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INFLUNCE OF WATER REGIMES AND WEED CONTROL TREATMENTS ON SESAME CROP

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ABSTRACT

A field experiment was conducted at Shandaweel Research Station, Sohag Governorate during 2012 and 2013 seasons to investigate the influence of three water regimes at 100, 80 and 60% of field capacity, two sesame cultivars (Shandaweel 3 and Sohag 2000) and six weed control treatments (Prometryn at rate of 375 g active ingredient (a. i) /fed. , bentazon at rate of 240 g a. i /fed., prometryn and bentazon with one hand hoeing, hand hoeing twice and weedy check) on water relations and sesame productivity. A split-split plot design with three replications was used. The results showed that irrigating sesame at 60 % of FC significantly reduced annual broad leaved, grassy and total weeds in both seasons compared to irrigation water at 100% of FC. While, irrigation at 100% of FC significantly increased growth and yields of sesame and its attributes compared to irrigation at 60 % FC. Sohag - 2000 cultivar significantly inhibits growth of annual broad leaved, grassy and total weeds and increased plant height, number of branches and capsules /plant, capsule length, 1000- seed weight, seed yield and oil %, compared with Shandaweel-3 cultivar. All weed control treatments significantly reduced the dry weight of annual broad leaved, grassy and total weeds in both seasons. Hand hoeing twice, bentazon followed by H.H. once, + prometryn follow by H.H. once, gave the highest reduction % in the total annual weeds and increased significantly plant height, the number of branches / plant, number of capsules /plant, capsule length, 1000 seed weight, seed yield /fad. and oil %, compared to un-weeded treatment. Water consumptive use (CU) values were 2252.6, 2016.1, 1656.9, 2261.7, 2020.4 and 1654.2 m^3/fed for 100, 80 and 60 % of FC treatment , respectively, in both seasons. The highest value of water use efficiency (WUE) was recorded by irrigation at 80 % of FC. The highest CU and WUE were recorded by Sohag - 2000 cultivar, compared to Shandaweel-3 cultivar. Under the conditions of this experiment sowing Sohag- 2000 cultivar with using hand hoeing twice, bentazon followed by H.H. once, and prometryn followed by H.H. once and irrigation at 80 % of FC can be recommended to obtain the highest oil and sesame yield/fed.

***Key words**: Prometryn, Bentazon, Water consumptive use, Water use efficiency, Hand hoeing.*

1.INTRODUCTION

Seeds of sesame (*Sesamum indicum*, L.) are rich in both portien and oil. Egypt is suffering drastically from the shortage of edible oils. The gap between the production of vegetable oils and their consumption is more than 95%. In Egypt, the total cultivated area of sesame is about 60,000 feddan giving 33,000 tons of seeds *Bulletin of the Agricultural statistics (2013).

The oil production can be increased horizontally by increasing the area of oil crops in new locations and/or vertically by increasing the total yield of seeds. This aim can be achieved by improving irrigation and weed control programs of high yielding cultivars. According to the report by the Ministry of Irrigation (1972), water use by sesame reached 1700, 2200 and 2300 m^3/feddan for Delta, Middle and Upper Egypt, respectively. Hong *et al.* (1985) indicated that drought stress during vegetative growth reduced seed yield of sesame from 8.5 to 4.3 t ha^{-1}. Joshi (1985) indicated that sesame is very susceptible to both drought and water logging since it is slow in establishment. Ayasamy and Kulandiavelu (1992) found that seed yield increased by increasing soil moisture content through different stages of plant development. Kwan *et al.* (2007) found that drought stress decreased seed yield per plant but did not affect the weight of individual seed. Ucan *et al.* (2007)

showed that increasing the number of irrigations, decreased sesame yield. Ahmed *et al.* (2010) showed that the highest water quantity (750 mm) significantly increased the number of capsules per plant, the number of seeds per capsule, 1000 seed weight, seed yield per plant and seed yield /ha, compared to the lowest water quantity (350 mm). Kassab *et al.,* (2012) revealed that the highest values of sesame growth parameters, seed and oil yields /fed. were gained by irrigating sesame plants with 100 % of Etc followed by 75 % of Etc in both seasons compared to 50 % of Etc. Damdar *et al.,* (2014) revealed that yield contributing characters and moisture studies were significantly higher with irrigation scheduling at 1.0 IW/CPE (Irrigation water amount/Cumulative pan evaporation) compared to irrigation scheduling at 0.4 IW/CPE.

In this concern, Basha (1998) showed that sesame varieties significantly differed in growth and yield attributes. Also, Basha and Awaad (2000) showed that B10 genotype surpassed Sharkia and Giza 32 cultivars in fruiting zone length, capsule length, seed and oil yields/fed, whereas the differences in number of branches and capsules/plant were in favor of Giza 32 variety. While, Sharkia cultivar gave the least values of plant height, fruiting zone length and capsule length. Abdel–Wahab *et al.* (2005) showed that Giza 32 variety significantly had longer fruiting zone and gave the higher number of capsules/plant, 1000-seed weight, seed yields and seed oil content over Toshky 1 cultivar. While, Abo-El-Wafa and Abdel-Latief (2006) showed that Toushky-1 and Giza 32-cultivars surpassed Shandaweel-3 in seed yield and yield attributes, while seeds of Giza 32 were more rich in oil content. Rehab and Fakkar (2007) reported that sowing Toshky-1 cultivar significantly decreased the dry weight of grassy, broad and total weeds/ m^2 and increased plant height, fruiting zone length , capsule length , number of capsules/plant, seed yield/fed., 1000 -seed weight, oil % in seeds compared to Shandawel-3 cultivar in both seasons. Hassanzadeh *et al.* (2009) studied the effect of water stress on yield and yield components of 27 sesame genotypes. He demonstrated that the numbers of capsules per plant and grain yield were significantly affected by irrigation and genotypes. Ahmed *et al.*(2010) showed that Khidir and Promo cultivars had insignificant effect on seed yield. Kassab *et al.* (2012) showed that Shandweel 3 sesame cultivars gave the highest plant height, the number of capsules/plant, and dry weight of capsules/plant.

