

## RESPONSE OF FLAX TO IRRIGATION FREQUENCY AND SOME MICRO-NUTRIENTS APPLICATION IN CALCAREOUS SOILS:

### 2- MACRO AND MICRO-NUTRIENTS UPTAKE BY FLAX PLANTS.

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### ABSTRACT

Two field experiments were conducted in calcareous soil of the farm of Nubaria Agric.Res.Station during two successive seasons to study the effect of irrigation frequency, microelement- nutrients and their interactions on macro and micronutrients uptake by flax plants Giza 7, Giza 8 and S<sub>1</sub> (the new strain) cultivars.

The result can be summarized as the following:

- 1- Giza 8 and new strain<sub>1</sub> recorded about the same maximum values of N, P and K uptake by both of seed and straw of flax plant, while those of Giza 7 reflected the lowest effects.
- 2- Irrigation frequency had significant effects on macronutrients uptake for all cultivars under study. Five or seven times of irrigation gave about the same highest values of N; P and K. data are represented by 15.92, 2.69 and 3.721 kg Fed<sup>-1</sup> respectively.
- 3- Concerning foliar treatment mixture of Fe,Zn and Mn, the treated plants gave the highest mean values of N uptake by seed (15.16 kg Fed<sup>-1</sup>) comparatively with those of untreated ones(12.14 kg Fed<sup>-1</sup>). Data of P and K uptake were not in higher values, but they showed some reasonable increases.
- 4- As for the triple interaction effect, it can be summarized that, the absolutely highest values of N, P and K were 23.16, 3.55 and 4.23 kg Fed<sup>-1</sup> respectively. The mentioned values were obtained from (I<sub>3</sub> x Foliar x Giza8), and (I<sub>4</sub> x foliar x Giza 8) interaction treatments respectively.
- 5- In respect of micronutrient uptake, the highest values of Fe uptake (566.6 and 565.97 g Fed<sup>-1</sup>) were obtained from (I<sub>4</sub> x foliar x Giza 8) and (I<sub>4</sub> x foliar x S<sub>1</sub>) respectively. While the highest values related to Zn and Mn uptake (188.87 and 52.4 g Fed<sup>-1</sup>) were obtained from (I<sub>4</sub> x foliar x Giza 8) and (I<sub>2</sub> x foliar x Giza 8) respectively.
- 6- It can be recommended to G8 and S<sub>1</sub>, with 7 times of irrigation that recorded the highest effects for all macro and micronutrients uptake under foliar application.

**Keywords:** Flax – Irrigation number- micronutrients as foliar spray- nutrients uptake, calcareous soil.

### INTRODUCTION

Increasing the production of flax (*Linum usitalissimum* L.) from the present limited area is a basic target. Therefore, the most developed varieties of high yielding potential with application of the best agronomic practices such as irrigation and using some of micronutrients.

Concerning to varieties differences, El-Sweify *et al* (1996 and 1997) and Arjun and Gururaj (1996) reported that genotypes differed significantly in the seed and fiber yields Foster *et al.* (1998) investigated the yield components of seven commonly cultivated linseed, the results recorded significant differences between those cultivars.

Micro- nutrients play an important role in plant growth as a result of affecting many physiological processes in plant life. Consequently, yield of the treated crops may be increased and crop quality is improved. Botin (1964) concluded that Mn and Zn favoured plant growth. Abo El-Saad *et al.*, (1975), stated that application of ZnSO<sub>4</sub> as foliar spray caused an increase in plant height, straw yield, number of capsules per plant, seed index, seed yield and fiber fineness of flax. Author and Moraghan (1984) found that flax showed the largest responses to added Zn. El-Shimy *et al.*, (1986) they obtained significant increase in all flax characters when its plants sprayed with mixture of Zn, Mn and Fe. Qu *et al.*, (1988). Found that Mn- containing fertilizer enhanced the growth and development of flax plants at early growth stages. El- Sweify (1993), recorded that Zn application insignificantly increased technical stem length, length of top capsule zone, straw yield per plant as well as per fad., also she found slight and insignificant increases in seed yield and its components due to Zn application; while, fiber length and fiber fineness were significantly increased.

