

## EFFECT OF PULLING DATE AND FOLIAR APPLICATION OF MICROELEMENTS AND GIBBERELIC ACID ON YIELD AND ITS COMPONENTS OF FLAX.

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### ABSTRACT

This investigation was carried out at pyramids land, Giza governorate during 1999/2000 and 2000/2001 seasons to study the response of sakha 2 flax variety to pulling date and foliar application of foliafeed including GA<sub>3</sub> and their effects on yield and yield components.

**The obtained results could be summarized as follows:**

1. Delayed harvesting date from 140 to 160 days after sowing significantly increased plant height, technical length, straw yield ton/fad., fruiting zone length, number of capsules per plant, number of seeds per capsules, seed yield / faddan, oil yield kg / fad, number of basal branches /plant, oil percentage, biological yield.
2. Foliafeed as microelements significantly increased straw and seed yield and its related characters comparison with control treatment. The highest straw and seed yield was obtained from harvesting date 160 days with foliafeed in the two seasons.
3. Gibberellic acid (GA<sub>3</sub>) as a growth regulator significantly increased straw and seed yield and its related characters in the two seasons. The highest straw and seed yield was obtained from harvesting date 160 days with GA<sub>3</sub> in the two seasons.
4. Remarkable reduction had shown in fiber yield/faddan and fiber percentage with foliafeed and GA<sub>3</sub> treatments as a foliar application compared with the control treatment.

### INTRODUCTION

At full maturity, flax plants characterize by fall down of the leaves from the bottom third part of the stems, yellowish capsules and the seeds turned brownish in color. After this stage great damage occurred in flax yield. Also before this stage the yield will be decreased when the harvesting date was early. Harvesting date were studied by many investigators to fine out the optimum stage (days from sowing) of harvesting date which gave the highest yield of fiber, seed and quality like El-Farouk *et al.* (1980), Samia and El-Farouk (1982), Mourad *et al.* (1990), El-deep (1958) and Mahdey (2002). They found that there are an increase in straw, fiber, seed yield and its related characters with advancement of flax plant towards maturity.

Growth regulators play an important role in regulating plant growth via nucleic acid and enzyme synthesis Overbeek (1966). GA<sub>3</sub> as a growth promoters at lower concentrations are capable of enhancing vegetative growth through increased meristematic activity due to enhanced cell division

and elongation, also it's regulate the growth of dormant buds Zaky (1985), Salisbury and Ross (1986), Abdel-Al *et al.* (1986), El-Hariri *et al.* (1996) and Bhattacharjee *et al.* (2000) found that there are an increase in growth, yield and yield components of straw and seed yield of flax and its related characters by using GA<sub>3</sub>. Micronutrients (foliafeed) play an important role in plant life. As a results of affecting many physiological processes in plant life and increasing mineral uptake by flax plants. In this respect, microelements effect on some enzymatic systems which lead to increased yield and yield components of flax. Several investigators confirmed these results like Abo-El-Saad *et al.* (1975), El-Shimy *et al.* (1986), El-Sayed and Abd-El-Hadi (1991), Kineber *et al.* (1998), El-Gazzar and El - Kady (2000) and El-Sweify *et al.* (2002).

The present work aims to study the effect of pulling date and foliar spray of microelements and gibberellic acid on yield and its components of flax variety sakha 2 as a recommended variety.

## MATERIALS AND METHODS

Two field experiments were performed during 1999/2000 and 2000/2001 seasons in pyramids location (Sobas land) which belongs to A.R.C., Giza governorate to study the effect of harvesting dates, microelements and gibberellic acid on yield and yield components of flax variety sakha 2. The treatments were arranged in complete randomize block design in four replications. Pulling date were 140, 150 and 160 days after sowing occupied the three parts of each block, where foliar application of microelements(foliafeed), gibberellic acid and without control were puten random in 9 plots of block. Each block has 9 treatments as a combination of three harvesting dates and two fertilizer resources with control. The plot area was 6 m<sup>2</sup> (2 x 3 m). Sowing date was 11<sup>th</sup> Novemper in the two seasons. Each plot consists of ten rows 3 meters long and 20 cm apart. At maturity, ten plants and six rows in each plot from the central area harvested to determine seed and straw yield/faddan, also to study yield components.

