WATER RELATIONS AND YIELD OF SESAME IN RELATION TO RIDGE WIDTH AND IRRIGATION REGIME

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ABSTRACT

The present investigation was conducted at Tameia agriculture research station Fayoum governorate, Egypt, during 2010 and 2011 seasons to study the combined effect of ridge width treatments i.e. R_1: ridges of 60 cm, R_2: ridges of 80 cm and R_3: ridges of 100 cm(beds planted from both sides) and irrigation regime treatments i.e. I_1: irrigation at 40% Available Soil Moisture Depletion(ASMD), I_2: irrigation at 60% (ASMD) and I_3: irrigation at 80% (ASMD) on yield components, yield and some water relations of sesame crop (Shandaweel -3 cv.).The split-plot design in randomized complatc block, with four replications was applied, where ridge width treatments were allocated to the main plots and the split ones were occupied with irrigation regime treatments.

The main obtained results were as follows:-

Plant height, capsule number plant^{-1}, seed weight plant^{-1}, 1000-seed weight, seed yield (t ha^{-1}) and seed oil content (%) were significantly affected by ridge width treatments and irrigation regime in both seasons.

The highest averages of yield components, seed yield, R_1I_1 (1.311 and 1.252 t ha^{-1}) and seed oil content (51.84 and 51.24%) were detected from planting on ridges of 60 cm width and irrigation at 40% ASMD in the two successive seasons.

Seasonal evapotranspiration as a function of all treatments were 121.01 and 117.68 cm ha^{-1} in 2010 and 2011 seasons, respectively. Planting on ridges of 60 cm width and irrigation at 40% ASMD gave the highest seasonal ET_C values, i.e. 132.57 and 129.30 cm ha^{-1} in 2010 and 2011 seasons, respectively. However, the lowest ET_C values, i.e. 110.22 and 107.48 cm ha^{-1} were detected from planting on ridges of 100 cm width (beds) and irrigation at 80% ASMD in the two successive seasons. The crop coefficient (K_C) values for the treatments which gave the highest seed yield and ET_C values (R_1I_1) were 0.42, 0.62, 0.80 and 0.57 for May, June, July and August months, respectively, (average of the two seasons).

The highest water use efficiency values, i.e. 0.261 and 0.253 kg seeds m^{-3} water consumed were resulted from planting on ridges of 60 cm width and irrigation at 40% ASMD, in 2010 and 2011 seasons, respectively. It could be concluded that planting sesame on wide ridges of 100 cm (beds) saved about 7.7% (423 m^3 ha^{-1}) in water evapotranspiration and gave acceptable yield.

Key words: *Sesame yield, yield components, ridge width, irrigation regime, sesame crop -water relationships.*

INTRODUCTION

Sesame *(Sesamum indicum* L.) is one of the most important oil crop in Egypt due to its high seed oil content (47 – 52 %). Sesame oil is an excellent edible with semi-dry properties. To reduce the gap between local oil production and consumption, improving the agronomic practices e.g. tillage, fertilization, irrigation management, sowing dates, cultivation practices and introducing high - yielding varieties are needed for increasing sesame seed production. **Majumdar and Roy(1992), Olowe and Busari(1994), Gercek *et al.* (2004) and Rahnama and Bakhashandeh (2006)** reported that there was no significant difference in yield between 30 and 40 cm row spacing. and highest yield was obtained from 30 cm row spacing (1620 kg ha^{-1}). That 50 cm row spacing led to a decrease in the yield, plant height, number of capsules per plant and oil content. **Davut *et al.* (2007)** revealed that increasing irrigation intervals from 12 to 24 days decreased yield components and seed yield (from 180.5 kg ha^{-1} to 113.2 kg ha^{-1}).

Regarding the effect of irrigation regime, **Ainer and Metwally (1987), El-Serogy, (1998), Attia *et al.* (1999), Ghallab *et al.* (2001)** and **El-Naim and Ahmed (2010),** found that the sesame yield and its components were higher as irrigation events increased. Moreover, the highest values of water consumption and water use efficiency for sesame crop were reported when irrigation was practiced as 50% of the available soil moisture was depleted, compared with 70 and 90% ones.

