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Response of Sugar Beet to Planting Dates and Water Requirements in Middle Egypt. 1- Consumptive Use and Water Use Efficiency

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TWO FIELD experiments were carried out at Sids Agric. Res. Station Farm. Beni-Suef Governorate, Egypt during 1995 / 96 and 1996 / 97 seasons to study the relationship between planting dates (25Sept., 10 Oct. and 25 Oct.) and irrigation treatments (irrigation at 40, 60 and 80% depletion from available soil moisture added to recommend irrigation). The results were as follows:

No clear difference in applied irrigation water could be attributed to planting dates. Early planting date caused small increase than other planting dates.

Irrigation at a depletion of 40, 60 and 80 % from available soil moisture saved 27.9, 30.7 and 32.3 % in the first season and 29.4, 32.9 and 34.5% in the second season, respectively compared to normal farm irrigation treatment (control).

No clear difference in ET could be noticed between the three planting dates. Average values of ET were 73.38, 71.48 and 71.52 cm in the first season and 76.77, 75.70 and 75.65 cm in the second one. Irrigation as recommended in the region recorded the highest ET in both seasons. Arranging these results in descending order, as average, was: ET of control > depletion at 40, 60 and 80 % from available soil moisture in both seasons.

The rate of soil moisture extraction from soil layers of root zone was very high in the surface layers (0-15 cm) and became less with

increasing depth of soil in all treatments. Data indicated that sharing of each layer depends on the sowing dates and irrigation treatments. The second planting date caused the highest soil moisture extraction in the first layer (0 - 15 cm) and second layer (15 - 30 cm), while the first planting and third planting date gave the highest figures of soil moisture extraction from the third and fourth layer . Also, soil moisture extraction increased from the fourth layer (45 - 60 cm) at irrigation after 80 % depletion of available water, while irrigation after 40 % depletion of available water gave the less rate of soil moisture extraction from the fourth layer.

Early planting date (25 / 9) was accompanied by the highest average of water use efficiency (WUE) of 9.39 and 9.55 kg roots/m^3 and 1.47 and 1.49 kg sugar/m^3 in the two seasons, respectively, while the late planting date resulted in the lowest values.

According to WUE values, irrigation treatments could be arranged in the following descending order: 60 > 40 > 80 % (ASMD) and control for root and sugar yield in both seasons.

Keywords: Sugar beet, Planting dates, Water requirements, Middle Egypt.

Sugar beet (*Beta vulgaris* L.) has become one of the strategic crops in Egypt due to its income to the farmers and as a source of sugar. Planting date and irrigation regimes play an important role on water utilized and consequently on yield and quality of sugar.

Prasad *et al.* (1985) stated that the maximum consumptive use values of 60.95 and 56.82 cm were observed at 80 % ASMD which resulted in maximum sugar yield of 5.9 and 6.7 ton ha in the 1^{st} and 2^{nd} year, respectively. Cucci and Caro (1986) found that the most effective seasonal irrigation requirements were 3000 - 5500 m^3 / ha. Ibrahim *et al.* (1993) reported that water requirements were in the range of 59.56 to 46.67 cm while the values of consumptive use were 58.06, 55.04 and 49.86 cm for the 2, 3 and 4 weeks intervals, respectively. The water use efficiency of 8.66 kg for sugar beet root was obtained using one cubic meter of water. Ibrahirn *et al.* (1995) found that average seasonal values of soil moisture depletion (ASMD) were 64.97, 51.73 and 46.75 cm for irrigation depth

6 cm and two weeks irrigation interval. Water duty for sugar beet was 2583.4 m^3 / fed. Abd El- Wahab *et al.* (1996) reported that the highest value of consumptive use (58.03cm) was recorded when plants were irrigated by 2625 m^3/fed. They added that values of water use efficiency (WUE) were 16.44, 13.92 % and 13.81 for root yield and 3.25, 2.81 and 2.9 ton/fed for sugar yield, using 2625 , 2100 and 1575 m^3 / fed, respectively.

Rayan *et al.* (1997) found that values of water consumptive use of sugar beet in Upper Egypt were 2252.8, 2115.7 and 2071.0 m^3 / fed in the first season while in the second, it reached to 2046.8, 2287 and 2198.5 m^3 / fed for the treatments irrigation after 25 - 30, 45 - 50 and 65 – 70 % depletion of available soil moisture , respectively .

The aim of this investigation was to study different irrigation regimes under three planting dates to reveal the best irrigation regime that can be adopted to increase sugar beet yield.

