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ROLE OF IRRIGATION ON YIELD AND SOME WATER RELATIONS OF SUNFLOWER AT NORTH Nile Delta.

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ABSTRACT

Two field experiments were conducted at Sakha Agricultural Research station, Kafr EL-sheikh Governorate North Nile Delta region during both seasons of 1998 and 1999 to find out the impact effects of timing of the first (A) and last (B) irrigation of sunflower on yield and its water relations.

The results showed that treatment of irrigation at 21 (A_2) days after sowing (DAS) and the last irrigation at 21 (B_2) days before harvesting (DBH) resulted in higher yield of 1.71 t./fed , seasonal crop water duties of 2374 m3/fed or 56.5 cm depth and contribution in saving irrigation water equaled 318 m^3/fed (11.8%) in comparison with that of the traditional irrigation regime of the first irrigation at 14 days after sowing and the last irrigation at 14 days before harvesting. This saving in irrigation water amounted 9.6 million m^3 for the national average of sunflower .In addition, seasonal crop water consumed " ETc " is 1216.6m^3/fed or 29.0 cm. with rate of 3.1 mm/day.Higher water efficiencies could be obtained with this promising treatment since values were 1.4 and 0.72kg./m^3 as water use efficiency (W.U.E.) and water utilization efficiency (W.UT.E.) ,respectively.

Therefore , it may be recommended to implements treatment A_2B_2 as an irrigation regime of sunflower in north Nile Delta ,in case of the availability of irrigation water .Otherwise ,in case of water shortage in summer , it is useful to follow treatment A_3B_1,ie , first irrigation at 28 days after sowing and last irrigation at 28 days before harvesting.

INTRODUCTION

Egypt is becoming more and more a water poor country. The per capita share of water which is now at the level of 1000m^3/person/year,which is just on the boarder of the so-called poverty line ,and is expected to go further down with time .On the other hand , Egypt is facing a serious shortage in edible oil production. At present, the national yield of edible oil is about 20% from the annual demand. Meaningfully, the gap between production and consumption of edible oil is amounted to be about 80 %.

Sunflower is considers as one of the main edible oil crop in Egypt as well as world wide. This is due to the refine high technological quality features of its oil from human health point of view.

Studies on the role of irrigation on yield and quality of sunflower were carried out by some researchers such as; Kassab (2003) , Ashoub,et al (2000),AbdelGawad et al (1997),Nandhagopal et al. (1996),Al Ghamdi et al (1999),Jana et al(1982) and Stegmen and Lemert (1981).

Among the main points which should be investigated are the timing of the first irrigation after sowing and when to stop sunflower irrigation.Therefore, the aim of this study was to find out the effect of irrigation timing of both the first and last watering on yield and crop- water relations of sunflower.

Layout of the experiment:

Two field trial experiments were conducted at the Crops Water Requirments Research Field, Sakha Agricultural Research Station, Kafr El_Sheikh Governorate during 1998 and 1999 seasons. The site of the experiment of field represents the circumstances and conditions of the middle north of Nile Delta regime .The location is situated at 31-07 N latitude, 30-57 E longitude with an elevation of 6 meters above mean sea level.

The soil is clayey in texture. Particle size distributions are tabulated in Table 1,according to (Black ,1965). In addition, soil-water parameters of field capacity (F.C), wilting point (W.P) and bulk density (Db) are also tabulated in Table (1).

Table (1): soil- water parameters, particle size distribution and texture of the experimental field .

Depth ,cm	F.C	W.P	A.W	Db	Sand	Silt	Clay	Texture
0-15	47.81	26.02	21.79	1.06	13.30	33.41	53.29	clayey
15-30	42.19	21.70	20.49	1.35	21.00	34.00	45.00	clayey
30-45	40.36	21.00	19.36	1.37	20.60	40.38	39.02	Clay-loam
45-60	38.04	20.05	17.99	1.39	22.00	40.50	37.50	Clay-loam
Mean	42.10	22.19	19.91	1.29	19.23	37.08	43.70	

F.C=field capacity. W.P=wilting point. A.W=available soil moisture. Db=bulk density.