The present trials aimea to assessing different irrigation regimes, based on soil monitoring technique, as interacted with ridge width treatments to find out the optimum interaction resulting in the sesame yield potential and improved water use efficiency as well.

MATERIALS AND METHODS

Two field experiments were carried out at Tameia agriculture research station, Fayoum governorate, Egypt during 2010 and 2011 seasons to study the effect of ridge width and irrigation regime treatments on seed yield, yield components, seed oil content percentage and some sesame crop -water relations. Three ridge width, i.e. R_1: ridges of 60 cm, R_2: ridges of 80 cm and R_3: ridges of 100 cm (beds planted from both sides) were combined with irrigation regime treatments i.e. I_1: irrigation at 40% Available Soil Moisture Depletion (ASMD), I_2: irrigation at 60% (ASMD) and I_3: irrigation at 80% (ASMD). The split- plot design in Mondomized complete blocks with four replicates was used, where ridge width occupied the main plots and irrigation regime treatments allocated to the sub-plots. The sub-plot area was 21 m^2 (6.0 × 3.5 m). Sesame seeds (shandaweel-3 cv) at the rate of 9.52 kg ha^{-1}. At the 1st irrigation, the plants were thinned to be two plants/hill. Calcium super phosphate (15.5 P_2O_5) at rate of 476 kg ha^{-1} were added during seed bed preparation. Nitrogen fertilization (71.4 kg N ha^{-1}) was applied in two equal doses at the 1st and 2nd irrigations. The preceding crop in the two seasons was Egyptian clover. Planting was in May 2nd in the two seasons. Harvesting was done on August 29th for the first and the second seasons. Soil physical and chemical properties of the experimental site were determined according to **Klute (1986)** and **Page *et al.* (1982)** and presented in Table 1. The monthly averages of weather factors for Fayoum governorate during the two growing seasons are shown in Table 2. Soil moisture constants of the experimental field (mean of the two seasons) are listed in Table 3. At harvesting time, the following data were collected from each sub-plot.

I. Yield and yield component:

1- Plant height (cm) 2- No. of capsules plant^{-1} 3- Seed weight plant^{-1} (g) 4- 1000-seed weight (g) 5- seed yield (t ha^{-1}) 6- seed oil content (%).

All the measurements and data collected were subjected to the statistical analysis as described by **Snedecor and Cochran (1980).**

Table 1: Physical and chemical properties of the experimental field during 2010 and 2011 seasons (average of two seasons)

Sand%	Silt%	Clay%	Texture classes	Organic matter%
23.43	44.37	32.20	Clay loam	1.64

Soluble cations, meq/L				Soluble anions, meq/L				EC dS/m	1:2.5 Extract pH	CEC Meq/100 gm soil
Ca^{++}	Mg^{+}	Na^{+}	K^{+}	Cl^{-}	HCO_3^{-}	CO_3^{--}	SO_4^{-}			
16.91	10.94	45.96	0.35	38.56	2.41	-	33.15	7.52	8.12	43.17

Table 2: The monthly averages of weather factors for Fayoum Governorate during 2010 and 2011 seasons

Month	Season	Temperature C°			Relative humidity (%)	Wind speed (m/sec)	Pan evaporation (mm/day)
		Max.	Min.	Mean			
May	2010	33.6	17.8	25.7	44	2.78	6.7
	2011	32.8	17.4	25.1	44	2.77	6.5
June	2010	38.4	21.4	29.9	48	3.01	8.3
	2011	35.7	20.6	28.2	48	2.98	8.1
July	2010	36.3	22.4	29.3	50	2.58	7.8
	2011	38.7	22.5	30.6	50	2.57	7.6
August	2010	40.2	24.5	32.3	46	2.44	7.4
	2011	38.6	22.9	30.8	49	2.42	7.2

Table 3: The average values of soil moisture constants for the experimental field during 2010 and 2011 seasons (average of the two seasons)

Soil depth(cm)	Field capacity (%)	Wilting point (%)	Bulk density (g cm^{-3})	Available Moisture (%)
00-15	37.94	18.71	1.31	19.23
15-30	35.65	16.55	1.49	19.10
30-45	34.24	16.02	1.40	18.22
45-60	29.71	14.32	1.25	15.39

