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EFFECT OF NITROGEN FERTILIZERS AND SOME MICRO-NUTRIENTS ON FLAX YIELD AND CHEMICAL COMPOSITION CHARACTERS

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ABSTRACT

Two field experiments were conducted at El-Gemmeiza Res. Station. Gharbia Governorate Agric. Res. Center during the two successive seasons of 2006/2007 and 2007/2008 to study the effect of micro-nutrients (Mn, Zn, Fe, Cu and B) foliar spraying and soil application and N levels (30 and 45 Kg/Fed) on seed and straw yield, yield components, quality characters and chemical composition of flax plants.

Results obtained can be summarized as follows:-

1- Regarding chemical contents at 90 days after sowing date the results indicating that soil or foliar application of Fe, Cu and B significantly increased N and P uptake from soil and increased their content in flax plants. In addition, Mn applications had significant influence at increasing K content in the treated plants.
2- Concerning micro-nutrients foliar application; results clearly showed that Mn, Zn, Cu and Fe significantly increased Zn content in flax plants at 90 days after sowing. Soil or foliar application (Mn, Zn, Cu and Fe) had increased Mn content in flax plants aged 90 days.
3- Results showed that Zn application was more effective on increasing plant height, technical stem length and straw and fiber yield. Foliar application of B, Cu, Mn and Zn increased seed yield / fad while B foliar application recorded the lowest oil percentage.
4- With respect of quality characters; results indicated that B applications gave the highest fineness which was not significantly affected by the other treatments.

INTRODUCTION

Flax in Egypt is ranked the second fiber crop after cotton cultivated area. It has been cultivated for two main purposes i.e. fiber and oil. In addition; it can be grown under broad range of climatic conditions, besides; it used to be adapted with low supplies of nutrients. The need of larger and larger amounts of macro and micro elements was geometrically increasing after the construction of the high dam, Nabhan (1966).

Micro-nutrients such as B, Cu, Mn, Fe and B are critically required in minor amounts for plant metabolism specially functioning of plant growth hormones. The role of micro-nutrients in biosynthesis in crops was discussed by El-Bastawesy *et al. .* (1983), Gardner *et al. .* (1985) and Marschner (1995). Several investigators reported that micro-nutrients applications are contributing to growth enhancement and increasing seed oil and stem fiber in flax; as mentioned by El- Sweify *et al. .* (2002) and El- Azzouny (2003). Micro-nutrients deficiencies are mainly due to low total available amounts in soil, low availability of micro-nutrients may be refers to high soil Ph, Ca Co3 %, low organic matter %, stress conditions and high plant requirements. Therefore, the target of this study was to investigate the response of flax plants to foliar spraying or soil application of some micro-nutrients i.e. Fe, Mn,

Cu, Zn and B, to obtain a high yield and quality of available flax area under the condition of high competition between flax and other winter crops namely; wheat, barely and beans.

MATERIALS AND METHODS

Two field experiments were carried out at El- Gemmeiza Res. Station. Gharbia Governorate. Egypt. during two successful seasons 2006/2007 and 2007/2008. The aim of this study is to investigate the effect of different micro-nutrients applications (Mn, Zn, Cu, Fe and B) as well as N levels on straw and seed yield and quality characters in Sakha 2 flax cultivar. The tested treatments were arranged as factorial experiment in RCBD with four replications, the plot area was 6 m². Flax seeds were broadcasting on 7 and 11 november for the first and second seasons respectively. Calcium super phosphate (15.5% P2O5) at the rate of 100 kg/fad was added during tillage, in RCBD

Treatments in four replications was conducted in factorial experiment in RCBD

A: Control; without any micronutrients applications and N fertilizer.

B: N fertilization

0 kg/N/fed , 30 kg /N/ fed and 45 kg/N/ fed

Was applied at two equal doses before the first and second irrigations.

