Response of Two Flax Cultivars to N,P and K Fertilizer Levels

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Abstract

Two field experiments were carried out at the Experimental Station, Faculty of Agriculture, Mansoura University, during the two successive winter seasons of 1996/97 and 1997/98 to study the response of two flax cultivars (Giza 8 and Blanka) to N (70, 120 and 170 kg N/ha^{-1}), P and K fertilizers levels (0 kg PK, 35 kg P, 30 kg K, 35 kg P + 30 kg K, 70 kg P + 30 kg K, 35 kg P+ 60 kg K and 70 kg P+ 60 kg K ha^{-1}). Giza 8 cv. surpassed Blanka in number of fruit branches plant^{-1}, number of capsules plant^{-1}, 1000-seed weight, weight of seeds plant^{-1} as well as seed and straw yields ha^{-1}. Blanka surpassed Giza 8 in stem diameter in the first season, plant height, technical length and straw yield in both seasons.

Increasing nitrogen fertilizer levels from 70 to 120 and 170 kg N/ha^{-1} significantly increased plant height, technical length, stem diameter, number of fruit branches/plant^{-1}, number of capsules/plant^{-1}, number of seeds capsule^{-1}, 1000-seed weight, seed and straw yields/plant and hectare. Nitrogen level of 170 kg N/ha^{-1} was the recommended level to increase seed and straw yields/ ha^{-1}. The application of 70 kg P+60 kg K ha^{-1} induced marked increases and surpassed other studied PK combinations regarding all studied characters. The highest seed yield/ha^{-1} was produced from Giza 8 when fertilized with 170 kg N ha^{-1} and the highest straw yield/ha^{-1} was produced from Blanka when fertilized with 170 kg N/ha^{-1}. Seed yield/ha^{-1} (in the first season) was significantly affected by the interaction between flax CVs, N and PK fertilizer levels.

Simple correlation analysis indicated that seed yield ha^{-1} was positively correlated with number of fruit branches plant^{-1}, number of capsules plant^{-1}, 1000-seed weight and seed yield/plant^{-1}. Multiple linear regression and stepwise regression procedures indicated that number of capsules plant^{-1}, number of seeds capsule^{-1} and weight of 1000-seed were the most important characters affecting seed yield/ha^{-1}.

In general, it can be stated that the application of 170 kg N + 70 kg P + 60 kg K ha^{-1} produced the highest seed yield ha^{-1} with Giza 8 CV. and the highest straw yield ha^{-1} with Blanka CV.

Introduction

Flax (*Linum usitatissimum,* L.) is the most important dual purpose crop for oil and fiber production in Egypt and in the world, as well. Flax plays an important role in the national economy due to its importance in exportation and many local industrial purposes. High yielding flax cultivars and proper fertilizing levels of NPK may produce high seed and straw yields per unit area.

Flax cultivars significantly differed in yield and its attributes (El-Shimy *et al*, 1993; Leilah, 1993; Sharief, 1993; El-Kady *et al*, 1995 and Abo-Zaid, 1997). Sharief (1999) reported that Liflora cultivar surpassed other four cultivars in plant height, technical length, 1000-seed weight and straw yield. However, Corse cultivar exceeded the others in stem diameter, number of top apical branches plant^{-1}, number of capsules plant^{-1}, number of seeds capsule^{-1} as well as seed and oil yields fad^{-1}. Meanwhile, Attanta cultivar overcame the others in number of basal branches/plant^{-1}.

Increasing nitrogen fertilizer levels up to 60 kg N fad^{-1} increased total plant height, technical length, stem diameter, number of upper branches, straw yield fad^{-1}, number of capsules plant^{-1}, seed index and seed yield fad^{-1}. (Leilah, 1993; El-Shimy *et al*, 1993; Abd-Elsamie and El-Bially,1996 and Sharief, 1999). Increasing nitrogen fertilizer level upto 70 kg/fad (El Hindi *et al*, 1992 and Haniyat, El Nimr *et al* 1997) and/or to 75 kg fad^{-1} (Ghanem, 1990 and Salama, 1991. With respect to P fertilization, Kandil (1986) and Hella et al. (1987) found that increasing P level from 0 to 30 kg P_2O_5 / fad^{-1}, increased total plant height, technical length, seed yield/plant and fad, straw yield/plant and fad, number of capsules plant^{-1}, number of seeds capsule^{-1} and seed index. Mean while it was found that Increasing potassium fertilizer levels from 0 to 45 kg K_2O ha^{-1} (Pali *et al*., 1995) maximized seed yield ha^{-1} in sandy loam soil. Hella *et at* (1987) reported that increasing potassium fertilizer levels up to 30 Kg K_2O fad^{-1}, had insignificant effect seed yield plant^{-1} and fad, number of capsules plant^{-1} and seeds number capsule^{-1}.