II. Crop- water relations:

1. Seasonal evapotranspiration (ET_C)

On determination the crop water consumptive use (ET_C), the soil samples were taken just before and 48 hours after each irrigation, as well as at harvest time, in 15 cm increment system to 60 cm of soil profile. The crop water consumptive use between each two successive irrigations was calculated according to **Israelsen and Hansen, 1962** as follows :-

$$Cu\ (ET_C) = \{(Q_2 - Q_1) / 100\} \times Bd \times D \quad \text{.................... where}$$

Cu = crop water consumptive use (cm).
Q_2 *= soil moisture percentage (wt/wt) 48 hours after irrigation.*
Q_1 *= soil moisture percentage(wt/wt) just before irrigation.*
Bd = soil bulk density (gmcm^{-3}*).*
D = soil layer depth (cm).

2. Daily ET_C rate (mm/day).

It was calculated from the ET_C between each two successive irrigations divided by the number of days.

3. Reference evapotranspiration (ET_0)

It was estimated as (mm day^{-1}), using the monthly averages of weather factors of Fayoum Governorate according to **FAO-Penman Monteith** equation (**Allen *et al.* 1998**).

4. Crop Coefficient (K_C).

The crop coefficient was calculated as follows:

$$K_C = ET_C / ET_0 \text{.. where}$$

ET_C = Actual crop evapotranspiration (mm day^{-1})
ET_0 = Reference evapotranspiration (mm day^{-1}).

5. Water Use Efficiency (WUE)

The water use efficiency as kg seedm^{-3} water consumed was calculated for different treatments as described by **Vites (1965):**

WUE, kg m^{-3}={seed yield (kg ha^{-1})/Seasonal crop evapotranspiration (m^3 ha^{-1}).

RESULTS AND DISCUSSION

Yield and yield components:

Data in Table (4) indicate that planting on 60 cm ridge width gave the highest averages of sesame seed yield and its components in 2010 and 2011 seasons. Planting sesame on 80 cm ridge width significantly reduced plant height, capsules number plant^{-1}, 1000-seed weight, seed yield ha^{-1} and seed oil percentage by 3.90, 10.35, 11.13, 3.99, 13.73 and 3.18%, respectively, in 2010 and by 4.55, 8.45, 8.11, 2.62, 13.42 and 2.28%, in 2011 season, respectively. The lowest averages of seed yield and its components were detected from planting on 100 cm wide ridge width (beds). These results may be referred to the inadequate wetting of the lower parts under wide ridges (beds) for some days after irrigation; which in turn reduced growth of roots. These results are consistent with those found by **Majumdar and Roy (1992), Olowe and Busari (1994), Gercek & Simsek (2004) and Rahnama and Bakhashandeh (2006).**

Regarding the effect of irrigation regime treatments, data in Table (4) show that sesame yield and its components were significantly affected by treatments in both seasons. Irrigation sesame at 40% ASMD gave the highest averages of yield and its components, whereas, irrigation at 80% ASMD gave the lowest ones in both seasons. Increasing the available soil moisture depletion (ASMD) from 40 to 80% significantly decrease plant height, capsules number plant^{-1}, 1000-seed weight, seed yield ha^{-1} and seed oil content percentage in the first season by 8.63, 29.85, 11.45, 10.14, 24.77 and 6.13%, respectively, and by 7.70, 33.50, 16.23, 8.93, 23.05 and 6.12%, respectively, in the second season. These results may be referred to the effect of moisture

Table 4: Averages of sesame yield and yield components as affected by ridge width and irrigation regime treatments in 2010 and 2011 seasons

