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IMPACT OF IRRIGATION AND MAGNESIUM FERTILIZATION ON YIELD, YIELD COMPONENTS AND CHEMICAL CONTENTS OF SUNFLOWER

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Ashoub[1], M.A.; I.M.A. Abdel-Aziz[2]; M.M. Shahin[2]; and M.N. Gohar[2]

ABSTRACT

The impact of three irrigation intervals (i.e. 7, 14 or 21 days) as well as seven magnesium treatments (i.e. untreated, 7.5 or 15 kg magnesium sulphate/ fed. as soil application, or foliar spray application treatments of 0.5% or 1.0% magnesium sulfate at both ages of 20 or 35 days) on dry matter of plant, yields, yield components and yields of chemical contents of sunflower G 101 were studied at Sids Agric. Res. Station, Middle Egypt, during 1996 and 1997 seasons.

Results reveal the following findings

1- Decreasing irrigation intervals(ir.intervals) from 21 to 7 days led to significant increases in dry matter/ plant at age of 49 days; head diameter; weight of 100 seeds; seed yield/ plant; seed, straw and biological yields/ fed., in the two seasons.
2- Applying magnesium sulphate fertilization(Mg ferttilization) in any case caused significant increases in dry matter/ plant at age of 49 days with the exception of 7.5 kg magnesium sulphate/ fed. as soil application, in the two seasons.
3- Using magnesium sulphate in any case caused significant increases in head diameter in the two seasons with the exception of 7.5 kg/ fed. in both seasons. While, applying magnesium sulphate caused significant increases in weight of 100 seeds and seed yield/ plant in the two seasons with the exception of 7.5 or 15 kg/ fed. in the first season and 7.5 kg/ fed. in the second season.
4- The use of magnesium sulphate in any treatment caused significant increases in seed yield, straw yield and biological yield/ fed. in the two seasons.
5- The interaction of (ir. IntervalsX Mg fertilization) had a significant effect on dry matter/ plant at age of 49 days, head diameter, seed yield/ plant, weight of 100 seeds; seed yield, straw yield and biological yield/ fed., in the two seasons.
6- The yield of oil of seeds/ fed., crude protein of seeds/ fed. and total carbohydrate of seeds/ fed. tended to increase significantly by decreasing the duration of irrigation intervals during the two seasons.

1- Agronomy Dept., Fac. of Agric., Ain Shams Univ., Shoubra El-Kheima, Cairo, Egypt
2- Soil, Water and Environment Res. Inst., ARC, Giza, Egypt

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7- The yields of oil of seeds and crude protein of seeds/ fed. were affected significantly by magnesium treatments in the two seasons; while they had no significant effect on carbohydrate yield of seeds/ fed. in both seasons.
8- The interaction of (ir. intervals X Mg fertilization) had significant effect on oil, crude protein or carbohydrate yields of seeds/ fed., in the two seasons.

Key words: Sunflower, Yield and it's componants , Yields of chemical contents.

INTRODUCTION

The cultivated sunflower (*Helianthus annuus* L.) is one of the most important annual crops in the world grown for edible oil. The sunflower production is affected greatly by the main environmental factors such as plant density, irrigation, fertilization, weed control visited bees and date of harvest.

In regard to irrigation practices, **Rawson and Turner (1982)** reported that water stress decreased seed weight and seed yield. **Unger (1983)** found that irrigation treatments affected the rate of oil accumulation in seed had a relatively small but significant effect on final oil content. **Abd El-Gawad *et al* (1987)** reported that dry weight/ plant, head diameter, 1000 seed weight, oil %, and seed yield/ fed. of sunflower were increased with decreased irrigation intervals from 18 to 10 days. **Rao *et al* (1987)** reported that as low leaf water potential developed, photosynthesis was inhibited. **Abd El-Halim *et al* (1989)** concluded that irrigating sunflower plants at 21 day intervals significantly decreased dry weight/ plant than plants irrigated at 7 day intervals. **Attia *et al* (1990)** found that irrigating sunflower at 25% available soil moisture, significantly decreased head diameter, seed yield/ plant, 100 seed weight, seed yield/ fed., oil % and oil yield/ fed. than those irrigated at 75 % available soil moisture. **El-Naggar (1991)** revealed that irrigating sunflower at 14 day intervals resulted in increasing head diameter, seed yield/ plant, 100 seed weight, oil content, seed and oil yields/ fed. than those irrigated at 21 day intervals. **Nour El-Din *et al* (1994)** found that increasing irrigation intervals from 9 to 21 days resulted in decreasing significantly head diameter, seed yield/ plant, 100 seed weight and seed yield. Also **Sharma (1994)** found that applying three irrigations caused an increase in head diameter and seed yield compared to those received one irrigation. Moreover, **Khalil (1997)** reported that increasing available soil moisture (ASM) before irrigation time from 20- 25 to 80- 85% led to increasing dry weight/ plant, head diameter, 100 seed weight and seed yield/ fed.; while the increase of (ASM) from 20- 25 to 60- 65% gave the maximum increases in number of seed/ head, seed weight/ plant, % of seed oil content and oil yield/ fed.

