EFFECT OF IRRIGATION TREATMENTS ON SOME ECONOMIC CHARACTERS OF SUNFLOWER

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INTRODUCTION

Sunflower is one of the most important source of edible oil in the world. The total national consumption of edible oil in 1986/1987 was 637000 M.T., out of it 20% produced from cotton seed (100000 M.T.) and soybean (20000 M.T.).

Great emphasis has to be given to the expansion of oil type sunflower for oil industry due to its wide adaptability to various environmental conditions.

This investigation was conducted to determine the optimum and more economic irrigation treatment for oil type sunflower varieties at Sakha (Delta) and Sids (Middle Egypt) Research Stations.

Patel and Singh (1980) found that irrigation schedule based on IW/PAN-E of 1.1 had maximum plant height. Unger (1982) reported that sunflower irrigated before flowering averaged 17 cm taller than those not irrigated Jana et al. (1982), Sarkar and Bhattacharya (1980) found that maximum seed yield was obtained at 60% available soil moisture (6 irrigations). Merrien et al. (1981) and Herman et al. (1982) concluded that seed production increased by increasing water supply.

Jana et al. (1982), Unger (1982) and Attia (1985) reported that irrigation increased 100-seed weight. Pal (1981), Jana et al. (1982) and Attia (1985) found that oil content increased with increasing soil moisture capacity. Jana et al. (1982) and Attia (1985) reported that irrigation increased oil yield. Pal (1981) and Attia (1985) found that increasing in available soil moisture increased husk percentage.

MATERIALS AND METHODS

Two trials were conducted at Sakha and Sids Research Stations Farms during 1985 and 1986 seasons to study the effect of four irrigation treatments on vegetative characters, seed and oil yield of two sunflower varieties Mayak and Ala.

The irrigation treatments were studied just after thinning (25—30 days after sowing) :

T_1 = 25 and 50 days ;
T_2 = 25, 40 and 65 days ;
T_3 = 25, 50 and 65 days ;
T_4 = 15, 30, 45 and 60 days (control).

Date of sowing was during first half of May in both seasons and locations.

The experimental design was a split plot with four replications. The main plots were assigned to the irrigation treatments and sub-plots for sunflower varieties. Plot size was 12 m^2 and plant density was 24 000 plants/feddan.

The following characters were recorded on ten guarded plants :

1. Plant height in cm ;
2. Head diameter in cm ;
3. Seed yield kg/feddan ;
4. 100-seed weight in g ;
5. Oil content % ;
6. Oil yield kg/feddan ;
7. Husk percentage.

The data were statistically analysed according to the procedures described by Snedecor (1956).

RESULTS AND DISCUSSION

1. Plant height

The data of *Table 1* presents the mean values of plant height of two varieties in both locations in cm. These data show that the irrigation treatments 1 and 2 have increased plant height of Mayak and Ala 5.25 and 8.80 cm respectively at Sakha with a significant difference than the control and other treatments in first season, meanwhile in second season the treatment 3 has increased significantly the plant height of both varieties than the control. However, at Sids the control treatment increased significantly the plant height in first season for both varieties,

Table 1

Plant height (cm) as affected by irrigation treatments for two sunflower varieties at Sakha and Sids locations in 1985 and 1986 seasons

Seasons Locations	Treatments varieties	1985					1986				
		1	2	3	4	Mean	1	2	3	4	Mean
Sakha	Mayak	161.15	150.45	154.41	155.90	155.48	173.00	164.20	183.65	173.11	173.49
	Ala	112.55	124.85	118.63	115.55	116.52	133.91	140.65	156.26	144.75	144.04
	Mean	136.85	137.40	134.02	135.73	136.00	153.46	152.43	170.26	158.93	158.77
Sids	Mayak	141.88	149.00	184.13	199.00	168.50	148.65	171.78	193.60	196.70	177.68
	Ala	113.55	151.50	152.13	178.25	148.86	139.20	162.65	174.13	179.90	163.97
	Mean	127.73	150.25	168.13	188.63	158.68	143.93	167.22	183.87	188.30	170.83
Overall mean for irrigation treatments	Mayak	151.52	149.73	169.27	177.45	161.99	160.83	167.99	188.83	184.91	175.59
	Ala	113.05	137.93	132.88	146.90	132.69	136.56	151.65	165.50	162.33	154.01
	Mean	132.29	143.83	151.08	162.18	147.35	148.70	159.82	177.07	173.62	164.80

