RESULTS AND DISCUSSION

I. Yield and yield components

The results of flax yield components as influenced by sowing dates, irrigation schedule treatments and their interactions are presented in Tables (10 to 18).

The analysis of variance proved that sowing dates, irrigation treatments and interactions had affected flax yield components significantly in the two seasons of this study.

1. Total plant height (cm).

Results in Table (10), present the means of total plant height of flax at harvest as influenced by planting dates, irrigation regimes (scheduling) and their interaction during 1993/1994 and 1994/1995 seasons.

A. Effect of sowing dates

The analysis of variance clearly show that plant height of flax measured at harvest was significantly affected by sowing date treatments. Early planting of flax (October20$^{\underline{th}}$) resulted to a longer plants (104.8 and 102.2 cm), followed by that sown on November 10$^{\underline{th}}$ (98.0 and 95.5 cm) in the two successive seasons, respectively. The shortest ones (88.9 and 86.5 cm), were obtained with the latest sowing date (December1$^{\underline{st}}$). These results clearly show that there was a general significant downward difference in plant height towards the late planting in both seasons.

These results concluded that delaying flax planting date after October 20$^{\underline{th}}$ decreased significantly the total plant height at harvest. This may be due to favourable climatic conditions to flax at early sowing date, i.e. the more favourable temperature, day length, longer growth period duration.

These results are in good agreement with those found by **El-Farouk *et al.* (1980), El-Haroun *et al.* (1982), Samia *et al.* (1987), Tomar and Mishra**

Table 10. **Total plant height (cm)** as affected by sowing dates, scheduling irrigation treatments (water regime) and their interactions in 1993/1994 and 1994/1995 seasons.

Sowing dates	1993/1994 Irrigation regimes accumulative pan evaporation (APE)					1994/1995 Irrigation regimes accumulative pan evaporation (APE)				
	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean
Early	96.3	103.9	106.7	112.4	104.8	93.9	101.3	104.1	109.6	102.2
Medium	91.4	95.9	99.7	105.0	98.0	89.1	93.4	97.1	102.4	95.5
Late	82.5	87.2	91.6	94.5	88.9	80.3	84.8	89.1	91.9	86.5
Mean	90.1	95.7	99.3	104.0	97.2	87.8	93.2	96.7	101.3	94.7
L.S.D. at 5% for:										
Sowing dates					1.04					1.01
Irrigation regimes					0.16					0.16
Interaction					0.98					0.96

(1989), Abou-Zaied (1991), Samui and Pintoo (1992), Verma and Pathak, (1993) and **Dixit *et al.* (1994).**

B. Effect of irrigation regimes

Results presented in Table (10), reveal that the total plant height of flax at harvest was significantly affected by irrigation regime treatments in 1993/1994 and 1994/1995 seasons. Flax plant height increased from 90.1 to 95.7, 99.3 and 104.0 cm when irrigation regime reduced from irrigation at 0.8 accumulative pan evaporation (APE) to 1.0, 1.2 and 1.4 (APE), respectively, in 1993/1994 season. In 1994/1995 season, the plant height increased from 87.8 to 93.2, 96.7 and 101.3 cm, for the same reduction in irrigation regime, respectively.

It can be noticed that plant height significantly increased by increasing irrigation frequency when irrigating flax at 1.2 or 1.4 APE rates. These results might be attributed to the retards in cell division and cell expansion resulted from irrigation at low soil moisture which cause plant height reduction. In this connection, **Vaadia *et al.* (1961)** and **Gates (1964),** pointed out that cell division appears less sensitivity to water stress than the cell enlargement. Similar results were reported by **Moursi and El-Hariri (1977), El-Farouk *et al.* (1982), Hussein *et al.* (1983), El-Kady (1985), El-Shimy *et al.* (1988), El-Farouk *et al.* (1989)** and **Abdallah (1990).**

C. Effect of the interaction

The interaction between sowing dates and irrigation regime treatment had a significant effect on flax plant height in both seasons. Means presented in Table (10), show that the higher plant height (112.4 and 109.6 cm) were obtained by sowing flax on October 20^{th} and irrigation at 1.4 accumulative pan evaporation (APE) in 1993/1994 and 1994/1995 seasons, respectively. On the contrast, planting flax on the December 1st and irrigation at 0.8 APE (dry level) gave the shorter plant height (82.5 and 80.3 cm) in the two successive seasons, respectively.

2. Technical length (cm)

Means of technical length of flax plant at harvest as affected by planting dates and irrigation treatments, as well as their interactions are presented in Table (11).

A. Effect of sowing dates

The differences between the means of technical length of flax plant due to sowing dates effect were significant in 1993/1994 and 1994/1995 seasons as shown in Table (11).

The technical length of flax plants in the two seasons was identical for plant height in its response to the studied sowing dates. Early sowing of flax October 20th produced the taller technical length (91.9 and 89.5 cm) in 1993/1994 and 1994/1995 seasons, respectively. Whereas, sowing flax in December 1st gave the shorter ones (76.9 and 74.6 cm) in both seasons, respectively. Delaying sowing dates of flax than October 20th to November 10th or December 1st decreased technical length by 6.4% and 16.4%, respectively. These results were found to be true in the two seasons of the study.

The increase in technical length with early sowing date may be due to the more favourable climatic conditions that give good change for plants to grow and hence stem elongation and technical length to increase.

These results are in harmony with those reported by **El-Nekhlawy *et al.* (1978), El-Haroun *et al.* (1981), Samia *et al.* (1987), Tomar and Mishra (1989)** and **Abou-Zaied (1991).**

Table 11. **Technical length (cm)** as affected by sowing dates, scheduling irrigation treatments (water regime) and their interactions in 1993/1994 and 1994/1995 seasons.

Sowing dates	1993/1994					1994/1995				
	Irrigation regimes accumulative pan evaporation (APE)					Irrigation regimes accumulative pan evaporation (APE)				
	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean
Early	81.1	90.0	95.9	100.5	91.9	79.0	87.8	93.4	97.9	89.5
Medium	77.1	85.1	88.2	94.0	86.1	75.0	82.8	85.8	91.4	83.8
Late	70.0	76.1	78.9	82.8	76.9	67.9	73.7	76.5	80.2	74.6
Mean	76.1	83.7	87.7	92.4	85.0	74.0	81.4	85.2	89.8	82.6
L.S.D. at 5% for:										
Sowing dates					1.50					1.48
Irrigation regimes					0.19					0.21
Interaction					1.41					1.40

B. Effect of irrigation regimes

Data recorded in Table (11), show that irrigation regime treatments (irrigation flax at different accumulative pan evaporation rates (APE) had a significant effect on technical length at harvesting in 1993/1994 and 1994/1995 seasons.

The higher means of technical length were 92.4 and 89.8 cm, resulted from irrigation flax at 1.4 APE rate (wet), in 1993/1994 and 1994/1995 seasons, respectively. However, the lower ones were 76.1 and 74.0 cm, obtained from irrigation at 0.8 APE rate (dry condition) in the two successive seasons, respectively.

Increasing irrigation frequency for flax plants from irrigation at 0.8 APE rate to 1.0, 1.8 and 1.4 rates gave gradual increases in technical length by 17.5%, 9.4% and 5.2%, respectively, in both seasons.

It can be concluded that increasing irrigation intervals (irrigation at 0.8 accumulative pan evaporation) or subjecting flax plants to soil moisture deficit decreased significantly technical length. These results may be due to the soil moisture effect on cell division as well as cell elongation.

These results are in harmony with those reported by **El-Farouk *et al.* (1982), El-Kady (1985), El-Shimy *et al.* (1988), El-Farouk *et al.* (1989)** and **Abdallah (1990).**

C. Effect of the interaction

The results presented in Table (11), reveal that the means of technical length were significantly affected by the interaction between sowing dates and irrigation treatments in both seasons.

The higher values of technical length were (100.5 and 97.9 cm), obtained from sowing flax on October 20th and irrigation at 1.4 APE rate in the two successive seasons, respectively. Whereas, the lower means (70.0 and 67.9 cm) were resulted from the late sowing of December 1^{st} and irrigation at 0.8 APE rate in both seasons, respectively.

It can be noticed that sowing flax early on October and increasing irrigation frequency is more profitable to increasing technical length of plants.

3. Number of fruiting branches/plant

The effect of sowing dates and irrigation regime treatments and their interactions in 1993/1994 and 1994/1995 seasons on number of fruiting branches/plant are shown in Table (12).

A. Effect of sowing dates

Results presented in Table (12), indicat that number of fruiting branches/plant of flax was significantly affected by sowing date treatments in both seasons.

Delaying sowing date from October 20^{th} to November 10^{th} or December 1^{st} decreased number of fruiting branches/plant by 20.7% and 35.7%, respectively, in 1993/1994 season. In 1994/1995 season the reduction values were 22.9% and 37.7%, respectively, for the same delay in sowing dates.

It can be reveal that sowing flax early increase the number of fruiting branches/plant. This result may be attributed to the fact that early sowing leads to long growth season and this in turn give plants a chance to utilize efficiency growth essentials, i.e. nutrients, water and light. Also, the more favourable conditions for growth and reproductive stages are found in early planting.

These results are in accordance with those found by **El-Haroun *et al.* (1982), Samia *et al.* (1987), Abou-Zaied (1991),** and **Samui and Pintoo (1992).**

Table 12. **Number of fruiting branches/plant** as affected by sowing dates, scheduling irrigation treatments (water regime) and their interactions in 1993/1994 and 1994/1995 seasons.

Sowing dates	1993/1994					1994/1995				
	Irrigation regimes accumulative pan evaporation (APE)					Irrigation regimes accumulative pan evaporation (APE)				
	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean
Early	17.3	18.2	22.2	19.3	19.3	16.2	17.3	21.2	18.3	18.3
Medium	13.5	14.8	17.5	15.5	15.3	12.5	13.8	16.5	14.5	14.3
Late	10.8	12.0	14.5	12.5	12.4	9.8	11.0	13.5	11.5	11.4
Mean	13.8	15.0	18.1	15.8	15.7	12.8	14.0	17.1	14.8	14.7
L.S.D. at 5% for:										
Sowing dates					1.74					1.72
Irrigation regimes					0.24					0.24
Interaction					1.65					1.63

B. Effect of irrigation regimes

Data recorded in Table (12), indicate that irrigation regime treatments (scheduling irrigation according to pan evaporation rates) had a significant effect on number of fruiting branches/plant in the two seasons.

Irrigation flax at 1.2 accumulative pan evaporation (APE) gave the high means of number of fruiting branches/plant (18.1 and 17.1) in 1993/1994 and 1994/1995 seasons, respectively, followed by irrigation at 1.4 or 1.0 APE rates. However, irrigation at 0.8 APE gave the lower means of number of fruiting branches/plant (13.8 and 12.8) in both season, respectively.

The results conclude that number of fruiting branches/plant increased by irrigation flax at 1.2 APE (moderate intervals). These results may be due to that increasing irrigation frequency to more short intervals may cause a temporary inhibition in the physiological processes after irrigation, which in turn on reducing the top buds activity. On the other hand, irrigation at 1.2 APE rate (moderate interval) may cause a balance between the vegetative growth (plant height, technical length, stem diameter, leaf appearance) and reproductive organs growth and appearance. These results are in harmony with those reported by **Hussein *et al.* (1983), El-Kady (1985), El-Shimy *et al.* (1988), El-Farouk *et al.* (1989)** and **Abdallah (1990).**

C. Effect of the interaction

The mean values presented in Table (12), show that number of fruiting branches/plant was significantly affected by the interaction between sowing dates and irrigation regime treatment in both seasons.

Sowing flax on October $20^{\underline{th}}$ and irrigation at 1.2 accumulative pan evaporation (APE) gave the highest number of fruiting branches/plant which equal 22.2 and 21.2, respectively, in 1993/1994 and 1994/1995 seasons. However, the lower means were 10.8 and 9.8, obtained from sowing flax on December 1st (late sowing) and irrigation at 0.8 APE (I_1) or prolonged intervals, in the two successive seasons, respectively.

4. Stem diameter (mm)

Results listed in Table (13), show that main stem diameter of flax plants was significantly affected by sowing dates, irrigation treatments and their interactions in both seasons.

A. Effect of sowing dates

The analysis of data in Table (13), show that there were significant differences in main stem diameter due to the studied sowing dates. Early sowing dates of flax, October 20th, produced the higher values of main stem diameter (2.73 and 2.70 mm) in 1993/1994 and 1994/1995 seasons, respectively. On the other hand, late sowing of December 1st, recorded the lowest means of stem diameter (1.98 and 1.94 mm) in the two successive seasons, respectively.

It can be reveal that sowing flax on late October significantly increased main stem diameter, whereas delaying sowing date to November 10th or December 1st reduce stem diameter. These results may be due to more favourable temperature, day length and longer duration of vegetative growth period with early sowing. Similar results were observed by **El-Haroun *et al.* (1982)** and **Abou-Zaied (1991).**

B. Effect of irrigation regimes

Data recorded in Table (13), indicate that main stem diameter significantly responded to irrigation regime treatments in both seasons. The increase in irrigation frequency from irrigation at 0.8 to irrigation at 1.0, 1.2 and 1.4 (APE) accumulative pan evaporation was significantly associated with the increase in main

Table 13. **Flax stem diameter (mm)** as affected by sowing dates, scheduling irrigation treatments (water regime) and their interactions in 1993/1994 and 1994/1995 seasons.

Sowing dates	1993/1994					1994/1995				
	Irrigation regimes accumulative pan evaporation (APE)					Irrigation regimes accumulative pan evaporation (APE)				
	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean
Early	2.38	2.59	2.93	3.04	2.73	2.36	2.56	2.90	3.00	2.70
Medium	2.21	2.38	2.63	2.80	2.50	2.18	2.34	2.59	2.75	2.46
Late	1.98	2.17	2.28	2.44	2.21	1.94	2.13	2.24	2.39	2.17
Mean	2.19	2.38	2.61	2.76	2.48	2.16	2.34	2.57	2.71	2.45
L.S.D. at 5% for:										
Sowing dates					0.040					0.039
Irrigation regimes					0.006					0.007
Interaction					0.038					0.038

stem diameter which ranged from 2.19 to 2.38, 2.61 and 2.76 mm in 1993/1994 seasons, respectively, and from 2.16 mm to 2.34, 2.57 and 2.71 mm in 1994/1995 season, respectively.

It can be concluded that short irrigation intervals (increasing irrigation frequency) significantly increased stem diameter of flax plant. These results might be attributed to the effect of high available soil moisture on enhancing cell division and the increase of meristmatic activity induced by good absorption of nutrients with high moisture levels of available moisture.

These results are consistent with those obtained by **El-Farouk *et al.* (1982), El-Kady (1985), El-Shimy *et al.* (1988), El-Farouk *et al.* (1989)** and **Abdallah (1990).**

C. Effect of the interaction

Results presented in Table (13), show that main stem diameter of flax plant was significantly affected by the interaction between sowing dates and scheduling irrigation according to the Class A pan evaporation (irrigation regimes) in 1993/1994 and 1994/1995 seasons.

Early sowing of flax on October 20$^{\underline{th}}$ and irrigation at 1.4 accumulative pan evaporation (APE), gave the higher means of stem diameter (3.04 and 3.00 mm) in 1993/1994 and 1994/1995 seasons, respectively. Whereas, the lower means were 1.98 and 1.94 mm, in both seasons, respectively, obtained from the late sowing of December 1$^{\underline{st}}$ and irrigation at 0.8 APE (prolonged intervals).