The field has its own irrigation canal water is available continuously upon demand. The experimental field was divided into individual plots, each of 7 by 7.5 m. with an area of 52.5m2 (1/80 feddan). Each plot has its own inlet to regulate irrigation water with steel gate. Irrigation water was delivered through lining canal. Constructed rectangular weir is the device for measuring the applied irrigation water .Discharge of the weir is 0.01654 m3/sec.at 10 cm.effective head.

Procedures:

Sunflower variety Euroflore is one of the new recommended seeds in the Nile Delta region was sown on July 1, 1998 and July 7, 1999 at the rate of 4 kg . per feddan. Sowing dimensions were 65 cm. apart rows and 20 cm. between hills.

All cultural practices were implemented as recommended by department of Oil Research Crops, Field Crops Research Institute, Agriculture Research Center (A.R.C.).

The only factor under study was the irrigation regime based on the timing of the first and last waterings as follows:

A-Main treatment (timing of the first irrigation following sowing irrigation date):

1-irrigation at 14 days after sowing (DAS).
2-irrigation at 21 (DAS)
3-irrigation at 28 (DAS)

B-Sub treatment (last irrigation = when to stop irrigation):

1-stop irrigation at 28 days before harvesting (DBH).
2-stop irrigation at 21 (DBH) .
3-stop irrigation at 14 (DBH).

Other irrigations during the sunflower growing season were applied as followed by the local farmers. Irrigation water was measured and controlled by the fixed rectangular weir and the plot steel gates respectively.

Consumptive use (C.U.) or crop evapotranspiration (Etc) of sunflower was computed based on soil moisture depletion in the effective root zone as follows:

$$C.U. = Etc = \frac{F.C.-\theta 1}{100} * Db * d * A \quad (1)$$

where:

F.C. =field capacity on the weight basis,
θ1 = Soil moisture content before irrigation on the weight basis,
Db = bulk density, gm/cm^3,
d = effective root zone = 60 cm., and
A = irrigated area.

Yield-water efficiencies were computed as follows (Doorenbos et al, 1979):

W.UT.E. =Y/I.W. (2)

W.U.E. =Y/C.U (3)

as

W.UT.E. = water utilization efficiency (kg/m^3),
I.W. = irrigation water (m^3),
W.U.E. = water use efficiency (kg/m^3),
C.U. = consumptive use, and
Y= yield (kg/feddan).

Statistical design was complete randomized block split plot with four replicates. Yield and its components were statistically analyzed according to Sendecor and Cochran (1967).

RESULTS AND DISCUSSIONS

1-Crop yield:

Euro Flore sunflower variety is more suitable to the area under study of north Nile Delta due to its high crop yield as shown in Table (2). Mean maximum yield (Ym) of the two seasons was 1.71 ton/fed which produced under the conditions of first irrigation at 21 days after sowing and stop irrigation at 21 days before harvesting (Trt.A_2B_2).On the other hand , the lowest relative yield (y/ym) of 0.73 and 0.81 for the two seasons were resulted from A_3B_1 and A_3B_2 treatments respectively .This finding of getting the highest yield with A_2B_2 treatment might be attributed to the clayey soil which accompanied with high water retention , in addition to the high water table which lies in average at about 80 cm depth .

2- Irrigation Water (I .W.):

Irrigation water of sun flower in north Nile Delta region is in average varied between 2088.1 m3/f. or 49.7cm depth to 2692.5 m^3/fed .or 64.1 cm depth. The previous values (quoted from Table 2) resulted from treatments A_3B_1 and A1 B3, respectively. Since , there is no significant difference among different treatments in relation to sunflower seed yield ,therefore, the least amount of applied irrigation water (I .W.) is considered as the proper water

duty of sunflower in north Nile Delta region which equaled about 2090 m3 /fed or about 50 cm depth , in case of irrigation water shortage . This amount resulted from treatment $A_3 B_1$ i.e. the first irrigation at 28 days after sowing and the last irrigation also at 28 days before harvesting. On the other hand, in case of the availability of irrigation water.,it is advisable to follow the irrigation regime as treatment A_2B_2 i.e. the first irrigation at 21 days after sowing and the last irrigation at 21 days before harvesting. The corresponding mean water duty is about 2375 m3/fed .or about 64 cm depth distributed over 5 irrigation including the sowing one .The abovementioned treatment has increasing trend in seed yield with about 0.3 ton/fed in comparison with that obtained from the least amount of irrigation water. that resulted from treatment A_3B_1 .