Weed infestation is one of the major factors limiting the yield of sesame as its seedling growth which was slow during the first three to four weeks making it a poor competitor at earlier stages of crop growth (Bennett *et al.*,2003). During the seedling phase, monocotyledonous and dicotyledonous weeds suppress sesame's growth and finally affect the production per unit area to about 44 percent (Gurnha, 1974). Balyan (1993) and Singh *et al.*(1992) reported that weeds reduced yield up to 135% and there is need for a critical weed-free period up to 50 days after planting. Several herbicides provide excellent control of weeds with minimal to no damage to sesame. Also, in some cases, at the same location, the herbicides effectively control weeds and little sesame injury was noted in one year; however, the opposite may be true the following year. Rehab and Fakkar (2007) reported that all weed control treatments increased significantly seed yield /fed. Water use efficiency by weeds is one type of loss that contributes to the cost of weeds to agriculture. Kassab *et al.* (2012) found that the highest seed yield (kg/fed.) and WUE was obtained from irrigating Shandweel 3 sesame cultivar by 100 % of Etc in two growing seasons.

The objectives of this investigation were to study the influence of different irrigation water regimes and some weed control treatments on the yield of two sesame cultivars. *

2.MATERIALS AND METHODS

Two field experiments were conducted during 2012 and 2013 seasons at the farm of Shandaweel Research Station, Sohag Governorate, Egypt to determine the effect of three irrigation regimes and some weed control treatments on growth and yield of two sesame cultivars as well as water consumptive use and water use efficiency. Soil texture and soil moisture constants of the experimental site are presented in Table (1).

Experiment was laid out in a split- split-plot design with three replicates. Each experiment contains the following treatments: -

Table (1): Soil texture, field capacity, available soil moisture, welting point and bulk density of the experimental site.

Soil depth (cm)	Soil texture	Field capacity (%)	Welting point (%)	Available soil moisture (%)	Bulk density (g/cm^3)
0 – 15	Clay loam	27.60	15.50	12.1	1.34
15 – 30	Clay loam	28.00	14.10	13.9	1.36
30 – 45	Clay	12.20	7.20	5. 0	1.56
45 – 60	Clay	15.10	6.40	8.7	1.57

2.1. Main plot (Water regimes)

Irrigation treatments (m^3/ fed.) were 100% 80 and 60% of field capacity. These irrigation treatments were 3754, 3360 and 2761 m^3/fed., respectively, in 2012 season and 3762, 3363.5 and 2759 m^3/feddan in 2013 season.

1. Water relation for sesame .
2. Water consumptive use

It was estimated by using the soil sampling method and calculated according to the technique used and according to Israelsen and Hansen (1962).

$CU = D \times B_d \times (Q2-Q1) /100$

Where:

CU = water consumptive use in the effective root zone.

D = Soil layer depth.

B_d = Soil bulk density.

Q_1 = Soil moisture %, before irrigation.

Q_2 = Soil moisture %, 48 hours after irrigation.

For soil moisture determination, soil samples were taken from each 15 cm depth up to 60 cm from the soil surface by a regular augur. The samples were weighed immediately and then oven dried to a constant weight at 105 °C. Percentage of soil moisture at the four soil depths was calculated on oven dry weight basis. The amount of water consumed in each irrigation interval was obtained from the difference between soil content before the following irrigation and field capacity.

Actual irrigation water requirement .

The amounts of actual applied water were determined according to James (1988) using the following equitation:

$$I = \frac{\left[\frac{(f_c - f_m)}{100} \right]}{IE} \times D_r \times LF$$

I = total actual irrigation water applied mm/ interval.

f_c = soil moisture content at field capacity on volume basis.

f_m = Volumetric soil moisture content before next irrigation

dr= depth of soil layer .

Lf= leaching factor 10 %.

IE = irrigation system efficiency.

2.2. Water use efficiency(WUE)

Water use efficiency (WUE) values for the examined treatments were calculated according to the relation given by Jensen (1983):

$$WUE = \frac{\text{Total seed yield}}{\text{Total water consumed}}$$

2.2.1. Sub-plot (Cultivars):

Shandaweel 3 unbranched stem and Sohag 2000 branched stem cultivars were used.

2.2.2. Weed control treatments (Sub-sub-plots):-

1. Prometryn 50% SC [4- amino- 3, 5- chloro- 6- fluoro- 2 pyridyloxyaceticacid] known commercially as (Gesagard) was applied at the rate of 375 g a.i/fed. as pre- emergence before sowing irrigation.
2. Bentazon 48% AS [3-Isopropyl-1H-2,1,3-benzothiadiazin-4 (3H)- one 2,2-dioxide] known commercially as (Basagran) was applied at rate of 240 g a.i /fed. as post- emergence at 21days after sowing (DAS).
3. Prometryn at rate of 375 g a.i/fed. plus hand hoeing once after one month from herbicide application.
4. Bazagran at rate of 240 g a.i /fed. applied at 30 DAS plus hand hoeing once after 42 DAS from herbicide application.
5. Hand hoeing twice at 21 and 42 days after sowing.
6. Un-weeded check.

Knapsack sprayer was used with water volume of 200 /fed. The experimental basic unit area included 3 ridges each of 120 cm width and 5.0 m length occupying an area of 18.0 m^2. The preceding winter crop was Egyptian clover (*Trifolium alexandrinum* L.) in both seasons. Seeds of sesame were sown in hills 10 cm a part on ridges of 120 cm spacing in June 5 and 10^{th} in the first and second seasons, respectively. Plants were thinned to secure only one plant per hill (10 cm. space) after full emergence of seedlings. The

other agricultural recommended practices for growing sesame were followed.

2.3. Data recorded

Weeds were hand pulled from one square meter randomly from each plot at 75 days after sowing and classified to broadleaved and grassy weeds and were air dried for seven days and then oven dried at 70 °C until reaching a constant weight. Dry weight of broadleaved weeds, grassy weeds and total dry weight of weeds were recorded.

At full maturity stage, sample of ten sesame plants were taken at random from each experimental unit at physiological maturity to measure plant height, the number of branches/plant, fruiting zone length, the number of capsules /plant, capsule length, seed yield/plant, 1000-seed weight.