C: Foliar spraying of micro-nutrients:-

1- Foliar spraying of Mn SO_4 – 4 H_2O (25%Mn) at the rate of 450mg/ Fad.
2- Foliar spraying of Zn So4 – 4 H_2O (25%Zn) at the rate of 600 g/Fad.
3- Foliar spraying of Cu So4 – 5 H_2O (25%Cu) 460 g/Fad.
4- Foliar spraying of Fe So4 – 7 H_2O (25%Fe) 350 g/Fad.
5- Foliar spraying of Na2 B4O7 – 10 H_2O (36%B) 15 g/Fad.

D: Soil application with micro-nutrients:-

1- 4.5 Kg Mn/Fad.
2- 6.5 Kg Zn/Fad.
3- 0.6 Kg Cu/Fad.
4- 3.5 Kg Fe/Fad.
5- 0.15 Kg B/Fad.

Soil applications were carried out during seed bed preparation, while spraying treatments was carried out as one dose at 45 days after sowing. Soil texture of the experimental field was clay-loam and the chemical and mechanical analysis of it is presented in table (1):

Micro-nutrients amounts in flax plants are related with the availability of N, P and K (Jackson 1967, Olsen *et al. .* 1954 and Piper 1950, respectively).

For determining some of growth and chemical characters; ten plants were taken randomly. From all plots; some plants were pulled out to measure the values of N, P and K in dry matter after 90 days from sowing, and also to estimate Mn, Zn, Fe, Cu and B contents in 2006/07 and 2007/08 seasons as well as to study straw and seed yield and some other technological characters:-

1- Nitrogen % was determined by micro-kildahl method according to A.O.A. C. (2000).
2- Phosphorus % was determined calorimetrically according to the method described by Frie *et al. .* (1964).
3- Potassium % was determined as described by Brown and Lilliand (1964) using flame-photometer.
4- Micro-nutrients % were determined in the plant digest using an atomic absorption Spectrophotometer (Perkins Elmer 2110).

Table (1): Chemical and mechanical analysis of experimental soil during the two seasons

Soil characters	Growing seasons	
Mechanical analysis	**2006/2007**	**2007/2008**
Sand	25.3	28.4
Silt	28.9	26.1
Clay	45.8	45.5
Soil texture	Clay-Loam	Clay-Loam
pH (1: 2.5 soil water sus.)	7.8	7.65
E.C. (ds/m) in (1:5) soil water ext.	0.38	0.43
Ca CO_3 %	1.8	2.1
Organic matter %	1.87	2.18
SAR %	1.96	1.78
Saturation percentage %	35.6	46
N (Nitrate N KCl ext.)	27.3	24.5
P (Na HCO_3 ex.)	20.18	16.60
K (Neutral NH4 – acetate ext.)	359	379
Fe (DTPA – ext.)	8.4	8.7
Cu (DTPA – ext.)	1.8	1.6
Zn (DTPA – ext.)	1.4	1.58
Mn (DTPA – ext.)	4.36	4.69
B (Ca Cl_2 ext.)	3.7	3.9

- **Straw yield characters:-**

1- Plant height (Cm) by measuring the distance from the cotyledon node to the upper capsule
2- Technical Length (Cm) the length of the main stem from the cotyledon node to the lower branch
3- Straw yield (Ton/Fad) estimated from the rest area of each plot
4- Fiber yield (Kg/Fad) estimated by fiber percentage Fiber percentage Fiber yield after retting / Straw yield after retting For each plot

- **Seed yield characters:-**

1- Seed yield (Kg/Fad).
2- Oil yield (Kg/Fad) estimated by oil percentage.
= Oil percentage X Seed yield (Kg/Fed)

- Technological characters:-

1- Fiber percentage.

2- Oil percentage. It was determined according to the method described by Horwitz *et al. .* (1965), using Soxhlet apparatus
3- Fiber length (Cm).
4- Fiber fineness (NL/G) where:-
   N= Number of fibers.
   L= Length of fibers.
   G= Weight of fibers.