5. Capsules number/plant

The average values of capsules number/plant as affected by sowing dates, irrigation treatments and their interactions in 1993/1994 and 1994/1995 seasons are presented in Table (14).

A. Effect of sowing dates

The analysis of variance proved that the differences between the means of capsules number per plant were significant due to sowing dates effects in the two seasons under study.

Results presented in Table (14), show that capsules number/plant, obtained from the medium sowing date (November 10$^{\underline{th}}$) was significantly surpassed those resulted from early (October 20$^{\underline{th}}$) or late (December1$^{\underline{st}}$) sowing by 26.7% and 40.2%, respectively, in 1993/1994 season. In 1994/1995 season, the reduction percentages were 25.9% and 41.2%, respectively.

It can be noticed that sowing flax on November 10$^{\underline{th}}$ gave the highest number of capsules/plant in the two seasons. This may be due to the favourable climatic conditions i.e. temperature, light and day length which affected number of days to flowering, flowering period and number of flowers/plant (**Dybing and Zemmerman, 1965 and Aurora and Dybing, 1973**). Also, in this connection, **Sheppard and Bates (1988),** reported that flax development in the field is dependent to some extent on photoperiod and from planting to the first flower was more accurately estimated by number of days to flowering rather than by day-degree.

Similar results were obtained by **El-Haroun *et al.* (1982), Zaky *et al.* (1988)** and **Abou-Zaid (1991).**

B. Effect of irrigation regimes

Data presented in Table (14), show that the means of capsules number/plant were significantly affected by scheduling irrigation treatments (irrigation regimes) in 1993/1994 and 1994/1995 seasons.

Table 14. **Capsules number/plant of flax** as affected by sowing dates, scheduling irrigation treatments (water regime) and their interactions in 1993/1994 and 1994/1995 seasons.

Sowing dates	1993/1994					1994/1995				
	Irrigation regimes accumulative pan evaporation (APE)					Irrigation regimes accumulative pan evaporation (APE)				
	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean
Early	9.5	12.2	15.5	13.0	12.6	8.5	11.2	14.5	12.0	11.6
Medium	14.8	16.5	20.5	17.2	17.2	13.8	15.5	19.5	16.2	16.2
Late	7.5	9.5	13.5	10.5	10.3	6.5	8.5	12.5	9.5	9.3
Mean	10.6	12.8	16.5	13.6	13.4	9.6	11.8	15.5	12.6	12.4
L.S.D. at 5% for:										
Sowing dates					0.57					0.572
Irrigation regimes					0.28					0.282
Interaction					0.70					0.701

The higher means of capsules number/plant of flax were (16.5 and 15.5), obtained from irrigation at 1.2 accumulative pan evaporation (moderate irrigation intervals) in the two successive seasons, respectively. However, irrigation at short intervals i.e. 1.4 accumulative pan evaporation (APE) or irrigation at long intervals i.e. 1.0 and 0.8 APE reduced significantly capsules number/plant by 17.6%, 22.4% and 36.8%, respectively in 1993/1994 season and by 18.7%, 24.9% and 38.1% in 1994/1995 season, respectively.

It can be reveal that increasing irrigation frequency (irrigation at 1.4 APE) or reducing it to prolonged intervals (irrigation at 1.0 or 0.8 APE) reduced significantly the number of capsules per plant of flax. These results may be due to the effect of soil moisture deficit of prolonged irrigation intervals on fruiting branches number/plant and consequently number of flowers per plant. Also, irrigation at short intervals may caused flower abscission and defoliation.

These results are in agreement with those found by **El-Farouk *et al.* (1982), El-Kady (1985), El-Shimy *et al.* (1988), El-Farouk *et al.* (1989), Abdallah (1990)** and **Mangal and Makkhanlal (1992).**

C. Effect of the interaction

Results presented in Table (14), reveal that the number of capsules per plant of flax was significantly affected by the interaction between sowing date and scheduling irrigation treatments in both seasons.

Sowing flax on November $10^{\underline{th}}$ and irrigation at 1.2 accumulative pan evaporation (APE) gave the higher means of capsules number/plant in 1993/1994 and 1994/1995 seasons, i.e. 20.5 and 19.5, respectively. Whereas, the late sowing of December $1^{\underline{st}}$ and irrigation at 0.8 APE (long irrigation intervals) gave the lower means of capsules number/plant (7.5 and 6.5) in the two successive seasons, respectively.

It could be shown from Table (14) that there was a consistent increase in number of capsules per plant from 0.8 accumulative pan evaporation (APE) tó 1.2 APE over all sowing dates then decreased at 1.4 APE in the two seasons. Also, it could be observed that number of capsules per plant reached its maximum number at medium sowing date (November 10$^{\underline{th}}$) over all irrigation treatments in the two seasons.

6. Seeds number/plant

Average of seeds number/plant of flax as affected by sowing dates, irrigation treatments and their interactions in both seasons of this study are listed in Table (15).

A. Effect of sowing dates

Number of seeds per plant was significantly affected by the tested sowing dates in both seasons. The effect of sowing date on number of seeds per plant was similar to that obtained on number of capsules per plant. Data in Table (15), reveal that the second sowing date, November 10$^{\underline{th}}$ produced the higher means of seed number/plant which equal 137.9 and 130.6 in 1993/1994 and 1994/1995 seasons, respectively, followed by those sown at October20$^{\underline{th}}$. On the other hand, late sowing of flax (December1$^{\underline{st}}$) recorded the lower means of seeds number/plant, i.e. 80.7 and 73.8 in the two successive seasons, respectively.

It can be noticed that the medium sowing date increased significantly the seeds number/plant of flax. These results might be attributed to the favourable climatic conditions, i.e. temperature, photoperiod and day length occurred for the second sowing date, which may make balance between the vegetative growth period and reproductive period. Also, it may be due to the high number of fruiting branches and capsule number/plant obtained from the November 10$^{\underline{th}}$ sowing date.

Table 15. **Seeds number/plant of flax** as affected by sowing dates, scheduling irrigation treatments (water regime) and their interactions in 1993/1994 and 1994/1995 seasons.

Sowing dates	1993/1994					1994/1995				
	Irrigation regimes accumulative pan evaporation (APE)					Irrigation regimes accumulative pan evaporation (APE)				
	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean
Early	80.2	98.5	120.0	104.5	100.8	73.8	91.5	112.5	97.5	93.8
Medium	114.7	134.8	159.8	142.2	137.9	107.8	127.8	151.8	135.2	130.6
Late	61.2	78.8	99.5	83.2	80.7	55.0	71.7	92.2	76.2	73.8
Mean	85.4	104.0	126.4	110.0	106.5	78.8	97.0	118.3	103.0	99.4
L.S.D. at 5% for:										
Sowing dates					2.50					2.37
Irrigation regimes					0.74					0.68
Interaction					2.60					2.45

These results are in accordance with those reported by **El-Haroun *et al.* (1992), Zaky *et al.* (1988)** and **Abou-Zaied (1991).** Whereas, **Tomar and Mishra (1989), Verma and Pathak (1993)** and **Dixit *et al.* (1994)** found contrary results to that found which may be due to the variation of locations, soil and other factors.

B. Effect of irrigation regimes

The analysis of variance proved that the means of seeds number/plant of flax were significantly affected due to irrigation treatments as presented in Tables (15).

Number of seeds/plant was 126.4 and 118.3 seed/plant, obtained from irrigation at 1.2 accumulative pan evaporation (APE) in the first and second seasons, respectively and surpassed those obtained from plants irrigated at 1.4, 1.0 and 0.8 APE by 16.4, 22.4 and 41.0 seed/plant in the first season, respectively by 15.3, 21.3 and 39.5 seed/plant for the same irrigation treatments, respectively in the second season.

These results conclude that over-irrigation (Shorter intervals) or subjecting flax plants to water deficit (irrigation at longer intervals) signifcantly reduce the number of seeds per plant. These results may be due to the same reductions in fruiting branches/plant and capsule number/plant resulted from the same treatments as a result of water deficit during flowering and seed formation stages. The high level of water (irrigation at 1.4 APE) may lead to remove nutrients away down the effective root zone, causing less absorption of nutrient than that in the moderate level of irrigation at 1.2 APE.

These results are in harmony with those reported by **El-Farouk *et al.* (1982), El-Kady (1985), El-Shimy *et al.* (1988)** and **Abdallah (1990).**

C. Effect of the interaction

Results presented in Table (15), show that the means of seeds number/plant of flax were significantly affected by the interaction between sowing dates and scheduling irrigation treatments in the two seasons under this study.

It could be shown that number of seeds/plant reached its maximum values at medium sowing date (November 10^{th}) over all water regime treatments. On the other hand, it reached its minimum value at late sowing date (December 1^{st}) over all water regime treatments.

With regard to water regime treatments, it could be observe that maximum number of seeds was obtained at 1.2 accumulative pan evaporation (APE) and its minimum value at 0.8 accumulative pan evaporation (APE). This was true over all sowing dates in the two seasons.

The higher mans of seed number/plant, i.e. 159.8 and 151.8 were obtained from the medium sowing of flax (November 10^{th}) and irrigation at 1.2 accumulative pan evaporation (moderate intervals) in 1993/1994 and 1994/1995 seasons, respectively. Whereas, the lower means (61.2 and 55.0 seed/plant) were resulted from the late sowing (December 1^{st}) and irrigation flax at 0.8 APE rate (prolonged intervals), in both seasons, respectively.

7. Seed yield/plant (gm)

Table (16), shows the means values of seed yield/plant as affected by sowing dates, irrigation regimes and the interaction between the two variables in 1993/1994 and 1994/1995 seasons.

A. Effect of sowing dates

Data in Table (16), indicate that seed yield/plant (gm) was significantly affected by sowing date in both seasons.

Sowing flax on November 10^{th} (medium planting) gave the higher means of seeds yield/plant, i.e. 1.43 and 1.39 gm in 1993/1994 and 1994/1995 seasons, respectively. However, the lower means (0.90 and 0.87 gm) were resulted from the late sowing date (December 1^{st}).

It is evident that sowing flax earlier in October 20^{th} or later than November 10^{th} reduced seed yield/plant significantly. It is suggested that seeds yield/plant depend on the duration of growing period which is actually correlated with certain planting time, and it might be attributed to the increase in fruiting branches number, capsules number and seeds number/plant, resulted from the same treatments. In this respect, **Dybing and Zimmerman (1965)** and **Aurora and Dybing (1973)**, reported that high seed production depend on day/night temperature during flowering and reproductive stages, as well as light intensity during flowering. These results are similar to those observed by **El-Nakhlawy *et al.* (1978), El-Haroun *et al.* (1982), Samia *et al.* (1987), Zaky *et al.* (1988)** and **Abou-Zaied (1991).**

B. Effect of irrigation regimes

The results recorded in Table (16), show clearly that the differences between the mean values of seed yield/plant were significant due to the different irrigation regime treatments in the two seasons.

The higher means of seed yield/plant (gm) were 1.32 and 1.28, obtained from irrigation flax plants at 1.2 accumulative pan evaporation (APE) in 1993/1994 and 1994/1995 seasons, respectively. The lower ones were 0.98 and 0.95 gm, resulted from irrigation practiced at 0.8 APE in the two successive seasons, respectively.

These results show apparently that decreasing irrigation intervals (irrigation at 1.4 APE) or increasing it (irrigation at 1.0 or 0.8 APE) than moderate irrigation treatment (irrigation at 1.2 APE) produced significant reductions in seed yield/plant of flax in both seasons. This may be ascribed to the effect of over-irrigation or water deficit on fruiting branches, capsules and seeds number per plant, which obtained from the same treatments. On the other hand, increasing irrigation frequency (irrigation at 1.4 APE) may increase the vegetative growth period which in turn decreased the reproductive period. These results are in good agreement with those found by **El-Farouk** ***et al.*** **(1982), El-Kady (1985), El-Shimy** ***et al.*** **(1988), El-Farouk** ***et al.*** **(1989)** and **Abdallah (1990).**

C. Effect of the interaction

Seeds yield/plant was significantly affected by the interaction between sowing dates and sheduling irrigation treatments in both season as presented in Table (16).

Seed yield per plant increased to its maximum weight at the medium sowing date (November 10$^{\underline{th}}$) under all irrigation treatments in the two seasons. With regard to irrigation treatments, it is clear from Table (16) that reached maximum weight at 1.2 accumulative pan evaporation (APE). Whereas reached minimum weight at 0.8 accumulative pan evaporation (APE) under all sowing dates. This was true in the two seasons.

The medium planting of flax (November 10$^{\underline{th}}$) and irrigation at 1.2 accumulative pan evaporation (moderate intervals) produced the higher means of seed yield/plant in 1993/1994 and 1994/1995 seasons (1.66 and 1.62 gm) respectively. Whereas, the late planting date of December 1$^{\underline{st}}$ and irrigation at 0.8 APE gave the lower means of seed yield/plant which equal 0.98 and 0.95 gm in the two successive seasons, respectively.

8. 1000-seed weight (gm)

Average of 1000-seed weight as affected by sowing dates, scheduling irrigation treatments and their interactions in the two seasons of this studies listed in Table (17).

A. Effect of sowing dates

Data shown in Table (17), confirm that the 1000-seed weight was significantly affected by the tested sowing dates. Early planting date (October 20th) gave the heaviest seed weight (8.21 and 8.08 gm) in 1993/1994 and 1994/1995 seasons, respectively. Delaying sowing date to November 10th or to December 1st reduced significantly 1000-seed weight to 8.04 and 7.47 gm, respectively in 1993/1994 season.

In 1994/1995 season, the respective values were 7.88 and 7.30 gm. It is evident that early planting of flax is more preferable in increasing the 1000-seed weight of flax. This result may be due to the longer duration of the vegetative and reproductive growth periods.

Similar findings were obtained by **El-Nakhlawy *et al.* (1978), El-Farouk *et al.* (1980), El-Haroun *et al.* (1982), Samia *et al.* (1987), Abou-Zaied (1991), Samui and Pintoo (1992), Verma and Pathak (1993)** and **Dixit *et al.* (1994).**

B. Effect of irrigation regimes

The data recorded in Table (17), emphasized that scheduling irrigation treatments had a significant effect on the 1000-seed weight of flax in 1993/1994 and 1994/95 seasons.

The higher means of 1000-seed weight were 8.18 and 8.02 gm, obtained from irrigation flax at irrigation at 1.2 APE in the two successive seasons, respectively. However, increasing irrigation frequency irrigation at 1.4 APE or decreasing it (1.0 or 0.8 APE) decreased significantly the 1000-seed weight by 2.7%, 3.9% and 7.0%, respectively, in the first season. These results were found to be true in the second season.

Table 17. **1000-seed weight (gm)** as affected by sowing dates, scheduling irrigation treatments (water regime) and their interactions in 1993/1994 and 1994/1995 seasons.