Regarding water supply, several investigators reported that irrigation increased flax yield i.e. seed, straw and fiber as well as its components. El-Farouk *et al.* (1982) concluded that application of five irrigations increased flax plant height, technical length, weight of fiber / plant as well as per fad. They added that the higher irrigation number gave the longest fibers and the highest fiber percentage.

Therefore, the target of this investigation is to evaluate a new flax strain comparatively with the two local cultivars Giza 7 and Giza 8 as affected by irrigation numbers and micro- nutrients application under the calcareous soil.

## MATERIAL AND METHODS

This investigation was conducted in calcareous soil in the farm of Nubaria Agric. Res. Station during two successive seasons to study the effect of irrigation regimes, micronutrients and their interaction on macro and micronutrients uptake by seed and straw of flax plants [local cultivars Giza 7 and Giza 8 in addition to strain 1 (cross between 2467&65)].

The physical and chemical properties of cultivated soil were presented in Table (1).

**Table (1): some soil properties of the investigated soil.**

PH	EC dS/m	Soluble cations (meq/L)*				Soluble anions (meq/L)*			
		Ca <sup>++</sup>	Mg <sup>++</sup>	Na <sup>+</sup>	K <sup>+</sup>	CO <sub>3</sub> <sup>-</sup>	HCO <sub>3</sub> <sup>-</sup>	Cl <sup>-</sup>	SO <sub>4</sub> <sup>-</sup>
8.14	0.875	2.34	0.72	5.40	0.42	--	2.60	4.96	1.24
Coarse sand %	Fine sand %	Silt %	Clay %	CaCO <sub>3</sub> %	Textural class				
26.36	32.79	16.70	24.15	25.0	Sandy clay loam				

\* Soil: water (1:5) extracts (Jakson, 1970).

**A split-split plot design with four replication was used in this experiment.**

Different irrigation numbers 2, 3, 5 and 7 (without deprivation of irrigation) distributed at certain growth stages, (Table 2) which released as  $I_1$ ,  $I_2$ ,  $I_3$  and  $I_4$  respectively, were assigned to the main plots and micronutrients to sub-plots; the three cultivars located as sub-sub plot which was  $2 \times 3\text{m}$  ( $6\text{m}^2$  in area) in which 70g of seeds of each flax cultivars were sown by broadcasting method on November 12 and 17 in the first and second seasons respectively. The irrigation took place in the following day. Other cultural practices were carried out as usual. Micronutrients were applied as mixture of foliar spray containing Fe, Mn and Zn at concentration of 100g/200L/fad. in sulphate form. It was carried out two times, after 60 and 75 days from sowing.

**Table (2): Schedule of irrigation regime.**

Irrigation treatment	Number of irrigation	Vegetative stage			Flowering stage			Maturity stage	
		(Days)							
		20	35	55	85	100	120	135	
$I_1$	2	+	+						
$I_2$	3	+	+	+					
$I_3$	5	+	+	+	+	+			
$I_4$	7	+	+	+	+	+	+	+	

At full maturity, the single plant study was done on samples each of ten guarded plant taken at random from each sub-sub plot. Seed and straw samples were dried in a forced oven at  $65\text{-}70^\circ\text{C}$  then ground and wet digested to determined N, P, K, Fe, Zn and Mn according to Chapman, (1961). Their uptakes were calculated as follows:

$$\text{NPK uptake} = \text{NPK concentration \%} \times \text{seed or straw yield, kg fed}^{-1}$$

$$\text{Fe, Zn, Mn- uptake} = \text{the concentration \%} \times \text{seed or straw yield, g fed}^{-1}$$

Statistical analysis of the data was carried out according to Snedecor and Cochran (1969). A combined analysis was performed for each character over two seasons as described by Le Clerg *et al.*, (1966)

## RESULTS AND DISCUSSION

### Effect of irrigation number on macronutrients uptake by seed and straw of flax plant:-

Irrigation regime had significant effects on N, P and K uptake ( $\text{kg fed}^{-1}$ ) by flax plant (seed and straw) as shown in Table (3). Plant irrigated with 5 or 7 times ( $I_4$  and  $I_3$  orders) realized the highest values. In this respect N values uptake by seed were  $15.45$  and  $14.44 \text{ kg fed}^{-1}$  respectively, while the highest value of P ( $3.54 \text{ kg fed}^{-1}$ ) was obtained from  $I_4$  treatment order (7 times). As for K uptake (Table 3) also, revealed that the maximum values were  $3.54$ ,  $3.53 \text{ kg fed}^{-1}$  obtained from  $I_4$  and  $I_3$  orders. The results may be attributed to the fact that, mineral nutrient uptake is frequently reduced to a considerable degree in stressed plant, which in turn reduced photosynthetic efficiency and

consequently dry matter accumulation. These findings were in a harmony of results pointed by Pande *et al.*, (1969) and Foster *et al.*, (1998).

