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تقييم إنتاجية وجودة بعض أصناف الكتان المحلية والمستوردة تحت مواعيد تقليع مختلفة بالاراضى الرملية

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الملخص العربى

أجريت تجربتان حقليتان بمحطة البحوث الزراعية بالاسماعيلية خلال موسمى ٢٠٠٩/٢٠١٠ و ٢٠١٠/٢٠١١ وذلك لتقييم ثمانية اصناف من الكتان منهم اربعة اصناف محلية (سخا٣، سخا٤، جيزه ٩، جيزه ١٠) ، أربعة أصناف مستوردة (استرو، دانيلا، بلنكا وايلونا) تحت ثلاثة مواعيد تقليع مختلفة (التقليع بعد ١٣٠، ١٤٥، ١٦٠ يوم من الزراعة. وقد تم دراسة صفات المحصول ومكوناته وجودة البذرة والالياف والتركيب الكيماوى للالياف بالاضافة الى تقدير معاملى الارتباط والمرور بهدف قياس مدى مساهمة تلك المكونات فى محصولى الالياف والبذور للفدان. هذا وقد استخدم تصميم القطع المنشقة مرة واحده فى اربعة مكررات . وكان نظام الرى المستخدم هو نظام الرى بالرش. ويمكن تلخيص اهم النتائج المتحصل عليها كمتوسط لموسمى الزراعة على النحو التالى:–

١– ادى ميعاد التقليع المتوسط (بعد ١٤٥ يوم من الزراعة) الى حدوث زيادة معنوية عالية لصفات محصول القش للفدان، النسبة المئوية للالياف الطويلة ، نعومة الالياف والنسبة المئوية للسليلوز والبكتين واللجنين بالالياف، ومحصول البذرة للنبات والفدان، النسبة المئوية للزيت فى البذرة ومحصول الزيت للفدان. على الجانب الاخر أدى تأخير ميعاد التقليع الى ١٦٠ يوم من الزراعة الى حدوث زيادة معنوية لصفات الرقم اليودى للزيت والنسبة المئوية للجنين بالالياف.

٢– اظهرت النتائج وجود اختلافات معنوية بين الثمانية أصناف المختبرة لكل الصفات المدروسة. هذا وقد تفوق صنف الكتان المحلى جيزه ٩ يليه الصنف المحلى سخا ٣ على بقية الاصناف فى صفات محصول القش وصفات جودة الالياف هذا بالاضافة الى صفات التركيب الكيماوى للالياف، بينما تفوق صنف الكتان المحلى جيزه ١٠ يليه الصنف المحلى سخا٤ على بقية الاصناف الاخرى المختبرة فى صفات محصول البذرة، وصفات جودة البذرة فى حين سجلت الاصناف المختبرة الاخرى قيم وسطية لجميع الصفات المدروسة.

٣– لوحظ وجود تفاعل معنوى كمتوسط لموسمى الزراعة بين مواعيد التقليع الثلاثة والثمانية أصناف فى صفات الطول الفعال، محاصيل القش والالياف والبذور والزيت والبروتين للفدان، محصول البذرة للنبات، الرقم اليودى للزيت، طول الالياف ونعومتها ومحتوى السليلوز بالالياف.

٤– اظهرت النتائج وجود ارتباط موجب وعالى المعنوية بين محصولى الالياف والبذور للفدان ومعظم الصفات المرتبطة بهما.

٥– اظهرت نتائج تحليل معامل المرور ان كل من محصول القش للنبات والطول الفعال وكذلك التفاعل بينهما كانت من اهم المصادر الرئيسية التى ساهمت فى زيادة محصول الالياف للفدان وفى نفس الوقت فان كل من محصول البذرة للنبات ودليل البذرة وكذلك التفاعل بينهما كانت من اهم المصادر الرئيسية التى ساهمت فى زيادة محصول البذرة للفدان.

٦ – يجب على مربى النبات ان يضع فى اعتباره الانتخاب لصفات محصول القش للنبات ، الطول الفعال للنبات ، محصول البذرة للنبات ودليل البذرة وذللك للحصول على اعلى محصول للألياف والبذرة كما" و نوعا" على التوالى.

٧– يمكن التوصية تحت ظروف هذه الدراسة بالتوسع بزراعة الكتان فى الاراضى الرملية وذلك بزراعة الأصناف المحلية المستنبطة حديثا مثل جيزه ٩، جيزه ١٠، سخا٣، سخا٤ على التوالى وتقليع نباتات هذه الأصناف بعد ١٤٥ يوم لتحقيق أعلى محصول وأفضل جودة للألياف والبذور.

EVALUATION OF PRODUCTIVITY AND QUALITY FOR SOME LOCAL AND INTRODUCED FLAX (*LINUM USITATISSIMUM,* L.) VARIETIES UNDER DIFFERENT PULLING DATES IN SANDY SOILS

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ABSTRACT: *Two field experiments were carried out at Ismailia Agric. Res. Station, ARC, during 2009 / 2010 and 2010 / 2011 seasons to evaluate eight local and introduced flax varieties namely Sakha3, Sakha4, Giza9, Giza10 (local varieties), Istru, Daneila, Blenika and Ilona (introduced varieties) under three pulling dates, i.e. 130, 145 and 160 days after sowing (DAS) which represents, early, medium and late pulling date, respectively. Seed and fiber yields and their components, seed and fiber qualities and fiber chemical composition, as well as simple correlation and path coefficients analysis between fiber and seed yield as well as some of their contributing characters were studied. Split plot design with four replicates was used, where pulling dates were allocated in main plot and flax varieties were arranged in subplot. Modern irrigation system (sprinkler irrigation) was used. The most important results as average of both seasons can be summarized as follows:*

1- *Delaying pulling dates from 130 to 145 days after sowing (DAS) significantly increased total and technical length /plant, straw yield/ plant, fiber length, numbers of apical branches and capsules/ plant, number of seeds/ capsule, seed protein percentage and protein yield/ fad. Medium pulling date (145 DAS) gave higher significant increases on straw and fiber yields/ fad, long fiber percentage, fiber fineness, fiber cellulose and fiber pectin percentages, seed yield/ plant, seed yield/ fad, seed oil percentage and oil yield/ fad. On the other hand, delayed pulling date up to 160 DAS significantly increased Iodine value and fiber lignin percentage.*
2- *Significant varietal differences were observed for all studied traits. Giza9 cv. followed by Sakha3 cv. exceeded significantly all other tested flax varieties in straw yield characters and fiber quality as well as fiber chemical composition. However Giza10 cv. followed by Sakha4 cv. outyielded significantly the other tested flax varieties in seed yield characters and seed quality.*
3- *Significant interaction effect was observed between the three pulling dates and the eight tested flax varieties on technical length, straw yield/ fad, fiber yield/ fad, seed yield/ plant, seed yield/ fad, oil yield/ fad, protein yield/ fad, Iodine value, fiber length, fiber fineness and fiber cellulose percentages.*
4- *There was positive and high significant association among fiber and seed yields/ fad and some of their components as well as quality characters.*
5- *Path coefficient analysis indicated that straw yield/ plant and technical length as well as their interaction are considered the main important sources in increasing fiber yield/ fad, having contribution percentage of 41.85, 3.40 and 20. 91%, respectively. In the same time, seed yield/ plant and seed index as well as their interaction are considered the main important sources in increasing seed yield/ fad with contribution percentage of 43.32, 12.98 and 35.14%, respectively.*

Key words: *Flax varieties, pulling dates, yield, yield components, quality, fiber chemical composition, correlation, path analysis.*

INTRODUCTION

Flax (*Linum usitatissimum*, L.) is an annual plant belongs to the family linaceae grown is some countries for seeds, whereas in others for fiber. In Egypt it is one of the oldest crops cultivated as a dual purpose crop for its fiber and seed. The fibers are used in textile as well as automobile and construction industries, while flax seeds are used in human food as source of omega-3-

fatty acids and animal feed. Linseed oil is used in the production of paint, soap, putty and polymers (Kozlowski, 2001). Nowadays, flax can be considered as a fiber crop with numerous utilization in industry with lower waste. It is an important crop grown for both exportation as well as local fabrication. Different flax products become more acceptable in many foreign markets, therefore more attention has been given lately to grow high yielding cultivars under more adapted agronomic practices which technological application to increase not only yield production but also quality of flax products specially emphasize of fiber owing to highly demands for the markets.