Sowing dates	1993/1994					1994/1995				
	Irrigation regimes accumulative pan evaporation (APE)					Irrigation regimes accumulative pan evaporation (APE)				
	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean
Early	7.94	8.16	8.47	8.25	8.21	7.82	8.04	8.34	8.13	8.08
Medium	7.75	7.99	8.32	8.10	8.04	7.59	7.83	8.15	7.93	7.88
Late	7.16	7.42	7.76	7.54	7.47	7.00	7.25	7.59	7.37	7.30
Mean	7.61	7.86	8.18	7.96	7.90	7.47	7.71	8.02	7.81	7.75
L.S.D. at 5% for:										
Sowing dates					0.043					0.042
Irrigation regimes					0.012					0.012
Interaction					0.044					0.043

It can be noticed that increasing or decreasing irrigation frequency than the moderate intervals (irrigation at 1.2 APE) significantly decreased 1000-seed weight of flax. These results might be attributed to the effect of short intervals in inhibiting the physiological processes of the plant to a short time after irrigation which in turn on reducing seed weight. Whereas, increasing irrigation intervals may decrease the dry matter accumulation during the reproductive stages and seed filling. In addition, shortage of water depressed translocation of metabolites from source to sink, therefore a reduction in seed weight could be expected.

These results are in harmony with those reported by **El-Farouk *et al.* (1982), El-Kady (1985), El-Shimy *et al.* (1988), El-Farouk *et al.* (1989), Abdallah (1990)** and **Mangal and Makkhanlal (1992).**

C. Effect of the interaction

Data in Table (17), show that the 1000-seed weight was significantly affected by the interaction between sowing dates and scheduling irrigation treatments in both seasons.

It is clear from Table (17) that the maximum 1000-seed weight was obtained from early sowing date (October 20th), whereas its minimum value was obtained at the late sowing date (December 1st). This was true under all irrigation treatments in the two seasons. With regard to irrigation treatments, it could be conclude that 1000-seed weight come to its minimum weight at 0.8 accumulative pan evaporation (APE), whereas it reached its maximum values at 1.2 accumulative pan evaporation (APE) over all sowing dates in the two seasons.

The higher means were 8.47 and 8.34 gm, obtained from sowing flax early at October 20th and practicing irrigation at 1.2 accumulative pan evaporation (moderate intervals) in 1993/1994 and 1994/1995 seasons, respectively. The lower ones i.e. 7.16 and 7.00 gm, were achieved from late sowing (December 1st) and irrigation at 0.8 APE (prolonged intervals) in the two successive seasons, respectively.

9. Straw yield/plant (gm)

The effect of sowing dates, scheduling irrigation treatments (irrigation regimes) and the interaction between them in 1993/1994 and 1994/1995 seasons are presented in Table (18).

A. Effect of sowing dates

Table (18) shows that sowing dates of flax were significantly affected the straw yield/plant in both seasons under study. Sowing flax early on October 20$^{\underline{th}}$ produced the higher means of straw yield/plant, i.e. 2.07 and 2.03 gm in 1993/1994 and 1994/1995 seasons, respectively. Delaying sowing dates of flax from October 20$^{\underline{th}}$ to November 10$^{\underline{th}}$ or December 1$^{\underline{st}}$ decreased significantly straw yield/plant to 1.75 and 1.45 gm, respectively, in 1993/1994 season. In 1994/1995 season the respective values were 1.71 and 1.41 gm.

It can be conclude that delay sowing date of flax than October 20$^{\underline{th}}$ decreased significantly straw yield/plant.

These results might be attributed to the increase of vegetative growth period resulted from the early sowing and favourable climatic conditions in increasing plant height, stem diameter which in turn caused straw yield increases. These results are in accordance with those obtained by **Samia *et al.* (1987), Abou-Zaied (1991)** and **Samui and Pintoo (1992).**

B. Effect of irrigation regimes

Results recorded in Table (18), indicate that the differences between the mean values of flax straw yield/plant were significant due to scheduling irrigation treatments (irrigation regimes) in both seasons of this study.

Table 18. **Straw yield/plant of flax** as affected by sowing dates, scheduling irrigation treatments (water regime) and their interactions in 1993/1994 and 1994/1995 seasons.

Sowing dates	1993/1994					1994/1995				
	Irrigation regimes accumulative pan evaporation (APE)					Irrigation regimes accumulative pan evaporation (APE)				
	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean
Early	1.74	1.90	2.15	2.50	2.07	1.71	1.85	2.11	2.45	2.03
Medium	1.47	1.63	1.83	2.08	1.75	1.43	1.59	1.78	2.03	1.71
Late	1.15	1.35	1.50	1.82	1.45	1.12	1.31	1.45	1.77	1.41
Mean	1.45	1.62	1.83	2.13	1.76	1.42	1.58	1.78	2.08	1.72
L.S.D. at 5% for:										
Sowing dates					0.089					0.085
Irrigation regimes					0.014					0.014
Interaction					0.085					0.082

The means of straw yield/plant decreased significantly by 0.30, 0.51 and 0.68 gm, in the first season, 0.30, 0.50 and 0.66 gm in the second season respectively, as irrigation regime increased from irrigation at 1.4 accumulative pan evaporation (APE) to irrigation at 1.2, 1.0 and 0.8 APE in the two seasons under study.

These results reveal that the straw yield/plant of flax decreased by decreasing irrigation frequency (increasing irrigation intervals). These results might be attributed to the increase in plant height, branch number/plant and stem diameter which obtained from the same treatments. In this connection, **Nordestgaard (1976),** pointed out that drought during the stem elongation stage restricted the vegetative growth of plant and decreased straw yield.

Similar results were obtained by **El-Farouk *et al.* (1982), El-Kady (1985), El-Shimy *et al.* (1988), El-Farouk *et al.* (1989)** and **Abdallah (1990).**

C. Effect of the interaction

Analysis of variance proved that the interaction between sowing dates and scheduling irrigation treatments had a significant effect on the straw yield/plant of flax in 1993/1994 and 1994/1995 season, as shown in Table (18).

Data in Table (18) shows that the maximum straw yield per flax plant was obtained at early sowing date (October 20th), whereas the minimum value was obtained at late sowing date (December 1st). This was true over all irrigation treatments in the two seasons. With regard to irrigation treatments, it could be shown that straw yield per plant come to its higher values at 1.4 accumulative pan evaporation (APE) over all sowing dates in the two seasons.

Sowing flax early on October 20th and irrigation at 1.4 accumulative pan evaporation (short intervals), gave the higher means of straw yield/plant, i.e. 2.50 and 2.45 gm in 1993/1994 and 1994/1995 seasons, respectively. On the other hand, sowing flax later on December 1st and irrigation at 0.8 accumulative pan evaporation (longer intervals) produced the lower means of straw yield/plant (1.15 and 1.12 gm) in the two successive seasons, respectively.

10. Seed yield (kg/feddan)

The effect of sowing dates, scheduling irrigation treatments (irrigation regimes) and their interactions on flax seed yield/feddan in 1993/1994 and 1994/1995 seasons are presented in Table (19).

A. Effect of sowing dates

Results recorded in Table (19), reveal that seed yield/feddan of flax was significantly affected by the tested sowing dates in the two seasons under study. Sowing flax on November 10th (2nd sowing date) produced the highest average of seed yield/feddan, i.e. 837.0 and 784.6 kg/feddan in 1993/1994 and 1994/1995 seasons, respectively. Whereas, sowing flax early on October 20th or later on December 1st decreased significantly seed yield/feddan by 17.0% and 31.3%, respectively, over the two seasons.

It could be concluded that sowing flax on November 10th significantly increased seed yield/feddan. These results might be attributed to the increase in capsules and seeds number/plant and seeds weight/plant resulted from the same sowing date. In this connection, **Abou-Zaied (1991),** suggested that seed yield/feddan depend on the length of vegetative and reproductive stages and the balance between the two which is actually correlated with certain sowing date. Also, **Mishra and Singh (1993),** showed that yield was positively correlated with plant dry weight, chlorophyll content, numbers of capsules and seeds/plant and 1000-seed weight. **Verma and Pathak (1993),** revealed that yield reduction in

Table 19. **Flax seed yield (kg/feddan)** as affected by sowing dates, scheduling irrigation treatments (water regime) and their interactions in 1993/1994 and 1994/1995 seasons.

Sowing dates	1993/1994 Irrigation regimes accumulative pan evaporation (APE)					1994/1995 Irrigation regimes accumulative pan evaporation (APE)				
	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean
Early	612.5	674.6	786.4	704.5	694.5	571.9	625.8	737.1	669.3	651.0
Medium	732.5	824.6	915.6	875.2	837.0	686.2	771.9	861.5	819.0	784.6
Late	498.1	557.2	660.8	593.0	577.3	458.3	512.1	606.4	544.9	530.4
Mean	614.4	685.5	787.6	724.2	702.9	572.1	636.6	735.0	677.7	655.4
L.S.D. at 5% for:										
Sowing dates					9.103					8.43
Irrigation regimes					0.874					0.80
Interaction					8.491					7.86

delayed sowing was also due to high temperature, more incidence of insects and fungal diseases.

These results are in good agreement with those found by **El-Nakhlawy *et al.*, (1978), El-Farouk *et al.* (1980), El-Haroun *et al.* (1982), Samia *et al.* (1987), Sharma and Roy (1987), Zaky *et al.* (1988), Abou-Zaied (1991), Verma and Pathak (1993)** and **Dixit *et al.* (1994).**

B. Effect of irrigation regimes

Data listed in Table (19), clearly show that scheduling irrigation or irrigation regime treatments had a significant effect on seed yield/feddan in both seasons.

Results in Table (19), reveal that there were gradual reductions in flax seed yield/feddan due to increasing or decreasing irrigation frequency than irrigation at 1.2 accumulative pan evaporation (APE) in both seasons under study.

Irrigation flax plants at 1.2 APE, increased significantly seed yield/feddan than irrigation at 1.4, 1.0 and 0.8 APE by 8.0%, 13.0% and 22.0%, respectively, over the two seasons of this study. Prolonged irrigation intervals (irrigation at 0.8 APE) produced the lower averages of seed yield/feddan, i.e. 614.4 and 572.1 kg/feddan in 1993/1994 and 1994/1995 seasons, respectively.

These results may be due to the effect of moderate level of soil moisture resulted from irrigation at 1.2 APE on dry matter production which gave better absorption of nutrients and water during flowering and seed filling stages. Also, it may be due to the higher number of capsules and seeds/plant and seed weight/plant, resulted from the same treatment. However, increasing irrigation frequency to 1.4 APE treatment caused reduction in these yield components as a result of inhibiting the physiological processes to sometime after irrigation. On the other hand, water deficit resulted from irrigation at 0.8 or 1.0 APE produced lower yield components. In this respect, **Nordestgaard (1976),** indicated that irrigation after stem elongation increased seed yield more than fiber yield. He added that, irrigation flax at 20 mm soil moisture depletion (SMD) and at application rate of 1-5 times SMD, generally gave better yield than irrigation at 10 or 30 mm SMD.

These results are in harmony with those observed by **Moursi and El-Hariri (1977), Talha and Osman (1978), El-Farouk *et al.* (1982), Hussein *et al.* (1983), El-Kady (1985), El-Shimy *et al.* (1988), El-Farouk *et al.* (1989), Abdallah (1990), Katole and Sharma (1990), Jibhakate and Jaipurkar (1991), Nimje (1991), Mangal and Makkhanlal (1992)** and **Dubey and Singh (1994).**

C. Effect of the interaction

Data in Table (19), indicate that the interaction between sowing dates and scheduling irrigation treatments significantly affected seed yield/feddan in both seasons.

With regard to sowing dates, it could be shown that seed yield/feddan was higher at medium sowing date (November $10^{\underline{th}}$) than the other two dates. On the other hand, the lower values obtained at late sowing date (December $1^{\underline{st}}$). This was true over all irrigation treatments in the two seasons. Irrigation treatment at 1.2 accumulative pan evaporation (APE) increased seed yield per feddan to its higher values, whereas it came to its minimum weight at 0.8 accumulative pan evaporation (APE) treatment over all sowing dates in the two seasons.

Sowing flax on November $10^{\underline{th}}$ and irrigation at 1.2 accumulative pan evaporation (APE), gave the higher average of seed yield/feddan (915.6 and 861.5 kg/feddan) in 1993/1994 and 1994/1995 seasons, respectively. Whereas, sowing flax on December $1^{\underline{st}}$ (late sowing) and irrigation at 0.8 APE (long intervals) produced the lower average of seed yield/feddan, i.e. 498.1 and 458.3 kg/feddan in the two successive seasons, respectively.

11. Straw yield (kg/feddan)

The response means of straw yield/feddan in 1993/1994 and 1994/1995 seasons to sowing dates and scheduling irrigation treatments (irrigation regimes) and their interactions are listed in Table (20).

A. Effect of sowing dates

Results in Table (20), emphasize that sowing dates had a significant effect on straw yield/feddan in both seasons.

The earliest sowing date of October 20th produced the higher means of flax straw yield/feddan, namely 2800.0 and 2701.9 kg in 1993/1994 and 1994/1995 seasons, respectively. Delaying sowing date from October 20th to November 10th or December 1st decreased significantly straw/feddan by 11.3% and 33.5%, respectively, in both seasons.

It can be noticed that delaying sowing date of flax than October 20th significantly decreased straw yield/feddan. These results may be due to more favourable climatic conditions, i.e. temperature, day length and long duration of the vegetative growth period of the early sowing, as well as the increases in plant height, stem diameter and straw yield/plant obtained from the same treatment.

Similar finding were reported by **El-Haroun *et al.* (1982), Samia *et al.* (1987), Abou-Zaied (1991),. Samui and Pintoo (1992), Verma and Pathak (1993)** and **Dixit *et al.* (1994).**

Table 20. **Flax straw yield/feddan in kg.** as affected by sowing dates, scheduling irrigation treatments (water regime) and their interactions in 1993/1994 and 1994/1995 seasons.

Sowing dates	1993/1994					1994/1995				
	Irrigation regimes accumulative pan evaporation (APE)					Irrigation regimes accumulative pan evaporation (APE)				
	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean
Early	2395.3	2791.8	2903.1	3110.6	2800.2	2312.5	2694.2	2801.0	3000.1	2701.9
Medium	2161.8	2441.9	2595.9	2734.4	2483.5	2087.7	2357.8	2506.2	2638.7	2397.6
Late	1505.3	1802.2	2012.3	2109.6	1857.3	1478.5	1741.6	1941.8	2037.1	1799.8
Mean	2020.8	2345.3	2503.8	2651.5	2380.4	1959.6	2264.5	2416.3	2558.6	2299.8
L.S.D. at 5% for:										
Sowing dates					9.16					9.84
Irrigation regimes					1.22					10.85
Interaction					8.65					20.01

intervals) by irrigation at 1.2, 1.0 and 0.8 APE caused gradual reductions in flax straw yield/feddan equal to 5.6%, 11.6% and 23.6%, over the two seasons of this study.

It could be reveal that increasing soil moisture in the root zone of flax plant by irrigation at short intervals (irrigation at 1.4 accumulative pan evaporation) significantly increase straw yield/feddan than moderate or longer irrigation intervals. These results may be attributed to the effect of short irrigation intervals on increasing total plant height, stem diameter, straw yield/plant and this in turn increased straw yield/feddan. In this connection, **Pande *et al.* (1969)**, reported that the increase in flax yields may be due to the fact that high levels of water helps in better vegetative growth.

These results are consistent with those found by **El-Farouk *et al.* (1982), Hussein *et al.* (1983), El-Kady (1985), El-Shimy *et al.* (1988), El-Farouk *et al.* (1989), Abdallah (1990)**, and **Mangal and Makkhanlal (1992).**

C. Effect of the interaction

The results presented in Table (20), show that the straw yield/feddan of flax was significantly affected by the interaction between sowing dates and scheduling irrigation treatments in both seasons.

