seasons.

Mt. Fact. / Month	Tem C°		ASSD hr./ day	
	1994	1995	1994	1995
April	20.1	20.9	12.9	12.8
May	23.0	24.9	13.6	13.6
June	25.3	30.1	14.0	14.1
July	26.8	29.9	14.2	13.9
August	26.6	29.6	13.4	13.2
September	26.5	29.1	12.7	12.3

Sourrce : Bahtim Agro meteorological station

3- Irrigation treatments carrying on

To carry on irrigation studies, soil samples from depth of 60 cm were takin, before and after each irrigation. Duplicated samples were immediately transferred in closed tins of aluminum and oven dried at 105 C°. Field capacity FC, Permanent wilting paint PWP and bulk density Bd were determined. The obtained estimations were 38.5, 18.5 and 1.46 in 1994 and 35.0, 15.0 and 1.40 in 1995, respectively.

Hansen et. al. (1979) suggested the following equation for calculating water consumptive use WCU as follows:

$$WCU = \left(\frac{e_2 - e_1}{100}\right) (B..d.) \left(\frac{S.D}{100}\right) (area/m^2) \text{ where}$$

e_2 = Soil moisture after irrigation .
e_1 = Soil moisture before irrigation
B.d. = Bulk density (gm/cm^3).
S.D.= Soil depth (cm).
Area /m^2 = standard used area, in Egypt = 1 Fed = 4200 m^2 .

Number of irrigations as well as WCU under the tested treatments, during the two growing seasons are shown in table 2 .

Table 2 : Number of irrigations I and WCU, m^3/fed at different SMD in the planting dates at Shalakan in 1994 and 1995.

Irrigation / Treatment	No. of Irrigation		WCU(m^3 / fed)	
	1994	1995	1994	1995
40% x PD_1	13	13	3538	3564
40% x PD_2	10	10	2721	2741
60% x PD_1	8	8	3266	3290
640% x PD_2	6	6	2449	2467
80% x PD_1	5	5	2722	2742
80% x PD_2	4	4	2177	2193

4 - Studied topics

A- Growth analysis

Growth analyses were performed twice, 80 and 120 day, after sowing. At each growth stage (sampling date), ten guarded plants were taken at random from the two inner rows of each sub plot. Plants were carefully uprooted and separated into leaves, stems, branches, recovered roots and fruiting parts. Different plant fractions were dried at 70°C to constant weight. The following growth attributes were studied :

1-Leaf area index (L.A.I.), as L.A.I. leaf area/plant/Area of plant.
2-Leaves dry weight (L.D.W.), gm.
3-Total plant dry weight (T.D.W.), gm.
4-Leaf weight ratio LWR as LDW ÷ TDW.

B- Yield and yield components :

Third ten guarded plants were taken at picking. Such other ten plants were used for carrying on the studies on cotton yield and its main attributes as follows:-

1-Plant height (PH), cm.
2-No. of bolls/plant (No. B/P)
3-Boll weight (BW), gm.
4-Seed index (SI), gm. as weight of 100 sound seeds.
5-Lint percentage (1%) as : L % = weight of lint cotton : weight of seed cotton x 100
6-Seed cotton yield/plant (SCY/P), gm.
7-Seed cotton yield/fed,(SCY/P), kentar (ken).
8-Lint yield /fed (LY/fed), (ken).

C - Water relationships :

1- Water consumptive use WCU was determined as previously mentioned, according to Hansen et. al. (1980).
2- Water use efficiency WUE. was determined according to Vites (1965) as follows :

$$W.U.E. = \frac{\text{Seed cotton yield (kg/fed)}}{\text{Water consumptive use (m}^3\text{/fed)}} \quad \frac{\text{S.C.Y./fed}}{\text{W.C.U./fed}}$$

5- Statistical analysis :

Data were exposed to the proper analysis of variance. Means followed by the same alphabetical letters are insignificantly different at 0.05 level of significance according to least significant difference LSD. All statistical analysis were straightforward according to Gomez and Gomez (1983).

RESULTS AND DISCUSSION

A - growth analysis

Table 3 : gives the means of growth traits as affected by irrigation levels and date of planting treatments and their interactions at Shalakan in 1994 and 1995.