It is important to the breeder to know the optimum stage of maturity in which flax would be pulled. So choosing the right time for flax pulling is very important and needs more skillful with highly experience. Pulling date affected greatly fiber and seed yields and their components, seed and fiber yields as well as their qualities. If flax plants pulled too early, the fiber will be very fine but lacking strength with low yield. On the other hand, if flax plants are left too long before pulling, lignifications take place and the fiber loses some of its quality and fineness rather than deficiency in seed yield. Pulling dates were studied by many investigators who recorded the optimum stage (days after sowing) of pulling date which gave the highest yields of fiber, seed and their qualities of flax was 150 DAS (El-Farouk *et al.* 1980, Ghanem 1990, El-Hariri *et al.* 1996, El-Azzouni 2003 and El-Sweify *et al.* 2006); 155 DAS (Hassan and El-Farouk 1982 , Esmail and Morsy 1994 and El-Sweify *et al*. 1996 and 2003) ; 160 DAS (Shafshak *et al.* 1992) and 165 DAS (Mourad *et al.* 1990).

Several researchers recorded significant varietal differences in yield and quality for some local and introduced flax varieties such as Giza5 and Reina cvs (El-Farouk *et al,* 1980); Giza6, F.506/1, F.81/4, Imp. 191, F.3248/1, F.77/1 and H.30 (Gaafar *et al*, 1990); Blenika, S.110/3 and Introduce 12467 (Mourad *et al*, 1990); Ariane, Giza7, Giza8 and S.402/20/5/2 (El-Hariri *et al*, 1996); Giza7 and Giza8 (El-Sweify *et al*, 1996); Ariane, Baltuciani and Blenika cvs. (Jankauskiene and Mikelionis 2001); Giza7 and Giza8, exotic cv. Viking and promising strains 336/2/1/2, 402/1 and 422/10 (El-Sweify *et al*, 2003); Sakha1 and Strains 402/3/18/9, 402/12/11/6, 2465/1/3 and 5 (El-Sweify *et al*, 2006); Giza7, Giza8, Sakha1, Sakha2, Sakha3, Sakha4, Blenika and Escalina (Mostafa *et al*, 2006); as oil types Giza6, Giza8 and Sakha2, fiber types as Sakha3, Sakha4 and dual purpose types Line.402/1 and Sakha1 (Naguib, 2006); Giza6, Giza8, Sakha1, Sakha2, Blenika, Escalina, Ilona, Sakha3, Sakha4, S16 and S22 (El-Kady and Abd El-Fatah, 2009) and Sakha3, Viking, Sakha2 and S.2419/1 (Hussein, 2012).

The correlation coefficient is one of the most important measurements for the degree of association between any two characters; thus it is applied in plant breeding programs. Correlation coefficient between yield and yield components varying in magnitude and direction were reported in different flax fiber and seed yields studies by many investigators such as Momtaz *et al.* (1977), El-Shaer *et al.* (1983), Ghanem (1990), Zeiton (1992), Aly and Awaad (1997), Al-Kaddoussi and Moawed (2001) and Hussein (2012).

Path coefficient analysis was performed to estimate the relative contribution of yield components of flax fiber and seed yield variations by several workers among of them Ghanem (1990), Aly and Awaad (1997), Al-Kaddoussi and Moawed (2001) and Hussein (2012).

Therefore, the present investigation aims to evaluate some quantity and quality characters, fiber chemical composition and yield analysis for some local and introduced flax varieties under different pulling dates to find out the optimum pulling date and identify the flax variety that have high yielding ability for fiber and seed production in sandy soil.

MATERIALS AND METHODS

Two field experiments were conducted during 2009/2010 and 2010/2011 seasons at the Experimental Farm of Ismailia Agric. Res. Station, ARC, to evaluate eight local

and introduced flax varieties under three pulling dates in relation to yield and yield components, seed quality, fiber quality, fiber chemical composition as well as yield analysis.

Every experiment included 24 treatments which were the combination between three pulling dates, i.e. 130, 145 and 160 days after sowing which represents early, medium and late pulling date, respectively and eight flax varieties namely Skha3, Sakha4, Giza9 and Giza10 as local varieties and Istru, Daneila, Blenka and Ilona as introduced varieties . These treatments were arranged in split plot design with four replications, where pulling dates were allocated in main plot and flax varieties were arranged in subplot. The subplot area (the experimental unit) was (2x3 m) $6m^2$ in both seasons. The pedigree of the eight tested flax varieties, origin and classification are presented in Table (1).

The soil of the experiment was sandy in texture. Some physical and chemical properties of a representative soil sample used in the experimental soil (Table, 2) were determined before preparation according to Jackson (1973). The experimental field was well prepared. Seeds of the eight tested flax varieties were hand drilled into rows 15 cm apart at sowing rate of 50 kg seeds/ fad on 10^{th} and 12^{th} November in the first and second seasons, respectively. Seeds of the eight tested flax varieties were obtained from Fiber Crops Research Section, Field Crops Res. Institute, ARC. Recommended P and K fertilizers were presowing added fully at the rate of 150 kg/fad calcium superphosphate (15.5% P_2O_5) and 50 kg/fad potassium sulphate (48.5% K_2O). Recommended N fertilizer was applied at the rate of 75 kgN/fad in the form of ammonium sulphate (20.5% N) in four equal doses, the first dose was added before the first irrigation, while the remainders were applied 15 day intervals.

Table (1): The pedigree of the eight tested flax varieties, origin and classification.

No.	Varieties	Origin	Type	Pedigree
1	Sakha3	local variety	Fiber	Blenika (2E) x 1.2096
2	Sakha4	local variety	Fiber	Blenika (R3) x 1.2596
3	Giza9	local variety	Fiber	L. 420 x Bombay
4	Giza10	local variety	Fiber	L. 420 x Bombay
5	Istru	Introduction	Fiber	Introduced from Romania
6	Daneila	Introduction	Fiber	Introduced from Romania
7	Blenika	Introduction	Fiber	Introduced from Holand
8	Ilona	Introduction	Fiber	Introduced from Holand

Table (2): Some physical and chemical properties of a representative soil samples in the experimental soil before sowing (0 – 30 cm depth) in 2009/2010 and 2010/2011 seasons.

	2009/2010 season	2010/2011 season
I- Physical properties:		
Coarse sand %.	63.05	62.25
Fine sand %.	22.35	21.45
Silt %.	8.7	9.5
Clay % .	5.9	6.8
Soil texture	Sandy	Sandy
II- Chemical properties:		
CaCo3 %.	1.68	1.52
Organic matter %.	1.92	2.18
PH (1:1 suspension).	8.13	7.95
EC (1 : 1 extract) (dsm-1).	0.19	0.25
Field capacity.	7.35	7.46
Available N (ppm).	33.38	34.65
Available P (ppm)..	4.75	5.21
Available K (ppm).	50.82	56.75

Each value represents the mean of the four replications.

Weeds were mechanically controlled. Irrigation was carried out using modern irrigation (Sprinkler irrigation). The preceding crop was corn and peanut in the first and second season, respectively. All other normal agronomic recommended practices of flax growing were followed. At harvesting time, sample of ten guarded plants in each experimental unit in four replicated were hand pulled carefully at random and left one week for complete air drying to determine yield components. Seed, straw and fiber yields/ fad were estimated from an area of 2.25 m^2 of each subplot and then the yields of seed, straw and fiber/ fad were calculated. The retting process made in Fiber Crops Research Section, Field Crops Research Institute, ARC to extract flax fiber for studying its quantity and quality parameters.

Characters studied:

I- Yield and yield components:

1- Total length/ plant (cm).
2- Technical length/ plant (cm).
3- Straw yield/ plant (g).
4- Straw yield/ fad (ton).
5- Fiber yield/ fad (ton).
6- Number of apical branches/ plant.
7- Number of capsules/ plant.
8- Number of seeds/ capsule.
9- Seed yield/ plant (g).
10- Seed yield/ fad (kg).

II- Seed quality:

1- Seed index (1000 seed weight in g).
2- Seed oil percentage: It was determined as describer by Horwitz *et al.,* (1965), using a Soxhlet apparatus and petroleum ether with a boiling range of 60-80 C a solvent for six hour, the oil percentage was calculated on dry weight basis.
3- Oil yield/ fad (kg): Calculated by multiplying seed oil percentage x seed yield/ fad.
4- Seed protein percentage: Determined by using the modified microkgeldahl apparatus according to the method described by A.O.A.C. method (1990), the obtained values were multiplied by 6.25 as used by Tripathi *et al.,* (1971).
5- Protein yield/ fad: Calculated by multiplying the crud protein content x seed yield/ fad.
6- Iodine value: It was determined according to Wij´s method as described by Jacobs (1959).

III- Fiber quality:

1- Long fiber percentage. It was estimated as follows:

$$\text{Long fiber percentage} = \frac{\text{The long fiber yield/fad}}{\text{The retted straw yield/fad}} \times 100$$

2- Fiber length (cm): It was measured as average of ten fiber ribbons (bundles from each subplot.
3- Fiber fineness (N.m): It was determined according to Radwan and Momtaz (1966) as follows: $N.m = \frac{NxL}{G}$ where N.m = metrical number, N = number of 20 fibers in mm (2000), G = weight of fibers in mg.