Seed and oil yield /feddan were estimated as following equations:

$$\text{Seed yield (kg/feddan)} = \frac{\text{Seed weigh (kg) X4200}}{\text{Harvested area } (m^2)}$$

Oil yield(kg/feddan =

Seed oil content (%) X seed yield (kg/feddan)

Oil content (%): The crude oil of sesame seed was determined by Suxhlet extraction method according to (A.O.A.C) 1990.

2.4. Statistical Analysis:

Statistical analysis was carried out according to Gomez and Gomez (1984) using MSTAT-C computer software (Freed *et al.*,1989).

3. RESULTS AND DISCUSSION

3. 1. Effect of water regime on annual weeds

The presented weeds in this study were *Xanthium strumarium* L, (Cocklebur) and *Ipomoea eriocarpa* (Morning glory) and *Portulaca oleracea,* L. (Common purslane) as broadleaved weeds and *Echinochloa colonum)* (L.) Link. (Barnyard grass) as grassy weed in first season and by *Xanthium strumarium* L. and *Corchorus olitorius,* L. (Nalta jute); as broadleaved weeds and *Echinochloa colonum,* (L.) Link. as grassy weed in the second season. It was noticed that *Xanthium strumarium* L. as broadleaved and *Echinochloa colonum* L. as grassy weed were the predominant weeds in both seasons.

Data in Table (2). revealed that water regimes had significant effect on the dry weight of annual weeds in both seasons. Irrigation at 60 % FC reduced the dry weight of broad leaved, grassy and total annual weeds by 40.0, 29.7 and 36.2 %, respectively, in the first season and by 34.0, 43.2 and 37.5 %, respectively, in the second season. While, irrigation at 80 % of FC gave 19.1, 20.6 and 19.6 % reduction, respectively, in the first season and by 16.0, 27.2 and 20.2 %, respectively, in the second season, as compared to 100% of FC.

3. 2. Effect of water regime on growth, yield and yield components of sesame:-

Results in Table 3 showed that water regime significantly affected agronomical traits of sesame except fruiting zone length in both seasons. Irrigation at 100% of FC gave the tallest plants (197.4 and 201.4 cm) than irrigation at 60% of FC (175.6 and 180.0 cm), respectively in both seasons. Also, irrigation at 100% of FC gave the highest number of branches / plant (2.81 and 2.91, respectively) in both seasons than irrigation at 60 % FC (2.23 and 2.33, respectively).

These results are in harmony with those obtained by Hong *et al.* (1985).

Data presented in Table (3) revealed that water regime had significant effect on capsule number /plant and seed oil % in the first season, capsule length, 1000- grain weight and yield /fed. in both seasons. Capsule number/plant was increased by irrigation at 100 % and 80 % of FC by 15.2 and 3.8 %, respectively, in the first season. So, capsule length was increased by irrigation at 100 % and 80 % of FC by 13.4 and 9.3 %, respectively, in the first season and by 15.2 and 12.9 %, respectively, in the second season. The highest 1000- grain weight was obtained from irrigation at 100 % and 80 % of FC by11.8 and 6.2 %, respectively, in the first season and by 14.0 and 9.0 %, respectively, in the second season. Irrigation at 100 % and 80 % of FC increased seed yield/ fed. by 26.9 and 19.8 %, respectively, in the first season and by 21.8 and 10.3 %, respectively, in the second season compared to irrigation at 60 % of FC . The same trend was observed with seed oil % in the first season. These results are in harmony with those obtained by Ucan *et al.* (2007), Ahmed *et al.* (2010) and Damdar *et al.*(2014).

3. 3. Effect of water regime on water consumptive use (CU) and water use efficiency (WUE)

Results presented in Table (4), show the effect of water regime on water consumptive use and water use efficiency by sesame crop. Water consumptive use values were 2252.6, 2016.1, 1656.9, 2261.7, 2020.4 and 1654.2 m^3/fed for irrigation at 100, 80 and 60 % of FC, respectively, in both seasons. Results indicate that irrigation at 80 and 60 % of FC reduced

Table (2): Effect of water regimes on dry weight (g/m^2) of annual weeds (g/m^2) in 2012 and 2013 summer seasons.

Water regime % of Field Capacity	Annual weeds dry weight (g/m^2)					
	Broad leaved weeds	Grassy weeds	Total weeds	Broad leaved weeds	Grassy weeds	Total weeds
	2012 season			2013 season		
100	196.8	114.3	311.1	198.4	120.1	318.5
80	159.3	90.8	250.1	166.7	87.4	254.1
60	118.1	80.4	198.5	130.9	68.2	199.2
L.S.D $_{0.05}$	**21.3**	**9.0**	**26.7**	**43.7**	**21.3**	**50.8**

Table (3): Effect of water regimes on growth, yield and yield components in 2012 and 2013 summer seasons.

Growth , yield and yield components	Water regime % of Field Capacity				Water regime % of Field Capacity			
	100	80	60	L.S.D $_{0.05}$	100	80	60	L.S.D $_{0.05}$
	2012 season				2013 season			
Plant height (cm)	197.4	185.2	175.6	**12.7**	201.4	189.3	180.0	**10.7**
Branches /plant (No)	2.81	2.50	2.23	**0.05**	2.91	2.63	2.33	**0.13**
Fruiting zone length (cm)	111.3	96.9	89.7	**ns**	108.3	94.1	91.8	**ns**
Capsules /plant (no)	141.7	124.9	120.1	**11.36**	165.6	147.2	134.9	**ns**
Capsule length (cm)	3.82	3.65	3.31	**0.18**	4.14	4.03	3.51	**0.16**
Seed yield/plant (g)	25.8	23.8	21.0	**ns**	27.50	24.06	23.00	**ns**
1000- seed weight (g)	4.99	4.69	4.40	**0.16**	5.08	4.80	4.37	**0.24**
Seed yield /fed. (kg)	778.0	709.0	568.7	**28.8**	749.7	653.3	586.0	**23.4**
Oil %	50.04	49.95	49. 68	**0.20**	51.25	51.29	50.42	**ns**

Table (4): Effect of water regimes on seed yield, consumptive use (CU) and water use efficiency (WUE) in 2012 and 2013 seasons.