A-1- Leaf area index (LAI) .

In 1994, significant differences were observed due to irrigation treatments (I) on both samples. No significant difference was detected when comparing the products of 40% SMD and 60% SMD at 80 and 120 day after planting. A gradual and significant reduction of LAI as SMD increased. In respect to sowing dates, it was observed that significance was detected only in at 80 day age where significant increment was detected in favor of PD_1 (3.8). No doubt, normal planting date PD_1 higher number of branches/plant and higher number of leaves/plant and hens higher number consequently greater LAI as compared to those of late date PD_2.The results are in line with those reported by El-Shazly (1992).

Interaction effect was significant in the two samples. The combination 40% SMD x PD_1 gave the highest value of LAI at the two respective growth stages, viz. 4.6 and 5.0, respectively. Moreover, the combinations 40% SMD x PD_1 and 60% SMD x PD_1 produced noticeable LAI. This means that more irrigations with normal planting date promoted cotton plant growth as expressed in more number of leaves with larger leaf area and hence. LAI. The present findings are in harmony with those found by Abd El-Haleem. (1995).

In 1995 season, data were in most cases, similar to those of the first one. Significance was absent with respect to irrigation at 120 day age. Also the combination 40% SMD x PD_2 at 80 day interval Pm_1 produced the highest LAI, i.e.4.3.

2- Leaves dry weight LDW:

In 1994, Table 3 : shows significant differences among irrigation treatments, either at 80 or 120 day. At both samples, more irrigation at 40% SMD produced the heaviest greatest LDW Irrigation at 80% SMD did the opposite. This means that more watering was extreemly important for the formation and accumulation of dry matter in leaves through its important role in photosynthesis .Growth rate was approximately doubled in 120 day as compared to 80. Abd El-Haleem. (1995) found similar trends.

Significant increments were detected between the two sowing dates in favor of the normal one. In other words, long growth season may promoted accumulation of dry matter in leaves. The irrigation x planting date interaction insignificantly affected this trait .

In 1995 season, only the difference between planting dates was insignificant. Growth trend and rate were as mentioned in 1994 season, either with Sm_1 or Sm_2.

Table 3 : Means of growth traits as affected by irrigation I levels, sowing date PD and their interactions in the two samples Sm at shalakan in 1994 and 1995.

Trait	L. A. I.				L. D. W. , gm.			
Season	1994	1995	1994	1995	1994	1995	1994	1995
Sample	Sm_1	Sm_2	Sm_1	Sm_2	Sm_1	Sm_2	Sm_1	Sm_2
Treatment								
I at DAM								
40 %	4.0a	4.4a	3.8a	3.8	8.7a	18.6a	8.3a	20.2a
60%	3.7a	3.6b	3.1b	3.1	8.6a	16.7b	5.2b	14.8b
80%	3.0b	2.9c	2.1c	3.5	3.5b	14.3c	3.7b	13.0b
PD								
PD_1	3.8	3.0	3.7a	8.0a	8.0a	17.2a	5.7	16.2
PD_2	3.5	3.5b	3.1	3.2b	7.0b	15.7b	5.8	15.8
Interactions								
40%xPD_1	4.6a	5.0a	3.4b	4.4a	9.6	20.4a	8.3	19.2a
40%xPD_2	3.5cd	3.7b	4.3a	3.1cd	7.8	16.7b	8.4	21.2a
60%xPD_1	3.6bc	3.7b	2.9bc	2.7d	9.4	16.5b	4.9	14.3bc
60%xPD_2	3.8b	3.5bc	3.3b	3.5bc	7.9	16.8b	5.4	15.3b
80%xPD_1	2.8e	2.6d	2.6c	3.8b	5.2	14.9ec	3.8	5.1b
80%xPD_2	3.2d	3.2c	1.6d	3.1cd	5.4	13.7c	3.6	10.9c
Trait	TDW, (gm)				LWR			
Season	1994	1995	1994	1995	1994	1995	1994	1995
Sample	Sm_1	Sm_2	Sm_1	Sm_2	Sm_1	Sm_2	Sm_1	Sm_2
Treatment								
I at DAM								
40%	23.0a	91.3a	33.1	93.2a	0.37	0.20	0.36	0.22
60%	20.5a	79.0b	13.7	75.2b	0.42	0.21	0.38	0.20
80%	15.5b	76.0b	10.9	67.6b	0.36	0.19	0.34	0.19
PD								
PD_1	20.0	86.4a	15.2	78.9	0.37	0.20	0.37	0.20
PD_2	19.3	77.7b	32.4	78.4	0.39	0.20	0.35	0.20
Interaction								
40%xD_1	23.8	95.8	21.2	86.9b	0.36	0.21	0.39	0.22
40%xD_2	22.1	86.7	45.1	99.5a	0.37	0.19	0.33	0.21
60%D_1	21.0	83.2	12.9	76.9bc	0.45	0.20	0.38	0.19
60%xD_2	20.0	74.7	14.6	73.5c	0.39	0.23	0.37	0.21
80%D_1	15.3	80.3	11.4	73.0c	0.31	0.19	0.33	0.21
80%xD_2	15.7	71.7	10.4	62.2d	0.40	0.19	0.35	0.17