Material and Methods

Two field experiments were carried out at Sids Agric. Res. Station Farm. Beni-Suef Governorate, Egypt during 1995 / 96 and 1996 / 97 seasons to study the relationship between planting dates, *i.e* 25 September, 10 October and 25 October and irrigation treatments, *i.e* irrigation at 40, 60 and 80% depletion from available soil moisture (ASMD) to recommended irrigation. A split - plot design with four replications was used. Planting dates were arranged randomly in the main plots, while four irrigation treatments were allocated in the sub-plots. The sub-plot area was 42 m^2. It consists of eight ridges, 8.75 m long and 60 cm width. The distance between hills was 20 cm. The soil of experimental field is clay loam. Phosphorus fertilization was applied during soil preparation at the rate of 15 kg P_2O_5, while potassium sulphate (48% K_2O) was added after thining at rate of 50 kg K_2O / fed. Nitrogen fertilization was applied as ammonium nitrate (33.5%) at the rate of 60 kg N / fed into two equal doses; the first after thinning, while the second dose applied after month later. All other agricultural practices were carried out as recommended for sugar beet production.

Results of chemical soil analysis according to Jackson (1967), mechanical and some of soil-water characteristics for the trail sites are shown in Tables 1 and 2, respectively.

TABLE 1. Mechanical and chemical soil analysis of the experimental sites in 1995/96 and 1996 / 97 seasons.

Characteristics	1995 / 96	1996 / 97
Mechanical analysis		
Sand %	20.25	16.42
Silt %	34.80	31.38
Clay %	44.95	52.20
Soil texture	Clay	Clay
Chemical analysis		
O.M. %	2.2	2.04
PH	7.7	7.9
E.C. mmhos / cm (1 : 5)	0.55	0.57
Cations and anions meq / L.		
Ca^{++}	2.6	2.8
Mg^{++}	2.2	2.1
Na^{+}	0.70	0.78
K^{+}	0.05	0.04
CO_3^{--}	-	-
HCO_3^{-}	5.0	5.0
Cl^{-}	0.35	0.54
SO_4^{--}	0.22	0.18

TABLE 2. Some soil-water characteristics of the experimental sites at different depth in 1995 / 96 and 1996 / 97 seasons.

Sample depth (cm)	FC %	PWP %	ASM %	D_b (g / cm^3)
	1995 / 96			
0 - 15	42.40	20.00	22.40	1.176
15 - 30	35.90	18.80	17.10	1.244
30 - 45	33.45	15.00	18.45	1.251
45 - 60	31.71	14.50	17.21	1.431
	1996 / 97			
0 - 15	42.40	20.93	21.47	1.186
15 - 30	36.99	18.02	18.97	1.261
30 - 45	33.41	15.61	17.80	1.264
45 - 60	32.61	15.58	17.03	1.336

FC = Field capacity
ASM = Available soil moisture
PWP = Permanent wilting point
D_b = Soil bulk density.

Collected data

Irrigation control

The irrigation water distributed through steel pipes and each plot received its irrigation water through valve fixed to the steel pipes as shown in Fig 1. Irrigation water was measured using counter meter.

