J. Agric. Sci. Mansoura Univ., 33 (6): 3937 - 3952, 2008

YIELD AND QUALITY OF TWO FLAX VARIETIES AS AFFECTED BY FOLIAR SPRAYING WITH POTASSIN RATES AND NITROGEN LEVELS UNDER SANDY SOIL CONDITION

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ABSTRACT

Two field experiments were performed at the Experimental Farm, Esmailia Agric. Res. Station Agric. Res. Center, Esmailia Governorate, Egypt during the two growing seasons of 2003/2004 and 2004/2005 to study the influence of foliar spraying of potassin rates at (1 and 1.5 liters potassin/fed.) and the three nitrogen levels of 25, 50 and 75 kg N/fed. on yield, yield components and some technological characters of the two flax varieties Sakha 1 and Sakha 2. Moreover, simple correlation coefficient among straw and seed yields and their components as well as fiber yield and its quality were studied. Results obtained could be summarized as follows:

The flax variety Sakha 1 surpass Sakha 2 in total length, technical length, straw yield/plant as well as per feddan, fiber yield/plant as well as per feddan, fiber length and fiber fineness in both seasons in addition to the combined analysis over them. Fiber percentage had similar trend except with only the second season where Sakha 2 superior over Sakha 1 in this case without significance.

The flax variety Sakha 2 ranked first in no. of fruiting branches, no. of capsules/plant, no. of seeds/capsule, 1000 seed weight, seed yield/plant as well as per feddan, seed oil percentage and oil yield/fed.

Foliar spraying with potassin at the rate of 1.5 liter/fed. achieved maximum mean values of all straw and seed characters under study, except with fiber fineness trait, which recorded highest estimates by spraying with 1 liter, these results were true in both seasons and the combined data.

There was gradual increment in straw and seed yields in addition to their components with increasing nitrogen levels from 25 towards the highest dose at 75 kg N/fed., except with fiber fineness trait which more fine fiber obtained by applying 25 kg N/fed. and more coarse fiber occurred with increasing nitrogen levels towards the highest level.

Straw yield/plant was highly significant and positive correlated with each of total length, technical length, fiber yield/plant, fiber yield/feddan and fiber length. Also, the r values were highly significant and positive between seed yield and either no. of capsules/plant or 1000 seed weight.

INTRODUCTION

Flax *(linum usitatissimum* L.) is consider as one of oldest bast fiber crops. Flax play an important role in developing the national economy by its fiber exportation and local fabrication. Fresh linseed oil is used as human food and after boiling and treated chemically used as painting and varnish industries. Moreover, linseed cake is a valuable protein source to poultry and ruminants. Recently, the cultivated area by flax in Egypt tended to decrease in the valley lands due to great competition with other major winter crops. Therefore, the flax limited area was insufficient to provide with the progressive demands for Egyptian population. For this reason, the extension of flax cultivated area must be occur in newly reclaimed lands especially in sandy soils under modern sprinkler irrigation system.

Yield of various flax genotypes were studied by many investigators in respect with yield., yield components and quality among of them Momtaz et al (1980 & 1989), El-Farouk *et al* (2003) Zedan (2004), El-Shimy *et al* (2006), El-Sweify *et al* (2006) and Atta *et al* (2007).

Potassin play vital role and stimulates biological process in the plant cell as enzymes activity, respiration, photosynthesis, chlorophyll, creation and water amounts in leaves and regulate stomata opining as well as a direct effect on the disease resistance. Many researchers reported about the important role of potassin as foliar spraying in increasing all characters studied of various flax genotypes among of them Ving Singir and Ramoar (1994), Khodyankova *et al* (1996), Zedan *et al* (1997), El-Gazzar and El-Kady (2000), El-Shimy *et al* (2002), El-Azzouni et al (2003) and Hussein et al (2007).

Nitrogen is an essential element for flax growth to build up protoplasm and protein which induce cell division, merstemic activity and furtherly increased cell number and size with an overall increase in flax growth, consequently more fiber and seed production. Some investigators found that increasing N levels increased also yield and quality of flax such as Hella et al (1988), Jaggi et al (1995), Abd El-Samie et al (2002), El-Shimy *et al* (2002), Mostafa *et al* (2003), Salem *et al* (2006), Atta *et al* (2007) and Hussein *et al* (2007).

The sandy soil contains small amounts of nitrogen and organic matter in addition to few potassin element. Therefore, it could be compensate this case by adding nitrogen fertilizer levels and potassin as K- biofertilizer in foliar spray. In this respect, many studies should be carried out in this case to maximize the flax productivity on such new lands. Therefore, the main objective of this investigation was to study the influence of foliar spraying of potassin and different nitrogen levels on yield and quality as well as to study the simple correlation coefficients between different straw and seed characters for two flax cultivars under sandy soils conditions.