Treatments		2010 season						2011 season					
Ridge width*	Irrigation Regime (ASMD)	Plant Height (cm)	Capsules No. /plant	Seed weight /plant (g)	1000-seed Weight (g)	Seed yield (t/h)	seed oil (%)	Plant Height (cm)	Capsules No. /plant	Seed weight /plant (g)	1000-seed Weight (g)	Seed yield (t/h)	seed oil (%)
R_1	40%	181.81	166.30	20.56	3.70	1.454	53.13	178.35	153.40	19.75	3.59	1.376	52.75
	60%	172.45	142.30	19.71	3.52	1.335	52.02	170.11	129.71	17.51	3.47	1.262	51.40
	80%	165.87	114.70	18.50	3.30	1.143	50.36	164.46	106.35	16.01	3.25	1.088	49.56
Mean		**173.38**	**141.1**	**19.59**	**3.51**	**1.311**	**51.84**	**170.97**	**129.28**	**17.76**	**3.44**	**1.252**	**51.24**
R_2	40%	174.21	147.90	18.75	3.54	1.261	51.60	170.40	142.74	17.61	3.48	1.201	51.48
	60%	165.91	128.10	17.11	3.36	1.146	50.87	161.81	120.01	16.20	3.36	1.107	50.72
	80%	159.70	103.50	16.36	3.21	0.987	48.11	157.37	92.33	15.16	3.21	0.945	48.01
Mean		**166.61**	**126.5**	**17.41**	**3.37**	**1.131**	**50.19**	**163.19**	**118.36**	**16.32**	**3.35**	**1.084**	**50.07**
R_3	40%	166.30	131.10	17.30	3.40	1.196	49.96	163.27	125.60	16.08	3.33	1.067	49.68
	60%	158.86	113.60	16.45	3.27	0.931	48.40	157.63	105.35	14.95	3.15	0.865	48.30
	80%	151.71	94.20	15.27	3.06	0.814	46.72	150.72	81.78	13.60	3.02	0.771	46.91
Mean		**158.96**	**112.97**	**16.34**	**3.24**	**0.980**	**48.36**	**157.21**	**104.24**	**14.88**	**3.17**	**0.901**	**48.30**
Irrigation Mean													
40%		174.11	148.43	18.87	3.55	1.304	51.56	170.67	140.58	17.81	3.47	1.215	51.30
60%		165.74	128.00	17.76	3.38	1.137	50.43	163.18	118.36	16.22	3.33	1.078	50.14
80%		159.09	104.13	16.71	3.19	0.981	48.40	157.52	93.49	14.92	3.16	0.935	48.16
R		2.05	1.50	0.62	0.06	0.14	0.26	2.81	2.73	0.66	0.85	0.06	0.14
I		1.58	1.09	0.25	0.03	0.01	0.05	1.05	1.35	0.41	0.05	0.03	0.06
R×I		N.S	1.90	0.65	N.S	0.02	0.09	N.S	2.35	0.71	N.S	0.05	0.09

R_1, R_2 and R_3 are referred to 60cm, 80cm and 100cm (beds) ridge widths, respectively

stress (under 80% ASMD treatment) on reducing photosynthesis, cell division, stem elongation, leaf area, leaf duration and dry matter accumulation in plant organs. The obtained results are in the same line with those reported by **Davut *et al.* (2007)**.

Data in Table (4) indicate that the seed yield and its components were significantly affected by the interaction between ridge width and irrigation regime treatments in the both seasons except plant height and 1000-seed weight. The highest averages of capsules number plant^{-1}, seed yield ha^{-1} and seed oil content percentage were detected from planting on 60 cm ridge width and irrigation at 40% ASMD in both seasons. On the other hand, the lowest averages of yield and its components were resulted from planting sesame on 100 cm wide ridges (beds) as interacted with irrigation at 80% ASMD in both seasons of study.

Crop water relations:

Seasonal evapotranspiration (ET_C)

Results in Table (5) indicate that seasonal evapotranspiration (ET_C) of sesame crop, as a function of ridge width and irrigation regime treatments and their interaction were, 121.01 and 117.68 cm ha^{-1} in 2010 and 2011 seasons, respectively.

Planting on 60 cm ridge width gave the highest values of sesame ET, i.e. 125.19 and 122.24 cm in the two successive seasons. Planting sesame on 80cm or 100 cm (beds) decreased seasonal ET_C in 2010 season by 3.06 and 6.94% and by 3.58 and 7.57 % in 2011 season, respectively, compared with planting on 60 cm ridge width. The present results may be referred to that the bottoms between wide ridges (beds) will be half those between normal ridges (60 cm width) and this in turn reduced water runoff, evaporation and inadequate wetting of the lower parts of the field, which may also reduced plant transpiration.