**Effect of different cultivars:**

The results (Table 3) of N and K uptake (kg fed<sup>-1</sup>) of three cultivars i.e. Giza 7, Giza8 and new strain 1, showed clearly that the values under test, responded significantly owing to different cultivars. The seed of strain 1 recorded the maximum values of macro nutrient uptake over the all (15.92, 2.69 and 3.72 kg fed<sup>-1</sup> respectively). It is worthy mentioned that N, P and K uptake values in the straw of Giza 8 and strain 1 were the same while those of Giza 7 were in low values.

**Table (3): Effect of irrigation number, micronutrients application and cultivars on macronutrient uptake by seed and straw of flax plant.**

Treatments			Seed yield (kg/fed)	Straw yield (ton/fed)	Nutrients uptake (kg fed <sup>-1</sup> ) by seed			Nutrients uptake (kg fed <sup>-1</sup> ) by straw		
Irrig. No.	Micro.	Variety			N	P	K	N	P	K
I <sub>1</sub>	Foliar	G7	568.2	2.31	8.81	1.19	3.03	8.11	1.64	21.94
		G8	667.3	3.10	15.68	2.20	3.07	12.40	2.17	27.90
		S1	475.5	3.19	9.51	1.52	2.57	11.16	1.75	27.75
	without	G7	587.9	2.20	4.41	1.94	2.70	5.53	1.10	22.10
		G8	677.9	2.80	6.44	1.42	3.22	8.40	1.68	26.88
		S1	493.2	2.95	7.40	2.07	2.47	10.33	1.77	27.14
I <sub>2</sub>	Foliar	G7	606.8	2.52	19.42	2.12	3.39	8.83	3.78	23.21
		G8	698.7	3.21	16.07	2.09	3.77	11.22	3.20	27.89
		S1	514.7	3.32	10.81	2.21	3.09	13.31	3.66	31.61
	without	G7	599.3	2.29	18.58	1.26	2.99	5.74	1.83	20.64
		G8	687.9	2.99	13.07	2.75	3.58	8.97	2.39	26.91
		S1	492.9	3.13	12.08	1.97	2.86	12.53	2.41	30.08
I <sub>3</sub>	Foliar	G7	637.5	2.71	13.71	3.12	3.76	8.12	3.55	25.78
		G8	735.2	3.32	23.16	3.09	4.19	9.96	4.82	32.20
		S1	534.7	3.73	13.37	2.67	3.38	11.18	3.34	36.15
	without	G7	615.8	2.54	11.08	1.65	2.26	5.08	2.03	24.41
		G8	726.0	3.11	16.69	3.34	3.77	9.35	2.81	27.43
		S1	506.4	3.27	14.68	2.48	2.84	6.54	3.27	27.17
I <sub>4</sub>	Foliar	G7	652.4	3.03	16.09	2.62	3.65	10.62	4.24	20.63
		G8	755.5	3.54	20.02	3.55	4.23	13.38	6.01	30.42
		S1	565.9	4.02	15.28	2.20	3.17	16.06	4.02	32.54
	without	G7	643.2	2.85	14.15	2.25	3.47	7.14	1.42	20.42
		G8	737.8	3.27	16.23	3.09	3.84	8.17	1.64	27.47
		S1	545.4	3.53	10.91	2.45	2.99	8.84	1.78	32.13
L.S.D.at 5%			14.07	0.15	1.01	0.20	0.08	0.191	0.34	0.25
Effect of irrigation number	Foliar	I <sub>1</sub>	526.451	2.518	8.71	1.73	2.86	9.32	1.69	25.62
		I <sub>2</sub>	608.700	3.093	15.00	2.07	3.28	10.10	2.88	26.72
		I <sub>3</sub>	636.646	3.116	15.45	2.73	3.53	8.37	3.33	28.85
		I <sub>4</sub>	685.944	3.439	15.44	2.69	3.54	10.54	3.18	27.27
L.S.D.at 5%			6.538	0.053	0.066	0.010	0.034	0.421	0.21	0.08
Effect of micronutrients	Foliar		620.389	3.110	15.16	2.38	3.529	11.11	3.53	28.17
	without		608.481	2.973	12.14	2.22	3.176	8.05	2.01	26.06
L.S.D.at 5%			3.088	0.053	0.053	0.09	0.022	0.09	0.04	0.05
Effect of cultivars	Foliar	G7	601.121	3.095	13.27	2.02	3.29	7.39	2.45	22.39
		G8	617.367	3.046	15.92	2.69	3.72	10.11	3.11	28.38
		S1	654.818	3.003	11.75	2.19	2.92	11.24	2.75	30.57
L.S.D.at 5%			4.027	0.022	0.04	0.08	0.03	0.08	0.05	0.09