As for magnesium fertilization, **Petrove (1978)** found that the growth of leaves, stems and roots of sunflower was more dependent on the ratio values of Mg: K, Ca: K and (Ca+ Mg): K than on the deficiency of K, Ca or Mg. **Csengeri and Kozak (1985)** concluded that application of 200 kg Ca/ ha and Mg markedly increased yield and oil. **Tandon (1989)** reported that Mg is associated with acti-

vation of enzymes, energy transfer, maintenance of electroneutvality, production of proteins and metabolism of carbohydrates etc. **Ahmed Khan *et al* (1990)** applied 10 kg Mg/ ha as $MgSO_4$; they found that average seed yield was increased from 0.56 t/ ha (with untreated control) to 0.80 t/ ha. **Kene *et al* (1990)** found that applying 1% $MgSO_4$ on sunflower as foliar application increased yield and oil content. **Segare *et al.* (1990)** observed that applying 15 or 30 kg Mg/ ha increased the oil contents. **Krishanamurthi and Mathan (1996)** added 0-40 kg Mg/ ha to sunflower cv. Morden, they found that as Mg rate increased, the yield increased. Moreover, **Darwish *et al* (1997)** found that the application of $MgSO_4$ as foliar spray or as soil treatments induced significant increases in 100 seed weight, seed and oil yields as well as seed contents of protein and oil.

This work aims to study the influence of irrigation and magnesium . as soil or foliar application on growth ,yield and chemical contents of sunflower (*Helianthus annus* L.) G 101.

MATERIAL AND METHODS

This investigation was carried out at Sids Agric. Res. Station, Beni Suef Governorate, Middle Egypt, in 1996 and 1997 seasons. The treatments of Mg fertilization were applied as soil application before the first irrigation at the rates of 7.5 or 15 kg $MgSO_4$. $7H_2O$/ fed. (in one portion); as well as, foliar spray application treatments were applied at two concentrations of 0.5% or 1% $MgSo_4$. $7H_2O$ i.e. 488 or 976 ppm Mg, respectively (in one portion through 145.5 l./ fed. at 20 day age); moreover, there were two other treatments at the concentrations of 0.5 or 1.0% $MgSO_4$. $7H_2O$ (in one portion through 291 l./ fed. at 35 day age); in addition to the untreated treatment (control), in the two successive seasons.

The experiment was laid out in a split plot design with four replications. Each plot contained 6 ridges, 6 m long and 60 cm wide; while, the distant between plants was 20 cm. The main plots were assigned to irrigation intervals. Sub plots were assigned to magnesium fertilization treatments.

The experimental sites were preceded by wheat in the two seasons.

The texture of the soil was clay, values of pH (1:2.5, soil: water), EC (mmhos/ cm at 25 c^{o}), organic mater %, available nitrogen (meq/ l.) and available phosphorus (meq/l.) were 7.32, 1.19, 1.58, 31.10 and 12.25 in the first season; and 7.40, 1.30, 1.58, 35.33 and 15.50 in the second season, respectively. Planting date were July 4th and July 2nd in the first and the second seasons, respectively. Plants were thinned to one plant per hill after 24 days from planting. Plants were harvested on October 2 and October 6 in 1996 and 1997, respectively. When plants were 49 day age average of dry weight of plant in g was recorded for ten guarded plant from each plot in the two seasons. Biological yield was determined using two guarded rows of each plot (i.e. 1.2m X 6m = $7.2m^2$). After shelling the seeds of each plot were weighed and average seed yield (kg/ fed.) was calculated at 9% moisture, the straw yield (kg/fed.) was calculated by subtracting the weight of seeds from the biological yield.