Regarding the effect of irrigation regime treatments, data in Table (5) show that irrigating sesame at 40% ASMD produced the highest values of ET_C which reached 127.47 and 123.90 cm in 2010 and 2011 seasons, respectively. The lowest ET_C values i.e. 115.02 and 111.84 cm were resulted from irrigating at 80% ASMD in two successive seasons. Moreover, irrigation at 60% ASMD decreased ET_C by 5.43 and 5.30 % in 2010 and 2011 seasons, respectively, comparable with that irrigated at 40% ASMD This could be attributed to increasing the available soil moisture in the root zone of sesame plants under irrigation at 40% ASMD treatment, where the crop received more irrigation events, resulted in higher ET_C values. Higher both transpiration rate from plants canopy and evaporative demands from soil surface under higher available soil moisture are responsible for higher ET_C values. Under water stress i.e. irrigating at 60 or 80% ASMD, the transpiration from plants may was decreased as a result of poor vegetative growth and less evaporation from dry soil surface as well. These results are in accordance with those reported by **Ainer and Metwally (1987), El-Serogy, (1998), Attia *et al.* (1999), Ghallab *et al.* (2001)** and **El-Naim and Ahmed (2010).**

Data in Table (5) indicate that planting on 60 cm ridge width as interacted with irrigating at 40% ASMD, gave the highest values of ET_C which comprised 132.57 and 129.31 cm in 2010 and 2011 seasons, respectively. However, the lowest ET_C values, i.e. 110.22 and 111.84 cm in the two successive seasons were obtained from the interaction between planting on 100 cm wide ridge width (beds) and irrigation at 80% ASMD

Table 5: Averages of seasonal evapotranspiration (ET_C, cm) in cm ha^{-1} of sesame crop as affected by ridge width, irrigation regime and their interaction in 2010 and 2011 seasons

Irrigation regime / Ridge width	2010 season			Mean	2011 season			Mean
	Irrigation regime (ASMD)				Irrigation regime (ASMD)			
	40%	60%	80%		40%	60%	80%	
R_1	132.57	124.04	118.95	**125.18**	129.30	122.24	115.17	**122.24**
R_2	127.14	121.02	115.93	**121.36**	123.36	117.33	112.86	**117.85**
R_3	122.69	116.60	110.22	**116.50**	119.02	112.40	107.48	**112.97**
Mean	**127.47**	**120.55**	**115.03**	**121.01**	**123.89**	**117.32**	**111.84**	**117.68**

***** R_1, R_2 and R_3 are referred to 60 cm, 80 cm and 100 cm (beds) ridge widths, respectively*

Daily ET_C (mm day^{-1})

Results in Table (6) show that the daily ET_C rates, as influenced by different treatments tested in both seasons, started with low values during May and then increased again during June to reach its maximum values on July. Thereafter, it tended to decrease August (plant harvesting). These results are referred to that at the initial growth stage, most of the water loss is due to evaporation from the bare soil and lower evaporation demands (lower values of temperature and solar radiation). Thereafter, as the plant cover and temperature increased both evaporation and transpiration tended to increase and reached maximum values during July. At maturity stage ET_C rate decreased again during August (harvesting). The results in Table (7) indicate that the highest values of ET_C, during the two growing seasons, were reported during (May–August) under planting on 60 cm ridge width treatments. On the other hand, under planting on 100 cm ridge width (beds) the lowest values of daily ET_C rates during growing seasons were recorded and such tend was observed in 2010 and 2011 seasons.

