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EFFECT OF PHOSPHORUS FERTILIZER LEVELS AND SOME MICROELEMENTS ON FLAX YIELD AND QUALITY

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Abstract

Two field experiments were performed in Sakha Agricultural Research Station during 1994/95 and 1995/96 seasons to study the effect of three levels of phosphorus fertilizer (zero, 15 and 30 kg. P_2O_5/ fed.) and only one concentration (250 ppm.) for each of microelements (Zn., Mn., Fe. and their mixture) as foliar application on the yield, yield components and some technological characters of Giza 7 flax variety. Increasing phosphorus levels from zero up to 30 kg. /fad. Significantly increased straw yield per faddan, fiber yield per faddan, long fiber percentage, fiber fineness, upper branching zone length, number of capsules per plant seed yield plant as well as per faddan and oil percentage. Spraying flax plants with Zn. was significantly surpassed over other microelements in each of straw yield per plant as well as per faddan, fiber yield per faddan, long fiber percentage and fiber fineness. While Mn. significantly increased seed yield and its related characters except seed index which did not reach the level of significane. Significant interaction between P. levels and microelements were recorded in all straw yield and its related characters except on technical length. On the other hand, the interaction was significant in respect to all seed yield characters.

INTRODUCTION

Flax is still the main source of bast fiber production in Egypt. However, its grown as a dual purpose type to extract fiber from straw and obtained oil from seed. Recently, flax acreage in Egypt decreased about 38000 faddans. Therfore, a great gap accrued between the production and consumption especially in seed yield. This gap could be minimized by increasing flax yield per unit area through evolving new varieties characterized by high yielding ability and improvement of agricultural practices. The effect of phosphorus fertilizer as soil application on

the yield, yield components and quality of flax have been studied by many workers. Hella *et al.* (1986), El-Farouk *et al.* (1988), Jain *et al.* (1989), Mohammed (1989), Yadov *et al.* (1990), Mahmoud (1993), Shrivastava *et al.* (1994) and Chaubey and Dwivedi (1995) found that the application of phosphorus caused an increase in yield and quality of flax. Some microelements as foliar application trials were don to improve fiber quantity and quality. Abo-Khadra *et al.* (1982), found that microelements increased and improved straw and seed yield of flax. Moreover, Abo-El-Soad *et al.* (1975), Mourad *et al.* (1988) and El-Sweify (1993), revealed that foliar spray of flax with Zn So4 significantly increased straw and seed yields per faddan as well as fiber quality. While Dixit and Sharma (1993) found that spraying flax plants with foliar application of Fe. Significantly increase all the characters of yield, yield components and quality of flax. Finally El-Shimy *et al.* (1986) reported that Mn. treatment increased and improved the quality of fiber.

The present trails were raised with the aim to investigate the separate effects of P, Zn., Fe. and Mn. as well as their mixtures on yield, yield components and fiber quality characteristics of Giza 7 flax variety.

MATERIALS AND METHODS

Two field experiments were carried out in Sakha Agric. Res. Stat. during the two sucessive seasons 1994/95 and 1995/96. The flax variety Giza 7 was used (It is considered as iocal and dual purpose variety.) The split plot design with four replications was applied to study the effect of three phosphorus levels (a) i.e. 0,15 and 30 kg. P. per faddan as the main plots and five microelements treatments (b) were added alone i.e. zero, Zn., Fe., Mn. in addition to their mixture with the concentration of 250 ppm./L. as foliar spray which carried out at the folume of 150 L. per faddan when plants reached first blooming stage. The area of sub plot was 6m2. All other agronomic practices were performed at the proper time. At full maturity, ten plants were taken at random from each split plot to be used in the following characters estimates.