MATERIALS AND METHODS

Two field experiments were performed during 2003/2004 and 2004/2005 growing seasons in sandy soils at Esmailia Agric. Res. Station, Esmailia Governorate, Agric. Res. Center, Egypt to study the influence of potassin foliar spraying rates and nitrogen fertilizer levels on yield, yield components and some technological characters of fibers and seeds for two flax varieties. The soil of the experimental sites was sandy in texture. Mechanical and chemical analysis of the experimental field are presented in Table (1). In each season a spilt split plot design with four replications was used for each trait. The main plots contained the two flax varieties namely Sakha 1 and Sakha 2, the sub plots were to the two potassin fertilizer rates (1 and 1.5 liter potassin/fed.), the sub sub plots were assigned to three nitrogen fertilizer levels i.e. 25, 50 and 75 kg N/fed. The flax varieties i.e. Sakha 1 and Sakha 2 were selected from cross between Bombay X I. 1485 and between Hera X I. 2348, respectively. The experimental unit area was 6 m^2 (1/700 fed.) with 10 rows 3 m long 20 cm apart. Seeds of flax cultivars

were equally drilled in rows at the rate of 70 kg seeds/fed. The sowing dates were on 15 th and 17 th November in the first and second season, respectively. Other agricultural practices for growing flax were conducted as recommended. The experiments were preceded by peanut and sunflower crops in each of the two successive seasons, respectively. Nitrogen was added as ammonium nitrate 33.5% N for the three nitrogen levels under study in four equal doses for each one at 15, 30, 45 and 60 days from sowing, respectively. On the other hand, potassin nutrient (30% K_2O) was sprayed at the two rates i.e., 1 and 1.5 liter potassin/fed. twice after 40 and 60 days from sowing in spray volume at 200 liter water/fed. for each one in the first and second dates, respectively. Moreover, simple correlation coefficients were calculated between straw and seed yields and their components as well as fiber yield and its quality. Moreover, simple correlation coefficients were calculated between straw and seed yields and their components as well as fiber yield and its quality.

At maturity, ten guarded plants were pulled at random from each sub-sub plot to be used for recording yield components of straw and seed yields as well as fiber yield and its quality. However, straw, seeds and fiber yields/fed. were calculated from the sub-sub plot area basis. Data collected including the following characters:

A- Straw yield and its components:

Total length/plant (cm), technical length/plant (cm), straw yield/plant (g) and straw yield/fed. (ton).

B- Seed yield and its components:

Number of fruiting branches/plant, number of capsules/plant, number of seeds/capsule, 1000 seed weight (g), seed yield/plant (g), seed yield/fed. (kg), seed oil percentage: determined according to the extraction method described by Horwitz *et al* (1965) using Sexhlet apparatus and petroleum ether. and oil yield/fed.

C- Fiber yield and its quality:

Fiber yield/plant (g), fiber yield/fed. (ton), fiber percentage, fiber length (cm) and fiber fineness (Nm), which estimated according to Radwan and Momtaz (1966) as follows: Nm = N x L / G, where Nm : metrical number, N : number of fibers {20 fibers}L: fiber long (20 x 10 x 10 = 2000) in mm and G :weight of fibers in mg.

Statistical analysis:

All data collected were subjected to statistical analysis as described by Snedecor and Cochran (1982). Significance of differences among mean treatments judged with Least Significant Differences (L.S.D.) at 5% and 1% levels of significance. Moreover, combined analysis of variance over the two seasons were performed for each character according to Le Clerg *et al* (1966).

Correlation studies:

Simple correlation coefficients between different flax characters were calculated according to Svab (1973) as follows:

$r = SPxy / (SSx*SSy)^{0.5}$ where : SPxy: is the phenotypic covariance between the two traits, SSx : is the phenotypic standard deviation of first trait and SSy: is the phenotypic standard deviations of the second one.

Table (1): Mechanical and chemical analysis of the experimental soil (0-60 cm soil depth).

variables	Seasons	
	2003/2001	2004/2005
Mechanical analysis		
Soil texture	Sandy	Sandy
Coarse sand %	71.67	72.19
Fine sand %	20.16	21.06
Clay %	5.55	4.08
Silt %	2.62	2.67
Chemical analysis		
PH value in 1:2. suspension	8.14	7.92
Ec (dsm $^{-1}$) at 25 oC	0.48	0.35
Organic matter %	0.78	0.62
Available N (ppm)	33.73	30.75
Available P (ppm)	9.23	7.85
Available K (ppm)	48.34	52.61
Cations (meg/L)		
Ca^{++}	1.35	1.48
Mg^{++}	1.86	1.92
N^{++}	0.68	0.62
Anions (meg/L)		
Co_3^-	0.07	0.06
So_4^-	0.22	0.49
CL^-	1.65	1.52

