EFFECT OF SOME GROWTH REGULATORS AND NITROGEN LEVELS ON FLAX YIELD AND ITS QUALITY

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ABSTRACT

The present investigation was carried out at Sakha Agric. Research Station Farm during the two successive seasons of 2002/2003 and 2003/2004 to study the effect of two nitrogen levels (35 and 70 kg N/fad) and some growth regulators i.e. GA_3 at 20, 40 and 80 ppm and IAA and NAA at 10, 20 and 40 ppm of each one compared with the check treatment on yield and its components and quality of flax plants (Sakha 1 cv.). This study was laid out in a split plot design with four replications. The obtained results could be summarized as follows:

The application of 35 kg N/fad significantly increased stem diameter, fiber yield per plant as well as per fad.. fineness and strength of fibers, seed oil content in both seasons and seed ash content in the first season. Increasing nitrogen levels from 35 up to 70 kg N/fad. significantly increased seed index in the second season, seed yield/fad. In the first season, protein content and crude fiber in both seasons of the study and total carbohydrate in the first season.

The concentration of GA_3 of 20 ppm gave the highest seed protein content. Application of GA_3 at 40 ppm increased significantly straw and seed yields per fad., fineness and tenacity fibers. While, the high level of GA3 (80 ppm) increased significantly stem diameter, straw with capsule yield/fad., fiber yield per plant and per fad., fiber percentage and fiber length in both seasons. Spraying with IAA at 10 ppm increased significantly seed index, seed protein content. While, the same rate (10 ppm) from NAA gave the highest value for number of seed/plant in the first season. Application of NAA at 40 ppm significantly increased fruiting zone length and straw with capsule yield/fad..

The interactions were significant for the following characters technical length, stem diameter, straw with capsules yield / fad., fruiting zone length , number of seeds/ plant and seed yield / fad. in the frist season of study . while the characters of the straw yield, fiber yield per plant and faddan, percentage, length, fineness, strength of fibers and seed index were significant in both seasons.
Keywords: Flax, linseed, *Linum usitatissmum* L., nitrogen levels, growth regulators.

INTRODUCTION

Flax (*Linum usitatissmum,* L.) is one of the most important sources of fiber and seed oil. It plays an effective role in the national economy due to its effect on the local industry and it may contribute in increasing exports. But, it is difficult to increase the cultivated area of flax as this well be in the account of the other important winter crops i.e., wheat, sugar beet and clover. Increasing the flax yield and improving its fiber and seed quality could be achieved through the agricultural treatments and over-come such shortage in flax production. The most important practices in this respect is the determination of the optimum level of nitrogen in relation to combination with the suitable plant growth regulators and its optimum level. These compounds play an important role in modern agriculture and used to increase the yield and improve quality.

Several workers investigated the effect of nitrogen fertilization on flax yield and its attributes and reported a positive response of flax plant to nitrogen fertilizer levels. Under Egyptian conditions, Fayed (1992) and Abo-Shetaia *et al.* (1996) reported that the highest values of straw, fiber and seed yields per fad. and its components were obtained by adding 75 kg N/fad. while, oil percentage was adversely affected by increasing nitrogen levels. El-Kady *et al.* (1995) and El-Gazzar (2000) found that increasing nitrogen level up to 60 kg N/fad. led to significantly increase of all the studied parameters and its components. Kineber *et al.* (1997)

and Mostafa *et al.* (2003) recorded that, increasing nitrogen level from 20 up to 50 or 60 kg N/fad. significantly increased straw, fiber, seed and oil yields/fad. and its components. El-Gazzar and Abou-Zaied (2001) and El-Gazzar and Kineber (2002) stated that, increasing N level from 30 or 40 up to 70 or 75 kg N/fad. significantly increased fiber yield per plant, per fad. and fiber quality and it increased straw with capsules yield/fad., seed yield/fad. and its related characters.