3-Consumptive use (C.U.):

Average consumptive use (C.U.) or so-called actual crop-water consumed during the growing season varies from 985.7 m^3 or 23.5 cm to 1573.7 m^3/fed or 37.5cm depth depending upon the irrigation regime. Mean C.U. for the two seasons of treatments which resulted in the highest seed yield (Trt.A_2B_2) was 1217m^3/fed or 29 cm .depth with seasonal C.U. rate of 3.1mm./day.

4-Crop _Water efficiencies:

Water use efficiency (W.U.E., kg./ m^3)reflects the yield obtained from each unit of consumed water (ET_C) and water utilization efficiency W.UT.E.,kg/m^3) assigned to the yield /water supply ratio .In other words ,both definitions used to identify the capability of both water consumed by growing plants and seasonal water applied in producing the marketable yield. The highest average value of W.U.E. is 1.53 kg./m^3 while the highest mean value of W.UT.E is 0.69 kg./m^3 (quoted from Table 2).

5-Growth attributes:

Plant height, stem diameter and flower diameter were measured to identify the role of irrigation regime on such data .In average seasonal values are, 135.9; 1.8m^3 and 17.5 cm.depth for the stated attributes respectively.

Conclusions and Remarks :

There is no significant difference among different treatments in relation to marketable sunflower seed yield, which might be due to the heavy clayey soil in texture with its high water holding capacity along with the high water table in the situe with a seasonal average value of about 80 cm.depth. Therefore, by following the irrigation regime of treatment A_2B_2 i.e. first irrigation at 21 days after sowing DAS and last irrigation at 21 days before harvesting DBH, the following advantages could be gained:

1-The highest sunflower seed yield of 1.71 ton/fed., could be obtained in north Nile Delta region.

2-Seasonal water duty of sunflower in north Nile Delta region is 2374.0 m^3/fed.or 56.5 cm depth .distributed over 6 irrigation including that of sowing one . Saving irrigation water in comparison with that of the traditional water regime in the area i.e. the first watering at 14 days after sowing and the last irrigation at 14 days before harvesting (Trt.A_1B_3) is

about 318m3/fed.or 11.8% which equals about 9.6 million m^3 for the national acreage of about 30,000 fed.

3-Mean seasonal sunflower water consumed (C.U). is 1216.6m3/fed or 29.0 cm depth. with its rate of 3.1 mm./day.

4-Higher crop-water efficiencies in average of 1.40 and 0.72 kg./m3 in relation to consumed and applied water or so-called water use and water utilization efficiencies i.e. W.U.E. and W.UT.E., respectively.

5_Regarding g rowth a ttributes, m ean values of plant height, stem diameter and flower diameter are 136.2 , 2.0 and 18.0 cm.depth respectively.

Table (2): yield of sunflower, its water relations and its yield attributes as affected by different irrigation regime during the two seasons .

