IMPACT OF NITROGEN FERTILIZER LEVEL AND TIMES OF FOLIAR SPRAYING WITH POTASSIUM ON YIELD AND ITS COMPONENTS OF SOME FLAX GENOTYPES

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ABSTRACT

Two field experiments were carried out at the Experimental Farm, Faculty of Agriculture, Kafrelsheikh University, Egypt, during 2013/2014 and 2014/2015 seasons to find out the effect of nitrogen fertilizer level and time of foliar spraying with potassium fertilizer on straw, fiber and seed yields and its components of some flax genotypes. The experiment was carried out in a split-split plot design with four replications. The main-plots were assigned to flax genotypes (Sakha 1, Strain 402/1, Sakha 5, Strain 541/G/1, Sakha 3 and Strain 620/3/5). The sub-plots were allocated to nitrogen fertilizer levels (30, 45 and 60 kg N/fed). The sub-sub-plots were occupied with times of foliar spraying with potassium (spraying with potassium after 50 DFS, after 70 DFS and after 50 and 70 DFS). The obtained results could be summarized as follows:

- Sakha 1 cultivar produced the highest values of 1000-seed weight in both seasons. Meanwhile, Strain 402/1 resulted in the highest values of seed yield g/plant in the second season. However, Sakha 5 produced the highest values of fruiting zone length, number of capsules/plant, number of seeds/capsule, number of seeds/plant, seed yield / plant (in the first season) and seed yield / feddan in both seasons. While, Sakha 3 cultivar resulted in the highest means of total plant height, technical length, straw yield/plant (in the first season) and straw yield/fed in both seasons. Strain 620/3/5 produced the highest values of straw yield/plant in the second season, fiber yield/plant and fiber yield/fed in both seasons.
- Maximum means of all studied characters were produced from fertilizing flax plants with 60 kg N/fed., while the lowest values of these characters were obtained from plants that fertilized with 30 kg N/fed.
- Foliar spraying flax plants twice with potassium after 50 and 70 DFS significantly exceeded other studied times of foliar spraying with potassium and produced the highest values of all studied characters.

Form the obtained data in this study, it can be concluded that mineral fertilizing Sakha 3 cultivar, Strain 620/3/5 and Sakha 5 with 60 kg N/fed and foliar spraying twice with potassium after 50 and 70 DFS from sowing could be recommended in order to maximizing straw, fiber and seed yields, respectively under the same conditions of this research.

Keywords: Flax, Genotypes, Nitrogen fertilization, Potassium fertilization, Yields

INTRODUCTION

Flax (*Linum usitatissimum* L.) is one of the earliest plants that has been domesticated by humans and its production dates back to ancient history. Flax fiber is being blended with certain types of plastic resins to produce automotive components. Seeds from flax are crushed to produce linseed oil and linseed meal. In Egypt, flax is cultivated as a dual purpose (seeds for oil and stems for fiber). The cultivated area through the last 20 years was decreased from 60.000 to 30.000 feddan due to the great competition of other economic winter crops resulting in a gap between production and consumption. The gap could be minimized partly by increasing flax yield per unit area through sowing high yielding cultivars and optimizing the agricultural practices for growing flax among them nitrogen fertilization and times of foliar spraying with potassium fertilizer.

Sowing the suitable cultivar is important factor to enhance growth, yields and its components and quality parameters of flax. In this connections, **Rahimi and Nourmohamadi (2010)** indicating that there are significant differences due to flax genotypes in yields and yield components due to the differences in genetic structure and their interaction with environmental conditions prevailing during growing season. **Khalifa *et al.* (2011), Al-Doori (2012), Bakry *et al.* (2012 a), Gallardo *et al.* (2014) and El-Borhamy (2016)** indicated that significant differences were observed among the flax varieties in all studied traits, *i.e.* yield, yield components. **Abd El-Mohsen *et al.* (2013) and Wadan (2013)** found that the two tested flax cultivars; Sakha 1 and Sakha 2 exhibited significant differences for almost traits. **Bakry *et al.* (2014)** revealed that Letwania-9 and Evelen cultivars surpassed all other varieties in seed yield/fed. Blanka variety recorded the lowest values of straw yield/fed and biological yield/fed, while, Posna variety gave the lowest values of technical length. **Abd Eldaiem (2015 a & b)** and **Abd El-Dayem and El-Borhamy (2015)** revealed that Giza 10 cultivar recorded the highest values of total plant height, technical length, straw yield/plant, biological yield/fed, straw yield/fed and long fiber yield/fed. Sakha 5 genotype produced the highest values of number of fruiting branches, seed yield/plant and seed yield/fed. Sakha 5 genotype exceeded Sakha 3, Giza 10 and Sakha 2 cultivars in number of fruiting branches, number of capsules/plant, seed yield (g/plant) and seed yield (kg/fed). **Barky *et al.* (2015 a)** showed that Sakha 2 variety surpassed Amon in plant height, fruiting zone length, number of fruiting braches/plant, number of capsules/plant, seed yield/plant, straw yield/plant, seed and straw yields/fed. However, Amon variety surpassed Sakha 2 in technical stem length.

Nitrogen is often the most important plant nutrients, which influences the amount of protein, protoplasm and chlorophyll formed, consequently increases cell size, leaf area and photosynthetic activity. The response of flax to nitrogen has been well established, as has the sensitivity of crop emergence and seed yield to seed-placed nitrogen (**Lafond *et al.*, 2003**). **Soethe *et al.* (2013)** reported that nitrogen levels influenced plant height, number of capsules/plant, 1000-seed weight and seed yield/ha. Applying 45 kg N/fed, resulted in approximately an increasing in straw, seed and technological characters when compared with the effect of the lower nitrogen levels at 0 and 30 kg N/fed **(Mousa *et al,.*(2010)**. While, fertilizing flax plants with 75 kg N/fed significantly increased all studied characters and produced the highest values as compared with control treatment (**Abd El-Dayem and El-Borhamy, 2015 and El-Borhamy, 2016).** Fertilizing flax plants with 90 kg N/ha significantly increased number of branches and capsules/plant and seed yield/ha (**Khajani *et al,.* 2012 ; Homayouni *et al.,* 2013 and Rahimi, 2014). Abdel-Galil *et al.* (2015)** found that the highest mineral nitrogen fertilizer rate (178.5 kg N/ha) had the highest values of plant height, technical length of the main stem, number of capsules/plant, number of seeds/capsule, 1000 – seed weight, seed yield per plant and per ha, straw and fiber yields per ha.

Potassium (K) is participate in many important functions in plants *i.e.* photosynthesis, translocation of photosynthates, protein synthesis, control of ionic balance, regulation of plant stomata and water use (**Marschner, 1995 and Reddya *et al.* 2004**), enzyme activation and osmoregulation (**Mengel 2007**). Also, potassium enhances the ability of plants to resist stress such as diseases, pests, cold and drought. Potassium performs these roles in all crops and flax, therefore it is important plant nutrient to sustain high productivity and quality, in equilibrium with other essential plant nutrients, so it is important to ensure adequate potassium for flax crop. Potassium is usually deficient or unavailable in most Egyptian soils. So, foliar application of this element is the best method of fertilizer application to control its loss from the soil and make it more and easily available to the plant and in turn increase the yield and quality of flax (**Arif *et al.*, 2006**).