Abo-El-Saod *et al.* (1975) reported that applying 50 ppm GA_3 and/or 3 rates of $ZnSO_4$ as foliar sprays increased plant height and number of basal branches/plant, applying 500 ppm Zn SO_4 + GA_3 gave the highest yields of seed and straw and highest fiber quality, seed oil percentage and long fiber was highest with 100 ppm Zn SO_4 + GA_3. Shaaban *et al.* (1982) and Guleria and Singh (1983) found that spraying with GA_3 at 25 ppm concentration increased fiber fineness. While, 50 ppm concentration increased plant height, leaf dry weight/plant, seed yield and its components, on the other hand, 100 ppm concentration gave higher fiber tenacity with lower cellulose content and coarser fiber than treatments without GA_3. Osman and Abu-Lila (1985) stated that GA_3 and Cycocel at 25, 50 and 100 ppm show clear increase in plant height and decrease in both number of fruiting branches and number of capsules with GA_3, while Cycocel show clear trend of decreasing plant height, number of branches and capsules. GA_3 (at 25 and 50 ppm) slightly increased oil content and affected the fatty acid composition of linseed oil. El-Shourbagy *et al.* (1990), El-Shourbagy *et al.* (1995) and El-Kady *et al.* (1997) concluded that. GA_3 and IAA applied to flax could significantly increase straw. fiber, seed and oil yields/fad. and its components. Fayed (1992) reported that, Ethephon application significantly decreased plant height, but it increased each of number of basal branches/plant, capsules number/plant. seeds number/capsule, 1000-seed weight/plant as well as straw and fiber yield/fad. and oil percentage. Wang *et al.* (1994) concluded that (Auxin Dongnong-1) could increase flax yield and improve fiber quality. El-Azzouni (2003) and Hanafy *et al.* (2004) reported that using GA_3 as a foliar application at the rate of 100 ppm significantly increased straw. fiber, oil and seed yields/fad. and its related characters.

Therefore, the main objective of this investigation was to study the effect of nitrogen levels and growth regulators on yield and quality of flax.

MATERIALS AND METHODS

Two field trials were carried out at the Experimental Farm of the Agriculture Research Station, Sakha at Kafr El-Sheikh Governorate, Egypt, during the two successive seasons (2002/2003 and 2003/2004). Split plot design was used with four replicates. The main plots were assigned to two rates of nitrogen (35 and 70 kg/fad.) and the sub-plots were assigned to 10 treatments of growth regulators distributed at random with the sub plots i.e. GA_3 (Gibberellic acid) at 20, 40 and 80 ppm, IAA (Indole-3-acetic acid) at 10, 20 and 40 ppm and NAA (Nephthalen acetic acid) at 10, 20 and 40 ppm in addition to the check treatment. The plot area was $6m^2$ (1.5. x 4 m) and the previous crop was maize (*Zea mays*, L.) in both seasons. Sakha 1 flax cultivar was planted in 8 and 10 November in the first and second seasons, respectively by using drill machine at the rate of 60 kg/fad. in rows 15 cm apart. The soil of the experimental fields was clay in texture.
The chemical analysis of the experimental soil was given in Table (1).

Table (1): Some chemical properties of the experimental soil fields in the two growing seasons (2002/2003 and 2003/204).

Variable	Season	
	2002/2003	2003/2004
pH	8.10	8.00
Organic matter%	1.80	1.71
Available N ppm	33.60	33.11
Available P ppm	7.40	7.10
Available K ppm	503.00	508.00

Phosphorus fertilizer was applied in the form of super phosphate at a rate of 15 kg (P_2O_5)/fad. during land preparation.

Nitrogen fertilizer as urea (46.5% N) was added in two equal doses (after 30 and 55 days from planting). The growth regulators treatments were applied twice as foliar spray at 45 and 60 days from sowing. Tween 20 was used as a wetting agent at the concentration of 0.5%. Check treatment was sprayed with water containing only the wetting agent. The other agricultural practices were carried out as recommended by the Ministry of Agriculture and land Reclamation. At harvesting time, 10 individual plants were randomly taken from each plot to determine plant characters. Straw, fiber and seed yields per plot were determined and calculated per faddan. Fiber fineness (N.m) and fiber strength (R.K.M.) were determined according to the method described by Radwan and Momtaz (1966).Randomly seed samples were taken from each plot and grounded to fine powder (pass through 2 mm sieve) for chemical analysis; i.e. moisture content, oil %, protein %, ash % and crude fiber according to procedures out line by A.O.A.C. (1990). Total carbohydrate was calculated by difference.