**Effect of micronutrients application:**

Data in Table (3) showed significant effect of foliar application with mixture of Fe, Mn and Zn on N, P and K uptake in seed and straw of flax plant. Data indicated that the treated plants gave the highest mean values of nitrogen uptake by seed (15.16 kg fed<sup>-1</sup>) comparatively with those of untreated ones (12.14 kg fed<sup>-1</sup>). Also, data of P and K uptake in seed as a result of mentioned foliar application were not in higher values but they showed some reasonable increases.

**Interaction effects:**

**1- Irrigation x cultivars**

NP and K uptake values as affected by interaction treatments of irrigation regime and flax plant cultivars under study were presented in Table (4a). Data revealed significant increases in seed as well as straw, whereas the highest value (19.93 kg fed<sup>-1</sup>) of N was obtained from the interaction I<sub>3</sub> x Giza 8 expressed Giza 8 cultivar and 5 times of irrigation.

P and K, realized absolutely the highest values (3.325 and 4.033 kg fed<sup>-1</sup> respectively) obtained from the interaction I<sub>4</sub> x G8 of the same cultivar. The results were in agreement with those obtained by Slatyer, 1957 and Hassan and El-Farouk, 1984).

**2- Irrigation x micronutrient**

N, P and K uptake by flax plant as affected by the interaction treatments of irrigation regime and foliar micronutrients showed (Table 4b) significant effects not only in seed values but in straw also. The third and the fourth orders interaction (I<sub>3</sub> x foliar and I<sub>4</sub> x foliar respectively) recorded the highest significant effects of P or K values for the third order and N for the fourth one. The values represented by 2.961% or 3.78 kg fed<sup>-1</sup> and 17.11 kg fed<sup>-1</sup> in seed of flax plant respectively.

**Table (4a): Interaction effect between irrigation and cultivars on macronutrients uptake by seed and straw flax plant.**

Irrig.No. x cultivars		Macronutrients uptake by seed (kg.fed <sup>-1</sup> )			Macronutrients uptake by straw (kg.fed <sup>-1</sup> )		
		N	P	K	N	P	K
I <sub>1</sub>	Giza7	6.61	1.570	2.870	4.540	1.370	22.020
	Giza 8	11.06	1.910	3.196	11.810	1.920	27.390
	Strain 1	8.45	1.796	2.517	10.750	1.760	27.450
I <sub>2</sub>	Giza7	18.99	1.691	3.198	7.280	2.810	21.930
	Giza 8	14.57	2.420	3.675	10.090	2.790	27.400
	Strain 1	11.44	2.090	2.973	12.920	3.030	30.850
I <sub>3</sub>	Giza7	12.39	2.390	3.512	6.603	2.790	25.090
	Giza 8	19.93	3.210	3.982	9.660	3.890	29.810
	Strain 1	14.03	2.580	3.110	8.860	3.310	31.660
I <sub>4</sub>	Giza7	15.09	2.440	3.563	8.880	2.830	20.520
	Giza 8	18.12	3.325	4.033	10.280	3.820	28.900
	Strain 1	13.09	2.331	3.085	12.450	2.890	32.300
L.S.D at 5%		0.12	0.05	0.08	n.s	n.s	n.s

**Table(4b): Interaction effect between irrigation and micronutrients application on macronutrients uptake by seed and straw flax plant.**