Flax straw yield as affected by irrigation treatments over all sowing dates came to its maximum weight at 1.4 accumulative pan evaporation (APE), whereas it was at its minimum weight at 0.8 accumulative pan evaporation (APE) in the two seasons. With regard to sowing dates over all irrigation treatments, it could be shown that straw yield of flax come to its maximum weight at early sowing date (October 20th) and it was minimum at late sowing date (December 1st) in the two successive seasons.

The higher means of straw yield/feddan, i.e. 3110.6 and 3000.1 kg/feddan were obtained from sowing flax early on October 20th and irrigation practices at 1.4 APE (accumulative pan evaporation) in 1993/1994 and 1994/1995 seasons, respectively. However, the lower ones were 1505.3 and 1478.5 kg/feddan, resulted from sowing flax later on December 1st and irrigating plant at 0.8 APE (prolonged intervals) in the two seasons, respectively.

12. Fiber yield in kg/feddan

Average of flax fiber yield/feddan as affected by sowing dates and scheduling irrigation treatments and the interaction between the two variables are recorded in Table (21).

A. Effect of sowing dates

Data in Table (21), reveal that significant differences were detected among the flax fiber yield/feddan due to sowing dates. Sowing flax on November 10th produced the higher means of fiber yield/feddan (370.8 and 336.1 kgs/feddan), followed by that sown on October 20th which gave 323.8 and 292.9 kgs/feddan, in 1993/1994 and 1994/1995 seasons, respectively. Delaying sowing flax to the December 1st decreased fiber yield to 248.8 and 223.8 kgs/feddan in the two successive seasons, respectively. The increase in fiber yield/feddan with the two early planting dates may be attributed to the favourable temperature, day length

Table 21. **Flax fiber yield in kg/feddan,** as affected by sowing dates, scheduling irrigation treatments (water regime) and their interactions in 1993/1994 and 1994/1995 seasons.

Sowing dates	1993/1994					1994/1995				
	Irrigation regimes accumulative pan evaporation (APE)					Irrigation regimes accumulative pan evaporation (APE)				
	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean
Early	277.9	313.1	365.6	338.5	328.3	250.9	283.0	331.3	306.4	292.9
Medium	324.8	357.3	413.0	387.9	370.8	293.8	323.8	374.9	351.9	336.1
Late	202.1	234.2	292.5	266.4	248.8	180.9	210.3	264.1	239.7	223.8
Mean	268.3	301.5	357.0	330.9	314.4	241.9	272.4	323.4	299.3	284.3
L.S.D. at 5% for:										
Sowing dates					7.35					7.01
Irrigation regimes					0.74					0.71
Interaction					6.87					6.55

during the vegetative growth period which resulted in increasing fiber cell performance.

These results are in good agreement with those found by **El-Haroun *et al.* (1982), Samia *et al.* (1987)** and **Abou-Zaied (1991).**

B. Effect of irrigation regimes

Data in Table (21), shows that fiber yield was significantly affected by irrigation treatments in both seasons of this study.

The higher averages of flax fiber yield were 357.0 and 323.4 kg/feddan, obtained when plants were irrigated at 1.2 accumulative pan evaporation (APE) in 1993/1994 and 1994/1995 seasons, respectively. Irrigation flax plants at 1.4 APE (high frequency) or at 1.0 and at 0.8 APE (low frequency) reduced fiber yield/feddan by 26.1, 55.5 and 88.7 kgs/feddan, respectively, in the first season. The same trend was obtained in the second season too.

It can be noticed that irrigation flax irrigation flax plants at 1.2 accumulative pan evaporation is advisable than irrigation at 1.4 or 0.8 APE in increasing fiber yield/feddan for the high production. These results may be attributed to the effect of water deficit resulted from long irrigation intervals (0.8 or 1.0 APE) on vegetative growth and physiological processes during fiber performance. On the other hand, irrigating flax at 1.4 APE (short irrigation intervals) or over irrigation may inhibits water uptake for some days after irrigation, which in turn affect physiological processes and fiber precipitation in plants.

These results are in the same line to those reported by **Moursi and El-Hariri (1977), El-Kady (1985), El-Shimy *et al.* (1988), El-Farouk *et al.* (1989)** and **Abdallah (1990).**

C. Effect of the interaction

Average of flax fiber yield/feddan were significantly affected by the interaction between sowing dates and irrigation regime treatments in 1993/1994 and 1994/1995 seasons, as shown in Table (21).

Flax fiber yield per feddan at 1.2 accumulative pan evaporation (APE) was higher than the other irrigation treatments, whereas it was lower at 0.8 accumulative pan evaporation (APE). This was true over all sowing dates in the two seasons. With regard to sowing dates, it is clear that fiber yield increased to its maximum weight at medium sowing date (November $10^{\underline{th}}$) and it was at its minimum weight at late date (December $1^{\underline{st}}$). This was true under all irrigation treatments in the two seasons.

The higher fiber yield values (413.0 and 374.9 kgs/feddan) were resulted from sowing flax on November $10^{\underline{th}}$ and irrigating plant at 1.2 accumulative pan evaporation (APE) in 1993/1994 and 1994/1995 seasons, respectively. Sowing flax later on December $1^{\underline{st}}$ and applying irrigation at 0.8 APE (longer intervals) produced the lower values of fiber yield, i.e. 202.1 and 180.9 kgs/feddan, in the two successive seasons, respectively.

II. Oil content

1. Oil percentage of seeds

A. Effect of sowing dates

Results presented in Table (22), reveal that the means of seed oil percentage were significantly affected by the tested sowing dates of flax in both seasons under study.

Sowing flax on November $10^{\underline{th}}$ produced the higher means of oil percentage, i.e. 42.04 and 41.59% in 1993/1994 and 1994/1995 seasons, respectively.

Gradual decrease in oil percentage of flax seeds were observed by sowing flax on October 20th or December 1st, i.e. 39.07 and 38.0%, respectively in the first season. In the second season, the means reduced to 38.61 and 37.50%, respectively, for the early and the late sowing dates. It could be concluded that sowing flax on November 10th is more preferable for producing high content of oil in seeds. These results may be due to the effect of suitable temperature degrees during the seed filling stage which enhanced plants to convert more carbohydrate compounds to fatty acids. In this respect, **Dybing and Zimmerman (1965)**, pointed out that the optimum performance of the flax plant was at relatively cool temperature and the significant influence of temperature on seed development and oil quality even when effects from other climatic factors are limited. These results are in harmony with those obtained **by El-Farouk *et al.* (1980), Samia *et al.* (1987), Zaky *et al.* (1988)** and **Abou-Zaied (1991).**

B. Effect of irrigation regimes

The results listed in Table (22), indicate that scheduling irrigation treatments according to the evaporation pan records had a significant effect on oil percentage of flax seed in the two seasons.

Irrigating flax plants on short intervals i.e. at 1.4 accumulative pan evaporation (APE), gave the higher means of oil percentage (40.14 and 39.67%) in 1993/1994 and 1994/1995 seasons, respectively. On the other hand, subjecting plants to soil moisture deficit (irrigation at 0.8 APE) produced the lower means of oil percentage in flax seed (39.20% and 38.75%) in the two successive seasons, respectively.

It can be noticed that increasing soil moisture in the root zone of flax plants increased the soil percentage of seeds. These results may be attributed to the increase in fat accumulation during seed development stage, as a result of

Table 22. **Oil percentage** as affected by sowing dates, scheduling irrigation treatments (water regime) and their interactions in 1993/1994 and 1994/1995 seasons.

Sowing dates	1993/1994					1994/1995				
	Irrigation regimes accumulative pan evaporation (APE)					Irrigation regimes accumulative pan evaporation (APE)				
	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean
Early	38.56	38.97	39.26	39.48	39.07	38.13	38.49	38.79	39.02	38.61
Medium	41.53	41.95	42.19	42.49	42.04	41.11	41.48	41.73	42.05	41.59
Late	37.50	37.91	38.14	38.44	38.00	37.02	37.40	37.64	37.94	37.50
Mean	39.2	39.61	39.86	40.14	39.70	38.75	39.13	39.39	39.67	39.23
L.S.D. at 5% for:										
Sowing dates					0.078					0.076
Irrigation regimes					0.008					0.010
Interaction					0.073					0.072

increasing sugar transformation to fatty acids. These results are in accordance with those reported by **Drewitt (1977), Mingeau and Vernede (1977), Talha and Osman (1978), El-Kady (1985)** and **Abdallah (1990).**

C. Effect of the interaction

The differences between the average of oil percentage were significant due to the interaction between sowing dates and scheduling irrigation treatments (irrigation regimes) in both seasons.

It could be observed that oil percentage in flax seeds increased to its maximum percentage at 1.4 accumulative pan evaporation (APE) treatment under all seeding dates in the two seasons. On the other hand, sowing flax at (November 10^{th}) produced the maximum oil percentage under all irrigation treatments in the two successive seasons, (Table 22). Here it should be noticed that the lowest oil percentage was obtained at late seeding date (December 1^{st}) under all irrigation treatments.

Sowing flax on November 10^{th} and irrigated plants at 1.4 accumulative pan evaporation gave the higher means of oil percentage, i.e. 42.49 and 42.05% in 1993/1994 and 1994/1995 seasons, respectively. Whereas, the lower means (37.50 and 37.02%), were resulted from sowing flax on December 1^{st} and irrigating plants at 0.8 accumulative pan evaporation in the two successive seasons, respectively.

It could be concluded that the medium sowing of November 10^{th} and short irrigation intervals (1.4 APE) treatment is preferable for high oil percentage in seeds.

2. Oil yield in kgs/feddan

Means of oil yield in kgs/feddan as affected by flax sowing dates, scheduling irrigation treatments and their interaction in 1993/1994 and 1994/1995 seasons are presented in Table (23).

A. Effect of sowing dates

The analysis of variance shown in Table (23), proved that oil yield/feddan was significantly affected by sowing dates of flax in both seasons of this study.

The higher means of oil yield were 352.1 and 326.5 kgs/feddan, obtained from sowing flax on November 10th in 1993/1994 and 1994/1995 seasons, respectively. However sowing flax plants on December 1st (later planting) gave the lower means of oil yield, i.e., 219.5 and 199.1 kgs/feddan in the two successive seasons, respectively. These results indicate that sowing flax plants three weeks early or later than November 10th reduced significantly the oil yield/feddan. These results may be attributed to the decrease in seed yield/feddan and oil percentage, resulted from the earliest or latest sowing dates, i.e. October 20th or December 1st in both seasons.

Similar results were observed by **Samia *et al.* (1987), Zaky *et al.* (1988)** and **Abou-Zaied (1991).**

B. Effect of irrigation regimes

Oil yield in kgs/feddan was significantly affected by scheduling irrigation treatments in the two seasons of this study as shown in Table (23).

Irrigation flax plants at 1.2 accumulative pan evaporation (APE), gave the higher means of oil yield, i.e. 315.7 and 291.2 kgs/feddan in 1993/1994 and 1994/1995 seasons, respectively. Whereas, the lower means were (242.4 and 223.3

Table 23. **Oil yield in kgs/feddan** as affected by sowing dates, scheduling irrigation treatments (water regime) and their interactions in 1993/1994 and 1994/1995 seasons.

Sowing dates	1993/1994					1994/1995				
	Irrigation regimes accumulative pan evaporation (APE)					Irrigation regimes accumulative pan evaporation (APE)				
	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean
Early	236.2	262.9	308.7	278.2	271.5	218.0	240.9	285.9	261.1	251.5
Medium	304.2	346.0	386.3	371.9	352.1	282.1	320.2	359.5	344.3	326.5
Late	186.8	211.2	252.0	227.9	219.5	169.7	191.5	228.3	206.8	199.1
Mean	242.4	273.4	315.7	292.7	281.0	223.3	250.9	291.2	270.8	259.0

L.S.D. at 5% for:	1993/1994	1994/1995
Sowing dates	4.20	3.85
Irrigation regimes	0.33	0.31
Interaction	3.90	3.57

kgs/feddan), obtained from irrigation practiced at 0.8 APE in the two successive seasons, respectively.

It can be noticed that increasing irrigation regime (long irrigation intervals) or decreasing it (short irrigation intervals) than irrigation at 1.2 accumulative pan evaporation reduced oil yield/feddan significantly. These results may be due to the increase in seed yield/feddan, obtained from irrigation flax plants at 1.2 APE as shown in Table (19). Whereas increasing irrigation intervals or decreasing it (irrigation at 1.4 APE) caused significant decrease in seed yield/feddan.

These results are in good agreement with those reported by **Talha and Osman (1978), El-Kady (1985)** and **Abdallah (1990).**

C. Effect of the interaction

Results presented in Table (23), show that the averages of oil yield/feddan were significantly affected by the interaction between flax sowing dates and scheduling irrigation treatments in both seasons.

Data obtained on oil yield as affected by the interaction was similar to that obtained on oil percentage. Sowing flax at (November 10th) produced the highest oil yield kgs/feddan under all irrigation treatments. Under all sowing dates the maximum oil yield kgs/feddan was obtained at 1.2 accumulative pan evaporation (APE) in the two successive seasons.

Sowing flax plants on November 10th and irrigation at 1.2 accumulative pan evaporation produced the higher means of oil yield, i.e. 386.3 and 359.5 kgs/feddan in 1993/1994 and 1994/1995 seasons, respectively. The lower means of oil yield (186.8 and 169.7 kgs/feddan) were obtained from the latest sowing date December 1st and irrigation at 0.8 accumulative pan evaporation (long irrigation intervals) in the two successive seasons.

III. Technological properties of fibers

1. Fiber percentage (%)

The effect of sowing dates, scheduling irrigation treatments (irrigation regimes) and their interaction on flax fiber percentage in 1993/1994 and 1994/1995 seasons are shown in Table (24).

A. Effect of sowing dates

Data in Table (24), clearly show that sowing dates had a significant effect on flax fiber percentage in both seasons. The higher means of flax fiber percentage were 14.94 and 14.02%, obtained when flax was sown on November 10$^{\underline{th}}$ (medium sowing) in 1993/1994 and 1994/1995 seasons, respectively. However, the lower ones (11.57 and 10.85%), were resulted from the early sowing of October 20$^{\underline{th}}$ for the same respective seasons.

It could be concluded that sowing flax plants earlier or later than November 10$^{\underline{th}}$ significantly decrease fiber percentage. The increase in fiber percentage obtained from November 10$^{\underline{th}}$ planting may be due to the high fiber yield/feddan (Table, 21) and moderate straw yield/feddan (Table, 20), resulted from this sowing date. Whereas, the early sowing date October 20$^{\underline{th}}$ produced less fiber yield and the higher straw yield. On the other hand, the latest sowing date gave the lower fiber yield and very low straw yield. Similar observation was obtained by **Zaky *et al.* (1988).**

B. Effect of irrigation regimes

Scheduling irrigation treatments (irrigation regimes) significantly affected fiber percentage of flax in both seasons of this study as presented in Table (24). Increasing irrigation intervals or reducing it than irrigation at 1.2 accumulative pan

Table 24. **Flax fiber percentage** as affected by sowing dates, scheduling irrigation treatments (water regime) and their interactions in 1993/1994 and 1994/1995 seasons.