The soil of the experiment was clay in texture, values of pH, organic matter, total nitrogen %, EC (milimhos/cm at 25°C), Available Zn, Mn, Fe ppm and CaCo<sub>3</sub> % were 7.5, 2.31 %, 1.23%, 0.11, 0.7, 4.63, 5.80 and 1.7 %, respectively as a mean of two seasons of experiments. The stracher of foliafeed are presented in Table (1) and the concentrations of GA<sub>3</sub> and foliafeed were 100 ppm and 250 gm/faddan, respectively. They spray on flax at two times during growth period and before blooming stage (40 and 60 days after sowing).

The characters studied were as follows:

- 1- Plant height cm.
- 2- Technical length cm.
- 3- Straw yield ton/faddan.
- 4- Fiber yield g/plant.
- 5- Fiber yield kg/faddan.

- 6- Fruting zone length cm.
- 7- Number of capsules/plant.
- 8- Number of seed/capsules.
- 9- Seed yield kg/faddan.
- 10- Oil yield kg/faddan.
- 11- Number of basal branches/plant.
- 12- Fiber percentage.
- 13- Oil percentage
- 14- Biological yield ton/faddan.(Straw yield + seed yield / fad )

The straw of the sample taken at random from each plot was retted to obtained fiber. Other cultural practices were about as usual for the region. The newly flax variety sakha 2 was proceed from cross between import 2348X Hera.

#### Statistical analysis

All data were subjected to statistical analysis according to procedures "ANOVA" reported by Snedecor and Cochran (1982). Treatment means were compared by Duncan's multiple range tests (1955).

Table1: foliafeed contents

Compound		%
Fe	Chelate	3
Mn	"	5
Zn	"	7
Cu	"	0.5
Mg	"	0.5
B	"	0.5
Mo	"	0.02

## RESULTS AND DISCUSSION

### 1. Straw yield and its related characters

#### A. Harvesting dates :

Mean vabues of straw yield and its related characters for Sakha 2 as affected by harvesting dates ,GA3 and foliafeed in 1999/2000 and 2000/2001 seasons are presented in table (2).

Statistical analysis indicated that the three harvesting dates significantly differed in their effect on all the five traits studied in both seasons. There was a gradual increments in plant height technical length and straw yield/ faddan from the harvesting date at 140 days old towards the oldest flax plants when reached 160 days in the two successive seasons. The averages of plant height ranged from 102.166 to 109.644cm., technical length recorded 83.893 to 96.066 cm and straw yield / fad . ranged from 3.366 to 4.400 ton in the first season . While in the second one , the respective ranged were 108.089 to 117.067cm, 93.966 to100.233 cm. and 2.976 to 4.385 ton / fad for the three characters combined with the two harvesting dates previously mentioned ,

Table 2: Mean values of straw yield and its related characters for sakha2 flax variety as affected by harvesting dates, foliar application with GA3 and foliafeed in the two seasons 1999-2000 and 2000-2001.

