J. Soil Sci. and Agric. Eng., Mansoura Univ., Vol. 3 (3): 389 - 400, 2012

WATER MANAGEMENT FOR SESAME UNDER DIFFERENT SOWING DATES

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ABSTRACT

The present investigation was conducted at Hawaret El-Maktaa village, El-Fayoum District, Fayoum governorate, Egypt, during 2010 and 2011 seasons to study the combined effect of sowing dates i.e. S_1: May 2^{nd}, S_2: May 16^{th} and S_3: May 31^{st} and scheduling irrigation treatments, i.e. irrigation at I_1: 0.7 cumulative pan evaporation (C.P.E.), I_2: 0.9 and I_3:1.1 C.P.E. on seed yield, yield components, seed oil content and some water relations of sesame crop (Shandaweel -3 cv.).The split-plot design with four replications was applied, where sowing dates were allocated to the main plots and the split ones were occupied with irrigation scheduling treatments. The main obtained results were as follows:-

Highly significant increases in plant height(179.22 180.50 cm), capsule number/plant (156.42, 165.70), seed weight/plant (19.88, 20.21 g) and seed yield (612.80, 605.89 kg fed^{-1}) in 2010 and 2011 seasons, respectively, resulted from planting on 2^{nd} May and irrigation at 1.1 C.P.E. interaction. The increases in1000-seed weight were not significant in the two seasons, while seed oil content % exhibited similar trend in the first season only.

Seasonal consumptive use (ET_C) averaged 51.05 and 49.83 cm in 2010 and 2011 seasons, respectively. Planting sesame on May 2^{nd} and irrigation at 1.1 C.P.E. gave the highest ET_C values i.e. 55.35 and 54.46 cm in the two successive seasons. Nevertheless, the lowest ET_C values i.e. 47.37 and 45.72 cm were detected from planting on May 31^{st} and irrigation at 0.7 C.P.E. in both seasons, respectively. The crop coefficient (K_C) average, under interaction of 1^{st} sowing date and irrigation at 1.1 C.P.E., were 0.45, 0.55, 0.85 and 0.64 for May, June, July and August, respectively.

The highest water use efficiency values i.e. 0.264 and 0.265 kg $seedsm^{-3}$ consumed water were obtained from planting on May 2^{nd} and irrigation at 1.1 C.P.E. interaction in 2010 and 2011 seasons, respectively. However, it is advisable to irrigate the early planted sesame crop according to 0.9 CPE treatment to obtain acceptable figure for water use efficiency and to save irrigation water as well.

Keywords: Sesame yield, yield components, sowing date, irrigation scheduling, 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 and introducing high - yielding varieties are needed for increasing sesame seed production. Lee *et al.* (1988), Bello(1997 and 1999), Okeleye *et al.* (1999), Olowe(2007), Bdran (2009) and Ogbonna and Umar-Shaoba (2011), revealed that sowing date effects were significant on seed yield and all the yield attributes and the highest seed yield was recorded under the early sowing date whereas, delaying sowing date led to a decrease in yield productivity by. Yousef *et al.* (1994) in Egypt, reported that delaying sowing date 3 or 6 weeks from Mid-

April decreased seasonal water consumption from 45.79 cm to 43.24 cm and 40.13 cm, respectively, and water use efficiency decrease from 0.397 kg seeds/m^3 water consumed to 0.373 and 0.263 kg seeds/m^3 water consumed, respectively.

The aim of irrigation scheduling is to keep soil moisture within a desired range, usually between field capacity (full point) and a predetermined refill point in order to avoid the problems resulted from either over or under – irrigation. Scheduling involves deciding when and how much water to apply and based on soil-based systems (monitoring soil moisture), climate-based systems or plant-based systems. Concerning climate-based systems, Phene *et al.* (1992) and Phene (1995) showed that frequent measurement of evaporation rates from an automated Class A evaporation pan corrected for water density and pan deformation errors can accurately estimate ET and be used as an irrigation scheduling tool. In addition, Ashraf *et al.* (2002) stated that the evaporation pan predicted the soil moisture close to that predicted by the gravimetric method and scheduling the irrigation, for wheat crop, saved about 50% of irrigation water irrespective of irrigation method used without affecting crop yield. As for irrigation scheduling based on monitoring the soil moisture, Ainer and Metwally (1987), El-Serogy *et al.* (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.