L.S.D.	0.05	Locations (L)	Treatments (Tr.)	Varieties (V)	L × Tr.	L × V	Tr. × V	L × Tr. × V
	1985	—	6.22	4.34	8.8	6.13	8.67	N.S.
	1986	—	9.96	7.30	—	14.60	14.09	N.S.

while in the second season there were significant differences between the control and treatments No. 1 and 2 only. These results agreed with those obtained by Patel and Singh (1980) and Unger (1982).

The differences in varieties response in both locations may be due to the differences in environmental effect. Moreover, there is a significant difference in plant height between the two varieties due to their genetic constitutions which is in agreement with that of Salih (1987).

However there is no significant difference in plant height of each variety in both locations.

The interactions between locations vs treatments in 1985 and between locations vs varieties, treatments vs varieties in both seasons have a significant effect on this trait.

2. **Head diameter**

Data presented in Table 2 show that locations had no significant effect on head diameter in first season only since the head diameter mean was 16.27, 16.68 at Sakha and 14.91, 14.15 at Sids in both seasons respectively. On other hand irrigation treatments had significant effect on head diameter in both seasons. The largest head diameter resulted from treatments No. 3 and 4 with no significant difference. The head diameter measurements of those treatments were 16.10,

Table 2

Head diameter (cm) as affected by irrigation treatments for two sunflower varieties at Sakha and Sids locations in 1985 and 1986 seasons

Seasons Locations	Treatments varieties	1985					1986				
		1	2	3	4	Mean	1	2	3	4	Mean
Sakha	Mayak	17.22	16.22	17.39	17.06	16.97	16.32	16.48	17.15	16.88	16.71
	Ala	15.62	15.95	15.28	15.44	15.57	17.06	16.46	17.10	15.96	16.65
	Mean	16.42	16.09	16.34	16.25	16.27	16.69	16.47	17.13	16.42	16.63
Sids	Mayak	12.65	14.90	15.60	15.85	14.75	12.10	14.35	14.85	16.20	14.38
	Ala	12.75	14.70	16.10	16.73	15.07	11.93	13.85	14.20	15.68	13.92
	Mean	12.70	14.80	15.85	16.29	14.91	12.02	14.10	14.53	15.94	14.15
Overall mean for irrigation treatments	Mayak	14.94	15.56	16.50	16.46	15.87	14.21	15.42	16.00	16.54	15.54
	Ala	14.19	15.33	15.69	16.09	15.12	14.50	15.16	15.65	15.82	15.28
	Mean	14.57	15.45	16.10	16.28	15.60	14.36	15.29	15.83	16.18	15.41

L.SOD.	0.0.5	Locations (L)	Treatments (Tr..	Varieties (V)	L × Tr.	L × V	Tr. × V	L × Tr. × V
	1985	N.S.	0.66	0.32	C.94	0.45	N.S.	0.91
	1986	1.20	0.50	N.S.	0.71	N.S.	N.S.	N.S.

