



EFFECT OF HARVESTING DATES ON THE YIELD AND QUALITY OF SOME FLAX GENOTYPES

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ABSTRACT

Two field experiments were conducted during the two successive seasons 2007/2008 and 2008/2009 at Sakha Agric. Res. Station, Kafr El-Sheikh Governorate to study the effect of four harvesting dates i.e. 135, 145, 155 and 165 days after sowing on yield and its quality of six flax genotypes namely, Sakha1, Sakha 2, Sakha 3 and Giza 9 varieties and two new promising strains (strain 16 and strain 22). This study was laid out in a split-plot design, with four replications, the main plots were allocated to the six flax genotypes, whereas, the sub-plots contained the harvesting dates. The obtained results could be summarized as follow:

Sakha 3 and Giza 9 varieties gave the highest means for technical length, fiber yield/plant as well as per fed., fiber length, fiber percentage, fiber strength, fiber fineness, germination % and crude protein %, whereas strain 22 (yellow seed) surpassed the other flax genotypes which produced the highest values for No. of seeds/plants, seed yield/fed., oil content and oil yield/fed.

The harvest date of 155 days after sowing showed significant increases in stem diameter, straw yield/plant as well as per fed. fiber yield and its quality and crude protein % compared to the other three dates (135, 145 and 165 days after sowing). However, delayed harvesting date to 165 days after sowing recorded significant increase in technical length, upper branching zone length, seed yield and its related characters, germination %, seedling vigour, seed index, volume of 1000-seed, oil content and oil yield/fed.

The interactions among the studied factors had significant effects on straw yield/fed., No. of capsules/plants, fiber strength and germination % in the first season of study, while the characters of the upper branching zone length, seed yield/fed., oil yield/fed., fiber length and oil content in both seasons.

INTRODUCTION

Flax (*Linum usitatissimum* L.) is a source of two products; flaxseed for oil and fiber for linen products. In Egypt, it is an old economic crop grown as a dual purpose crop for seeds and fibers which is used for the manufacture of linen. The oil is edible and also, due to its quick drying properly, is used for the preparation of paints, varnishes, printing ink, oil cloth and soap.

In Egypt, flax plays an important role in the national economy owing to export beside local industry. Increasing the production of flax from the present limited areas is considered as a basic target. This could be achieved through growing high yielding genotypes and proper harvesting dates occupy an important role in this respect. Many investigators obtained varietal differences in yield and quality of flax in many regions of growing flax. El-Shimy *et al* (1997); Kineber & El-Kady (1998), El-Sweify *et al* (2003); Abd El-Fatah (2007) and El-Kady & Abd El-Fatah (2009).

Choosing the right time for flax pulling is very important and needs more skill and high experience, pulling date affects yield and quality of flax products, fibers and oil, as reported by Ghanem (1990), who stated that, the harvesting date at 150 days after sowing resulted in significant increase in technical length, number of capsules and seed numbers/plant, seed yield (kg/fed), oil percentage,

oil and straw yields/fed., fiber length, fiber percentage and fiber yield (kg/fed) compared to the other three dates i.e. 130, 140 and 160 days after sowing. Similar views were expressed by Gontia and Sonakia (2002); El-Azzouni (2003); El-Deeb & Abd El-Fatah (2006) and El-Sweify *et al* (2006).

This work was undertaken to investigate the beneficial effects of genotypes and harvesting dates on quantity of flax production, fiber quality, germination, physical properties and chemical composition of flaxseed.

MATERIALS AND METHODS

Two field experiments were carried out at Sakha Agricultural Research Station, ARC, during the two successive seasons of 2007/2008 and 2008/2009 to investigate the influence of: 1- six flax genotypes four varieties (Sakha 1, Sakha 2, Sakha 3, and Giza 9) as well as two promising strains 16 and 22 released by Fiber Crops Res. Dept., Field Crops Res. Inst., ARC (Table 1) and 2- four harvesting dates i.e. 135, 145, 155 and 165 days after sowing on yield and its components and quality.

Treatments were arranged in split plot design with four replicates where genotypes were the main plots, and harvesting dates as sub plot. The sub plot was 6 m² (4 x 1.5 m) area. Flaxseeds were sown on 10 November 2007 and 6 November 2008 in rows 4 m long and 15 cm apart. Recommended N, fertilizer was applied at the rate of 100 kg N/fed. in the form of urea (46% N).