Harvest dates	Treatments	Season (1999-2000)						Fiber yield g/plant		
		Plant height cm.	Technical length cm	Straw yield ton/fad.	Fiber yield kg/fad	Fiber yield g/plant	Fiber yield g/plant			
140 days	Spraying	96.817	f	77.067	g	2.261	e	374.060	a	0.453
	Control GA <sub>3</sub>	104.833	cd	85.516	ef	3.345	d	208.553	c	0.253
	Foliafeed	104.860	cd	89.073	de	4.492	bc	228.917	c	0.297
	Means	102.166		83.893		3.366		270.51		0.314
150 days	Control GA <sub>3</sub>	98.833	ef	83.400	f	2.779	de	353.723	b	0.373
	Foliafeed	107.600	bd	94.500	bc	4.098	c	169.447	c	0.167
	Means	109.917	ac	93.117	cd	4.528	ab	137.907	c	0.157
	Means	105.466		90.339		3.905		223.692		0.235
160 days	Control GA <sub>3</sub>	103.133	df	90.333	cd	2.829	de	499.523	a*	0.290
	Foliafeed	112.533	ab	98.133	ab	5.163	a*	172.690	c	0.130
	Means	113.287	a*	99.733	a*	5.390	a*	190.773	c	0.123
	Means	109.644		96.068		4.460		287.662		0.181
	General means	105.758		90.099		3.910		260.521		0.243
	F values	12.38**		23.27**		33.32**		19.34**		43.37**
Season 2000-2001										
140 days	Control GA <sub>3</sub>	99.933	d	88.067	f	2.030	d	525.857	a*	0.450
	Foliafeed	110.667	c	96.200	cd	3.395	c	305.610	b	0.230
	Means	113.667	bc	97.833	bd	3.500	c	212.813	bc	0.180
	Means	108.089		93.966		2.976		348.093		0.288
150 days	Control GA <sub>3</sub>	103.967	d	91.100	ef	2.197	d	329.680	b	0.393
	Foliafeed	115.183	bc	99.717	bc	3.731	bc	128.380	c	0.16
	Means	117.300	ab	100.800	b	4.214	b	138.723	c	0.147
	Means	112.150		97.205		3.380		198.594		0.233
160 days	Control GA <sub>3</sub>	111.267	c	94.933	de	3.102	c	300.070	b	0.290
	Foliafeed	118.267	ab	99.833	bc	4.385	b	133.547	c	0.140
	Means	121.667	a*	105.933	a*	5.670	a*	130.630	c	0.123
	Means	117.067		100.233		4.365		188.082		0.184
	General means	112.435		97.134		3.580		244.923		0.234
	F values	22.91**		15.36**		26.37**		13.39**		76.82**

\* Highest response values

respectively . Meanwhile , results showed that fiber yield / fad ranged from 270.51 to 287.66 kg in the first season . While in the second one the respective ranged were 348.09 to 188.08 kg. On the other hand opposite trend were obtained in fiber yield / plant and faddan characters. Generally delayed harvesting date increased most of these characters to an increase in metabolites synthesized by flax plants owing to prolonged growth period and increased dry matter accumulation of plant organs till it reached the full maturity. Similar results were obtained by El-Farouk *et al.* (1980), Mourad *et al.* (1990), El-Hariri *et al.* (1996), El-Sweify *et al.* (1996), El-deeb (1998) and Mahdy (2002).

#### **B- GA<sub>3</sub> as growth regulator and foliafeed :**

Using GA<sub>3</sub> as a foliar application (spray) on flax plant increased straw yield and its related characters significantly comparison with control treatment. There are opposite trend by using GA<sub>3</sub> on fiber yield per faddan and per plant. This result was confirmed in the second season. The increasing in all studied characters (straw, yield and its related characters) may be due to the role of GA<sub>3</sub> in delayed senescence, thus producing more photo pigments. Also it know to increase the flowering hormone and regulation of the cell division of the sub apical meristem and promote short growth also regulate the growth of dormant buds. GA<sub>3</sub> as a growth regulator caused a significant increase in mono-di and polysaccharides as compared to the control this effect is temporal. Similar results were obtained by Zaky (1985), Salisbury and Ross (1986), Abdel-Al *et al.*(1986); El-Hariri *et al.* (1996); and Bhattacharjee *et al.* (2000). Generally, foliar spray by foliafeed and GA<sub>3</sub> did not differ inside each of harvesting date in most of characters understanding, meanwhile foliafeed exceed GA<sub>3</sub> especially in plant height technical length and straw yield / fad in both seasons. Moreover, the differences between foliafeed and GA<sub>3</sub> effect concerning fiber yield / fad . and fiber yield / plant did not reached the level of significance in most cases.

#### **C- Foliafeed as microelements:**

The trend of foliafeed as a foliar application in these characters was similar with GA<sub>3</sub> and did not differed in each effect inside every harvesting date. This significant increase could be attributed to the important role of microelements in plant growth as a result of affecting many physiological processes in plant life and increasing mineral uptake by flax. In this respect Zinc play an important role in some enzymatic systems which lead to increased yield and yield components of straw and seed yield of flax and its related characters. The obtained results are in agreement with those obtained by Abo El-Saad *et al.* (1975), El-Shimy *et al.* (1986), El-Sayed and Abd El-Hadi (1991), Kineber *et al.* (1998), El-Gazzar and El Kady (2000), and El-Sweify *et al.* (2002).