Data collected included:

1. Straw yield and its related characters:

a: Technical stem length (cm) b: Stem diameter (mm)
c: Straw yield/plant (g) d: Straw yield/fad. (ton)
e: Straw with capsules yield/fad

2. Fiber yield and its related characters:

a: Fiber yield/plant (g) b: Fiber yield/fad. (kg)
c: Fiber percentage d: Fiber length (cm)
e: Fiber fineness (N.m) f: Fiber strength (R.K.M.)

3. Seed yield and its related characters:

a: Fruiting zone length (cm) b: Number of capsules/plant
c: Number of seeds/capsules d: Number of seeds/plant
e: Seed index (g/1000 seed) f: Seed yield (g/plant)
g: Seed yield (kg/fad)

4. Gross chemical composition of flax seed

a: Moisture content
b: Oil content
c: Protein content
d: Ash content
e: Crude fiber
f: Total carbohydrate

All data were subjected to the analysis of variance according to the procedures outlined by Snedecor and Cochran (1967). The mean value of treatments were compared according to Duncan Multiple Range Test (Duncan, 1955). All statistical analysis were performed using analysis of variance technique by means of MSTATC computer software package.

RESULTS AND DISCUSSION

1. Straw yield and its related characters:

Data presented in Table (2) clearly show that straw yield and its components were not significantly affected by nitrogen levels except for stem diameter in the first season. In general, 35 kg N/fad. gave the highest stem diameter value. On the other hand, adding 70 kg N/fad. gave the highest values for technical length in the first season, straw yield/plant as well as per fad. and straw with capsules yield/fad. But, the differences did not reach the level 5% level of significance in both seasons. This may be due to that the experimental soils had 33.6 and 33.11 ppm available N which is equal to 33.0 kg N/fad. (Table 1). The amount added as the first N-level (35 kg N/fad.) it becomes enough for the recommended N-dose for flax growth and high yields. These results are in acceptance with those obtained by Fayed (1992), El-Gazzar and Kineber (2002) and Mostafa *et al.* (2003). Growth regulators significantly increased stem diameter and straw with capsules yield/fad. in the first season and straw yield/fad in both seasons. The highest means of stem diameter and straw with capsules yield/fad. were found by using 80 ppm GA_3 and 40 ppm NAA. Spraying with GA_3 at 40 ppm gave the highest values of straw yield/fad. in both seasons. But, the differences in the second season did not reach the 5% level of significance. It could be concluded that the stimulating effect of the growth regulators on growth of flax plants during the vegetative growth stages caused clear

Table (2): Straw yield and its related characters on flax as affected by N-levels, GA_3, IAA and NAA in 2002/2003 and 2003/2004 seasons.

Constituents	Season	Sig.	N-level kg/fad.		Sig.	Control	Growth regulators									Interactions
			35	70			GA3			IAA			NAA			
Technical length (cm)	2002/2003	NS	77.1	78.6	NS	75.4	75.2	81.7	78.3	77.2	76.7	79.6	78.8	74.9	80.9	*
	2003/2004	NS	84.6	83.9	NS	84.4	83.9	85.2	82.6	83.7	85.4	83.5	82.4	86.0	84.9	NS
Stem diameter (mm)	2002/2003	*	1.96a	1.88b	*	1.69b	1.73b	1.93ab	2.11a	2.02a	1.91ab	1.93ab	2.01a	1.82ab	2.03a	*
	2003/2004	NS	2.23	2.25	NS	2.29	2.31	2.24	2.33	2.21	2.22	2.27	2.11	2.25	2.20	NS
Straw yield/plant (g)	2002/2003	NS	0.98	1.06	NS	1.08	0.89	1.01	1.15	1.02	0.87	1.09	1.13	0.89	1.09	**
	2003/2004	NS	1.61	1.69	NS	1.67	1.61	1.60	1.46	1.77	1.80	1.55	1.67	1.60	1.70	*
Straw yield/fad (ton)	2002/2003	NS	2.88	2.95	*	2.800ab	2.990ab	3.200a	2.510c	2.950ab	2.750abc	2.790bc	2.860abc	3.110a	3.040ab	**
	2003/2004	NS	4.244	4.373	*	4.345bc	4.118bcd	4.587a	3.947cd	4.164bc	4.216bcd	4.337bc	4.365bc	4.538a	4.473ab	*
Straw with capsules yield (t/fed)	2002/2003	NS	4.530	4.670	*	4.370b	4.790a	4.620ab	4.830a	4.450b	4.240b	4.700a	4.480b	4.670ab	4.830a	*
	2003/2004	NS	6.620	6.666	NS	6.729	6.808	6.554	6.895	6.414	6.309	6.685	6.405	6.764	6.869	NS

*, ** and NS indicate $P<0.05$, $P<0.01$ and not significant, respectively.

