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EFFECT OF WATER REGIME AT DIFFERENT GROWTH STAGES ON YIELD FOR SOME SESAME VARIETIES AND ITS RELATION WITH WILT DISEASES

BY

El- Samanody, M.K.M.*; Manal, M.El-Tantawy and Rehab, H.K.A. ***

* Field Crops Res. Inst., ARC, Egypt

** Soil. Water & Envi. Res. Inst., ARC, Egypt

ABSTRACT

Two field experiments were carried out in a private farm at Shandaweel region during 2005 and 2006 seasons to study the effect of withholding irrigation at different growth stages [i.e. withholding irrigation at 45 days after sowing (I_1), withholding irrigation at 60 days after sowing (I_2), withholding irrigation at 90 days after sowing (I_3) and without withholding irrigation (I_4)] on four sesame varieties [i.e. $Giza_{32}$ (V_1), $Toshky_1$ (V_2), $Shandaweel_3$ (V_3) and $Sohag_3$ (V_4)]. The effect of the previously mentioned factor on yield, yield components and crop susceptibility factor were studied.

Results of two seasons indicated that significant interaction effects were found between irrigation treatments and sesame varieties for seed yield (kg/fed), seed weight /plant (g), 1000-seed weight (g), length of fruit (cm), number of capsules/plant, and oil yield. The best interaction effect for all characters was obtained from the treatment I_3 with the variety V_3.

Results indicated that maximum values of oil yield were obtained from the third treatment (withholding 90 days after sowing).

The interaction effects were found between irrigation treatments and sesame variety (capsule development stage with $Shandaweel_3$).

Results cleared that the $Shandaweel_3$ variety was the most tolerant to water stress compared with the other varieties under study.

In general, seed development and branching stages are the most tolerant stages to water stress for sesame plants. Sesame $Shandaweel_3$ CV with I_3 (withholding 90 days after sowing) recorded maximum sesame yield as a result of decreasing wilt diseases percentage.

INTRODUCTION

In Egypt, oil production covers only about 10% of the annual requirements, which is far self-sufficiency. Thus, it is necessary to increase the yield of commercial cultivars, in order to narrowing the gap between production and consumption.

Elemery *et al.* (1997) studied the influence of irrigation number and harvesting date on the quality of sesame seeds of four genotypes. They indicated that weight of 1000 seeds and seed yield/ fed were improved by increasing the number of irrigation from 5 to 6 times (15 day intervals). El-Serogy *et al.* (1998) determined the optimal time of terminal irrigation and harvesting date of some sesame varieties. They indicated that higher growth measurements of sesame were recorded from 6 irrigations and harvesting after 105 days from sowing. They added that water use efficiency was increased by 6 irrigation, delaying harvest date for Giza-32 variety from 90 to 105 days after sowing in both season. Ghosh *et al.* (1997) found that among irrigation treatments, seed yield was highest (0.76 t/ha) with irrigations at branching, flowering and pod development (30, 50 and 70 days after sowing). El-Tantawy *et al.* (2003) found that average actual evapotranspiration (ETa) values varied between 38.17 and 47.30 cm/ fed. The ETa values increased with decreasing interval between irrigations. Methew and Kunju (1993) showed that sesame seed yield increased with increasing number of irrigation. El-Serogy *et al.* (1997) and Metwally *et al.* (1984) indicated that seed oil percentage increased with increasing water availability to the crop. Rao and Raju (1991) studied in field trail, 7 irrigation treatments designed to give moderate or severe evapotranspiration deficits (ETd) at vegetative, reproductive or ripening growth stages. Seed yield decreased with increasing water stress and lowest with ETd at the reproductive stage (0.56 t/ ha).

MATERIALS AND METHODS

Tow field experiments were carried out in a private farm at Shandaweel region (Sohag Governorate), Egypt, on some sesame varieties during 2005 and 2006 seasons to study the effect of water stress on water relations, seed yield, yield components and its relation with wilt diseases.