RESULTS AND DISCUSSION

A- Straw yield and its components:

Results in Table (2) showed significant differences between the mean values for each of flax varieties, potassin rates and nitrogen levels in all four straw characters studied i.e., total length/plant, technical length/plant, straw yield/plant and straw yield/fed. in the two seasons and their combined data. The flax variety Sakha 1 achieved highest values of total length/plant, technical length/plant, straw yield/plant and straw yield/fed. in both seasons and combined data. The superiority ratios for Sakha 1 over Sakha 2 from the combined analysis were 7.02, 11.44. 48.98 and 27.91% for the previous traits, respectively. The differences between these two flax varieties were mainly due to the genetically make up for each one. These results are in accordance with those obtained by Momtaz et al (1980 & 1989), El-Farouk *et al* (2003), Zedan (2004), El-Shimy *et al* (2006), El-Sweify *et al* (2006) and Atta et al (2007).

Table(2)

Regarding potassin fertilizer rate effect, data showed that foliar application with 1.5 liter potassin/fed. significantly increased all straw yield characters in the two successive seasons and combined over them. The excess percentage were 6.55, 7.30, 40.59 and 27.82% between the highest rate of potassin and the lowest one for the previous traits, respectively as average from the combined analysis. These results could be attributed to the important role of potassin in stimulating biological process in plant as enzymes activity, respiration, photosynthesis, chlorophyll creation and water amount in leaves. Also stimulating effect especially on merestimatic tissue which produce more cells and more vegetative growth which in turn reflect on increasing straw yield and its components. These results are in harmony with those obtained by Khodyankova *et al* (1996), Ving Singir and Ramoar (1994), Zedan *et al* (1997), El-Gazzar and El-Kady (2000), El-Shimy *et al* (2002), El-Azzouni et al (2003) and Hussein *et al* (2007).

Owing to nitrogen fertilizer levels effect, data illustrated that there was gradual increase in each of straw characters i.e., total length/plant, technical length/plant, straw yield/plant and straw yield/fed. with increasing N levels from 25 up to 75 kg N/fed. in both seasons and the combined analysis. The superiority ratios between the averages obtained by maximum dose and the lowest one were 16.10, 33.92, 40.60 and 50.12% for the previous traits, respectively as shown from the combined data. On the other hand, no significant differences among mean values of straw yield/plant as well as per feddan occurred as a result of added 50 and 75 kg N/fed. These results could be explained on the basis the favorable effect of nitrogen element for flax growth to build up protoplasm and proteins which induce cell division, merestimatic activity and furtherly flax growth and its yield. These results are in accordance with those obtained by Hella *et al* (1988), Jaggi *et al* (1995), El-Shimy *et al* (2002), Abd El-Samie *et al* (2002), Mostafa *et a*l (2003), Salem *et al* (2006), Atta *et al* (2007) and Hussein *et al* (2007).

B- Fiber yield and its quality:

As shown from Table (3), data revealed that flax varieties significantly differed in fiber characters i. e., fiber yield/plant, fiber yield/fed, fiber length and fiber fineness with an exception for fiber percentage trait which did not reached the level of significance. Moreover, the mean values for each of potassin rates and nitrogen levels differed significantly in both seasons and combined data concerning all five fiber traits.

With respect to varietal differences, Sakha 1 ranked first and recorded highest values of fiber yield/plant, fiber yield/fed, fiber percentage, fiber length and fiber fineness from the combined analysis and outyielded Sakha 2 by 57.65, 34.67, 4.58, 12.36 and 5.41% for the previous traits, respectively. Similar results were obtained by Momtaz *et al* (1980 & 1989), El-Farouk *et al* (2003), Zedan (2004), El-Shimy *et al* (2006), El-Sweify *et al* (2006) and Atta *et al* (2007).

Table(3)

The foliar spraying with potassin rate at 1.5 liter/fed. resulted the highest values of fiber yield/plant, fiber yield/fed, fiber percentage and fiber length when compared with the lowest rate (1 liter potassin/fed.) The superiority ratios from the combined analysis between the highest rate of potassin and the lowest one were 56.25, 39.78, 9.97 and 8.51% for the previous traits, respectively. Meanwhile, remarkable reduction had been observed in fiber fineness trait due to increase potassin rate from 1 to 1.5 liter/fed. The decrement was 5.74% for this trait. Increasing fiber yield/fed. with increasing potassin rates were reported by Hella *et al* (1988), Ving Singir and Ramoar (1994), Khodyankova *et al* (1996), Zedan *et al* (1997), El-Gazzar and El-Kady (2000), El-Shimy *et al* (2002) and El Azzouni *et al* (2003).