In the present research trials irrigation was scheduled, using climate – based system, via different coefficients , for the Cumulative Pan Evaporation records, under different sowing dates in order to find out the most proper interaction resulting in the sesame yield potential and optimizing crop water use efficiency as well.

MATERIALS AND METHODS

Two field experiments were carried out at Hawaret El-Maktaa village, El-Fayoum District, Fayoum governorate, Egypt during 2010 and 2011 seasons to study the effect of sowing dates and irrigation scheduling treatments on seed yield, yield components, , oil content and some sesame crop -water relations. Three sowing dates, i.e. S1: May 2nd , S2: May 16th and S3: May 31st were combined with three irrigation scheduling treatments according to the Cumulative Pan Evaporation (C.P.E.), i.e. irrigation at I_1: 0.7 , I_2: 0.9 and I_3:1.1 C.P.E. The split- plot design with four replicates was used, where sowing dates occupied the main plots and irrigation scheduling treatments allocated to the sub-plots. The sub-plot area was 21 m^2 (6.0 × 3.5 m) and contained 7 ridges 50 cm width. Sesame seeds (shandaweel-3 cv) at the rate of 4.0 kgfed^{-1} were planted in hills of 10 cm apart. At the 1st irrigation, the plants were thinned to be two plants/hill. Calcium super phosphate (15.5 P_2O_5) at rate of 200 kgfed^{-1} were added during seed bed preparation. Nitrogen fertilization (30 kg Nfed^{-1}) was applied in two equal doses at the 1st and 2nd irrigations. The preceding crop in the two seasons was Egyptian clover. Harvesting was done on August 28th and 29th for the first sowing date in 2010 and 2011 seasons, respectively. Harvest, for the 2nd and 3rd sowing dates was on September 10th in the two 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. Some 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 under each sub-plot.

I. Yield and yield component:

1- Plant height (cm) 2- No. of capsules plant^{-1} 3- Seed weight plant (g)
4- 1000-seed weight (g) 5- seed yield (kg fed^{-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)

Physical properties				Chemical properties	
Sand%	Silt%	Clay%	Texture classes	Organic matter%	$CaCo_3$%
28.22	23.95	47.73	Clay	1.58	7.25

Chemical analysis														
Soluble cations, meq/L				Soluble anions, meq/L				EC dS m^{-1}	pH 1:2.5 Extract	CEC Meq/ 100 g soil	Exchangeable Cations Meq/100 g soil			
Ca^{++}	Mg^{+}	Na^{+}	K^{+}	Cl^{-}	HCO_3^{-}	CO_3^{--}	SO_4^{--}				Ca^{++}	Mg^{++}	K^{+}	Na+
8.42	4.28	18.53	0.50	20.87	2.75	-	8.11	3.17	8.25	33.06	16.88	10.57	1.39	4.22

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^{-1})	Pan evaporation (mm day^{-1})
		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
September	2010	36.2	21.9	29.1	50	2.60	6.5
	2011	36.1	22.1	29.1	49	2.58	6.4

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 (%,g/g)	Wilting point (%,g/g)	Bulk density (g cm^{-3})	Available Moisture(%, g/g)	Available moisture (mm)
00-15	44.76	23.10	1.16	21.66	37.69
15-30	35.48	19.70	1.29	15.78	30.53
30-45	34.49	18.90	1.33	15.59	31.10
45-60	30.22	17.10	1.37	13.12	26.96

II. Crop- water relations:

1. Seasonal consumptive use (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 :-

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

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:

$$K_C = ET_C / ET_0 ....$$

Where

ET_C = Actual crop evapotranspiration(mm)

ET_0 = Reference evapotranspiration(mm).