Leilah (1993) reported that flax cultivars significantly differed in the response to different nitrogen levels. The highest seed yield fad was obtained from Giza 8 cultivar when fertilized with 50 or 60 kg N fad^{-1} while Giza 7 cultivar with application 50 or 60 kg N fad^{-1} produced the highest straw yield fad^{-1}. Similar conclusions were reported by Sharief (1999) on other cultivars. The interaction NP had significant effects on seed and straw yields fad^{-1} (Kandil, 1986 and Yadav *et al*., 1990).

The objective of this investigation was to study the response of two flax cultivars to NPK fertilizer levels on seed and straw yield and its components under the environmental conditions of Dakahlia district.

Materials and Methods

Two field experiments were conducted at the Experimental Station, Faculty of Agriculture, Mansoura University, during the two seasons of 1996/1997 and 1997/1998. The aim of this investigation was to study the response of two flax cultivars to nitrogen, phosphorus and potassium fertilization under Dakahlia district conditions. Each field experiment was laid out in a split –split plot design with four replications. The main plots were assigned to two flax cultivars i.e. Giza 8 and Blanka. The sub plots were occupied with three nitrogen fertilizer levels i.e. 70, 120 and 170 Kg N ha^{-1}. The sub-sub plots were devoted for the following P and K fertilizer combinations:

1. 0 kg P_2O_5 + 0 kg K_2O ha^{-1} (P0K0).
2. 35 kg P_2O_5 + 0 kg K_2O ha^{-1} (P1K0).
3. 0 kg P_2O_5 + 30 kg K_2O ha^{-1} (P0K1).
4. 35kg P_2O_5+30 kg K_2O ha^{-1} (P1K1).
5. 70 kg P_2O_5 +30 kg K_2O ha^{-1} (P2K1).
6. 35 kg P_2O_5 +60 kgK_2O ha^{-1} (P1K2).
7. 70 kg P_2O_5 +60 kgK_2O ha^{-1} (P2K2).

The experimental plot size was 3.5 meters long and 3.0 meters width occupying an area of 10.5 m^2. Phosphorus in the form of ordinary calcium superphosphate (15.5% P_2O_5) and potassium in the form of potassium sulphate (48 % K_2O were applied as the above seven combinations before first irrigation. Nitrogen fertilizer in the form of urea (46 % N) was applied in two equal portions (before first watering, 30 days after sowing. and before second watering) at the rates previously mentioned. Sowing took place during the last week of November in both seasons and for both flax cultivars. Seeds with seeding rate 140 kg seeds ha^{-1} were hand drilled in rows 15 cm apart. Seeds of flax were obtained from the Fibers Crop Research Section, F.C.R.S, A.R.C. Physical and chemical soil analysis are presented in Table 1 as described by Page (1982) methods.

Table (1)
Physical and chemical soil characteristics at the experimental sites.

Season	Mechanical analysis				Chemical analysis					
	Clay%	Silt%	Fine sand%	Texture	Organic matter (%)	Available N (ppm)	Available P (ppm)	Available K (ppm)	Ec^{+} (ds/m)	pH
1996/97	41.5	31.0	25.6	Clay	1.9	36.2	11	315.0	2.2	7.8
1997/98	42.0	30.3	25.5	Clay	2.2	35.8	11.2	328.4	2.1	7.6

At full maturity stage (middle of May), ten plants were taken at random from each sub plot to estimate plant height (cm), technical length (cm), stem diameter (mm), numbers of fruit branches $plant^{-1}$, capsules $plant^{-1}$, seeds $capsule^{-1}$, 1000-seed weight (g) and seed weight $plant^{-1}$ (g). Seed and straw yields/ha^{-1} were estimated from the central area of one square meter of each sub plot. Plants were harvested, tied and left to dry, thereafter they were threshed to remove the capsules and weighted to determine straw yield and then converted to straw yield in ton/ha^{-1}. Seeds were cleaned from straw and other residuals and weighed to the nearest gram and converted to record seed yield in ton/ha^{-1}.

All data were statistically analyzed according to the technique of analysis of variance (ANOVA) for the split-split plot design as published by Gomez and Gomez (1984). Relationships between seed yield ha^{-1} and its attributes were subjected to various statistical techniques i.e. simple correlation coefficients and multiple linear regression analysis according to

Snedecor and Cochran (1981) as well as stepwise regression analysis according to Draper and Smith (1966). All statistical analysis were performed using tha facility of computer and MSTAT-C computer software package.