There was a significant increase in each of fiber yield/plant, fiber yield/fed, fiber percentage and fiber length with increasing N levels from 25 up to 75 kg N/fed. with an exception with fiber fineness trait which decreased by 11.88% between the highest and the lowest nitrogen levels. The increment between the highest and the lowest averages were 68.83, 81.75, 20.98 and 21.21% for the previous four traits, respectively as calculated from the combined data. On the other hand, no significant differences among mean values of fiber yield/fed. and fiber percentage as result of added 50 and 75 kg N/fed. These findings are in accordance with those obtained by Hella *et al* (1988), Jaggi *et al* (1995) , Zedan et al (1997) Abd El-Samie *et al* (2002), El-Shimy *et al* (2002), Mostafa *et al* (2003),Salem *et al* (2006), Atta *et al* (2007) and Hussein *et al* (2007).

The interaction between potassin (P) and nitrogen (N) had significant effect on total length character with the maximum mean value of 79.93 cm which achieved by foliar spraying with potassin at the rate of 1.5 liter/fed. combined with nitrogen level of 75 kg N/fed.

The interaction between flax varieties (V) and potassin (P) had significant effect on fiber yield/plant and fiber percentage which obtained by Sakha 1 0.509 g and 14.57%, respectively and combined with spraying potassin at the rat of 1.5 liter/fed.

V x N interaction had significant effect on fiber fineness character, the highest estimate 186.689 Nm obtained by Sakha 1 combined with the nitrogen level of 75 kg N/fed.

Table (4): Mean values of total length/plant as affected by the interaction between potassin rates and nitrogen fertilizer levels (combined analysis of 2003/2004 and 2004/2005 seasons).

Potassin rates (liter/fed.)	Nitrogen fertilizer levels (kg N/fed.)		
	25	**50**	**75**
1	63.94	74.80	76.36
1.5	70.67	78.61	79.93
L.S.D. 5 %	4.99	3.40	2.81

Table (5): mean values of fiber yield/plant and fiber percentage as affected by the interaction between flax varieties and potassin rates (combined analysis of 2003/2004 and 2004/2005 seasons).

Varieties	Fiber yield/plant (g)		Fiber percentage	
	Potassin rates (liter/fed.)			
	1	1.5	1	1.5
Sakha 1	0.293	0.509	12.34	14.57
Sakha 2	0.218	0.290	12.73	13.00
L.S.D. 5 %	0.061	0.119	0.18	1.10

Table (6): Mean values of fiber fineness as affected by the interaction between flax varieties and nitrogen fertilizer levels (combined analysis of 2003/2004 and 2004/2005 seasons).

Varieties	Nitrogen fertilizer levels (kg N/fed.)		
	25	50	75
Sakha 1	214.26	201.80	186.68
Sakha 2	201.68	190.28	179.84
L.S.D. 5%	9.80	8.50	5.90

C- Seed yield and its components:

Mean values of eight characters related to seed yield for two flax varieties as affected by potassin rates and nitrogen levels in 2003/2004 and 2004/2005 as well as their combined analysis are presented in Tables 7 and 8 .

Statistical analysis of variance showed significant differences between each of flax varieties, potassin rates and nitrogen levels for the eight characters under study i.e., number of fruiting branches/plant, number of capsules/plant, number of seeds/capsule, 1000 seed weight, seed yield/plant, seed yield/fed., seed oil percentage and oil yield/fed. It could be noticed that Sakha 2 variety produced the highest values of seed yield and its components in addition to outyielded Sakha 1 variety by 54.52, 61.87, 15.85, 10.04, 35.40, 25.82, 2.97 and 29.45% for the previous traits, respectively from the combined analysis. The superiority of Sakha 2 in seed yield/fed. may be attributed to the increase in number of fruiting branches/plant, number of capsules/plant, number of seeds/capsule, 1000 seed weight and seed yield/plant. Similar results were reported by Momtaz *et a*l (1980 & 1989), El-Farouk et al (2003) El-Azzouni *et al* (2003), Mostafa *et al* (2003),El-Shimy *et al* (2006), El-Sweify *et al* (2006), Atta *et al* (2007), Hussein (2007) and Hussein *et al* (2007).

Regarding potassin rates effect, data in Tables 7 and 8 indicated that increasing potassin rate from 1 to 1.5 liter/fed. increased significantly all eight seed characters The superiority ratios from the combined analysis between the highest potassin rate and the lowest one were 22.41, 22.75, 15.15, 9.14, 19.08, 10.32, 4.63 and 15.24% for the previous traits, respectively. Many investigators detected the important role of potassin in flax among of them Hella *et al* (1989), Khodyankova *et al* (1996), Ving Singir and Ramoar (1994), Zedan *et al* (1997), El-Gazzar and El-Kady(2000), El-Shimy *et al* (2002), El-Azzouni *et al* (2003) and Hussein et al (2007).