Water regime of FC* %	CU (mm)	Seed yield /fed. (kg)	WUE (Kg/m^3)	CU (mm)	Seed yield /fed. (kg)	WUE (Kg/m^3)
	2013 season			2013 season		
100	2252.6 (53.6 cm)	778.0	0.345	2261.7 (53.9 cm)	749.7	0.329
80	2016.1 (48.0 cm)	709.0	0.352	2020.4 (48.1 cm)	653.3	0.335
60	1656.9 (39.5 cm)	568.7	0.343	1654.2 (39.4 cm)	586.0	0.334
L.S.D $_{0.05}$	**66.02**	**28.8**	**0.03**	**87.4**	**23.4**	**0.02**

*** Field Capacity (FC)**

water consumptive use by 26.4, 10.5, 26.9 and 10.7 %, respectively, in both seasons as compared to irrigation at 100 % of FC. The obtained results are in agreement with those of Metwally *et al.,* (1984) and Attia *et al.* (1999). Who reported that water consumptive use values of sesame crop varied from 41 to 53 cm/fed at Giza and from 36 to 49 cm/fed at the calcareous soils of Nubaria area.

The calculated water use efficiency values as affected by the tested variables are presented in Table (4). Results reveal that WUE values were 0.345, 0.352 and 0.343 kg seed/m^3 water consumed for the irrigation at 100, 80 and 60 % of FC, respectively in the first season and 0.329, 0.335 and 0.334 kg seed/m^3 water consumed, respectively in the second season. The obtained results are in agreement with those of Damdar *et al.* (2014).

The highest WUE value (0.352 and 0.335 kg seed/m^3 water consumed) in the first and second seasons resulted from irrigation at 80 % of FC.

3.4. Effect of cultivars on annual weeds:

As shown in Table (5) the dry weight of broad leaved and the total annual weeds were reduced significantly with sowing Sohag 2000 cultivar by 15.2 and 9.9 %, respectively, in the first season. In the second season, the reduction in the dry weight of broad leaved, grassy weeds and total annual weeds with Sohag 2000 cultivar were 16.2, 16.9 and 38.4 %, respectively, as compared with Shandaweel 3 cultivar. These results may be due to the fact that plants of Sohag 2000 cultivar were more taller and had higher number of branches and can overcome weed competitions in camparison with Shandaweel 3 cultivar. These finding are are in harmony with those reported by Rehab and Fakkar (2007).

3..5. Effect of cultivars on growth, yield and yield components of sesame

Results in Table (6) indicated that the varieties significantly differed in growth traits, except fruiting zone length in the second season and plant height in both seasons.

Sohag-2000 cultivar gave the highest number of branches / plant (3.19 and 3.30), respectively, in both seasons than Shandaweel 3 (1.84 and 1.95). Also, the fruiting zone length of Sohag 2000 cultivar was the longest (103.4 cm), compared to Shandaweel 3 (95.2 cm) in the first season only. These results are in harmony with those of Basha (1998), Basha and Awaad (2000), Abdel–Wahab *et al.* (2005) as well as Rehab and Fakkar (2007).

Results in Table (6) cleared that sesame cultivars were significantly different in capsule number /plant, capsule length and seed yield/plant in 2012 and 2013 seasons.

Sohag-2000 gave the highest values for the above characteristics in both seasons compared to Shandaweel 3. Seed yield/plant of Sohag 2000 exceeded that of Shandaweel 3 by 18.5 and 21.2 %, respectively, in the first and second seasons. Similar results were obtained by Basha (1998), Basha and Awaad (2000), Abdel–Wahab *et al.*(2005), Abo-El-Wafa and Abdel-Laltief (2006), Rehab and Fakkar (2007) Hassanzadeh *et al.*, (2009) and Kassab *et al.* (2012).

3.6. Effect of cultivars on water consumptive use (CU) and water use efficiency (WUE)

For water consumptive use (CU) results in Table (7) showed also that, there were slight difference in total consumptive use between the two cultivars. Sohag 2000 cultivar increased consumptive use by 2.7 and 2.8 % in both seasons, compared to Shandaweel-3 cultivar.

For water use efficiency (WUE) results in Table (7) indicate that Sohag 2000 cultivar gave the highest values of water use efficiency (Kg/m^3) by (0.361 and 0.344 kg seed/m^3 water consumed, respectively) in both seasons, compared to Shandaweel 3 cultivar. Similar results were obtained by Kassab *et al.*(2012)

3.7. Effect of weed control treatments on annual weeds:

All tested weed control treatments significantly reduced the dry weight of annual broad-leaved, grassy weeds and their total in comparison with unweeded treatment in both seasons (Table 8). The superior treatments on reduction % of broad-leaved weeds were hand hoeing twice, bentazon followed by H.H. once, prometryn followed by H.H. once and bentazon alone by 97.7, 97.1, 96.4 and 95.7 %, in the first season, and 99.3, 98.4, 96.3 and 93.6 % in the second season, respectively, compared to un-weeded treatment. While, The superior treatments in reduction % of grassy weeds were hand hoeing twice, prometryn followed by H.H. once, bentazon followed by H.H. once and prometryn alone, by 90.1, 86.7, 82.1 and 56.7 %,respectively in the first season. In the second season, hand hoeing twice, bentazon followed by H.H. once prometryn followed by H.H. once and prometryn alone,and 99.5, 90.3, 89.3 and77.6 %, respectively, compared to un- weeded treatment

Table (5): Effect of cultivars on the dry weight of annual weeds (g/m^2) in 2012 and 2013 summer seasons.

Sesame cultivars	Annual weeds dry weight (g/m^2)					
	Broad leaved weeds	Grassy weeds	Total weeds	Broad leaved weeds	Grassy weeds	Total weeds
	2012 season			2013 season		
Shandaweel 3	171.1	95.4	266.5	179.9	100.4	380.3
Sohag 2000	145.1	94.9	240.0	150.8	83.4	234.2
F-test	**	ns	**	**	**	**

Table (6): Effect of cultivars on growth, yield and yield components in 2012 and 2013 summer seasons.