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 fed^{-1}) / Seasonal crop water consumptive use (m^3 fed^{-1}).

On determining the irrigation time, pan evaporation records was multiplied by the different adopted coefficient, and irrigation was practiced as the two sides of the following formula were the same.

Pan evaporation record(mm) x assessed coefficient = Available soil moisture(mm) in the root zone,60 cm depth

Dates of irrigation and irrigation numbers for different treatments in 2010 and 2011 seasons are recorded in Table 4.

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RESULTS AND DISCUSSION

Yield and yield components:

Data in Table 5 indicate that early sowing date (May 2^{nd}) gave the highest averages of sesame seed yield and its components in 2010 and 2011 seasons. Delaying sowing date from 2^{nd} to 16^{th} of May significantly reduced plant height, capsules number plant^{-1}, seed weight plant^{-1}, 1000-seed weight, seed yield fed^{-1}. and seed oil percentage by 4.31, 11.67, 9.39, 2.35, 16.42 and 3.60%, respectively, in 2010 and by 3.85, 12.09, 8.26, 2.61, 8.91 and 3.60% in 2011 season, respectively. The lowest averages of seeds yield and its components were detected from the late sowing date (31^{st} of May). These results are consistent with those found by Mulkey *et al.* (1987), Lee *et al.* (1988), Ogunremi (1988), Bello(1997 and 1999), Okeleye *et al.*(1999), Olowe (2007), Badran (2009) and Ogbonna and Umar-Shaoba(2011).

Regarding the effect of scheduling irrigation treatments, data in Table 5 show that sesame seed yield and its components were significantly affected by irrigation scheduling treatments in both seasons. Irrigating sesame plant at 1.1 (C.P.E.) gave the highest averages of yield and its components, whereas irrigation at 0.7 (C.P.E.) gave the lowest ones in both seasons. Increasing irrigation scheduling coefficient from 0.7 to 1.1 C.P.E. significantly increased plant height, capsules number/plant, seeds weight/plant, 1000-seed weight, seeds yield/ fed. and seed oil percentage in 2010 season by 8.25, 34.29, 17.98, 7.02, 27.02 and 6.19%, respectively, and in 2011 season by 8.52, 30.54, 9.89, 8.02, 30.10 and 5.98%, respectively, These results may be referred to the effect of moisture stress (under 0.7 C.P.E. 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 Yousef *et al.* (1994).

Data in Table 5 indicate that the seeds yield and its components were significantly affected by the interaction between sowing dates and irrigation scheduling treatments except 1000-seed weight and seed oil percentage in first season and 1000- seed weight in second one. The highest averages of plant height, capsules number plant^{-1}, seed weight plant^{-1}, 1000-seed weight, seed yield fed^{-1}. and seed oil percentage were detected from planting sesame on May 2^{nd} and irrigating at 1.1 C.P.E. in both seasons. On the other hand, the lowest averages of yield and its components were resulted from planting sesame in May, 31^{st} as interacted with irrigation at 0.7 C.P.E. in both seasons of study.

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Crop-water relationships:

Seasonal consumptive use (ET_C)

Results in Table 6 indicate that seasonal consumptive use or evapotranspiration (ET_c) of sesame crop, as a function of sowing dates and irrigation scheduling treatments were, 51.05 and 49.83 cm in 2010 and 2011 seasons, respectively. The difference may be due to the variation in weather factors of the two seasons (Table, 3) and higher seeds yield in 2010 season. Early sowing dates treatments gave the highest values of sesame ET, i.e. 53.45 and 52.88 cm in the two successive seasons. Moderate or late sowing date decreased seasonal ET_c in 2010 season by 5.72 and 7.75% and by 7.09 and 10.19% in 2011 season, respectively, compared with early sowing date. The present results may be referred to the shorter periods of crop duration under both moderate and late sowing dates, comparable with early sowing.