I- Straw yield and its related characters

1. Technical length in cm.
2. Stem diameter in mm.
3. Straw yield/plant in g.
4. Straw yield/faddan in tons

5. Fiber yield/faddan in kg
6. Fiber length in cm.
7. Long fiber percentage
8. Fiber fineness in Nm.

II- Seed yield and its related characters

1. Upper branching zone length in cm.
2. Number of capsule/plant
3. Number of seeds/capsule
4. Seed yield/plant in g.
5. Seed yield/faddan in kg.
6. Seed index (1000 seed weight in g.)
7. Oil percentage

The statistical analysis was carried out according to Sendecor and Cochran (1982) and means were compared by Least Significant Differences (L.S.D.) at 5% level.

RESULTS AND DISCUSSION

Straw yield and its related characters

Means values of straw yield and its related characters as affected by phosphorus fertilizer levels and one concentration of some microelements in the two successive seasons 1994/95 and 1995/96 are presented in Table 1.

Regarding phosphorus fertilizer effect, data showed significant differences in straw yield/faddan, fiber yield/faddan, long fiber percentage and fiber fineness. Meanwhile, differences of technical stem length, stem diameter, straw yield/plant and fiber length did not reach the level of significant in the two seasons. It is clear that there were gradual increments towards the highest phosphorus level in all eight previous characters in both seasons, meaning that the maximum mean value is associated with the highest phosphorus level application. In the first season, the range between the untreated control mean and the highest one obtained by the application of the highest phosphorus level in each of the following characters were 72.323 to 73.034 cm for technical length, 2.119 to 2.229 mm for stem diameter, 0.893 to 0.992 g for straw yield/plant, 1.711 to 2.138 tons for straw yield/faddan, 226.946 to 287.019 kg for fiber yield/faddan, 70.142 to 71.005 cm for fiber le-

Table 1. Means of straw yield and its related characters as affected by phosphorus fertilizer and some microelements during 1994/96 season.

Characters	1994 / 1995										1995 / 1996									
	P.levels				Microelement						P.levels				Microelement					
	zero	15	30	L.S.D	Cont.	Zn.	Fe.	Mn.	Mix.	L.S.D	zero	15	30	L.S.D	Cont.	Zn.	Fe.	Mn.	Mix.	L.S.D
Technical length (cm)	72.3	72.7	73.0	N.S.	72.1	73.8	70.9	73.4	73.4	N.S.	72.0	72.3	73.7	N.S.	71.9	73.8	71.0	73.7	73.1	N.S.
Stem diameter (mm)	2.1	2.2	2.2	N.S.	2.2	2.2	2.2	2.2	2.2	N.S.	2.1	2.1	2.2	N.S.	2.1	2.2	2.1	2.2	2.1	N.S.
Straw yield/plant (g)	0.9	0.9	1.0	N.S.	1.0	1.0	0.7	1.0	1.0	0.082*	0.9	0.9	1.0	N.S.	1.0	1.0	0.7	1.0	1.0	0.053*
Straw yield/fad. (tons)	1.7	1.8	2.1	0.165*	1.6	2.2	1.6	2.2	1.9	0.129*	1.6	1.8	2.1	0.062*	1.6	2.1	1.6	2.1	1.9	0.044*
Fiber yield/fad. (kg)	226.9	233.8	287.0	12.484*	224.9	291.3	212.5	265.7	251.9	11.336*	217.9	231.9	279.5	12.257*	213.7	282.0	210.2	256.6	253.0	7.629*
Fiber length (cm)	70.1	70.4	71.0	N.S.	70.1	71.5	68.5	71.4	71.0	N.S.	89.6	70.0	71.2	N.S.	69.2	71.4	68.6	71.1	70.9	N.S.
Long fiber percentage	12.9	13.1	13.33	0.059*	12.9	13.6	12.2	13.6	13.3	0.06*	12.9	13.1	13.3	0.065*	12.9	13.5	12.3	13.5	13.2	0.053*
Fiber fineness (Nm)	193.5	195.3	197.1	1.244*	193.5	201.7	191.3	196.4	193.6	1.262*	191.9	192.9	194.2	1.679*	191.6	197.3	189.0	194.4	192.3	1.594*