Means followed by the same letter within rows are not significantly different at the 5% level using Duncan's Multiple Range test.

increases in plant height and dry matter accumulation and caused an increase in straw yield and fiber yield. These data are in agreement with the results obtained by Fayed (1992), El-Kady *et al.* (1997), El-Azzouni (2003) and Hanafy *et al.* (2004). This shows that N-fertilizer levels and growth regulators levels act dependently on the previous characters.

The interactions were significant for fruiting zone length and No. of seeds/plant in the first season and seed index and seed yield/fad. in both seasons. This shows that nitrogen fertilizer levels and growth regulators levels act dependent by on the previous characters.

2. Fiber yield and its related characters:

The results in Table (3) indicated that fiber yield per plant in the second season, fiber yield/fad., fiber fineness and fiber strength in both seasons of this study were significantly increased under the application of 35 kg N/fad. These results may be due to the experimental soil contain about 33 ppm available nitrogen which is equal to 33 kg N/fad. (Table 1). This caused the first level of nitrogen fertilizer (35 kg N/fad.) to complete the flax needs of nitrogen and the high nitrogen level (70 kg N/fad.) exceeded the plant needs and might led to high wood content compared to the suitable N-level and increasing N-level led to clear increase of lignin and bicteen than cellulose. These results are in agreement with those obtained by El-Gazzar and Abou-Zaied (2001), El-Gazzar and Kineber (2002) and Mostafa *et al.* (2003).

Growth regulators significantly increased fiber yield per plant and per fad., fiber percentage, fiber length, fiber fineness and fiber strength in both seasons. Generally, all the concentrations of GA_3, IAA and NAA in this study increased fiber yields and quality compared with the control treatment. The highest means of fiber yields per plant, per fad., fiber percentage and fiber length were obtained by using 80 ppm GA3 and 40 ppm IAA while fibers fineness and strength resulted from 40 ppm of GA_3. The trend of results similar to those of straw yields and its components and similar discussion could be cited. These results agree with those

Table (3): Fiber yield and its related characters on flax as affected by N-levels, GA_3, IAA and NAA in 2002/2003 and 2003/2004 seasons.

Constituents	Season	Sig.	N-level kg/fad.		Sig.	Control	Growth regulators									Interactions
			35	70			GA3			IAA			NAA			
Fiber yield (g/plant)	2002/2003	NS	0.23	0.20	*	0.20bc	0.22b	0.20bc	0.24a	0.20bc	0.22ab	0.23a	0.21b	0.20bc	0.23a	*
	2003/2004	*	0.25a	0.22b	*	0.22b	0.23b	0.23b	0.25a	0.22b	0.23b	0.24a	0.23b	0.24a	0.23b	*
Fiber yield (kg/fad.)	2002/2003	*	615.0a	590.0b	*	584.0d	597cd	610.0b	619.0a	595cd	601c	611.0b	598.0cd	602.1c	607.0bc	*
	2003/2004	*	645.0a	629.0b	**	630.4c	637.5b	637.3b	644.2a	634.0bc	640.0ab	637.8b	635.4bc	639.ab	637.0b	*
Fiber percentage	2002/2003	NS	20.9	19.6	*	19.0b	19.8b	20.9a	21.4a	19.5b	20.4ab	21.0a	19.9b	20.1ab	20.9a	*
	2003/2004	NS	19.1	18.5	*	17.6b	17.6b	18.9a	19.0a	18.0ab	18.5ab	18.9a	18.0ab	18.5ab	18.2ab	*
Fiber length (cm)	2002/2003	NS	81.2	80.7	*	80.0b	80.8ab	81.0ab	82.3a	79.9b	80.9ab	81.9a	80.0b	80.6ab	82.0	*
	2003/2004	NS	88.6	87.7	*	87.3b	87.7b	88.6ab	89.2a	87.8b	88.3ab	89.1a	87.0b	88.3ab	89.0a	*
Fiber fineness (M.m)	2002/2003	*	230.6a	225.7b	*	226.0b	228.2ab	229.3a	230.2c	228.ab	228.1ab	228.3ab	227.1b	228.2ab	229.0a	*
	2003/2004	*	240.0a	235.0b	*	236.0c	238.0ab	239.0a	238.0ab	236.9b	237.5b	238.6ab	237.0b	237.7b	238.0b	*
Fiber strength (R.K.M.)	2002/2003	*	28.3a	26.1b	*	26.0b	26.9ab	28.9a	27.4ab	26.4b	27.0ab	28.4a	27.0ab	27.2ab	27.4ab	*
	2003/2004	*	37.0a	35.0b	*	35.5b	35.7b	37.0a	36.0ab	35.7b	36.0ab	36.3ab	35.6b	36.0ab	36.4ab	*