Spilt plots design with three replicates was used. The plot area was 1/42 fed. The nine plots were devoted to irrigation treatment and the sub plots were sesame varieties. Sowing date was cultivated in May 17th and 18th in 2005 and 2006 seasons respectively.

The description of the experimental treatments was irrigated as follows:-
Main plots: Irrigation treatments:

1- I_1: Withholding irrigation at the 45th day after sowing (Branching stage).
2- I_2: Withholding irrigation at the 60th day after sowing (Flowering stage).
3- I_3: Withholding irrigation at the 90th day after sowing (Capsule development stage).
4- I_4: Control (irrigation each 15 days).

Sub-plots: sesame varieties:

1- Giza-32 variety.
2- Toshky-1 variety.
3- Shandaweel-3 variety.
4- Sohag-3 variety.

The soil moisture constants and meteorological data of Shandaweel Agricultural Research Station are shown in Tables (1) and (2), respectively.

Table (1): Soil moisture constants at Shandaweel area (Sohag Governorate).

Soil Depth	Field Capacity	Welting Point	Available Water	Bulk Density
(cm)	%	%	%	(g/ cm^3)
01 - 15.	35.04	14.45	20.59	1.26
15 - 30.	31.21	13.90	17.31	1.30
30 - 45.	27.11	13.09	14.02	1.34
45 - 60.	27.85	12.69	15.16	1.35

Table (2): Meteorological data at Shandaweel Agricultural Research Station in 2005 and 2006 seasons.

	T.max.	T.min.	W.S	R.H	S.S	S.R
Month	2005					
May	35.0	18.2	2.2	56	11.3	604
June	38.0	22.2	2.2	47	12.3	638
July	37.4	21.8	1.9	58	12.2	630
August	36.3	20.9	1.9	57	11.9	608
September	35.2	18.3	2.3	57	10.8	540
	2006					
May	34.9	19.0	2.2	34	11.3	604
June	38.5	22.6	2.2	39	12.3	638
July	36.2	20.7	1.9	46	12.2	630
August	36.1	21.4	1.9	56	11.9	608
September	35.9	11.7	2.3	54	10.8	540

Where: T.max., T.min. = maximum and minimum temperatures °C; W.S = wind speed (m/ sec); R.H. = relative humidity (%); S.S = actual sun shine (hour); S.R = solar radiation (cal/ cm^2/ day).

Characters Studied:

I Crop water use parameters:

1.1. Sesame evapotranspiration estimated by some ET formulae (Potential evapotranspiration or ET crop):

Three methods of calculating potential evapotranspiration were compared in this study, namely: (A) Modified Penman and (B) Doorenbos and Pruitt methods, as described in the "WATER MANAGEMENT UTILITIES" model (Zazueta and Smajstrla, 1984) and (C) Penman-Monteith as described in the "CROPWAT" model (Allen *et al.*, 1998).

A- Modified Penman method:

Penman equation is given as:

$$ETp = \frac{\Delta (Rn/L) + \gamma Ea}{\Delta + \gamma}$$

Where:

ETp = daily potential evapotranspiration, mm/day.

Δ = slope of saturated vapor pressure curve of air, mb/°C.

Rn = net radiation, cal/cm²/day.
L = latent heat of vaporization of water, about 58 cal/cm².
Ea = 0.263 (ea-ed) (0.5 + 0.0062 u).
ea = average vapor pressure of air, mb.
ed = vapor pressure at dew point temperature, mb.
u = wind speed at a height of 2 meters, km/day.
γ = psychometric constant = 0.66 mb/°C.

Table (3): Date of sowing and harvesting for different varieties used in the trail during 2005 and 2006 seasons.