Sowing dates	1993/1994					1994/1995				
	Irrigation regimes accumulative pan evaporation (APE)					Irrigation regimes accumulative pan evaporation (APE)				
	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean
Early	11.61	11.22	12.59	10.88	11.57	10.85	10.51	11.83	10.21	10.85
Medium	15.03	14.63	15.90	14.18	14.94	14.07	13.73	14.96	13.34	14.02
Late	13.42	12.99	14.54	12.63	13.40	12.25	12.08	13.60	11.77	12.42
Mean	13.35	12.95	14.34	12.56	13.30	12.39	12.10	13.46	11.77	12.43
L.S.D. at 5% for:										
Sowing dates					0.280					0.342
Irrigation regimes					0.032					0.093
Interaction					0.263					0.349

evaporation significantly decreased flax fiber percentage in the two seasons under study.

The higher fiber percentage were 14.34 and 13.46%, obtained from irrigation flax plants at 1.2 accumulative pan evaporation (APE) in 1993/1994 and 1994/1995 seasons, respectively. However, the lower means (12.56 and 11.77%) were resulted from irrigating plants at 1.4 APE in the two successive seasons, respectively. On the other hand, irrigating plants at 0.8 APE produced higher fiber percentages than irrigation at 1.0 or at 1.4 APE. These results may be due to the effect of soil moisture content on straw and fiber yield resulted from the same treatments (Tables, 20 and 21).

This results are in the same trend of the results found by **El-Farouk (1968), El-Kady (1985)** and **Abdallah (1990).**

C. Effect of the interaction

The mean values of fiber percentage were significantly affected by the interaction between flax sowing dates and irrigation regimes (irrigation schedule treatment) in 1993/1994 and 1994/1995 seasons as recorded in Table (24).

Sowing flax early on October 20$^{\underline{th}}$ and irrigating plants at 1.4 accumulative pan evaporation produced the lower means of fiber percentage, i.e. 10.88 and 10.21% in the first and second seasons, respectively. The maximum fiber percentage values were 15.90 and 14.96%, resulted from sowing flax on November 10$^{\underline{th}}$ and irrigating flax plants at 1.2 accumulative pan evaporation 1993/1994 and 1994/1995 seasons, respectively.

It could be shown that fiber percentage as affected by the interaction was similar to that obtained on oil percentage. Fiber percentage reached its maximum values at medium seeding date (November 10$^{\underline{th}}$), whereas the lowest values was at early sowing date (October 20^{th}). This was true under all irrigation treatments in the two seasons. With regard to irrigation treatments, irrigation at 1.2 accumulative pan evaporations (APE) was better than other irrigation treatments for producing fiber percentage under all seedling dates in the two seasons.

These results may be due to the straw and fiber yields obtained from the same treatments (Tables, 20 and 21).

2. Fiber length (cm)

Fiber length as affected by flax sowing dates, irrigation regimes (scheduling irrigation treatments) and their interactions in both seasons of this study are listed in Table (25).

A. Effect of sowing dates

Results in Table (25), reveal that fiber length was significantly affected by the tested sowing dates in both seasons.

Delaying sowing dates of flax from October 20^{th} to November 10^{th} or December 1^{st} decreased fiber length from 89.5 cm to 85.5 and 80.5 cm in the first season, respectively. In the second season, it decreased from 87.9 cm to 83.5 and 78.5 cm for the same respective sowing dates. The improvement and increase in flax fiber length obtained from the early planting may be attributed to the increase in growing season duration which gives chance for plants to utilize the environmental sources i.e. nutrients, light, temperature and water with high efficiency. Also, the early sowing gave the longer technical length and that in turn increased fiber length.

These results are in accordance with those found by **Samia *et al.* (1987)** and **Abou-Zaied (1991).**

Table 25. **Fiber length in cm, as affected by sowing dates, scheduling irrigation treatments (water regime) and their interactions in** 1993/1994 and 1994/1995 seasons.

Sowing dates	1993/1994					1994/1995				
	Irrigation regimes accumulative pan evaporation (APE)					Irrigation regimes accumulative pan evaporation (APE)				
	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean
Early	85.9	88.0	90.6	93.7	89.5	84.4	86.4	88.9	92.0	87.9
Medium	81.9	84.2	86.4	89.5	85.5	80.0	82.3	84.4	87.4	83.5
Late	76.0	79.1	82.2	84.8	80. 5	74.1	77.2	80.2	82.6	78.5
Mean	81.3	83.8	86.4	89.3	85.2	79.5	82.0	84.5	87.4	83.3

L.S.D. at 5% for:	1993/1994	1994/1995
Sowing dates	1.18	1.18
Irrigation regimes	0.03	0.05
Interaction	1.09	1.09

B. Effect of irrigation regimes

The analysis of variance presented in Table (25), proved that fiber length was significantly affected by scheduling irrigation treatments in both seasons.

Increasing irrigation frequency from irrigation at 0.8 accumulative pan evaporation (APE) to irrigation at 1.0, 1.2 and 1.4 APE increased fiber length from 81.3 to 83.8, 86.4 and 89.3 cm, respectively, in the first season. The respective increases in the second season were from 79.5 to 82.0, 84.5 and 87.4 cm.

It can be noticed that subjecting plants to water stress during the growing season significantly decreased fiber length. These results are true, since water deficit during vegetative growth of flax caused decreased in plant height and technical length. This may be due to the effect of water deficit on cell division and enlargement, as well as the physiological processes of plants. In this manner, **Nordestgaard (1976),** indicated that drought during stem elongation of flax plants restricted vegetative growth and decreased fiber yield.

These results are in full agreement with those reported by **El-Farouk (1968), El-Farouk *et al.* (1982), El-Kady (1985), El-Shimy *et al.* (1988)** and **Abdallah (1990).**

C. Effect of the interaction

Results listed in Table (25), emphasize that fiber length was significantly affected by the interaction between flax sowing dates and irrigation regimes (scheduling irrigation treatments) in the two seasons of this study.

The higher means of fiber length were 93.7 and 92.0 cm, obtained from the early sowing (October 20th) and irrigating plants at short intervals (1.4 accumulative pan evaporation) in 1993/1994 and 1994/1995 seasons, respectively. Whereas, the lower means of fiber length (76.0 and 74.1 cm) were resulted from the latest sowing date (December 1st) and irrigating plants at 0.8 accumulative pan evaporation (pronloged irrigation intervals) in the two successive seasons, respectively. Data presented in Table (25), cleared that fiber length increased to its maximum value at the early seedling date (October 20th), whereas the lowest value was at the late sowing date (December 1st) under all irrigation treatments in the two seasons. With regard to irrigation treatments, it is clear that the maximum fiber length was obtained at 1.4 accumulative pan evaporation (APE), whereas the lowest one was at 0.8 accumulative pan evaporation (APE). This was true under all sowing dates in the two seasons. These results may be due to the effect of early sowing on increasing growth season duration and sufficient water in the root zone which in turn increased plant height and technical length.

3. Fiber strength (R.K.m.)

The mean values of fiber strength as affected by flax sowing dates, irrigation regimes (scheduling irrigation treatments) and their interaction in 1993/1994 and 1994/1995 seasons are shown in Table (26).

A. Effect of sowing dates

The differences between the averages of fiber strength as affected by flax sowing dates in both seasons were significant and presented in Table (26).

Delaying sowing date from October 20th to November 10th or December 1st produced gradual increase in fiber strength from 17.72 to 22.98 and 28.17 R.K.m., in the first season, respectively. In the second season fiber strength increased from 16.96 to 21.92 and 26.98 R.K.m. for the same respective treatments.

This indicated that there was a positive correlation between cellulose precipitation in the secondary walls of fiber cells and certain duration of growing

Table 26. **Flax fiber strength in R.K.m.**, as affected by sowing dates, scheduling irrigation treatments (water regime) and their interactions in 1993/1994 and 1994/1995 seasons.

Sowing dates	1993/1994					1994/1995				
	Irrigation regimes accumulative pan evaporation (APE)					Irrigation regimes accumulative pan evaporation (APE)				
	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean
Early	15.74	17.12	18.41	19.62	17.72	15.07	16.38	17.63	18.77	16.96
Medium	21.04	22.37	23.68	24.84	22.98	20.03	21.33	22.62	23.71	21.92
Late	26.38	27.53	28.79	29.98	28.17	25.27	26.36	27.54	28.74	26.98
Mean	21.05	22.34	23.63	24.81	22.96	20.12	21.36	22.60	23.74	21.96
L.S.D. at 5% for:										
Sowing dates					0.025					0.058
Irrigation regimes					0.015					0.020
Interaction					0.034					0.062

season of flax plant . Similar observations were recorded by **Zaky *et al.* (1988)** and **Abou-Zaied (1991).**

B. Effect of irrigation regimes

Results in Table (26), indicate that irrigation regime treatments affected significantly fiber strength in both seasons.

Fiber strength markedly increased with each increment in irrigation frequency. Shortening the irrigation intervals by irrigation flax plants at 1.4 accumulative pan evaporation (APE) produced the higher strength, i.e. 24.81 and 23.74 R.K.m. in 1993/1994 and 1994/1995 seasons, respectively. The lower fiber strength were 21.05 and 20.12 R.K.m., resulted from irrigation practiced at 0.8 APE (long irrigation intervals)in the two successive seasons, respectively. The increase in fiber strength in the shortest irrigation intervals might be due to the effect of high soil moisture in increasing nutrition and cellulose accumulation in fibers during the growth stages and this in turn caused increasing the coarseness and fiber strength.

The results are in the same line with those obtained by **El-Kady (1985)** and **Abdallah (1990).**

C. Effect of the interaction

Data in Table (26), reveal that the interaction between flax sowing dates and scheduling irrigation treatments (irrigation regimes) significantly affected fiber strength in the two seasons of this study.

The higher values of fiber strength (29.98 and 28.74 R.K.m.) were obtained from sowing flax plants on December 1st (later sowing) and irrigation at 1.4 accumulative pan evaporation (short intervals) in 1993/1994 and 1994/1995 seasons, respectively. On the other hand, the lower values of fiber strength i.e. 15.74 and 15.07 R.K.m., resulted from sowing flax plants on October 20th (early sowing date) and applying water at 0.8 accumulative pan evaporation (long intervals) in the two successive seasons, respectively.

It is clear from Table (26), that fiber strength as affected by sowing dates increased to its maximum values at late sowing date (December 1st) whereas, the lowest values was at early sowing date (October 20th) under all irrigation treatments in the two seasons. With regard to irrigation treatments, the maximum values of fiber strength was obtained at 1.4 accumulative pan evaporation (APE) whereas, the lowest values was obtained at 0.8 accumulative pan evaporation (APE). This was true under all sowing dates in the two seasons.

4. Fiber fineness (N.m.)

Means of fiber fineness in metrical number (N.m.) as affected by sowing dates and scheduling irrigation treatments (irrigation regimes) and the interaction between the two variables are recorded in Table (27).

A. Effect of sowing dates

Results in Table (27) reveal that the studied sowing dates significantly affected fiber fineness in both seasons.

Fiber fineness reached its maximum values (252.6 and 247.4 N.m.) at the second sowing date (November 10th) in 1993/1994 and 1994/1995 seasons, respectively. The lower values of fiber fineness (165.5 and 160.3 N.m.) were obtained from sowing flax early on October 20th in the two successive seasons, respectively.

It could be concluded that sowing flax plants three weeks early or later than November 10th decreased fiber fineness significantly. These results may be attributed to the effect of growing season duration on increasing or decreasing the cellulose precipitation in fibers which in turn affected fiber coarseness.

Table 27. **Flax fiber fineness in N.m.**, as affected by sowing dates, scheduling irrigation treatments (water regime) and their interactions in 1993/1994 and 1994/1995 seasons.

Sowing dates	1993/1994					1994/1995				
	Irrigation regimes accumulative pan evaporation (APE)					Irrigation regimes accumulative pan evaporation (APE)				
	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean
Early	191.5	172.6	156.0	141.8	165.5	185.7	167.4	150.4	137.6	160.3
Medium	279.8	259.9	242.5	228.4	252.6	274.2	254.7	236.6	223.9	247.4
Late	219.7	202.8	185.9	171.7	195.1	214.2	197.8	180.3	167.5	189.9
Mean	230.3	211.8	194.8	180.7	204.4	224.7	206.6	189.1	176.3	199.2

L.S.D. at 5% for:	1993/1994	1994/1995
Sowing dates	1.54	1.52
Irrigation regimes	0.48	0.47
Interaction	1.62	1.59

Similar finding were reported by **Samia** ***et al.*** **(1987), Zaky** ***et al.*** **(1988)** and **Abou-Zaied (1991).**

B. Effect of irrigation regimes

The analysis of variance presented in Table (27), proved that scheduling irrigation treatments had a significant effect on fiber fineness in both seasons.

Increasing irrigation frequency to short intervals caused a significant reduction in fiber fineness. The higher values of fiber fineness were 230.3 and 224.7 N.m., obtained from irrigating plants at 0.8 accumulative pan evaporation (APE) in 1993/1994 and 1994/1995 seasons, respectively. Whereas, the lower means were (180.7 and 176.3 N.m.) resulted from irrigating plants at 1.4 APE (short irrigation intervals) in both seasons, respectively. These results reveal that increasing irrigation frequency (short irrigation intervals) significantly decreased flax fiber fineness. These results may be due to the trend of fiber coarseness toward increasing number of irrigations. This indicate that any factor enhancing heavier nutrition and cellulose accumulation in fibers could affect fineness towards heavier weight for the given length of fibers recorded as metrical number. These finding may support those of technical length and stem diameter which increased as soil moisture in the root zone increased.

These results are in harmony with those reported by **El-Farouk (1968), El-Farouk** ***et al.*** **(1982), El-Kady (1985), El-Shimy** ***et al.*** **(1988), El-Farouk** ***et al.*** **(1989)** and **Abdallah (1990).**

C. Effect of the interaction

Data in Table (27) indicated that the average of fiber fineness were significantly affected by the interaction between flax sowing dates and scheduling irrigation treatments (irrigation regimes) in the two seasons under study.

The higher values of fiber fineness i.e, 279.8 and 274.2 N.m.were obtained from sowing flax plants on November 10th and practicing irrigation at 0.8 accumulative pan evaporation (prolonged irrigation intervals) in 1993/1994 and 1994/1995 seasons, respectively. However, the lower values of fiber fineness were 141.8 and 137.6 N.m., resulted from the early sowing of October 20th and applying irrigation at 1.4 accumulative pan evaporation (short irrigation intervals) in the first and second seasons, respectively.

It can be noticed that sowing flax plants three weeks early or later than November 10th and increasing irrigation frequency (irrigation at short intervals) gave significant reductions in fiber fineness.

Conclusion

A. Effect of sowing dates

The statistical analysis of data proved that flax yield and yield components, oil content and technological characteristics of fibers were significantly affected by different sowing dates tested in both seasons. Sowing flax on October 20th (early) significantly increased plant height, technical length, number of fruiting branches/ plant, stem diameter, 1000-seed weight, straw yield/plant and per feddan and fiber length to its higher values, as compared with November 10th and December 1st sowing dates.

The higher values of capsules number/plant, seeds number/plant, seed yield/plant and feddan, fiber yield/feddan, oil percentage in seeds, oil yield/feddan, fiber percentage and fiber fineness were obtained from sowing flax on November 10th (moderate sowing date) in both seasons. Whereas, delaying sowing date from October 20th to November 10th or December 1st significantly increased fiber strength in the two seasons.