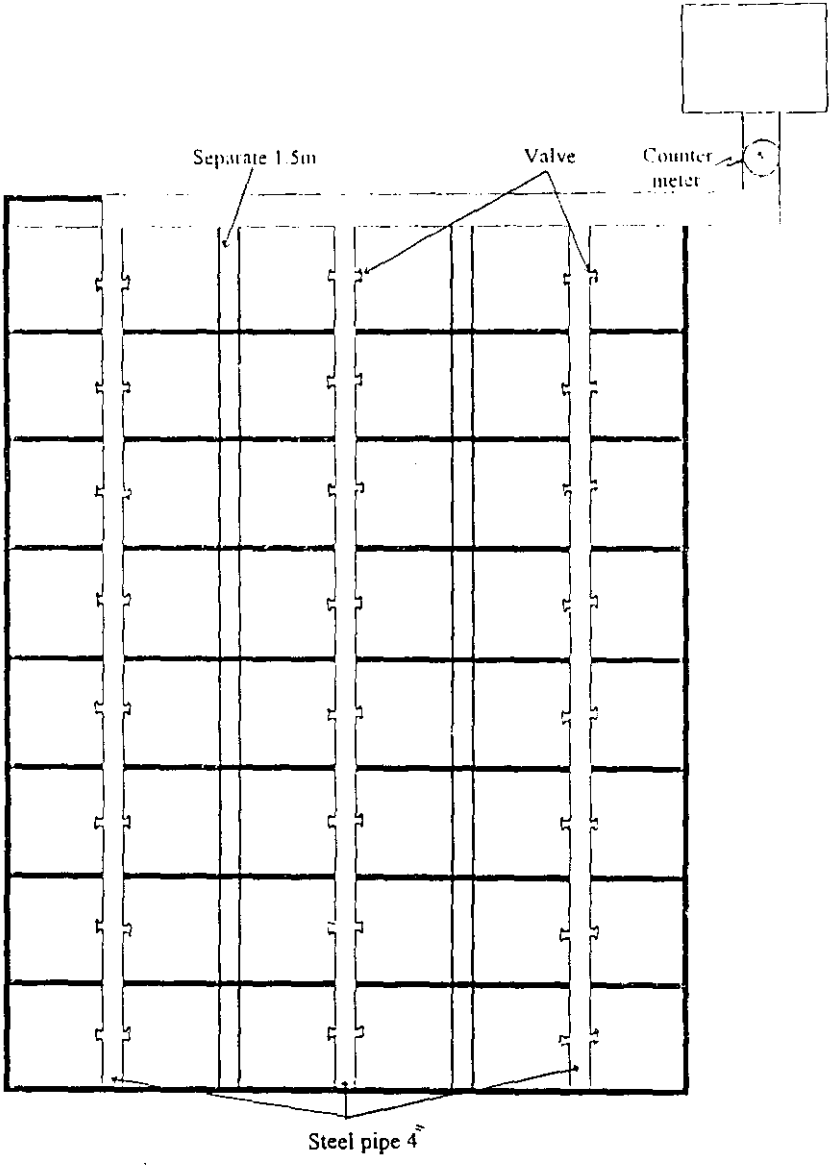

Fig. 1. Layout of the experiment site.

Soil moisture content

Soil moisture percentage was determined gravimetrically on oven dry before each irrigation and at harvesting. At each sampling date, duplicate soil samples were taken at 0-15, 15-30 and 30-45 and 45-60 cm soil depth. The samples were immediately transferred in highly closed aluminum cans to the laboratory, weighed and dried in oven at 105°C for 24 hr. After that, they were reweighed and their moisture content was determined.

Bulk density (Db), field capacity (FC %) and permanent wilting point (PWP%)

Bulk density was determined by Core method, field capacity was determined by field method and permanent wilting point was determined using a pressure membrane apparatus (Black, 1965).

Seasonal irrigation water (amount use)

The irrigation water amounts used values were obtained from the summation of water consumptively used for all irrigation per treatment from sowing until harvesting.

Soil moisture depletion (SMD)

Soil moisture depletion was determined according to Hansen *et al.* (1979) as follows:

$$CU = \sum_{i=1}^{I=n} \frac{(P_{w2} - P_{w1}) \times D_{bi} \times D_i}{100}$$

Where

CU = Actual evapotranspiration in cm

I = Soil moisture depletion (SMD) in the effective root zone

I = Number of soil layer for i = 1 to I =n

P_{W2} = Percentage of soil moisture content after 48 hr from irrigation (w/w%).

P_{W1} = percentage of soil moisture before irrigation (w/w %).

D_{bi} = Bulk density of the specified soil layer (gm / cm^3)

D_i = Depth of soil layer (cm).

Soil moisture extraction pattern (SMEP)

Percentage of soil moisture extraction from a certain layer (15 cm) was calculated according to the equation of Israelse and Hansen (1962):

$$\text{Percentage of extraction moisture} = \frac{(SMEL)}{(SMELs)}$$

Where
SMEL = Soil moisture extracted from a certain layer.
SMELs = Sum of soil moisture extracted from all soil layers.

Water use efficiency (WUE)
WUE was calculated according to Doorenbos and Pruitt (1975):

$$\text{WUE for root yield} = \frac{\text{Root yield in kg / fed}}{\text{ET in } m^3 \text{ / fed}}$$

$$\text{WUE for sugar yield} = \frac{\text{Sugar yield in kg/ fed}}{\text{ET in } m^3 \text{ / fed}}$$

Results and Discussion

Water requirements are a function of crop growth stages, and climatic conditions. So, two factors were selected to study water relations and productivity of sugar beet in Beni-Suef Governorate. The two factors were, three different planting dates designated A_1, A_1 and A_3 represented climate conditions, and three irrigation treatments irrigated after 40, 60 and 80 % depletion from available soil moisture (ASMD), B_1, B_2 and B_3, respectively compared with normal farmer irrigation (control) B_4.