Therefore, this investigation was established to determine the effect of nitrogen fertilizer levels and times of foliar spraying with potassium on straw, fiber and seed yields and its components of some flax genotypes under the environmental conditions of Kafrelshiekh governorate, Egypt.

MATERIALS AND METHODS

The present study was carried out at the Experimental Farm, Faculty of Agriculture, Kafrelshiekh University, Egypt, during the two successive winter seasons of 2013/2014 and 2014/2015 to find out the effect of nitrogen fertilizer levels and times of foliar spraying with potassium fertilizer on straw, fiber and seed yields and its components of some flax genotypes.

The experiment was carried out in a split-split plot design with four replications. Where, the main-plots were assigned to flax genotypes as follows:

1. Two genotypes of the dual purpose flax (Sakha 1 and Strain 402/1).
2. Two genotypes of oil flax (Sakha 5 and Strain 541/G/1).
3. Two genotypes of fiber flax (Sakha 3 and Strain 620/3/5).

These genotypes were obtained from Fibers Research Section, Field Crops Research Institute, Agricultural Research Center, Giza, Egypt and its pedigree as shown in Table 1.

Table 1: Type and pedigree of studied flax genotypes

Genotype	Type	Pedigree
Sakha 1	Dual purpose	[Bombay (USA) × 1.1485 (USA)
Strain 402/1	Dual purpose	Giza 5 × I. C 235 (USA)
Sakha 5	Oil	I.370 × I.2561
Strain 541/C/1	Oil	Giza 8 × S.24/9/1
Sakha 3	Fiber	Belinka 2E × I.2096
Strain 620/3/5	Fiber	S.422 × Giza 7

The sub-plots were allocated to nitrogen fertilizer levels (30, 45 and 60 kg N/fed). The mineral nitrogen fertilizer in the form of urea (46.0 % N) at the mentioned rates was added in two equal doses (the first dose before the first irrigation and the second dose before the second irrigation.

The sub-sub-plots were occupied with the following times of foliar spraying with potassium:

1. Spraying with potassium after 50 days from sowing (DFS).
2. Spraying with potassium after 70 DFS.
3. Spraying with potassium after 50 and 70 DFS.

Foliar spraying was conducted by hand sprayer (for experimental plots) until saturation point at the rate of 200 L /fed., Potassium fertilizer in the form of commercial compound (Royal potassium) contains 50 % potassium (K_2O) at the rate of 1 Liter/fed.

Each experimental unit area was 3 × 3 m occupying an area of 9.0 m^2. The preceding summer crop was maize (*Zea mays* L.) in both seasons. Soil samples were taken at random from the experimental field area at a depth of 0 - 30 cm from soil surface before the growing seasons to measure the physical and chemical soil properties as shown in Table 2.

Table 2: Some physical and chemical properties of the experimental site during 2013/2014 and 2014/2015 seasons

Soil analysis		2013/2014	2014/2015
A: Physical analysis			
Clay (%)		40.60	42.55
Silt (%)		32.75	35.20
Sand (%)		21.30	24.00
Texture class		Clay	Clay
B: Chemical analysis			
pH		8.05	8.12
E.C. (mho/cm at 25 °C)		2.25	2.73
Organic matter (%)		1.45	1.25
Available nitrogen (ppm)		25.65	20.70
Available P (ppm)		10.17	11.45
Available K (ppm)		380.00	405.00
Cations (meq./100 g soil)	Ca^{++}	5.17	7.62
	Mg^{++}	4.58	2.31
	Na^{+}	15.42	18.73
	K^{+}	0.25	0.32
Anions (meq./100 g soil)	HCO_3^{-}	3.48	2.85
	Cl^{-}	5.65	8.46
	SO_4^{--}	7.35	5.24

The experimental field was well prepared through two ploughings, compaction, division and then divided into the experimental units with dimensions as previously mentioned. The mineral phosphorus fertilizer in the form of calcium superphosphate (15.5% P_2O_5) at the rate of 100 kg/fed. and mineral potassium fertilizer in the form of potassium sulphate (48.0% K_2O) at the rate of 50 kg/fed were added during seed bed preparation.

Flax genotypes were sown by using broadcasting method at the recommended rate of each genotype on 10th and 17th of November in the first and second seasons, respectively. The other common agricultural practices for growing flax according to the recommendations of Ministry of Agriculture were followed.

STUDIED CHARACTERS*:*

Yields and its components:

At full maturity, ten guarded plants were taken at random from each sub-sub plot to be used in recording the following yields and its components.

A. Straw and its components:

1. Total plant height (cm).
2. Technical length (cm).
3. Stem diameter (mm).
4. Straw yield (g/plant).
5. Straw yield (t/fed). It was estimated from the whole sub-sub plot area basis.

6. Fiber yield (g/plant).
7. Fiber yield (kg/fed). Long fiber yield/fed were recorded from the whole sub-plot area basis.

B. Seed and its components:

1. Length of fruiting zone (cm).
2. Number of capsules/plant.
3. Number of seeds/capsule.
4. 1000-seed weight (g).
5. Number of seeds/plant.
6. Seed yield (g/plant).
7. Seed yield (kg/fed). It was recorded from the whole sub-plot area basis.

All obtained 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)**. Means of grains treatments were compared using Duncan's multiple range tests at 5 % level of probability as described by **Duncan (1955)**.

RESULT AND DISCUSSION

1- GENOTYPES PERFORMANCE:

From obtained results in Tables 3 and 4, it could be noticed that there were significant differences in straw yield and its components (total plant height, technical length, stem diameter, straw yield “g/plant”, straw yield “t/fed”, fiber yield “g/plant” and fiber yield “kg/fed”) and seed yield and its components (length of fruiting zone, number of capsules/plant, number of seeds/capsule, 1000-seed weight, number of seeds/plant, seed yield “g/plant” and seed yield “kg/fed”) among studied flax genotypes *i.e.* dual purpose flax (Sakha 1 and Strain 402/1), oil flax (Sakha 5 and Strain 541/G/1) and fiber flax (Sakha 3 and Strain 620/3/5) in the two growing seasons.