B. Effect of irrigation regimes

Increasing irrigation frequency (irrigation at 1.4 APE) significantly increased flax plant height, technical length, stem diameter, straw yield/plant and feddan, oil percentage in seeds, fiber percentage, fiber length and strength to the higher values in both seasons. However, irrigating flax at 1.2 APE produced the higher values of number of fruiting branches/plant, capsules and seed number/plant, seed yield/plant and feddan, 1000-seed weight, fiber yield/feddan and oil yield/feddan when compared with irrigation at 0.8, 1.0 and 1.4 APE in both seasons. Irrigation flax plants at 0.8 APE (prolonged intervals) significantly increased fiber fineness to its high value.

C. Effect of the interaction

Sowing flax early (October 20$^{\underline{th}}$) and irrigation at 1.4 APE significantly increased plant height, technical length, stem diameter, straw yield/plant and feddan and fiber length. Whereas the early sowing and irrigation at 1.2 APE produced the higher values of number of fruiting branches/plant and 1000-seed weight in both seasons. Medium sowing (November 10$^{\underline{th}}$) and irrigation at 1.2 APE gave the higher capsule number/plant, seed number/plant, seed yield/plant and feddan, fiber yield/feddan, oil yield/feddan and fiber percentage in 1993/1994 and 1994/1995 seasons. Increasing irrigation frequency to 1.4 APE treatment for the moderate sowing date significantly increased oil percentage to the higher values. However irrigation flax planted on November 10$^{\underline{th}}$ at 0.8 APE produced fibers much more fineness. The short irrigation intervals with the later sowing date (1.4 APE with December 1$^{\underline{st}}$ sowing) gave the higher values of fiber strength in both seasons.

IV. Crop water use

The crop water use of water managements of flax will be reported in this study under the following heading:

1. Actual evapotranspiration

   i) Seasonal evapotranspiration (ETc) in cm

   ii) Daily evapotranspiration in mm/day

2. The Class A pan evaporation studies

   i) Pan evaporation and some climatic factors relations

   ii) Pan evaporation and actual daily ET rates relation

3. Potential evapotranspiration (ETp)in cm

   i) Monthly ETp

   ii) Seasonal ETp

4. Crop coefficient(Kc)

5. Water use efficiency (WUE)

   i) WUE in kgs seeds/m^3 water)

   ii) WUE in kgs fibers/m^3 water)

1. Actual evapotranspiration (ETc)

(i) Seasonal ET (cm)

Seasonal evapotranspiration by flax plants expressed in cm of water depth, as affected by sowing dates and scheduling irrigation treatments (irrigation regimes) in 1993/1994 and 1994/1995 seasons are presented in Table (28).

Seasonal ET values by flax irrespective to sowing dates and scheduling irrigation treatments were 35.65 and 33.91 cm in 1993/1994 and 1994/1995 seasons, respectively.

It can be noticed that seasonal ET by flax plants was higher in the first season than that in the second one. These results may be due to the differences occurred in climatic factors between the two seasons (Tables 7 and 8), which may affect the ET rates of flax plants.

In the same respect, **Pruitt (1960)** indicated that water consumptive use was closely correlated with climatic conditions. Also, **Chang (1971)** concluded that ET by the crop plants depends on the evaporative power of the air, i.e. temperature, relative humidity and solar radiation. **Yousef (1989)** found that the relationships between pan evaporation and climatic factors, as well as the crop ET were significantly correlated.

A. Effect of sowing dates

Data recorded in Table (28); indicated that seasonal evapotranspiration (ET) by flax plants was differed due to sowing dates effect on both seasons of this study.

The higher values of seasonal ET by flax plants were 38.40 and 36.14 cm, obtained from the early sowing date of October 20th in 1993/1994 and 1994/1995 seasons, respectively, delaying sowing date of flax to November 10th or December 1st reduced seasonal ET to 35.26 and 33.29 cm, respectively in the first season. In the second season it was reduced to 33.67 and 31.92 cm with the same delay in sowing dates, respectively.

It can be concluded that sowing flax early on October 20th increased seasonal evapotranspiration, whereas each 3-weeks delay in sowing date than

Table 28. **Flax evapotranspiration in cm/season** as affected by sowing dates, scheduling irrigation treatments (water regime) and their interactions in 1993/1994 and 1994/1995 seasons.

Sowing dates	1993/1994					1994/1995				
	Irrigation regimes accumulative pan evaporation (APE)					Irrigation regimes accumulative pan evaporation (APE)				
	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean
Early	33.32	36.21	39.75	44.31	38.40	31.26	33.29	38.00	42.00	36.14
Medium	30.00	33.18	36.99	40.88	35.26	29.14	31.27	34.89	39.39	33.67
Late	28.33	31.11	35.05	38.66	33.29	27.81	29.86	33.41	36.61	31.92
Mean	30.55	33.50	37.26	41.28	35.65	29.40	31.47	35.43	39.33	33.91

October 20^{th} gave more reduction in seasonal ET. These results may be attributed to the growing season duration which increased by sowing flax on October 20^{th} to 168 days, whereas each three weeks delay in sowing reduced season duration by 8-days. Also, the length of maximum water demands period (mid-season period) for October 20^{th} sowing than the two other sowing dates.

These results are in the same trend with that reported by **Jensen (1968), Doorenbos and Pruitt (1977), Gab-Alla *et al.* (1986)** and **Yousef (1989).**

B. Effect of irrigation regimes

The results presented in Table (28), show that seasonal evapotranspiration by flax plants was affected by scheduling irrigation treatments (irrigation regimes) in the two seasons under study.

Increasing irrigation frequency or irrigating plants at short intervals (irrigation at 1.4 accumulative pan evaporation) gave the highest seasonal ET values i.e., 41.28 and 39.33 cm in 1993/1994 and 1994/1995 seasons, respectively. On the other hand, long irrigation intervals for flax plants (irrigation at 0.8 accumulative pan evaporation) caused pronounced reductions in seasonal ET to the lowest values (30.55 and 29.4 cm) in the two successive seasons, respectively. Increasing the length of irrigation intervals or decreasing number of irrigations applied to flax plants, i.e. irrigation at 1.2 or 1.0 or 0.8 accumulative pan evaporation (APE) reduced seasonal ET by 9.8, 18.8 and 26.0%, respectively, when compared with irrigation at 1.4 APE (short irrigation intervals) in 1993/1994 season. In 1994/1995 season, the respective percentages of reduction were 9.9, 20.0 and 25.2%.

These results show that as the pan evaporation rate increased, the seasonal ET of flax increased. It is clearly that seasonal evapotranspiration of flax crop increased when the available soil moisture increased in the root zone by frequent irrigation in short intervals (irrigation at 1.4 APE). In this connection, **Tanner *et al.* (1960),** indicated that total evapotranspiration depends on available water to plants, available moisture of the soil surface and net radiation. **Doorenbos and Pruitt (1977),** reported that after rain or irrigation the soil water content will be reduced primarily by evapotranspiration and as the soil dried the rate of water transmitted through the soil will be reduced. They added that the effect of soil water content on evapotranspiration varies with crop, soil type and water holding characteristics.

The results are in agreement with those reported by **Israelsen and Hansen (1962), Doorenbos and Pruitt (1977), Singh and Singh (1978), Yusuf *et al.* (1978), Bauder and Ennen (1981), El-Kady (1985), Abdallah (1990)** and **Albinet (1992).**

C. Effect of the interaction

The effect of interaction between sowing dates and scheduling irrigation treatments (irrigation regimes) on seasonal ET values by flax plants are listed in Table (28).

Results show that sowing flax early on October 20th and irrigation at 1.4 accumulation pan evaporation (APE) i.e., short irrigation intervals gave the highest values of seasonal evapotranspiration (44.31 and 42.00 cm) in 1993/1994 and 1994/1995 seasons, respectively. On the other hand, the lowest values of seasonal evapotranspiration were 28.33 and 27.81 cm, resulted from sowing flax later on December 1st and applying irrigation at 0.8 APE (prolonged irrigation intervals) in the two successive seasons, respectively.

These results may be due to the effect of growing season duration which increased with the early date and decreased with delaying sowing date, as well as the effect of irrigation frequency on increasing or decreasing the available soil moisture in the root zone with irrigating plants in short intervals or long intervals, respectively.

(ii) Daily ET rate (mm/day)

The daily evapotranspiration rates by flax plants during the growing seasons as affected by sowing dates and irrigation regimes (Scheduling irrigation as pan evaporation) during 1993/1994 and 1994/1995 seasons are presented in Tables (29 and 30).

As a general trend, the results in Tables (29 and 30), indicate that the daily ET rates were low through the initial growth period and increased gradually during the crop development stage (December and January) as a result of the plant cover. The daily ET rates reached its maximum values at the mid season stage (during flowering and seed development stages) which occurred on February and March and then decreased again at late season stages (April-May), as plants began maturity. These trend was found to be true either in the two seasons or under the sowing dates tested or irrigation scheduling treatments. In this respect, **Lemon *et al.* (1959)** reported that the gradual increase in evapotranspiration from planting to maturity can be explained on the basis of percent cover and that the decrease in ET values at maturity is probably resulted from the plant development factor. However, in most studies the soil moisture is not maintained at a high level condition after maturity. **Fretschen and Van Bavel (1964),** revealed that when plants reached maturity, evapotranspiration was much less than at the early growth stages.

Table 29. Daily evapotranspiration rates of flax in mm/day during growing season duration, as affected by sowing dates and scheduling irrigation treatments in 1993/1994 season.

Treatments		Season duration							
Sowing date	Irrigation regime (APE)	October	November	December	January	Febrauary	March	April	May
Early	0.8	1.92	1.84	1.67	2.0	2.39	2.07	1.72	-
20/10	1.0	1.92	1.98	1.98	1.99	2.77	2.22	1.99	-
	1.2	1.92	2.29	2.19	2.40	3.22	2.10	1.71	-
	1.4	1.92	2.53	2.46	2.50	3.82	2.42	1.88	-
	Mean	1.92	2.16	2.08	2.22	3.05	2.20	1.82	-
Medium	0.8	-	1.59	1.61	1.67	2.18	2.37	1.78	-
10/11	1.0	-	1.59	1.69	1.94	2.81	2.36	1.98	-
	1.2	-	1.59	1.96	2.45	3.14	2.54	1.94	-
	1.4	-	1.59	2.14	2.68	3.74	2.81	2.02	-
	Mean	-	1.59	1.85	2.18	2.97	2.52	1.93	-
Late	0.8	-	-	1.27	1.44	2.09	2.55	1.95	1.36
1/12	1.0	-	-	1.39	1.63	2.51	2.84	1.95	1.63
	1.2	-	-	1.39	1.93	3.12	3.13	2.05	1.54
	1.4	-	-	1.39	2.45	2.45	3.83	3.06	1.52
	Mean	-	-	1.32	1.86	2.89	2.90	2.01	1.51
Over all average		1.92	1.88	1.75	2.09	2.97	2.54	1.92	1.51

Table 30. Daily evapotranspiration rates of flax in mm/day during growing season duration, as affected by sowing dates and scheduling irrigation treatments in 1994/1995 season.

Treatments		Season duration							
Sowing date	Irrigation regime (APE)	October	November	December	January	Febrauary	March	April	May
Early	0.8	1.62	1.63	1.61	1.78	2.33	2.23	1.34	-
20/10	1.0	1.60	1.68	1.81	1.94	2.48	2.36	1.54	-
	1.2	1.70	1.87	2.17	2.31	2.91	2.49	1.60	-
	1.4	1.72	2.04	2.43	2.45	3.34	2.80	1.69	-
	Mean	1.66	1.81	2.01	2.12	2.76	2.47	1.54	-
Medium	0.8	-	1.39	1.57	1.68	2.06	2.53	1.48	-
10/11	1.0	-	1.39	1.57	1.79	2.49	2.62	1.59	-
	1.2	-	1.39	1.82	2.33	2.70	2.80	1.66	-
	1.4	-	1.39	2.08	2.66	3.16	3.18	1.85	-
	Mean	-	1.39	1.76	2.12	2.60	2.78	1.64	-
Late	0.8	-	-	1.11	1.43	1.87	2.68	1.96	1.46
1/12	1.0	-	-	1.34	1.69	2.18	2.83	1.84	1.66
	1.2	-	-	1.39	1.87	2.51	3.28	2.00	1.82
	1.4	-	-	1.44	2.33	3.13	3.22	2.03	1.88
	Mean	-	-	1.32	1.83	2.42	3.00	1.96	1.71
Over all average		1.66	1.60	1.70	2.02	2.59	2.75	1.71	1.71

A. Effect of sowing dates

The effect of sowing dates on daily evapotranspiration rates by flax plants in 1993/1994 and 1994/1995 seasons are recorded in Tables (29 and 30), respectively.

Results in Tables (29 and 30) indicate that daily ET values were somewhat higher in the early sowing of October 20th at the initial period, crop development, mid-season (flowering and seed formation) stages than those of November 10th or December 1st plantings. Whereas, daily ET values at the late season stage were increased as sowing date delayed. This trend was found to be true in both seasons.

The higher values of daily ET rates during two initial and crop development stages during (October, November and December) were resulted from sowing flax early on October 20th in both seasons, followed by sowing flax on November 10th. The lower values of daily ET rates during the initial period and crop development stages were 1.32 and 1.86 mm/day (December and January), obtained from the late sowing date of December 1st in 1993/1994 season. These results were true in 1994/1995 season.

At mid-season stage, the higher daily ET rates were occurred during February and March either in the three sowing dates or in the two seasons. In 1993/1994 season the higher daily ET was 3.05 mm/day, resulted from the early sowing date after 105-132 days from sowing (during February), followed by that of November 10th sowing date (2.97 mm/day) which occurred at 84-112 day from planting. Whereas, the late sowing date gave less daily rate during mid-season (after 88-119 days from sowing) or on March. In 1994/1995 season (Table, 30) the data indicate that at mid-season stage the peak of water consumption occurred at February (102-130 days from sowing) by the early sowing date, whereas the higher daily ET values for the second and third sowing dates obtained on March (112-143 days and 88-119 days, respectively). Also, in 1994/1995 season, the early sowing resulted in the lowest value of daily ET (2.76 mm) during the peak time of water consumption (mid-season) as compared with the values of November 10th and December 3rd plantings for the same stage.

These results may be due to the differences in climatic factors during the growth stages and between sowing dates, as well as the duration periods of different growth stages which varied from sowing date to the other. The same trend was reported by **Prashar *et al.* (1968).**

B. Effect of irrigation regimes

The daily ET rates by flax plants as affected by irrigation regimes (scheduling irrigation treatments) in 1993/1994 and 1994/1995 seasons are presented in Tables (29 and 30).

Results indicated that prolonged irrigation intervals, i.e. irrigation at 0.8 accumulative pan evaporation (APE) gave the lower values of daily ET of flax at all growth stages or during months of growing season either in the three sowing dates or in the two seasons of this study. On the other hand, increasing irrigation frequency to short intervals (irrigation at 1.4 APE) produced the higher values of daily ET rates during the several stages or during months of the growing season. These results were found to be true for the three sowing dates and the two seasons.

It could be concluded that increasing the available soil moisture in the root zone of flax plant by irrigation at short intervals caused an increase in the daily ET rates. The explanation of such results was reported by **Blac (1965),** who concluded that the independence of the evapotranspiration and density of vegetative canopy may be exists for different reasons when the soil is dry than when water availability for evaporation and transpiration is unlimited. He added that in wet soil the atmosphere is the control but for dry soil the control is in the soil and under medium conditions the control may be partly in the soil and partly in the plant.