#### **Highest response values**

The highest straw yield/fad., total plant height and technical length were obtained as a combination of harvesting date 160 days and foliafeed as

a foliar spray treatment in the two seasons. On the other hand the highest fiber yield kg/ fad was obtained without foliar spray at harvest date 160 days in the two seasons

## **II. Seed yield and its related characters:**

### **A- Harvesting date:**

Mean values of seed yield and its related characters of flax variety sakha 2 as affected by harvesting dates, GA<sub>3</sub> and foliafeed in 1999/2000 and 2000/2001 are presented in Table 3 Seed yield kg/fed means ranged from 338.799 (140 days) to 542.321 (160 days) in the first season and 302.693 (140 days) to 443.495 (160 days) in the second one. There was a significant effect for harvesting date on seed yield and its related characters in the two seasons. The mean values of all seed traits studied increased with increasing harvest date from the smallest age up to the oldest one in both seasons. These results are in agreement with those of Samia and El-Farouk (1982), Nimije and Gandhi . (1994), El-deeb (1998) and Mahdy (2002).

### **B- GA<sub>3</sub> as growth regulator ;**

Data in Table (3) indicated that GA<sub>3</sub> significantly affected in most of seed yield and its related characters in the two seasons comparison with control treatment.

Seed yield kg/a means ranged from 424.133 (140 days) to 619.787 (160 days) in the first season and 329.380 (140 days) to 496.067 (160 days) in the second one. There was a significant effect for GA<sub>3</sub> compared with control treatment on seed yield and its related characters in the two seasons. Similar results were obtained by El-Bastawesy *et al.* (1983), Bahia *et al.* (1995), El-Hariri *et al.* (1996) and Bhattacharjee *et al.* (2000).

### **C- Foliafeed:**

Foliafeed data in Table 3 had a significant effect on seed yield and its related characters comparison with control treatment in the two seasons. Seed yield kg/fad ranged from 342.707 (140 days) to 666.977 (160 days) in the first season and 424.00 (140 days) to 581.473 (160 days) in the second one. The increment in seed yield by using foliafeed spray may be due to the increased of number of capsules/plant, number of seeds/capsule, fruting zone length and number of basal branches. These results are comply with those obtained by Abou-Khadrah *et al.* (1982), Lu and Qu (1986), Abdel-Al *et al.* (1986), El-Sayed and Abd El-Hadi (1991), Mosatafa *et al.* (1998) and El\_Sweify *et al.* (2002).

### **Highest response values**

The highest seed yield/fad., oil yield kg, number of seeds/capsule (in the first season) and number of basal branches were obtained as a combination of harvesting date 160 days and foliafeed treatment in the two seasons. Meanwhile GA<sub>3</sub> with 160 days from sowing gave the heighest response values with fruting zone length (in the first season), number of capsules/plant (in the two seasons) number of seeds/capsoule and number of basii pranches (in the second season)

Table3: Mean values of seed yield and its related characters for sakha2 flax variety as affected by harvesting dates, foliar application with GA3 and foliafeed in the two seasons 1999-2000 and 2000-2001.