Irrig.No. x micro.		Macronutrients uptake by seed (kg.fed <sup>-1</sup> )			Macronutrients uptake by straw (kg.fed <sup>-1</sup> )		
		N	P	K	N	P	K
I <sub>1</sub>	Foliar	11.33	1.64	2.03	10.56	1.85	25.86
	Without	6.08	1.81	2.83	8.08	1.82	25.37
I <sub>2</sub>	Foliar	15.43	2.14	3.42	11.12	3.55	27.57
	Without	14.58	1.94	3.14	9.08	2.21	25.88
I <sub>3</sub>	Foliar	16.74	2.96	3.78	9.75	3.96	31.37
	Without	14.15	2.49	3.29	6.99	2.70	26.34
I <sub>4</sub>	Foliar	17.11	2.79	3.68	13.02	4.76	27.86
	Without	13.76	2.60	3.44	8.05	2.70	26.34
L.S.D at 5%		0.11	0.015	0.07	0.24	0.54	0.14

### 3- Cultivars x micronutrients

Values of nitrogen and phosphorus uptake by flax plant as shown in Table (4c) illustrated high significant only for seed. The highest values 18.73 and 2.73 kg fed<sup>-1</sup> were obtained from foliar x G8 interaction treatment. In spite of the increase of K values was not significant, it was noticed that, the absolutely highest value of K(3.82 kg fed<sup>-1</sup>) in seed was obtained from the same previous treatment. In this respect, it can be concluded that G8 cultivars evidently responded to foliar applications.

**Table (4c): Interaction effect between micronutrients application and cultivars on macronutrients uptake by seed and straw flax plant.**

Micro. x cultivars		Macronutrients uptake by seed (kg.fed <sup>-1</sup> )			Macronutrients uptake by straw (kg.fed <sup>-1</sup> )		
		N	P	K	N	P	K
Foliar	Giza 7	14.49	2.57	3.46	8.92	3.31	22.89
	Giza 8	18.73	2.73	3.82	11.49	4.09	29.60
	Strain 1	12.24	2.15	3.05	12.93	3.19	32.01
Without	Giza 7	12.06	1.78	3.11	5.87	1.59	21.89
	Giza 8	13.11	2.65	3.63	8.72	2.20	27.17
	Strain 1	11.57	2.24	2.79	9.56	2.21	29.13
L.S.D at 5%		0.10	0.15	n.s	n.s	n.s	n.s

### 4- Irrigation x micronutrients x cultivar interaction

Table (3) showed triple interaction effects of irrigation number, foliar micronutrients and flax plant cultivars. Values of N,P and K affected by the mentioned triple interactions were thoroughly not significant. Nitrogen uptake was greatly affected by treatments under study.

The highest values were those related to N uptake of flax straw in the four orders of interaction with foliar application treatments. Data also, (Table3) revealed that the highest value of P uptake by plant straw (4.25 kg fed<sup>-1</sup>) was obtained from the fourth order specifically at I<sub>4</sub> x foliar x G7 interaction treatment.

In respect with K uptake by straw of flax plant, the highest value (32.539 kg fed<sup>-1</sup>) was obtained from I<sub>4</sub> x foliar x S<sub>1</sub> treatment. It is worthy mentioned that the obtained values of K uptake were out of sequence.

As for the macro-element uptake by seed, it can be concluded that the absolutely highest values of N,P and K uptake were (23.16, 3.55 and 4.23 kg fed<sup>-1</sup>) obtained from (I<sub>3</sub> x foliar x G8), (I<sub>4</sub> x foliar x G8) and (I<sub>4</sub> x foliar x G8) interaction treatments respectively.

**Effect of irrigation number on micronutrients uptake by seed of flax plant:**

Irrigation number had significant effects on micronutrients uptake (Fe, Zn and Mn) by seed of flax plant as shown in Table (5).