1st,irr.	A_1			A_2			A_3		
Last irr.	B_1	B_2	B_3	B_1	B_2	B_3	B_1	B_2	B_3
	The First season								
Y,T,f	1.43	1.37	1.39	1.35	1.77	1.34	1.33	1.82	1.51
Y\ym	0.79	0.75	0.76	0.74	0.97	0.74	0.73	1.00	0.83
	Irrigation water(seasonal) in m^3\fed. and cm depth								
m^3.fed	2304.1	2608.4	2674.6	2118.8	2357.0	2581.9	2085.2	2389.5	2459.5
cm	54.9	62.1	63.7	50.4	56.1	61.5	49.6	56.9	58.6
	Consumptive use(seasonal) in m^3\fed. and cm depth								
M^3.f	1227.7	1300.3	1573.7	1200.8	1260.0	1392.3	985.7	1070.2	1213.8
cm	29.2	31.0	37.5	28.6	30.0	33.2	23.5	25.5	28.9
	Efficiencies in $kg.m^3$								
WUE	1.16	1.05	0.88	1.12	1.40	1.21	0.96	1.70	1.24
WUTE	0.62	0.53	0.52	0.64	0.75	0.52	0.64	0.76	0.61
	Growth characters								
Pl.h.cm	131.2	128.9	143.0	136.8	130.7	128.9	311.6	129.9	121.2
St.d.cm	1.8	1.8	1.9	2.0	1.9	2.0	1.8	1.9	1.6
Fl.d.cm	16.2	17.5	18.6	17.2	17.9	17.7	18.0	17.4	16.2
	The Second season								
Y,T,f	1.47	1.62	1.46	1.59	1.64	1.68	1.41	1.36	1.47
Y\ym	0.88	0.96	0.87	0.95	0.98	1.0	0.84	0.81	0.88
	Irrigation water(seasonal) in m^3\fed. and cm depth								
M^3.f	2350.4	2690.6	2710.3	2190.7	2390.9	2599.4	2090.9	2400.6	2470.7
cm	56.0	64.1	64.5	52.2	56.9	61.9	49.8	57.2	58.8
	Consumptive use(seasonal) in m^3\fed . and cm depth								
M^3.f	1143.2	1298.2	1489.3	1115.9	1173.1	1316.3	1028.2	996.7	1206.2
cm	27.2	30.9	35.5	26.6	27.9	31.3	24.5	23.7	28.7
	Efficiencies in $kg.m^3$								
WUE	1.29	1.25	0.98	1.42	1.40	1.28	1.37	1.36	1.22
WUtE	0.63	0.60	0.54	0.73	0.69	0.65	0.67	0.57	0.59
	Growth characters								
Pl.h.cm	140.9	141.7	135.3	135.5	141.6	136.4	149.6	144.3	138.5
St.d.cm	1.7	1.7	1.7	1.8	2.0	2.0	1.7	1.8	1.7
Fl.d.cm	17.5	17.9	17.7	16.3	18.0	17.8	16.5	18.5	18.5

1st, irr = the first irrigation after sowing — **Last irr = last irrigation before harvesting**

Pl.h.cm= plant height in cm. — **St.d.cm = stem diameter in cm**

Fl.d.cm = head diameter in cm — **Y,T,f = seed yield in ton per feddan**

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الرى وأثرةعلى المحصول وبعض العلاقات المائية لعباد الشمس بشمال دلتا النيل

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أقيمت تجربتين حقليتين بمحطة البحوث الزراعية بسخا –محافظة كفر الشيخ والتى تمثل منطقة شمال الدلتا وذلك خلال عامى١٩٩٨ و١٩٩٩م تهدف الى دراسة أثر موعد كلا من رية المحاياة (الاولى بعد رية الزراعة) والرية الاخيرة على محصول عباد الشمس وكذا بعض العلاقات المائي.وقد اوضحت الدراسة أن اعطاء رية المحاياة بعد٢١ يوما من الزراعة مع وقف الرى قبل٢١ يوما من الحصاد –ادت الى احسن النتائج–بالحصول على ١,٧١ طن/ فدان= ١، ٤ طن/هكتار من بذرة عباد الشمس با حتياج مائى قدره ٢٣٧٤ م٣/فدان فى الموسم –بوفر ٣١٨ م٣/فدان اوحوالى(٦،٩ مليون م٣ على المستوى القومى) مقارنة برية المحاياة بعد ١٤ يوم من الزراعة واستمرار حتى ١٤ يوما قبل الحصاد مؤدية الى استهلاك مائى موسمى قدره ١٢١٦ م٣ /فدان = ٢٩ سم بمعدل٣،١ مم/يوم. وهذه المعاملة أدت الى كفاءة استعمال أعلى تقدر بمقدار ١,٤ ،٧٢، ٠ كجم/م٣ ماء مستهلك وماء رى على الترتيب. وفى حالة نقص مياة الرى خلال موسم الصيف فتوصى الدراسة بتأخيررية المحاياة الى ٢٨ يوما من الزراعة مع ايقاف الرى قبل ٨ ٢ يوما من الحصاد.