Table 3

Seed yield kg/fed. as affected by irrigation treatments for two sunflower varieties at Sakha and Sids locations in 1985 and 1986 seasons

Seasons Locations	Treatments varieties	1985					1986				
		1	2	3	4	Mean	1	2	3	4	Mean
Sakha	Mayak	1 043.00	693.25	938.00	878.25	888.13	1 238.00	1 106.00	951.00	1 284.00	1 144.75
	Ala	688.75	725.00	587.25	641.75	659.44	741.00	998.00	603.00	759.00	775.25
	Mean	863.38	709.63	762.63	760.00	773.78	989.50	1 052.00	777.00	1 021.50	960.00
Sids	Mayak	331.75	616.00	588.25	700.00	559.00	461.00	798.00	1 040.50	1 025.25	831.19
	Ala	321.25	676.50	620.75	717.75	584.06	493.00	804.00	910.00	1 067.50	818.63
	Mean	326.50	646.25	640.50	708.88	571.53	477.00	801.00	975.25	1 046.38	824.91
Overall mean for irrigation treatments	Mayak	687.38	654.63	763.13	789.13	723.57	849.50	952.00	995.75	1 154.63	987.97
	Ala	502.50	700.25	604.00	679.75	621.75	617.00	901.00	756.50	913.25	796.94
	Mean	594.94	677.44	683.57	734.44	672.66	733.25	926.50	876.13	1 033.94	892.46

L.S.D.	0.05	Locations (L)	Treatments (Tr.)	Varieties (V)	L × Tr.	L × V	Tr. × V	L × Tr. × V
	1985	N.S.	N.S.	89.46	157.66	126.52	N.S.	N.S.
	1986	N.S.	147.73	65.16	208.92	92.15	N.S.	184.80

16.28 cm in 1985 and 15.83, 16.18 cm in 1986. Similar results were reported by Jana et al. (1982).

The interactions between locations vs treatments, locations vs varieties and locations vs treatments vs varieties had a significant effect on head diameter in 1985. However, locations vs treatments had a significant effect on head diameter in 1986.

3. **Seed yield/fed**

Data presented in *Table 3* show that locations had no significant effect on seed yield/fed in both seasons.

Irrigation treatments had no significant effect in 1985, while it had significant effect in 1986. The highest seed yield resulted from treatment No. 4 (control), 1 154.6, 912.3 kg/fed. for Mayak and Ala respectively. Due to the fact that plants consumed more quantity of water, the dry matter accumulation, head diameter and seed index were increased, which consequently increased seed yield/fed. These results agreed with those obtained by Sarkar and Bhattacharya (1980), Merrien et al. (1981) and Herman et al. (1982).

Moreover, there is a significant difference in seed yield/fed. between the two varietes due to their genetic constitutions which is in agreement with that of Salih (1987).

The interactions between locations vs treatments and locations vs varieties had significant

Table 4

Hundred seed weight (g) as affected by irrigation treatments for two sunflower varieties at Sakha and Sids locations in 1985 and 1986 seasons

Seasons Locations	Treatments varieties	1985					1986				
		1	2	3	4	Mean	1	2	3	4	Mean
Sakha	Mayak	5.83	6.88	7.33	7.98	7.01	5.70	6.20	7.50	8.03	6.86
	Ala	5.60	6.13	6.63	6.76	6.28	4.76	5.15	5.75	7.48	5.79
	Mean	5.72	6.51	6.98	7.37	6.64	5.23	5.68	6.63	7.76	6.32
Sids	Mayak	5.90	6.83	7.60	8.05	7.10	5.70	6.40	7.85	7.80	6.94
	Ala	5.60	6.10	6.48	7.10	6.32	5.55	6.08	6.43	6.88	6.24
	Mean	5.75	6.47	7.04	7.58	6.71	5.63	6.24	7.14	7.34	6.59
Overall mean for irrigation treatments	Mayak	5.87	6.86	7.47	8.02	7.05	5.70	6.30	7.68	7.92	6.90
	Ala	5.60	6.12	6.56	6.93	6.30	5.16	5.62	6.09	7.18	6.01
	Mean	5.74	6.49	7.00	7.48	6.68	5.43	5.96	6.89	7.55	6.46

L.S.D.	0.05	Locations (L)	Treatments (Tr.)	Varieties (V)	L × Tr.	L × V	Tr. × V	L × Tr. × V
	1985	N.S.	0.23	0.23	N.S.	N.S.	N.S.	N.S.
	1986	0.14	0.22	0.18	0.31	0.26	0.36	N.S.