IV- Fiber chemical composition :

1- Fiber cellulose percentage: It was determined using Garner method (1949).
2- Fiber pectin percentage: It was determined according to the method described by Nanji and Norman (1928).
3- Fiber lignin percentage: It was determined using the method described by Ritter *et al.* (1932).

V- Correlation coefficient study:

The association between straw, fiber and seed yields/ fad and their attributes as average of the two seasons were subjected to simple correlation coefficient according to Svab (1973) using the following equation:

$$r = \frac{SPxy}{\sqrt{SSx.SSY}}$$, where:

SPxy =$\sum xy - (\sum x \cdot \sum y)/n$, SSx = $\sum x^2 - (\sum x)^2/n$, SSy = $\sum y^2 - (\sum y)^2/n$. SPxy is the phenotypic covariance between the two traits, SSx is the phenotypic standard deviation of the first character and SSy is the phenotypic standard deviation of the second character. The r test was used the significant of r (value).

VI- Path coefficient analysis study:

Calculated from the combined data over the two seasons by partitioning the simple correlation coefficient between:

- Fiber yield/ fad and its components i.e. straw yield/ plant, technical length and fiber length.
- Seed yield/ fad and its components i.e. seed yield/ plant, number of capsules/ plant and seed index. The path coefficient analysis study was computed by using the method mentioned by Li (1975).

Statistical analysis:

The data obtained were subjected to the proper statistical analysis as split plot design according to Snedecor and Cochran (1982) and treatment means were compared using L.S.D at 5% and 1% level of probability in both seasons after testing the homogeneity of the error according to Bartlett's test. Therefore combined analysis was preformed for each character over the two growing seasons as described by LeClerg *et al.* (1966).

RESULTS AND DISCUSSION

I- Yield and yield components:

A- Effect of pulling dates:

Analysis of variance for data presented in Table (3) showed that yield and yield components, i.e. total and technical length/ plant, straw yield/ plant, straw and fiber yields/fad, numbers of apical branches and capsules/ plant, number seeds/ capsule, seed yield/ plant and seed yield/ fad were significantly responded to pulling dates. It is obviously that most yield and yield components significantly increased with delaying pulling date from 130 to 145 (DAS). These traits achieved their maximum values at the medium pulling date (145 DAS). This might be due to continues growing in fiber cells as well as precipitation of cellulose in secondary walls of individual fiber unit and this in turn increase fiber yield. On the other hand, the decline in straw and seed yields/fad with delaying pulling date up to 160 DAS might be due to low moisture content and shattering of seed at late pulling dates as well as chemical changes in different tissues of flax plant especially lignifications which cause harmful effect on yield and quality. In addition, delay harvest exposed flax plants to over maturity which is often as companied by a loss of some plant organs (basal or apical branches and capsules). Confirmed results were obtained by El- Farouk *et al.* (1980), Yousef *et al.* (1980), Hassan and El-Farouk (1982), Mourad *et al.* (1990), Shafshak *et al.* (1992), Esmail and Morsy (1994), El-Hariri *et al.* (1996), El-Azzouni (2003) and El-Sweify *et al.* (2003 and 2006).

B- Varietal differences:

Mean values of yield and yield components for the eight flax varieties in 2009/2010 and 2010/2011 seasons and their combined are presented in Table (3). Analysis of variance revealed significant differences among the means of the eight flax varieties for total and technical length/ plant, straw yield / plant and / fad, fiber yield/ fad, numbers of apical branches and capsules/ plant, number of seeds/ capsule, seed yield / plant and / fad. Moreover, Giza 9 exceeded the other tested varieties in total and technical length / plant , straw yield /plant , straw and fiber yields/ fad., However, Giza10 outyielded the other tested varieties in numbers of apical branches and capsules /plant , number of seeds / capsule, seed yield /plant and seed yield/ fad. These results are fairly true in the two seasons and their combined. On contrary, the introduced varieties namely Istru , Blenika and Daneila generally produced the lowest values of the above mentioned traits in both seasons and their combined. The differences between the tested flax varieties could mainly be attributed to the differences in their genetically constitution and their response to the environmental conditions. These results are in harmony with those obtained by El-Farouk *et al.* (1980), Hella *et al.* (1986), Gaafar *et al.* (1990), Mourad *et al.* (1990), El-Hariri *et al.* (1996), Mostafa *et al.* (2006), El-Kady and Abd El-Fatah (2009), and Hussein (2012).

C-Effect of interaction:

The interaction between pulling dates and the tested flax varieties was significant with respect to technical length, straw and

Table 3

Table 3

fiber yields/ fad, seed yield/ plant and seed yield/ fad as average of both seasons. This indicated that pulling dates were not similar in their effects to flax varieties in those characters (Table 4). Combined analysis of the two seasons revealed that the longest flax plants and the highest values of straw and fiber yields/ fad were recorded for Giza9 cv. when was pulled at 145 DAS. However, the highest values of seed yields/ plant and/ fad were recorded for Giza10 cv. when was pulled at 145 DAS. On the other hand, the interaction between flax varieties and pulling dates on straw yield/plant, numbers of apical branches and capsules/plant as well as number of seeds/capsule in the combined analysis of 2009/2010 and 2010/2011 seasons was insignificant, indicating that the two factors acted these traits independently, therefore, the data of these interactions were excluded. Similar results were reported by El-Hariri *et al.* (1996) and El-Sweify *et al.* (2003 and 2006).

Table 4: The significant interaction between the tested flax varieties and pulling dates on technical length, straw yield/fad, fiber yield/fad, seed yield/plant and seed yield/fad. (combined analysis of 2009/2010 and 2010 /2011 seasons).

Pulling dates	Flax varieties								L.S.D at 5%
	Sakha3	Sakha4	Giza9	Giza10	Istru	Daneila	Blenika	Ilona	
	Technical length / plant (cm)								
130 DAS	73.01	71.67	75.23	73.88	70.00	67.49	68.89	72.14	
145 DAS	78.50	75.97	85.26	81.31	76.60	72.70	74.98	79.07	3.77
160 DAS	78.47	75.12	83.53	79.53	74.96	71.00	73.67	77.31	
L.S.D at 5%	3.14								
	Straw yield/fad (ton)								
130 DAS	3.015	2.788	3.215	3.120	3.019	2.545	2.809	3.006	
145 DAS	3.855	3.758	4.115	3.970	3.842	3.415	3.515	3.816	0.226
160 DAS	3.751	3.556	3.940	3.804	3.599	3.296	3.435	3.716	
L.S.D at 5%	0.214								
	Fiber yield/fad (ton)								
130 DAS	0.398	0.332	0.458	0.410	0.328	0.304	0.361	0.407	
145 DAS	0.581	0.534	0.654	0.582	0.499	0.475	0.525	0.628	0.072
160 DAS	0.488	0.417	0.585	0.492	0.453	0.405	0.437	0.512	
L.S.D at 5%	0.066								
	Seed yield/plant (g)								
130 DAS	0.375	0.436	0.407	0.459	0.239	0.289	0.271	0.332	
145 DAS	0.441	0.499	0.482	0.513	0.338	0.424	0.392	0.427	0.054
160 DAS	0.421	0.462	0.438	0.483	0.306	0.381	0.349	0.389	
L.S.D at 5%	0.047								
	Seed yield/fad (kg)								
130 DAS	290.56	330.58	310.08	348.70	202.61	227.60	215.56	253.04	
145 DAS	415.33	466.56	435.93	485.14	302.29	368.49	336.72	389.24	48.16
160 DAS	374.76	421.49	394.79	442.90	262.71	326.86	284.99	359.38	
L.S.D at 5%	46.79								

II- Seed quality:

A- Effect of pulling dates:

The results reported in Table (5) show clearly that seed quality, i.e. seed index, seed oil percentage, oil yield/ fad, seed protein percentage, protein yield/fad and Iodine value were significantly responded to pulling dates. Results revealed that each of seed index, seed oil percentage, oil yield/fad and protein yield/ fad were significantly increased with delaying pulling date from 130 to 145 DAS where they reached their maximum values at the 2nd pulling date (145 DAS). However, Iodine value significantly increased with delaying pulling date up to 160 (DAS). The differences between values of seed quality traits obtained from plants pulled at medium date comparing with either early or late dates reached the high significant level. These results suggest that flax plants continues to growing as well as building of different organs until the pulling symptoms are reached, might be due to an increase in metabolites synthseized by flax plants owing to prolonged growth period and that was more pronounced especially during the latest pulling date which in turn increased dry matter accumulation in plant organs till it reached full maturity stage. On the other hand, Iodine value is closely related to unsaturated fatty acids composition of the oil. These results suggest that delayed pulling date prolonged the growth period of flax plant and this in turn exposed flax plants to available climatic conditions which affected the relationship between saturated and unsaturated fatty acids formations. These results are in agreement with those obtained by El-Farouk *et al.* (1980), Yousef *et al.* (1980), Hassan and El-Farouk (1982), Zeiton (1992), El-Sweify *et al.* (1996 and 2006).