At harvest time, samples of 10 plants randomly chosen were used to determine average head diameter, weigh of 100 seeds and seed yield/ plant. Moreover, chemical analysis was run to determine

oil yield (kg/fed.), crude protein yield (kg/fed.) and total carbohydrate yield (kg/fed.) for dry seeds, according to **A.O.A.C. (1975).**

Data obtained in each season were statistically analysed as out lined by **Cochran and Cox (1957).** Mean values were compared for each other using the least significant difference (L.S.D.).

RESULTS AND DISCUSSION

Dry matter/ plant

Data in Table (1) indicate that irrigation intervals of 7 or 14 days gave significant increases in dry matter/ plant (at the age of 49 days) by 26.5% and 18.56% in the first season, and by 29.31% and 18.17% in the second season as compared to intervals of 21 days, respectively. Thus it could be concluded that dry matter/ plant increased by shortening irrigation intervals to 7 days. This increase is most probably due to the role of water in physiological processes in plant, whereas water plays essential roles in plants as a constituent, a solvent, and a reagent in various chemical reactions, also in maintenance of turgidity for cell enlargement and growth. Similar results were obtained by **Abd El-Gawad *et al* (1987), Abd El-Halem *et al* (1989) and Khalil (1997).**

As for Mg- fertilization, results reveal that using 7.5 or 15 kg magnesium sulphate/ fed. as soil application, 0.5% or 1% magnesium sulphate as foliar spray after 20 or 35 days from planting caused significant increases in this criteria by 9.4%, 14.24%, 19.94%, 17.51%, 21.76% and 24.26% in the first season and by 8.42%, 13.0%, 17.53%,15.36%, 14.41% and 21.01% in the second season as compared to the control, respectively. Thereon, it could be concluded that using Mg fertilization led to an increase in the dry matter/ plant. This increase may be attributed to the increase of Mg in plant (i.e. increases in chlorophyll) and hence, the products of photosynthesis increase. On the other hand, the sufficient amount of Mg at the different green parts of plant initials the nuclear division, which causes rapid growth. These findings are similar to those of **Petrove (1978).** The interaction between irrigation and Mg fertilization on increasing the dry matter of plant was found to be significant in the two seasons. The highest value was obtained with 1% magnesium sulphate as foliar application at 35 day age under 7 day irrigation intervals. Whereas, the lowest value was obtained with zero Mg under 21 day intervals.

Yield and yield components

Results in Tables (2 and 3) reveal that irrigating sunflower plants every 7 days caused significant increases in head diameter, seed yield/ plant, weight of 100 seeds, seed yield/ fed., straw yield/ fed. and biological yield/ fed. by 15.74, 42.51, 24.68, 47.14, 40.18 and 41.25% in the first season and by 28.66, 35.54, 31.43, 53.22, 24.91 and 29.08% in the second season as compared to intervals of 21 days, respectively. Also, irrigating sunflower plants every 14 days caused significant increases for the same respective characters by 5.13, 26.25, 18.87, 15.39, 25.94 and 24.45% in the first season and by 15.29, 13.09, 16.25, 30.33, 11.40 and 14.13% in the second season as compared to intervals of 21 days, respectively. Thus it could be concluded that, as the duration of irrigation intervals decreased from 21 to 7 days, each of head diameter,

Table 1. Effect of irrigation intervals and magnesium fertilization on dry matter of plant in (g) at the age of 49 days, during 1996 and 1997 seasons

Magnesium sulphate treatments	1996 season			
	Irrigation interval (days)			
	7	14	21	Average
(A) Control	59.34	55.58	44.6	53.17
(B) 7.5 kg/fed.	63.04	59.51	51.97	58.17
(C) 15 kg/fed.	66.14	61.71	54.38	60.74
(D) 0.5 %	70.42	65.95	54.94	63.77
(E) 1.0%	68.99	64.61	53.85	62.48
(F) 0.5%	71.51	66.95	55.75	64.74
(G) 1.0 %	72.57	68.03	57.62	66.07
Average	67.43	63.19	53.3	61.31
L.S.D at 5% level for:				
Irregation			3.12	
Magnesium treatments			4.77	
Irri. X magnesium treat			8.27	

Table 1. Cont.