**Table (5): Effect of irrigation number, micronutrients application and cultivars on Fe, Zn and Mn- uptake by seed of flax plant.**

Treatments			Seed yield (kg. fed <sup>-1</sup> )	Micronutrients uptake (g. fed <sup>-1</sup> ) by seed		
Irrig. No.	Micro.	Variety		Fe	Zn	Mn
I <sub>1</sub>	Foliar	G7	568.2	241.49	71.00	28.42
		G8	667.3	333.65	100.06	33.35
		S1	475.5	297.20	71.30	23.80
	Without	G7	587.9	220.43	88.17	44.10
		G8	677.9	169.47	135.60	33.92
		S1	493.2	234.26	73.97	24.66
I <sub>2</sub>	Foliar	G7	606.8	379.30	106.17	45.50
		G8	698.7	524.03	139.80	52.40
		S1	514.7	386.03	60.40	31.93
	Without	G7	599.3	149.87	104.90	29.97
		G8	687.9	172.00	120.43	34.40
		S1	492.9	184.87	86.23	24.63
I <sub>3</sub>	Foliar	G7	637.5	478.13	159.37	31.93
		G8	735.2	367.53	165.40	36.83
		S1	534.7	403.52	133.70	26.73
	Without	G7	615.8	153.97	123.17	15.14
		G8	726.0	254.10	145.20	36.27
		S1	506.4	151.94	88.63	25.30
I <sub>4</sub>	Foliar	G7	652.4	489.30	163.30	40.43
		G8	755.5	566.60	188.87	37.73
		S1	565.9	565.97	155.63	28.30
	Without	G7	643.2	225.13	150.80	32.17
		G8	737.8	258.23	184.40	36.93
		S1	545.4	163.60	136.36	27.30
L .S.D.at 5%			14.073	4.020	1.801	0.350
Effect of irrigation number	I <sub>1</sub>		526.451	244.00	90.02	31.37
	I <sub>2</sub>		608.700	299.35	107.95	36.47
	I <sub>3</sub>		636.646	301.53	135.91	28.74
	I <sub>4</sub>		685.944	378.14	164.87	33.811
L .S.D.at 5%			6.538	1.796	0.622	0.131
Effect of micronutrients	Foliar		620.389	419.39	128.70	34.78
	without		608.481	194.825	120.66	30.42
L .S.D.at 5%			3.088	1.38	0.4936	0.159
Effect of cultivars	G7		601.121	292.20	122.10	33.49
	G8		617.367	330.76	147.47	37.73
	S1		654.818	292.20	104.00	26.58
L .S.D.at 5%			4.027	0.9605	0.309	0.0637

Generally, values of Fe and Zn uptake were in ascending order according to irrigation treatment i.e.  $I_1 < I_2 < I_3 < I_4$ . Plant irrigated seven or five times realized the highest values of Fe or Zn. They are 378.14 and 301.53 g  $fed^{-1}$  respectively, so that the highest values of Mn uptake (36.47 g  $fed^{-1}$ ) was obtained from  $I_3$  treatment.

**Effect of different cultivars:**

Results (Table 5) of Fe, Zn and Mn uptake by seed plant of three cultivars under study, showed clearly that the values under test responded significantly. Data revealed also that Giza8 cultivars of flax plant realized the maximum values of Fe, Zn and Mn uptake. They are represented by 330.76, 147.47 and 37.73 g  $fed^{-1}$  respectively.

**Effect of Micronutrients application:**

Data (Table 5) showed high significant effects of foliar application with mixture of Fe, Mn and Zn on micronutrients (Fe, Zn and Mn) uptake by seed of flax plant. Data indicated that the effect of foliar application was more pronounced in the case of Fe uptake than the others. Thus, the foliar application treatment evidently doubled Fe value to reach 419.39 g  $fed^{-1}$  relatively to 194.825 g  $fed^{-1}$  of untreated one.

**Interaction effects:**

**1- Irrigation x cultivars**

Fe, Zn and Mn uptake values as affected by interaction of irrigation number and flax plant cultivars under study were presented in Table (6a). Data revealed significant increases in Fe, Zn and Mn uptake by seed flax plant under all treatments.

The highest values of Fe were 412.42 and 364.79 g  $fed^{-1}$  obtained from the fourth order of irrigation with G8 and S1 cultivar respectively.

Concerning Zn and Mn uptake Table (6a) also illustrated that the highest values were 186.64 and 43.40 g  $fed^{-1}$  obtained from the fourth order  $I_4$  with G8 and the second order  $I_2$  with the same cultivars respectively.

The previous results gave an impression that G8 cultivars proved its absolute superiority.