Means followed the some letters are insignificantly different according to LSD test at α 0.05

3- Total plant dry weight, TDW (gm).

In 1994, Table 3 : declares that the difference among irrigation level reached the level of significance. The TDW followed LDW and hence produced the highest value by irrigation at 40% SMD, in the two stages of growth. This assured the positive relation between abundant water and dry matter accumulation. In other words, soil moisture stress reduced net photosynthesis which automatically led to noticeable loss in total dry weight, (Krieg ,1983).

The first sample showed insignificant difference between the two sowing dates. In the second one, the opposite was quite true, where a significant increment was obtained in favor of PD_1. These results followed those previously mentioned regard an LDW Selim (1984) found different results. Interaction had significant effects. Apparently, the values of the trait in Sm_2 were about four times as at Sm_1.

Data in 1995 showed no significant effects on all respects at Sm_1, except the absence of significance within planting dates. In spite of these different results, the main trends, including growth rate, mentioned in 1994 were observed in 1995 too.

4- Leaf weight ratio LWR

Table 3 gives no significant differences in LWR, either in 1994 or 1995. With this respect, LAI, LDW and TDW were gradually increased from sample 1 to sample 2 . Generally, it was accepted that irrigation at 40% SMD and planting at end of March and their interaction gave the pronounced products of LAI, LDW and TDW. For LWR the 60% SMD replaced 40 % SMD for such purpose.

B- Yield and Yield attributers:

Table 4 gives the obtained means of seed cotton yield and yield and its attributers, as affected by irrigation levels, planting dates and their interactions, in 1994 and 1995 seasons.

1-Plant height, PH, (cm):

In both seasons plant height was significantly increased by the increase of water addition. It seemed that sufficient irrigations may have had enhanced cell division, cell expansion and enlargement and hence stem elongation. Their for taller plants were obtained. These results are in agreement with those of Abd El-Haleem (1995), who declared that shorter plants were commonly seen during water shortage and after drought periods. Arafa (2004) found similar results.

Late planting produced taller plants with significant difference over the normal one in the first season .This was not observed in the second season. However, shorter plants were obtained due late planting but with out significantly differences. The present results are in harmony with those of Nagib (1990), but are in different with those of Shahine (1986).

2-Number. of bolls/plant , No. B/P:

In 1994, no significant differences were detected, regarding the effect of irrigation treatment on number of bolls/plant. In 1995, however, irrigation at the 60% SMD produced the highest number of bolls/plant followed by the 80% SMD where the lower number was produced by the frequent irrigation at the 40% SMD. This means that suitable reduction of watering may induce fruiting development, oppositely to its effect on vegetative growth.

Regarding the effect of planting date, in both seasons early planting by end of March produced significantly higher number of bolls/plant than late planting in end of April. Similar results were reported by El- Shazly (1992) but are different from those obtained by Abd El- Kader (1980).