Under conditions of this study, Sakha 1 cultivar produced the highest values of 1000-seed weight of flax at harvesting in both seasons. Meanwhile, Strain 402/1 significantly surpassed other studied genotypes and resulted in the highest values of seed yield (g/plant) in the second season. However, Sakha 5 produced the highest values of length of fruiting zone, number of capsules/plant, number of seeds/capsule, number of seeds/plant, seed yield per plant (in the first season) and seed yield per feddan of flax at harvesting in both seasons. While, Sakha 3 cultivar resulted in the highest means of total plant height, technical length, straw yield/plant (in the first season) and straw yield/fed in both seasons. Strain 620/3/5 produced the highest values of straw yield/plant (in the second season), fiber yield per plant and per feddan during 2013/2014 and 2014/2015 seasons. It could be concluded that varietal differences among flax genotypes may be due to genetical make up. Similar results were found by **Gallardo *et al.* (2014), Abd Eldaiem (2015 a), Abd Eldaiem (2015 b), Abd El-Dayem and El-Borhamy (2015), Barky *et al.* (2015 a) and El-Borhamy (2016).**

2. EFFECT OF NITROGEN FERTILIZER LEVELS:

With respect to the effect of nitrogen fertilizer levels on all studied characters *i.e.* straw yield and its components (total plant height, technical length, stem diameter, straw yield “g/plant”, straw yield “t/fed”, fiber yield “g/plant” and fiber yield “kg/fed”) and seed yield and its components (length of fruiting zone, number of capsules/plant, number of seeds/capsule, 1000-seed weight, number of seeds/plant, seed yield “g/plant” and seed yield “kg/fed”), it was significant in the two growing seasons of this study (Tables 3 and 4).

All studied characters of flax gradually increased as a result of increasing nitrogen fertilizer levels from 30 to 45 and 60 kg N/fed in both seasons. It was evident that, under the environmental conditions of this study, flax plants still responded to more levels of nitrogen fertilizer up to 60 kg N/fed. Generally, maximum means of all studied characters were produced from fertilizing flax plants with 60 kg N/fed in the first and second seasons. On the contrary, the lowest values of these characters were obtained from plots that received lowest nitrogen fertilizer levels (30 kg N/fed). These increases in straw, fiber and seed yields and its components due to increasing mineral nitrogen fertilizer levels might be due to the role of nitrogen in protoplasm and chlorophyll formation, enhancement meristematic activity and cell division, consequently increases cell size which improving vegetative growth, plant height and stem diameter accordingly increasing straw and fiber yields. Moreover, nitrogen encourages plant to uptake other elements activating, thereby growth of plants, consequently enhancing growth measurements and all seed yield components. **Soethe *et al.* (2013), Rahimi (2014), Abd El-Dayem and El-Borhamy (2015), Abdel-Galil *et al.* (2015) and El-Borhamy (2016)** came out similar results.

3. EFFECT OF TIMES OF FOLIAR SPRAYING WITH POTASSIUM:

Times of foliar spraying with potassium (50 DFS, 70 DFS and 50 and 70 DFS) were associated significant effect on straw yield and its components (total plant height, technical length, stem diameter, straw yield “g/plant”, straw yield “t/fed”, fiber yield “g/plant” and fiber yield “kg/fed”) and seed yield and its components (length of fruiting zone, number of capsules/plant, number of seeds/capsule, 1000-seed weight, number of seeds/plant, seed yield “g/plant” and seed yield “kg/fed”) in both seasons (Tables 3 and 4).

Foliar spraying flax plants twice with potassium fertilizer in the form of commercial compound contains 50 % potassium (K_2O) at the rate of 1 Liter/fed after 50 and 70 DFS significantly exceeded other studied times of foliar spraying with potassium and produced the highest values of all studied characters in the first and the second seasons of this study. This treatment was followed by foliar spraying with potassium one time after 70 DFS concerning all studied characters in the two growing seasons. Whereas, the lowest values of all studied characters were resulted from foliar spraying with potassium one time after 50 DFS in both seasons. The enhancement of straw, fiber and seed yields and its components due to foliar spraying flax plants with potassium may be ascribed to the role of potassium in building up the photosynthetic area of flax plants and consequently increased dry matter accumulation and straw and fiber yields. In addition, providing sufficient potassium for flax often include promoting early plant maturity, resistance to diseases and other pests, vigorous growth, and consequently improved seed yield. A positive association between potassium fertilizer and straw yield has been reported by **Bakry *et al.* (2012 b), Bakry *et al.* (2015 a) and Barky *et al.* (2015 b)**.

4- Effect of interaction:

With regard to the interactions among the three studied factors, great deals of them were statistically significant in most cases. Thus, the author will discuss only some of them dealing with the second or der of interaction among flax genotype nitrogen fertilizer level and time of foliar spraying with potassium on straw, fiber and seed yields.

The interaction among flax genotype, nitrogen fertilizer level and time of foliar spraying with potassium had a significant effect on straw yield per plant in the first season and straw yield per feddan in the second season. It can be noticed that, the highest value of straw yield per plant in the first season was (2.750 g/plant) and straw yield per feddan in the second season was (4.572 t/fed), which resulted from mineral fertilizing Sakha 3 cultivar with 60 kg N/fed and foliar spraying twice with potassium at 50 and 70 DFS as presented in Table 5. Mineral fertilizing Sakha 3 cultivar with 60 kg N/fed and foliar spraying with potassium at 70 DFS considered as the second best interaction treatment regarding to straw yield per plant.

The interaction among flax genotype, nitrogen fertilizer level and time of foliar spraying with potassium had a significant effect on fiber yield per plant in both seasons. It can be observed that, the highest values of fiber yield per plant (0.810 and 0.811 g/plant) ware resulted from mineral fertilizing Strain 620/3/5 with 60 kg N/fed and foliar spraying twice with potassium at 50 and 70 DFS as presented in Table 6. Mineral fertilizing Strain 620/3/5 with 60 kg N/fed and foliar spraying with potassium at 70 DFS considered as the second best interaction treatment regarding to fiber yield per plant.

The interaction among flax genotype, nitrogen fertilizer level and time of foliar spraying with potassium had a significant effect on fiber yield per feddan in both seasons. It can be observed that, the highest values of fiber yield per feddan (701.3 and 689.0 kg/fed.) were resulted from mineral fertilizing Strain 620/3/5 with 60 kg N/fed and foliar spraying twice with potassium at 50 and 70 DFS as presented in Table 7. Mineral fertilizing Strain 620/3/5 with 60 kg N/fed and foliar spraying with potassium at 70 DFS considered as the second best interaction treatment regarding to fiber yield per feddan without significant differences between them in both seasons.

The interaction among flax genotype, nitrogen fertilizer level and times of foliar spraying with potassium had a significant effect on seed yield per plant in both seasons. It can be observed that, the highest values of seed yield per plant (0.723 and 0.693 g/plant) were resulted from mineral fertilizing Sakha 5 with 60 kg N/fed and foliar spraying twice with potassium at 50 and 70 DFS as presented in Table 8. Mineral fertilizing Sakha 5 with 60 kg N/fed and foliar spraying with potassium at 70 DFS considered as the second best interaction treatment, followed by mineral fertilizing Sakha 5 with 60 kg N/fed and foliar spraying with potassium at 50 DFS, then mineral fertilizing Sakha 5 with 45 kg N/fed and foliar spraying twice with potassium at 50 and 70 DFS and mineral fertilizing Strain 402/1 with 60 kg N/fed and foliar spraying twice with potassium at 50 and 70 DFS without significant among them in both seasons regarding to seed yield per plant.