Table(7)

Table(8)

With respect to nitrogen levels effect, data reveled significant increase in seed characters with increasing N levels from 25 up to 75 kg N/fed. The increment from the combined data were 50.49, 52.79, 24.57, 14.30, 59.05, 44.04, 6.36 and 53.10% for the previous traits, respectively. On the other hand, no significant differences among mean values of 1000 seed weight, seed yield/fed., seed oil percentage and oil yield/fed. as result of added 50 and 75 kg N/fed. These results are in harmony with those obtained by Hella *et al* (1988), Jaggi *et al* (1995) , Zedan et al (1997), Abd El-Samie *et al* (2002), El-Shimy *et al* (2002), Mostafa *et al* (2003),Salem *et a*l (2006), Atta *et al* (2007) and Hussein *et al* (2007).

The combined analysis for data in presented Table (9) showed that number of seeds/capsule trait affected significantly by the interaction between flax varieties and nitrogen levels. The highest number of seeds/capsule was obtained by Sakha 2 when fertilized with 75 kg N/ed.

From the combined analysis for both seasons, data presented in Table (10) revealed that the interaction between flax varieties and potassin rates had significant effect on seed yield/plant. The maximum values of this character was resulted from Sakha 2 when sprayed with 1.5 liter potassin/fed.

Table (9):Mean values of number of seeds/capsule as affected by the interaction between flax varieties and nitrogen fertilizer levels (combined analysis of 2003/2004 and 2004/2005 seasons).

Varieties	Nitrogen fertilizer levels (kg N/fed.)		
	25	50	75
Sakha 1	5.39	6.23	6.74
Sakha 2	6.17	7.44	7.67
L.S.D. 5%	0.55	0.98	0.85

Table (10): mean values of seed yield/plant as affected by the interaction between flax varieties and potassin rates (combined analysis of 2003/2004 and 2004/2005 seasons).

Varieties	Potassin rates (liter/fed.)	
	1	1.5
Sakha 1	0.420	0.545
Sakha 2	0.618	0.690
L.S.D. 5%	0.156	0.135

Correlation studies:

Data presented in Table (11) showed positive and highly significant correlation coefficients between straw yield/fed. and each of straw yield/plant, total length/plant, technical length/plant, fiber yield/fed., fiber yield/plant and fiber length. Similar results were obtained by Badwal et al (1971), Momtaz *et al* (1977), El-Shaer *et al* (1983), El-Azzouni *et al* (2003), El-Shimy *et al* (2006), El-Sweify *et al* (2006) and Hussein (2007).

Table(11)

Positive and highly significant association was found between straw yield/plant and each of total and technical length/plant, fiber yield/fed., fiber yield/plant and fiber length. Moreover, positive and insignificant correlation was found between straw yield/fed. and each of seed yield/fed., seed yield/plant, number of capsules/plant and 1000 seed weight. These results are in agreement with those reported by Al-Kaddoussi and Moawad (2001), Zedan (2004), El-Shimy *et al* (2006) and El-Sweify *et al* (2006).

Seed yield/fed. was positively and highly significant correlated with each of seed yield/plant, number of capsules/plant and 1000 seed weight. Also positive and highly significant correlation was found between seed yield/plant and each of number of capsules/plant and 1000 seed weight. These results are in accordance with those obtained by Momtaz *et al* (1977), El-Shaer and Momtaz (1983), Zahana (1994), and Hussein *et al* (2007).

Conclusion:

From the present work. It can be concluded that for maximum production from straw and seed achieved by spraying flax varieties namely Sakha 1 and Sakha 2 with potassin at the rate of 1.5 liter/fed. and flax plants must be fertilized with 75 kg N/fed. under the condition of this study. Moreover, plant breeder must take care for plant length trait as indication to more straw, in addition to no. of capsules/plant as explanation to more seed yield.

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تأثير معدل الإضافة الورقية للبوتاسين ومستويات مختلفة من التسميد النتروجينى على المحصول وجودته لصنفين من الكتان تحت ظروف الأراضى الرملية

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قسم بحوث محاصيل الألياف- معهد بحوث المحاصيل الحقلية - مركز البحوث الزراعية

أقيمت تجربتان حقليتان بمحطة البحوث الزراعية بالإسماعلية – مركز البحوث الزراعية خلال موسمى ٢٠٠٤/٢٠٠٣ , ٢٠٠٥/٢٠٠٤ لدراسة تأثير الرش بمعدلين من البوتاسين (١ ,١,٥ لتر/فدان) وثلاث مستويات من التسميد النتروجينى ٢٥, ٥٠, ٧٥ كجم نتروجين/فدان على المحصول ومكوناته وبعض الصفات التكنولوجية لصنفى الكتان سخا ١ وسخا ٢ بالإضافة إلى دراسة معامل الأرتباط بين كل من محصولى القش والبذور ومكوناتهما وأيضا بين محصول الألياف وصفات الجودة.