Characters		Sowing date		Harvesting date	
Season		2005	2006	2005	2006
Irri.	Var.				
I_1	V_1	17/5/2005	18/5/2006	26/9	28/9
	V_2			12/9	15/9
	V_3			15/9	17/9
	V_4			18/9	21/9
I_2	V_1	17/5/2005	18/5/2006	19/9	21/9
	V_2			5/9	7/9
	V_3			7/9	7/9
	V_4			12/9	15/9
I_3	V_1	17/5/2005	18/5/2006	9/9	10/9
	V_2			31/8	1/9
	V_3			1/9	2/9
	V_4			4/9	9/9
I_4	V_1	17/5/2005	18/5/2006	27/9	28/9
	V_2			13/9	15/9
	V_3			15/9	17/9
	V_4			17/9	19/9

Where:
I_1 = withholding irrigation at the 45th day after sowing.
I_2 = withholding irrigation at the 60th day after sowing.
I_3 = withholding irrigation at the 90th day after sowing.
I_4 = control (irrigation each 15 day)
V_1 = Giza$_{32}$, V_2 = Toshky$_1$, V_3 = Shandaweel$_3$ and V_4 = Sohag$_3$

B- Doorenbos and Pruitt method:

Doorenbos and Pruitt (1977) adapted the Makkink (1957) radiation formula to predict potential ET as follows:

$$ETp = b\ W\ (Rs/L) - 0.3$$

Where:
ETp = daily potential evapotranspiration, mm/day.
b = adjustment factor based on wind and mean relative humidity.
W = weighting factor based on temperature and elevation above sea level.
Rs = daily total incoming solar radiation, cal/cm²/day.
L = latent heat of vaporization of water, cal/cm²/day.

The factors b and W could be obtained from Tables (Doorenbos and Pruitt, 1977).

C- Penman Monteith method:

Penman Monteith method used in CROPWAT model (Smith, 1991) and described by Allen *et al.* (1998) is given as:

$$ETo = \frac{0.408\,\Delta\,(Rn - G) + \gamma\,[900/(T + 273)]\,U2\,(es - ea)}{\Delta + \gamma\,(1 + 0.34\,U2)}$$

Where:

ETo	= reference evapotranspiration, mm/day
Rn	= net radiation ($MJm^{-2}d^{-1}$)
G	= soil heat flux ($MJm^{-2}d^{-1}$)
Δ	= slope vapor pressure and temperature curve (kPa $°C^{-1}$)
γ	= psychrometric constant (kPa $°C^{-1}$).
U_2	= wind speed at 2 m height (ms^{-1}).
e_s-e_a	= vapor pressure deficit (kPa).
T	= mean daily air temperature at 2 m height (°C).

The input parameters needed to calculate ETo using the CROPWAT model are air temperature, relative humidity, sunshine hours and wind speed.

1.2. Comparison with the actual ET:

ET crop values estimated by Modified Penman, Penman Monteith, and Doorenbos- Pruitt methods were compared to the estimated ET ones to clarify the efficiency of the studied methods in calculating the ET crop values.

II. Yield and growth parameters:

1. Seed yield (kg/fed).
2. Seed weight/plant (g).
3. 1000-seed weight (g).
4. Number of capsules/ plant.
5. Length of fruting zoon (cm).

III Chemical analysis:

Seed oil percentage. A harvest time, seed samples were collected to determine seed oil percentage according to the Standard Methods of A.O.A.C. (1990), using Soxlhlet apparatus and hexane as solvent. .

IIII Crop susceptibility factor (Cs):

Crop susceptibility factor was calculated as described by (Hiler and Clark, 1971) as follows:

$$Cs = Ym - Yi$$

Where:

Ym = potential yield without withholding irrigation.

Yi = yield under withholding irrigation.

Statistical analysis:

Data were statistically analyzed according to Snedecor and Cochran (1980). Average values from the three replicates of each treatment were interpreted using the analysis of variance (ANOVA).