The interaction among flax genotype, nitrogen fertilizer level and times of foliar spraying with potassium had a significant effect on seed yield per feddan in both seasons. It can be observed that, the highest values of seed yield per feddan (779.3 and 763.2 kg/fed) were resulted from mineral fertilizing Sakha 5 with 60 kg N/fed. and foliar spraying twice with potassium at 50 and 70 DFS as presented in Table 9. Mineral fertilizing Strain 402/1 with 60 kg N/fed. and foliar spraying with potassium at 50 and 70 DFS considered as the second best interaction treatment regarding to seed yield per feddan in both seasons.

CONCLUSION

Form the obtained results in this study, it can be concluded that mineral fertilizing Sakha 3 cultivar, Strain 620/3/5 and Sakha 5 with 60 kg N/fed and foliar spraying twice with potassium fertilizer after 50 and 70 DFS from sowing could be recommended in order to maximizing straw, fiber and seed yields, respectively under the some conditions of this research.

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Table 3: Total plant height(cm), technical length(cm), stem diameter(mm), straw and fiber yields per plant (g) and per feddan (kg) of of some flax genotypes as affected by nitrogen fertilizer level and times of foliar spraying with potassium during 2013/2014 and 2014/2015 seasons

Treatment	Total plant height (cm)		Technical length (cm)		Stem diameter (mm)		Straw yield (g/plant)		Straw yield (t/fed.)		Fiber yield (g/plant)		Fiber yield (kg/fed.)	
	2013/2014	2014/2015	2013/2014	2014/2015	2013/2014	2014/2015	2013/2014	2014/2015	2013/2014	2014/2015	2013/2014	2014/2015	2013/2014	2014/2015
A- Genotype														
Sakha 1	96.10 b	104.41 ab	86.6 bc	90.28 b	1.964 a	1.778 a	1.695 b	1.594 ab	3.840 b	3.874 b	0.594 b	0.606 bc	584.2 c	614.6 a
Strain 402/1	100.00 ab	99.32 b	87.1 c	88.65 c	1.747 b	1.719 ab	1.729 b	1.635 ab	3.862 b	3.976 ab	0.632 a	0.573 cd	566.1 d	619.0 a
Sakha 5	78.44 d	74.53 c	62.7 e	60.9 d	1.606 b	1.542 c	1.389 c	1.376 c	3.541 c	3.516 c	0.467 c	0.511 e	452.5 f	464.5 c
Strain 541/G/1	94.10 c	93.49 b	82.7 d	82.7 c	1.669 b	1.682 b	1.500 c	1.509 bc	3.496 c	3.479 c	0.486 c	0.529 de	473.5 e	485.1 b
Sakha 3	112.70 a	120.70 a	102.5 a	113.2 a	1.711 b	1.643 b	1.980 a	1.615 ab	4.044 a	4.111 a	0.649 a	0.636 ab	605.2 b	615.5 a
Strain 620/3/5	105.60 ab	98.83 b	94.85 b	94.58 b	1.692 b	1.717 ab	1.961 a	1.715 a	3.898 b	4.072 a	0.657 a	0.663 a	627.5 a	619.5 a
F. test	*	*	*	*	*	*	*	*	*	*	*	*	*	*
B- Nitrogen fertilizer level:														
30 kg N/fed	85.00 c	84.54 c	75.05 c	74.31 c	1.449 c	1.398 c	1.293 c	1.138 c	3.443 c	3.519 c	0.452 b	0.468 c	503.1 c	517.5 c
45 kg N/fed	99.00 b	101.49 b	86.85 b	90.98 b	1.755 b	1.741 b	1.778 b	1.667 b	3.874 b	3.942 b	0.638 a	0.637 b	564.1 b	573.4 b
60 kg N/fed	109.30 a	109.79 a	96.35 a	99.90 a	1.990 a	1.901 a	2.056 a	1.917 a	4.024 a	4.053 a	0.652 a	0.654 a	587.3 a	618.3 a
F. test	*	*	*	*	*	*	*	*	*	*	*	*	*	*
C- Times of foliar spraying with potassium (after days from sowing):														
50	93.60 c	96.21 c	83.05 c	86.38 c	1.601 c	1.527 c	1.497 c	1.340 c	3.580 c	3.692 c	0.549 b	0.541 c	536.0 c	551.6 c
70	98.40 b	98.77 b	86.55 b	88.28 b	1.706 b	1.670 b	1.690 b	1.604 b	3.811 b	3.855 b	0.561 b	0.591 b	551.5 b	571.0 b
50 and 70	101.30 a	100.68 a	88.65 a	90.53 a	1.887 a	1.843 a	1.939 a	1.779 a	3.949 a	3.968 a	0.632 a	0.627 a	567.1 a	586.5 a
F. test	*	*	*	*	*	*	*	*	*	*	*	*	*	*
D- Interactions														
A × B	*	NS	*	*	NS	NS	*	*	*	*	*	NS	*	*
A × C	*	NS	*	*	NS	NS	*	*	NS	*	NS	NS	*	NS
B × C	*	*	*	*	*	NS	NS	NS	NS	NS	*	*	*	*
A × B × C	NS	*	NS	*	NS	NS	*	NS	NS	*	*	*	*	*

*,** and NS indicate P < 0.05, P < 0.01 and not significant, respectively.
Means followed by the same letter within columns are not significantly different at P < 0.05 using Duncan`s multiple range test.

Table 4: Length of fruiting zone (cm), number of capsules/plant, number of seeds/capsule, 1000-seed weight (g), number of seeds/plant, seed yield per plant(g) and per feddan (kg) of some flax genotypes as affected by nitrogen fertilizer level and times of foliar spraying with potassium during 2013/2014 and 2014/2015 seasons