ويمكن تلخيص النتائج كما يلى:

تفوق الصنف سخا ١ على الصنف سخا ٢ فى صفات الطول الكلى, الطول الفعال، محصول القش/نبات كما للفدان، محصول الألياف/نبات كما للفدان، طول الألياف، نعومة الألياف فى كلا الموسمين وكذلك التحليل التجميعى بالإضافة إلى النسبة المئوية للألياف فيما عدا الموسم الثانى فقط حيث تفوق الصنف سخا ٢ على سخا ١ وبدون معنوية.

أحتل الصنف سخا ٢ المكانة الأولى وتفوق على الصنف سخا ١ فى عدد الفروع الثمرية، عدد الكبسولات/نبات، عدد بذور الكبسولة، وزن الألف بذرة، محصول البذرة/نبات كما للفدان و النسبة المئوية للزيت، محصول الزيت/فدان.

حقق رش نباتات الكتان بالبوتاسين وبمعدل ١,٥ لتر/فدان أعلى المتوسطات فى كل صفات القش والبذرة تحت الدراسة فيما عدا صفة نعومة الألياف حيث حقق الرش بمعدل ١ لتر/فدان أعلى قيم نعومة فى كلا الموسمين وكذلك التحليل التجميعى.

أشارت النتائج إلى وجود زيادة معنوية فى محصولى القش والبذور ومكوناتهما بزيادة التسميد النتروجينى من ٢٥ إلى ٧٥ كجم ن/فدان فيما عدا نعومة الألياف فقد حدث العكس حيث أن التسميد بمعدل ٢٥ كجم ن/فدان أعطى ألياف أكثر نعومة.

كان معامل الأرتباط معنوى جدا وموجب بين محصول القش/نبات وكل من الطول الكلى، الطول الفعال، محصول الألياف/نبات كما للفدان, طول الألياف وبين محصول البذرة/نبات وكل من عدد الكبسولات/نبات، وزن الألف بذرة.

Table (2): Mean values of straw yield and its related characters for two flax varieties as affected by potassin rates, nitrogen fertilizer levels and their interaction in 2003/2004 and 2004/2005 seasons in addition to the combined analysis.

Characters	Total length /plant (cm)			Technical length/plant (cm)			Straw yield/plant (g)			Straw yield/fed. (ton)		
Season / Treatments	1 st	2 nd	Comb.	1 st	2 nd	Comb.	1 st	2 nd	Comb.	1 st	2 nd	Comb.
Varieties:												
V 1: Sakha 1	81.56	71.56	76.56	70.25	68.24	69.25	3.123	2.693	2.908	2.666	2.623	3.144
V 2: Sakha 2	74.81	68.28	71.54	64.52	59.77	62.14	2.014	1.890	1.952	2.727	2.188	2.458
F.test	*	*	*	*	*	*	**	*	**	*	**	**
Potassin rates												
P1: 1 liter/fed.	74.99	68.42	71.70	64.62	62.14	63.38	2.149	1.891	2.020	2.860	2.058	2.459
P2: 1.5 liter/fed.	81.39	71.42	76.40	70.14	65.87	68.01	2.988	2.692	2.840	3.533	2.752	3.143
L.S.D. 5%	4.09	2.07	3.50	4.82	2.71	4.33	0.600	0.701	0.630	0.505	0.55	0.510
L.S.D. 1%	6.03	N.S.	4.61	5.5	N.S.	4.60	0.763	0.800	0.790	0.630	0.620	0.625
Nitrogen fertilizer levels												
N1: 25 kg N/fed.	69.92	64.69	67.31	56.80	55.99	56.39	2.144	1.748	1.946	2.353	1.929	2.141
N2: 50 kg N/fed.	81.45	71.97	76.71	71.52	66.82	69.17	2.704	2.513	2.608	3.508	2.587	3.048
N3: 75 kg N/fed	8 3.19	73.10	78.15	73.84	69.20	71.52	2.857	2.614	2.736	3.729	2.700	3.214
L.S.D. 5%	6.31	5.25	7.32	9.83	8.31	7.12	0.392	0.511	0.499	0.819	0.311	0.532
L.S.D. 1%	9.22	6.05	8.90	11.5	10.3	9.81	0.512	0.696	0.610	1.06	0.599	0.811
Interactions												
V x P	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	*	N.S.
V x N	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	*	N.S.	N.S.
N x P	N.S.	*	*	*	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	*	N.S.
V x P x N	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

Table (3): Mean values of fiber yield and its quality for two flax varieties as affected by potassin rates, nitrogen fertilizer levels and their interaction in 2003/2004 and 2004/2005 seasons in addition to the combined analysis.