Growth , yield and yield components	Sesame cultivars			Sesame cultivars		
	Shandaweel 3	Sohag 2000	F-test	Shandaweel 3	Sohag 2000	F-test
	2012 season			2013 season		
Plant height (cm)	183.9	188.2	ns	192.7	187.7	ns
Branches /plant (No)	1.84	3.19	*	1.95	3.30	*
Fruiting zone length (cm)	95.2	103.4	**	94.4	101.7	ns
Capsules /plant (no)	132.9	124.9		153.0	145.4	ns
Capsule length (cm)	3.61	3.58	ns	4.07	3.72	*
Seed yield/plant (g)	25.9	21.1	*	27.8	21.9	*
1000- seed weight (g)	4.63	4.75	*	4.70	4.80	*
Seed yield /fed. (kg)	648.7	721.8	**	635.8	690.2	**
Oil %	49.94	49.83	*	51.32	50.64	*

Table (7): Effect of cultivars on yield and water relations in the two summer seasons.

Sesame cultivars	Yield and water relations					
	CU (m^3/fed.)	Seed yield /fed. (kg)	WUE (Kg/m^3)	CU (m^3/fed.)	Seed yield /fed. (kg)	WUE (Kg/m^3)
	2012 season			2013 season		
Shandaweel 3	1948.0 (46.4 cm)	5.41	0.333	1951.1 (46.5 cm)	5.30	0.326
Sohag 2000	2002.4 (47.7 cm)	6.02	0.361	2006.5 (47.8 cm)	5.75	0.344
F-test	**	*	*	**	*	*

Table (8): Effect of weed control treatments on dry weight of annual weeds (g/m^2) in 2012 and 2013 summer seasons.

Weed control treatments	Annual weeds dry weight (g/m^2)					
	Broad leaved weeds (gm)	Grassy weeds (gm)	Total weeds (gm)	Broad leaved weeds (gm)	Grassy weeds (gm)	Total weeds (gm)
	2012 season					
Prometryn	365.4	92.3	457.8	410.9	53.0	463.9
Bentazon	22.4	197.9	220.3	33. 3	213.2	246.5
Prometryn + H.H once	18.6	38.1	56.6	18.9	22.8	41.7
Bentazon + H.H once	15.0	28.4	43.5	8.4	25.3	33.7
Hand hoeing twice	11.7	21.1	12.8	3.7	1.1	4.8
Untreated (check)	515.3	213.2	728.5	516.7	236.1	752.7
L.S.D $_{0.05}$	**29.2**	**12.3**	**31.4**	**30.7**	**23.0**	**40.1**

Actually, hand hoeing twice, prometryn followed by H.H. once, bentazon followed by H.H. once gave the highest reduction % on total weeds by 98.2, 94.0 and 92.2 %, respectively, in the first season, and 99.4, 95.4 and 94.3 %, respectively, in the second season, compared to un-weeded treatment. Bentazon gave reduction % on weeds because they killed broadleaf weeds only. These results are in agreement with those obtained by Joshi (1985).

3.8. Effect of weed control treatments on growth, yield and yield components of sesame

Results in Table (9) show that weed control treatments significantly affected the tested agronomical traits except fruiting zone length in both seasons.

The tallest sesame plants were observed with using hand hoeing twice, prometryn + hand hoeing once and bentazon followed by hand hoeing once compared to other weed control treatments in the first season. In the second season, the same trend was obtained from hand hoeing twice, prometryn application followed by hand hoeing once and bentazon, followed by hand hoeing once compared to other weed control treatments.

Controlling weeds by using hand hoeing twice, prometryn application followed by hand hoeing once and bentazon application followed by hand hoeing once, gave the highest number of branches /plant (3.24, 2.79 and 2.71, respectively, in the first season and 3.36, 2.91 and 2.82, respectively, in the second season) compared to other weed control treatments (Table 9).

Results in Table (9) show that weed control treatments significantly affected yield and yield components in both seasons. Using hand hoeing twice, prometryn or bentazon followed by hand hoeing once, resulted in the highest capsule number /plant and capsule length in both seasons. The same trend was obtained with seed yield/plant which increased by 43.4, 34.1 and 24.4 %, respectively, in the first season and by 47.0, 37.5 and 31.4 %, respectively, in the second season, compared to the un-weeded. Using hand hoeing twice, prometryn or bentazon followed by hand hoeing once gave the highest 1000-grain weight (27.3, 24.2 and 21.5%, respectively, in the first season and by 24.6, 21.2 and 18.0 %, respectively, in the second season) compared to the un-weeded. Using hand hoeing twice, bentazon herbicide followed by hand hoeing once and prometryn herbicide followed by hand hoeing once increased seed yield by 35.8, 33.8 and 31.3%, respectively, in the first season and by 35.6, 30.7 and 27.5 %, respectively, in the second season compared to the un-weeded treatment. The highest seed content of oil was obtained with hand hoeing twice, prometryn or bentazon followed by hand hoeing once (54.53, 51.14 and 50.80, respectively, in the first season and by 53.64, 52.41 and 50.44, respectively, in the second season) compared to the un-weeded treatment. These results are in harmony with those reported by Rehab and Fakkar (2007).

3.8.1. Effect of weed control treatments on water consumptive use (CU) and water use efficiency (WUE)

For water consumptive use (CU) results presented in Table (10), showed that the effect of weed control treatments on water consumptive use by sesame crop. Using hand hoeing twice, prometryn + hand hoeing once and bentazon + hand hoeing once for controlling weeds increased water consumptive use by 13.9, 11.9 , 9.6 ,13.9,11.9 and 9.5 %, respectively, compared to the untreated .

For water use efficiency (WUE) results in Table (10) reveal that using hand hoeing twice, bentazon followed by hand hoeing once and prometryn followed by hand hoeing once gave the highest values of water use efficiency compared to the untreated.

The highest WUE value resulted from hand hoeing twice or bentazon + hand hoeing once or prometryn followed by hand hoeing with Sohag 2000 variety under 80% of FC irrigation which may be recommended for cultivating sesame under conditions of Sohag Governorate, Egypt.

3.9. Effect of interactions.

3.9. 1.Effect of the interactions between water regimes and sesame cultivars

Data in Table (11) reveal that all interactions between water regimes and sesame cultivars had statically significant effect on branch number /plant and seed yield/ plant in both seasons and capsule number /plant , capsule length, water consumptive use and water use efficiency in the first season meaning that the two factors act independently. Generally, the highest values of all characteristics above were obtained when sesame plants of Sohag-2000 cultivar were irrigated with 100% of FC water regime, compared to Shandawee l-3 cultivar with

Table (9): Effect of weed control treatments on growth, yield and yield component of sesame in 2012 and 2013 summer seasons.