Resules and Disscution

1. Cultivars performance: Relevant results in Tables 2,3 and 4 show that flax cultivars significantly differed in all studied characters in both seasons. Giza 8 cultivar surpassed Blanka in most of the studied characters except plant height, technical length, number of seeds capsule^{-1} (in the first season), and straw yield/ha in both seasons. Giza 8 cultivar exceeded Blanka cultivar by 3.7 and 1.8% in stem diameter; by 25.6 and 20.5% in fruit branches plant^{-1}; by 40.6 and 39.1% in number of capsules plant^{-1}; by 27.7 and 29.3% in 1000-seed weight; by 45.7 and 26.5% in seed yield ha^{-1} in the first and second seasons, respectively. In addition, Blanka exceeded Giza 8 by 6.6 and 4.7% in plant height, by 8.6 and 22.5% in technical length and by 18.4 and 15.1% in straw yield ha^{-1} in the first and second seasons, respectively. The differences between the two Flax cultivars in different characters may be attributed to genetical factors. Similar results were reported on other cultivars such as Hella et al. (1987), El-Shimy et al. (1993), Leilah (1993), Sharief (1993) and (1999).

Table (2)
Plant height, technical length, stem diameter and number of fruit branches plant^{-1} as affected by cultivars, nitrogen levels and PK fertilizer combinations during 1996/97 and 1997/98 seasons.

Characters / Treatments	Plant height (cm)		Technical length (cm)		Stem diameter (mm)		No. of fruit branches	
	1996/97	1997/98	1996/97	1997/98	1996/97	1997/98	1996/97	1997/98
A: Cultivars								
Giza 8	117.9	120.7	97.4	96.1	2.81	2.85	5.4	5.3
Blanka	125.7	126.4	105.8	117.7	2.71	2.80	4.3	4.4
F-test	**	**	**	**	**	**	**	**
B: Nitrogen levels								
70 kg N ha^{-1}	119.6	120.1	99.0	103.7	2.65	2.72	4.3	4.4
120 kg N ha^{-1}	122.0	124.5	101.3	106.8	2.77	2.81	5.0	4.9
170 kg N ha^{-1}	123.8	126.1	104.4	110.2	2.86	2.93	5.3	5.4
F. test	**	**	**	**	**	**	**	**
LSD (5 %)	1.2	1.3	0.9	2.8	0.06	0.07	0.1	0.1
C: PK combinations:								
1- P_0K_0	120.4	122.8	100.5	102.3	2.74	2.76	4.6	4.6
2- P_1K_0	121.2	122.0	100.9	103.3	2.66	2.77	4.7	4.7
3- P_0K_1	121.6	122.9	102.5	104.1	2.75	2.79	4.9	4.8
4- P_1K_1	120.7	123.6	100.5	108.1	2.70	2.81	4.8	4.9
5- P_2K_1	121.7	123.4	101.5	108.5	2.74	2.82	4.8	5.0
6- P_1K_2	122.7	124.5	101.8	108.2	2.79	2.87	5.0	4.9
7- P_2K_2	124.4	125.8	103.5	108.7	2.93	2.92	5.1	5.2
F. test	**	**	**	N.S	**	**	**	**
LSD (5 %)	1.1	1.0	0.9	-	0.06	0.04	0.1	0.1

P_0=0 kg P_2O_5 ha^{-1}, P_1=35 kg P_2O_5 ha^{-1}, P_2=70 kg P_2O_5 ha^{-1} , K_0= 0kg K_2O ha^{-1}, K_1=30 kg K_2O ha, K_2=60 kg K_2O ha^{-1}

Table (3)

Number of capsules $plant^{-1}$, seeds $capsule^{-1}$, 1000-seed weight and weight of seeds $plant^{-1}$ as affected by cultivars, nitrogen levels and PK fertilizer combinations during 1996/97 and 1997/98 seasons.