Data in Table (6) show that the daily ET_C rates of sesame during the growing season months (May – August) of both seasons, were increased by irrigation at 40% ASMD and the same trend was observed either with irrigation at 60% or 80% ASMD. It is obvious that increasing the available moisture in sesame root zone (frequent irrigation i.e. more irrigation events) resulted in increasing the ET_C rate during the entire growing season. These results are in the same line of those reported by **Ainer and Metwally (1987), El-Serogy. (1998), Attia *et al.* (1999), Ghallab *et al.* (2001)** and **El-Naim and Ahmed (2010).**

Reference evapotranspiration (ET_0)

Reference evapotranspiration rate (ET_0) in mmday^{-1} during the months of sesame growing season of 2010 and 2011, were estimated using the FAO penman-Monteith method via the meteorological data of Fayoum governorate (Table 6). Data indicate that the ET_0 rate values were somewhat low during May, and then increased during June and August in both seasons. These results are attributed to the variation in weather factors from one month to another. **Allen *et al.* (1998)** reported that the reference ET values depend mainly on the evaporative power of the air at each area, i.e. temperature, radiation, relative humidity and wind speed.

Table (6): Effect of ridge width, irrigation regime treatments and their interaction on daily water consumption use (mm/day) in 2010 and 2011 seasons.

Treatment		2010				2011			
Ridge width	Irrigation Regime(ASMD)	May	Jun	July	Aug.	May	Jun	July	Aug.
R1	**40%**	2.65	5.40	6.24	4.22	2.94	4.85	6.16	4.09
	60%	2.65	5.15	6.01	3.92	2.94	4.47	5.85	3.80
	80%	2.65	4.48	5.69	3.77	2.94	4.08	5.54	3.50
	Mean	**2.65**	**5.01**	**5.98**	**3.97**	**2.94**	**4.47**	**5.85**	**3.80**
R2	**40%**	2.52	5.15	6.01	4.07	2.87	4.62	5.85	3.87
	60%	2.52	4.98	5.62	3.77	2.87	4.31	5.54	3.65
	80%	2.52	4.73	5.30	3.63	2.87	4.16	5.15	3.58
	Mean	**2.52**	**4.95**	**5.64**	**3.82**	**2.87**	**4.36**	**5.51**	**3.70**
R3	**40%**	2.52	4.90	5.85	3.85	2.87	4.39	5.69	3.65
	60%	2.52	4.81	5.38	3.55	2.87	4.16	5.23	3.43
	80%	2.52	4.32	5.07	3.48	2.87	3.85	4.99	3.29
	Mean	**2.52**	**4.68**	**5.43**	**3.63**	**2.87**	**4.13**	**5.30**	**3.46**
Mean of irrigation **40%**		2.56	5.15	6.03	4.05	2.89	4.62	5.90	3.87
60%		2.56	4.98	5.67	3.75	2.89	4.31	5.54	3.63
80%		2.56	4.67	5.35	3.62	2.89	4.03	5.23	3.46
Over mean		**2.56**	**4.89**	**5.68**	**3.81**	**2.89**	**4.32**	**5.56**	**3.65**

***** ***R!, R_2andR3 are referred to 60 cm, 80 cm and 100 cm (beds) ridge widths, respectively***

Crop coefficient (K_C)

The crop coefficient (K_C) is a function of both Etc and ET_0 values. The crop cover percentage affects ETc and consequently Kc values, Table 6. Results in Table (7) show that the over all mean K_C value of the adopted treatments, started with lower values (0.41 and 0.41), after planting, during May and then increased during Jun (0.58 and 0.56) The K_C values reached its maximum values (0.73 and 0.71) as the percentage of crop cover increased during July and then tended to decrease again (0.52 and 0.50) during August (at harvesting).

Data in Table (7) reveal that planting on 60 cm ridge width, comparable with planting on 80 or 100 cm ridge width exhibited the highest K_C values during the entire growing season. Increasing the irrigation events (irrigating at 40% ASMD) seemed to increase the K_C values entire the growing season, whereas the lowest K_C values were observed under irrigation at 80% ASMD and such findings were true in both seasons. The K_C values of sesame, as a function of different treatments were 0.41, 0.57, 0.72, and 0.51 for May, June, July and August, respectively, (average of the two seasons). Such findings are in the same line of those reported by **Ainer and Metwally (1987), El-Serogy. (1998), Attia *et al.* (1999), Ghallab *et al.* (2001)** and **El-Naim and Ahmed (2010)**.