Seasonal irrigatiou water (amount use)

Results of effect of sowing dates and irrigation treatments on irrigation water diverted to sugar beet are shown in Table 3 through 1995 / 96 and 1996 / 97 seasons. To some extent, the amount of irrigation water to meet sugar beet requirements in the second season was higher than that of the first season. These values were 3749, 3736 and 3667 m^3 / fed in the second season and 3629, 3524 and 3536 m^3 / fed in the first season. For first, second and third sowing date (A_1), (A_2) and (A_3), no clear differences in applied irrigation amounts could be attributed to planting dates. However, the first sowing dates, in the two seasons, received the highest irrigation amounts.

TABLE 3. Effect of planting dates, irrigation treatments and their interaction on the amount of applied irrigation water in 1995 /96 and 1996/97 seasons.

Planting dates (A)	Amount of applied irrigation water m^3 / fed.// season							
	1995 / 96				1996 / 97			
Irrig.Treat. (B)	A_1	A_2	A_3	Mean	A_1	A_2	A_3	Mean
B_1	3410	3299	3257	3322	3555	3452	3383	3463
B_2	3258	3163	3164	3195	3303	3363	3209	3291
B_3	3117	3157	3097	3123	3199	3291	3138	3209
B_4	4733	4478	4628	4613	4928	4839	4940	4902
Mean	3629	3524	3536	3563	3746	3736	3667	3716

A_1.A_2.A_3: Sowingdates(25/9, 10/10, 25/10)

B_1. B_2, B_3: Irrigation treatments (40, 60 , 80 % ASMD)

B_4: Normal farmer irrigation (control)

To achieve irrigation practices, farmer treatment (B_4) received amount of irrigation water more than other irrigation treatments. These data were in agreement with Ibrahim *et al.* (1995) who stated that farmer practices led to abuse irrigation water. The less irrigation water amounts, through the two seasons, were discharged to irrigation treatments 80 % ASMD (B_3). Table 4 shows that the treatments of irrigation water (B_1), (B_2) and (B_3) saved water irrigation about 27.9 , 30.7 and 32.3 %, respectively than the farmer treatment (B_4) in the first season and 29.4 , 32.9 and 34.5 % in the second season. These results reflex low much irrigation water we can save when using the reasonable irrigation treatments.

TABLE 4. Effect of irrigation treatments on saving water of sugar beet in 1995 / 96 and 1996 / 97 seasons.

Irrigation Treatments	1995 / 96			1996 / 97		
	A.I.W.	S.W.	S.W.P. %	A.I.W.	S.W.	S.W.P. %
B_1	3322	1291	27.9	3463	1439	29.4
B_2	3195	1418	30.7	3291	1611	32.9
B_3	3123	1490	32.3	3209	1693	34.5
B_4	4613	-	-	4902	-	-

A.I.W = Applied irrigation water, m^3 / fed.

S.W. = Saved water m^3 / fed.

S.W.P. = Saved water percentage

Evapotranspiration (E.T.)

Table 5 indicates the effect of irrigation treatments, planting dates, on evapotranspiration of sugar beet. Generally, ET values of second season were higher than that of the first one. In the two seasons, no clear differences in ET could be attributed to sowing dates.

TABLE 5. Effect of planting dates, irrigation treatments on ET of sugar beet in 1995 /96 and 1996 / 97 seasons.

Planting dates (A)	ET of sugar beet (cm. / season)							
	1995 / 96				1996 / 97			
Irrig.Treat. (B)	A_1	A_2	A_3	Mean	A_1	A_2	A_3	Mean
B_1	72.96	70.84	69.72	71.17	76.61	74.42	73.14	74.72
B_2	76.98	65.98	66.85	69.93	71.04	70.74	69.50	69.94
B_3	66.67	67.16	65.34	66.39	68.74	70.11	69.64	69.49
B_4	85.91	81.95	84.19	84.01	90.70	87.54	90.31	89.51
Mean	73.38	71.48	71.52	72.88	76.77	75.70	75.65	76.04

Farmer treatments (B_4) recorded the higher ET compared with other treatments. Arranging these data, as average were (B_4) 84.01, (B_1) 71.17, (B_2) 69.93 and (B_3) 66.39 cm in the first season and (B_4) 89.51, (B_1) 74.72, (B_2) 69.94 and (B_3) 69.49 cm in the second season.

Root extraction patterns

Root extraction patterns mean the share of each layer (15 cm each) in the total amount of ET. Table 6 and Fig. 2, 3 indicate that the soil moisture was removed till 60 cm deep.