Characters / Treatments	Capsules $plant^{-1}$ (No.)		**Seeds $capsule^{-1}$** (No)		1000 – seed weight (g)		Seed weight $plant^{-1}$ (g)	
	1996/97	1997/98	1996/97	1997/98	1996/97	1997/98	1996/97	1997/98
A: Cultivars								
Giza 8	14.9	15.3	8.2	9.5	7.19	7.11	0.784	0.820
Blanka	10.6	11.0	9.5	9.3	5.63	5.50	0.538	0.648
F-test	**	**	**	N.S	**	**	**	**
B: Nitrogen levels								
70 kg N ha^{-1}	11.7	11.7	8.5	8.8	5.98	5.93	0.606	0.636
120 kg N ha^{-1}	12.8	13.0	8.9	9.5	6.50	6.30	0.672	0.744
170 kg N ha^{-1}	13.7	14.7	9.1	9.8	6.76	6.69	0.706	0.820
F. test	**	**	**	**	**	**	**	**
LSD (5 %)	0.2	0.4	0.3	0.3	0.18	0.19	0.020	0.044
C: PK combinations:								
1- P_0K_0	12.3	12.6	8.7	9.2	6.19	6.14	0.624	0.678
2- P_1K_0	12.4	12.8	8.7	9.2	6.15	6.14	0.628	0.700
3- P_0K_1	12.8	12.6	8.8	9.4	6.45	6.24	0.644	0.728
4- P_1K_1	12.5	13.1	8.7	9.0	6.33	6.30	0.660	0.736
5- P_2K_1	12.8	13.2	8.8	9.5	6.55	6.38	0.686	0.740
6- P_1K_2	13.0	13.6	8.9	9.6	6.52	6.41	0.680	0.779
7- P_2K_2	13.3	14.1	9.1	9.6	6.71	6.54	0.700	0.786
F. test	**	**	**	N.S	**	**	**	**
LSD (5 %)	0.3	0.4	0.1	-	0.19	0.09	0.036	0.019

P_0=0 kg P_2O_5 ha^{-1}, P_1=35 kg P_2O_5 ha^{-1}, P_2=70 kg P_2O_5 ha^{-1} , K_0= 0kg K_2O ha^{-1}, K_1=30 kg K_2O ha, K_2=60 kg K_2O ha^{-1}

Table (4)

Seed and straw yields ha^{-1} as affected by cultivars, nitrogen fertilizer levels and PK fertilizer combinations during 1996/97 and 1997/98 seasons.

Characters	Seed yield (kg ha^{-1})		Straw yield (t ha^{-1})	
Treatments	1996/97	1997/98	1996/97	1997/98
A: Cultivars				
Giza 8	1919.0	1976.1	12.143	12.450
Blanka	1339.2	1340.4	14.375	14.335
F-test	**	**	**	**
B: Nitrogen levels				
70 kg N ha^{-1}	1488.2	1455.1	12.414	12.600
120 kg N ha^{-1}	1646.7	1666.0	13.423	13.230
170 kg N ha^{-1}	1752.4	1853.8	13.940	14.349
F. test	**	**	**	**
LSD (5 %)	40.2	86.9	0.745	0.566
C: PK combinations:				
1- P_0K_0	1568.2	1564.4	13.135	13.159
2- P_1K_0	1584.8	1604.4	13.476	13.661
3- P_0K_1	1649.8	1656.5	13.021	13.216
4- P_1K_1	1577.2	1577.7	12.821	13.507
5- P_2K_1	1662.9	1723.1	13.385	13.299
6- P_1K_2	1630.8	1702.2	13.309	13.894
7- P_2K_2	1682.9	1780.0	13.668	13.011
F. test	**	**	N.S	N.S
LSD (5 %)	53.1	96.6	-	-

P_0=0 kg P_2O_5 ha^{-1}, P_1=35 kg P_2O_5 ha^{-1}, P_2=70 kg P_2O_5 ha^{-1} , K_0= 0kg K_2O ha^{-1}, K_1=30 kg K_2O ha, K_2=60 kg K_2O ha^{-1}

2. Nitrogen fertilizer levels effect: Tables 2,3 and 4 include also averages of the studied traits as affected by N levels and P + K combinations. Increasing nitrogen fertilizer levels from 70 to 120 and 170 kg N ha^{-1} significantly increased plant height, technical length, stem diameter, number of branches $plant^{-1}$, number of capsule $plant^{-1}$, number of seeds $capsule^{-1}$, 1000-seed weight, seed weight plant as well as seed and straw yields ha^{-1} in both seasons. Increasing nitrogen fertilizer from 70 to 120 kg N ha^{-1} increased plant height by 2.0 and 3.7%, technical length by 2.3 and 2.9%, stem diameter by 4.5 and 3.3%, number of fruit branches/plant by 16.3 and 11.4%, number of capsules/plant by 9.4 and 11.1%, number of seeds/capsule by 4.7 and 7.9%, 1000- seed weight by 8.7 and 6.2%, seed yield/plant by 10.9 and 16.9%, seed yield /ha by 10.7 and 14.5% and straw yield/ha by 8.1 and 5.0% in the first and second seasons, respectively. In addition, increasing nitrogen fertilizer level from 70 to 170 kg N ha^{-1} increased plant height by 3.5 and 5.0%, technical length by 5.5 and 6.3%, stem diameter by 7.9 and 7.7%, number of fruit branches/plant by 23.3 and 22.7%, number of capsules/plant by 17.1 and 25.6%, number of seeds/capsule by 7.1 and 11.3%, 1000-seed weight by 13.0 and 12.8%, seed yield/plant by 16.5 and 28.9%, seed yield/ha by 17.8 and 27.3%, and straw yield/ha by 12.3 and 13.9% in the first and second seasons, respectively. However, in the first season, 170 kg N ha^{-1} resulted insignificant increase in straw yield, compared with 120 kg N ha^{-1}. The increases in seed and straw yields/ha due to the increase in nitrogen levels up to 170 kg N ha^{-1} might be attributed to the effect of nitrogen on growth and development of flax plant that presented in increases in number of fruit branches and capsules number $plant^{-1}$ (Tables 2 and 3) which resulted in the increases of seed weight $plant^{-1}$ and hence seed yield/ha. The increases in straw yield ha^{-1} due to increases in nitrogen fertilizer levels may be attributed to increases in plant height and stem diameter (Table 2) causing, thereby, the increase in straw yield/ha. These results agree with those reported by Salama (1991), Abo-Zaied (1997) and Sharief (1999).