RESULTS AND DISCUSSION

I. Crop water use parameter

1.1 Sesame evapotranspiration estimated by some ET formulae (Potential evapotranspiration or ET crop):

Values of ETo and ET crop mm/month estimated by Modified Penman, Penman Monteith and Doorenbos-Pruitt for the control treatment (I4 treatment) and Monthly Kc values (FAO No.33) are shown in Table (4). In 2005, seasonal ET crop values were 598.7, 599.0 and 526.2 mm for Modified Penman, Penman Monteith and Doorenbos-Pruitt formulae, respectively. In 2006, ET crop values 599.2, 614.4 and 525.4 mm for the same respective formulae. It is clear that Penman Monteith gave the maximum values in the two seasons. While, Doorenbos-Pruitt formula recorded the lowest ones.

Table (4): Monthly ETo and ET crop for Modified Penman, Penman Monteith and Doorenbos-Pruitt formulae for some sesame varieties in 2005 and 2006 seasons.

Season	2005						
		Modified Penman		Penman Monteith		Doorenbos-Pruitt	
	Kc	ETo	ET crop	ETo	ET crop	Eto	ET crop
Month		mm /	month	mm /	month	mm /	Month
May	0.4	105.3	42.1	104.0	41.6	91.4	36.5
June	0.8	225.6	180.5	232.8	186.2	198.6	158.9
July	1.0	224.1	224.1	223.8	223.8	200.0	200.0
August	0.8	214.2	171.4	212.0	169.6	191.0	152.8
September	0.5	86.1	43.0	83.1	41.5	70.9	35.4
Seasonal	0.7	855.3	598.7	855.7	599.0	751.7	526.2
Season	2006						
May	0.4	104.7	41.9	111.6	44.6	91.2	36.5
June	0.8	227.7	182.2	240.6	192.5	199.8	159.8
July	1.0	218.9	218.9	227.2	227.2	198.1	198.1
August	0.8	213.3	170.6	210.5	168.4	189.7	151.8
September	0.5	91.5	45.8	87.8	43.9	71.8	35.9
Seasonal	0.7	856.1	599.2	877.7	614.4	750.6	525.4

1.2. Comparison between different methods of calculating potential evapotranspiration

ET crop / Actual ET (estimated last year under the same conditions for this experiment) values are shown in Table (5). Average ratios of the two seasons of 1.15, 1.17 and 1.01 were recorded with Modified Penman, Penman Monteith and Doorenbos-Pruitt formulae, respectively. It is clear that Doorenbos-Pruitt formula was superior in calculating ET crop for sesame in Upper Egypt (i.e. Shandaweel region) due to their least difference from the actual ET value compared to those of the other formulae.

Table (5): Ratios of ET crop estimated by different formulae to the estimated ET for some sesame varieties in 2005 and 2006 seasons.

Formulae	2005		2006		Average	
	ET crop	Ratio	ET crop	Ratio	ET crop	Ratio
Modified Penman	598.7	1.15	599.2	1.15	599.0	1.15
Penman Monteih	599.0	1.15	614.4	1.18	606.7	1.17
Doorenbos& Pruitt	526.2	1.01	525.4	1.01	525.8	1.01
Estimated ET	521.9	---	519.1	---	520.5	---

II. Growth, yield and yield component parameters:

Seed yield (kg/ fed), seed weight/plant (g), 1000-seed weight (g), length of fruit (cm) and number of capsules/ plant were significantly affected by different irrigation treatments, (see Table 6 and 7). The maximum values were obtained from the treatment I_3 followed by I_1 in both studied seasons. The application of I_3 treatment (withholding irrigation at the 90^{th} day after sowing) increased sesame yield by 5, 19.5 and 30.7% as compared with I_1, I_2 and I_4 ones, respectively in the first season. In the second season, the corresponding increases were 5.8, 28.0 and 27.0%, respectively.

Regarding varieties, it is clear the significantly affected seed yield. The maximum values of all characters under study were obtained for V_3 (Shandaweel$_3$ cv.). The increase in seed yield for V_3 in 2005 reached about 25.9, 7.3 and 9.3% as compared V_1, V_2 and V_4, respectively. However, in 2006 the increase in seed yield using V_3 reached about 35.2, 5.4 and 5.6% compared with the same respective varieties. This may be due to decreasing irrigation water in this period caused decreasing wilt diseases percentage.