2. The Class A pan evaporation studies

(i) Pan evaporation and some climatic factors relations

Correlation between the daily Class A pan evaporation records and mean daily air temperature (°C), mean daily wind speed m/sec, mean daily relative humidity and mean daily vapour pressure deficit (ml.bar) has been estimated. The data of the two seasons 1993/1994 and 1994/1995 were subjected to statistical analysis. The results of the correlation coefficient and linear regression parameters of these relations are listed in Table (31).

Data recorded in Table (31), indicate that the relation between the daily Class A pan evaporation and the mean daily air temperature was highly significant in the two seasons under study. This trend is expected since water loss from the free water surface depends primarily on the evaporative power of the air. The evaporation rate from the Class A pan significantly affected by the air temperature.

The regression line of the Class A pan evaporation and the daily mean of air temperature relationship is as follows:

$$Y = 1.2721 + 0.1399X$$

where:

Y = Class A pan evaporation rate in mm/day

X = Mean daily air temperature (°C)

These results are in the same trend with that reported by **Yousef (1989).**

Table 31.Correlation coefficienct (r) and linear regression parameters (Y = a + bX) for rlationships between (Y) the Class A pan evaporation in mm/day and daily means of some climatic factors (X) in1993/1994 and 1994/1995 seasons.

Climatic factors (X) daily mean	Parameters	Seasons		The two years
		1993/1994	1994/1995	
Air temperature (°C/day)	r	0.5691*	0.4702**	0.523**
	b	0.140	0.1374	0.1399
	a	1.3031	1.2821	1.2721
Wind speed (m/sec.)	r	0.2386	0.0993	0.1507
	b	0.2296	0.1111	0.1556
	a	3.369	3.4373	3.4403
Relative humidity (%)	r	-0.6324**	-0.448**	-0.5426**
	b	-0.0585	-0.0537	-0.0569
	a	7.5278	7.1096	7.3719
Vapour pressure deficit (ml/bar)	r	0.6178**	0.5106**	0.4817**
	b	0.111	0.1455	0.1051
	a	2.7864	2.4481	2.8148

where:
- * Significant on the level of 5% probability.
- ** Significant on the level of 1% probability.

Regarding the relation between mean daily wind speed the Class A pan evaporation rate, the data of Table (31), indicate that the relation between the two variables was not significant in the two seasons. This result may be due to the slight variations in mean daily wind speed during the periods of this study when compared with the Class A pan evaporation rates. In this respect, **Chang (1971),** pointed out that evaporation is a diffusive process, partly turbulent and partly molecular. The turbulent process is the domen in the thin layer near the surface or evaporation. **Yousef (1989),** in Egypt, concluded that the relationship between evaporation rates from the Class A pan and mean daily wind speed was not significant in the three seasons of this study.

Table (31), represented the relation between the Class A pan evaporation rate/day and mean daily relative humidity (RH %) in 1993/1994 and 1994/1995 seasons.

The correlation analysis showed a negative relation between evaporation rates and mean daily relative humidity in both seasons. The statistical analysis proved that this relationship was highly significant through the two season under this study. The correlation coefficient values between daily evaporation and mean daily RH % were -0.6324 and -0.4480 in 1993/1994 and 1994/1995 seasons, respectively. These results may be attributed to the fact that diffusion of vapour from a free water surface depends on the amount of water vapoured in the air.

The linear function of the relationship between the Class A pan evaporation rate/day and mean daily RH % is as follows:

$$Y = 7.3719 + (-0.0569X)$$

where:

Y = Class A pan evaporation rate in mm/day

X = Mean daily relative humidity (%)

These findings are in harmony with those reported by **Smith (1964)** and **Yousef (1989).**

The correlation coefficient values between daily Class A pan evaporation and daily vapour pressure deficit in 1993/1994 and 1994/1995 seasons are presented in Table (31). The statistical analysis of the data proved that the correlation coefficient was highly significant in the two seasons. The coefficient values for this relationship were 0.6178 and 0.5106 in 1993/1994 and 1994/1995 seasons, respectively. In this connection, **Chang (1971),** indicated that the upward flow of water vapour is more affected by the changes in the vertical gradient of vapour pressure and mixing rate of vapour in the surrounded air. These results are true, since vapour pressure deficit significantly correlated with temperature and relative humidity values.

The results recorded in Table (31), show the linear regression parameters for the equation used for predicting the rate of water evaporated from the Class A pan in relation to mean daily vapour pressure deficit at Giza region, which is as follows:

$$Y = 2.8148 + 0.1051X$$

where:

Y = Class A pan evaporation rate in mm/day

X = Mean daily vapour pressure deficit (ml.bar)

These results agree with those reported by **Robins and Haiseo (1961), Smith (1964)** and **Doorenbos and Pruitt (1975),** whom revealed that evaporation from the pan may provide a measurements of integrated effect of radiation, wind speed, temperature and relative humidity on evaporation from free water surface.

(ii) Class A pan evaporation and flax ET relation

Interest in using the Class A pan evaporation for estimating potential evapotranspiration and scheduling crop irrigation has been increased recently.

Finding out the relation between pan evaporation rates and the crop evapotranspiration (ETc) is the simplest method in evaluating the accuracy of the Class A pan in scheduling the crop irrigation.

Data in Table (32) represent the correlation between the Class A pan evaporation rates (mm/day) and the actual ET measured from the flax field (mm/day) for the three sowing dates and irrigation regime treatments in 1993/1994 and 1994/1995 seasons.

The results presented in Table (32) reveal that the relationship between the daily Class A pan records and actual evapotranspiration (ETc) was not significant in the early sowing date in both seasons and it was found to be negative relation with irrigation treatments of 1.2 and 1.4 APE in both season. On the other hand, the relationships between the Class A pan evaporation records and daily ETc were highly significant when irrigation was scheduled at 0.8 and 1.0, 1.2 and 1.4 accumulative pan evaporation (APE) in November 10$^{\underline{th}}$ and December 1$^{\underline{st}}$ sowing dates during 1993/1994 and 1994/1995 seasons, except those irrigated at 1.2 and 1.4 APE of the medium sowing date in 1993/1994 season.

These results conclude that the crop ET of flax is closely correlated with the daily records of Class A pan when flax sown from November 10$^{\underline{th}}$ to December 1$^{\underline{st}}$. These results may be due to the higher ET values consumed by the early sowing date plants and the growing season length. In this connection, **Brutsaert (1965)**, reported that the correlation coefficient between ET measured by lysimeters and results obtained by the Class A pan evaporation was 0.977. Also, **Chang (1971)**,

Table 32. Correlation coefficint values (r) for the relationship between the Class A pan evaporation records and daily actual ET by flax plants in 1993/1994 and 1994/1995 seasons.

Sowing dates	Irrigation regimes			
	0.8	1.0	1.2	1.4
		1993/1994 season		
Early	0.0869	0.0609	-0.1430	-0.1064
Medium	0.3812**	0.2436*	0.0719	0.0341
Late	0.5401**	0.4670**	0.4137*	0.2803*
		1994/1995 season		
Early	0.1347	0.0876	-0.0870	-0.0630
Medium	0.4169**	0.3498**	0.2106*	0.1804**
Late	0.5746**	0.4487**	0.4963**	0.3159**

where:
- * Significant on the level of 5% probability.
- ** Significant on the level of 1% probability.

concluded that the Class A pan evaporation can be used for estimating ET values throughout the crop life cycle.

The correlation studies mentioned in this study proved that the relationships between the Class A pan evaporation records and some climatic factors, as well as flax crop ET of the November 10^{th} and December 1^{st} sowing dates were closed and significant in both seasons, for irrigation regimes.

Since, the Class A pan is inexpensive, easily to handle and use in the field, needs short time and little efforts for records and calculation, can be located close to the crop field, avoiding soil destruction by sampling of normal method, save efforts of transporting, weighing and drying the soil samples and will incorporate to most of the climatic factors affecting evaporation from the free water surface, as well as factors affecting the crop plants evapotranspiration. Therefore, it can be concluded that the Class A pan evaporation records can be used as a direct method for scheduling the crop irrigation and measuring the crop ET when it well located and all factors affecting evaporation from it are considered. These results are in good agreement with those reported by **Hagood (1964), Bowman and King (1965), Brutsaert (1965), Chang (1971), Ibrahim (1981), Eid and Metwally (1982)** and **Yousef (1989).**

3. Potential evapotranspiration (ETp)

Penman (1956) defined the potential evapotranspiration as the amount of water transpired per time unit by a short green crop, completely shading the ground and of a uniform height. The ETp is determined primarily by the weather and is not affected by plant species or irrigation treatments, etc.

(i) Monthly ETp (mm)

Monthly values of potential evapotranspiration, based on the daily evaporation records of the Class A pan located at Giza agrometeorological station and closed to the experimental plots are presented in Table (33).

Results listed in Table (33), indicated that the monthly ETp values for the early sowing date started with somewhat high values on October and November and decreased during December and January, then reincreased again on February and March till harvesting. These results were found to be true in the two seasons under study. Whereas the values of ETp for the second and third sowing dates started with low values through November, December and January and increased gradually to reach its maximum values during March and April in the two seasons.

These results may be due to that temperature, radiation and evaporation demands were still high during October and November and decreased through December and January months. Whereas, the evaporation power of the air began to increase again from February till harvesting to reach maximum on March and April. The low ETp values recorded in Table (33), in April and May months were a result to the date of harvesting during these month (Table, 4). In this manner, **Chang (1971),** concluded that the ETp rate depends on the evaporative power of the air determined by temperature, wind speed, relative humidity, radiation and vapour pressure deficit.

(ii) Seasonal ETp (cm)

Regarding seasonal ETp values estimated by the Class A pan evaporation method the results presented in Table (33), reveal that the values were higher in 1993/1994 season than it in 1994/1995 season. These results can be ascribed as the differences between the two seasons in the evaporative power of the air, i.e. temperature, winds, relative humidity and evaporation.

Table 33. Monthly and seasonal potential evapotranspiration for flax grown season of the three sowing date treatments in 1993/1994 and 1994/1995..

Sowing dates	Monthly ETp (mm)								Seasonal ETp (cm)
	October	November	December	January	Febrauary	March	April	May	
				1993/1994 season					
Early	41.95	79.56	63.18	64.91	74.90	92.04	19.14	-	43.57
Medium	-	53.10	63.18	64.91	74.90	92.04	61.59	-	40.97
Late	-	-	63.18	64.91	74.90	92.04	102.07	5.42	40.25
				1994/1995 season					
Early	35.35	72.10	65.27	60.36	66.42	101.18	17.44	-	41.81
Medium	-	40.42	65.27	60.36	66.42	101.18	57.98	-	39.16
Late	-	-	61.09	60.36	66.42	101.18	85.84	5.71	38.06

The higher values of seasonal ETp were 43.57 and 41.81 cm, obtained from the early sowing date (October 20th) in 1993/1994 and 1994/1995 seasons, respectively. Whereas, the lower ETp values (40.25 and 38.06 cm) were gained from the late sowing date of December 1st in the two successive seasons, respectively. These results are true since the sowing dates were differed in its growing season duration, which decreased with each three weeks delay in sowing date than October 20th, as presented in Table (4). In this respect, **Jensen (1968),** indicated that most of field crops require less amounts of water than those be needed to meet the potential evapotranspiration even though adequate soil moisture is provided. On the other hand, **Pruitt and Jensen (1955),** as well as **Suzuki and Fukuda (1958)**, reported that the Class A pan evaporation rate gave much closer estimates of crop water use than empirical formula. They also found that the ETp estimated by the Class A pan evaporation method was highly correlated (r = 0.97). **Stanhill (1961),** concluded that calculating the ETp by Penman method or by the Class A pan evaporation method are the satisfactory methods.

It can be concluded that the evaporation records of the Class A pan can used in estimating ETp with high efficiency if it will located and all factors affecting evaporation were considered. Similar finding were reported by **Mukammal and Bruce (1960), Hagan and Vaadia (1961), Khafagi *et al.* (1967), Eid (1977), Ibrahim (1981), Miseha (1983), Sherif (1983), Abdel Hamid *et al.* (1985)** and **Yousef (1989).**

4. Crop coefficient(Kc)

The crop coefficient (Kc) reflects the crop characteristics of the evapotranspiration by the crop. The crop Kc calculated as the dimension less rate of the crop ET and the potential evapotranspiration (ETp).

A. Effect of sowing dates

The values of Kc by flax plants throughout its life cycle as affected by sowing dates in 1993/1994 and 1994/1995 seasons are presented in Table (34).

Monthly Kc values during flax growing season from planting to harvesting were estimated according to the monthly actual ET values, drived from the four irrigation treatments, i.e. 0.8, 1.0, 1.2 and 1.4 APE and the monthly ETp estimated by the Class A pan method (Table, 33). The results recorded in Table (34) show that the Kc values were low at the initial period of each sowing date i.e. October and November in the early sowing date, November and December in the second one and December and January for the late sowing date in both seasons, as a result of the large diffusive resistance of bare soil after planting. Then the Kc values increased as the crop cover percent increased. The crop coefficient reached its maximum values throughout the mid-season stage which occurred on February in the three sowing dates and the two seasons. The Kc values at mid-season stage in 1993/1994 season were 1.14, 1.11 and 1.08 for the early, medium and late sowing dates, respectively. Whereas,, in 1994/1995 season the Kc values were 1.165, 1.099 and 1.022 for the successive sowing dates. The higher Kc values at mid-season stage (February) may be due to that this period considered as the peak period of water consumption by flax plants. Thereafter, the Kc values redecreased again during the late season (March - April) as the crop started to mature. At harvesting stage (April) the Kc values were low again due to crop maturity and very less ET by the plants while the ETp still high as a result of the increase of temperature and evaporation. These results were found to be true either in the three sowing dates or in the two seasons under study.

The data presented in Table (34), indicated that the Kc values by the flax at any growth stage or at any month were decreased with each 3-weeks delay in sowing date than October 20^{th}. These results were true in both seasons. These

Table 34. The crop coefficient values (Kc) of flax through its life cycle as affected by sowing dates in 1993/1994 and 1994/1995..

Sowing dates	Growing season (months)								Seasonal Kc
	October	November	December	January	Febrauary	March	April	May	
1993/1994 season									
Early	0.549	0.814	1.018	1.061	1.140	0.742	0.500	-	0.881
Medium	-	0.629	0.909	1.044	1.110	0.850	0.533	-	0.861
Late	-	-	0.652	0.891	1.080	0.976	0.591	0.557	0.827
Mean	0.500	0.722	0.860	0.999	1.110	0.856	0.541	0.557	0.856
1994/1995 season									
Early	0.471	0.749	0.952	1.089	1.165	0.758	0.531	-	0.864
Medium	-	0.653	0.835	1.087	1.099	0.852	0.536	-	0.860
Late	-	-	0.650	0.941	1.022	0.920	0.680	0.597	0.839
Mean	0.471	0.701	0.812	1.039	1.095	0.843	0.582	0.597	0.854

results may be attributed to the decrease in the actual ET resulted from delaying planting than October 20th (Tables, 29 and 30).

Results presented in Table (34) reveal that average values of seasonal Kc in 1993/1994 season were 0.881, 0.861 and 0.827 for early, medium and late sowing dates, respectively, with over mean of 0.856. Whereas, in 1994/1995 season they were 0.864, 0.860 and 0.839 for the same sowing dates, respectively, with over mean of 0.854.