3. PK fertilizer combinations effect: Results presented in Tables 2,3 and 4 show that PK fertilizer combinations significantly affected most of studied characters except technical length and number of seeds/capsule in the second season and straw yield/ha in both seasons. Increasing phosphorus + potassium fertilizer levels to 70 kg P_2O_5 + 60 kgK_2O ha^{-1} maximized plant height, stem diameter, number of fruit branches $plant^{-1}$, number of capsules $plant^{-1}$, 1000-seed weight, seed weight $plant^{-1}$ and seed yield ha^{-1}, which were exceeded by 3.3 and 3.1%, 6.9 and 5.8%, 10.9 and 13.0%, 8.1 and

11.9%, 8.4 and 6.5%, 12.2 and 15.9%, and 4.2 and 13.8%, respectively, compared with the control (without PK fertilization) in the first and second seasons, respectively. The increases in seed yield ha^{-1} due to PK fertilization might be attributed to their beneficial effect on growth and development of plant.

4- Interaction effect: Seed and straw yields fad^{-1} were significantly affected by the interaction between cultivars and nitrogen fertilizer levels as presented in Tables 5 and 6. The highest seed yield/ha (2020.4 kg) was realized by cultivating flax CVs Giza 8 cultivar and N-fertilization at the rate of 170 kg N ha^{-1}. Where as, the lowest seed yield/ha (1141.2) was produced by cultivating Blanka CV and lowest dose N fertilization, i.e. 70 kg N/ha in the first season. In addition, planting Blanka cultivar and increasing nitrogen fertilizer levels up to 170 kg N/ha produced the highest straw yield (15.660 ton ha^{-1}) in the second season. However, the lowest straw yield/ha (11.660 ton/ha) was obtained from planting Giza-8 cultivar and lowest nitrogen fertilization level of 70 kg N ha^{-1}. Moreover, increasing N level from 120 to 170 kg N ha^{-1} resulted insignificant increase in straw yield of Giza 8, while that was significant with Blanka CV. Regarding the interaction between cultivars, nitrogen fertilizer and PK fertilizer combinations, the results in Table 6 indicate that seed yield/ha was significantly affected by the interaction between flax cultivars, nitrogen fertilizer levels and PK fertilization in the first season only. The results indicated that highest seed yield/ha^{-1} was produced from Giza-8 cultivar when fertilized with 170 kg N ha^{-1} and PK fertilizer of 70 kg P_2O_5 + 60 kgK_2O ha^{-1}. However, the lowest seed yield/ha was produced from Blanka cultivar when fertilized with 70 kg N ha and without PK fertilizers addition.

5. Yield analysis:

a. Simple correlation coefficients between seed yield ha^{-1} and yield attributes:

Simple correlation coefficients between seed yield/ha and each of its attributing variables are presented in Table 7. Relevant results showed that seed yield ha^{-1} of flax positively correlated with number of branches $plant^{-1}$ (0.866), number of capsules $plant^{-1}$ (0.956), 1000-seed weight (0.878), and seed yield plant^{-1} (0.238). However, a negative and insignificant correlation association was found between seed yield plant^{-1} and number of seeds capsule^{-1} (-0.135) as well as a negative and significant correlation association was found between seed yield fad^{-1} and plant height (-0.425). In addition, a significant correlation coefficient was found between plant height and number of seeds/capsule (0.775) and between number of branches plant^{-1} and number of capsules plant^{-1} (0.904) as well as 1000-seed weight (0.803). Also, a significant and positively correlation was found between number of capsules plant^{-1} and 1000-seed weight (0.892) as well as seed yield plant^{-1} (0.281). However, a negative and significant correlation was found between 1000-seed weight and number of seeds capsules^{-1} (-0.271) as well as between plant height and number of branches plant^{-1} (-0.256) as well as between plant height and number of capsules plant^{-1} (-0.412) as well as plant height and 1000-seed weight (-0.502). Similar findings were found by Leilah (1993) and Sharief (1999).