Significant interaction effects were found between irrigation treatments and sesame varieties for seed yield (kg/fed), seed weight/plant (g), 1000-seed weight (g) and length of fruit (cm), number of capsules/plant. The best interaction effect on all characters was obtained from the treatment I_3 with the variety V_3.

In this connection, Jana *et al.* (1995) studied effect of irrigation on yield, consumptive use and consumptive use efficiency of sesame crop. Sesame was either irrigated or not irrigated at 4- to 6- leaf stage, at branching, at flowering and at the seed development stage. The highest seed yield (1.28 t/ ha) and oil (0.52 t/ ha) were obtained by 3 irrigations, applied at the branching, flowering and seed development stages.

III Chemical analysis

Oil yield

Results in Table (7) show the effect of different irrigation treatments on oil yield as an average of two growing seasons. Results indicated that average oil yield values were 349.5, 290.1, 368.4 and 265.4 for I_1, I_2, I_3 and I_4, respectively.

The maximum values were obtained from treatment I_3 (withholding irrigation at the 90^{th} day after sowing)

These results may be due to exposing sesame plants to water stress especially during translocation of the sugars from the leaves to seeds, increase seed oil content. In this connection, Dutta *et al.* (2000) studied response of summer sesame to different levels of irrigation. Treatments comprised: one irrigation at the branching stage; two irrigations (one each at branching and capsule-development stages; and three irrigations (one each at the branching, flowering and capsule-development stages). In sesame (*S. indicum*) increase in the levels of irrigation from 1 to 3 increased all growth attributes and yield components. three irrigations, one each applied at branching, flowering and capsule-development stages recorded the highest yield (seed + oil), followed by two irrigations (branching + flowering).

Table (6): Seed yield (Kg/fed), Seed weight/plant (g), 1000-seed weight (g) and length of fruit (cm) for some sesame varieties as affected by irrigation regimes and its relation with wilt diseases in 2005 and 2006 seasons.

Characters		Seed yield (kg/fed)		Seed weight /plant(g)		1000-seed weight (g)		Length of fruit (cm)	
Season: Irri.	Var.	2005	2006	2005	2006	2005	2006	2005	2006
I_1	V_1	490.75	452.25	14.75	15.85	3.70	3.98	134.50	151.25
	V_2	584.50	818.75	22.43	22.38	4.65	4.38	176.25	168.75
	V_3	616.75	863.75	22.13	25.38	4.80	4.48	162.75	166.25
	V_4	590.00	807.50	21.22	22.75	4.73	4.30	172.00	180.00
Average		570.50	735.56	20.14	21.59	4.47	4.29	161.38	166.56
I_2	V_1	401.25	469.25	11.33	15.38	4.03	4.05	125.00	150.00
	V_2	491.00	589.50	19.10	20.75	4.53	4.23	152.50	152.00
	V_3	549.50	604.25	20.20	22.15	4.58	4.35	163.50	162.50
	V_4	489.75	583.50	18.60	18.25	4.68	4.33	146.25	156.25
Average		482.88	561.63	17.32	19.13	4.46	4.24	146.81	155.31
I_3	V_1	475.25	597.25	14.43	16.50	4.03	4.25	139.25	160.00
	V_2	619.50	842.50	25.58	27.38	4.60	4.70	176.00	176.25
	V_3	700.00	877.50	27.23	29.88	4.70	4.78	181.25	183.75
	V_4	603.75	805.00	25.98	25.73	4.96	4.60	167.50	186.25
Average		599.63	780.56	23.31	24.87	4.57	4.58	166.00	176.56
I_4	V_1	347.75	419.75	10.28	12.85	4.00	3.95	146.25	170.00
	V_2	450.00	581.25	18.80	20.5	4.73	4.15	188.75	181.25
	V_3	448.50	647.50	19.88	21.00	4.83	4.30	193.50	191.25
	V_4	415.00	630.00	18.88	18.5	4.80	4.30	176.75	185.00
Average		415.31	569.63	16.96	18.21	4.59	4.18	176.31	181.88
Average for all varieties	V_1	428.75	484.63	12.69	15.15	3.94	4.06	136.25	157.81
	V_2	536.25	708.00	21.48	22.75	4.63	4.37	173.38	169.69
	V_3	578.69	748.25	22.36	24.6	4.73	4.45	175.25	175.94
	V_4	524.63	706.50	21.73	21.31	4.79	4.38	165.63	176.88
Average		517.08	661.85	19.57	20.95	4.52	4.31	162.62	180.88
LSD 5%	Irr.	21.02	9.896	0.714	0.584	0.085	0.075	4.303	3.932
	Var.	21.02	9.896	0.714	0.584	0.085	0.075	4.303	3.932
	Irr.xVar.	68.19	72.29	5.630	4.020	0.320	0.200	17.50	14.99