Weed control treatments	Growth, yield and yield component						
	Prometryn	Bentazon	Prometryn + H.H once	Bentazon + H.H once	Hand hoeing twice	Untreated (check)	L.S.D $_{0.05}$
2012 season							
Plant height (cm)	175.7	180.2	190.2	190.9	209.7	169.6	**10.4**
Branches /plant (No)	2.14	2.33	2.71	2.79	3.24	1.87	**0.12**
Fruiting zone length (cm)	94.5	99.0	101.1	98.9	98.5	103.9	**ns**
Capsules /plant (no)	123.0	125.3	133.7	134.3	141.2	116.2	**14.34**
Capsule length (cm)	3.35	3.51	3.76	3.88	3.49	3.13	**0.18**
Seed yield/plant (g)	20.1	20.2	23.8	27.3	31.8	18.0	**2.77**
1000- seed weight (g)	4.14	4.26	5.06	5.24	5.46	3.97	**0.08**
Seed yield /fed. (kg)	579.3	608.7	770.0	800.0	824.0	529.3	**27.5**
Oil %	48.38	47.93	51.14	50.80	54.53	46.53	**0.11**
2013 season							
Plant height (cm)	180.6	184.8	192.8	195.9	213.6	173.7	**9.3**
Branches /plant (No)	2.25	2.44	2.82	2.91	3.36	1.97	**0.12**
Fruiting zone length (cm)	94.2	99.2	96.5	100.2	98.0	100.4	**n.s**
Capsules /plant (no)	138.3	150.0	153.4	157.0	160.8	135.7	**14.52**
Capsule length (cm)	3.67	3.76	4.06	3.99	4.19	3.69	**0.22**
Seed yield/plant (g)	21.44	23.28	25.61	28.11	33.11	17.56	**2.85**
1000- seed weight (g)	4.24	4.34	5.05	5.24	5.48	4.13	**0.08**
Seed yield /fed. (kg)	564.7	603.3	721.3	754.0	811.3	522.7	**25.1**
Oil %	50.44	49.06	50.01	52.41	53.64	50.35	**0.75**

Table (10): Effect of weed control treatments on water consumptive use (CU), water use efficiency (WUE) and seed yield/ fed.

Weed control Treatments	Yield and moisture studies					
	CU (m^3/fed.)	Seed yield /fed. (kg)	WUE (Kg/m^3)	CU (m^3/fed.)	Seed yield /fed. (kg)	WUE (Kg/m^3)
	2012 season			**2013 season**		
Prometryn	1909.4 (45.5 cm)	579.3	0.304	1911. 7 (45.5 cm)	564.7	0.296
Bentazon	1948.1 (46.4 cm)	608.7	0.312	1951.2 (46.5 cm)	603.3	0.309
Prometryn + H.H once	2007.7 (47.8 cm)	770.0	0.384	2012.1 (47.9 cm)	721.3	0.358
Bentazon + H.H once	2061.6 (49.1 cm)	800.0	0.388	2066.8 (49.2 cm)	754.0	0.365
hand hoeing twice	2108.8 (50.2 cm)	824.0	0.391	2115.1 (50.4 cm)	811.3	0.384
Untreated (check)	1815.5 (43.2 cm)	529.3	0.291	1816.0 (43.2 cm)	522.7	0.288
L.S.D $_{0.05}$	**7.09**	**27.5**	**0.02**	**9.35**	**25.1**	**0.03**

Table (11): Effect of water regimes and cultivars on sesame yield and yield components and moisture studies in 2012and 2013 summer seasons.

Sesame characters	Water regimes						L.S.D. 0.05
	100 % FC		80 % FC		60 % FC		
	Shandaweel 3	Sohag 2000	Shandaweel 3	Sohag 2000	Shandaweel 3	Sohag 2000	
	2012 season						
Branches / plant (No)	2.22	3.59	1.88	3.38	1.73	2.93	**0.12**
Capsule /plant (No)	131.5	151.9	129.1	120.8	114.2	126.1	**13.08**
Capsule length (cm)	3.73	3.57	3.73	3.76	3.17	4.05	**0.26**
Seed yield/ plant (g)	22.2	29.5	21.9	25.6	19.3	22.7	**0.61**
CU (m^3/fed.)	2275.5	2229.7	2047.8	1984.4	1683.8	1630.0	**7.36**
WUE (Kg/m^3)	0.361	0.329	0.362	0.340	0.357	0.329	**0.02**
	2013 season						
Branches / plant (No)	2.13	3.49	1.75	3.25	1.63	2.83	**0.11**
Seed yield/ plant (g)	24.4	30.6	23.0	25.1	18.4	27.6	**3.06**

irrigation at 60 % of FC. The highest values of seed yield /plant were produced when sesame plants of Sohag-2000 cultivar were irrigated by 100 % of FC water compared to Shandaweel-3 cultivar with irrigation 60 % of FC.

3.9.2. Effect of the interactions between water regimes and weed control treatments

Results in Table (12) indicate that all interactions between water regimes and weed control treatments significantly affect dry weight of annual weeds in both seasons, meaning that the two factors act independently.

Hand hoeing twice, prometryn followed by hand hoeing once and bentazon followed by hand hoeing once gave the lowest dry weight of annual weeds under irrigation at 60 and 80 % of FC water regimes, compared to the same weed control treatments with irrigation at 100 % of FC water regime.

Results in Table (13) show that all interactions between water regime and weed control treatments had no significant effect for all characteristics of yield and yield components under study except for the number of branches

Table (12): Effect of the interaction between water regimes and weed control treatments on annual weeds in 2012and 2013 summer seasons.