*, ** and NS indicate $P<0.05$, $P<0.01$ and not significant, respectively.

Means followed by the same letter within rows are not significantly different at the 5% level using Duncan's Multiple Range test.

obtained by Abo-El-Saod *et al.* (1975); Guleria and Singh (1983); El-Kady *et al.* (1997); El-Azzouni (2003) and Hanafy *et al.* (2004). The interaction effect was significant for fiber yield and its related characters in both seasons.

3. Seed yield and its related characters:

Data in Table (4) showed that the increase of nitrogen levels from 30 to 70 kg N/fad. increased seed yield per plant and per fad. and its related characters. Such increases did not reach the level of significance in both seasons except for seed index in the second season and seed yield/fad. in the first season. Such conclusion is in harmony with that reported by Abo-Shetaia *et al.* (1996); El-Gazzar and Abou-Zaied (2001) and El-Gazzar and Kineber (2002).

Growth regulators significantly increased fruiting zone length and number of seeds/plant in first season and seed index and seed yield/fad. in both seasons. The highest means of fruiting zone length were found by using 40 ppm NAA and 80 ppm GA_3. Spraying with NAA at 10 ppm, 40 ppm, IAA at 40 ppm and GA_3 at 80 ppm gave the highest values of No. of seeds/plant.

The highest means of seed index of (9.98 and 9.96 g/100 seed) were found by using 10 ppm IAA while, the highest seed yield/fad. of (614.4 and 948 kg/fad) resulted from 40 ppm GA_3 in both seasons. The effect of GA_3, IAA and NAA concentrations on increasing seed yield and its related characters was reported by Abo-El-Saod *et al.* (1975), El-Kady *et al.* (1997), El-Azzouni (2003) and Hanafy *et al.* (2004).

The interactions were significant for fruiting zone length and No. of seeds/plant in first season and seed index and seed yield/fad. in both seasons.

4- Gross chemical composition of flax seed

Data presented in Table (5) show clearly that flax seed oil content in both seasons and ash content in the first season were significantly increased with adding 30 kg N/fad. The significant increase in protein content, crude fiber in both seasons and total

Table (4): Seed yield and its related characters on flax as affected by N-levels, GA_3, IAA and NAA in 2002/2003 and 2003/2004 seasons.