ngth, 12.887 to 13.303% for long fiber percentage and 193.510 to 197.145 for fiber fineness, with the corresponding superiority ratios of 0.98, 5.19, 11.09, 11.09, 24.96, 26.47, 1.23, 3.23 and 1.88%. At the second season, the excess ratios for the same respective characters were 2.39, 4.44, 5.72, 30.18, 28.27, 2.30, 2.97 and 1.18%. It must be mentioned that the three traits i.e., straw yield/faddan, fiber yield/faddan and fiber length were improved greatly with increasing P level in both seasons. These results suggest that the increases in straw yield and its related characters may be due to physiological activities stimulation in flax plants. The results reported in this work are in in agreement with those obtained by El-Farouk *et al.*, (1988) and Mahmoud (1993).

Table 1. Means of straw yield and its related characters as affected by phosphorus fertilizer and some microelements during 1994/96 season.

Characters	Interactions P.levels X Microelements	
	1994/95	1994/95
Technical length (cm)	76.2 N.S.	77.4 N.S.
	15 kg P. X Zn	15 kg P. X Zn
Stem diameter (mm)	2.4*	2.3*
	30 kg P. X cont.	30 kg P. X cont.
Straw yield/plant (g)	1.1*	1.1*
	15 kg P. X Zn.	15 kg P. X Zn.
Straw yield/fad. (kg)	2.4*	2.3*
	15 kg P. X Mix.	15 kg P. X Mix.
Fiber yield/fad. (Kg)	308.2*	294.3*
	15 kg P. X Zn.	15 kg P. X Zn.
Fiber length (cm)	74.6*	294.3*
	15 kg P. X Zn.	15 kg P. X Zn.
Long fiber percentage	13.9*	13.9*
	30 kg P. X Zn.	30 kg P. X Zn.
Fiber fineness (Nm)	203.6*	198.1*
	30 kg P. X Zn.	30 kg P. X Zn.

Concerning microelements as foliar applications effect, results indicated that straw yield/plant as well as per faddan, fiber yield/faddan, long fiber percentage

and fiber fineness were significantly differed, but differences in technical length, stem diameter and fiber length did not each the level of significance in the both two seasons. It is clear that Zinc application caused maximum increases in all the eight straw traits under study in comparison with the other treatments, where Manganese ranked second after Zinc in this case and followed by microelements mixture, the untreated control and finally the negligible effect caused by adding ferrous (Fe.) element. The mean values of the corresponding untreated control appeared from the following superiority ratios in the two seasons i.e., 2.27 and 2.64; 3.43 and 1.98; 3.64 and 6.93 33.07 and 30.15; 29.54 and 31.99; 2.02 and 3.18; 5.36 and 5.12; 4.23 and 2.98% for technical length, stem diameter, straw yield/plaant, straw yield/faddan, fiber yield/faddan, fiber length, long fiber percentage and fiber fineness, respectively. From the above mentioned results, similar trend had shown among the two seasons for each phosphorus and microelements application effect on straw yield and its related characters. Abo El-Soad *et al.*; (1975), Dixit and Sharma (1993) and El-Sweifty (1993) come to similar conclosion.

Table 2 illustrates the different interaction effects on straw yield and its related characters.

The interaction between P.levels and microelements had significant effect on the seven characters i.e., stem diameter, straw yield per plant as well as per faddan, fiber faddan, fiber length, long fiber percentage and fiber fineness. While technical length was not significantly affected.

II- Seed yield and its related characters:

Mean values of seed yield its related characters as affected by phosphorus levels and only one concentration of some microelements in the two successive seasons 1994/95 and 1995/96 are presented in Table (3).