Table 5

Oil content % as affected by irrigation treatments for two varieties at Sakha and Sids locations in 1985 and 1986 seasons

Seasons Locations	Treatments varieties	1985					1986				
		1	2	3	4	Mean	1	2	3	4	Mean
Sakha	Mayak	33.60	36.13	39.55	41.58	37.72	34.23	35.75	40.80	41.75	38.13
	Ala	32.00	34.18	38.48	40.52	36.30	31.98	34.48	38.60	41.58	36.66
	Mean	32.80	35.16	39.02	41.05	37.01	33.11	35.12	39.70	41.67	37.40
Sids	Mayak	31.50	37.25	39.75	41.00	37.38	32.50	36.50	39.75	41.50	37.56
	Ala	29.50	33.00	39.50	42.50	36.13	31.25	32.75	39.75	40.75	36.13
	Mean	30.50	35.13	39.63	41.75	36.75	31.88	34.63	39.75	41.13	36.84
Overall mean for irrigation treatments	Mayak	32.55	36.69	39.65	41.29	37.55	33.37	36.13	40.28	41.63	37.85
	Ala	30.75	33.59	38.99	41.151	36.21	31.62	33.62	39.18	41.17	36.40
	Mean	31.65	35.14	39.32	41.40	36.88	32.50	34.88	39.73	41.40	37.13

L.S.D.	0.05	Locations (L)	Treatments (Tr.)	Varieties (V)	L × Tr.	L × V	Tr. × V	L × Tr. × V
	1985	N.S.	0.53	0.52	0.75	N.S.	8.05	1.48
	1986	N.S.	0.72	0.50	N.S.	N.S.	0.48	1.41

effect on seed yield/fed. in both seasons while interaction between locations vs treatments vs varieties had significant effect on this trait in 1986 only.

4. **100-seed weight**

The data of *Table 4* present the mean values of 100-seed weight of two varieties at Sakha and Sids Stations in 1985 and 1986. These data show that locations had significant effect on 100-seed weight in 1986 season only since the means of 100-seed weight were 6.64, 6.71 g at Sakha and 6.32, 6.59 g at Sids in both seasons respectively. On other hand the highest 100-seed weight (7.48 and 7.55 g) for Mayak and Ala respectively were obtained from treatment No. 4 (control). The decrease in seed weight under treatment 1 may be due to deficit of variable water in root zone and less absorption which affected cell division and expansion, also decrease in dry matter accumulation. Therefore plants produced small heads and seeds which consequently affected seed weight. Similar results were obtained by Jana et al. (1982), Unger (1982) and Attia (1985).

The interactions between location vs treatments, locations vs varieties and treatments vs

Table 6

Oil yield/fed. as affected by irrigation treatments for two varieties at Sakha and Sids locations in 1985 and 1986 seasons

Seasons Locations	Treatments varieties	1985					1986				
		1	2	3	4	Mean	1	2	3	4	Mean
Sakha	Mayak	348.44	250.56	371.50	366.16	334.17	422.17	395.19	388.24	536.89	435.62
	Ala	219.57	247.21	226.84	260.51	238.53	237.46	344.74	232.03	315.79	282.51
	Mean	284.01	248.89	299.17	313.34	286.35	329.82	369.97	310.14	426.34	359.06
Sids	Mayak	104.53	229.62	233.84	286.94	213.73	149.87	291.34	413.57	425.60	320.10
	Ala	94.93	223.69	245.26	305.08	217.24	154.34	263.63	361.86	435.15	307.75
	Mean	99.73	226.66	239.55	296.01	215.49	152.11	277.49	387.72	430.38	311.92
Overall mean for irrigation treatments	Mayak	226.49	240.09	302.67	326.55	273.95	286.02	343.27	400.91	418.25	377.86
	Ala	157.25	235.45	236.05	282.80	227.89	195.90	304.19	296.95	375.47	293.13
	Mean	191.87	237.77	269.36	304.68	250.92	240.95	323.73	348.93	428.36	335.50