In this connection, **Jensen (1968),** concluded that the seasonal ET for most field crops will be less than the ETp because the soil may be completely bare before the establishment of plants. However, at the beginning of plant maturity the transpiration resistance seems to increase. **Burch *et al.* (1978),** found that the rate of ET crop to ETp increased from 0.2 in the early period tc about 1.2 at later stages for well watered plants.

It could be be concluded that sowing flax early on October 20th increased the Kc values at the initial and mid-season stages, whereas the Kc values decreased at the late season stage compared with November 10th and December 1st sowing dates.

These results may be due to the crop performance and the variation in growing season length and the high values of actual ET resulted from the early sowing. In this respect, **Doorenbos and Pruitt (1977),** reported that factors affecting Kc are mainly, crop characteristics, sowing date, rate of the crop development, growing season length and the climatic conditions. They also, reported that Kc of flax during mid-season was 1.1-1.15.

B. Effect of irrigation regimes

The values of flax coefficient (Kc) as affected by scheduling irrigation treatments according to Class A pan evaporation (water regimes) from planting until harvesting in 1993/1994 and 1994/1995 seasons are listed in Table (35).

Generally, results presented in Table (35), show that monthly Kc values were low in the first months (initial period) of October and November, then the Kc values increased gradually during December and January as the crop cover increased. The Kc values reached its maximum during February (mid-season stage), the redecreased again as plants started maturity to reach low values at harvest time. These results are true either for all irrigation treatments or in the two seasons of this study.

The data in Table (35) indicated that Kc values at any month of the flax life cycle (any crop stage) were increased as the frequency of irrigation increased (irrigation at short intervals). The higher monthly Kc values were resulted from irrigating flax plants at 1.4 accumulative pan evaporation (APE), whereas the lower monthly values were obtained from irrigation practiced at 0.8 APE. These results were found to be true in the two seasons. These results are expected since, actual ET was increased to the higher values as irrigation frequency increased (1.4 APE) as shown in Table (28). However, irrigating flax plants at 0.8 APE produced the lower ET values.

Regarding, seasonal Kc values as affected by irrigation treatments, results in Table (35), show that the Kc values in 1993/1994 season were increased from 0.734 to 0.805, 0.895 and 0.992 when irrigation frequency increased from irrigation at 0.8 APE to irrigation at 1.0, 1.2 and 1.4 APE, respectively. In 1994/1995 season, the respective values were from 0.741 to 0.793, 0.893 and 0.991.

Table 35. The crop coefficient values (Kc) of flax through its life cycle as affected by scheduling irrigation treatments (irrigation regimes) in 1993/1994 and 1994/1995.

Irrigation regiems	Growing season (months)								Seasonal Kc
	October	November	December	January	Febrauary	March	April	May	
				1993/1994 season					
0.8 APE	0.549	0.440	0.747	0.811	0.830	0.785	0.534	0.557	0.734
1.0 APE	0.549	0.444	0.813	0.886	1.008	0.834	0.547	0.557	0.805
1.2 APE	0.549	0.497	0.897	1.079	1.182	0.872	0.529	0.557	0.895
1.4 APE	0.549	0.528	0.980	1.213	1.419	0.932	0.553	0.557	0.992
Mean	0.549	0.477	0.859	0.997	1.11	0.856	0.541	0.557	0.856
				1994/1995 season					
0.8 APE	0.458	0.664	0.709	0.838	0.881	0.761	0.538	0.511	0.741
1.0 APE	0.458	0.675	0.747	0.928	1.005	0.797	0.571	0.581	0.793
1.2 APE	0.481	0.714	0.853	1.114	1.142	0.875	0.598	0.637	0.893
1.4 APE	0.487	0.750	0.940	1.275	1.353	0.940	0.621	0.658	0.991
Mean	0.471	0.701	0.812	1.040	1.100	0.843	0.582	0.597	0.854

It can be noticed that increasing the available soil moisture in the root zone of flax plants by irrigation in short intervals at 1.4 APE, increased the Kc values to its maximum values at any growth stage or at the all season.

5. Water use efficiency (WUE)

i) WUE for seeds (kgs seeds/m³ water)

Water use efficiency is expressed as kgs seeds/m³ water consumed. The values of water use efficiency (WUE) by flax as affected by sowing dates and scheduling irrigation treatments according to accumulative pan evaporation rates (irrigation regimes) and their interactions in 1993/1994 and 1994/1995 seasons are presented in Table (36).

A. Effect of sowing dates:

Results presented in Table (36), clearly show that the higher values of WUE by flax were 0.575 and 0.558 kgs seeds/m³ water consumed, resulted from the second sowing date on November 10th in 1993/1994 and 1994/1995 seasons, respectively. Whereas, the lower WUE values (0.415 and 0.396 kgs seeds/m³ water) were obtained from the third sowing date of December 1st in the two successive seasons, respectively.

Sowing flax three weeks early or later than November 10th decreased WUE values by 24.7 and 27.9%, respectively, in 1993/1994 season. In 1994/1995 season, the respective decrease values were 22.8 and 29.0%. The WUE values, obtained from the early sowing date (October 20th) surpassed those obtained from the late sowing date of December 1st by 4.2 and 8.1% in the first and second seasons, respectively.

It can be concluded that sowing flax on November 10th is more efficient in water utilization than the October 20th or the December 1st sowing dates. These results can be ascribed due to the higher productivity of seeds and moderate

Table 36. **Values of water use efficiency (WUE) by flax in kgs seeds/m³** as affected by sowing dates, scheduling irrigation treatments (water regime) and their interactions in 1993/1994 and 1994/1995 seasons.

Sowing dates	1993/1994					1994/1995				
	Irrigation regimes accumulative pan evaporation (APE)					Irrigation regimes accumulative pan evaporation (APE)				
	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean
Early	0.438	0.444	0.471	0.379	0.433	0.436	0.448	0.462	0.379	0.431
Medium	0.610	0.592	0.589	0.510	0.575	0.561	0.588	0.588	0.495	0.558
Late	0.419	0.426	0.449	0.365	0.415	0.392	0.408	0.432	0.354	0.396
Mean	0.489	0.487	0.503	0.418	0.474	0.463	0.481	0.494	0.409	0.462

seasonal evapotranspiration, obtained from November 10th sowing date. Whereas, the early sowing gave somewhat high seed yield and higher seasonal ET values, as a result of increasing season duration period (Tables 19 and 28). On the other hand, sowing flax on December 1st decreased significantly the seed yield/feddan, (Table 19) much more the decrease occurred in the seasonal ET values obtained from the late sowing (Table, 28). In this respect, **Pendleton (1965),** revealed that in arid and semi arid regions sowing dates are an extremely important cultural practice in efficient use of water.

These result are in harmony with those concluded by **Yousef (1989).**

B. Effect of irrigation regimes

The values of water use efficiency (WUE) in kgs seeds/m³ water, as affected by irrigation regimes (scheduling irrigation according to accumulative pan evaporation rates) in the two seasons of this study are recorded in Table (36).

Data in Table (36), indicate that irrigating flax plants at 1.2 accumulative pan evaporation (moderate irrigation intervals) produced the higher WUE values i.e. 0.503 and 0.494 kgs seeds/m³ water consumed in 1993/1994 and 1994/1995 seasons, respectively. However, irrigating flax at short irrigation intervals (irrigation at 1.4 accumulative pan evaporation) gave the lower values of WUE i.e. 0.418 and 0.409 kgs seeds/m³ water consumed in the two successive seasons, respectively. Increasing irrigation frequency (irrigation at 1.4 pan evaporation) or decreasing it i.e. irrigation at 1.0 or 0.8 accumulative pan evaporation (APE) decreased WUE values by 16.9, 3.2 and 2.8%, respectively, when compared with irrigation at 1.2 APE in 1993/1994 season. The respective values of reduction in WUE were 17.2, 2.6 and 6.3% for the same treatments in 1994/1995 season.

It could be reveal that irrigation flax plants at 1.2 APE (moderate irrigation intervals) is more efficient in water utilization than irrigation at short or long intervals i.e. 1.4 or 1.0 and 0.8 APE. These results may be due to the significant increase in seed yield resulted from the moderate irrigation intervals (1.2 APE) as shown in Table (19), whereas the increase in seasonal ET at this level of irrigation was less than those obtained from irrigation at 1.4 APE (Table, 28). On the other hand, irrigating flax at 1.4 APE produced seed yield less than irrigation at 1.2 APE and consumed much more water, which in turn reduced WUE values. In this connection, **Ritchie (1974)** concluded that some water conservation benefits can be derived from moderate irrigation regime. It is well know that plant roots extract more soil water from greater depth under moderate stress than plants irrigated at wet levels, thus the stored water in soil of moderate irrigation can be used with more efficiency.

These results are in agreement with those found by **Ismail (1974), Yusuf *et al.* (1978), El-Kady (1985), Gregory (1989), Yousef (1989)** and **Abdallah (1990).**

C. Effect of the interaction

The effect of interaction between sowing dates and irrigation regime treatments on the values of water use efficiency by flax crop in kgs seeds/m^3 water in 1993/1994 and 1994/1995 seasons are presented in Table (36).

Results recorded in Table (36), reveal that WUE values (kgs seeds/m^3 water) were affected by the interaction between sowing dates and irrigation regimes in both seasons. Sowing flax plants on November 10th and applying irrigation at 1.2 APE produced the higher values of WUE i.e. 0.589 and 0.588 kgs seeds/m^3 water consumed in 1993/1994 and 1994/1995 seasons, respectively. Whereas, the lower values of WUE were 0.365 and 0.354 kgs seeds/m^3 water consumed, resulted from the late sowing date of December 1st and irrigation practiced at 1.4 APE in the two successive seasons, respectively.

ii) WUE for fibers (kg fibers/m³ water)

Water use efficiency in kgs fibers/m³ water consumed as affected by sowing dates and scheduling irrigation treatments (irrigation regimes) in 1993 /1994 and 1994/1995 seasons are recorded in Table (37).

A. Effect of sowing dates

The data recorded in Table (37), indicate that WUE values were significantly affected by sowing dates of flax in both seasons.

The higher values of water use efficiency in kgs fibers/m³ water consumed were 0.255 and 0.239, resulted from the second sowing date (November 10th) in 1993/1994 and 1994/1995 seasons, respectively. The lower ones were 0.178 and 0.167 kgs fibers/m³ water consumed, gained from sowing flax on December 1st (the later sowing date) in the two successive seasons, respectively. Sowing flax early on October 20th reduced WUE values by 20.8 and 18.8% than those of November 10th sowing date in 1993/1994 and 1994/1995 seasons, respectively.

It can be noticed that sowing flax 3-week early or later than November 10th decreased the values of WUE (kgs fibers/m³ water) consumed. These results may be attributed to the highest fiber yield resulted from the second sowing date (Table, 21) and the moderate seasonal water consumption of this sowing date as shown in Table (28). On the other hand, the early sowing date of October 20th produced high fiber yield/feddan but less than the second sowing date and consumed much more water during its growing season than November 10th planting as shown in Tables (21 and 28).

B. Effect of irrigation regimes

regarding the effect of irrigation regime treatments i.e., scheduling irrigation according to accumulative pan evaporation rate (APE), results in Table (37),

Table 37. **Values of water use efficiency (WUE) by flax in kgs fiber/m^3 water** as affected by sowing dates, scheduling irrigation treatments (water regime) and their interactions in 1993/1994 and 1994/1995 seasons.

Sowing dates	1993/1994					1994/1995				
	Irrigation regimes accumulative pan evaporation (APE)					Irrigation regimes accumulative pan evaporation (APE)				
	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean	0.8 (APE)	1.0 (APE)	1.2 (APE)	1.4 (APE)	Mean
Early	0.199	0.206	0.219	0.182	0.202	0.191	0.202	0.208	0.174	0.194
Medium	0.271	0.256	0.266	0.226	0.255	0.240	0.247	0.256	0.213	0.239
Late	0.170	0.179	0.199	0.164	0.178	0.156	0.168	0.188	0.156	0.167
Mean	0.213	0.214	0.228	0.191	0.212	0.195	0.206	0.217	0.181	0.200

indicate that irrigation flax plants at 1.2 APE (moderate irrigation intervals) produced the higher values of WUE which were 0.228 and 0.217 kgs fibers/m^3 water consumed in 1993/1994 and 1994/1995 seasons. respectively. Whereas, irrigating flax plants at 1.4 or 1.0 or 0.8 APE rates decreased WUE values as kgs fiber/m^3 water by 16.2, 6.1 and 6.6%, respectively, in 1993/1994 season and by 16.6, 5.1 and 10.1%, respectively, in 1994/1995 season when compared with WUE, obtained from irrigated at 1.2 APE. These results may be due to the high fiber yield resulted from irrigation plants at 1.2 APE and moderate seasonal ET values. Whereas, irrigating flax at 1.4 APE (short intervals) consumed much more water than the increase in fiber yield. Also, the fiber yield obtained from irrigation at 1.0 or 0.8 APE (long intervals) were less than those of 1.2 APE but the seasonal ET values did not decreased enough by the same percentage of yield reduction (Tables 21 and 28).

These results are consistent with those reported by **Ismail (1974), Yusuf *et al.* (1978), El-Kady (1985)** and **Abdallah (1990).**

C. Effect of the interaction

Water use efficiency values in kgs fibers/m^3 water consumed as affected by the interaction between sowing dates and irrigation regimes in 1993/1994 and 1994/1995 seasons are presented in Table (37).

Results recorded in Table (37), show that sowing flax on November 10th and irrigating at 1.2 accumulative pan evaporation produced the higher WUE, i.e. 0.266 and 0.256 kgs fiber/m^3 water in the two successive seasons, respectively. The lower WUE values were 0.164 and 0.156 kgs fibers/m^3 water, resulted from sowing flax later on December 1st and applying irrigation at 1.4 APE in both seasons, respectively.

It can be concluded that from the stand point of the water economy, sowing flax on November 10th and practiced irrigation at 1.2 accumulative pan evaporation can be recommended. In this connection, **Haise and Hagan (1967),** pointed out that when water is scarcer, irrigation should be scheduled to maximize crop production per unit of water applied. However, when the good land is scarcer than water, irrigation should be scheduled to maximize crop production per unit area planted.

SUMMARY

Two field experiments were carried out at the farm of Agric. Res. Center, Giza, Egypt, during 1993/1994 and 1994/1995 seasons to manage flax irrigation (scheduling irrigation according to the Class A pan evaporation records) under three sowing dates. The effect of sowing dates and irrigation regimes on flax yield and its components, oil content, some technological character of fibers, and the crop water use were studied. Also, the potential evapotranspiration and Class A pan relation to climate and crop water use were estimated.

Flax cultivar, Giza 8 a double purpose variety was used in both seasons. The experimental design was split-plot with four replications. Sowing date treatment were arranged at random in the main plots and the irrigation regimes (scheduling irrigation) treatments were assigned randomly with the sub-plots. The sub-plot area was 10.5 m^2 (3.0 x 3.5 m) and each sub-plot was isolated by leaves 1.2 from other plots to avoid the water lateral movements during irrigation. The experimental treatments were as follows:

A. Sowing dates

1. Early sowing	(October 20th)
2. Medium sowing	(November 10th)
3. Late sowing	(December 1st)

The period between intervals were 3-weeks.

B. Irrigation regimes

I_1: Irrigation at 0.8 accumulative pan evaporation (APE)

I_2: Irrigation at 1.0 accumulative pan evaporation