Treatment	Length of fruiting zone (cm)		Number of capsules/plant		Number of seeds/capsule		1000-seed weight (g)		Number of seeds/plant		Seed yield (g/plant)		Seed yield (kg/fed.)	
	2013/2014	2014/2015	2013/2014	2014/2015	2013/2014	2014/2015	2013/2014	2014/2015	2013/2014	2014/2015	2013/2014	2014/2015	2013/2014	2014/2015
A- Genotype														
Sakha 1	9.46 d	9.83 c	8.45 d	9.39 c	7.28 bc	7.33 abc	8.99 a	8.66 a	61.52 c	68.83 c	0.553 c	0.596 b	530.0 c	587.4 c
Strain 402/1	12.87 b	10.68 b	11.71 b	11.26 b	7.72 b	7.08 bcd	8.44 b	8.03 b	90.40 b	79.72 b	0.762 a	0.640 a	676.7 b	625.3 b
Sakha 5	15.74 a	13.54 a	13.07 a	12.19 a	8.35 a	7.84 a	6.19 c	6.58 c	109.13 a	95.57 a	0.766 a	0.629 a	697.7 a	677.8 a
Strain 541/G/1	11.38 c	10.79 b	10.21 c	9.93 c	7.82 b	7.58 ab	8.24 b	8.00 b	79.84 b	71.18 b	0.658 b	0.569 b	637.3 c	549.7 c
Sakha 3	10.20 c	7.53 e	6.68 f	7.11 d	6.32 d	6.68 d	5.99 c	6.27 c	42.22 e	47.49 e	0.253 e	0.298 d	444.9 d	451.8 e
Strain 620/3/5	10.75 c	8.72 d	7.30 e	7.60 d	6.77 cd	6.90 cd	6.33 c	6.51 c	49.42 d	52.44 d	0.318 d	0.342 c	465.1 d	490.6 d
F. test	*	*	*	*	*	*	*	*	*	*	*	*	*	*
B- Nitrogen fertilizer level:														
30 kg N/fed	10.05 b	8.09 c	6.60 c	6.52 c	6.07 c	5.82 c	5.97 c	6.15 c	39.81 c	35.59 c	0.408 c	0.372 c	523.2 c	510.4 c
45 kg N/fed	12.28 a	9.34 b	9.67 b	9.80 b	7.77 b	7.57 b	7.51 b	7.51 B	74.67 b	71.89 b	0.553 b	0.521 b	572.9 b	561.4 b
60 kg N/fed	12.85 a	10.47 a	12.44 a	12.41 a	8.29 a	8.31 a	8.60 a	8.37 a	101.78 a	100.16 a	0.692 a	0.645 a	629.9 a	619.4 a
F. test	*	*	*	*	*	*	*	*	*	*	*	*	*	*
C- Times of foliar spraying with potassium (after days from sowing):														
50	10.60 b	8.09 c	8.82 c	8.74 c	7.04 b	6.87 c	6.90 c	7.04 c	63.70 c	60.08 c	0.511 c	0.474 c	558.4 c	544.8 c
70	12.00 a	9.16 b	9.56 b	9.48 b	7.30 b	7.23 b	7.24 b	7.31 B	71.22 b	68.38 b	0.533 b	0.494 b	570.2 b	560.3 b
50 and 70	12.58 a	10.64 a	10.33 a	10.52 a	7.79 a	7.62 a	7.95 a	7.68 a	81.33 a	79.18 a	0.610 a	0.569 a	597.4 a	586.1 a
F. test	*	*	*	*	*	*	*	*	*	*	*	*	*	*
D- Interactions														
A × B	*	NS	*	*	*	NS	*	*	*	*	*	*	*	*
A × C	*	*	*	*	NS	NS	NS	NS	*	*	NS	NS	NS	*
B × C	*	*	*	*	*	*	*	NS	NS	*	*	NS	NS	*
A × B × C	NS	NS	NS	NS	NS	NS	*	NS	*	NS	*	*	*	*

*,** and NS indicate P < 0.05, P < 0.01 and not significant, respectively.
Means followed by the same letter within columns are not significantly different at P < 0.05 using Duncan`s multiple range test.

Table 5: Straw yield of flax per plant during 2013/2014 season and per feddan during 2014/2015 season as affected by the interaction among genotype, nitrogen fertilizer level and time of foliar spraying with potassium

Treatment			Straw yield (g/plant) 2013/2014		Straw yield (t/fed.) 2014/2015	
Sakha 1	30 kg N/fed	50 DFS	0.750	uvw	3.363	opqrs
		70 DFS	0.997	stuvw	3.188	qrs
		50 & 70 DFS	0.893	tuvw	3.439	mnopqrs
	45 kg N/fed	50 DFS	1.237	pqrstuv	3.548	klmnopqr
		70 DFS	1.703	ghijklmnopq	4.025	abcdefghijkl
		50 & 70 DFS	1.473	klmnopqrs	4.262	abcdefg
	60 kg N/fed	50 DFS	1.727	ghijklmnop	4.475	abcd
		70 DFS	1.933	defghijklm	4.043	abcdefghijkl
		50 & 70 DFS	1.783	efghijklmnop	4.525	abc
Strain 402/1	30 kg N/fed	50 DFS	1.383	mnopqrst	3.588	jklmnopqr
		70 DFS	1.007	stuvw	3.987	bcdefghijklm
		50 & 70 DFS	1.380	nopqrst	4.044	abcdefghijkl
	45 kg N/fed	50 DFS	1.700	ghijklmnopq	3.871	fghijklmnop
		70 DFS	1.800	efghijklmn	4.312	abcdef
		50 & 70 DFS	1.783	efghijklmnop	3.972	cdefghijklm
	60 kg N/fed	50 DFS	2.133	cdefghi	4.087	abcdefghijkl
		70 DFS	1.750	fghijklmnop	4.453	abcde
		50 & 70 DFS	2.317	abcde	4.330	abcdef
Sakha 5	30 kg N/fed	50 DFS	0.717	vw	3.240	qrs
		70 DFS	1.003	stuvw	3.261	qrs
		50 & 70 DFS	1.467	klmnopqrs	3.305	pqrs
	45 kg N/fed	50 DFS	1.617	ijklmnopqr	3.686	hijklmnopqr
		70 DFS	0.567	w	3.686	hijklmnopqr
		50 & 70 DFS	2.107	cdefghi	3.629	ijklmnopqr
	60 kg N/fed	50 DFS	1.793	efghijklmno	3.122	rs
		70 DFS	2.067	defghij	3.976	cdefghijklm
		50 & 70 DFS	2.163	cdefghi	3.742	ghijklmnopq
Strain 541/G/1	30 kg N/fed	50 DFS	0.893	tuvw	3.208	qrs
		70 DFS	1.663	hijklmnopqr	3.387	nopqrs
		50 & 70 DFS	1.917	defghijklmn	3.348	opqrs
	45 kg N/fed	50 DFS	1.250	opqrstu	3.736	ghijklmnopq
		70 DFS	1.847	efghijklmn	2.968	s
		50 & 70 DFS	2.150	cdefghi	3.724	ghijklmnopq
	60 kg N/fed	50 DFS	1.633	ijklmnopqr	3.732	ghijklmnopq
		70 DFS	2.207	bcdefgh	3.528	lmnopqr
		50 & 70 DFS	2.000	defghijk	3.681	hijklmnopqr
Sakha 3	30 kg N/fed	50 DFS	1.417	lmnopqrst	3.557	klmnopqr
		70 DFS	1.887	efghijklmn	3.901	efghijklmno
		50 & 70 DFS	1.843	efghijklmn	4.198	abcdefghi
	45 kg N/fed	50 DFS	1.530	jklmnopqrs	4.046	abcdefghijkl
		70 DFS	1.987	defghijk	4.354	abcdef
		50 & 70 DFS	2.280	abcdef	4.123	abcdefghijk
	60 kg N/fed	50 DFS	1.417	lmnopqrst	4.143	abcdefghij
		70 DFS	2.707	ab	4.120	abcdefghijk
		50 & 70 DFS	2.750	a	4.572	a
Strain 620/3/5	30 kg N/fed	50 DFS	1.163	qrstuv	3.234	qrs
		70 DFS	1.157	rstuv	3.382	nopqrs
		50 & 70 DFS	1.737	fghijklmnop	3.714	ghijklmnopq
	45 kg N/fed	50 DFS	2.140	cdefghi	3.862	fghijklmnop
		70 DFS	2.203	bcdefgh	4.247	abcdefgh
		50 & 70 DFS	2.623	abc	4.476	abcd
	60 kg N/fed	50 DFS	2.450	abcd	3.951	defghijklmn
		70 DFS	1.943	defghijkl	4.350	abcdef
		50 & 70 DFS	2.233	bcdefg	4.556	ab

Means followed by the same letter within columns are not significantly different at $P < 0.05$ using Duncan`s multiple range test.