In respect of phosphorus fertilizer effect, results demonstrated that P. levels significantly affected upper branching zone length, number of capsules/plant, seed yield/plant as well as per faddan and oil percentage. On the contrary, number of seeds/ plant and seed index did not reach the level of significance in the two seasons. Moreover, there was a progressive increment in all seed characters by increasing P. levels from the untreated control up to 30 kg./fad. in the two seasons and the Table No.3 greatest mean values of the above mentioned characters were in connection with the highest P. level (30 kg. P. / fad.). It is clear to notice that the superiority ratios between 35 kg. P. and untreated control was 6.23, 5.20, 0.61,

Table 3. Means of seed and its related characters as affected by phosphorus fertillzer and some microelements during 1994/95 and 1995/96 season.

Characters	1994 / 1995										1995 / 1996									
	P.levels				Microelement						P.levels				Microelement					
	zero	15	30	L.S.D	Cont.	Zn.	Fe.	Mn.	Mix.	L.S.D	zero	15	30	L.S.D	Cont.	Zn.	Fe.	Mn.	Mix.	L.S.D
Upper branching zone length (cm)	9.9	10.5	10.5	0.287*	10.0	10.3	10.2	10.8	10.3	0.479*	9.8	10.4	10.5	0.299*	10.1	10.2	10.1	10.8	10.2	0.509*
Number of capsules/plant	6.6	6.7	7.0	0.156*	6.3	6.9	6.5	7.6	6.6	0.331*	6.5	6.7	6.8	0.159*	6.2	6.9	6.3	7.5	6.6	0.203*
Number of seeds/plant	47.3	47.4	47.5	N.S.	40.9	49.0	45.4	53.5	48.1	3.097*	46.3	47.0	47.1	N.S.	39.9	48.4	46.4	51.1	48.1	1.852*
Seed yield / plant (g)	0.3	0.4	0.4	0.021*	0.3	0.4	0.4	0.5	0.4	0.028*	0.4	0.4	0.4	0.022*	0.3	0.4	0.4	0.5	0.4	0.017*
Seed yield/fed. (Kg)	376.7	392.2	454.6	10.566*	376.4	436.9	380.0	441.5	404.4	12.581*	380.1	394.4	453.0	11.513*	377.8	433.5	382.2	442.1	410.2	11.322
Seed index (g)	8.6	8.8	8.9	N.S.	8.8	8.9	8.9	8.9	8.6	N.S.	8.8	8.9	9.1	N.S.	8.5	9.0	8.8	9.1	8.8	N.S.
Oil percentage	39.8	40.0	40.1	0.068*	39.7	40.1	39.7	40.3	39.9	0.048*	39.8	40.0	40.1	0.062*	39.7	39.9	40.1	40.2	39.8	0.1

6.72, 20.69, 3.00 and 0.82% in the first season while it was 6.66, 4.72, 1.92, 7.05, 19.19, 2.62 and 0.78% in the second one for upper branching zone length, number of capsules/ plant, number of seed/plant, seed yield/plant, seed yield/fad. seed index and oil percentage, respectively. It could be reported that the application of phosphorus encouraged the physiological reactions which was reflected in higher seed yield and its related characters. Similar findings were reported by Hella *et al.*; (1986), El-Farouk *et al.*; (1988) and Mahmoud (1993).

Table 4. Highest response value and the combination of the interaction effects on straw yield and its related characters of flax in 1994/95 and 1995/96 season.

Characters	Interactions P.levels X Microelements	
	1994/95	1994/95
Upper branching zone length (cm)	11.4*	11.8*
	Zero. P. X Mn.	Zero P. X Mn
No. of capsules/plant	7.9*	7.8*
	15 kg P. X Mn.	15 kg P. X Mn.
No. of seeds/plant	56.8*	54.4*
	15 kg P. X Mn.	15 kg P. X Mn.
Seed yield/plant (g)	0.5*	0.5*
	15 kg P. X Mn.	15 kg P. X Mn.
Seed yield / fad. (kg)	482.3*	476.3*
	15 kg P. X Mn.	15 kg P. X Mn.
Seed index (g) /100 seeds	9.1*	9.4*
	15 kg P. X Mn.	15 kg P. X Mn.
Oil percentage (%)	40.5*	40.5*
	30 kg. P X Fe	30 kg P. X Fe.