Regarding the effect of scheduling irrigation treatments, data in Table 6 show that irrigating sesame at 1.1 C.P.E. produced the highest values of ET_c which reached 52.75 and 51.44 cm in 2010 and 2011 seasons, respectively. The lowest ET_c values i.e. 49.24 and 47.89 cm were resulted from irrigating at 0.7 C.P.E. in two successive seasons. Moreover, irrigation at 0.9 C.P.E. decreased ET_C by 3.01 and 2.49 % in 2010 and 2011 seasons, respectively, comparable with that irrigated at 1.1 C.P.E. This could be attributed to increasing the available soil moisture in the root zone of sesame plants under irrigation at 1.1 C.P.E. 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 0.9 or 0.7 C.P.E., 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 *et al.* (1998), Attia *et al.* (1999), Ghallab *et al.* (2001) and El-Naim and Ahmed (2010).

Table 6: Averages of seasonal consumptive use (ET_{C}, cm) of sesame crop as affected by sowing date and scheduling irrigation treatments in 2010 and 2011 seasons

Scheduling Irrig. / Sowing date*	2010 season Pan evaporation coefficient			Mean	2011 season Pan evaporation coefficient			Mean
	0.7	0.9	1.1		0.7	0.9	1.1	
S_1	51.68	53.32	55.35	**53.45**	51.09	53.09	54.46	**52.88**
S_2	48.66	50.51	52.00	**50.39**	46.87	49.77	50.74	**49.13**
S_3	47.37	49.65	50.91	**49.31**	45.72	47.62	49.13	**47.49**
Mean	**49.24**	**51.16**	**52.75**	**51.05**	**47.89**	**50.16**	**51.44**	**49.83**

*** S1, S2 and S3 are referred to May 2nd , May 16 th and May 31 st sowing dates, respectively**

Data in Table 6 indicate that early sowing date as interacted with irrigating at 1.1 C.P.E., gave the highest values of ET_c which comprised 55.35 and 54.46 cm in 2010 and 2011 seasons, respectively. Nevertheless, the lowest ET_c values, i.e. 47.37 and 45.72 cm in the two successive seasons were obtained from the interaction between late sowing date and irrigation at 0.7 C.P.E.

Reference evapotranspiration (ET_0)

Reference evapotranspiration rate (ET_0) in mm day^{-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 7). 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.

Crop coefficient (K_c)

The crop coefficient (K_c) is an unitless fraction reflects the crop cover percentage and estimated by dividing ET_c over the ET_0. Data in Table 7 show the K_C values of sesame crop under first sowing date and irrigation at 1.1 C.P.E., as the interaction gave the highest seeds yield/fed. Results in Table 7 reveal that in both seasons, the K_C values were low at the initial growth stage (May), then increased at June as the plant cover percentage increased to reach the maximum values during July (maximum plant growth, flowering and seed setting period). The K_C values decreased again during August as plants reaching maturity and harvesting. These results are due to that at the initial growth period, the low K_C values are mainly due to high diffusive resistance of bare soil. The diffusive resistance decreased as plants become dry and transpiration decreased to very low rates. These results are in agreement with those reported by Ainer and Metwally (1987), El-Serogy *et al.* (1998), Attia *et al.* (1999), Ghallab *et al.* (2001) and El-Naim and Ahmed (2010).

Table 7: Crop coefficient values under first sowing date and irrigation at 1.1 C.P.E, as the interaction resulted in the highest sesame yield, in 2010 and 2011 seasons

Month	2010 season			2011 season		
	ET_0 (mm)	ET_C (mm)	K_C	ET_0 (mm)	ET_C (mm)	K_C
May	6.3	2.84	0.45	7.0	3.08	0.44
June	8.3	4.65	0.56	7.7	4.16	0.54
July	7.8	6.12	0.78	7.8	6.40	0.82
August	7.4	4.88	0.66	7.3	4.46	0.61

Water Use Efficiency (WUE)

Results in Table 8 show that WUE average values, as affected by sowing date and scheduling irrigation treatments were 0.208 and 0.217 kg seeds m^{-3} water consumed in 2010 and 2011 seasons, respectively. The highest water use efficiency values of 0.239 and 0.237 kg seeds m^{-3} water consumed in 2010 and 2011 seasons, respectively, were obtained from early sowing date, whereas, the lowest values, i.e. 0.173 and 0.184 kg seeds $/m^3$

water consumed in the two successive seasons were obtained from the late sowing date May 31st.