Statistical analysis of the obtained data was performed according to combined analysis presented by Steel and Torrie (1980), means of the treatments were compared using the Least Significant Difference method (L.S.D.) at 0.05% level of probability in both seasons. Waller and Duncken (1969).

RESULTS AND DISCUSSION

Mean values of some straw, seed and technological characters in Sakha 2 flax cultivar as affected by nitrogen levels and some micro elements rates are presented in Table (2 and 3) over two seasons.

Statistical combined analysis indicated that either nitrogen fertilizer or micro elements rates had significant effect on the average of all studied characters.

Regarding the three N levels (0,30 and 45 Kg N/Fed); data revealed that applying 45 kg N/fad, resulted in approximately an increasing of all the characters previously mentioned when compared with the effect of the lower N level at 0 and 30 kg N/fad. Therefore; it must be mentioned that nitrogen is an essential element for flax growth to build up protoplasm and protein which is important for cell division and meristematic activity, such effect resulted in an increase in cell number, cell size and plant growth Cabou – khadra *et al.* (1997).

Generally; adding 45 Kg N/Fed was superior and higher performance than 0 or 30 Kg N/Fed, while 0 Kg N/Fed gave the highest number of fiber fineness.

Table (3) exhibited averages of some chemical components of the dry matter for plants of the Sakha 2 flax varieties at 90 days from sowing as affected by N levels and some micro elements rates. Data showed significant differences between the three nitrogen levels which 45 Kg N/Fed increased all micro elements uptake than 0 or 30 Kg N/Fed (Abd el Aal *et al.* (1986).

Data in tables (2 and 3) showed that the maximum plant height, technological stem length and fiber fineness were obtained by applying the Cu element at the rate of 460 gm/Fed as a foliar spray combined with adding 45 Kg N/Fed on the other side the highest seed, straw and fiber yield / Fed were achieved by foliar plants by Zn at the rate of 600 gm/Fed under 45 Kg N/Fed (Kadry W. M. 1981) and (Nabhan 1995). B element at the rate of 15 gm/Fed as a foliar application gave the highest oil yield / Fed and fiber fineness. Micro elements nutrient improved the technological characters i.e. fiber fineness, oil percentage and fiber length by increasing photo synthesis in flax plants (El-Bastawesy *et al.* (1983).

Table (2): Means of plant height (cm) technological length (cm) fiber length (cm) straw yield (ton / fed) fiber and oil yield (kg/fed) and fiber fineness (Nm) as affected by nitrogen levels and micro elements over two seasons

Characters / Treatments			Plant height	Tech Length	Fiber length	Straw yield	Seed yield	Fiber yield	Fiber fine	Oil yield
Control			74.19	59.92	48.12	2.92	370.21	168.11	222.09	22.09
30 Kg N/Fed	Mn	Foliar	83.54	62.04	53.89	3.36	609.12	224.21	36.18	231.51
		Soil	80.73	56.18	56.18	3.34	570.62	203.81	35.76	208.72
	Zn	Foliar	97.5	70.22	63.11	3.65	682.31	240.81	35.31	244.16
		Soil	93.99	58.15	58.15	3.16	619.44	216.72	34.49	220.86
	Cu	Foliar	79.36	69.23	51.07	3.19	574.13	206.91	35.89	220.64
		Soil	77.15	51.06	51.06	3.43	543.31	187.12	33.82	212.72
	Fe	Foliar	91.33	66.41	57.98	3.49	644.29	219.18	33.92	252.49
		Soil	88.15	55.11	55.11	3.04	603.21	203.91	13.18	224.71
	K	Foliar	77.11	78.01	71.11	3.03	534.15	199.51	37.38	237.41
		Soil	76.32	55.13	55.13	3.29	519.43	188.11	35.76	231.33
Mean			84.52	66.29	57.28	3.29	590	209.02	229.37	35.17
45 Kg N/Fed	Mn	Foliar	83.27	69.28	59.12	3.82	728.15	278.19	38.29	208.72
		Soil	82.61	67.29	59.19	3.54	694.17	251.43	36.17	260.12
	Zn	Foliar	98.72	89.18	61.18	4.12	810.12	279.81	35.22	220.2
		Soil	92.42	78.17	69.17	3.67	760.31	363.61	53.12	319.23
	Cu	Foliar	108.32	92.16	83.01	3.62	696.12	256.51	36.82	237.41
		Soil	104.13	83.88	57.18	3.46	670.15	239.14	35.72	310.52
	Fe	Foliar	91.19	74.65	63.14	3.98	764.32	263.11	34.34	252.49
		Soil	88.24	75.81	64.44	3.6	627.18	251.21	34.61	323.83
	K	Foliar	103.11	91.17	78.99	3.53	662.25	263.43	39.81	321.03
		Soil	101.01	88.13	73.19	3.42	650.18	239.22	36.78	329.01
Mean			93.5	80.69	62.86	3.68	706.35	257.06	231.7	38.09
Over all mean			84.07	68.83	56.08	3.51	555.52	211.39	227.72	31.78
L.S.D at 0.05		A	0.99	0.82	0.96	0.72	1.16	0.88	0.97	0.92
		B	0.12	0.18	0.12	0.38	0.27	0.99	0.89	0.89
		AXB	0.18	0.38	0.91	0.22	0.39	0.88	0.92	0.37