Magnesium sulphate treatments	1997 season			
	Irrigation interval (days)			
	7	14	21	Average
(A) Control	63.72	58.68	49.06	57.15
(B) 7.5 kg/fed.	69.04	62.57	54.28	61.96
(C) 15 kg/fed.	72.23	65.38	56.13	64.58
(D) 0.5 %	75.11	68.58	57.83	67.17
(E) 1.0%	73.68	67.38	56.73	65.93
(F) 0.5%	76.15	69.92	58.65	68.24
(G) 1.0 %	77.18	70.86	59.43	69.16
Average	72.44	66.2	56.02	64.89
L.S.D at 5% level for:				
Irregation			2.66	
Magnesium treatments			4.07	
Irri. X magnesium treat			7.05	

A= untreated, B & C = Soil application, D & E= Foliar spray at 20 day age, and F & G = Foliar spray at 35 day age

Table 2. Effect of irrigation interveals and magnisium fertilization on yield and its components, and some chemicals properties for sunflower, in 1996 season

Ir. Intervals (days)	Magnesium treatments	Seed yield (kg/fed)	Straw yield (kg/fed)	Bio. Yield (kg/fed)	Seed yield/ plant (g)	Head diameter (cm)
7	A) control	1098	6020	7118	89.60	16.80
	B) 7.5 kg/fed	1190	6207	7397	92.10	17.40
	C) 15 kg/fed	1245	6312	7558	95.80	17.70
	D) 0.5 kg/fed	1247	6626	7873	103.40	18.10
	E) 10%	1215	6504	7719	99.00	17.90
	F) 0.5 %	1293	6699	7992	106.80	18.30
	G) 1.0%	1338	6960	8298	112.50	19.00
14	A) control	864	5402	6266	77.50	15.20
	B) 7.5 kg/fed	945	5649	6595	81.30	15.70
	C) 15 kg/fed	959	5674	6633	87.10	15.90
	D) 0.5 kg/fed	977	5946	6923	92.20	16.90
	E) 10%	956	5836	6792	89.70	16.50
	F) 0.5 %	1018	6011	7029	94.50	17.10
	G) 1.0%	1053	6246	7299	97.40	17.30
21	A) control	714	4323	5037	57.80	14.70
	B) 7.5 kg/fed	767	4374	5141	65.80	15.00
	C) 15 kg/fed	860	4398	5258	68.70	15.20
	D) 0.5 kg/fed	865	4758	5623	74.00	16.00
	E) 10%	860	4671	5531	71.70	15.40
	F) 0.5 %	891	4811	5702	76.10	16.30
	G) 1.0%	907	4998	5905	76.90	16.90
Av. of ir. Intervals	7	1233	6475	7708	99.90	17.90
	14	967	5823	6791	88.50	16.40
	21	838	4619	5457	70.10	15.60
Av. of magnesium sulphate treatments	A) control	892	5248	6140	75.50	15.60
	B) 7.5 kg/fed	967	5410	6377	79.70	16.00
	C) 15 kg/fed	1021	5463	6483	83.90	16.30
	D) 0.5 kg/fed	1030	5777	6806	89.90	17.00
	E) 10%	1010	5670	6608	86.00	16.60
	F) 0.5 %	1067	5840	6981	92.50	17.20
	G) 1.0%	1099	6068	7167	95.60	17.70
A = untreated, B & C = Soil application, D & E = Foliar spray at 20 day age, and F & G = Foliar spray at 35 day age						
L.S.D at 5% level for :						
Irrigation		48	105	93	6.46	0.40
Mg treatments		74	160	142	9.88	0.6
Ir. X Mg treatments		129	277	264	17.12	1.06

Table 2. Cont.