Regardless sowing dates, data in Table 8 reveal that the highest WUE values, i.e. 0.230 and 0.236 kg seeds m^{-3} water consumed in 2010 and 2011 seasons, respectively, were detected from irrigating sesame plants at 1.1 C.P.E. Irrigation at 0.7 C.P.E. gave the lowest WUE values, i.e. 0.180 and 0.189 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 *et al.* (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 sowing date and scheduling irrigation treatments in 2010 and 2011 seasons

Sowing Date*	2011 season				2010 season			
	Pan evaporation coefficient				Pan evaporation coefficient			
	0.7	0.9	1.1	Mean	0.7	0.9	1.1	Mean
S_1	0.201	0.253	0.264	**0.239**	0.203	0.247	0.265	**0.237**
S_2	0.189	0.212	0.235	**0.212**	0.201	0.211	0.242	**0.218**
S_3	0.149	0.179	0.190	**0.173**	0.162	0.191	0.200	**0.184**
Mean	**0.180**	**0.215**	**0.230**	**0.208**	**0.189**	**0.216**	**0.236**	**0.217**

*** S1, S2 and S3 are referred to May 2nd , May 16 th and May 31 st sowing dates, respectively**

Under the present experiment conditions and on managing the limited irrigation water efficiently, it is advisable to irrigate the early planted sesame crop (2nd May) according to 0.9 CPE to obtain reasonable figure for water use efficiency and to save irrigation water as well.

REFERENCES

Ainer, N. G. and M. A. Metwally (1987). Effect of antitranspirants on seed yield and water relations of sesame crop. Ann. of Agric. Sci., Moshtohor, 25(1): 79-85.

Allen, R.G.; L.S. Pereio; D.S. Raes and M.D. Smith (1998). Crop evapotranspiration. Guidelines for computing crop water requirements. Irrigation and Drainage, PP No.56.FAO, Rome, Italy.

Ashraf, M.; M. M. Saeed and M. N. Asgher (2002).Evaporation Pan: A Tool for Irrigation Scheduling. Journal of Drainage and Water Management, Vol.6(1) :45 -51.

Attia, M. M.; A. M. Osman,; M. A. Sayed and A.A. El-Kafoury (1999). Effect of irrigation intervals and row width on yield, water use efficiency and some economic studies on sesame in calcareous soil. Third conference of on-farm irrigation and agroclimatology. Vol. 1(No. 2): 525-533.

Badran, M. S. S.(2009). Effect of intercropping system and sowing times on productivity of sesame crop intercropped with maize under newly planted sandy soil conditions. Alex. J. Agric. Res. Vol. 54, No. 1: 9-17.

Bello, N. J. (1997). An investigation of the agro-climatic potential of the forest-Savanna transition zone of Nigeria. Exp. Agric., 33: 157-171.

Bello, N. J. (1999). Investigating the optimum planting date for sorghum in the forest-Savanna transition zone of Nigeria. Exp. Agric., 35: 461-470.

El- Naim, M. A. and Ahmed M. F. (2010). Effect of irrigation on consumptive use, water use efficiency and crop coefficient of sesame J. Agric. Extension and Rural Dev., Vol. 2 (4): 59-63.

El-Serogy, S. T. M. A. (1988). Agricultural studies on growth yield and yield components of sesame. Ph.D. Thesis, Agron., Fac. Agric., Minia Univ., Egypt.