B- Varietal differences:

The response of seed quality for eight different flax varieties i.e. Sakha3, Sakha4, Giza9, Giza10, Istru, Daneila, Blenika and Ilona were investigated and the results are illustrated in Table (5). These results showed clearly that seed quality characters responded significantly owing to different tested flax varieties. Seed index, seed oil percentage, oil yield/ fad and protein yield/ fad reached their maximum values in Giza10 cv. followed by Sakha4 in comparison with the other tested flax varieties. However, the lowest values of seed quality characters were obtained by the introduced variety (Istru cv.). The superiority ratios of the local variety Giza10 compared with introduced one Istru cv. were 29.43, 10.41, 82.65, 79.88 and 3.46%. for seed index, seed oil%, oil yield/ fad, protein yield/ fad and Iodine value traits as average of the two seasons, respectively. However Giza10 cv. exceeded Sakha4 by 18.54% for seed protein percentage These results may be due to high adaptation of the local varieties Giza10 and Sakha4 compared with the introduced variety Istru which have poor adaptability under these conditions. Also, it could be concluded that these varietal differences are due to variability in genetic constituents and potential. Similar conclusions were reported by El-Farouk *et al.* (1980), Yousef *et al.* (1980), Naguib (2006), El-Sweify *et al.* (2006), El-Kady and Abd El-Fatah (2009) and Hussein (2012).

C- Effect of interaction

As an average for both seasons, data presented in Table (6) showed that the interaction between pulling dates and flax varieties had significant effect on oil and protein yields/ fad as well as Iodine value. The highest values of oil and protein yields/fad were obtained from Giza10 cv. when was pulled at 145 DAS. However, the highest value of Iodine value was recorded for Giza10 cv. when was pulled at 160 DAS. However, the other traits were not significantly affected by the interaction between the two factors studied , therefore the data were excluded. Similar findings were obtained by El-Farouk *et al.* (1980) and El-Sweify *et al.* (1996).

III- Fiber quality:

A- Effect of pulling date:

The results reported in Table (7) revealed that flax fiber quality, i.e. long fiber percentage, fiber length and fiber fineness aspects were significantly responded to pulling date. There was an increase in fiber

Table 5

Table 6: **The significant interaction between the tested flax varieties and pulling dates on oil yield/fad, protein yield/fad and Iodine value. (Combined analysis of 2009/2010 and 2010 /2011 seasons).**

Pulling dates	Flax varieties								L.S.D at 5%
	Sakha3	Sakha4	Giza9	Giza10	Istru	Daneila	Blenika	Ilona	
	Oil yield/fad (kg)								
130 DAS	99.98	116.97	110.07	127.52	74.23	77.96	74.58	89.78	
145 DAS	150.60	173.17	167.23	185.56	104.15	133.70	120.14	142.08	20.82
160 DAS	132.46	150.45	144.45	160.96	89.23	115.26	99.10	128.42	
L.S.D at 5%	18.45								
	Protein yield/fad (kg)								
130 DAS	67.31	72.73	76.78	82.98	53.63	57.25	51.78	58.06	
145 DAS	104.80	111.61	124.01	127.04	86.05	99.32	88.83	97.19	17.85
160 DAS	94.29	101.71	110.43	117.43	75.51	98.16	76.94	89.78	
L.S.D at 5%	15.28								
	Iodine value								
130 DAS	166.35	168.21	166.85	169.36	163.72	164.65	165.50	167.82	
145 DAS	169.94	170.72	169.60	172.40	166.68	167.62	168.77	170.16	2.82
160 DAS	172.52	174.18	173.12	175.78	169.83	170.63	172.37	173.30	
L.S.D at 5%	2.48								

Table (7): Mean values of flax fiber quality for some local and introduced varieties under three pulling dates and their interaction in 2009/2010 and 2010/2011 and their combined analysis

Characters	Long fiber%			Fiber length (cm)			Fiber fineness (N.m)		
Seasons / Treatments	1st	2nd	Comb.	1st	2nd	Comb.	1st	2nd	Comb.
A-Pulling dates (P):									
P1 : 130 DAS.	12.27	13.12	12.70	74.18	75.93	75.06	231.99	236.98	234.48
P2 : 145 DAS.	14.27	15.14	14.71	79.75	82.59	81.17	258.58	263.58	261.08
P3 : 160 DAS.	13.45	14.25	13.85	78.68	81.07	79.88	242.78	247.38	245.08
F. test.	**	**	**	*	**	**	**	**	**
L.S.D at 5%.	0.46	0.48	0.38	2.80	2.03	1.44	10.56	9.34	8.51
L.S.D at 1%.	0.76	0.79	0.49	—	2.70	1.80	13.22	10.88	9.64
B- Flax varieties (V):									
V1 : Sakha3.	13.76	14.43	14.09	78.43	81.10	79.67	250.43	255.94	253.18
V2 : Sakha4.	12.66	13.53	13.09	76.61	78.71	77.66	244.71	249.13	246.92
V3 : Giza9.	14.75	15.36	15.05	82.73	84.88	83.81	258.22	259.92	259.07
V4 : Giza10.	13.58	14.49	14.03	80.16	82.85	81.51	254.58	260.29	257.43
V5 : Istru.	12.64	13.28	12.96	75.73	78.38	77.06	233.36	245.22	239.29
V6 : Daneila.	11.54	12.44	11.99	72.58	75.25	73.91	225.98	233.10	229.54
V7 : Blenika.	13.51	14.60	14.05	75.66	76.88	76.27	237.94	239.47	238.71
V8 : Ilona.	14.21	15.26	14.74	78.41	80.85	79.63	250.40	251.43	250.92
F.test.	**	**	**	**	**	**	**	**	**
L.S.D at 5%.	0.76	0.81	0.54	3.28	2.13	1.71	12.06	11.84	10.22
L.S.D at 1%.	0.87	1.01	0.68	4.38	2.61	2.27	14.43	13.47	11.59
C- Interactions: (PxV).	N.S	N.S	N.S	N.S	*	*	N.S	*	*

*, ** and N.S indicate significant at 5%, 1% level of probability and insignificant, respectively.

quality characters with advancement of plants towards maturity up to the 2nd pulling date (145 DAS). This means that this pulling date gave the highest mean values of the above mentioned traits. These results may be attributed to an increase in metabolites synthesis by flax plants owing to prolonged growth period and in turn the significant increases in fiber quality characters were more expected. Moreover, delayed pulling date up to 160 DAS exposed flax plants over maturity which is often accompanied by a decrease in the moisture content inside flax plants.

Long fiber percentage trait increment at 2nd pulling date (145 DAS) might be attributed to continuous precipitation of cellulose in the secondary walls of fiber cells, while the decline in fiber percentage after 2nd pulling date might be due to more lignifications which occurred late and this in turn increased retting losses resulting in lower fiber percentage.

Fiber length trait showed considerable significant increase with delaying pulling dates up to 145 DAS, without significant effect between the 2nd and the 3rd pulling date in this respect as average of the two seasons. It could be concluded that delaying pulling increased the individual fiber units to tie at their tapering ends to form long standards of fibers.

Fiber fineness trait responded favorably to delay pulling date. These results indicate that the highest fiber fineness was achieved at the 2nd pulling date (145 DAS). It could be concluded that the medium pulling date could be recommended for higher fiber fineness. On the other hand, the decline in fiber fineness trait might be due to lignification which takes place in flax plants were left too long before pulling. These results are harmony with those reported by El-Farouk *et al* (1980), Yousef *et al.* (1980), Hassan and El-Farouk (1982), Zeiton (1992), El-Hariri *et al.* (1996) and El-Sweify *et al.* (2003 and 2006).

B- Varietal differences:

Data presented in Table (7) revealed that fiber quality parameters of flax, i.e. long fiber percentage, fiber length and fiber fineness were high significantly differed owing to the tested flax varieties. Giza9 cv. gave the highest values for the same respective quality parameter. Moreover, Daneila cv. recorded the lowest values for all tested characters. The other tested flax varieties recorded intermediate estimates between values for the same above mentioned fiber quality. Moreover, it can be noticed that the local flax Giza9 variety exceeded the introduced flax Daneila cv. by 25.52, 13.39 and 12.86% for long fiber percentage, fiber length and fiber fineness traits as average for both seasons, respectively. It could be concluded that fiber quality parameters, depended mainly on varieties and this is mainly due to the genetically constituents as will it is interacted with environmental conditions. Similar conclusions were reported by El- Farouk *et al.* (1980), El-Hariri *et al.* (1996), Jankauskiene and Mikelionis (2001), El-Sweify *et al.* (2003 and 2006) and Hussein (2012).

C- The effect of interaction

Data presented in Table (8) indicate that fiber length and fiber fineness traits were significantly affected by the interaction between pulling dates and varieties recording the highest mean values (87.4 cm and 275.00 N.m) for plants of Giza9 when were pulled at 145 DAS. On the other hand, no significant interaction effect between flax varieties and pulling dates on long fiber percentage trait. These indicate that each of these two factors acted this trait indepently. These results are in agreement with those reported by El-Farouk *et al.* (1980) and El-Sweify *et al.* (1996).