Table 6: Fiber yield per plant of flax at as affected by the interaction among genotype, nitrogen fertilizer level and time of foliar spraying with potassium during 2013/2014 and 2014/2015 seasons

Treatment			Fiber yield (g/plant)			
			2013/2014		2014/2015	
Sakha 1	30 kg N/fed	50 DFS	0.437	mnopqrs	0.387	n
		70 DFS	0.393	pqrs	0.470	jklmn
		50 & 70 DFS	0.503	jklmnopq	0.603	fghi
	45 kg N/fed	50 DFS	0.603	efghijk	0.657	cdefgh
		70 DFS	0.643	bcdefghi	0.567	hij
		50 & 70 DFS	0.730	abcd	0.643	defgh
	60 kg N/fed	50 DFS	0.657	bcdefghi	0.700	bcdefg
		70 DFS	0.673	bcdefgh	0.703	bcdef
		50 & 70 DFS	0.707	abcde	0.727	abcd
Strain 402/1	30 kg N/fed	50 DFS	0.457	lmnopqrs	0.400	n
		70 DFS	0.450	lmnopqrs	0.440	mn
		50 & 70 DFS	0.550	hijklmn	0.573	hij
	45 kg N/fed	50 DFS	0.770	ab	0.653	cdefgh
		70 DFS	0.720	abcde	0.623	defgh
		50 & 70 DFS	0.710	abcde	0.703	bcdef
	60 kg N/fed	50 DFS	0.697	abcdef	0.580	hi
		70 DFS	0.640	cdefghi	0.630	defgh
		50 & 70 DFS	0.693	abcdef	0.557	hijkl
Sakha 5	30 kg N/fed	50 DFS	0.360	rs	0.397	n
		70 DFS	0.347	s	0.413	mn
		50 & 70 DFS	0.507	jklmnop	0.473	jklmn
	45 kg N/fed	50 DFS	0.483	klmnopqr	0.510	ijklm
		70 DFS	0.417	opqrs	0.610	efghi
		50 & 70 DFS	0.493	jklmnopq	0.593	ghi
	60 kg N/fed	50 DFS	0.447	mnopqrs	0.563	hijk
		70 DFS	0.603	efghijk	0.587	hi
		50 & 70 DFS	0.550	hijklmn	0.613	efghi
Strain 541/G/1	30 kg N/fed	50 DFS	0.353	s	0.383	n
		70 DFS	0.390	pqrs	0.413	mn
		50 & 70 DFS	0.433	nopqrs	0.433	mn
	45 kg N/fed	50 DFS	0.403	pqrs	0.460	klmn
		70 DFS	0.407	pqrs	0.557	hijkl
		50 & 70 DFS	0.660	bcdefghi	0.603	fghi
	60 kg N/fed	50 DFS	0.573	fghijkl	0.457	lmn
		70 DFS	0.537	ijklmno	0.653	cdefgh
		50 & 70 DFS	0.613	defghij	0.640	defgh
Sakha 3	30 kg N/fed	50 DFS	0.470	lmnopqrs	0.447	mn
		70 DFS	0.483	klmnopqr	0.457	lmn
		50 & 70 DFS	0.600	efghijk	0.570	hij
	45 kg N/fed	50 DFS	0.683	bcdefg	0.607	efghi
		70 DFS	0.680	bcdefg	0.757	abc
		50 & 70 DFS	0.763	abc	0.753	abc
	60 kg N/fed	50 DFS	0.630	defghi	0.700	bcdefg
		70 DFS	0.763	abc	0.727	abcd
		50 & 70 DFS	0.760	abc	0.710	abcdef
Strain 620/3/5	30 kg N/fed	50 DFS	0.380	qrs	0.433	mn
		70 DFS	0.463	lmnopqrs	0.553	hijkl
		50 & 70 DFS	0.560	ghijklm	0.583	hi
	45 kg N/fed	50 DFS	0.757	abc	0.703	bcdef
		70 DFS	0.730	abcd	0.660	cdefgh
		50 & 70 DFS	0.770	ab	0.713	abcde
	60 kg N/fed	50 DFS	0.677	bcdefg	0.710	abcdef
		70 DFS	0.770	ab	0.800	ab
		50 & 70 DFS	0.810	a	0.811	a

Means followed by the same letter within columns are not significantly different at $P < 0.05$ using Duncan`s multiple range test.

Table 7: Fiber yield per feddan of flax as affected by the interaction among genotype, nitrogen fertilizer level and time of foliar spraying with potassium during 2013/2014 and 2014/2015 seasons

Treatment			Fiber yield (kg/fed.)			
			2013/2014		2014/2015	
Sakha 1	30 kg N/fed	50 DFS	524.7	mnop	514.7	nopq
		70 DFS	596.8	defghij	583.5	ijkl
		50 & 70 DFS	592.7	efghijk	607.0	ghij
	45 kg N/fed	50 DFS	563.6	hijklmno	620.5	defghij
		70 DFS	616.7	bcdefgh	611.1	fghij
		50 & 70 DFS	585.8	fghijklm	650.4	abcdef
	60 kg N/fed	50 DFS	596.1	defghij	618.0	efghij
		70 DFS	598.0	cdefghij	661.1	abcd
		50 & 70 DFS	583.6	fghijklm	664.9	abc
Strain 402/1	30 kg N/fed	50 DFS	541.3	jklmnop	541.5	mno
		70 DFS	508.6	opq	579.5	jklm
		50 & 70 DFS	502.0	opq	593.9	hij
	45 kg N/fed	50 DFS	573.9	ghijklmn	604.3	hij
		70 DFS	547.7	ijklmnop	603.2	hij
		50 & 70 DFS	588.9	fghijkl	646.9	abcdefg
	60 kg N/fed	50 DFS	631.4	bcdefg	665.8	abc
		70 DFS	581.3	fghijklm	656.4	abcde
		50 & 70 DFS	619.5	bcdefgh	661.3	abcd
Sakha 5	30 kg N/fed	50 DFS	380.8	t	416.7	stu
		70 DFS	416.2	st	454.9	rs
		50 & 70 DFS	389.5	t	446.0	st
	45 kg N/fed	50 DFS	430.5	rst	401.1	u
		70 DFS	413.5	st	430.4	stu
		50 & 70 DFS	493.7	pq	486.7	qr
	60 kg N/fed	50 DFS	503.7	opq	499.6	pq
		70 DFS	528.7	lmnop	513.9	nopq
		50 & 70 DFS	516.3	nopq	531.6	nop
Strain 541/G/1	30 kg N/fed	50 DFS	403.0	st	410.9	tu
		70 DFS	460.3	qrs	421.5	stu
		50 & 70 DFS	459.5	qrs	452.5	rs
	45 kg N/fed	50 DFS	405.9	st	455.2	rs
		70 DFS	503.7	opq	486.5	qr
		50 & 70 DFS	515.4	nopq	501.7	opq
	60 kg N/fed	50 DFS	506.3	opq	534.7	nop
		70 DFS	484.6	pqr	553.1	klmn
		50 & 70 DFS	523.1	mnop	549.5	lmn
Sakha 3	30 kg N/fed	50 DFS	488.8	pq	501.2	opq
		70 DFS	572.3	ghijklmn	541.5	mno
		50 & 70 DFS	571.9	ghijklmn	595.0	hij
	45 kg N/fed	50 DFS	583.8	fghijklm	646.9	abcdefg
		70 DFS	633.7	bcdefg	648.0	abcdefg
		50 & 70 DFS	660.0	abc	633.5	bcdefgh
	60 kg N/fed	50 DFS	658.1	abcd	671.3	ab
		70 DFS	625.3	bcdefgh	660.1	abcde
		50 & 70 DFS	653.4	abcde	648.8	abcdef
Strain 620/3/5	30 kg N/fed	50 DFS	531.5	klmnop	531.3	nop
		70 DFS	509.0	opq	533.3	nop
		50 & 70 DFS	607.7	bcdefghi	589.6	ijk
	45 kg N/fed	50 DFS	668.9	ab	624.8	cdefghi
		70 DFS	667.5	ab	650.3	abcdef
		50 & 70 DFS	643.9	abcdef	619.4	defghij
	60 kg N/fed	50 DFS	655.9	abcd	669.8	ab
		70 DFS	662.2	ab	679.9	a
		50 & 70 DFS	701.3	a	689.0	a