3- Boll weight, BW, (gm):

In 1994, Table 4 shows no significant effect to irrigation or planting date on boll weight. Their interaction significantly affected it. Mohamed The

combination 40% SMD x PD_1 gave the heaviest boll weight, i.e. 3.0 gm. In 1995, differences reached the level of significance with all studied respects. Irrigation at 40% SMD significantly exceeded the two other treatments, which did not vary significantly from each other. The reduction in BW under the 60 % or 80% SMD treatments may be explained as they produced higher No. B/P, Abd El- Haleem (1985) came to similar conclusions.

Normal planting date gave the heavier BW as compared with that of the late one. This indicates that normal planting date by end of March, enhanced the growth and development of cotton plants and expressed heavier in longer LAI and heavier total plant dry weight, table 3. The present findings are in accordance with those of Mohammed Magda (1993).

Table 4 : mean of yield and yield components as significantly affected by irrigation I levels sowing dates SD and their interactions at Shalkan in 1994 and 1995.

Trait	PH, (cm)		No. of B/P		BW, (gm)		SI, (gm)	
Season	1994	1995	1994	1995	1994	1995	1994	1995
Treatment								
I at DAM								
40 %	117.5a	119.3a	6.7	8.2c	2.9	2.9a	11.1a	11.2a
60%	89.8b	90.9ab	11.8	12.4a	2.6	2.6b	10.7b	10.2b
80%	78.9c	79.9c	11.8	10.9b	2.9	2.6b	10.2b	9.9b
PD								
PD_1	91.3b	96.6b	13.2a	12.0a	2.7	2.8a	11.2a	11.7a
PD_2	100.1a	94.6	7.0b	9.0b	2.8	2.6b	9.74b	9.2b
Interactions								
40%xPD_1	115.2	120.5	7.7	9.3	3.0a	3.0a	12.37a	12.6a
40%xPD_2	119.8	118.0	5.7	7.0	2.7b	2.9ab	9.78bc	9.9bc
60%xPD_1	83.4	81.6	16.5	13.2	2.5b	2.8bc	10.89b	11.9a
60%xPD_2	96.2	100.0	7.0	11.7	2.6b	2.4d	9.25c	8.5d
80%xPD_1	75.4	81.4	15.3	13.5	2.7b	2.6c	10.21bc	10.5b
80%xPD_2	84.3	58.3	8.3	8.3	3.1a	2.6c	10.19bc	9.4c
Trait	L%		SCY/P		SCY/fed		LY/fed, (ken)	
Season	1994	1995	1994	1995	1994	1995	1994	1995
Treatment								
(I.) at DAM								
40%	34.4c	35.7c	13.9b	1.38b	1.8b	2.1b	2.0b	2.3b
60%	35.1b	36.7b	24.4a	17.2a	2.9a	3.0a	3.3a	3.4a
80%	36.9a	37.9a	24.8a	17.1a	2.9a	2.9a	3.4a	3.4a
PD								
PD_1	35.7	36.2b	30.1a	21.4a	3.9a	3.9a	3.5a	4.5a
PD_2	35.2	37.4a	11.9b	10.7b	1.1b	1.3b	1.3b	.5
Interaction								
40%xD_1	34.4	34.7	20.7b	16.4c	3.0b	2.9c	3.4	3.2b
40%xD_2	34.4	36.7	7.0d	11.2d	0.6d	1.2e	0.7	1.4d
60%xD_1	35.6	36.3	35.3a	24.7a	4.0a	4.6a	5.2	5.3a
60%xD_2	34.6	37.1	13.46c	9.8e	1.2c	1.3de	1.4	1.5cd
80%xD_1	37.1	37.4	34.26a	23.1b	4.3a	4.2b	5.0	1.0a
80%xD_2	36.8	38.4	15.28c	11.0d	1.5c	1.5d	1.8	1.8c

Means followed the some letters are insignificantly different according to LSD test at α 0.05

4- Seed index SI:

In both season, Table 4 declares significant effect to the two factors and their interactions on seed index. Frequent irrigation produced the

heaviest seed index. The two other treatments did not significantly vary from each other. This could be attributed to the lower number of bolls/plant recorded by this treatment. These results are contradicting with those of Abd El-Haleem (1995), who did not find significant effect to irrigation on seed index.