IV- Fiber chemical composition:

A- Effect of pulling dates:

Analysis of variance for data presented in Table (9) revealed that pulling dates had a significant effect on cellulose, pectin and lignin percentages in the two seasons and their combined. Relevant results indicate that cellulose and pectin percentages show remarkable increases with delaying pulling date up to the 2nd pulling date and then it decreased. These results might owe much

to the progressive and consist on precipitation of cellulose during the period of 130 to 145 DAS. In this connection, if plants are left too long before pulling, lignifications takes place and consequently cellulose percentage decreased. These results could be attributed to that the pectin is not a homogenous material in the plant but it becomes more complex substances with advancement of flax plants towards maturity.

Table 8: The significant interaction between the tested flax varieties and pulling dates on fiber length and fiber fineness. (Combined analysis of 2009/2010 and 2010 /2011 seasons).

Pulling dates	Flax varieties								L.S.D at 5%
	Sakha3	Sakha4	Giza9	Giza10	Istru	Daneila	Blenika	Ilona	
	Fiber length (cm)								
130 DAS	76.82	75.30	78.68	77.46	73.35	70.79	72.36	75.78	
145 DAS	81.75	79.45	87.41	84.91	78.73	76.33	79.04	82.70	2.96
160 DAS	80.83	78.24	86.16	82.16	79.11	74.63	77.42	80.46	
L.S.D at 5%	2.38								
	Fiber fineness (N.m)								
130 DAS	241.07	233.52	246.77	244.05	221.48	213.75	226.80	239.70	
145 DAS	265.88	260.95	275.00	271.00	250.75	243.22	249.23	266.88	11.87
160 DAS	251.93	244.97	254.00	257.03	244.40	230.46	232.93	244.92	
L.S.D at 5%	10.34								

Table (9): Mean values of flax fiber chemical composition as affected by flax **varieties, pulling dates and their interaction in 2009/2010 and 2010/2011, and their combined analysis.**

Characters / Seasons / Treatments	Fiber cellulose%			Fiber pectin %			Fiber lignin %		
	1st	2nd	Comb.	1st	2nd	Comb.	1st	2nd	Comb.
A-Pulling dates (P):									
P1 : 130 DAS.	72.81	73.85	73.33	2.82	3.25	3.03	1.35	1.84	1.59
P2 : 145 DAS.	74.99	75.76	75.37	4.03	4.53	4.28	1.90	2.40	2.15
P3 : 160 DAS.	73.99	75.56	74.66	3.34	3.84	3.59	2.10	2.59	2.34
F. test.	**	**	**	**	**	**	**	**	**
L.S.D at 5%.	0.76	0.71	0.68	0.28	0.35	0.22	0.18	0.20	0.15
L.S.D at 1%.	0.92	1.18	0.84	0.46	0.65	0.32	0.29	0.30	0.19
B- Flax varieties (V):									
V1 : Sakha3.	74.74	75.61	75.18	3.95	4.47	4.21	2.02	2.52	2.27
V2 : Sakha4.	73.46	75.11	74.28	3.12	3.59	3.35	1.60	2.11	1.87
V3 : Giza9.	75.70	76.83	76.27	4.21	4.71	4.46	2.14	2.63	2.39
V4 : Giza10.	74.13	75.26	74.64	3.31	3.80	3.55	1.77	2.26	2.02
V5 : Istru.	73.12	74.57	73.85	3.21	3.68	3.44	1.68	2.17	1.93
V6 : Daneila.	72.19	73.65	72.92	2.39	2.88	2.64	1.45	1.95	1.70
V7 : Blenika.	73.37	74.16	73.76	2.99	3.48	3.24	1.56	2.06	1.80
V8 : Ilona.	74.21	75.33	74.77	3.96	4.40	4.18	2.01	2.50	2.26
F.test.	**	**	**	**	**	**	**	**	**
L.S.D at 5% .	1.16	0.88	0.72	0.50	0.54	0.36	0.25	0.24	0.19
L.S.D at 1%.	1.55	1.04	0.92	0.63	0.65	0.54	0.42	0.31	0.23
C- Interactions: (PxV).	*	N.S	*	N.S	*	N.S	*	N.S	N.S

*, ** and N.S indicate significant at 5%, 1% level of probability and insignificant, respectively.

There was a considerable and consisted increase in lignin percentage with advancement of flax plants towards the last pulling date (160 DAS). The noticeable increase in lignin percentage till the last pulling might be due to the lignifications which take place when the plants are left too long before pulling. In this respect, the lignin occurs chefly towards the outside of the walls and particularly when flax plants have been allowed to over mature stage before pulling. These results are in accordance with those reported by El-Farouk *et al.* (1980), Hassan and El-Farouk (1982), El-Hariri *et al.* (1996), El-Sweify *et al.* (1996 and 2003).

B- Varietal differences:

As shown from Table (9) there was a significant differences in all fiber chemical compositions, i.e. fiber cellulose, pectin and lignin percentages among the eight tested flax varieties. In comparison among the tested flax varieties, it can be noticed that the local variety Giza9 produced the highest values of fiber chemical composition (fiber cellulose, fiber pectin and fiber lignin percentages), while the introduced variety namely Daneila produced the lowest one. As the combined analysis for the two seasons Giza9 variety surpassed Daneila variety in the fiber cellulose%, fiber pectin% and fiber lignin% by 4.95, 68.93 and 40.59%, respectively. Moreover, the other tested flax varieties recorded intermediate estimates for fiber chemical compositions studied.

It could be concluded that chemical composition of fiber depends on genetic potential as well as genetic makeup of the material under test which in turn interact with the environmental conditions. Similar findings were reported by El-Farouk *et al.* (1980), El-Sweify *et al.* (1996) and Jankauskiene and Mikelionis (2001).

C- Effect of interaction:

The interaction effect between pulling dates and flax varieties on fiber chemical composition traits did not reach the level of significance, except fiber cellulose percentages as average for both seasons. The highest values of fiber cellulose % were obtained from Giza9 cv. plants when were pulled at 145 DAS as shown in Table (10). These results are in accordance with those reported by El-Farouk *et al.* (1980) and El-Sweify *et al.* (1996).

V- Correlation coefficient study:

Results of simple correlation coefficient between fiber and seed yields/ fad and some of their associated characters as affected by pulling dates and flax varieties in combined analysis for 2009/2010 and 2010/2011 seasons are presented in Table (11). Relevant results showed that there are significant and positive simple correlation generally between each of fiber yield/fad, total length/plant, technical length / plant, straw yield/plant, straw yield/fad, long fiber%, fiber length, fiber fineness, fiber cellulose, fiber pectin and fiber lignin percentages. On the contrary, there are insignificant and positive simple correlation between total length/plant and straw yield/plant; between straw yield/fad and fiber fineness and between fiber fineness and fiber pectin%. These associations could be employed through selecting both of higher straw yield/plant and longer technical length to obtained higher fiber yield per unit area of the land. Similar results were reported by El-Shaer *et al.* (1983), Ghanem (1990), Zeiton (1992), Al-Kaddoussi and Moawed (2001), and Hussein (2012).

Table (10): The significant interaction between the tested flax varieties and pulling dates on fiber cellulose percentage. (Combined analysis of 2009/2010 and 2010 /2011 seasons)

Pulling dates	Flax varieties								L.S.D at 5%
	Sakha3	Sakha4	Giza9	Giza10	Istru	Daneila	Blenika	Ilona	
130 DAS	74.35	72.68	75.22	73.77	72.45	72.08	72.56	73.52	
145 DAS	76.88	74.88	77.36	75.58	75.02	73.85	74.64	75.78	
160 DAS	75.31	73.99	76.23	74.73	74.08	72.84	74.10	75.02	2.25
L.S.D at 5%	1.92								

Table 11: Simple correlation coefficients between fiber yield/fad and some of its components and its quality characters for some local and introduced flax varieties under three pulling dates (combined analysis of 2009/2010 and 2010/2011 seasons).