Table (3): Means of N, P.K .Zn, Fe , Cu , Mn , and B% in dry matter of Sakha 2 flax plants as affected by nitrogen levels and micro elements over two seasons

Characters / Treatments			N%	P%	K%	Zn%	Fe%	Cu%	Mn%	B%
Control			1.98	0.51	2.54	18.99	275.4	7.96	27.42	29.01
30 Kg N/Fed	Mn	Foliar	2.68	0.62	3.31	27.21	280.12	9.55	52.55	44.22
		Soil	3.32	0.51	3.26	26.02	325.92	8.74	47.42	48.01
	Zn	Foliar	2.69	0.68	3.39	47.32	453.17	11.23	47.55	41.92
		Soil	2.87	0.55	2.61	50.31	301.71	10.17	44.02	37.84
	Cu	Foliar	2.97	0.63	3.67	36.62	339.15	13.74	63.42	39.12
		Soil	3.32	0.6	2.58	36.31	376.92	12.83	36.62	38.43
	Fe	Foliar	2.94	0.58	3.61	52.67	492.14	15.4	43.95	39.62
		Soil	3.28	0.58	2.57	59.6	404.15	14.33	41.22	39.79
	K	Foliar	2.32	0.59	3.82	40.11	818.29	12.59	27.88	45.82
		Soil	3.33	0.51	2.58	42.71	352.17	11.82	29.13	41.05
Mean			2.97	0.58	3.04	38.68	384.37	11.04	43.38	51.35
45 Kg N/Fed	Mn	Foliar	3.5	0.61	3.62	29.1	460.17	12.93	59.26	46.15
		Soil	3.75	0.55	3.55	28.22	360.07	11.58	52.33	40.11
	Zn	Foliar	3.9	0.65	3.66	47.32	463.12	15.65	50.05	41.85
		Soil	3.86	0.66	3.58	38.67	363.12	13.91	46.92	36.21
	Cu	Foliar	3.56	0.62	3.67	36.62	498.18	17.29	35.72	36.63
		Soil	3.77	0.65	3.59	40.13	339.17	15.11	35.22	33.63
	Fe	Foliar	3.54	0.61	3.62	52.32	356.18	19.23	39.86	50.15
		Soil	3.46	0.59	3.6	65.13	492.14	12.81	40.81	44.91
	K	Foliar	3.47	0.62	3.67	40.77	550.14	11.23	29.91	45.3
		Soil	3.9	0.62	3.6	51.67	418.92	10.41	27.16	48.21
Mean			3.67	0.62	3.67	41.99	431.71	14.04	41.72	42.3
Over all mean			2.87	0.57	3.61	33.22	363.82	11.01	37.5	40.88
L.S.D at 0.05		A	0.01	0.06	0.01	0.02	0.01	0.03	0.28	1.03
		B	0.07	0.12	0.22	0.07	0.12	0.26	0.27	0.18
		AXB	0.01	0.15	0.18	0.01	0.18	0.38	0.08	0.92