Data indicate that the share of each layer depends on the sowing dates and irrigation treatments. In the first season, sugar beet extracted 42.93 (A_3B_3), 27.64(A_1B_1), 10.73 (A_2B_1) and 3.48% (A_2B_1) from ET as lower limit and 57.27 (A_2B_1), 30.5 (A_2B_2), 17.93 (A_3B_3) and 10.93 (A_1B_3) from ET as an upper limit from first, second, third and fourth soil layer, respectively. These figures agree with Parshar and Pastane (1974); Ibrahim *et al.* (1993) and Sherif *et al.* (1994).

The same trend was obtained in the second season. Data indicate that prolonging the interval between irrigation (80 % ASMD) led to more water extract from the fourth layer. On the other hand, irrigation at 40 % ASMD

TABLE 6. Soil moisture extraction pattern% by sugar beet roots from different layers during the two growing seasons 1995/96 and 1996/97.

Season	Soil Depth cm	A_1					A_2					A_3					Mean
		B_1	B_2	B_3	B_4	Mean	B_1	B_2	B_3	B_4	Mean	B_1	B_2	B_3	B_4	Mean	
1995/96	0-15	52.81	49.84	44.23	53.16	50.01	57.27	50.56	44.56	52.23	51.16	54.19	48.45	42.93	52.87	49.61	50.26
	15-30	27.64	28.85	28.82	28.27	28.40	28.52	30.50	29.41	29.33	29.44	29.83	28.65	28.76	28.57	29.03	28.95
	30-45	12.72	14.63	16.02	13.01	14.10	10.73	12.41	16.22	14.32	13.42	12.11	15.82	17.93	13.04	14.73	14.08
	45-60	6.84	6.68	10.93	5.56	7.50	3.48	6.53	9.81	4.12	5.99	3.87	7.08	10.38	5.25	6.65	6.71
1996/97	0-15	49.92	47.93	43.23	49.71	47.70	55.20	50.04	42.82	48.59	49.16	52.48	47.49	41.54	51.51	48.33	48.40
	15-30	28.31	29.99	30.80	29.26	29.59	30.09	30.36	29.73	30.21	30.10	30.20	29.78	27.97	28.8	29.19	29.62
	30-45	15.17	14.34	15.78	15.07	15.08	11.43	12.69	16.42	14.91	13.86	12.42	14.99	19.17	13.67	15.07	14.67
	45-60	6.61	7.74	10.19	5.96	7.63	2.98	6.91	11.03	6.29	6.80	4.90	7.44	11.32	6.02	7.42	7.28

A: Planting dates (A_1, A_2 and A_3).

B: Irrigation treatments (B_1, B_2, B_3 and B_4).

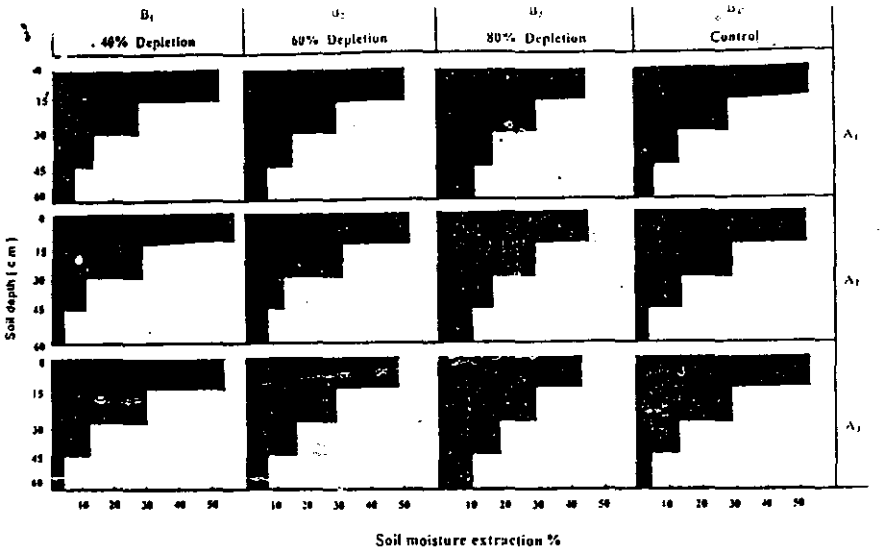

Fig. 2. Soil moisture extraction by sugar beet from soil layers of root zone at irrigation treatments (B_1, B_2, B_3 and B_4) in different sowing dates (A_1, A_2, and A_3) in 1995 / 96 growing season.