Normal agronomic recommended practices of flax growing were followed till proposed harvesting date, then flax plants were hand pulled and left one week for complete air-drying. At each of harvesting dates under this investigation, ten individual plants in each plot were taken to determine the yield components. Flax straw yield, seed yield and fiber yield per fed. were calculated from the sub-plot area. Data collected included:

I. Yield and its components

1. Technical stem length (cm)
2. Stem diameter (mm)
3. Straw yield/plant (g)
4. Straw yield/fed. (ton)
5. Upper branching zone length (cm)
6. Number of capsules/plant
7. Number of seeds/plant
8. Seed yield/plant (g)
9. Seed yield/fed. (kg)
10. Oil yield/fed. (kg)

II. Fiber yield and quality

1. Fiber yield/plant (g)
2. Fiber yield/fed. (kg)
3. Fiber length (cm)
4. Fiber percentage
5. Fiber fineness (N.m)
6. Fiber strength (R.K.M.)

Fiber fineness and fiber strength were determined according to Radwan and Momtaz Method (1966).

III. Germination, seedling vigour and some physical properties

A standard *in vitro* germination test (I.S.T.A., 1993) was conducted on four replicates of 50 seeds for each seed sample using folded paper towels at 20°C and germination counts for normal seedlings were done after seven days. The length of shoot and radial (cm) of the most 15 vigorous seedlings of each replicate was measured, then seedlings were oven dried at 105°C to a constant weight.

Seedling vigour

1. Shoot length (cm)
2. Radical length (cm)
3. Seedling dry weight (g)

Measured according to the procedures exported in the seed vigour tested handbook (A.O.S.A., 1991).

Some physical properties

1. Seed index (1000 seed weight) (g)
2. Volume of 1000 seed: was measured by absolute displacement methods (Kramer and Twigg, 1962).
3. Relative density: was calculated according to Kramer and Twigg (1962) method and using the following equation:

$$\text{Relative density} = \frac{\text{The weight of 1000 seed (g)}}{\text{The volume of 1000 seed (cm}^3\text{)}} = \text{g/cm}^3$$

IV. Chemical composition of flaxseed genotypes

1. Moisture %
2. Oil content %
3. Crude protein %
4. Ash %

Table 1. The pedigree of the different genotypes in the investigation

Genotypes	Classification and seed colour	Year released	Pedigree
Sakha 1	D, brown seed	1999	I.1485 x Bombay
Sakha 2	D, brown seed	1999	I.2348 x Hera
Sakha 3	F, brown seed	2006	Belinka2E x I.2096
Giza 9	F, brown seed	2009	S20/140/5/10 x Bombay
Strain 16	O, brown seed	-	Giza 8 x S.2419/1
Strain 22	O, yellow seed	-	I.370x I.2561

D = dual purpose type, F = fiber purpose type, O = oil purpose type

were determined according to the method described by A.O.A.C. (1990). All collected data, were subjected to statistical analysis for each season and the homogeneity of experimental error in both seasons was done by Bartlett test. Then, the results for each season are discussed separately, as described by Snedecor and Cochran (1982). The mean values were compared according to Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

1. Yield and yield components

Data presented in Table (2) revealed high significant differences among the flax genotypes in yield and its components. The means of technical length ranged from 54.32 cm to 75.03 cm in 2007/2008 season and 56.04 cm to 74.51 cm in 2008/2009 season. Giza 9 and Sakha 3 varieties gave the highest technical length in both seasons. On the other hand, strain 22 produced the shortest technical length and thinnest stem compared with other flax genotypes.

The mean of straw yield/plant, ranged from 1.63 g for strain 22 to 2.26 g for Sakha 1 variety in 2007/2008 season, whereas 2008/2009 season ranged from 1.49 g for strain 22 to 2.19 g for Sakha 1 variety. Sakha 1 variety was significantly the highest in straw yield/fed., whereas the strain 22 produced the lowest yield of straw/fed. The highest of upper branching zone length was obtained from Sakha 2 variety, whereas, the strain 22

gave the shortest one in both seasons. The mean number of capsules/plant for six genotypes ranged from 5.53 (Sakha 3) to 6.51 (strain 16) and from 3.44 (Sakha 3) to 5.61 (Sakha 2) in both seasons, respectively. It could be stated from Table (2), that the same trend mentioned above in the case of capsule number/plant could be implied in the number of seeds/plant in the first season.