Table (5)

Seed yield (kg ha^{-1}) in 1997/98 and straw yields (ton ha^{-1}) in 1996/97 season as affected by the interaction between cultivars and nitrogen fertilizer levels.

Character	Seed yield (kg ha^{-1})			Straw yield (ton ha^{-1})		
N levels (kg ha^{-1})	70	120	170	70	120	170
Flax CVs.						
Giza 8	1835.5	1901.6	2020.4	11.660	12.657	13.035
Blanka	1141.2	1391.8	1484.6	13.542	13.802	15.660
F. test	**			*		
LSD (5 %)	42.4			0.809		

Table (6)
Seed yield (kg ha^{-1}) as affected by the interaction between cultivars, N and PK fertilizer levels during 1996/97 season

Cv	Treatments	P_0K_0	P_1K_0	P_0K_1	P_1K_1	P_2K_1	P_1K_2	P_2K_2
Giza 8	70 kg N ha^{-1}	1796.7	1832.8	1881.6	1791.0	1938.0	1797.1	1810.0
	120 kg N ha^{-1}	1910.4	1658.1	2010.9	1814.8	1803.3	1896.1	1979.4
	170 kg N ha^{-1}	2053.2	1919.0	1979.9	1985.4	2014.2	2053.5	2090.4
Blanka	70 kg N ha^{-1}	1175.5	1082.9	1145.7	1111.2	1134.5	1140.5	1198.6
	120 kg N ha^{-1}	1276.9	1337.6	1381.1	1435.4	1405.4	1428.7	1477.3
	170 kg N ha^{-1}	1434.9	1439.9	1499.2	1330.7	1667.9	1468.0	1541.1
	F. test	**						
	LSD (5 %)	119.0						

P_0=0 kg P_2O_5 ha^{-1}, P_1=35 kg P_2O_5 ha^{-1}, P_2=70 kg P_2O_5 ha^{-1} , K_0= 0kg K_2O ha^{-1}, K_1=30 kg K_2O ha^{-1}, K_2=60 kg K_2O ha^{-1}

Table (7)
Matrix of simple correlation coefficients of seed yield/fad and yield components (Data over seasons and treatments)

Variables	6	5	4	3	2	1
Y- Seed yield/ha	0.238*	0.878**	-0.135	0.956**	0.866**	-0.425
1- Plant height	0.169	-0.502	0.774**	-0.411**	-0.256*	1.00
2- No. of branches $plant^{-1}$	0.169	0.803**	-0.062	0.904**	1.00	
3- No. of capsules $plant^{-1}$	0.281*	0.892**	-0.145	1.00		
4- No. of seeds $capsule^{-1}$	0.408**	-0.271	1.00			
5- 1000-seed weight	0.071	1.00				
6- Seed yield $plant^{-1}$	1.00					

Tabulate r at (5 and 1 %) = 0.217 and 0.283, respectively

b. Multiple linear regression analysis: Data in Table 8 show results of multiple linear regression analysis coefficient, standard error and relative contribution (R^2) for flax seed yield/ha and its components. The obtained results revealed that the prediction equation for flax seed yield/ha ($\hat{Y}$) was formulated as follows:

$$\hat{Y} = 409.60 - 8.63\ X_1 + 114.63\ X_2 + 55.52\ X_3$$

Where: X_1 = Plant height , X2 = No. of capsules plant^{-1} and X_3 = No. of seeds capsule^{-1}.

The multiple correlation coefficient for flax seed yield in this equation was equal 0.9212. This explains that 92.12 % of the total variations in seed yield fad^{-1} could be linearly related to the previously mentioned characteristics and only 7.88 % to other characters. Plant height, number of capsules plant^{-1} and number of seeds capsule^{-1} were the most effective traits affecting flax seed yield ha^{-1}, which recorded significant coefficients of determination reached 3.98 %, 39.37 and 5.62 %, respectively. This means that the most limiting factors for flax seed yield ha^{-1} were plant height, number of capsules plant^{-1} and number of seeds capsule^{-1}.

Table (8)

Relative contributions of yield attributes in predicting seed yield ha^{-1} of flax by using multiple linear regression analysis.