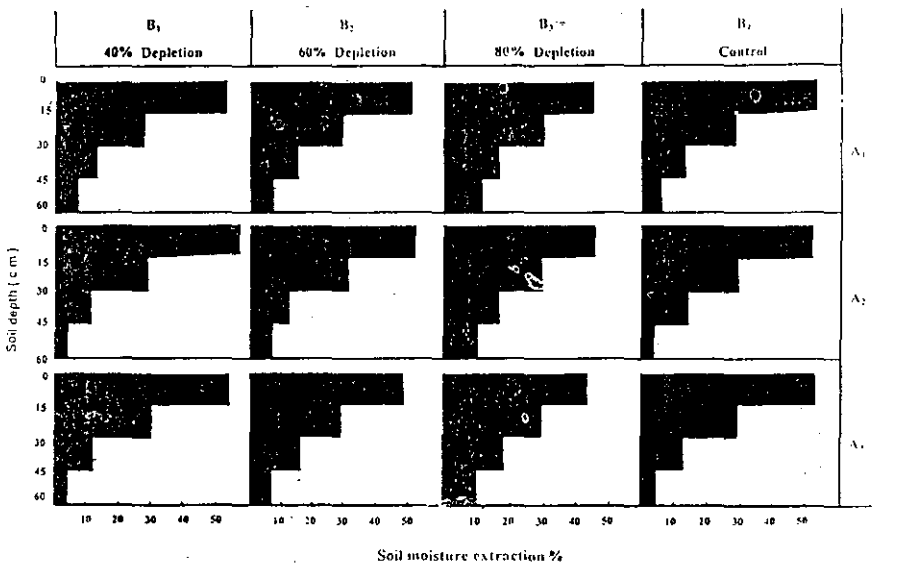

Fig. 3. Soil moisture extraction by sugar beet from soil layers of root zone at irrigation treatments (B_1, B_2, B_3 and B_4) in different sowing dates (A_1, A_2, and A_3) in 1996 / 97 growing season.

recorded the lowest water extraction from the fourth layer. Farmer treatment was close to 40 % ASMD treatment. These data supported by Prasad *et al.* (1985); Ibrahim *et al.* (1995) and Abd El-Wahab *et al.* (1996).

Water use efficiency of root yield (WUE)

The effect of planting dates and irrigation treatments on water use efficiency of roots, kg / m^3, is shown in Table 7 and Fig. 4. The sowing date affected water use efficiency in the two seasons, 1995 / 96 and 1996 / 97. The first sowing date, 25 September in the first and second seasons resulted in the higher WUE followed by second planting date.

TABLE 7. Effect of planting dates, irrigation treatments and their interaction on water use efficiency (WUE) of root yield in 1995/96 and 1996/97 seasons.

Planting dates (A)	Water use efficiency of root yield Kg / m^3							
	1995 / 96				1995 / 97			
Irrig.Treat. B)	A_1	A_2	A_3	Mean	A_1	A_2	A_3	Mean
B_1	9.92	9.53	9.24	9.56	9.89	9.84	8.99	9.57
B_2	10.40	10.13	9.44	9.99	10.36	9.68	9.26	9.77
B_3	9.61	8.33	8.15	8.70	9.97	9.24	8.18	9.13
B_4	7.62	7.47	7.02	7.37	7.98	7.71	6.54	7.41
Mean	9.39	8.87	8.46	8.91	9.55	9.12	8.24	8.97

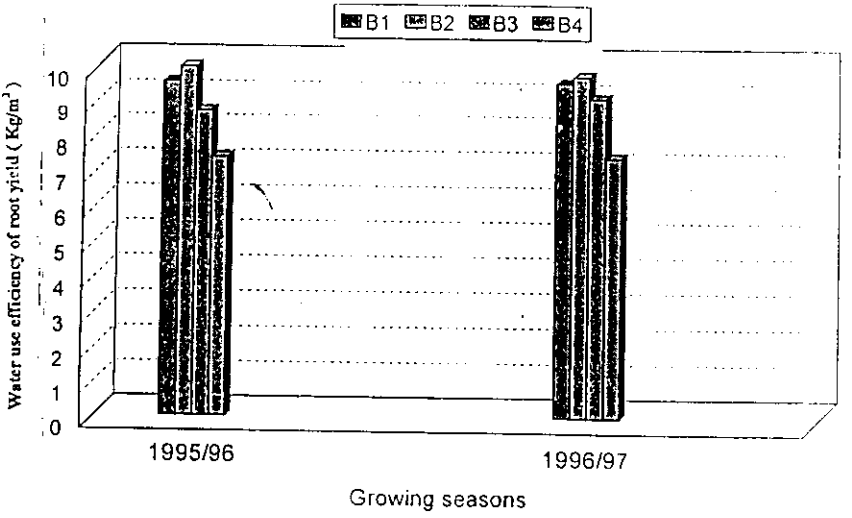

Fig. 4. Water use efficiency of sugar beet as affected by different irrigation treatments (B_1, B_2, B_3 and B_4) in 1995/96 and 1996/97 seasons.