Table (7): Reference evapotranspiration, ET_0 (mm/day) and K_C for seasame crop during 2010 and 2011 seasons as affected by ridge width and irrigation regime treatments.

Treatments		2010				2011			
Ridge width	Irrigation Regime (ASMD)	May	Jun	July	Aug.	May	Jun	July	Aug.
Reference ET_0 mm/day		6.3	8.3	7.8	7.4	7.00	7.70	7.80	7.30
R_1	40%	0.42	0.65	0.80	0.57	0.42	0.63	0.79	0.56
	60%	0.42	0.62	0.77	0.53	0.42	0.58	0.75	0.52
	80%	0.42	0.57	0.73	0.51	0.42	0.53	0.71	0.49
	Mean	**0.42**	**0.61**	**0.77**	**0.54**	**0.42**	**0.58**	**0.75**	**0.52**
R_2	40%	0.40	0.62	0.77	0.55	0.41	0.60	0.75	0.53
	60%	0.40	0.60	0.72	0.51	0.41	0.56	0.71	0.50
	80%	0.40	0.54	0.68	0.49	0.41	0.52	0.66	0.47
	Mean	**0.40**	**0.59**	**0.72**	**0.52**	**0.41**	**0.56**	**0.71**	**0.50**
R_3	40%	0.40	0.59	0.75	0.52	0.41	0.57	0.73	0.50
	60%	0.40	0.58	0.69	0.48	0.41	0.54	0.67	0.47
	80%	0.40	0.52	0.65	0.47	0.41	0.50	0.64	0.45
	Mean	**0.40**	**0.56**	**0.70**	**0.49**	**0.41**	**0.54**	**0.68**	**0.47**
Mean of irrigation									
40%		0.41	0.62	0.77	0.55	0.41	0.60	0.76	0.53
60%		0.41	0.60	0.73	0.51	0.41	0.56	0.71	0.50
80%		0.41	0.54	0.69	0.49	0.41	0.52	0.67	0.47
Over all mean		**0.41**	**0.59**	**0.73**	**0.52**	**0.41**	**0.56**	**0.71**	**0.50**

***** ***R_1, R_2andR_3 are referred to 60 cm, 80 cm and 100 cm (beds) ridge widths, respectively***

Water Use Efficiency (WUE)

Results in Table (8) show that WUE average values, as affected by ridge width and irrigation regime treatments were 0.221 and 0.216 kg seeds/m^3 water consumed in 2010 and 2011 seasons, respectively. The highest water use efficiency values of 0.249 and 0.241 kg seeds m^{-3}water consumed in 2010 and 2011 seasons, respectively, were obtained from planting on 60 cm ridge width, whereas, the lowest values, i.e. 0.194 and 0.189 kg seeds m^{-3} water consumed in the two successive seasons were obtained from planting on 100 cm ridge width (beds).

Regardless irrigation regime treatments, data in Table (8) reveal that the highest WUE values, i.e. 0.237 and 0.233 kg seeds m^{-3} water consumed in 2010 and 2011 seasons, respectively, were detected from irrigating sesame plants at 40% ASMD. Irrigation at 80% ASMD gave the lowest WUE values, i.e. 0.203 and 0.198 kg seeds m^{-3} water consumed in the two successive seasons, respectively. These results are in agreement with those reported by **Ainer and Metwally (1987), El-Serogy, (1998), Attia *et al.* (1999), Ghallab *et al.* (2001)** and **El-Naim and Ahmed (2010).**

Table 8: Water use efficiency for sesame crop as affected by ridge width and irrigation regime treatments in 2010 and 2011 seasons

Ridge width	2010 season				2011 season			
	Irrigation regime (ASMD)				**Irrigation regime (ASMD)**			
	40%	**60%**	**80%**	**Mean**	**40%**	**60%**	**80%**	**Mean**
R_1	0.261	0.256	0.229	**0.249**	0.253	0.246	0.225	**0.241**
R_2	0.236	0.225	0.203	**0.221**	0.232	0.225	0.199	**0.219**
R_3	0.215	0.190	0.176	**0.194**	0.213	0.183	0.171	**0.189**
Mean	**0.237**	**0.224**	**0.203**	**0.221**	**0.233**	**0.218**	**0.198**	**0.216**

** R!, R_2andR$_3$ are referred to 60 cm, 80 cm and 100 cm (beds) ridge widths, respectively*

Under the present experiment conditions and on managing the limited irrigation water efficiently, it is advisable to plant sesame on ridge width 100 (beds) cm and irrigate it at 40% ASMD to obtain reasonable figure for water use efficiency and to save irrigation water as about 7.7%.