Variables		1	2	3	4	5	6	7	8	9	10
Y	Fiber yield/fad	0.6324**	0.8200**	0.8752**	0.6652**	0.8786**	0.7978**	0.5641*	0.7093**	0.6831**	0.6184**
1	Total length/plant	–	0.8769**	0.2345	0.7263**	0.6693**	0.9581**	0.9020**	0.6937**	0.5594*	0.7324**
2	Technical length		–	0.8795**	0.7959**	0.6946**	0.8700**	0.8542**	0.6231**	0.5119*	0.6269**
3	Straw yield/plant			–	0.8437**	0.7656**	0.8664**	0.6758**	0.6254**	0.5269*	0.5058*
4	Straw yield/fad				–	0.6976**	0.7582**	0.2312	0.6243**	0.5672*	0.5769*
5	Long fiber %					–	0.7201**	0.5508*	0.6899**	0.6822**	0.5864*
6	Fiber length						–	0.9037**	0.6744**	0.5115*	0.6899**
7	Fiber fineness							–	0.6037**	0.4070	0.7303**
8	Fiber cellulose %								–	0.9396**	0.8391**
9	Fiber pectin %									–	0.7921**
10	Fiber lignin %										–

Simple correlation coefficient between seed yield/ fad and some of its attributed variables are presented in Table (12). Relevant results showed that seed yield/fad was positive and significant associated with each of number of apical branches/ plant number of capsules/ plant, number of seeds/ capsule, seed index, seed yield/ plant, seed oil%, oil yield/ fad, seed pectin% and protein yield/ fad as well as all of these traits were positive and significant correlated with each other. On the other hand, positive and insignificant association was found between seed protein% and each of number of apical branches/ plant and number of capsules/plant, number of seeds/capsule, seed index, seed yield/plant, seed oil% and oil yield/fad. Similarly, number of seeds/capsule was associated positively and insignificantly with seed oil%. These associations could be employed through selecting both of higher seed yield/plant and heavior seed index to produce higher seed yield per unit area of the land. Similar findings are in harmony with those obtained by Momtaz *et al.* (1977), El-Shaer *et al.* (1983), Ghanem (1990), Zeiton (1992), Al-Kaddoussi and Moawed (2001) and Hussein (2012).

VI- Path coefficient analysis study:

1- Path analysis related to fiber yield and its components:

Direct and Joint effects of fiber yield components, i.e. straw yield/ plant, technical length and fiber length as well as their interactions recorded as percentage of fiber yield/ fad variation as affected by pulling dates and flax varieties are given in Table (13). Results revealed that straw yield/ plant and technical length as well as their interaction are considered the main sources of fiber yield/ fad variation having contribution percentage of 41.58, 3.40 and 20.91%, respectively. Also, R^2 reached 77.77% of the total fiber yield variation. However, the residual effect of the other fiber yield components was 22.23%. Similar results were reported by Ghanem (1990), Zeiton (1992), Aly and Awaad (1997), Al-Kaddussi and Moawed (2001) and Hussein (2012).

Table 12: Simple correlation coefficients between seed yield/fad and some of its components and its quality characters for some local and introduced flax varieties under three pulling dates (combined analysis of 2009/2010 and 2010/2011 seasons).

Variables		1	2	3	4	5	6	7	8	9	10
Y	Seed yield/fad	0.7747**	0.7687**	0.8720**	0.8685**	0.9470**	0.9158**	0.9976**	0.6913**	0.9633**	0.5731*
1	No. of apical branches/plant	–	0.9860**	0.7981**	0.7184**	0.7566**	0.8504**	0.7838**	0.3424	0.7400**	0.7146**
2	No. of capsules/plant		–	0.7783**	0.6951**	0.7772**	0.8588**	0.7800**	0.0866	0.7056**	0.7222**
3	No. of seeds/capsule			–	0.6873**	0.8799**	0.4118	0.8625**	0.1156	0.8490**	0.8476**
4	Seed index				–	0.7407**	0.7806**	0.8632**	0.3877	0.9143**	0.6341**
5	Seed yield/plant					–	0.9267**	0.9489**	0.1090	0.8633**	0.6418**
6	Seed oil %						–	0.9355**	0.0623	0.8550**	0.6566**
7	Oil yield/fad							–	0.0772	0.3493	0.6947**
8	Seed protein %								–	0.3198	0.1503
9	Protein yield/fad									–	0.6940**
10	Iodine value										–

Table 13: Direct and Joints effects of straw yield plants, technical length and fiber length as well as their interactions recorded as percentage of fiber yield/fad variation of flax (combined analysis of 2009/2010 and 2010/2011 seasons).

Source of variation	C.D	%
Straw yield/plant	0.4158	41.58
Technical length	0.0340	3.40
Fiber length	0.0058	0.58
Straw yield/plant x technical length	0.2091	20.91
Straw yield/plant x fiber length	0.0878	8.78
Technical length x fiber length	0.0252	2.52
Direct and indirect (R^2)	0.7777	77.77
Residual (RE)	0.2223	22.23
Total	1.0000	100.00

Where: C.D and % are symbols allude to coefficient of determination and contribution percentage.

2- Path analysis related to seed yield/ fad and its components:

Results in Table (14) revealed that seed yield/ plant, seed index and their interaction are considered the main sources of seed yield/ fad variation having contribution percentage of 43.32, 12.98 and 35.14%, respectively. Also, R^2 reached 96.16% of the total seed yield variation. However the residual effect of seed yield components included in the present study was 3.81%. These results are in accordance with those reported by Ghanem (1990), Zeiton (1992), Aly and Awaad (1997), Al-Kaddoussi and Moawed (2001) and Hussein (2012).

Table 14: Direct and Joints effects of seed yield plant, no. of capsules/plant and seed index as well as their interactions recorded as percentage of seed yield/fad variation of flax (combined analysis of 2009/2010 and 2010/2011 seasons).

Source of variation	C.D	%
Seed yield/plant	0.4332	43.32
No. of capsules/plant	0.0008	0.08
Seed index	0.1298	12.98
Seed yield/plant x no. of capsules/plant	0.0.316	3.16
Seed yield/plant x seed index	0.3514	35.14
No. of capsules/plant x seed index	0.0151	1.51
Direct and indirect (R^2)	0.9619	96.16
Residual (RE)	0.0381	3.81
Total	1.0000	100.00

Where: C.D and % are symbols allude to coefficient of determination and contribution percentage.

Conclusion

From the previous results it could be concluded that new flax varieties Giza9, Giza10, Sakha3 and Sakha4 which released by Fiber Crops Research Station in Giza exceeded the introduced flax varieties in yield and yield components as well as fiber and seed quality parameters were plants pulled at medium dates (145 days after sowing), so it may be recommended to encourage expansion of this new varieties in sandy soil under new irrigation system (sprinkler irrigation) and this in turn encourage expansion of flax growing horizontally where there is no competition between flax and other winter feeding crops.

Improving and maximizing the productivity and quality for these new varieties whereas plant breeder could be focalize his attention on straw yield/ plant, technical length, seed yield/ plant and seed index to improve and maximize the final fiber and seed yields per unit area of the land.

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تقييم إنتاجية وجودة بعض أصناف الكتان المحلية والمستوردة تحت مواعيد تقليع مختلفة بالاراضى الرملية

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الملخص العربى

أجريت تجربتان حقليتان بمحطة البحوث الزراعية بالاسماعيلية خلال موسمى ٢٠٠٩/٢٠١٠ و ٢٠١٠/٢٠١١ وذلك لتقييم ثمانية اصناف من الكتان منهم اربعة اصناف محلية (سخا٣، سخا٤، جيزه ٩، جيزه ١٠) ، أربعة أصناف مستوردة (استرو، دانيلا، بلنكا وايلونا) تحت ثلاثة مواعيد تقليع مختلفة (التقليع بعد ١٣٠، ١٤٥، ١٦٠ يوم من الزراعة والتى تمثل الميعاد المبكر، والمتوسط، والمتاخر على التوالى). وقد تم دراسة صفات المحصول ومكوناته وجودة البذرة والالياف والتركيب الكيماوى للالياف بالاضافة الى تقدير معاملى الارتباط والمرور بهدف قياس مدى مساهمة تلك المكونات فى محصولى الالياف والبذور للفدان. هذا وقد استخدم تصميم القطع المنشقة مرة واحده فى اربعة مكررات فى تنفيذ التجربة حيث وضعت مواعيد التقليع فى القطع الرئيسية بينما وضعت الأصناف فى القطع الشقية وكان نظام الرى المستخدم هو نظام الرى الحديث (الرى بالرش). ويمكن تلخيص اهم النتائج المتحصل عليها كمتوسط لموسمى الزراعة على النحو التالى:–

١– ادى تاخير ميعاد التقليع من ١٣٠ الى ١٤٥ يوم من الزراعة الى زيادة معنوية لصفات الطول الكلى والفعال للنبات، محصول القش للنبات،طول الالياف، عدد الأفرع القمية للنبات، عدد كبسولات النبات، عدد بذور الكبسولة ، النسبة المئوية للبروتين للبذرة ، وكذلك محصول البروتين للفدان وقد ادى ميعاد التقليع المتوسط (بعد ١٤٥ يوم من الزراعة) الى حدوث زيادة معنوية عالية لصفات محصول القش للفدان، النسبة المئوية

للالياف الطويلة ، نعومة الالياف والنسبة المئوية للسليلوز والبكتين واللجنين بالالياف، ومحصول البذرة للنبات والفدان، النسبة المئوية للزيت فى البذرة ومحصول الزيت للفدان. على الجانب الاخر أدى تأخير ميعاد التقليع الى ١٦٠ يوم من الزراعة الى حدوث زيادة معنوية لصفات الرقم اليودى للزيت والنسبة المئوية للجنين بالالياف.