The differences in seed yield/plant between the six flax genotypes showed that strain 16 and strain 22 had the highest seed yield/plant in the first and second seasons, respectively. On the contrary, Sakha 3 was significantly the lowest in seed yield/plant. Seed yield/fed. ranged from 547.4 kg for Sakha 3 variety to 923.8 kg for strain 22 and 554.2 kg for Giza 9 to 923.6 kg for strain 22 in both seasons, respectively. The same trend was obtained in oil yield/fed. in both seasons. The differences between the tested genotypes could mainly be attributed to the differences in their genetical constitution and their response to the environmental conditions. Such results are in harmony with those obtained by many investigators, Kineber and El-Kady (1998), El-Sweify *et al* (2003) and Abd El-Fatah (2007).

Data presented in Table (2) showed that harvesting dates significantly affected all the studied characters in both seasons. In general, harvesting at 155 days after sowing gave the highest values for stem diameter, straw yield/plant and straw yield/fed. in both seasons. On the other hand, data indicated that the last harvest date (165 days after sowing)

Table 2. Mean values of yield and its components as affected by genotypes and harvesting dates during 2007/2008 and 2008/2009 seasons

Variables	Season	Genotype							Harvesting date (days after sowing)				Interaction	
		Sig.	Sakha 1	Sakha 2	Sakha 3	Giza 9	Strain 16	Strain 22	Sig.	135	145	155		165
Technical length (cm)	2007/08	**	71.96 b	70.28 c	71.08 bc	75.03 a	70.04 c	54.32 d	**	64.27 c	68.14 b	70.91 a	71.82 a	NS
	2008/09	**	73.83 a	72.63 a	74.51 a	74.01 a	71.87 a	56.04 b	**	68.32 b	70.40 a	71.18 a	72.02 a	NS
Stem diameter (mm)	2007/08	**	1.84 ab	1.77 bc	1.65 cd	1.67 cd	1.95 a	1.62 d	**	1.62 c	1.68 c	1.93 a	1.78 b	NS
	2008/09	**	1.91 a	1.93 a	1.63 bc	1.68 bc	1.77 ab	1.61 c	**	1.66 b	1.68 b	1.89 a	1.78 ab	NS
Straw yield (g/plant)	2007/08	**	2.26 a	2.20 a	1.85 c	1.86 c	2.05 b	1.63 d	**	1.78 c	1.95 b	2.16 a	2.01 b	NS
	2008/09	**	2.19 a	2.06 b	1.80 c	1.80 c	2.07 b	1.49 d	**	1.81 d	1.87 c	1.99 a	1.93 b	NS
Straw yield (ton/fed.)	2007/08	**	2.759 a	2.592 ab	2.592 ab	2.387 ab	2.356 ab	2.102 b	*	2.307 b	2.415 ab	2.669 a	2.467 ab	*
	2008/09	**	3.020 a	2.674 b	2.453 b	2.273 b	2.360 b	2.219 b	**	2.342 c	2.382 c	2.739 a	2.536 b	NS
Upper branching zone length (cm)	2007/08	**	12.26 a	12.71 a	10.48 b	10.24 b	10.60 b	8.70 c	**	9.93 c	10.66 b	11.27 a	11.47 a	*
	2008/09	**	10.73 b	12.02 a	8.75 cd	9.24 c	10.72 b	8.54 d	**	9.03 b	10.09 a	10.36 a	10.53 a	*
No. of capsules/plant	2007/08	**	5.32 b	6.04 a	5.53 c	4.84 b	6.51 a	6.13 a	**	4.45 c	5.11 b	5.30 b	6.73 a	*
	2008/09	**	4.77 bc	5.61 a	3.44 d	3.48 d	4.18 c	5.02 ab	**	3.81 b	3.95 b	4.74 a	5.16 a	NS
No. of seeds/plant	2007/08	**	26.12 bc	26.69 bc	24.00 c	25.03 bc	33.13 a	28.13 b	**	23.01 c	25.39 b	27.40 b	32.93 a	NS
	2008/09	**	25.54 b	26.02 b	18.19 d	23.29 c	26.01 b	28.12 a	**	19.01 d	22.50 c	27.13 b	29.47 a	NS
Seed yield (g/plant)	2007/08	**	0.226 ab	0.232 ab	0.182 b	0.226 ab	0.250 a	0.175 b	**	0.131 c	0.216 b	0.251 a	0.263 a	NS
	2008/09	**	0.188 ab	0.220 a	0.110 c	0.169 b	0.204 ab	0.232 a	**	0.106 d	0.146 c	0.219 b	0.278 a	NS
Seed yield (kg/fed.)	2007/08	**	642.6 c	692.9 b	547.4 d	610.3 c	626.6 c	923.8 a	**	461.8 c	655.2 b	788.7 a	790.4 a	*
	2008/09	**	636.6 cd	798.9 b	587.9 de	554.2 e	655.8 c	923.6 a	**	403.0 d	630.6 c	808.9 b	928.7 a	*
Oil yield (kg)	2007/08	**	271.1 c	294.7 b	213.1 e	242.2 d	264.3 c	447.7 a	**	181.0 c	280.9 b	342.5 a	350.6 a	*
	2008/09	**	274.1 c	345.9 b	247.9 cd	223.7 d	276.9 c	456.4 a	**	147.5 d	277.6 c	365.7 b	425.7 a	*