L.S.D.	0.05	Locations (L)	Treatments (Tr.)	Varieties (V)	L × Tr.	L × V	Tr. × V	L × Tr. × V
	1985	N.S.	39.80	32.69	56.29	46.24	N.S.	N.S.
	1986	N.S.	41.57	24.95	83.14	35.28	N.S.	70.56

Table 7

Husk percentage as affected by irrigation treatments for two sunflower varieties at Sakha and Sids locations in 1985 and 1986 seasons

Seasons Locations	Treatments varieties	1985					1986				
		1	2	3	4	Mean	1	2	3	4	Mean
Sakha	Mayak	20.22	21.09	22.52	24.33	22.04	19.51	20.48	21.55	23.07	21.15
	Ala	19.45	20.72	21.73	23.20	21.28	19.67	21.01	21.74	23.50	21.48
	Mean	19.84	20.91	22.13	23.77	21.66	19.59	20.75	21.65	23.29	21.32
Sids	Mayak	18.50	21.00	21.00	23.50	21.00	19.75	19.75	20.75	22.25	20.38
	Ala	18.00	20.00	20.75	21.00	19.94	17.50	20.25	20.00	22.25	20.00
	Mean	18.25	20.50	20.88	22.25	20.47	18.13	20.00	20.38	22.25	20.19
Overall mean for irrigation treatments	Mayak	19.36	21.05	21.76	23.92	21.52	19.13	20.12	21.15	22.66	20.76
	Ala	18.73	20.36	21.24	22.10	20.61	18.59	20.63	20.87	22.88	20.74
	Mean	19.05	20.71	21.50	23.01	21.07	18.86	20.38	21.01	22.77	20.75

L.S.D.	0.05	Locations (L)	Treatments (Tr.)	Varieties (V)	L × Tr.	L × V	Tr. × V	L × Tr. × V
	1985	0.93	0.59	0.47	N.S.	N.S.	N.S.	N.S.
	1986	0.99	0.78	N.S.	N.S.	N.S.	N.S.	N.S.

varieties had significant effect on 100-seed weight in 1986 season only.

5. **Oil content**

Data presented in *Table 5* show that locations had no significant effect on oil content in both seasons, while the irrigation treatments had significant effect on oil content in both locations and seasons. Irrigation of sunflower periodically every 15 days after thinning gave the highest oil content 41.40 and 41.40% in 1985 and 1986 respectively. These results agreed with those reported by Pal (1981), Jana et al. (1982) and Attia (1985).

Moreover, there is a significant difference in oil content between the two varieties in both seasons.

The interaction effects were significant between locations vs treatments in 1985 season, treatments vs varieties and locations vs treatments vs varieties in both seasons.

6. **Oil yield/fed.**

Data presented in *Table 6* show that locations had no significant effect on oil yield/fed. in both seasons.

On other hand irrigation treatments had significant effect on oil yield/fed. in both seasons. The highest oil yield/fed. resulted from treatments 3 and 4 with no significant differences. The oil yield/fed. of those treatments were 269.36, 304.86 kg in 1985 and 348.93, 428.36 kg in 1986. The lowest oil yield/fed. resulted from treatment 1. These results are in harmony with those reported by Jana et al. (1982) and Attia (1985).

Moreover, there is a significant difference in oil yield/fed. between the two varieties at Sakha in both seasons.

The interactions between locations vs treatments and locations vs varieties were significant in both seasons, while the interaction between location vs treatments vs varieties was significant in 1986 season only.