Table (3) exhibited averages of some chemical components of the dry matter for plants of Sakha 2 flax cultivar at 90 days old as affected by N levels and some micro elements. Results cleared that Ferric and Cupper values in dry matter reached the highest estimates when applied as foliar application synchronizing with 45 Kg N/Fed as a foliar spray parallel with 30 Kg N/Fed Marchner H. (1993) and Jackson M. (1967).

The highest Zn quantity (65.13 mg) obtained by applying Fe at 3.5 Kg/fad. when fertilizing flax plants with 45 Kg N/fad. Moreover; the highest Fe and Cu values were recorded when applying 45 Kg N/fad parallel with. 15 g B/fad. and 350 g Fe/fad. respectively. Applying 30 Kg N/fad. recorded the highest estimates for Mn and B elements when flax plants fertilized by 460 g Cu/fad. and 350 g Fe/fad. respectively.

N x M interaction had significant effect regarding all the studied micro elements as shown in table (3). The highest estimate for N content was 3.905 which performed by adding 15 Kg B/fad. with 45 Kg N/fad.. Maximum P estimate (0.683) was achieved by adding 600 g Zn/fad. as a foliar application combined with 30 Kg N./fad.. The greatest estimate of K element in plant dry matter was obtained by applying B at the rate of 15 g/fad. as a foliar application with the lowest N level 30 Kg N/fad.

Conclusion:

We recommend that applying of 45 Kg N/Fed with some micro elements as a foliar application gave the highest seed and straw yield and improved the technological characters such as fiber fineness.

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تأثير التسميد النيتروجيني وبعض العناصر الصغرى على محصول وجودة الكتان

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أجريت تجربتين حقليتين في المزرعة البحثية بمزرعة محطة البحوث الزراعية بالجميزة – محافظة الغربية في الموسمين الزراعيين ٢٠٠٦/٢٠٠٧، ٢٠٠٧/٢٠٠٨ لدراسة أثر التغذية الأرضية والورقية بالعناصر الصغرى تحت ثلاثة مستويات ٠ ، ٣٠ ، ٤٥ كجم نيتروجين للفدان.

وكانت النتائج كالتالي:-

- أكدت النتائج المأخوذة أن الرش والتسميد الأرضي بعناصر الحديد والنحاس والبورون قد أدى إلى زيادة امتصاص النبات للنيتروجين ، ومن ثم فقد أدى إلى زيادة معنوية في محصول القش والبذور للنبات.
- أما إضافة عنصر المنجنيز فقد أدت إلى زيادة معنوية في محتوى النبات من عنصر البوتاسيوم.
- وأوضحت الدراسة أن هناك علاقة سلبية وإيجابية في التغذية ببعض العناصر على امتصاص العناصر للعناصر الأخرى.
- أدى الرش بعنصر الزنك إلى زيادة معنوية في طول النبات والطول الفعال ومحصول القش وكذلك محصول الألياف للفدان، أما التغذية بعناصر النحاس والبورون والحديد فقد أدت إلى زيادة معنوية في محصول البذور ومكوناته، أما الرش بالبورون فقد أثر سلبا على النسبة المئوية للألياف ولكنه أثر إيجابيا معنويا على النعومة.

التوصية:

يمكن القول أن الرش بالعناصر الصغرى مع ٣٠ أو ٤٥ كجم نيتروجين للفدان يعطي أعلى محصول لنبات الكتان من القش والبذور، ويحسن الصفات التكنولوجية للكتان لاسيما نعومة الألياف.

قام بتحكيم البحث

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