revealed significant increases in each of technical length, upper branching zone length, No. of capsules/plant, No. of seeds/plant, seed yield/plant, seed yield/fed. and oil yield/fed.

These results show that the highest values of last harvesting date may be attributed to the prolonged growth period of more accumulated metabolites and in turn, the significant increases seen in seed yield and its attributive characters were more expected. These results were found to be similar to those mentioned by several workers among them, Ghanem (1990), El-Azzouni (2003) and El-Deeb and Abd El-Fatah (2006).

II. Fiber yield and its quality

Data presented in Table (3) showed clearly that fiber yield and quality parameters of flax significantly differed owing to genotypes. Sakha 3 and Giza 9 varieties gave maximum values in all fiber characters i.e. fiber yield/plant, fiber yield/fed, fiber length, fiber percentage, fiber fineness and fiber strength. On the other hand, the promising oil type strain 22 gave lower values for the same respective fiber yield and quality parameters in both seasons. It could be concluded that fiber yield and quality parameters, depended mainly on genotype and this is mainly due to the genetically constituents as well as its interaction with environmental conditions. In this connection, it should be mentioned that many workers obtained similar results El-Sweify *et al* (2003); El-Deeb and Abd El-Fatah (2006) and Hussein (2007).

The results in Table (3) illustrated that fiber yield and quality, fiber yield/plant as well as per fed., fiber length, fiber percentage, fiber fineness and fiber strength significantly responded to harvesting date except fiber yield/plant in the first season. There was an increase in fiber quality parameters with advancement towards maturity up to 155 days after sowing, except for fiber length which was gradually increased from 61.92 cm to 69.54 cm and from 59.83 cm to 69.96 cm at first and last harvesting date in both seasons, respectively. The decline in fiber quality which recorded by plants pulled at 165 days after sowing, may be due to lignifications which takes place when flax plants were left too long before harvesting. In this respect, confirmed results were reported by Ghanem (1990), and El-Sweify *et al* (2006).

III. Germination, seedling vigour and some physical properties of flaxseed

As shown in Table (4) significant differences between genotypes in the percentage of germination in 2008/2009 season only, Sakha 3, Giza 9 varieties and Strain 16 had the highest values, while Strain 22 had the lowest one. The percentage of germination increased with increasing the days from sowing to harvest with highly significant differences in both seasons. Harvesting at 155 and 165 days after sowing had the highest percentage of germination in both seasons. These results are in agreement with those obtained by Abdel-Rahman and Youssef (1979) and Siddique *et al* (2003) who found that the greatest increase in germination percent took place after the dry matter and oil contents reached its maximum. The results of seedling vigour (shoot length, radical length and seedling dry weight) were significant between genotypes under study except seedling dry weight in the first season, strain 16 had the highest shoot length (6.23 cm) in both seasons, while strain 22 recorded the lowest one 5.55 cm and 5.53 cm in both seasons. Sakha 3 achieved the highest value for radical length of 9.20 cm and 9.75 cm in both seasons, while strain 22 showed the lowest one compared to the other genotypes. In this respect, confirmed results were reported by Saeidi and Rowland (1999). They mentioned that yellow seed had lower seed vigour than brown flaxseed, this may be due to that yellow seed had lower concentration of tannins which are phenolic compounds, have antimicrobial properties and are therefore the likely source of the improved seed vigour in brown seed (Scalbert, 1991)