Ir. Intervals (days)	Magnesium treatments	Wt. of 100 seeds (g)	Oil yield of seeds (kg/fed)	Protein yield of seeds (kg/fed)	Charbohy yield of seeds (kg/fed.)
7	A) control	6.30	497	248	193
	B) 7.5 kg/fed	6.40	562	277	205
	C) 15 kg/fed	6.69	585	292	202
	D) 0.5 kg/fed	7.04	589	304	183
	E) 10%	6.86	572	288	169
	F) 0.5 %	7.30	613	321	190
	G) 1.0%	7.44	636	339	194
14	A) control	6.01	382	180	165
	B) 7.5 kg/fed	6.19	424	201	176
	C) 15 kg/fed	6.33	433	210	170
	D) 0.5 kg/fed	6.71	450	223	156
	E) 10%	6.55	436	217	161
	F) 0.5 %	6.95	472	237	154
	G) 1.0%	7.10	491	252	148
21	A) control	5.14	312	139	141
	B) 7.5 kg/fed	5.29	337	156	147
	C) 15 kg/fed	5.41	380	179	158
	D) 0.5 kg/fed	5.59	391	185	147
	E) 10%	5.45	382	182	151
	F) 0.5 %	5.79	407	193	144
	G) 1.0%	5.91	417	203	145
Av. Of ir. Intervals	7	6.87	579	296	191
	14	6.55	441	217	161
	21	5.51	375	177	148
Av. of magnesium sulphate treatments	A) control	5.82	397	189	166
	B) 7.5 kg/fed	5.99	441	211	176
	C) 15 kg/fed	6.13	466	227	177
	D) 0.5 kg/fed	6.45	477	237	162
	E) 10%	6.29	463	229	160
	F) 0.5 %	6.68	497	250	163
	G) 1.0%	6.82	515	265	162

A = untreated, B & C = Soil application, D & E = Foliar spray at 20 day age, and F & G = Foliar spray at 35 day age

L.S.D at 5% level for :				
Irrigation	0.33	28.13	21.26	9.21
Mg treatments	0.35	43.60	32.53	N.S.
Ir. X Mg treatments	0.61	74.24	56.30	24.40

Table 3. Effect of irrigation interveals and magnisium fertilization on yield and it's components and some chemicals properties for sunflower, in 1997 season

Ir. Intervals (days)	Magnesium treatments	Seed yield (kg/fed)	Straw yield (kg/fed)	Bio. Yield (kg/fed)	Seed yield/ plant (g)	Head diameter (cm)
7	A) control	1243	6083	7326	93.50	18.80
	B) 7.5 kg/fed	1300	6325	7625	99.10	19.20
	C) 15 kg/fed	1397	6475	7872	103.60	19.50
	D) 0.5 kg/fed	1400	6866	8266	114.30	20.10
	E) 10%	1364	6700	8064	106.90	20.10
	F) 0.5 %	1447	7099	8546	119.70	21.50
	G) 1.0%	1502	7136	8638	123.70	21.90
14	A) control	1049	5517	6566	82.00	17.10
	B) 7.5 kg/fed	1131	5775	6906	84.70	17.30
	C) 15 kg/fed	1178	5791	6969	87.20	17.80
	D) 0.5 kg/fed	1188	6056	7244	93.20	18.30
	E) 10%	1151	5950	7101	91.00	18.00
	F) 0.5 %	1243	6117	7360	94.40	18.70
	G) 1.0%	1268	6397	7665	102.60	19.30
21	A) control	812	4871	5683	75.20	15.10
	B) 7.5 kg/fed	875	5162	6037	78.40	15.20
	C) 15 kg/fed	912	5254	6166	79.50	15.70
	D) 0.5 kg/fed	923	5425	6348	81.50	15.70
	E) 10%	891	5321	6212	80.50	15.50
	F) 0.5 %	933	5550	6483	82.20	15.80
	G) 1.0%	951	5762	6713	84.00	17.00
Av. of ir. Intervals	7	1379	6664	8048	108.70	20.20
	14	1173	5943	7116	90.70	18.10
	21	900	535	8235	80.20	15.70
Av. of magnesium sulphate treatments	A) control	1035	5490	5414	83.60	17.00
	B) 7.5 kg/fed	1102	5754	5745	87.40	17.20
	C) 15 kg/fed	1162	5840	7002	90.10	17.70
	D) 0.5 kg/fed	1170	6116	7286	96.30	18.20
	E) 10%	1135	5990	7126	92.80	17.90
	F) 0.5 %	1208	6255	7463	98.20	18.70
	G) 1.0%	1240	6432	7672	103.40	19.40
A = untreated, B & C = Soil application, D & E = Foliar spray at 20 day age, and F & G = Foliar spray at 35 day age						
L.S.D at 5% level for :						
Irrigation		41	101	77	4.12	0.30
Mg treatments		60	155	117	6.30	0.46
Ir. X Mg treatments		104	268	203	1091	0.80

Table 3. Cont.