Characters	Regression coefficient	Standard error	Relative contribution (R^2%)
1- Plant height	-8.63	4.83	3.98 *
2- No. of branches plant	13.47	39.46	0.15
3- No. of capsules plant	114.63	16.21	39.37 **
4- No. of seeds capsule	55.53	28.76	4.62 *
5- 1000-seed weight	39.89	31.49	- 2.04
6- Seed yield plant	-6.25	7.96	0.80
Y intercept = 409.60 R squared = 0.9212		Adjusted R^2 = 0.9150 Multiple R = 0.9598	

c. Stepwise regression analysis: Accepted and removed variables and their relative contributions in predicting flax seed yield/fad are presented in Table 9. The results revealed that number of capsules plant^{-1} and 1000-seed weight were the most variables mainly related with seed yield ha^{-1}. Hence, these variables were except as significantly contributing to variation in flax seed yield ha^{-1}. The relative contribution of the two accepted variables reached 91.70 % and 8.30 % due to residual variables. The best prediction equation for flax seed yield ha^{-1} ($\hat{Y}$) was formulated as follows:

$$\hat{Y} = - 197.18 + 117.95\ X_1 + 49.20\ X_2$$

Where: X_1 = No. of capsules plant^{-1} and X_2 = 1000-seed weight.

So, it could be summarized that number of branches plant^{-1}, number of capsules plant^{-1}, 1000-seed weight and seed yield plant^{-1} were the most closely variables that positively and significantly associated with flax seed yield/ha. In addition, number of capsules plant^{-1} and 1000-seed weight were the most effective variables toward seed yield/fad that contributed 40.35 %.

Table (9)

Accept and removed variables and their relative contribution (R^2%) in seed yield/ha according to stepwise analysis.

Characters	Regression coefficient	Standard error	Relative contribution (R^2%)
A: Accepted variables:			
1- No. of capsules plant	117.95	9.90	36.66 **
2- 1000-seed weight	49.20	27.93	3.69 *
B: Removed variables			
1- Plant height			0.33
2- No. of branches plant			0.03
3- No. of seeds capsule			0.60
4- Seed yield plant			0.12
Y intercept = - 197.18 R squared = 0.9170		Adjusted R^2 = 0.9149 Multiple R = 0.9576	

REFERENCES

1. Abd EL-Samie, F.S. and M.E. EL-Bially (1996): performance of flax under some agronomic practices. Moshtohor Ann. Agric. Sci., 34(1): 13-23.
2. Abo Zaied, T.A. (1997): Comparative study of yield technological characters of some flax varieties. Ph. D. Thesis, Fac. of Agric. Mansoura Univ., Egypt.
3. Draper, N.R. and H. Smith (1966): Applied regression analysis. John Wiley and Sons, NY. 7407 pp.
4. EL-Azouny, A.M.A. (1992): Effect of plant density, nitrogen fertilizer and Irrigation on yield and fiber gwality of flax. M. Sc. Thesis, Fac. Agric, AL-Azhar Univ.
5. EL-Hindi, M.H. ; A.T. El-Kassaby ; A.A. Leilah and T.A. Abou Zaied (1992): Response of flax to levels and times of nitrogen application under various planting dates. Proc. 5th Conf. Agron. Zagazig, 13-15 Sept., Vol. 2: 821-835.
6. EL-Kady, E.F.A.; S.E. ShafShak ; F.L. Gab-Allah and M.E.A. Kineber (1995): Effect of seeding rates on yield and its components for six promising flax genotypes under saline conditions. J. Agric. Sci. Mansoura Univ. 20(2): 593-602.
7. EL-Shimy, G.H. ; E.A. El-Kady and N.K.M. Mourad (1993): Effect of seeding rates and nitrogen fertilizer levels on yield and anatomical manifestation on some flax genotypes. J. Agric. Res. Tanta. Univ., 19(1): 92-104.
8. Ghanem, S.A.I (1990): The influences of N fertilizer and rates of oil, fiber yields and their contributing characters of flax. Zagazig. J. of Agric. Res., 17(3 a): 575-586.
9. Gomez , K.A. and A.A. Gomez (1984): Statistical procedures for agricultural researches . John Wiley Sons. Inc., New York.
10. Haniyat, M. El-Nimr ; A.H.H. El-Sweify and N.S.Rizk (1997): Effect of nitrogen fertilizer levels on yield components of three flax genotypes grown on clay loam soil. Egypt J. Appl. Sci., 12(1): 105-1188.
11. Hella, A.M.A ; N.K.M. Mourad and S.M. Gaafer (1987): Effect of NPK fertilizer application on yield and its components in flax (*Linum usitatissmum*L.).Agric.Res.Rev., 66(3):399-406.
12. Kandil A.A. (1986): Response of flax plants to time and rates of nitrogen under various phosphorus levels. J. Agric. Sci. Mansoura univ., 1(1): 1-10.
13. Leilah, A.A (1993): Evaluation of yield and its components of flax cultivars under different nitrogen fertilizer levels. J. Agric. Sci. Mansoura Univ., 18(2): 313-321.