Ghallab, K. H.; K. M. R. Yousef and Megawer, Ekram A. (2001). Yield and water relations of some promising sesam lines grown in new reclaimed soils. Ann. Agric. Sci., Moshtohor, Vol. 39(4): 1977-1992.

Israelsen, O. W. and V. E. Hansen (1962). Irrigation principles and practices. The 3rd ed. John, Wiley and Sons Inc., New York.

Klute, A. (1986). Methods of Soil Analysis. Part-1: Physical and Mineralogical Methods (2nd ed.) American Society of Agronomy, Madison, Wisconsin. U.S.A.

Lee, B. H.; J. I Lee; Lee, S. T. and R. K. Park (1988). Response of growing and flowering to day length and temperature in sesame cultivars. Res. Report of the Rural Development Administration, Upland and Industrial crops. Korea Repub., 30(1): 35-40. (c.f. Field Crop Abst., 42(10): 8225, 1989).

Mulkey, J. R.; H. J. Drawe and R. E. Jr. El-Ledge, (1987). Planting date effects on plant growth and development in sesame. Agron. J., 79(4): 701-703.

Ogbonna, B. E. and Y. G. Umar-Shaaba (2011). Yield responses of sesame to rates of poultry manure application and time of planting in a derived Savannah ecology of South Eastern Nigeria. African J. of Biotechnology. Vol. 10(66) 1488-14887.

Ogunremi, E. A. (1988). Cultivation of early season sesame in South West Nigeria: period of sowing. East African, Agric. And Forestry J., 51(2): 82-88. (c.f. Field Crop Abst., 41 (2): 9278,1988).

Okeleye, K. A.; O. J. Ariyo and V. I. O. Olowe (1999). Evaluation of early and medium duration cowpea cultivars for agronomic traits and grain yield. The Nigerian Agric. J., 30: 1-11.

Olowe, V. I. O. (2007). Optimum planting date for sesame (*sesamum indicum* L.) in the transition zone of South West Nigeria. Agric. Tropica Et Sub-Tropica. Vol. 40(4).

Page, A.L.; R.H. Miller and D.R. Keeney (eds.) (1982). Methods of Soil Analysis. Part-2: Chemical and Microbiological Properties. (2nd ed.) American Society of Agronomy, Madison, Wisconsin. USA.

Phene, R.C. (1995). Class "A" evaporation pan for irrigation scheduling in real-time. Proc. Inter. Expo. And Tech. Conf., Phoenix, AZ. p153-160.

Phene, C.J.; W.R. DeTar and D.A. Clark (1992). Real-time irrigation scheduling of cotton with an automated pan evaporation system. App. Engineer in Agric, 8(6):787-793.

Snedecor, G.W. and W.G. Cochran (1980). Statistical Methods. (7th ed.) Iowa State Univ. Iowa, U.S.A.

Vites, F. G. (1965). Increasing water use efficiency by soil management in plant environment and efficient water use. J. American Soc. Agron., 26: 537-546.
Yousef, K. M. R.; F. I. GAB-Alla and H. M. Eid (1994). Effect of sowing date and planting density on seed yield and water consumptive use of sesame. Egypt J. Appl. Sci. 9(5) : 644-660.

ادارة المياه في محصول السمسم تحت مواعيد زراعة مختلفة

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معهد بحوث الاراضى والمياه والبيئة – مركز البحوث الزراعية – الجيزة - مصر

أقيمت هذة الدراسة بقرية هوارة المقطع- مركز الفيوم- محافظة الفيوم خلال موسمي 2010 ، 2011 لدراسة تأثير التفاعل بين مواعيد الزراعة (2 مايو ، 16 مايو ، 31 مايو) مع معاملات لجدولة الري (0,7 ، 0,9 ، 1,1 من البخر التراكمي لوعاء البخر القياسي) علي محصول البذور ومكونات المحصول ونسبة الزيت بالبذور في محصول السمسم (شندويل 3). في تصميم القطع المنشقه مرة واحدة في اربعة مكررات. وفيما يلي أهم النتائج المتحصل عليها:-