Treatments		Dry weight of annual weeds (g/ m^2)					
		Broad leaved weeds	Grassy weeds	Total weeds	Broad leaved weeds	Grassy weeds	Total weeds
		2012 season			2013 season		
100 % FC	Prometryn	435.0	109.3	544.3	473.5	94.0	567.5
	Bentazon	35.2	241.2	276.4	54.4	257.7	312.1
	Prometryn + H.H	17.7	45.0	62.7	23.5	37.7	61.2
	Bentazon + H.H	18.7	32.7	51.4	13.7	40.8	54.5
	H.H. twice	8.8	0.0	8.8	11.2	0.0	11.2
	Untreated	665.7	257.7	923.4	614.2	290.3	904.5
80 % FC	Prometryn	362.0	89.5	451.5	435.0	39.0	474.0
	Bentazon	17.2	189.7	206.9	27.5	213.3	240.8
	Prometryn + H.H	20.6	36.3	56.9	22.5	17.0	39.5
	Bentazon + H.H	17.7	25.3	43.0	11.7	25.3	37.0
	H.H. twice	14.9	0.0	14.9	0.0	0.0	0.0
	Untreated	523.3	204.2	727.5	503.3	229.8	733.1
60 % FC	Prometryn	299.4	78.2	377.6	324.2	26.0	350.2
	Bentazon	14.9	162.8	177.7	18.2	168.7	186.9
	Prometryn + H.H	17.4	32.8	50.2	10.8	13.8	24.6
	Bentazon + H.H	8.7	27.3	36.0	0.0	9.6	9.6
	H.H. twice	11.3	3.3	14.6	0.0	3.3	3.3
	Untreated	357	177.8	534.8	432.5	188.0	620.5
L.S.D. at 5%		**50.53**	**22.14**	**54.48**	**53.17**	**39.85**	**69.47**

Table (13): Effect of the interaction between water regimes and weed control treatments on some studied traits in two summer seasons.

Treatments		Branches /plant (No)	Oil %	CU (m^3/fed.)	Branches /plant (No)	Seed yield/ plant (g)	CU (m^3/fed.)
		2012 season			2013 season		
100 % FC	Prometryn	2.50	48.3	2070.2	2.40	23.3	2075.8
	Bentazon	2.53	48.8	2384.7	2.43	23.5	2396.3
	Prometryn + H.H	3.18	51.7	2323.7	3.08	27.7	2334.0
	Bentazon + H.H	3.30	50.7	2297.3	3.20	34.3	2307.5
	H.H. twice	3.75	54.3	2247.2	3.65	35.3	2256.2
	Untreated	2.17	46.4	2192.5	2.08	20.8	2200.5
80 % FC	Prometryn	2.18	48.4	1880.3	2.05	18.2	1882.0
	Bentazon	2.48	47.8	2144.5	2.35	21.3	2151.5
	Prometryn + H.H	2.83	50.2	2111.7	2.70	26.8	2118.0
	Bentazon + H.H	2.88	51.1	2063.8	2.75	28.0	2069.2
	H.H. twice	3.43	54.6	1967.8	3.80	35.8	1971.2
	Untreated	1.98	46.0	1928.5	1.85	14.2	1930.8
60 % FC	Prometryn	2.07	48.5	1496.0	1.97	22.8	1490.2
	Bentazon	2.30	47.3	1797.3	2.20	25.0	1797.5
	Prometryn + H.H	2.45	51.6	1749.5	2.35	22.3	1748.3
	Bentazon + H.H	2.53	50.6	1661.8	2.43	22.0	1659.5
	H.H. twice	2.88	54.7	1629.3	2.78	28.2	1626.2
	Untreated	1.77	47.2	1607.3	1.67	17.7	1603.7
L.S.D. at 5%		0.21	0.21	12.28	0.21	4.93	16.20

/plant and water consumptive use in both seasons, oil % in the first season and seed yield/ plant in the second season. Using hand hoeing twice, prometryn treatment followed by hand hoeing once and bentazon treatment followed by hand hoeing once gave the highest values of all above characteristics under irrigation at 100 % of FC water regime, compared to the same weed control treatments with irrigation at 60 and 80 % of FC water regimes.

3.9.3. Effect of the interaction between cultivars and weed control treatments

Results in Table (14) show that all interactions between cultivars and weed control treatments had no significant effect for all characteristics under study, except for the number of branches/plant, oil % and water consumptive use in both seasons, broad leaved

Table (14): Effect of the interaction between cultivars and weed control treatments on weeds and some sesame studied traits in 2012and 2013 summer seasons.

Treatments		Broad leaved weeds (gm)	Total weeds (gm)	Branches / plant (No)	Capsule length (cm)	Oil %	Branches / plant (No)	Oil %
		2012 season					2013 season	
Shandaweel 3	Prometryn	346.0	438.3	1.58	3.44	48.4	1.69	49.3
	Bentazon	15.0	210.3	1.68	3.51	47.7	1.79	49.4
	Prometryn + H.H	15.8	54.4	1.94	3.54	51.3	2.06	51.4
	Bentazon + H.H	15.2	50.0	1.99	3.78	51.2	2.10	51.1
	H.H. twice	10.6	12.8	2.40	4.09	53.1	2.51	52.8
	Untreated	467.7	677.0	1.43	3.27	47.2	1.53	49.8
Sohag 2000	Prometryn	384.8	477.0	2.70	3.26	48.3	2.81	51.5
	Bentazon	29.9	230.3	2.98	3.50	48.2	3.09	48.7
	Prometryn + H.H	21.3	58.8	3.48	3.98	51.0	3.59	48.6
	Bentazon + H.H	14.8	37.0	3.60	3.68	50.4	3.71	53.7
	H.H. twice	12.7	12.7	4.09	4.01	55.9	4.20	54.5
	Untreated	563.0	780.1	2.30	3.08	45.9	2.41	50.9
L.S.D. at 5%		41.26	44.48	0.18	0.26	0.17	0.17	1.06

and total weeds in the first season. The effects of interaction between Sohag-2000 cultivar with hand hoeing twice, prometryn treatment followed by hand hoeing once and bentazon followed by hand hoeing once were the best than comparable treatments with Shandaweel-3. This may be owing to effect of the interaction between the cultivars with mechanical and chemical methods in controlling weeds in sesame or genetic potential of sesame Sohag 2000 cultivar.

3.9. 4. Effect of the interaction between water regimes, cultivars and weed control treatments

Results in Table (15) reveal that the effects of the interaction between water regimes, cultivars and weed control treatments were significant only on water consumptive use in both seasons at 0.05 levels.

Yield reduction at 60 % of FC water regime

Table (15):Effect of the interactions among water regimes, cultivars and weed control treatments on water consumptive use (CU) in 2012 and 2013 two summer seasons.