Characters	Fiber yield /plant (g)			Fiber yield/fed. (ton)			Fiber percentage			Fiber length (cm)			Fiber fineness (Nm)		
Season / Treatments	1 st	2 nd	Comb.	1 st	2 nd	Comb.	1 st	2 nd	Comb.	1 st	2 nd	Comb.	1 st	2 nd	Comb.
Varieties:															
V 1: Sakha 1	0.445	0.357	0.402	0.524	0.346	0.435	13.96	12.96	13.46	72.04	66.36	69.20	205.38	196.44	200.91
V 2: Sakha 2	0.249	0.260	0.255	0.345	0.301	0.323	12.17	13.56	12.87	64.75	58.44	61.59	194.04	187.17	190.60
F.test	*	N.S.	*	*	*	**	N.S.	N.S.	N.S.	*	*	**	**	*	**
Potassin rates															
P1: 1 liter/fed.	0.275	0.237	0.256	0.374	0.258	0.316	12.53	12.54	12.54	65.25	60.21	62.73	205.82	198.02	201.92
P2: 1.5 liter/fed.	0.420	0.380	0.400	0.496	0.388	0.442	13.60	13.98	13.79	71.54	64.59	68.07	193.60	185.58	190.34
L.S.D. 5%	0.125	0.129	0.136	0.115	1.9	0.110	1.33	1.23	1.09	4.99	3.25	4.72	10.20	11.50	9.25
L.S.D. 1	0.143	0.138	0.141	0.120	0.121	0.118	N.S.	1.40	1.21	5.82	N.S.	5.22	11.82	12.75	10.31
Nitrogen fertilizer levels															
N1: 25 kg N/fed.	0.250	0.212	0.231	0.269	0.235	0.252	11.20	12.17	11.68	60.32	55.77	58.04	211.42	205.52	207.97
N2: 50 kg N/fed.	0.384	0.342	0.363	0.503	0.350	0.426	13.89	13.45	13.67	71.35	64.23	67.79	201.33	204.52	196.04
N3: 75 kg N/fed	0.408	0.373	0.390	0.533	0.384	0.458	14.11	14.16	14.13	73.51	67.19	70.35	186.38	180.14	183.26
L.S.D. 5%	0.025	0.087	0.105	0.162	0.110	0.161	2.10	1.00	1.61	9.11	7.80	6.35	8.25	9.33	8.11
L.S.D. 1	0.122	0.115	0.125	0.215	0.114	0.170	2.51	1.21	1.96	10.82	8.35	9.40	9.71	21.5	9.80
Interactions															
V x P	**	*	**	N.S.	N.S.	N.S.	*	**	**	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
V x N	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	*	*
N x P	N.S.	*	N.S.	N.S.	*	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	*	N.S.
V x P x N	N.S.	*	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

Table (7): Mean values of four characters related to seed yield for two flax varieties as affected by potassin rates, nitrogen fertilizer levels and their interaction in 2003/2004 and 2004/2005 seasons in addition to the combined analysis.

Characters	No. of fruiting branches/plant			No. of capsules /plant			No. of seeds /capsule			1000 seed weight (g)		
Season / Treatments	1 st	2 nd	Comb.	1 st	2 nd	Comb.	1 st	2 nd	Comb.	1 st	2 nd	Comb.
Varieties												
V 1: Sakha 1	7.71	7.11	7.41	6.69	5.94	6.32	6.74	5.50	6.12	8.30	8.05	8.17
V 2: Sakha 2	12.47	10.43	11.45	11.13	9.34	10.23	7.69	6.50	7.09	9.18	8.81	8.99
F.test	**	**	**	**	**	**	*	*	**	**	**	**
Potassin rates												
P1: 1 liter/fed.	8.92	8.04	8.48	7.83	6.03	6.93	6.62	5.67	6.14	8.33	8.09	8.21
P2: 1.5 liter/fed.	11.26	9.50	10.38	9.99	9.26	9.62	7.81	6.33	7.07	9.15	8.77	8.96
L.S.D. 5%	1.89	1.30	1.55	1.86	2.10	2.18	1.15	0.45	0.81	0.75	0.55	0.62
L.S.D. 1%	2.04	N.S.	1.88	2.04	N.S.	2.50	1.18	N.S.	0.900	0.80	0.61	0.72
Nitrogen fertilizer levels												
N1: 25 kg N/fed.	7.80	6.61	7.21	7.03	5.52	6.27	6.42	5.14	5.78	8.02	7.78	7.90
N2: 50 kg N/fed.	10.88	9.59	10.23	9.54	8.39	8.96	7.44	6.22	6.83	8.99	8.67	8.83
N3: 75 kg N/fed	11.58	10.12	10.85	10.16	9.02	9.58	7.78	6.63	7.20	9.21	8.85	9.03
L.S.D. 5%	2.60	1.99	2.15	1.81	2.20	2.10	0.98	0.85	0.88	0.75	0.77	0.85
L.S.D. 1%	3.05	2.65	2.80	2.50	2.70	2.61	1.00	1.05	0.98	0.90	0.86	0.92
Interactions												
V x P	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
V x N	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	*	N.S.	*	N.S.	N.S.	N.S.
N x P	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
V x P x N	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