أوضحت الدراسة تفوق الزراعة يوم 2 مايو والري عند 1,1 من بخر الوعاء التراكمي في زيادة محصول السمسم ومكوناتهارتفاع النبات (179.22 180.50سم) ، عدد الكبسولات بالنبات (156.42- 165.70)، وزن بذور النبات (19.88-20.21 جم) ومحصول الفدان (612,80 ، 605,89 كجم/فدان) في موسمي 2010 ، 2011 . وقد كانت الزيادة في وزن ال 1000 بذرة وكذا نسة الزيت بالبذور في الموسم الاول وكذا وزن ال 1000 بذرة بالموسم الثاني غير معنوية.

وصل المتوسط العام الاستهلاك المائي الموسمي الي (51,05 ، 49,83 سم) في موسمي 2010، 2011 علي الترتيب. وكانت اعلي قيم للاستهلاك المائي الموسمي وهي (55,35 ، 54,46 سم) وذلك عند الزراعة عند 2 مايو والري عند 1و1 من البخر التراكمي لوعاء البخر القياسي في موسمي الزراعة علي الترتيب وكانت أقل قيم للاستهلاك المائي الموسمي (47,37 ، 45,72 سم) عند الزلراعة يوم 31 مايو والري عند 0,7 من البخر التراكمي لوعاء البخر القياسي في الموسمين المتعاقبين علي التوالي. كان معامل المحصول للمعاملة التي اعطت اعلي محصول للفدان هي 0,45 ، 0,55 ، 0,84 ، 0,63 لشهور مايو ، يونيو ، يوليو، اغسطس علي الترتيب (كمتوسط للموسمين). بلغت أعلي كفاءة في استخدام ماء الري (0,264 ، 0,265 كجم /م3 ماء مستهلك) في موسمي 2010 ،2011 علي الترتيب عند الزراعة يوم 2 مايو والري عند 1,1 من البخر التراكمي لوعاء البخر القياسي.

قام بتحكيم البحث

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Table 4: Dates and irrigation numbers for sesame crop under studied sowing dates* and irrigation scheduling treatments in 2010 and 2011 seasons

Irrigation event	2010 season									2011 season								
	S_1			S_2			S_3			S_1			S_2			S_3		
	Pan evaporation coefficient			Pan evaporation coefficient			Pan evaporation coefficient			Pan evaporation coefficient			Pan evaporation coefficient			Pan evaporation coefficient		
	0.7	0.9	1.1	0.7	0.9	1.1	0.7	0.9	1.1	0.7	0.9	1.1	0.7	0.9	1.1	0.7	0.9	1.1
	Date of irrigation			Date of irrigation			Date of irrigation			Date of irrigation			Date of irrigation			Date of irrigation		
Planting	2/5	2/5	2/5	16/5	16/5	16/5	31/5	31/5	31/5	2/5	2/5	2/5	16/5	16/5	16/5	31/5	31/5	31/5
1st	23/5	23/5	23/5	5/6	5/6	5/6	20/6	20/6	20/6	22/5	22/5	22/5	6/6	6/6	6/6	21/6	21/6	21/6
2nd	15/6	10/6	5/6	29/6	23/6	19/6	14/7	10/7	4/7	14/6	9/6	6/6	30/6	24/6	19/6	15/7	11/7	5/7
3rd	1/7	28/6	18/6	22/7	10/7	3/7	7/8	28/7	18/7	2/7	27/6	20/6	23/7	11/7	4/7	9/8	28/7	20/7
4th	23/7	16/7	2/7	13/8	28/7	17/7	30/8	12/8	1/8	24/7	16/7	4/7	15/8	30/7	18/7	31/8	13/8	2/8
5th	16.8	2/8	21/7	-	15/8	30/7	-	30/8	15/8	17/8	3/8	20/7	-	16/8	31/7	-	31/8	16/8
6th	-	19/8	4/8	-	-	18/8	-	-	29/8	-	-	6/8	-	-	19/8	-	-	30/8
7th	-	-	16/8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Harvest	28/8	28/8	28/8	2/9	2/9	2/9	10/6	10/6	10/6	29/8	29/8	29/8	3/9	3/9	3/9	3/9	3/9	3/9
Irrigation count	6	7	8	5	6	7	5	6	7	6	7	8	5	6	7	5	6	7