With regard to the effect of microelements, data illustrated that the upper branching zone length, number of capsules/plant, number of seeds/plant, seed yield /plant as well as /faddan and oil percentage were significantly affected by application of microelements, while seed index did not significantly affected in the two seasons. The highest mean values of the seven seed characters under study recorded when plants were sprayed with Manganese element. The descending regularity af-

terward was Zn., microelements mixture Fe. and the lowest mean values were obtained by the untreated control. The range between averages obtained between the untreated control and the corresponding highest ones were recorded by application of manganese in the two seasons, where the estimates in the first season were 10.028 to 10.769 cm. for upper branching zone length, 6.251 to 7.626 for number of capsules/plant, 40.850 to 53.508 for number of seeds/plant, 0.351 to 0.490 g. for seed yield/plant, 367.448 to 441.531 kg. for seed yield/faddan, 8.829 to 8.928 g. for seed index and 39.719 to 40.297% for oil percentage with the excess ratios of 7.39, 22.00, 31.00, 39.60, 17.29, 1.13 and 1.46%, respectively. Meanwhile, at the second season the superiority ratios for the above mentioned characters were 7.00, 21.53, 7.96, 38.46, 17.01, 2.72 and 1.26%, respectively. It is clear to show that applied manganese greatly results were obtained by El-Shimy *et al.*, (1986), Mourad et al., (1988) and El-Sweify (1993).

It could be concluded that phosphorus fertilizer of 15 kg. per faddan and spraying flax plants with Zn so4 is the best combination to produce higher straw yield and its related characters, while using the same P. level with manganese as a foliar application is favorable to get the highest seed yield and its related characters.

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تأثير مستويات التسميد الفوسفاتى وبعض العناصر الصغرى على محصول الكتان وجودته

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معهد بحوث المحاصيل الحقليه – قسم بحوث محاصيل الألياف .

اجريت تجربتان حقليتان بمحطة سخا للبحوث الزراعية خلال الموسمين ١٩٩٤/٩٥، ١٩٩٥ / ٩٦ لدراسة تأثير ثلاث مستويات من التسميد الفوسفاتى (صفر و ١٥ و ٣٠ كجم فو أ ٥ / فدان) وتركيز واحد (٢٥٠ جزء فى المليون) من بعض العناصر الصغرى (زنك ومنجنيز وحديد ومخلوط من الثلاث عناصر) على المحصول ومكوناته وبعض الصفات التكنولوجية لصنف الكتان جيزة ٧ وقد ادى زيادة مستوى التسميد الفوسفاتى من صفر حتى ٣٠كجم / فدان الى زيادة معنوية فى محصول القش ، الالياف للفدان ، النسبة المئوية للالياف الطويلة ، نعومة الالياف، طول المنطقة الثمرية، عدد الكبسولات للنبات، محصول البذور للنبات وللفدان والنسبة المئوية للزيت في البذور. كما ادى رش نباتات الكتان بالزنك الى تفوق معنوى على الرش ببقية العناصر الصغرى فى كل من محصول الالياف للفدان، النسبة المئوية للالياف الطويلة ونعومة الالياف. بينما ادى اضافة المنجنيز الى زيادة معنوية فى محصول البذور وصفاته المرتبطة ماعدا صفة دليل البذرة التى لم تصل الى مستوى المعنوية، وكان هناك تفاعل معنوى بين مستويات التسميد الفوسفاتى والعناصر الصغرى على محصول القش وصفاته المرتبطة فيماعدا الطول الفعال، ومن ناحية اخرى كان التفاعل معنوى فيما يختص بجميع صفات البذور.