Ir. Intervals (days)	Magnesium treatments	Wt. of 100 seeds (g)	Oil yield of seeds (kg/fed)	Protein yield of seeds (kg/fed)	Charbohy yield of seeds (kg/fed.)
7	A) control	6.77	567	282	221
	B) 7.5 kg/fed	6.97	595	305	220
	C) 15 kg/fed	7.06	641	334	231
	D) 0.5 kg/fed	7.54	649	343	218
	E) 10%	7.39	627	328	218
	F) 0.5 %	7.78	675	359	220
	G) 1.0%	8.02	718	379	219
14	A) control	5.91	461	234	204
	B) 7.5 kg/fed	6.11	501	261	215
	C) 15 kg/fed	6.28	531	274	218
	D) 0.5 kg/fed	6.79	541	289	201
	E) 10%	6.46	520	274	200
	F) 0.5 %	6.92	757	305	207
	G) 1.0%	7.11	596	314	225
21	A) control	5.35	348	164	168
	B) 7.5 kg/fed	5.43	378	183	176
	C) 15 kg/fed	5.48	396	194	181
	D) 0.5 kg/fed	5.66	408	200	174
	E) 10%	5.54	392	190	172
	F) 0.5 %	5.81	420	203	171
	G) 1.0%	5.90	438	214	165
Av. Of ir. Intervals	7	7.36	639	333	221
	14	6.51	532	279	210
	21	5.60	397	193	172
Av. of magnesium sulphate treatments	A) control	6.01	459	227	198
	B) 7.5 kg/fed	6.17	491	250	204
	C) 15 kg/fed	6.27	523	267	210
	D) 0.5 kg/fed	6.66	533	277	198
	E) 10%	6.46	513	264	197
	F) 0.5 %	6.84	557	289	199
	G) 1.0%	7.01	584	302	203

A = untreated, B & C = Soil application, D & E = Foliar spray at 20 day age, and F & G = Foliar spray at 35 day age

L.S.D at 5% level for :				
Irrigation	0.17	20.01	23.18	10.12
Mg treatments	0.26	31.14	35.50	N.S
Ir. X Mg treatments	0.45	53.82	61.40	26.82

seed yield/ plant, weight of 100 seeds, seed yield/ fed., straw yield/ fed. and biological yield/ fed.were increased. The increase of seed yield/ plant or seed yield/ fed. is mainly due to the increase in weight of 100 seeds and head diameter. Also, the increase of biological yield/ fed. is mainly due to the increase of seed yield/ fed. and straw yield/ fed. While the increase of weight of 100 seeds, head diameter or straw yield/ fed. may be due to the increase of dry matter/ plant in accordance with the role of water in physiological processes in the plant. In addition to the effect of water on root functions; whereas, when root shrinks the contact between the root and soil solution decreases. Since ion transfer to roots occurs only in contact areas it must also be decreases **(Huck *et al.*,1970).** These results are similar to those of **Rawson and Turner (1982), Abd El- Gawad *et al.* (1987) Attia *et al.* (1990), El- Naggar (1991), Nour El-Din *et al.* (1994), Sharma (1994) and Khalil (1997).**

As for Mg fertilization, results in Tables (2-3) show that using 7.5 or 15 kg magnesium sulphate/ fed. as soil applications; 0.5% or 1.0% magnesium sulphate as foliar application at 20 or 35 days from planting led to significant increase in seed yield/ fed. by 8.41, 14.46, 16.47, 13.23, 19.62 and 23.21% in the first season; and by 6.47, 12.27, 13.04, 9.66, 16.71 and 19.81% in the second season; also the previous treatments led to significant increases in straw yield/ fed. by 3.09, 4.10, 10.08, 8.04, 11.28 and 15.63% in the first season and by 4.81, 6.38, 11.40, 9.11, 13.93 and 17.16% in the second season, as well as the same treatments caused significant increases in biological yield/ fed. by 3.86, 5.59, 10.85, 8.81, 12.51 and 16.73% in the first season and by 5.07, 7.31, 11.66, 9.21, 14.38 and 17.58% in the second season as compared to the untreated control, respectively. Moreover, the use of 0.5% or 10% magnesium sulphate as foliar applications at 20 or 35 days from planting caused significant increases in seed yield/ plant by 19.87, 14.67, 23.33 and 27.47% in the first season and by 15.19, 11.00, 18.18 and 23.68% in the second season, as compared to untreated control, respectively. The same previous respective treatments led to significant increase in weight of 100 seeds by 10.82, 3.09, 14.78 and 17.18% in the first season; while, 15 kg magnesium sulphate/ fed. as soil application; 0.5% or 1.0% magnesium sulphate as foliar applications at 20 or 35 days from planting led to significant increase in this characters by 4.33, 10.82, 7.49, 13.81 and 16.64 in the second season as compared to untreated control, respectively.