Constituents	Season	Sig.	N-level kg/fad.		Sig.	Control	Growth regulators									Interactions
			35	70			GA3			IAA			NAA			
Fruiting zone length (cm)	2002/2003	NS	9.5	9.7	**	10.5ab	9.2b	5.1c	11.1a	9.5b	9.6	9.4b	10.4ab	10.7ab	11:4a	**
	2003/2004	NS	11.9	12.3	NS	13.4	12.9	12.2	9.9	11.9	13.2	12.9	11.3	11.2	12.3	NS
Number of capsules/plant	2002/2003	NS	5.09	5.76	NS	5.55	4.86	5.30	5.62	4.56	4.91	6.02	6.15	5.02	5.25	NS
	2003/2004	NS	8.46	8.86	NS	8.05	8.62	9.39	8.35	9.70	10.31	7.44	7.75	7.93	9.06	NS
Number of seeds/capsule	2002/2003	NS	4.51	4.55	NS	4.48	4.39	4.69	4.95	4.61	4.16	4.70	4.65	4.33	4.31	NS
	2003/2004	NS	7.24	7.40	NS	7.15	7.30	7.25	7.34	7.57	7.19	7.29	7.50	7.38	4.62	NS
No. of seeds/plant	2002/2003	NS	23.3	26.8	*	26.9b	20.7c	26.4b	27.4a	21.6c	20,4c	27.5a	29.9a	21.7c	27.7a	**
	2003/2004	NS	45.3	45.6	NS	48.0	45.6	49.7	42.9	50.1	52.2	38.4	38.3	39.3	49.7	NS
Seed index (g/100 seed)	2002/2003	NS	9.47	9.53	*	8.73b	9.54c	9.61bc	9.76b	9.98a	9,58c-	9.55c	8.83ab	9.88ab	9.50c	*
	2003/2004	**	9.61b	9.91a	**	9.74bc	9.74bc	9.73bc	9.77bc	9.96a	9.69c	9.69c	9.66c	9.81b	9.76bc	**
Seed yield (g/plant)	2002/2003	NS	0.22	0.25	NS	0.23	0.20	0.30	0.24	0.21	0.20	0.27	0.24	0.21	0.26	NS
	2003/2004	NS	0.44	0.45	NS	0.46	0.47	0.49	0.40	0.49	0.51	0.39	0.39	0.41	0.48	NS
Seed yield (kg/fad)	2002/2003	*	504.5b	540.4a	**	484.6cd	491.4de	614.4a	511.9bcd	515.8bcd	533.2bcd	456.9e	551.7b	546.7bc	517.9bcd	**
	2003/2004	NS	866.1	900.9	**	764.2f	836.1d	948.0a	883.0c	913.b	910.9b	818.0c	925.7ab	893.2c	941.7a	NS

*, ** and NS indicate P<0.05, P<0.01 and not significant, respectively.

Means followed by the same letter within rows are not significantly different at the 5% level using Duncan's Multiple Range test.

Table (5): Gross chemical composition of flax seed as affected by N-levels, GA_3, IAA and NAA in 2002/2003 and 2003/2004 seasons (Percentage were calculated on dry matter weight basis).

Constituents	Season	Sig.	N-level kg/fad.		Sig.	Control	Growth regulators									Interactions
			35	70			GA3			IAA			NAA			
Moisture.	2002/2003	NS	5.33	5.19	NS	5.16	5.56	5.41	5.17	5.08	4.96	5.17	5.61	5.35	5.42	NS
	2003/2004	NS	5.52	5.55	NS	5.65	5.54	5.39	5.19	5.16	5.51	5.84	5.54	5.64	5.87	NS
Oil	2002/2003	*	42.41a	39.95b	NS	40.60	41.20	41.58	41.35	41.75	41.34	41.00	41.73	40.60	40.63	NS
	2003/2004	*	43.21a	40.63b	NS	41.80	41.32	42.69	42.11	42.05	42.16	42.08	42.14	42.06	41.33	NS
Protein	2002/2003	*	19.11b	20.56a	**	19.11c	20.77a	19.43b	19.54b	20.63a	19.79b	19.79b	19.45b	20.29a	19.66b	NS
	2003/2004	**	18.27b	21.01	**	19.10c	20.39a	19.54b	19.89ab	20.38a	19.47b	19.04c	19.99a	19.42b	19.17c	NS
Ash	2002/2003	*	4.07a	3.96b	NS	3.98	4.04	3.94	3.97	4.04	3.98	3.99	4.00	4.06	4.16	NS
	2003/2004	NS	4.04	4.06	NS	3.95	4.09	4.07	4.06	4.16	4.10	4.07	4.03	3.98	3.98	NS
Crude fiber	2002/2003	**	5.53b	6.30a	NS	6.01	5.75	6.06	5.73	5.64	5.71	5.90	6.00	6.22	6.03	NS
	2003/2004	*	5.37b	5.52a	NS	5.96	5.63	5.51	5.40	5.40	5.48	5.17	5.14	5.28	5.51	NS
Total carbohydrate	2002/2003	*	34.23b	35.49a	NS	35.96	34.09	35.05	35.14	33.58	34.89	35.56	34.08	35.73	35.44	NS
	2003/2004	NS	34.43	34.46	NS	35.05	34.14	33.77	33.95	33.58	34.11	34.30	33.80	34.60	35.51	NS

*, ** and NS indicate P<0.05, P<0.01 and not significant, respectively.