Means followed by the same letter within columns are not significantly different at $P < 0.05$ using Duncan`s multiple range test.

Table 8: Seed yield per plant of flax as affected by the interaction among genotype, nitrogen fertilizer level and time of foliar spraying with potassium during 2013/2014 and 2014/2015 seasons

Treatment			Seed yield (g/plant)			
			2013/2014		2014/2015	
Sakha 1	30 kg N/fed	50 DFS	0.247	st	0.273	st
		70 DFS	0.297	pqrst	0.267	pqrst
		50 & 70 DFS	0.340	nopqr	0.370	nopqr
	45 kg N/fed	50 DFS	0.420	jklmn	0.410	jklmn
		70 DFS	0.397	klmno	0.433	klmno
		50 & 70 DFS	0.470	ijk	0.503	ijk
	60 kg N/fed	50 DFS	0.500	ghij	0.490	ghij
		70 DFS	0.560	defgh	0.553	defgh
		50 & 70 DFS	0.657	abc	0.587	abc
Strain 402/1	30 kg N/fed	50 DFS	0.307	pqrst	0.260	pqrst
		70 DFS	0.350	mnopq	0.323	mnopq
		50 & 70 DFS	0.367	mnop	0.420	mnop
	45 kg N/fed	50 DFS	0.433	jklm	0.430	jklm
		70 DFS	0.423	jklmn	0.420	jklmn
		50 & 70 DFS	0.573	cdefg	0.503	cdefg
	60 kg N/fed	50 DFS	0.640	abcd	0.627	abcd
		70 DFS	0.617	bcde	0.600	bcde
		50 & 70 DFS	0.703	a	0.643	a
Sakha 5	30 kg N/fed	50 DFS	0.330	opqrs	0.273	opqrs
		70 DFS	0.350	mnopq	0.340	mnopq
		50 & 70 DFS	0.397	klmno	0.413	klmno
	45 kg N/fed	50 DFS	0.500	ghij	0.503	ghij
		70 DFS	0.523	fghi	0.533	fghi
		50 & 70 DFS	0.700	a	0.647	a
	60 kg N/fed	50 DFS	0.717	a	0.660	a
		70 DFS	0.720	a	0.680	a
		50 & 70 DFS	0.723	a	0.693	a
Strain 541/G/1	30 kg N/fed	50 DFS	0.340	nopqr	0.280	nopqr
		70 DFS	0.357	mnop	0.327	mnop
		50 & 70 DFS	0.423	jklmn	0.410	jklmn
	45 kg N/fed	50 DFS	0.457	ijkl	0.443	ijkl
		70 DFS	0.437	jklm	0.463	jklm
		50 & 70 DFS	0.573	cdefg	0.547	cdefg
	60 kg N/fed	50 DFS	0.540	efghi	0.597	efghi
		70 DFS	0.650	abc	0.640	abc
		50 & 70 DFS	0.670	ab	0.697	ab
Sakha 3	30 kg N/fed	50 DFS	0.227	t	0.253	t
		70 DFS	0.247	st	0.257	st
		50 & 70 DFS	0.303	pqrst	0.347	pqrst
	45 kg N/fed	50 DFS	0.340	nopqr	0.413	nopqr
		70 DFS	0.373	lmnop	0.413	lmnop
		50 & 70 DFS	0.473	ijk	0.473	ijk
	60 kg N/fed	50 DFS	0.477	hijk	0.497	hijk
		70 DFS	0.460	ijkl	0.547	ijkl
		50 & 70 DFS	0.573	cdefg	0.600	cdefg
Strain 620/3/5	30 kg N/fed	50 DFS	0.257	rst	0.220	rst
		70 DFS	0.270	qrst	0.270	qrst
		50 & 70 DFS	0.373	lmnop	0.340	lmnop
	45 kg N/fed	50 DFS	0.417	jklmno	0.373	jklmno
		70 DFS	0.403	klmno	0.380	klmno
		50 & 70 DFS	0.477	hijk	0.437	hijk
	60 kg N/fed	50 DFS	0.480	hijk	0.463	hijk
		70 DFS	0.587	bcdef	0.433	bcdef
		50 & 70 DFS	0.613	bcde	0.553	bcde

Means followed by the same letter within columns are not significantly different at $P < 0.05$ using Duncan`s multiple range test.