Normal sowing date produced the heavier seeds than late one. This could be attributed to the more photosynthesis produced by early ones, however they had larger leaf area index than late planted cotton. The present finding confirmed those of Nagib (1990). El–Shazly (1992) found different results. Meanwhile, Abd El-Karim (2003) agreed with the present results.

5- lint percentage L %:

In 1994, Table 4 illustrates significant differences in lint percentage due to irrigation treatments where L.% was gradually decreased with frequent irrigation. These findings may be attributed to the heavier seed index recoded by this irrigation treatment Alvarez Reyna (1991) found different results.

In 1995, similar results were detected. Moreover, late sowing significantly exceeded the normal one. The present results confirmed those of Wahdan (1980), but in adverse to those of Yassen (1986) and Abou Zaid (1991).

6- Seed cotton yield/plant SCY/P gm :

In both seasons, frequent irrigation at the 40% SMD produced significantly lower seed cotton yield/plant than irrigation at either 60% or 80% SMD treatments. In other words, irrigation at 60% or 80% SMD made a good balance between vegetative growth and fruiting growth and hence out yielded the frequent irrigation treatment. These results confirmed those obtained by El-Saidi (1974) and Abd-Haleem (1995).

In both seasons, normal planting date out yielded the late one. This was rather expected for early planting than late one. Moreover, normal planting gave higher values of growth aspects, including LAI, LDW and TDW, (Table 3), as well as higher No. of B/P (13.2) and heaviest SI (11.2 gm), (Table 4), which were turned in the term of SCY/P. The present findings confirmed those obtained by Mohamed Magda (1993), Gad Allha (2002), El-Sayed (2005) and Hamoda (2006).

The interaction effect was significant, whereas, the combination 60% SMD x PD_1 produced the highest SCY/P, in both seasons.

7- Seed cotton yield /fed. SCY, (ken/fed) :

In both seasons, significant effect was observed due to the two studied factors and their interactions on seed cotton yield/fed. All the trends mentioned above in respect to SCY/P, without any deviation, were also noticed herein. This means that the effect of No. of plants/area at harvest was the same under all treatments. Thereafter, all discussions and explanations mentioned on SCY/P would be safety considered herein.

As mentioned above, irrigation at 40% SMD which consumed about 3129.50 m^3/fed, throughout the growing season, Table 2 produced the lowest yield/fed, i.e. 1.8 ken. Such yield was significantly lower than both of the two other treatments, which did not vary significantly from each other. Table 2 shows that the corresponding WCU of 60% SMD and 80% SMD were 2857.5

and 2449.5 m^3/fed, respectively. However SCY/fed, mainly depended on SCY/P, it could be expected that irrigation at suitable SMD such as 60% or 80% SMD may have had promoted root penetration and hence better soil moisture utilization. Such utilization consequently enhances photosynthesis and efficiency of some biological processes within the plant, (Slatyer 1957). Such positive effect was also observed on some growth aspects, (Table 3) as well as most of yield components considered herein, (Table 4). Therefore, plant yield was progressively increased by applying irrigation water of 2857.5 m^3/fed or 2449.5 m^3 through larger and fewer numbers of irrigations, (Table 2). These results are in general agreement with those of Abd El-Haleem (1985) and Adb El-Haleem. (1995).

In both seasons ,normal planting date out yielded the late one by about 2.5 ken/fed, assuring the value of early planting as it was mentioned above. These results are in accordance with those reported by Nagib (1990), who found that early planting led to a pronounced seed cotton yield/fed.

The interaction between irrigation x date of planting was significant in both seasons. In the first season, the higher yield of 4.3 Ken/fed. was recorded by the 80% x PD_1 but was not significantly different from that recorded by the 60% x PD_1 treatment 4.0 ken/fed. In the second season, the highest yield of 4.6 ken/fed. was recoded again by the 60% x PD_1 treatment. The contribution of ground water might have had a role in satisfying the water requirements of cotton plants (Dastane 1972).

8-Lint yield, LY, ken/fed :

Table 4 shows that frequent watering as 40% SMD significantly reduced LY, as compared to the two other treatments, which did not significantly vary from each other. However, such results are in constitution with those obtained on SI which may directly favor LY Alvarez- Reyna (1991) found no significant effect of watering on LY.