Harvest dates	Treatments	Season (1999-2000)					Season (2000-2001)						
		Fruiting zone length cm.	Number of capsules /plant	Number of seeds/capsule	Seed yield kg/fad.	Oil yield kg/fad.	Number of basal branches	Fruiting zone length cm.	Number of capsules /plant	Number of seeds/capsule	Seed yield kg/fad.	Oil yield kg/fad.	Number of basal branches
140 days	Control	10.283	13.067	5.300	249.557	90.354	1.083	12.667	19.467	7.250	424.133	165.943	1.933
	GA <sub>3</sub>	11.316	20.050	6.850	342.707	167.979	1.787	11.316	17.528	6.466	338.799	141.425	1.601
	Foliafeed	13.133	15.137	6.983	315.490	117.799	1.433	16.883	29.217	7.500	458.493	187.157	2.600
150 days	Control	16.043	24.850	7.533	500.977	196.734	2.267	15.353	23.068	7.005	424.958	167.230	2.100
	GA <sub>3</sub>	18.817	19.067	6.200	340.200	128.829	1.867	21.117	35.267	7.780	619.787	259.730	3.217
	Foliafeed	19.760	28.067	7.873	666.977	267.464	2.720	19.898	27.514	7.284	542.321	218.674	2.601
General means	Means	15.522	22.330	6.918	435.358	175.776	2.100	15.930	14.990*	22.08*	13.88*	44.01**	10.04
	F values												
140 days	Control	11.067	9.567	5.460	154.700	55.290	1.117	12.917	24.683	6.590	329.380	127.266	1.917
	GA <sub>3</sub>	13.667	19.800	6.467	424.00	159.822	1.527	13.667	18.016	6.172	302.693	114.126	1.527
	Foliafeed	14.867	17.150	5.763	218.311	80.532	1.550	15.717	22.833	7.100	466.267	186.645	2.433
150 days	Control	15.644	22.722	6.846	284.480	188.009	2.000	15.644	22.722	6.846	389	151.728	1.994
	GA <sub>3</sub>	17.400	19.700	6.333	252.947	94.596	1.983	18.800	29.400	8.233	496.067	202.250	2.767
	Foliafeed	19.167	24.667	7.313	581.473	230.302	2.533	18.455	24.589	7.293	443.495	175.716	2.427
160 days	Control	15.549	21.775	6.770	378.624	147.190	1.982	15.549	21.775	6.770	378.624	147.190	1.982
	GA <sub>3</sub>	14.44*	12.36**	17.04**	75.54*	80.21**	4.93*	14.44*	12.36**	17.04**	75.54*	80.21**	4.93*
	Foliafeed												
General means	Means												
	F values												

\* Highest response values

III. Technological and biological yield:

1. Fiber percentage:

Data in Table 4 showed that used GA<sub>3</sub> or Foliafeed as a foliar application decreased this character. Also delaying harvesting date from (140 days) to (160 days) took the same trend. Similar results were obtained by Feihu *et al.* (2000). He revealed that GA<sub>3</sub> application on ramie sometimes decreased fiber yield because of the side effects of excessive enlargement of leaf area and stem height.

Table 4: Mean values of technological and biological yield for sakha2 flax variety as affected by harvesting dates, foliar application with GA3 and foliafeed in the two seasons 1999-2000 and 2000-2001.

Season (1999-2000)							
Treatments		Fiber percentage %		Oil percentage %		Biological yield ton/fad.	
Harvest dates	Spraying			0			
140 days	Control	18.033	a*	36.200	G	2.897	e
	GA <sub>3</sub>	6.097	d	39.133	D	.724	c
	Foliafeed	4.870	de	38.200	E	5.600	c
Means		9.666		37.844		4.740	
150 days	Control	15.567	b	37.200	F	4.014	d
	GA <sub>3</sub>	4.007	ef	40.833	B	6.523	b
	Foliafeed	3.293	ef	39.267	D	6.633	ab
Means		7.622		39.100		5.723	
160 days	Control	11.743	c	37.900	E	5.170	c
	GA <sub>3</sub>	3.207	ef	41.900	a*	7.21	a*
	Foliafeed	2.350	f	40.100	c	7.124	ab
Means		5.768		39.966		6.501	
General means		7.684		38.970		5.654	
F values		120.47**		38.970**		5.654**	
Season (2000-2001)							
140 days	Control	18.620	a*	35.733	f	2.450	d
	GA <sub>3</sub>	6.903	d	38.633	c	4.393	c
	Foliafeed	4.137	e	37.700	d	4.867	bc
Means		9.886		37.355		3.903	
150 days	Control	15.367	b	36.867	e	3.010	d
	GA <sub>3</sub>	3.547	e	40.033	b	4.970	bc
	Foliafeed	3.293	e	38.800	c	5.340	ab
Means		7.402		38.566		4.440	
160 days	Control	12.530	c	37.400	de	4.303	c
	GA <sub>3</sub>	2.693	e	41.100	a*	6.030	a*
	Foliafeed	2.193	e	39.600	b	5.933	a*
Means		5.805		39.366		5.422	
General means		7.697		38.429		4.588	
F values		61.79**		72.103**		27.12**	

\* Highest response values



## 2. Oil percentage and Biological yield :

The results in oil percentage character in Table 4 shown a significant effect by delaying harvesting date from (140 days) to (160 days) in the two seasons. Its mean ranged from 37.84% (140 days) to 39.97 % (160 days) in the first season and 37.36% (140 days) to 39.37% (160 days) in the second one. Similar trend were obtained by added GA<sub>3</sub> and foliafeed as a foliar application comparison with control treatment in the two seasons. Also biological yield ton/fad take the same trend of harvesting date, GA<sub>3</sub> and foliafeed. This result agree with those of Bahia *et al.* (1995), Bhattacharjee *et al.* (2000) and Moawed (2001).