Table 9: Seed yield per feddan of flax as affected by the interaction among genotype, nitrogen fertilizer level and time of foliar spraying with potassium during 2013/2014 and 2014/2015 seasons

Treatment			**Seed yield (kg/fed.)**	
			2013/2014	2014/2015
Sakha 1	30 kg N/fed	50 DFS	633.7 hij	649.2 f
		70 DFS	652.0 ghi	651.5 f
		50 & 70 DFS	668.5 fg	666.7 f
	45 kg N/fed	50 DFS	682.7 efg	692.2 e
		70 DFS	693.0 ef	710.3 de
		50 & 70 DFS	714.2 cde	732.4 bc
	60 kg N/fed	50 DFS	739.2 bc	728.5 cd
		70 DFS	734.8 bcd	711.7 de
		50 & 70 DFS	612.2 jk	596.1 hi
Strain 402/1	30 kg N/fed	50 DFS	574.4 lm	545.4 j
		70 DFS	610.3 jk	579.9 i
		50 & 70 DFS	635.9 hij	595.1 hi
	45 kg N/fed	50 DFS	671.1 fg	605.7 h
		70 DFS	659.5 gh	627.6 g
		50 & 70 DFS	705.9 de	692.7 e
	60 kg N/fed	50 DFS	704.1 de	698.5 e
		70 DFS	600.2 kl	707.8 e
		50 & 70 DFS	760.6 ab	748.2 ab
Sakha 5	30 kg N/fed	50 DFS	489.6 pqrs	394.2 xy
		70 DFS	442.6 uvw	404.1 wx
		50 & 70 DFS	494.4 opqr	434.3 tu
	45 kg N/fed	50 DFS	500.5 opqr	454.5 qrs
		70 DFS	524.4 no	473.1 opq
		50 & 70 DFS	549.2 mn	501.4 lmn
	60 kg N/fed	50 DFS	556.7 m	541.1 j
		70 DFS	749.8 ab	587.4 hi
		50 & 70 DFS	779.3 a	763.2 a
Strain 541/G/1	30 kg N/fed	50 DFS	456.6 stu	394.2 xy
		70 DFS	474.3 qrstu	394.9 xy
		50 & 70 DFS	490.6 pqr	422.0 uvw
	45 kg N/fed	50 DFS	496.4 opqr	435.0 stu
		70 DFS	509.7 op	440.4 rstu
		50 & 70 DFS	551.8 mn	472.8 opq
	60 kg N/fed	50 DFS	578.8 lm	474.6 op
		70 DFS	622.6 ijk	495.5 mn
		50 & 70 DFS	654.4 gh	517.7 kl
Sakha 3	30 kg N/fed	50 DFS	401.9 xy	406.7 vwx
		70 DFS	412.2 wxy	424.7 tuv
		50 & 70 DFS	418.1 wx	442.5 rst
	45 kg N/fed	50 DFS	440.8 uvw	398.8 xy
		70 DFS	419.7 vwx	465.8 opq
		50 & 70 DFS	467.3 rstu	475.9 op
	60 kg N/fed	50 DFS	467.6 rstu	483.4 no
		70 DFS	473.9 qrstu	513.8 lm
		50 & 70 DFS	502.3 opq	534.3 jk
Strain 620/3/5	30 kg N/fed	50 DFS	386.0 y	344.2 z
		70 DFS	393.7 xy	348.5 z
		50 & 70 DFS	420.7 vwx	382.3 y
	45 kg N/fed	50 DFS	441.3 uvw	393.9 xy
		70 DFS	451.4 tuv	398.7 xy
		50 & 70 DFS	472.2 qrstu	426.2 tu
	60 kg N/fed	50 DFS	467.7 rstu	439.7 rstu
		70 DFS	478.4 pqrst	441.6 rstu
		50 & 70 DFS	494.5 opqr	459.0 pqr

Means followed by the same letter within columns are not significantly different at $P < 0.05$ using Duncan`s multiple range test.

تأثير مستويات السماد النيتروجينى وأوقات الرش الورقي بالبوتاسيوم على المحصول ومكوناته لبعض التراكيب الوراثية للكتان

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أجريت هذه الدراسة في المزرعة البحثية بكلية الزراعة، جامعة كفر الشيخ، مصر، خلال موسمى2014/2013 و2015/2014 لدراسة تأثير مستويات السماد النيتروجينى (30 ، 45 و60 كجم نيتروجين / فدان) وأوقات الرش الورقي بالبوتاسيوم (مرة واحدة بعد 50 و بعد 70 يوماً من الزراعة ومرتين بعد 50 و70 يوماً من الزراعة) على النمو والمحصول ومكوناته لبعض التراكيب الوراثية للكتان (سخا 1 ، السلالة 402/1 ، سخا 5 ، السلالة 541/C/1 ، سخا 3 والسلالة 620/3/5). وقد أجريت التجربة في تصميم القطع المنشقة مرتين فى أربع مكررات. حيث تم تخصيص القطع الرئيسية للتراكيب الوراثية للكتان. بينما تم تخصيص القطع الشقية لمستويات السماد النيتروجينى. في حين تم تخصيص القطع تحت الشقية لأوقات الرش الورقي بالبوتاسيوم. ويمكن تلخيص أهم النتائج المتحصل عليها كما يلي:

- أظهرت نتائج هذه الدراسة أن الصنف سخا 1 أنتج أعلى القيم لصفات قطر الساق عند الحصاد ووزن 1000 بذرة في كلا الموسمين. بينما تفوقت السلالة 1/402 على التراكيب الوراثية الأخرى تحت الدراسة وأنتجت أعلى القيم لصفات المحصول البذور للنبات في الموسم الثانى فقط. أما سخا 5 فقد أنتجت أعلى القيم لصفات طول المنطقة الثمرية ، عدد الكبسولات / نبات ، عدد البذور / كبسولة ، عدد البذور / نبات، محصول البذور للنبات (في الموسم الأول فقط)، محصول البذور للفدان في كلا الموسمين. في حين أن الصنف سخا 3 قد أعطى أعلى القيم لصفات الارتفاع الكلى للنبات ، الطول الفعال ، محصول القش / نبات (في الموسم الأول) ومحصول القش / فدان في كلا الموسمين. بينما السلالة 5/3/620 قد أنتجت أعلى القيم لصفات محصول القش / نبات (في الموسم الثاني) ومحصول الألياف للنبات والفدان خلال موسمى الزراعة.
- تشير النتائج المتحصل عليها أن أعلى القيم لجميع الصفات المدروسة تم الحصول عليها من تسميد نبات الكتان بـ 60 كجم نيتروجين / فدان في كلا الموسمين. على العكس من ذلك، تم الحصول على أدنى القيم لجميع الصفات تحت الدراسة من تسميد نباتات الكتان بـ 30 كجم نيتروجين / فدان فى كلا الموسمين.
- أدى الرش الورقي لنباتات الكتان مرتين بالسماد البوتاسى بعد 50 و 70 يوماً من الزراعة إلى تفوق معنوى على أوقات الرش الورقى الأخرى والحصول على أعلى القيم لجميع الصفات الدروسة في كلا الموسمين. وأعقب هذه المعاملة الرش الورقي بالسماد البوتاسي مرة واحدة بعد 70 يوماً ثم الرش الورقي بالبوتاسيوم مرة واحدة بعد 50 يوماً من الزراعة في كلا الموسمين.

من النتائج المتحصل عليها من هذه الدراسة، يمكن أن نستنتج أنه بتسميد الكتان صنف سخا 3 ، السلالة 620/3/5 والصنف سخا 5 بـ 60 كجم نيتروجين / فدان والرش الورقي مرتين بالسماد البوتاسيوم بعد 50 و 70 يوما من الزراعة يمكن التوصية بها للحصول على أقصى محصول قش وألياف وبذور وذلك تحت نفس الظروف لهذا.