Treatments			CU (m^3/fed.)	CU (m^3/fed.)
Water regimes	**Cultivars**	**Weed control treatments**	**2012 season**	**2013 season**
100 % FC	**Shandaweel 3**	**Prometryn**	2180.3	2173.0
		Bentazon	2220.7	2212.0
		Prometryn + H.H	2283.0	2273.3
		Bentazon + H.H	2287.3	2277.7
		H.H. twice	2371.7	2360.7
		Untreated	2087.0	2081.3
	Sohag 2000	**Prometryn**	2220.7	2212.0
		Bentazon	2291.7	2282.3
		Prometryn + H.H	2332.0	2321.3
		Bentazon + H.H	2380.7	2369.7
		H.H. twice	2421.0	2408.7
		Untreated	2059.0	2064.7
80 % FC	**Shandaweel 3**	**Prometryn**	1876.0	1877.3
		Bentazon	1937.0	1940.0
		Prometryn + H.H	2050.7	2056.0
		Bentazon + H.H	2098.7	2104.7
		H.H. twice	2116.0	2122.7
		Untreated	1828.0	1828.7
	Sohag 2000	**Prometryn**	1981.0	1984.3
		Bentazon	1998.3	2002.3
		Prometryn + H.H	2077.0	2082.3
		Bentazon + H.H	2124.7	2131.3
		H.H. twice	2173.0	2180.3
		Untreated	1932.7	1935.3
60 % FC	**Shandaweel 3**	**Prometryn**	1592.3	1588.0
		Bentazon	1614.0	1610.7
		Prometryn + H.H	1631.3	1628.3
		Bentazon + H.H	1736.3	1735.0
		H.H. twice	1758.0	1757.3
		Untreated	1448.0	1441.3
	Sohag 2000	**Prometryn**	1622.3	1619.3
		Bentazon	1644.7	1641.7
		Prometryn + H.H	1692.3	1690.7
		Bentazon + H.H	1762.7	1761.7
		H.H. twice	1836.7	1837.7
		Untreated	1544.0	1539.0
L.S.D. at 5%			**17.36**	**22.90**

was higher than at 100 % of FC water regime. This may be due to vigorous of plant growth under water sufficient on competition of weeds and decreasing this vigorous at low level of water regime. Sohag-2000 cultivar was the highest in seed yield and water use efficiency compared to Shandaweel 3 cultivar.

CONCLUSION

Under the conditions of the present investigation, using hand hoeing twice, bentazon followed by H.H. once, prometryn followed by H.H. once with Sohag-2000 cultivar and irrigation at 80 % of FC which can be recommended as the best treatment for cultivating sesame under similar conditions of Sohag governorate, Egypt.

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تأثير نظم الرى و معاملات مقاومة الحشائش على محصول السمسم

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مركز البحوث الزراعية – الجيزة - مصر

ملخص

أقيمت تجربتان حقليتان بمزرعة محطة البحوث الزراعية بشندويل – سوهاج خلال موسمى 2012و 2013 لدراسة تأثير ثلاثة معاملات ري (الرى عند 100 و80 و 60% من السعة الحقلية) وستة معاملات لمقاومة الحشائش (مبيد بروميترين بمعدل 375 مادة فعاله / فدان ، مبيد بنتازون بمعدل 240 مادة فعاله / فدان ، مبيد بروميترين ومبيد بنتازون متبوعا بعزقة واحدة ، عزيق مرتين وبدون معاملة) وصنفين من السمسم (شندويل -3 وسوهاج-2000) على العلاقات المائية وإنتاجية بعض أصناف السمسم. أستخدم تصميم القطع المنشقة مرتين. أوضحت النتائج أن استخدام الرى عند 60% من السعه الحقليه أدى إلي انخفاض معنوى فى الوزن الجاف للحشائش الضيقه والعريضة والكلية مقارنة الرى عند 100% من السعه الحقلية. بينما أدى استخدام الرى عند 100% من السعه الحقلية وكذلك زيادة صفات طول النبات وطول الكبسولة وطول المنطقة الثمرية ووزن الألف بذرة والنسبة المئوية للزيت ومحصول البذور للفدان فى كلا الموسمين مقارنة بالرى عند 60% من السعه الحقلية . أدى زراعة الصنف سوهاج-2000 إلى انخفاض معنوى فى الوزن الجاف للحشائش الضيقة والعريضة الأوراق والحشائش الكلية وزيادة فى صفات طول النبات وعدد الأشطاء للنبات وعدد وطول الكبسولة ووزن الألف بذرة والنسبة المئوية للزيت ومحصول البذور للفدان عن الصنف شندويل 3 فى كلا الموسمين. أدى استخدام معاملات مقاومة الحشائش إلى نقص معنوي فى الوزن الجاف للحشائش الضيقة والعريضة الأوراق والكلية وذلك مقارنة بمعاملة الكنترول. حققت معاملة العز يق مرتين ومعاملة المبيد متبوعا بعزيق مرة واحدة أكبر إنخفاض فى وزن الحشائش وأعلى القيم بالنسبة لصفات طول النبات وعدد الأفرع/ نبات وعدد الكبسولات/ نبات ووزن البذور/ نبات ووزن الـ1000بذرة والنسبة المئوية للزيت ومحصول البذور/ فدان في الموسمين مقارنة بمعاملة الكنترول. بلغ الإستهلاك المائى للسمسم 2252.6 ، 2016.1 ، 1656.9 ، 2261.7، 2020.4 و 1654.2م3 /فدان عندما تم الرى عند 100% و80% و 60% من السعة الحقلية فى الموسمين على الترتيب – وسجل الرى عند 80% أعلى قيمة لكفاءة إستعمال للماء . سجل الصنف سوهاج- 2000 أعلى قيمة للإستهلاك المائى و لكفاءة إستعمال للماء.

يمكن تحت ظروف هذه الدراسة التوصية بزراعة صنف السمسم سوهاج-2000 واستخدام معاملة العز يق مرتين أو استخدام مبيد بروميترين أو مبيد بنتازون متبوعا بعزقة والرى عند (80 %) من السعة الحقلية للحصول على أعلى محصول من الزيت والسمسم لكل فدان.

المجلة العلمية لكلية الزراعة – جامعة القاهرة – المجلد (66) العدد الأول (يناير2015): 40-53.