Results indicated that seedling vigour was increased with delaying harvest date. Harvest at 165 days after sowing recorded the highest values in both seasons being of shoot length for (6.57, 6.52 cm), radical length for (10.47, 10.18 cm) and seedling dry weight for (110.44, 112.78 g).

Table (4) cleared some physical properties of flaxseed as affected by genotypes and harvesting dates. The high significant differences between genotypes in the seed index indicated that Sakha 1, Sakha 2 and Strain 16 had the highest values followed by Giza 9 and Strain 22 in both seasons and the values ranged between 7.973 and 6.050 g. On the other hand, Sakha 3 had the lowest value of seed index (5.705 g) in the first season. Seed index increased by increase the days after sowing, the highest value recorded after 165 days of sowing 7.800 (g) and 8.063 (g) in both seasons, respectively.

Table 3. Fiber yield and quality as affected by genotypes and harvesting dates during 2007/2008 and 2008/2009 seasons

Variables	Season	Genotype							Harvesting date (days after sowing)				Interaction	
		Sig.	Sakha 1	Sakha 2	Sakha 3	Giza 9	Strain 16	Strain 22	Sig.	135	145	155		165
Fiber yield, g/plant	2007/08	*	0.317 a	0.307 a	0.328 a	0.331 a	0.306 a	0.259 b	NS	0.295	0.310	0.317	0.310	NS
	2008/09	**	0.318 a	0.313 a	0.322 a	0.324 a	0.310 a	0.256 b	**	0.296 b	0.299 b	0.330 a	0.302 b	NS
Fiber yield, kg/fed	2007/08	*	453.3 b	414.2 c	510.1 a	478.6 ab	377.9 d	318.4 d	*	371.5 c	410.6 b	481.5 a	436.7 ab	NS
	2008/09	**	503.4 a	435.6 b	502.6 a	447.3 b	360.8 c	349.9 c	*	381.0 c	411.4 bc	506.1 a	434.2 b	NS
Fiber length, cm	2007/08	**	68.19 a	67.44 a	68.25 a	68.38 a	66.56 a	52.69 b	**	61.92 c	62.46 c	67.08 b	69.54 a	*
	2008/09	**	68.69 b	67.00 b	72.88 a	71.94 a	65.63 b	51.25 c	**	59.83 c	65.42 b	69.71 a	69.96 a	*
Fiber, %	2007/08	*	16.43 b	15.98 b	19.68 a	20.05 a	16.04 b	15.15 c	*	16.10 c	17.00 b	18.04 a	17.70 ab	NS
	2008/09	*	16.62 b	16.29 b	20.49 a	19.68 a	15.29 c	15.77 bc	*	16.27 c	17.27 b	18.77 a	17.12 b	NS
Fiber fineness	2007/08	**	292.7 c	288.1 d	320.6 a	316.2 b	286.9 e	284.0 f	**	297.2 c	298.1 b	298.9 a	298.1 b	NS
	2008/09	**	296.2 c	292.2 d	325.0 a	320.2 b	290.8 e	289.2 f	**	301.5 c	302.3 b	303.1 a	302.2 b	NS
Fiber strength	2007/08	**	41.01 c	39.27 e	43.99 a	42.08 b	40.22 d	38.17 f	**	40.40 c	40.73 b	41.33 a	40.71 b	**
	2008/09	**	44.39 c	42.43 e	47.19 a	45.40 b	43.16 d	41.37 f	**	43.43 c	44.06 b	44.57 a	43.90 b	NS

Table 4. Germination, seedling vigour and some physical properties of flaxseed as affected by genotypes and harvesting dates during 2007/2008 and 2008/2009 seasons