IIII Crop susceptibility factor (Cs):

With respect to crop susceptibility factor as shown in Table (7), it is clear that through branching stage, the variety of V_4 (Sohag 3) recorded that highest tolerance to shortage of water, while the variety of V_1 (Giza 32) was the most sensitive to water stress in this stage in both seasons. As to withholding irrigation at flowering stage (60 day after sowing), V_4 (Sohag 3) was the best resistant to water stress in this stage as compared with the other varieties under study. However, V_1 (Giza 32) was the most sensitive to water stress in the flowering stage in both seasons. At capsules-development stage, results cleared that the variety of V_4 (Sohag 3) was the most tolarent to water shortage in this stage as compared with the other varieties, while V_1 (Giza 32) is the most sensitive variety to water shortage.

Table (7): Number of capsules/plant, oil yield/ fed (kg) and crop susceptibility for some sesame varieties as affected by irrigation regimes and its relation with wilt diseases in 2005 and 2006 seasons.

Characters		No. of Capsules /plant		Oil yield / fed (kg)		Crop susceptibility factor (Cs)	
Irri.	Season / Var.	2005	2006	2005	2006	2005	2006
I_1	V_1	65.75	107.50	254.93	234.73	10.50	12.75
	V_2	225.00	246.25	310.08	429.03	6.50	14.75
	V_3	290.25	255.00	336.18	457.83	5.25	7.50
	V_4	163.75	191.25	344.28	427.00	5.00	4.50
Average		196.19	200.00	311.36	387.56	6.81	9.88
I_2	V_1	57.00	87.50	209.25	239.15	9.75	12.25
	V_2	157.25	200.00	266.03	306.15	8.25	12.00
	V_3	192.25	240.00	296.73	427.20	4.00	4.75
	V_4	141.25	175.00	261.10	314.90	2.24	1.50
Average		136.94	175.63	258.28	321.85	6.00	7.63
I_3	V_1	92.75	115.00	250.33	311.05	6.25	8.25
	V_2	245.00	246.25	328.33	349.78	3.00	7.75
	V_3	283.25	250.00	377.9	475.23	1.25	3.25
	V_4	168.25	183.75	324.48	428.93	1.25	1.50
Average		200.25	198.75	320.26	416.24	2.94	5.19
I_4	V_1	67.75	77.50	184.50	218.90	29.50	18.50
	V_2	194.5	180.00	243.05	311.65	20.75	26.25
	V_3	212.5	218.75	246.68	351.40	18.75	18.75
	V_4	150.25	152.50	223.35	343.40	16.25	14.75
Average		161.75	157.19	224.39	306.37	21.31	19.59
Average for all varieties	V_1	70.81	96.88	224.72	250.96	14.00	12.94
	V_2	205.44	218.13	286.87	374.15	9.63	15.19
	V_3	244.56	240.94	314.39	427.94	7.31	8.56
	V_4	155.88	175.63	288.3	378.56	6.19	5.56
Average		169.17	182.89	278.58	357.90	9.28	10.56
LSD 5%	Irr.	8.504	3.831	11.946	2.945	1.378	1.637
	Var.	8.504	3.831	11.946	2.945	1.378	1.637
	Irr.xVar.	37.32	28.14	45.170	41.21	5.220	5.420