Irrigating sugar beet after soil lost 60 % ASMD (B_2) produced the higher root yield from each cubic meter consume by sugar beet followed by treatment (B_1) that was irrigation 40 % ASMD. Farmer treatment introduced the lowest WUB amount.

The higher WUE amount was obtained from treatment (B_2) under the condition of first planting date in the two seasons. On the other hand, the farmer treatment with the third sowing date recorded the lowest WUF, compared with any of other treatments.

The same trend was obtained by many workers (Prasa *et al.*,1985; Sherif *et al.*, 1994 and Abd-El Wahab *et al.*, 1996).

Water use efficiency of sugar yield (WUE)

As shown in Table 8 and Fig. 5 from 1995 / 96 and 1996 / 97 seasons. the highest sugar yield produced from each unit of water (kg/m^3) consumed by sugar beet was accured from first sowing date (A_1). On the other hand, the third sowing date reduced WUE to reach its lowest amounts.

TABLE 8. Effect of planting dates, irrigation treatments and their interaction on water use efficiency (WUE) for sugar yield in 1995 / 96 and 1996 / 97 seasons.

Planting dates (A)	Water use efficiency of sugar yield Kg / m^3							
	1995 / 96				1996 / 97			
Irrig.Treat. (B)	A_1	A_2	A_3	Mean	A_1	A_2	A_3	Mean
B_1	1.50	1.44	1.43	1.46	1.50	1.54	1.46	1.50
B_2	1.67	1.57	1.59	1.61	1.62	1.53	1.52	1.56
B_3	1.59	1.35	1.42	1.45	1.62	1.56	1.40	1.53
B_4	1.12	1.12	1.12	1.12	1.20	1.07	1.04	1.10
Mean	1.47	1.37	1.39	1.41	1.49	1.43	1.36	1.43

Farmer irrigation treatment (B_4) lowered sugar produced from unit of water consumptive use to reach its lowest value. The reverse occurred due to earliest sowing date, 25 Sep. and 10 Oct. in the first and second seasons, respectively.

To obtain the higher WUE amount, sugar beet should be irrigated at 60% ASMD. Farmer treatment gave the lowest sugar yield of water consumptive use unit and irrigation at 40 % and 80 % ASMD. Their WUE were close to each other.

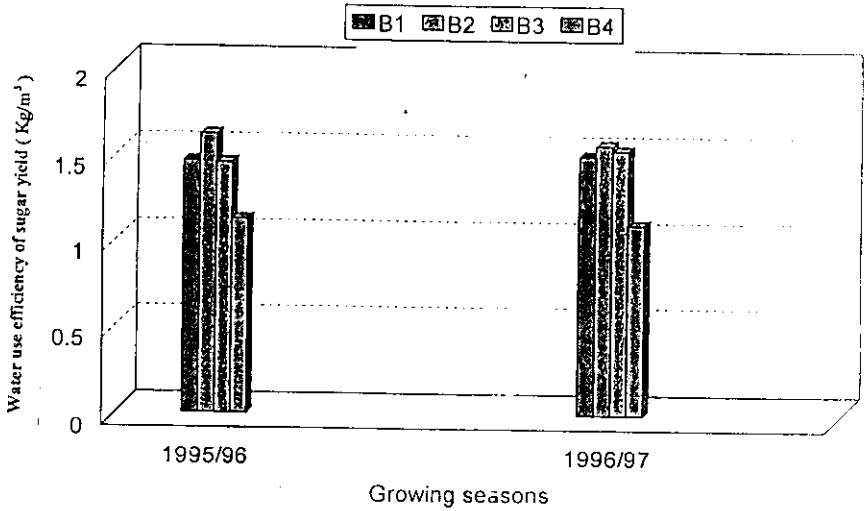

Fig. 5. Effect of irrigation treatments on water use efficiency for sugar yield in 1995/96 and 1996/97 seasons.

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استجابة بنجر السكر لمواعيد الزراعة والاحتياجات المائية فى مصر الوسطى.