Variables	Season	Genotype							Harvesting date (days after sowing)				Interaction	
		Sig.	Sakha 1	Sakha 2	Sakha 3	Giza 9	Strain 16	Strain 22	Sig.	135	145	155		165
Germination %	2007/08	NS	88.83	88.25	89.17	89.17	88.92	87.75	**	69.50 c	88.89 b	96.94 a	99.39 a	*
	2008/09	*	89.83 ab	88.08 bc	91.00 a	90.50 a	90.50 a	87.50 c	**	68.06 c	94.33 b	96.56 b	99.33 a	NS
Seedling vigour														
shoot length, cm	2007/08	**	6.05 ab	6.03 ab	5.98 abc	5.61 bc	6.23 a	5.55 c	**	5.22 c	5.82 b	6.03 b	6.57 a	NS
	2008/09	**	5.86 ab	5.68 ab	5.56 b	6.02 ab	6.23 a	5.53 b	**	5.12 c	6.52 a	5.73 b	5.88 b	NS
Radical length, cm	2007/08	*	8.83 abc	8.95 ab	9.20 a	8.25 c	8.49 bc	8.17 c	**	6.41 c	8.83 b	8.88 b	10.47 a	NS
	2008/09	*	8.42 b	8.90 b	9.75 a	9.04 ab	8.93 b	8.78 b	**	7.08 c	8.53 b	10.09 a	10.18 a	NS
Dry weight, mg	2007/08	NS	68.50	65.17	62.67	69.17	64.67	64.00	**	41.44 c	48.33 c	62.56 b	110.44 a	NS
	2008/09	*	70.67 a	67.83 ab	62.17 b	71.25 a	70.83 a	63.67 b	**	53.56 b	46.61 c	58.00 b	112.78 a	NS
Physical properties														
Seed index	2007/08	**	7.701 a	7.846 a	5.705 c	6.281 b	7.977 a	6.280 b	**	5.811 c	6.697 b	7.551 a	7.800 a	NS
	2008/09	**	7.777 a	7.864 a	5.918 b	6.129 b	7.993 a	6.050 b	**	5.688 d	6.524 c	7.545 b	8.063 a	NS
Volume of 1000 seed, ml ³	2007/08	**	6.758 a	6.800 a	4.783 c	5.067 bc	7.167 a	5.400 b	**	5.222 b	4.589 c	7.044 a	7.128 a	NS
	2008/09	**	6.800 c	7.333 b	5.917 d	5.542 e	7.833 a	5.400 e	**	4.894 d	5.522 c	7.556 b	7.911 a	NS
Relative density	2007/08	NS	1.189	1.177	1.193	1.252	1.150	1.198	**	1.138 b	1.434 a	1.096 b	1.105 b	NS
	2008/09	NS	1.162	1.130	1.040	1.145	1.134	1.123	**	1.187 a	1.266 a	1.009 b	1.028 b	NS

Strain 16 had the highest volume of 1000-seed compared with other genotypes in two seasons (7.167 and 7.833 ml³). Delayed harvest up to 165 days after sowing led to high significant increase the volume of 1000-seed in both seasons.

No significant different indicated between genotypes of flaxseed for relative density in both seasons. On the other hand the effect of days after sowing was high significant and decreased with increase the number of days after sowing. It may be due to the increase of oil content in the flaxseed. These results are in the same trend of those reported by El-Kady (2000) and El-Kady and Abd El-Fatah (2009).

IV. Chemical composition of flaxseed genotypes

Chemical composition of experimental flaxseed as affected by genotypes, harvesting dates and their interaction during two seasons 2007/2008 and 2008/2009 are shown in Table (5). Results showed highly significant differences between the moisture content of the experimental genotypes, the values ranged between 5.22 and 5.83% in the 1st and 2nd seasons, respectively, delayed harvest up to 165 days after sowing led to highly significant decrease in moisture content of tested flaxseed in both seasons.