Generally, it must be recommended by harvesting flax plants when reached 160 days old and added either GA<sub>3</sub>(100ppm) or foliafeed at the rate of 250gm./ fad which achieved highest estimates in vegetative growth ( plant height, technical length and straw yield / fad. ), in addition to seed yield / fad., oil yield / fad., oil percentage and biological yield / faddan .

### Highest response values

The highest oil percentage and biological yield ton/fad were obtained from harvesting date 160 days with GA<sub>3</sub> as a foliar in the two seasons. On the other hand the highest fiber percentage was obtained without foliar spray at harvesting date 140 days in the two seasons.

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### تأثير مواعيد الحصاد و التسميد الورقي بالرش بالعناصر الصغرى و حمض الجبريليك على المحصول و مكوناته للكتان. على محمد علي العزوني

قسم بحوث الألياف-معهد بحوث المحاصيل الحقلية-مركز البحوث الزراعية- الجيزة- مصر

قيمت تجربتان حقلين بارض الصوب بالهرم و التابعة لمركز البحوث الزراعية بالجيزة خلال الموسمين ١٩٩٩/٢٠٠٠ و ٢٠٠٠/٢٠٠١ و ذلك لدراسة تأثير مواعيد الحصاد ١٤٠، ١٥٠ و ١٦٠ يوم من الزراعة و كذلك الرش بالعناصر المغذية الصغرى و حمض الجبريليك (كمنظم نمو) على كل من المحصول و مكوناته لصف الكتان المحلي سخا ٢ و ذلك مقارنة بالكنترول. و نتلخص أهم نتائج البحث فيما يلي  
أولاً: ميعاد الحصاد

ادي التأخير في موعد الحصاد و حتى ١٦٠ يوم من الزراعة إلى الحصول على زيادة معنوية في كل من طول النبات ، الطول الكلي، محصول القش بالطن للفدان، طول المنطقة الثمرية، عدد كبسولات النبات، عدد البذور في الكبسولة، محصول البذرة للفدان، محصول الزيت للفدان ، عدد الأفرع القاعدية للنبات، النسبة المئوية للزيت و كذلك المحصول البيولوجي  
ثانياً: العناصر الصغرى

استخدام مركب الفوليفيد رشا على النباتات و الذي يحتوي على العديد من العناصر الصغرى التي تصل نسبتها إلى ١٦,٥% أدى إلى زيادة معنوية في محصول القش و البذرة و الصفات المرتبطة بهما و ذلك مقارنة بالكنترول (الذي لم يرش) .

#### ثالثاً: حمض الجبريليك

أظهر استخدام حمض الجبريليك كمنظم للنمو و مشجع له خلال مراحل النمو الخضري للنباتات و قبل الإزهار رشا على النباتات زيادة معنوية في جميع الصفات السابقة و الخاصة بمحصول القش و البذرة و ذلك مقارنة بالكنترول.

رابعاً: كان هناك تأثير سلبي لإستخدام العناصر الصغرى و كذلك حمض الجبريليك رشا على النباتات على محصول الألياف للفدان و النسبة المئوية للألياف و ذلك لزيادة النمو الخضري في الساق على حساب الألياف.  
التوصية :

توصى الدراسة بأنه للحصول على أعلا محصول قش و بذرة للفدان من الصنف التجاري سخا٢ الحصاد على ١٦٠ يوم من الزراعة والرش بمركب الفوليفيد بتركيز ٢٥٠ جرام للفدان أو حمض الجبريليك بتركيز ١٠٠ جزء في المليون. ويمكن الحصول على محصول ألياف جيد بالتبكير في الحصاد مع تقليل التسميد بالعناصر الصغرى و ذلك تحت ظروف مشابهة لظروف الزراعة .