The normal sowing date significantly surpassed the late one by about 3.2 ken/fed. These results declare the great promoting role of long season which allows good conditions for lint formation, elongation and thickness through the accumulation of cellulose. The results herein are in close harmony with those reported by Shafshak et. al. (1987).

The irrigation x date of planting interaction insignificantly affected this trait . In 1995, significance appeared on all respects. Similar trends as in the first season were observed on all respects too. The highest LY/fed, viz. 3.9, 4.5 and 5.3 ken. were produced by the treatments of 60%, PD_1 and 60 % x PD_1, respectively.

C- Water relationship :

1- Water consumptive use:

Table 5 represents WCU (m^3/fed), SCY (kg/fed) and WUE (kg m^3). In both seasons, a gradual decrease in WCU was observed as depletion percentage before irrigation was increased. The lowest WCU was detected by irrigation at 80% SMD. The obtained WCU at the highest SMD was 2449.5 m^3/fed in 1994 and 2467.5 m^3/fed in 1995. Hussein (1973) showed that WCU was 3028, 3166, 3150 and 3150 m^3/fed for cotton plants irrigated after depletion of 100, 75, 50 and 25% of available soil moisture, respectively. The

seasonal WCU in the study of Mahrous (1971) was 61.8 cm. (2595.6 m^3/fed) at Northern Delta.

Similarly, obtained WCU as affected by planting date was deferent between the first and second season. This means that there was noticeable effect of meteorological conditions on consumptive use, (Table 2). However, lower WCU was needed by late planting due to the shorter growing season. Late planting saved about 726.3 and 731.7 m^3/fed in 1994 and 1995 respectively. Ibrahim (1995) found similar trends. However, these savings were on the expense on both seed cotton and lint yields when were decrease by about 2.5 and 3.0 ken/fed, in respect order due to late planting.

Table 5 : water consumptive use WCU m^3/fed., seed cotton yield SCY in kg/fed, and water use efficiency WUE kg/m^3, as affected by irrigation (I) level, planting date PD and their interactions, at Shalakan, in 1994 and 1995.

Traits / Season / Treatments	WCU (m^3/fed)		SCY (kg/fed)		WUE (kg/m^3)	
	1994	1995	1994	1995	1994	1995
I at SMD						
40%	3129.5	3152.5	281.1	323.0	0.09	0.10
60%	2857.5	2878.5	456.8	467.8	0.16	0.16
80%	2449.5	2467.5	459.1	448.9	0.19	0.18
PD						
PD_1	3175.3	3198.7	621.1	615.8	0.20	0.19
PD_2	2449.0	2467.0	176.9	211.1	0.07	0.09
Interactions						
40% PD_1	3538.0	3564.0	467.8	459.9	0.13	0.13
40% PD_2	2721.0	2741.0	94.5	187.4	0.03	0.07
60% PD_1	3266.0	3290.0	719.8	729.2	0.22	0.22
60% PD_2	2449.0	2467.0	193.7	206.3	0.08	0.08
80% PD_1	2722.0	2742.0	675.7	658.6	0.25	0.24
80% PD_2	2177.0	2193.0	242.6	239.4	0.11	0.11

However, the treatments 40% and PD_1 revealed separately higher WCU it could be expected that their combination did the same too. Actually, The combination 40% x PD_1 reflected the highest WCU, viz. 3538 and 3546 m^3/fed. in 1994 and 1995, respectively. Similarly it was expected that the combination 80% x PD_2 could show the lowest WCU being 2177 and 2193 m^3/fed. in the two successive seasons.

2- Water use efficiency, WUE (kg/m^3):

Table 5 shows that irrigation at 80% produced the highest WUE either in 1994 0.19 kg/m^3 or in 1995 0.18 kg/m^3. Such soundly WCU would be attributed to the corresponding lower WCU on one side and to the absolute higher SCY/fed, in 1994 i.e 459 kg as well as to the relative higher SCY/fed, in both seasons on the other side. Therefore, irrigation at 80% SMD as a mean over all other respects may be recommended, according to WUE.