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العلاقات المائية والمحصول في السمسم وعلاقته بعرض الخط ونقص الرطوبة الارضية

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أقيمت هذه الدراسة بمحطة البحوث الزراعية بطامية- محافظة الفيوم خلال موسمي ٢٠١٠ ، ٢٠١١ لدراسة تأثيرالتفاعل بين عرض الخط (الزراعة علي خطوط عرض ٦٠ سم ، ٨٠ سم ، مصاطب ١٠٠ سم) مع معاملات لاستنزاف (٤٠%، ٦٠%، ٨٠% من الرطوبة الارضية الميسرة) علي محصول البذور ومكونات المحصول ونسبة الزيت بالبذور في محصول السمسم (شندويل ٣). في تصميم القطع المنشقه مرة واحدة في توزيع قطاعات كاملة عشوائية في أربعة مكررات. وفيما يلي أهم النتائج المتحصل عليها:

تأثر إرتفاع النبات، عدد الكبسولات بالنبات، وزن البذور/نبات ، وزن ١٠٠٠ بذرة ومحصول البذرة (طن/هكتار) ومحتوي البذور من الزيت % معنويا لكل من معاملات عرض الخط ونقص الرطوبة الارضية الميسرة في كلا الموسمين المتعاقبين.

كانت أعلي المتوسطات لمكونات المحصول، محصول البذرة (١,٣١١ ، ١,٢٥٢ طن /هكتار) ومحتوي البذرة من الزيت (٥١,٨٤ ، ٥١,٢٤ %) تم التحصل عليها من الزراعة علي خطوط عرض ٦٠سم والري عند ٤٠% من نقص الرطوبة الارضية الميسرة في كلا الموسمين المتعاقبين.

كان متوسط الاستهلاك المائي نتيجة التفاعل بين كل المعاملات هو (١٢١,٠١ ، ١١٧,٦٨ سم /هكتار) في موسمي ٢٠١٠ ،٢٠١١ علي الترتيب. أدت الزراعة علي خطوط عرض ٦٠ سم والري عند فقد ٤٠% من رطوبة التربة الميسرة الي الحصول علي أعلي قيم للاستهلاك المائي وهي (١٣٢,٥٧ ، ١٢٩,٣٠ سم /هكتار) في موسمي ٢٠١٠، ٢٠١١ علي الترتيب بينما كانت أقل القيم هي (١١٠,٢٢ ، ١٠٧,٤٨ سم /هكتار) قد نتجت من الزراعة علي مصاطب عرض ١٠٠ سم والري عند فقد ٨٠% من الماء الميسر من التربة في الموسمين المتعاقبين .

كانت قيم ثابت المحصول للمعاملة التي اعطت اعلي محصول للفدان هي ٠,٤٢ ، ٠,٦٢، ٠,٨٠، ٠,٥٧ لشهور مايو، يونيو، يوليو، أغسطس علي الترتيب (كمتوسط للموسمين). بلغت أعلي كفاءة في استخدام ماء الري (٠,٢٦١، ٠,٢٥٣ كجم م$^{-3}$ ماء مستهلك) في موسمي ٢٠١٠، ٢٠١١ علي الترتيب عند الزراعة علي خطوط ٦٠ سم والري عند إستنزاف ٤٠% من الرطوبة الارضية الميسرة من البخر التراكمي لوعاء البخر القياسي.

ويمكن استنتاج أن زراعة السمسم علي خطوط عرض ١٠٠سم (مصاطب) يمكنها توفير ٧,٧% (٤٢٣م^{3} هكتار$^{-1}$) في الماء المستهلك لكل هكتار مع الحصول علي محصول إقتصادي مقبول.