**Table (6a): Interaction effect between irrigation and cultivars on micronutrients uptake by seed flax plant.**

Irrig.No. x cultivars		Macronutrients uptake by seed (g.fed <sup>-1</sup> )		
		Fe	Zn	Mn
I <sub>1</sub>	Giza7	230.96	79.59	36.26
	Giza 8	251.56	117.83	33.35
	Strain 1	265.73	72.64	24.23
I <sub>2</sub>	Giza7	264.59	105.54	37.74
	Giza 8	348.02	130.12	43.40
	Strain 1	285.45	73.32	28.28
I <sub>3</sub>	Giza7	316.05	141.27	23.52
	Giza 8	310.82	155.30	36.55
	Strain 1	277.73	111.17	31.07
I <sub>4</sub>	Giza7	357.22	162.05	36.30
	Giza 8	412.42	186.64	37.33
	Strain 1	364.79	145.99	27.80
L.S.D at 5%		2.42	1.2	0.15

**2- Irrigation x micronutrients**

Fe, Zn and Mn uptake by seed of flax plant as affected by the interaction treatments of irrigation number and foliar micronutrients showed significant effects in all treatments under study. Table (6b) revealed that Fe and Zn uptake were in ascending order according the interaction orders i.e. I<sub>1</sub> x foliar < I<sub>2</sub> x foliar < I<sub>3</sub> x foliar < I<sub>4</sub> x foliar. The values of Fe are represented by 290.78, 429.78, 416.39 and 540.60 g fed<sup>-1</sup> respectively, while those of Zn are 80.79, 102.12, 152.80 and 169.27 g fed<sup>-1</sup> respectively.

Concerning Mn uptake as affected with the same interaction treatments, Table (6b) also revealed that the highest values of Mn uptake (43.28 g fed<sup>-1</sup>) was obtained from the I<sub>2</sub> x foliar order of the mentioned interaction treatments. The previous results are in agreement with those of Nagaraja(1997).

**Table (6b): Interaction effect between irrigation and micronutrients application on micronutrients uptake by seed flax plant.**

Irrig.No. x micro.		Macronutrients uptake by seed (g.fed <sup>-1</sup> )		
		Fe	Zn	Mn
I <sub>1</sub>	Foliar	290.70	80.79	28.52
	Without	208.05	99.25	34.22
I <sub>2</sub>	Foliar	429.79	102.12	43.20
	Without	168.91	103.85	29.66
I <sub>3</sub>	Foliar	416.39	152.80	31.83
	Without	186.67	119.00	25.57
I <sub>4</sub>	Foliar	540.60	169.27	35.49
	Without	215.60	160.52	32.13
L.S.D at 5%		2.1	1.3	.301

**3- Cultivars x micronutrients**

Values of Fe, Zn and Mn uptake by flax as shown in Table (6b) illustrated high significant effects in all treatments under study. The highest values of Fe uptake obtained from the foliar treatment with G8 (447.95 g fed<sup>-1</sup>), followed by foliar treatment with S1 (413.18 g fed<sup>-1</sup>), while the last one (397.05g fed<sup>-1</sup>) obtained from foliar treatment with G7.

With respect to Zn and Mn uptake, the highest values (148.53 and 40.08 g fed<sup>-1</sup> respectively) were both obtained from foliar with G8 treatment.

**Table (6c): Interaction effect between micronutrients application and cultivars on Fe, Zn and Mn- uptake by seed flax plant.**

Micro. x cultivars		Macronutrients uptake by seed (g.fed <sup>-1</sup> )		
		Fe	Zn	Mn
Foliar	Giza 7	397.05	124.96	36.57
	Giza 8	447.95	148.53	40.08
	Strain 1	413.18	105.26	27.69
Without	Giza 7	187.35	119.26	30.35
	Giza 8	213.45	146.41	35.38
	Strain 1	183.67	96.30	25.47
L.S.D at 5%		1.17	0.19	0.08

#### 4- Irrigation x micronutrients x cultivar

Values (Table 5) revealed that Fe, Zn and Mn uptake by seed of flax plant were thoroughly significantly affected by the triple interactions treatments under study. The highest values of Fe uptake were (566.6 and 565.97 g fed<sup>-1</sup>) obtained from I<sub>4</sub> x foliar x G8 or S1 respectively, followed by I<sub>2</sub> x foliar x G7 (478.13), while the last one (333.65 g fed<sup>-1</sup>) was obtained from I<sub>1</sub> x foliar x G8 treatment.