Also, using 15 kg magnesium sulphate/ fed. as soil application; 0.5% or 1.0% magnesium sulphate as foliar applications at 20 or 35 days from planting led to significant increases in head diameter by 4.49, 8.79, 6.41, 10.26 and 13.46% in the first season and by 4.12, 7.06, 5.29, 10.00 and 14.12% in the second season as compared to untreated control, respectively.

The increase of seed yield/ fed. or seed yield/ plant is mainly due to the increase of weight of 100 seeds and head diameter. Moreover the increase of biological yield is mainly due to the increase of seed yield/ fed. and straw yield/ fed. While the increase of weight of 100 seeds, head diameter or straw yield/ fed. may be owing to the increase of dry matter in accordance with the role of Mg in plant which gave increases in chlorophyll

and hence, the products of photosynthesis increase. Similar results were obtained by **Petrove (1978), Ahmed Khan *et al* (1990), Kene *et al* (1990), Krishanamurthi and Mathan (1996) and Darwish *et al* (1997).**

The analysis of variance reveals that the interaction between irrigation and Mg treatments clarifies an increase over the control of all the studied characters. Meanwhile, the significant increases for yield and its components, and studied chemical properties for sunflower was obtained mainly for F & G treatments in the two studied seasons.

Yield of chemical contents

Data in Tables (2 and 3) reveal that the yield of each of oil, crude protein and total carbohydrate of seeds tended to increase significantly by decreasing the duration of irrigation intervals during the two seasons. Whereas, irrigating sunflower every 7 days gave significant increase in the previous characters by 54.4, 67.23 and 29.05% in the first season, and by 60.96, 72.54 and 28.49% in the second season as compared to 21 day interval, respectively. While, irrigating sunflower every 14 days gave significant increase in the same respective characteristics by 17.6, 22.6 and 8.78% in the first season, and by 34.01, 44.56 and 22.09% in the second season as compared to 21 day interval, respectively. These increases are mainly due to the increase of seed yield/ fed.

These findings are in harmony with those of **Unger (1983), Abd El- Gawad *et al* (1987), Rao *et al* (1987), El-Naggar (1991), Quttar *et al* (1992) and Khalil (1997).**

As for Mg treatments, data in Table (2 and 3) show that the yields of oil of seeds and crude protein of seeds were affected significantly by Mg treatments in the two seasons; while, they had no significant effect on carbohydrate yield of seeds in both seasons.

Results show that the use of 7.5 or 15 kg magnesium sulphate /fed. as soil application, 0.5 or 1.0% magnesium sulphate as foliar spray after 20 or 35 days from planting gave significant increase in yield of oil of seeds by 11.08, 17.38, 20.15, 16.63, 25.19 and 29.72% in the first season and by 6.97, 13.99, 16.12, 11.76, 21.35 and 27.23% in the second season as compared to untreated control, respectively. Also, the use of 15 kg magnesium sulphate /fed. as soil application, 0.5 or 1.0% magnesium sulphate as foliar spray after 20 or 35 days from planting gave significant increase in yield of crude protein of seeds by 20.11, 25.40, 21.16, 32.28 and 40.21% in the first season and by 17.62, 22.03, 16.30, 27.31 and 33.04% in the second season as compared to the untreated control, respectively.

The analysis of variance reveal that Mg treatments had significant effect on carbohydrate yield, in the two seasons. Thereon, it could be concluded that the use of Mg fertilization led to increase in oil yield of seeds and crude protein yield of seeds. These findings are similar to those of **Csengeri and Kozak (1985), Tandon (1989), Kene *et al*(1990), Sagare *et al* (1990) and Darwish *et al* (1997).**

The interaction between irrigation and Mg treatments had significant effects on increasing oil, crude protein and total carbohydrate yields,whereas ,the highest values were obtained with 1% magnesium sulphate as foliar spray at 35 days

from planting under 7 days of irrigation in the oil and protein yields in the two seasons. While, the highest values were obtained with 7.5 kg magnesium sulphate /fed. in the first season or 15 kg magnesium sulphate / fed. in the second season for the carbohydrate yield .