Table (8): Mean values of seed yield and its related characters for two flax varieties as affected by potassin rates, nitrogen fertilizer levels and their interaction in 2003/2004 and 2004/2005 seasons in addition to the combined analysis.

Characters	Seed yield/plant (g)			Seed yield/fed. (kg)			Seed oil percentage (%)			Oil yield/fed. (kg)		
Season / Treatments	1 st	2 nd	Comb.	1 st	2 nd	Comb.	1 st	2 nd	Comb.	1 st	2 nd	Comb.
Varieties:												
V_1: Sakha 1	0.535	0.430	0.483	379.61	331.21	355.41	37.41	36.67	37.04	142.87	122.14	132.50
V_2: Sakha 2	0.719	0.589	0.654	476.74	417.63	447.18	38.57	37.71	38.14	184.86	158.22	171.54
F. test	**	**	**	*	*	**	*	*	**	*	*	**
Potassin rates												
P1: 1 liter/fed.	0.575	0.463	0.519	404.98	358.24	381.61	37.16	36.33	36.74	151.52	130.99	141.26
P2: 1.5 liter/fed.	0.680	0.555	0.618	451.36	390.60	420.98	38.82	38.05	38.44	176.21	149.36	162.79
L.S.D. 5%	0.088	0.070	0.077	34.6	27.8	35.7	1.04	1.57	1.32	19.20	16.5	15.20
L.S.D. 1%	0.102	0.090	0.091	49.0	N.S.	38.5	1.60	1.71	1.92	23.8	18.01	18.9
Nitrogen fertilizer levels												
N1: 25 kg N/fed.	0.469	0.372	0.420	339.84	285.38	312.61	36.36	35.96	36.16	123.85	103.09	113.47
N2: 50 kg N/fed.	0.686	0.547	0.617	471.48	410.52	440.99	38.65	37.66	38.15	182.85	154.90	168.87
N3: 75 kg N/fed	0.728	0.609	0.668	473.20	427.38	450.29	38.97	37.95	38.46	184.89	162.54	173.72
L.S.D. 5%	0.198	0.156	0.180	119.5	110.31	118.8	1.95	1.25	1.75	41.8	43.5	49.2
L.S.D. 1%	0.210	0.171	0.191	130.6	121.2	125.7	2.11	1.69	1.89	55.5	49.6	53.7
Interactions												
V x P	**	**	**	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
V x N	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
N x P	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
V x P x N	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

Table (11): Simple correlation coefficients among some studied characters for flax varieties as affected by potassin rates and nitrogen fertilizer levels (combined analysis of 2003/2004 and 2004/2005 seasons).

Variables	1	2	3	4	5	6	7	8	9	10	11	12
1- Straw yield/fed.	----	0.921**	0.967**	0.954**	0.978**	0.916**	0.981**	-0.063	0.344	0.363	0.163	0.425
2- Straw yield/plant		----	0.877**	0.856**	0.930**	0.984**	0.921**	0.189	0.155	0.151	-0.041	0.256
3- Total length/plant			----	0.972**	0.958**	0.878**	0.981**	-0.209	0.484	-0.390	0.252	0.490
4- Technical length/plant				----	0.964**	0.878**	0.982**	-0.290	0.023	0.448	0.223	0.457
5- Fiber yield/fed.					----	0.956**	0.976**	-0.118	0.417	0.440	0.234	0.506
6- Fiber yield/plant						----	0.923**	0.096	0.249	0.274	0.044	0.368
7- Fiber length							----	-0.158	0.359	0.359	-0.098	-0.824**
8- Fiber fineness								----	-0.624*	-0.602*	-0.550	-0.457
9- Seed yield/fed.									----	0.982**	0.930**	0.919**
10- Seed yield/plant										----	0.960**	0.962**
11- No. of capsules/plant											----	0.923**
12- 1000 seed weight												----