*** S1, S2 and S3 are referred to May 2nd , May 16 th and May 31 st sowing dates, respectively**

Table 5: Averages of sesame yield and yield components as affected by sowing dates and scheduling irrigation treatments in 2010 and 2011 seasons

Treatments		2009 season						2010 season					
Sowing date*	Pan evaporation coefficient	Plant Height (cm)	Capsules N° plant^{-1}	Seed weight plant^{-1} (g)	1000-seed Weight (g)	Seed yield (kg fed^{-1})	seed oil (%)	Plant Height (cm)	Capsules No plant^{-1}	Seed weight plant^{-1} (g)	1000-seed Weight (g)	Seed yield (kg fed^{-1})	seed oil (%)
S_1	0.7	163.81	105.41	15.88	3.26	435.20	49.71	164.91	112.3	18.63	3.29	435.86	50.03
	0.9	170.40	132.60	17.93	3.40	565.60	51.67	171.40	141.5	19.25	3.46	551.63	51.92
	1.1	179.22	156.42	19.88	3.54	612.80	52.88	180.50	165.7	20.21	3.61	605.89	52.90
Mean		**179.22**	**131.48**	**17.90**	**3.40**	**537.87**	**51.42**	**172.27**	**139.83**	**19.36**	**3.45**	**531.13**	**51.62**
S_2	0.7	157.4	90.80	14.91	3.21	386.40	47.57	159.29	100.8	16.89	3.24	395.21	47.75
	0.9	162.12	117.40	16.01	3.33	449.30	50.11	164.12	125.6	17.58	3.35	440.52	50.42
	1.1	171.50	140.21	17.74	3.42	512.90	51.03	173.51	142.4	18.82	3.48	515.65	51.12
Mean		**171.50**	**116.14**	**16.22**	**3.32**	**449.53**	**49.57**	**165.64**	**122.93**	**17.76**	**3.36**	**483.79**	**49.76**
S_3	0.7	149.36	79.14	13.12	3.06	296.30	46.89	150.86	90.1	15.59	3.10	310.91	46.92
	0.9	157.62	100.72	14.82	3.18	372.50	48.11	159.71	110.3	16.68	3.25	381.52	48.21
	1.1	162.20	122.40	15.92	3.31	406.10	49.77	165.30	128.4	17.71	3.37	412.10	49.89
Mean		**162.20**	**100.75**	**14.62**	**3.18**	**358.30**	**48.26**	**158.62**	**109.60**	**16.66**	**3.24**	**368.18**	**48.34**
Irrigation Mean													
0.7		156.86	91.78	14.64	3.18	372.63	48.06	158.35	101.07	17.04	3.21	380.66	48.23
0.9		163.38	116.91	16.25	3.30	462.47	49.96	165.08	125.80	17.84	3.35	457.89	50.18
1.1		170.97	139.68	17.85	3.42	510.60	51.23	173.10	145.5	18.91	3.49	544.55	51.30
L.S.D: 0.05													
S		0.62	4.95	0.43	0.12	58.46	0.20	0.58	1.23	0.10	0.12	1.26	0.28
I		0.28	1.97	0.29	0.10	10.96	1.21	0.23	0.57	0.06	0.04	0.75	0.07
S×I		0.49	3.41	0.51	N.S	18.99	N.S	0.40	0.99	0.11	N.S	1.30	0.13

*** S1, S2 and S3 are referred to May 2nd , May 16 th and May 31 st sowing dates, respectively**