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مجلة اتحاد الجامعات العربية للدراسات والبحوث الزراعية ، جامعة عين شمس ، القاهرة ، ١١(١) ، ١٩١ - ٢٠٤، ٢٠٠٣

تأثير الرى والتسميد الماغنسيومى على المحصول ومكوناته والمحتوى الكيميائى لعباد الشمس

[١٥]

ممدوح عبد الرحمن عشوب[١] - إبراهيم محمد عبد العزيز[٢] - مجدى محمد شاهين[٢] - محمد نائل جوهر[٢]

١- قسم المحاصيل - كلية الزراعة - جامعة عين شمس - شبرا الخيمة - القاهرة - مصر

٢- معهـــد بحوث الأراضى والمياه والبيئة - مركـز البحوث الزراعية - الجيزة - مصر

درس تأثير ثلاثة فترات للرى (٧ ، ١٤، ٢١ يوما) والتسميد الماغنسيومى (معاملـــة المقارنـــة ، ٧,٥ أو ١٥ كجـم كبريتـــات ماغنسيوم) فدان كإضافـــة أرضيـــة و ٠,٥ أو ١% رشا علـــى المجمـــوع الخضـــرى بكبريتات ماغنسيوم عنـــد عمـــر ٢٠ ، ٣٥ يوما) على المادة الجافة بالنبات والمحصـــول ومكوناته والمكونات الكيميائية فـــى عبـــاد

الشمس G101. وذلك بمحطة البحوث الزراعية بسدس - محافظة بنى سويف موسمى ٩٦ ، ١٩٩٧ .

وتتلخص أهم النتائج فيما يلى

١- أظهر تقصير فترات الرى من ٢١ إلى ٧ أيام زيادة معنوية فى المادة الجافة للنبات (عند عمر ٤٩ يوما) و قطر القرص ووزن الـ ١٠٠ بذرة ومحصول بذور النبات ومحصول البذور ومحصول القش والمحصول البيولوجى/فدان فى موسمى الدراسة .

٢- أدى التسميد بكبريتات الماغنسيوم إلى زيادة معنوية فى المادة الجافة للنبات عند عمر ٤٩ يوما باستثناء المعدل ٧,٥ كجم كبريتات ماغنسيوم / فدان كإضافة أرضية فى موسمى الدراسة .

٣- أدى استخدام سماد كبريتات الماغنسيوم فى جميع الحالات إلى زيادة معنوية فى قطر القرص فى كلا الموسمين استثناء المعدل ٧,٥ كجم/فدان فى كلا الموسمين كإضافة أرضية ، وإلى زيادة معنوية فى وزن الـ ١٠٠ بذرة ومحصول البذور للنبات فى كلا الموسمين باستثناء المعدلين ٧,٥ ، ١٥ كجم/فدان فى الموسم الأول ومعدل ٧,٥ كجم/فدان فى الموسم الثانى .

٤- أظهر استخدام كبريتات الماغنسيوم فى جميع المعاملات زيادة معنوية فى محصول البذور ومحصول القش والمحصول البيولوجى/فدان خلال موسمى الدراسة .

٥- أظهر التفاعل (فترات الرى × السماد الماغنسيومى) تأثيرا معنويا على زيادة المادة الجافة للنبات عند عمر ٤٩ يوما وقطر القرص ومحصول البذور للنبات ووزن الـ ١٠٠ بذرة ومحصول البذور ومحصول القش والحصول البيولوجى /فدان خلال موسمى الدراسة .

٦- أوضحت الدراسة أن محصول الزيت بالبذور/فدان ومحصول البروتين الخام بالبذور/فدان ومحصول الكربوهيدرات الكلية بالبذور/فدان اتجه إلى الزيادة معنويا بالنقص فى طول فترة الرى خلال موسمى الدراسة .

٧- أوضحت الدراسة أن محصول الزيت بالبذور/فدان ومحصول البروتين الخام بالبذور/فدان زاد معنويا بزيادة معاملات الماغنسيوم خلال موسمى الدراسة ، بينما لم يتحصل على زيادة معنوية فى محصول الكربوهيدرات بالبذور/فدان خلال الموسمين .

٨- أظهر التفاعل (فترات الرى × التسميد الماغنسيومى) وجود تأثير معنوى على كل من محصول الزيت والبروتين الخام والكربوهيدرات بالبذور/فدان خلال موسمى الدراسة .

تحكيم: أ.د نعمت عبد العزيز نور الدين
أ.د جابر عبد اللطيف سارى