7. **Husk percentage**

With regard to the effect of irrigation treatments on husk percentage, data of *Table 7* show that locations had significant effect on husk percentage in both seasons.

Irrigation treatments had significant effect on husk percentage in both seasons. The highest husk percentage was obtained from treatment 4. Increasing number of irrigations increased head diameter, seed weight and consequently husk percentage. Similar results were recorded by Pal (1981) and Attia (1985).

There is a significant difference in husk percentage between the two varieties in 1985 only.

The interactions between the combinations of the three factors had no significant effect on this trait.

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L'INFLUENCE DU RÉGIME D'IRRIGATION SUR QUELQUES CARACTÈRES ÉCONOMIQUES CHEZ LE TOURNESOL

Résumé

Les stations de recherches Sakha et Sida ont entrepris des essais (1985 et 1986) pour établir l'influence de quatre traitements d'irrigation sur les caractères économique des variétés Mayak et Ala. Les variantes du régime d'irrigation ont été :

T_1 = 25 et 50 jours après le démariage ;
T_2 = 25, 40 et 65 jours après le démariage ;
T_3 = 25, 50 et 65 jours après le démariage ;
T_4 = périodiquement tous les 15 jours après le démariage (témoin).

Les résultats peuvent être présentés comme il suit :

T_4 a déterminé une augmentation significative de la hauteur des plantes en 1985 tandis qu'en 1986 c'est T_3 qui a déterminé la plus grande hauteur des plantes.

T_4 a déterminé les plus hautes valeurs pour le diamètre du capitule, le poids de 100 graines, le rendement en graines et huile, la teneur en huile et le taux des coques.

L'interaction localité-variante a eu une influence significative sur la hauteur des plantes, le diamètre du capitule, le poids de 100 graines, la teneur en huile et le rendement en semences et huile.

L'interaction localité-variété a eu une influence significative sur la hauteur des plantes, le diamètre du capitule, le poids de 100 graines, le rendement en graines et huile.

L'interaction variante d'irrigation-variété a eu une influence significative sur la hauteur des plantes, le poids de 100 graines et la teneur en huile.

Les interactions localité-variante-variété ont eu une influence significative sur le diamètre du capitule, la teneur en huile et le rendement en graines et huile.

EFECTO DE TRATAMIENTOS DE RIEGO SOBRE ALGUNOS CARACTERES ECONOMICOS DEL GIRASOL

Resúmen

Dos experimentos en campo fueron conducidos en las estaciones experimentales de Sakha y Sids durante los años 1985 y 1986 para estudiar el efecto de cuatro tratamientos de riego en algunos caracteres económicos de las dos variedades Mayak y Ala. Los tratamientos de riego fueron :

T_1 = después de 25 y 50 dias del aclareo.
T_2 = después de 25, 40 y 65 dias del aclareo.
T_3 = después de 25, 50 y 65 dias del aclareo.
T_4 = periódicamente cada 15 dias del aclareo (Control)

Los resultados obtenidos pueden resumirse como sigue :

— T_4 incrementó significativamente la altura de la planta, en el año 1985 mientras t_3 dió las plantas mas altas en 1986.

— T_4 dió el mayor diámetro del capitulo, peso de 100 semillas y rendimiento de aceite y semilla/fed., contenido de aceite y porcentaje de cáscara.

— La interacción localidades vs tratamientos influenciaron significativamente la altura de la planta, el diámetro del capitulo, peso de cien semillas, contenido de aceite y rendimiento de semilla y aceite/fed.

— Las interacciones localidades vs variedades influenciaron significativamente la altura de la planta, el diámetro del capitulo, peso de cien semillas y el rendimiento de semilla y aceite/fed.

— Las interacciones de tratamientos vs variedades influenciaron significativamente la altura de la planta, peso de cien semillas y contenido de aceite.

— Las interacciones localidades vs tratamientos influenciaron significativamente el diámetro del capitulo, contenido de aceite y el rendimiento de semilla y aceite/fed.