Oil content of the tested genotypes showed high significant differences between them. Strain 22 had the highest content of oil percentage in both seasons (48.28 and 48.01%), while Sakha 3 variety had the lowest value in both seasons (38.82 and 38.60), respectively. Oil content of flaxseed increased with delaying the date of harvesting. The oil content of tested flaxseed increased from 38.56 and 33.94% to 43.91 and 45.17% at 135 and 165 days from sowing to harvest in both seasons, respectively. This is due to the decrease of flaxseed moisture content. Also, data in Table (5) showed highly significant differences between the tested flaxseed genotypes in seed protein content. Sakha 3 had the highest content of protein (19.35 and 21.56% in both seasons, respectively). On the other hand, harvest at 155 days after sowing gave the highest content of protein (20.39 and 21.24% in both seasons, respectively), while harvest at 135 day after sowing recorded the lowest content of flaxseed protein (16.48 and 17.19% in both seasons, respectively).

Ash percentage showed significant difference as affected by flaxseed genotypes in both seasons; Sakha 1, Sakha 2 and Sakha 3 varieties gave the highest values in both seasons, while strain 22 had the lowest one.

The increase of days after sowing to harvest led to highly significant decrease in ash content of flaxseed in both seasons. Similar results were obtained by El-Kady *et al* (2001), El-Sweify *et al* (2003) and El-Kady and Abd El-Fatah (2009).

V. The interaction effect

The interaction effect between the two studied factors i.e. genotypes and harvesting dates, were insignificant for all tested characters except the following parameters, Table (6).

Data presented in Table (6) revealed that the highest values of straw yield/fed. in the first season, fiber length in both seasons and fiber strength in the first season were (3.051 ton/fed, 80.250 cm, 80.500 cm and 44.272 R.K.M.), respectively which obtained from Sakha 3 variety when harvested at 165 days after sowing for straw yield/fed. and fiber length and at 155 days after sowing for fiber strength. While, Sakha 2 variety recorded the highest values for upper branching zone length (14.75 cm and 14.70 cm) in both seasons, respectively when its plants were harvested after 155 days from sowing and germination % (100%) at the first season after 165 days from sowing, but the promising strain 16 had the highest number of capsules/plant (13.95) in the first season at 165 days after sowing. On the other hand, new strain 22 when its plants were harvested at 155 or 165 days after sowing, gave the highest values of seed yield/fed. (1254.10 and 1226.15 kg), oil yield/fed. (608.27 and 615.85 kg) and oil content (%) (49.62 and 50.54%) in both seasons, respectively.

From the previous data it could be concluded that the fiber type varieties Sakha 3 and Giza 9 produced the highest values for straw yield and its related characters and fiber yield and its quality parameters when its plants harvested at 155 days after sowing, while seed yield and its components gave the highest values by the promising oil type genotypes strain 16 and strain 22 when it harvested at 165 days after sowing.

Table 5. Chemical composition of flaxseed as affected by genotypes and harvesting dates during 2007/2008 and 2008/2009 seasons

Variables	Season	Genotype							Harvesting date (days after sowing)					Interaction
		Sig.	Sakha 1	Sakha 2	Sakha 3	Giza 9	Strain 16	Strain 22	Sig.	135	145	155	165	
Moisture %	2007/08	**	5.64 a	5.62 a	5.47 ab	5.43 ab	5.52 a	5.22 b	**	5.99 a	5.83 a	5.49 b	4.63 c	NS
	2008/09	**	5.83 a	5.81 a	5.44 ab	5.56 ab	5.62 ab	5.28 b	**	6.15 a	5.55 c	5.92 b	4.73 d	NS
Oil content %	2007/08	**	41.39 c	42.02 b	38.82 d	39.13 d	41.89 b	48.28 a	**	38.56 c	42.56 b	42.67 b	43.91 a	*
	2008/09	**	41.15 bc	41.74 b	38.60 d	39.62 cd	41.49 b	48.01 a	**	33.94 c	43.33 b	44.63 ab	45.17 a	*
Crude protein %	2007/08	**	17.92 bc	17.12 cd	19.35 a	18.70 ab	17.90bc	16.52 d	**	16.48 c	17.59 b	20.39 a	17.22 bc	NS
	2008/09	**	19.91 ab	18.00 c	21.56 a	20.53 ab	18.78 bc	17.83 c	**	17.19 c	20.49 a	21.24 a	18.83 b	NS
Ash%	2007/08	*	3.63 a	3.63 a	3.65 a	3.44 ab	3.43 ab	3.36 b	**	3.77 a	3.55 b	3.54 b	3.22 c	NS
	2008/09	**	3.73 a	3.69 a	3.68 a	3.49 c	3.58 b	3.45 c	**	3.73 a	3.61 b	3.57 bc	3.50 c	NS