14. Page, A.L. (1982): Methods of Soil Analysis (Ed.) part III. Chemical and Microbiological Properties. 2nd Ed. Agron. J. Am. Soc. Agron. Inc., Madison, Wisc., USA.
15. Pali, G.P.; C. Sarkar ; S.R. Patel and R.S. Tripathi (1995): Response of linseed to phosphorous and potassium levels under rainfed condition. Journal of Oil Seed Research, 12(2): 236-238.
16. Salama, A.M. (1991): Growth and yield of flax (*Linum usitatissmum*, L.) to nitrogen and phosphorus fertilization. J. Agric. Sci. Mansoura Univ., 16(3): 498-506.
17. Sharief, A.E. (1993): Response of some introduced and local flax cultivars to seeding rates. J. Agric. Sci. Mansoura Univ., 18(10): 2827-2834.
18. Sharief, A.E. (1999): Performance of some flax cultivars in response to nitrogen fertilizer rates and yield analysis. Bull. Fac. Agric. Cairo Univ., 50:394-415.
19. Snedecor, G.W. and W.G. Cochran (1981): Statistical methods. 7th ed. Iowa State Univ., Press, Iowa, USA.
20. Yadav, L.N. ; A.K. Jain ; P.P. Singh and M.D. Vyas (1990): Response of linseed to nitrogen and phosphorus application. Indian J. of Agron., 35(4): 427-428.

إستجابة صنفين من الكتان لمستويات التسميد النتروجينى والفوسفاتى والبوتاسى

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الملخص:

أقيمت هذه الدراسة بمحطة التجارب– كلية الزراعة – جامعة المنصورة خلال الموسمين ١٩٩٦/١٩٩٧ ، ١٩٩٧/١٩٩٨ لدراسة إستجابة صنفين من الكتان لمستويات من التسميد النتروجينى والفوسفاتى والبوتاسى وأثر ذلك على صفات النمو والمحصول ومكوناته. وأظهرت نتائج الدراسة تفوق الصنف جيزة ٨ فى قطر الساق، عدد الأفرع الثمرية/نبات ، عدد الكبسولات/نبات ، وزن الألف بذرة ، وزن البذور/نبات، محصول البذور/هكتار. بينما تفوق الصنف بلانكا فى طول النبات، الطول الفعال ، عدد البذور بالكبسولة ، محصول القش للهكتار فى كلا موسمى الزراعة. أدت زيادة مستويات التسميد النتروجينى من ٧٠ و ١٢٠ إلى ١٧٠ كجم نتروجين / هكتار إلى زيادة معنوية فى جميع الصفات تحت الدراسة وسجل أعلى معدل نيتروجين (١٧٠ كجم نتروجين/ هكتار) إلى زيادة معنوية فى طول النبات، الطول الفعال ، قطر الساق ، عدد الفروع / نبات، عدد الكبسولات / نبات، عدد البذور بالكبسولة ، وزن الألف بذرة، محصول البذور/ نبات، محصول القش/ هكتار فى كلا موسمى الزراعة. وأ وضحت النتائج أن إضافة التسميد الفوسفاتى والبوتاسى بمعدل ٧٠ كجم فو٢ أ٥ + ٦٠ كجم بو٢ أدت إلى زيادة في جميع الصفات بالدراسة. نتج أعلى محصول من البذور والقش/ هكتار من الصنف جيزة ٨ وبلانكا ، على الترتيب عند التسميد النيتروجينى بمعدل ١٧٠ كجم / هكتار. أثر التفاعل بين الأصناف ومستويات التسميد النتروجينى والفوسفاتى والبوتاسى معنويا على صفة محصول البذور للهكتار فى الموسم الأول.

أظهرت نتائج تحليل الإرتباط البسيط وجود إرتباط معنوى موجب بين محصول البذور/هكتار وكل من عدد الفروع/نبات، عدد الكبسولات/نبات، عدد البذور بالكبسولة ، وزن الألف بذرة ومحصول البذور للنبات. أشارت نتائج تحليل معامل الإنحدار المتعدد والإنحدار المرحلي أن عدد الكبسولات/نبات وعدد البذور بالكبسولة ووزن الألف بذرة كانت أكثر الصفات مساهمة لمحصول البذور/هكتار.

توصى الدراسة بتسميد الكتان بمعدل ١٧٠ كجم نتروجين + ٧٠ كجم فو$_{٢}$ أ$_{٥}$ + ٦٠ كجم بو$_{٢}$ أ / هكتار وزراعة الصنف جيزة ٨ للحصول على أعلى إنتاجية من محصول البذور والصنف بلانكا للحصول على أعلى إنتاجية لمحصول القش تحت ظروف منطقة الدراسة.