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تأثير تحريم الرى على المحصول ومكوناته لبعض أصناف السمسم وعلاقته بأمراض الذبول

مصطفى كمال محمد السمنودى*، منال محمود الطنطاوى، حمام خضرى أحمد رحاب***

* معهد بحوث المحاصيل الحقلية ــ مركز البحوث الزراعية ــ مصر.
** معهد بحوث الأراضى والمياه والبيئة ــ مركز البحوث الزراعية ــ مصر.

أقيمت تجربتان حقليتان بمزرعة خاصة بشندويل خلال موسمي ٢٠٠٥، ٢٠٠٦ لدراسة تأثير تحريم الري على المحصول ومكوناته لبعض أصناف السمسم.

وتهدف الدراسة إلى معرفة مدى تأثر الأصناف المختلفة لنبات السمسم وكذلك حساسية الأطوار المختلفة داخل كل صنف لنقص المياه وتحديد أفضل الأصناف التي تعطى أعلى إنتاجية من حيث محصول البذور والزيت.

وكانت المعاملات الرئيسية للدراسة كما يلي:

أ- المعاملات الرئيسية (تحريم الرى):

١- تحريم الري في طور النمو الخضري (بعد ٤٥ يوم من الزراعة).
٢- تحريم الري في طور النمو الزهري (بعد ٦٠ يوم من الزراعة).
٣- تحريم الري في طور تطوير الكبسولات(امتلاء الكبسولات وجفافها) (بعد ٩٠ يوم من الزراعة).
٤- بدون تحريم (معاملة الكنترول).

ب- المعاملات الشقية (الاصناف): (جيزة٣٢ وتوشكى١ و شندويل٣ وسوهاج١)

وقد أوضحت النتائج أن تحريم الري في طور تطوير الكبسولات (بعد ٩٠ يوم من الزراعة) أدى إلى اعطاء أعلى إنتاجية من محصول البذور ويرجع ذلك الى انخفاض نسبة الذبول عند تحريم الرى فى هذه المرحلة الامر الذى ترتب عليه زيادة نسبة النباتات القائمة عند الحصاد.كما أظهرت النتائج أن وزن البذور لكل من الفدان أو للنبات أو وزن ١٠٠٠ بذرة وكذلك طول المنطقة الثمرية وعدد الكبسولات للفدان قد تفوق معنويا بمعاملة التحريم في طور تطوير الكبسولات للصنف شندويل٣ . كذلك أظهرت النتائج أن التحريم في طور النمو الخضرى أدى إلى خفض المحصول بحوالي ٥% بينما التحريم في طور النمو الزهري أدى إلى خفض المحصول بحوالي ٢٤ % بينما وجد في المعاملة بدون تحريم (الكنترول) خفض المحصول بنسبة حوالي ٢٩ % وذلك مقارنة بمرحلة تطوير الكبسولات. ومن هذا يتضح أن طور تطوير الكبسولات في نبات السمسم من الأطوار التي يجب زيادة الفترة بين الريات عندها حيث أن زيادة

المحتوى الرطوبى أو اعطاء الرى فى هذه المرحلة يؤدى الى تعــرض النبــات الـــى الذبول.

وقد أوضحت النتائج انه بحساب الاستهلاك المائي النظري لمحصول السمسم في الموسمين باستخدام معدلات الري المناخية (بنمان المعدلــة- بنمــان مونتيــث – دورينبوز وبرت) تفوقت معادلة دورينبوز و برت لحساب الاستهلاك المائي النظــري لنبات السمسم في منطقة مصر العليا مقارنة بالمعادلات الأخرى ويرجع ذلك إلى قلــة الاختلافات بين قيمها وقيم الاستهلاك المائي للنبات.