Table 6. Highest values of all characters studied as affected by the significant interactions between genotypes and harvesting dates in 2007/2008 and 2008/2009 seasons

Variables	Season	Genotypes x Harvesting dates	
		Highest value	Treatment
Straw yield (ton/fed)	2007/2008	3.051	(Sakha 3) x (165 days after sowing)
Upper branching zone length (cm)	2007/2008	14.750	(Sakha 2) x (155 days after sowing)
	2008/2009	14.700	(Sakha 2) x (155 days after sowing)
No. of capsules/plant	2007/2008	13.950	(Strain 16) x (165 days after sowing)
Seed yield (kg/fed)	2007/2008	1254.100	(Strain 22) x (155 days after sowing)
	2008/2009	1226.150	(Strain 22) x (165 days after sowing)
Oil yield (kg/fed)	2007/2008	608.268	(Strain 22) x (155 days after sowing)
	2008/2009	615.853	(Strain 22) x (165 days after sowing)
Fiber length (cm)	2007/2008	80.250	(Sakha 3) x (165 days after sowing)
	2008/2009	80.500	(Sakha 3) x (165 days after sowing)
Fiber strength	2007/2008	44.272	(Sakha 3) x (155 days after sowing)
Germination %	2007/2008	100.000	(Sakha 2) x (165 days after sowing)
Oil content, %	2007/2008	49.617	(Strain 22) x (155 days after sowing)
	2008/2009	50.538	(Strain 22) x (165 days after sowing)

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تأثير مواعيد الحصاد على المحصول والجودة لبعض التراكيب الوراثية للكتان

[٢٥]

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الموجز

بذور/نبات، محصول البذور/فدان، % للزيت
ومحصول الزيت/فدان .

كانت هناك زيادة معنوية لميعاد الحصاد عند ١٥٥ يوما من الزراعة لصفات قطر الساق ومحصول القش/نبات وللقدان ومحصول الألياف وجودتها، % للبروتين الخام وذلك بالمقارنة بمواعيد الحصاد الأخرى (١٣٥، ١٤٥، ١٦٥ يوما من الزراعة) وقد سجل ميعاد الحصاد ١٦٥ يوما من الزراعة تأثيرا معنويا لصفات الطول الفعال، طول الجزء الثمري، محصول البذرة/نبات وللقدان والصفات المرتبطة بها، % للإنبات، قوة البادرة، وزن وحجم ١٠٠٠ بذره، % للزيت ومحصول الزيت/فدان .

كان التفاعل بين العوامل المدروسة معنويا لصفات محصول القش/فدان، عدد كبسولات/نبات، متانه الألياف، % للإنبات وذلك فى الموسم الأول من الدراسة، اما صفات طول الجزء الثمري، محصول البذرة/فدان، محصول الزيت/فدان، طول الألياف، % للزيت فكانت معنوية فى كلا الموسمين .

اجريت تجربتان حقليتان بمحطة البحوث الزراعية بسخا - محافظة كفر الشيخ خلال موسمى ٢٠٠٧/٢٠٠٨، ٢٠٠٨/٢٠٠٩ م لدراسة تأثير اربعة مواعيد حصاد عند ١٣٥، ١٤٥، ١٥٥، ١٦٥ يوما من الزراعة على محصول الكتان وجودته لسته تراكيب وراثيه منها اربعة اصناف هى سخا ١، سخا ٢، سخا ٣، جيزه ٩ وسلالتين مبشرتين هما السلالة ١٦ والسلالة ٢٢ واستخدم فى هذه الدراسه تصميم القطع المنشق مره واحده فى اربع مكررات . وقد احتوت القطع الرئيسيه على التراكيب الوراثيه للكتان والقطع المنشق على مواعيد الحصاد . وتتخلص النتائج المتحصل عليها كما يلى:

اعطى الصنفان سخا٣، جيزه٩ اعلى القيم فى صفات الطول الفعال، محصول الألياف للنبات وللقدان، طول الألياف، % للألياف، متانه ونعومه الألياف، % للإنبات، % للبروتين الخام بينما تفوقت السلالة ٢٢ (ذات البذور الصفراء) فى صفات عدد