Means followed by the same letter within rows are not significantly different at the 5% level using Duncan's Multiple Range test.

carbohydrate in first season were ascertained by increasing nitrogen up to 70 kg N/fad. These results are in harmony with those of El-Gazzar and Abou-Zaied (2001) and El-Gazzar and Kineber (2002). Nitrogen occurs in amino acids, purine and pyrimidine bases which are essential for protein synthesis (Sadasivam and Manickam, 1991). A negative correlation was observed between the oil content and protein content in flax seed. These results are in agreement with those of Rai *et al.* (1990), Eman (2000) and El-Kady *et al.* (2001).

Foliar spraying with growth regulators levels significantly increased flax seed protein content compared with the control treatment. The low levels of GA3, IAA and NAA gave the higher percentage of seed protein content in both season (Table 5). Chu and Ho (1975) indicated that low concentration of IAA increased protein synthesis. The obtained results were confirmed by those of Popov and Ivanova (1966) and El-Beheery (1987).

The other seed contents (moisture, oil, ash, crude fiber and total carbohydrate) were not significantly affected by growth regulator treatments and the interaction between nitrogen fertilizer and the concentrations of GA_3, IAA and NAA (Table 5). These results are in agreement with those obtained by Shaaban *et al.* (1982).

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تأثير مستويات التسميد النتروجيني وبعض منظمات النمو على محصول وجودة الكتان

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أجريت تجربتان حقليتان بمزرعة محطة البحوث الزراعية بسخا خلال موسمي ٢٠٠٣/٢٠٠٢ و ٢٠٠٤/٢٠٠٣ وذلك لدراسة تأثير مستويين من السماد النتروجيني وهما ٣٥ و ٧٠ كجم ن/ف والرش ببعض منظمات النمو وهي حامض الجبريلليك بتركيزات ٢٠ ، ٤٠ و ٨٠ جزء في المليون وإندول حامض الخليك ونفثالين حامض الخليك بتركيزات ١٠ ، ٢٠ و ٤٠ جزء في المليون لكل منهما بالإضافة إلى معاملة المقارنة على محصول وجودة الكتان (صنف سخا ١).

أوضحت النتائج أن التسميد بمعدل ٣٥ كجم ن/ف أدى إلى زيادة معنوية في قطر الساق ، محصول الألياف للنبات والفدان ، نعومة الألياف ومتانتها ومحتوى البذور من الزيت في كلا موسمي الدراسة والرماد في

الموسم الأول فقط بينما التسميد بمعدل ٧٠ كجم ن/ف أدى إلى زيادة معنوية لوزن الألف بذرة فى الموسم الثانى ومحصول الفدان من البذرة ومحتوى البذور من البروتين والألياف الخام فى كلا موسمى الدراسة ومحتوى البذور من الكربوهيدرات فى الموسم الأول فقط.

وقد أدى الرش بحامض الجبريليك بتركيز ٢٠ جزء فى المليون إلى زيادة معنوية فى محتوى البزرة من البروتين وتركيز ٤٠ جزء فى المليون أدى إلى زيادة معنوية فى محصول الفدان من القش والبذرة ونعومة الألياف ومتانتها. وأدى الرش بـ ٨٠ جزء فى المليون من حامض الجبريليك إلى زيادة معنوية لكل من قطر الساق ومحصول النبات والفدان من الألياف ومحصول الفدان من القش بالكبسول وكذلك طول الألياف ونسبتها.

بينما أدى الرش بـ ١٠ جزء فى المليون من أندول حامض الخليك إلى زيادة معنوية لوزن الألف بذرة ومحتوى البذرة من البروتين . وأعطى الرش بنفثالين حامض الخليك بتركيز ١٠ جزء فى المليون زيادة فى عدد بذور النبات فى الموسم الأول وتركيز ٤٠ جزء فى المليون أدى إلى زيادة معنوية فى طول المنطقة الثمرية ومحصول الفدان من القش بالكبسول للفدان.

وكان التفاعل معنوياً فى الصفات التالية: الطول الفعال و قطر الساق ومحصول الفدان من القش بالكبسول والطول الثمرى وعدد بذور النبات ومحصول الفدان من البذرة وذلك فى الموسم الأول من الدراسة أما صفات محصول قش النبات والفدان ومحصول ألياف النبات والفدان والنسبة المئوية للألياف وطول ونعومة الألياف ومتانتها ووزن الألف بذرة فكانت معنوية فى الموسمين.