١- الاستهلاك المائى وكفاءة استعمال الماء

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اقيمت تجربتان حقليتان بمزرعة محطة البحوث الزراعية بسدس- محافظة بنى سويف خلال موسمى ١٩٩٥ / ١٩٩٦، ١٩٩٦ / ١٩٩٧ وذلك لدراسة العلاقة بين مواعيد الزراعة (٢٥/٩، ١٠/١، ٢٥/١٠) ومعاملات الرى (الرى عند استنفاذ ٤٠، ٦٠، ٨٠ من الرطوبة الميسرة وكذلك الرى العادى فى المنطقة) ولقد أظهرت النتائج ما يلى:

١- كمية مياه الرى: لم تظهر فروق معنوية بين مواعيد الزراعة فى كميات المياه المستخدمة خلال موسمى النمو وإن كان ميعاد الرى المبكر أدى إلى زيادة كمية المياه المستخدمة. وأدى الرى عند استنفاذ ٤٠، ٦٠، ٨٠٪ من الرطوبة الميسرة إلى توفير ٩ر٢٧، ٧ر٣٠، ٣ر٣٢٪ من مياه الرى خلال الموسم الأول وتوفير ٤ ٢٩، ٩ ٣٢، ٥ ٣٤٪ من مياه الرى خلال الموسم الثانى على الترتيب بالمقارنة بمعاملة الرى المتبعة فى المنطقة (الكنترول).

٢- الاستهلاك المائى (البخر - نتح): لم يكن هناك فروق واضحة فى قيم الاستهلاك المائى لمحصول بنجر السكر بين مواعيد الزراعة الثلاثة حيث كانت ٣٨، ٧٣، ٣٨، ٧١، ٥٢، ٧١سم فى الموسم الأول ٧١، ٧٦، ٧٠، ٧٥، ٦٥، ٧٥سم فى الموسم الثانى بالنسبة لمواعيد الزراعة الثلاثة على التوالى وكان ترتيب معاملات الرى تنازليا

حسب الاستهلاك المائى كالتالى: معاملة المقارنة ثم معاملة الرى عند استنفاذ ٤٠، ٦٠، ٨٠٪ من الماء الميسر.

٣- معدل استنفاذ الرطوبة من طبقات التربة: كان معدل استنفاذ الرطوبة من طبقات التربة أعلى ما يمكن فى الطبقة السطحية (صفر -١٥سم) ويتناقص هذا المعدل بزيادة عمق قطاع التربة وذلك لجميع المعاملات، واختلف هذا التناقص من معاملة إلى أخرى، حيث أدت الزراعة فى الميعاد الثانى (١٠/١٠) إلى أعلى قيم لاستنفاذ الرطوبة الأرضية فى الطبقة الأولى (صفر-١٥سم) والثانية (١٥-٣٠سم) بينما أعطت الزراعة فى الميعاد الأول (٩/٢٥) والثالث (١٠/٢٥) أعلى قيم لاستنفاذ الرطوبة من الطبقة الثالثة (٣٠-٤٥سم) والرابعة (٤٥-٦٠سم) على التوالى. وزاد أيضا استنفاذ الرطوبة من الطبقة الرابعة (٤٥-٦٠سم) بتطبيق الرى عند استنفاذ ٨٠٪ من الماء الميسر، بينما أدى الرى عند استنفاذ ٤٠٪ من الماء الميسر إلى أقل معدل لاستنفاذ رطوبة التربة من الطبقة الرابعة (٤٥-٦٠سم).

٤- كفاءة استخدام المياه: أعطت الزراعة المبكرة (٩/٢٥) أعلى كفاءة لاستخدام المياه بالنسبة لمحصول الجذور والسكر حيث كانت القيم (٣٩. ٩، ٥٥. ٩ كجم جذور/م^3)، (٤٧. ١، ٤٩. ١ كجم سكر/م^3) فى موسمى التجربة على التوالى. بينما أعطى ميعاد الزراعة المتأخر (١٠/٢٥) أقل القيم (٤٦. ٨، ٢٤. ٨ كجم جذور/م^3) ، (٣٩. ١، ٣٦. ١ كجم سكر/م^3).

وبالنسبة لمعاملات الرى فإن كفاءة استخدام المياه بالنسبة لمحصول الجذور والسكر كان ترتيبها تنازليا كالتالى: الرى عند استنفاذ ٦٠،٤٠،٨٠٪ من الماء الميسر ثم معاملة الرى المتبعة فى المنطقة.