Concerning Zn uptake the absolutely highest value (188.87 g fed<sup>-1</sup>) was obtained from I<sub>4</sub> x foliar x G8.

As for Mn uptake Table (5) also showed that the highest value (52.4 g fed<sup>-1</sup>) was obtained from triple interaction treatment (I<sub>2</sub> x foliar x G8).

It can be recommended to use G8 and S1 cultivars with 7 times of irrigation treatment which recorded the highest effects for all macro and micronutrients uptake under foliar application.

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## استجابة محصول الكتان لعدد مرات الري وإضافة بعض العناصر الصغرى فى الاراضى الجيرية

٢- التأثير على امتصاص العناصر الكبرى والصغرى لنبات الكتان.

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اجريت تجربتان حقليتان فى الاراضى الجيرية بمزرعة محطة البحوث الزراعية بالنوبارية فى  
موسمى ١٩٩٩/٢٠٠٠ و ٢٠٠٠/٢٠٠١ وذلك لدراسة تأثير عدد مرات الري وإضافة العناصر الغذائية  
الصغرى والتفاعل بينهما على امتصاص العناصر الكبرى والصغرى للصنفين التجاريين من الكتان (جيزة ٧  
، جيزة ٨) بالإضافة الى السلالة الجديدة س ١ .  
تتلخص النتائج كما يلى:-

- ١- أعطى الصنف جيزة ٨ والسلالة س ١ أعلى محتويات من النتروجين والفوسفور والبوتاسيوم لكلا من  
الحبوب والقش بينما عكست نتائج جيزة ٧ التأثيرات الأقل.
- ٢- أعطت عدد مرات الري ٧ ، ٥ أعلى نتائج فى محتوى العناصر الكبرى وكانت شبة متساوية للمعاملتين  
وكانت القيم هي ١٥،٩٢ ، ٢،٦٩ ، ٤،٧٢ كجم/فدان لل ن ، فو ، بو على الترتيب
- ٣- كان أكثر تأثير لمعاملة الرش بالعناصر الصغرى هو عنصر النتروجين فى محتوى البذرة حيث أعطى  
أعلى قيم وهو ١٥،١٦ كجم/فدان بينما الغير معاملة كانت ١٢،١٤ كجم/فدان بينما ذادت أيضا قيم  
الفوسفور والبوتاسيوم زيادة ملحوظة.
- ٤- فى معاملات التداخل الثلاثية كانت ن ، فو ، بو فى البذرة ٢٣،١٦ ، ٣،٥٥ ، ٤،٢٣ كجم/فدان على  
الترتيب وهذه النتائج تحصل عليها من المعاملات ( ٥ ريات × الرش بالعناصر × الصنف جيزة ٨ )  
( ٧ ريات × الرش بالعناصر × الصنف جيزة ٨ ) .
- ٥- بالنسبة لمحتوى النبات من العناصر الصغرى حديد- زنك- منجنيز كانت أعلى قيم لامتصاص الحديد  
هي ٥٦٦،٦ ، ٥٦٥،٩٧ جم/فدان تحصل عليها من معاملتى ( ٧ ريات × رشالعناصر الصغرى × جيزة  
٨ ) ، ( ٧ ريات × الرش بالعناصر × السلالة س ١ ) . أما بالنسبة للزنك والمنجنيز كانت قيم  
الامتصاص هي ١٨٨،٨٧ ، ٥٢،٤ كجم/فدان تحصل عليها من ( ٧ ريات × الرش بالعناصر الصغرى ×  
الصنف جيزة ٨ ) ، ( ريتان × معاملة الرش بالعناصر × الصنف جيزة ٨ ) على الترتيب.
- ٦- هذه الدراسة أوضحت أن الصنف جيزة ٨ والسلالة س ١ وعدد ريات ٧ سجلت أعلى نتائج فى كلا  
من امتصاص العناصر الكبرى والصغرى فى وجود معاملات الرش الورقى بالعناصر الصغرى لذا  
يوصى بأهمية التسميد رشا بالعناصر الصغرى (حديد-زنك-منجنيز) تحت معدلات الري العالية مع  
التركيز على الصنفين جيزة ٨ والسلالة المبشرة س ١.