٢- اظهرت النتائج وجود اختلافات معنوية بين الثمانية أصناف المختبرة لكل الصفات المدروسة. هذا وقد تفوق صنف الكتان المحلى جيزه ٩ يليه الصنف المحلى سخا ٣ على بقية الاصناف فى صفات محصول القش (الطول الكلى والفعال للنبات، محصول القش للنبات والفدان ، محصول الالياف للفدان) وصفات جودة الالياف (النسبة المئوية للالياف الطويلة، وطول الالياف ونعومتها) هذا بالاضافة الى صفات التركيب الكيماوى للالياف (النسبة المئوية للسليلوز والبكتين واللجنين)، بينما تفوق صنف الكتان المحلى جيزه ١٠ يليه الصنف المحلى سخا٤ على بقية الاصناف الاخرى المختبرة فى صفات محصول البذرة (عدد الافرع القمية والكبسولات للنبات، عدد بذور الكبسولة، محصول البذرة للنبات وللفدان)، وصفات جودة البذرة (دليل البذرة ونسبة الزيت بالبذرة ومحصول الزيت للفدان ونسبة البروتين بالبذرة ومحصول البروتين للفدان والرقم اليودى للزيت) فى حين سجلت الاصناف المختبرة الاخرى قيم وسطية لجميع الصفات المدروسة.

٣- لوحظ وجود تفاعل معنوى كمتوسط لموسمى الزراعة بين مواعيد التقليع الثلاثة والثمانية أصناف فى صفات الطول الفعال، محاصيل القش والالياف والبذور والزيت والبروتين للفدان، محصول البذرة للنبات، الرقم اليودى للزيت، طول الالياف ونعومتها ومحتوى السليلوز بالالياف.

٤- اظهرت النتائج وجود ارتباط موجب وعالى المعنوية بين محصولى الالياف والبذور للفدان ومعظم الصفات المرتبطة بهما.

٥- اظهرت نتائج تحليل معامل المرور ان كل من محصول القش للنبات والطول الفعال وكذلك التفاعل بينهما كانت من اهم المصادر الرئيسية التى ساهمت فى زيادة محصول الالياف للفدان بمساهمة نسبية تقدر بـ ٤١.٥٨، ٣.٤٠، ٢٠.٩١% على التوالى وفى نفس الوقت فان كل من محصول البذرة للنبات ودليل البذرة وكذلك التفاعل بينهما كانت من اهم المصادر الرئيسية التى ساهمت فى زيادة محصول البذرة للفدان بمساهمة نسبية مقدارها ٤٣.٣٢، ١٢.٩٨، ٣٥.١٤% على التوالى.

٦ – لتحسين وتعظيم انتاجية محصول تلك الاصناف وتحقيق افضل جودة لها يجب على مربى النبات ان يضع فى اعتباره الانتخاب لصفات محصول القش للنبات والطول الفعال للنبات للحصول على اعلى محصول الياف كما" ونوعا". وفى نفس الوقت الانتخاب لصفات محصول البذرة للنبات ودليل البذرة للحصول على اعلى محصول للبذرة كما" و نوعا".

٧- يمكن التوصية تحت ظروف هذه الدراسة بالتوسع بزراعة الكتان فى الاراضى الرملية وذلك بزراعة الأصناف المحلية المستنبطة حديثا مثل جيزه ٩، جيزه ١٠، سخا٣، سخا٤ على التوالى وتقليع نباتات هذه الأصناف بعد ١٤٥ يوم لتحقيق أعلى محصول وأفضل جودة للألياف والبذور.

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١– ادى ميعاد التقليع المتوسط (بعد ١٤٥ يوم من الزراعة) الى حدوث زيادة معنوية عالية لصفات محصول القش للفدان، النسبة المئوية للالياف الطويلة ، نعومة الالياف والنسبة المئوية للسليلوز والبكتين واللجنين بالالياف، ومحصول البذرة للنبات والفدان، النسبة المئوية للزيت فى البذرة ومحصول الزيت للفدان. على الجانب الاخر أدى تأخير ميعاد التقليع الى ١٦٠ يوم من الزراعة الى حدوث زيادة معنوية لصفات الرقم اليودى للزيت والنسبة المئوية للجنين بالالياف.

٢– اظهرت النتائج وجود اختلافات معنوية بين الثمانية أصناف المختبرة لكل الصفات المدروسة. هذا وقد تفوق صنف الكتان المحلى جيزه ٩ يليه الصنف المحلى سخا ٣ على بقية الاصناف فى صفات محصول القش وصفات جودة الالياف هذا بالاضافة الى صفات التركيب الكيماوى للالياف، بينما تفوق صنف الكتان المحلى جيزه ١٠ يليه الصنف المحلى سخا٤ على بقية الاصناف الاخرى المختبرة فى صفات محصول البذرة، وصفات جودة البذرة فى حين سجلت الاصناف المختبرة الاخرى قيم وسطية لجميع الصفات المدروسة.

٣– لوحظ وجود تفاعل معنوى كمتوسط لموسمى الزراعة بين مواعيد التقليع الثلاثة والثمانية أصناف فى صفات الطول الفعال، محاصيل القش والالياف والبذور والزيت والبروتين للفدان، محصول البذرة للنبات، الرقم اليودى للزيت، طول الالياف ونعومتها ومحتوى السليلوز بالالياف.

٤– اظهرت النتائج وجود ارتباط موجب وعالى المعنوية بين محصولى الالياف والبذور للفدان ومعظم الصفات المرتبطة بهما.

٥– اظهرت نتائج تحليل معامل المرور ان كل من محصول القش للنبات والطول الفعال وكذلك التفاعل بينهما كانت من اهم المصادر الرئيسية التى ساهمت فى زيادة محصول الالياف للفدان وفى نفس الوقت فان كل من محصول البذرة للنبات ودليل البذرة وكذلك التفاعل بينهما كانت من اهم المصادر الرئيسية التى ساهمت فى زيادة محصول البذرة للفدان.

٦ – يجب على مربى النبات ان يضع فى اعتباره الانتخاب لصفات محصول القش للنبات ، الطول الفعال للنبات ، محصول البذرة للنبات ودليل البذرة وذللك للحصول على اعلى محصول للألياف والبذرة كما" و نوعا" على التوالى.

٧– يمكن التوصية تحت ظروف هذه الدراسة بالتوسع بزراعة الكتان فى الاراضى الرملية وذلك بزراعة الأصناف المحلية المستنبطة حديثا مثل جيزه ٩، جيزه ١٠، سخا٣، سخا٤ على التوالى وتقليع نباتات هذه الأصناف بعد ١٤٥ يوم لتحقيق أعلى محصول وأفضل جودة للألياف والبذور.

Table 3: Mean values of yield and yield components as affected by the tested flax varieties, pulling dates and their interaction in 2009/2010 and 2010/2011 seasons and their combined analysis.

Characters	Total length/plant (cm)			Technical length (cm)			Straw yield/plant (g)			Straw yield/fad (ton)			Fiber yield/fad (ton)		
Seasons / Treatments	1st	2nd	Comb.	1st	2nd	Comb.	1st	2nd	Comb.	1st	2nd	Comb.	1st	2nd	Comb.
A- Pulling dates (P):															
P1 : 130 DAS.	87.02	88.40	87.71	70.66	72.41	71.54	0.711	0.819	0.765	2.851	3.028	2.939	0.351	0.398	0.375
P2 : 145 DAS.	91.58	93.29	92.44	76.04	79.31	77.67	0.838	0.924	0.881	3.684	3.919	3.801	0.525	0.594	0.559
P3 : 160 DAS.	93.87	94.47	94.17	75.60	77.89	76.75	0.776	0.888	0.832	3.485	3.345	3.415	0.469	0.477	0.474
F. test.	**	**	**	*	**	**	*	*	**	**	**	**	**	**	**
L.S.D at 5%.	1.92	2.47	1.76	2.13	1.88	1.35	0.072	0.085	0.064	0.241	0.293	0.191	0.031	0.079	0.030
L.S.D at 1%.	2.12	3.44	1.97	–	2.45	1.97	–	–	0.090	0.401	0.449	0.278	0.051	0.110	0.043
B- Flax varieties (V):															
V1 : Sakha3.	92.69	94.01	93.35	75.27	78.35	76.81	0.807	0.904	0.855	3.431	3.482	3.457	0.473	0.505	0.489
V2 : Sakha4.	90.43	93.23	91.83	71.28	75.23	73.25	0.702	0.848	0.775	3.278	3.189	3.234	0.416	0.436	0.428
V3 : Giza9.	95.78	97.06	96.42	80.73	81.95	81.34	0.896	1.003	0.949	3.671	3.809	3.740	0.544	0.588	0.566
V4 : Giza10.	93.16	95.09	94.13	77.13	79.35	78.24	0.835	0.909	0.872	3.477	3.536	3.506	0.474	0.514	0.494
V5 : Istru.	88.86	89.38	89.12	72.81	74.89	73.85	0.755	0.856	0.805	3.386	3.654	3.520	0.426	0.468	0.447
V6 : Daneila.	86.01	86.77	86.39	69.02	71.76	70.39	0.671	0.783	0.727	2.911	3.127	3.019	0.336	0.379	0.358
V7 : Blenika.	87.44	87.09	87.27	71.63	73.39	72.51	0.705	0.788	0.746	3.102	3.172	3.137	0.418	0.464	0.441
V8 : Ilona.	92.21	93.80	93.01	74.95	77.39	76.17	0.829	0.925	0.877	3.465	3.477	3.471	0.496	0.535	0.516
F.test.	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
L.S.D at 5% .	3.30	2.70	1.83	2.09	1.55	1.28	0.078	0.066	0.050	0.305	0.270	0.201	0.047	0.057	0.033
L.S.D at 1%.	4.40	3.26	2.42	2.79	2.06	1.70	0.102	0.086	0.065	0.407	0.361	0.266	0.062	0.072	0.042
C- Interactions: (PxV).	N.S	*	N.S	*	N.S	*	N.S	*	N.S	N.S	*	*	N.S	*	*