Normal planting date PD_1 showed higher WUE either in 1994 0.20 kg/m^3 or in 1995 0.19 kg/m^3. These two estimations were mainly due to the higher corresponding SCY/fed, viz. 621.1 and 615.8 kg in 1994 and 1995

respectively. Such higher SCY/fed, compensated the corresponding higher WCU in the two seasons and consequently produced the highest WUE (Table 5).

The combination 80% x PD_1 produced the highest WUE, viz. 0.25 and 0.24 kg/m^3 in 1994 and 1995, respectively. Such results may be explained in the light of the explanation of the independent effect of 80% and PD_1 treatments, which promoted growth of crop plants (Table 3) and hence their seed cotton yield and all of its attributes (Table 4).

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المحصول والمقنن المائى للقطن فى الزراعة العادية والمتأخرة

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قسم العلاقات المائية والرى الحقلى – المركز القومى للبحوث

أجريت تجربتان حقليتان بمزرعة المركز القومى للبحوث بناحية شلقان قليوبية فى ١٩٩٤ و ١٩٩٥ لدراسة تأثير ٣ مستويات وذلك عند استنفاذ ٤٠ ، ٦٠ ، ٨٠ % من الماء الميسر وموعدين للزراعة وهما العادية فى ٣١ مارس والمتأخرة فى ٣٠ ابريل على صنف القطن جيزة ٧٥ استخدم تصميم القطع المنشقة فى ثلاثة مكررات – أجريت الدراسة على بعض صفات النمو، مكونات المحصول والمحصول وفيما يلى أهم النتائج:

أولا : صفات النمو

- تفوق الرى عند استنفاذ ٤٠% من الماء الميسر تفوقا معنويا مع صفات دليل مساحة ، الوزن الجاف للأوراق والوزن الجاف الكلى فى حين لم تتأثر صفة نسبة وزن الأوراق بمعاملات الرى
- كان لموعد الزراعة العادية تفوقا ملموسا على الموعد المتأخر على جميع الصفات
- كان للتفاعل بين العاملين السابقين تأثيرا معنويا على جميع صفات النمو

ثانيا : المحصول ومكوناته

- أظهرت معاملة الرى عند استنفاذ ٤٠ % من الماء الميسر تفوقا معنويا فى صفات ارتفاع النبات ، وزن اللوزة ومعامل البذور، فى حين ظهر التفوق المعنوى للرى عند استنفاذ ٦٠ او ٨٠ % من الماء الميسر على محصول القطن الزهر/نبات ومحصول القطن الزهر/الفدان .
- كان للزراعة المتأخرة تأثيرا سلبيا على محصول القطن الزهر/فدان وجميع مكوناته باستثناء نسبة التيلة والتى زادت فى الزراعة المتأخرة بسبب زيادة دليل البذرة.
- اظهر تداخل الفعل بين عاملى الدراسة ان اعلى محصول من القطن الزهر/فدان واعلى محصول تيلة/فدان قد تحققا بالزراعة مبكرا فى نهاية مارس مع إجراء الرى عند استنفاذ ٦٠ و ٨٠ % من الماء الميسر فى الموسم الأول والثانى على التوالى.

ثالثاً العلاقات المائية :-

- تراوحت قيم المقنن المائى بين ٢١٧٧ و٣٥٦٤ م٣مفدان موزعة على ٤ ، ١٣ رية فى الموسمين المتعاقبين. ولقد تراوحت كمية المياه المستغلة لإنتاج أعلى محصول بين حوالى ٣٢٦ ، ٣٢٩٠ م^{3} للفدان فى الموسمين على التوالى حيث وزعت كل من الكميتين على ٨ ريات خلال موسم النمو.
- تباينت قيم كفاءة استخدام المياه بين ٠,٣ الى ٠,٢٥ كجم / م^{3} فى موسمي الدراسة .

ولقد تحقق اعلى القيم عند الزراعة المبكرة فى ٣٠ مارس مع إجراء الرى عند استنفاذ ٨٠ % من الماء الميسر وهو ما يمكن ان يوصى به من هذه الدراسة.