*, ** and N.S indicate significant at 5%, 1% level of probability and insignificant, respectively.

Table 3:Cont.

Characters	Number of apical branches/plant			Number of capsules/plant			Number of seeds/capsule			Seed yield/plant (g)			Seed yield/fad (kg)		
Seasons / Treatments	1st	2nd	Comb.	1st	2nd	Comb.	1st	2nd	Comb.	1st	2nd	Comb.	1st	2nd	Comb.
A- Pulling dates (P):															
P1 : 130 DAS.	12.78	13.72	13.25	10.98	11.48	11.23	6.89	7.54	7.22	0.306	0.396	0.351	285.46	287.39	272.92
P2 : 145 DAS.	13.82	15.01	14.42	12.03	12.52	12.28	7.71	8.39	8.05	0.395	0.484	0.439	378.06	425.90	401.98
P3 : 160 DAS.	14.10	15.57	14.83	12.28	12.77	12.53	8.36	8.65	8.50	0.358	0.449	0.403	333.01	385.12	359.06
F. test.	*	**	**	**	**	**	**	*	**	**	**	**	*	**	**
L.S.D at 5%.	0.97	0.74	0.60	0.66	0.67	0.59	0.52	0.50	0.40	0.033	0.039	0.023	53.36	43.06	34.16
L.S.D at 1%.	–	1.21	0.83	0.86	0.91	0.67	0.86	—	0.54	0.042	0.059	0.041	—	58.24	45.09
B- Flax varieties (V):	12.99	13.90	13.44	11.23	11.72	11.48	8.08	8.47	8.28	0.368	0.456	0.412	340.41	379.92	360.17
V1 : Sakha3.	14.29	15.41	14.85	12.55	13.04	12.80	8.11	8.55	8.33	0.419	0.513	0.466	379.89	432.44	406.17
V2 : Sakha4.	14.04	15.46	14.75	12.07	12.56	12.32	8.40	8.75	8.57	0.397	0.487	0.442	371.27	403.63	387.45
V3 : Giza9.	14.97	16.51	15.74	13.41	13.90	13.66	8.68	9.28	8.98	0.440	0.529	0.485	395.08	455.90	425.49
V4 : Giza10.	11.39	12.46	11.92	9.34	9.86	9.60	6.51	7.23	6.87	0.249	0.339	0.294	236.56	278.43	257.49
V5 : Istru.	14.33	15.28	14.81	12.43	12.92	12.68	7.21	7.66	7.44	0.319	0.409	0.365	291.16	324.04	307.60
V6 : Daneila.	12.30	13.53	12.92	10.65	11.14	10.89	6.90	7.47	7.18	0.293	382	0.337	252.58	305.51	279.04
V7 : Blenika.	14.23	15.57	14.90	12.43	12.92	12.67	7.33	8.14	7.74	0.338	0.427	0.383	318.47	349.20	333.83
V8 : Ilona.	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
F.test.	0.67	0.64	0.56	0.76	0.58	0.47	0.42	0.61	0.39	0.042	0.041	0.028	67.89	58.23	47.46
L.S.D at 5% .	0.90	0.86	0.71	1.01	0.77	0.62	0.53	0.68	0.49	0.059	0.06	0.045	87.25	74.46	56.40
L.S.D at 1%.	*	N.S	N.S	*	N.S	N.S	*	N.S	N.S	*	*	*	N.S	*	*
C- Interactions: (PxV).															

*, ** and N.S indicate significant at 5%, 1% level of probability and insignificant, respectively

Table 5: Mean values of seed quality as affected by the tested flax varieties, pulling dates and their interaction in 2009/2010 and 2010/2011seasons and their combined analysis.

Characters	Seed index (g)			Seed oil %			Oil yield/fad (kg)			Seed protein %			Protein yield/fad (kg)			Iodine value		
Seasons / Treatments	1st	2nd	Comb.	1st	2nd	Comb.	1st	2nd	Comb.	1st	2nd	Comb.	1st	2nd	Comb.	1st	2nd	Comb.
A-Pulling dates (P):																		
P1 : 130 DAS.	4.17	4.62	4.39	34.60	35.17	34.88	89.72	101.53	95.62	23.66	24.16	23.91	61.11	69.13	65.12	165.63	167.63	166.63
P2 : 145 DAS.	6.33	6.82	6.60	36.11	36.71	36.41	137.13	156.94	147.03	25.77	26.51	26.14	97.09	112.63	104.86	168.27	170.48	169.38
P3 : 160 DAS.	5.50	6.30	5.90	35.33	35.93	35.63	117.76	137.87	127.82	26.16	26.77	26.47	86.32	102.48	94.40	171.30	173.61	172.46
F. test.	**	**	**	**	**	**	**	**	**	*	*	**	**	**	**	**	**	**
L.S.D at 5%.	0.26	0.31	0.24	0.76	0.77	0.63	22.88	24.81	18.48	0.89	1.25	0.82	14.57	11.61	9.75	3.55	3.26	2.67
L.S.D at 1%.	0.31	0.45	0.28	0.93	0.95	0.78	34.65	31.28	22.31	—	—	1.69	24.16	19.26	13.24	4.23	4.09	3.11
B- Flax varieties (V):	5.21	5.70	5.51	35.10	35.54	35.32	119.81	135.47	127.64	24.27	24.77	24.52	82.83	94.78	88.81	168.30	170.49	169.39
V1 : Sakha3..	5.65	6.30	5.97	36.05	36.62	36.33	137.33	156.31	146.82	23.12	23.60	23.36	88.30	102.67	95.49	170.03	171.93	170.98
V2 : Sakha4.	5.50	6.09	5.79	35.92	36.53	36.23	132.38	147.47	139.93	26.34	26.81	26.58	98.62	108.85	103.74	167.76	170.74	169.25
V3 : Giza9.	5.89	6.51	6.20	36.98	37.68	37.33	146.42	172.42	159.42	27.31	28.08	27.69	107.90	128.02	117.82	171.40	173.52	172.46
V4 : Giza10.	4.51	5.06	4.79	33.53	34.09	33.81	79.42	95.13	87.28	25.22	25.67	25.44	59.66	71.47	65.50	165.67	167.73	166.70
V5 : Istru.	5.65	6.21	5.93	34.93	35.55	35.24	102.10	115.63	108.87	25.93	27.00	26.46	75.79	88.02	81.41	166.53	168.61	167.57
V6 : Daneila.	4.93	5.42	5.17	34.69	35.33	35.01	87.79	108.00	97.89	25.39	26.07	25.73	64.61	80.42	72.52	168.11	170.21	169.16
V7 : Blenika.	5.33	6.02	5.69	35.57	36.14	35.86	113.69	126.47	120.07	23.99	24.51	24.25	77.04	86.32	81.68	169.40	171.34	170.37
V8 : Ilona.	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
F.test.	0.31	0.40	0.28	0.76	0.86	0.67	24.99	23.15	20.21	1.02	1.01	0.70	10.23	13.27	9.70	3.07	3.21	2.79
L.S.D at 5%.	0.39	0.51	0.34	0.89	1.08	0.79	28.35	29.25	23.54	1.35	1.34	0.93	12.99	17.74	12.18	3.42	3.61	3.05
L.S.D at 1%.																		
C- Interactions: (PxV).	N.S	N.S	N.S	N.S	*	N.S	N.S	*	*	N.S	*	N.S	N.S	*	*	N.S	*	*

*, ** and N.S indicate significant at 5%, 1% level of probability and insignificant, respectively.