

sCOMPARATIVE STUDY ON SOME FLAX CULTIVARS

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ABSTRACT

The present investigation was carried out at Sakha Agricultural Research Station to compare growth characteristics, yield and its components of four flax cultivars as well as to throw the light on the interrelationship between yield and its components during 2005/06 and 2006/07 seasons.

Results of the combined analysis of the two seasons showed that significant differences were observed among the three commercial varieties Sakha 1, Sakha 2 and Sakha 3 and strain 16 in dry weight/plant, leaves and stems percentage at 90 and 120 days after sowing. Significant differences among the four flax cultivars were observed for apical branches and capsules percentage at 120 and 150 days after sowing. Flax strain 16 gave the highest dry weight/plant at all growth stages (60, 90, 120 and 150 days after sowing), followed by the commercial variety, Sakha 2. Meanwhile, Sakha 3 variety gave the lowest dry weight/plant in most growth stages.

Comparative study on yield and its components showed that the commercial variety Sakha 1 gave the highest straw yield/feddan, followed by variety Sakha 3. However, Sakha 3 variety exhibited the highest total stem length, technical stem length, fiber yield/plant and feddan, fiber length and fiber fineness. Flax strain 16 had the highest seed yield/feddan, number of seeds/capsules and seed index, followed by the commercial variety Sakha 2.

Correlation coefficients calculated between straw yield/plant and total stem length, number of apical branches, number of capsules and fiber yield were positive and significant in all cultivars. Moreover, seed yield/plant exhibited significant positive associations with number of apical branches, straw and fiber yields, number of capsules and seeds in all studied cultivars.

INTRODUCTION

Flax (*Linum usitatissimum*) is usually grown in Egypt as dual purpose crop for the production of fiber and oil. The maximum productivity of crop plant depends on variety, agronomic practices, population density, the amount of light interception and rate of CO₂ assimilation by the crop leaves. The development of every organ for a growing plant is influenced to some degree by the physiological processes prevailing in some other organs. This phenomenon differs from one variety to another in various crops. Consequently, the size, vigor and ratio of each plant organ differ according to plant age.

The present investigation was designed to gain some information on the relative variation in growth, yield and quality differences between four flax cultivars. This study could furnish a satisfactory basis for selection in flax breeding programs either for fiber or seed improvement.

Several investigators reported that the vegetative growth and yield of flax show obvious response to varietal differences. Mourad *et al.* (1990); Zahran *et al.* (1995); Kineber and El-Kady (1998); Kineber and Eman El-Kady (2002) and El-Kady and Kinber (2004), found that the general means of total dry weight/plant, dry weight of flax stem continued to increase as the plant

advanced in age while the dry mater of leaves decreased. So, they found that flax varieties differed significantly in yield and its components.

MATERIALS AND METHODS

The materials used for this study were the three commercial flax varieties Sakha 1, Sakha 2 and Sakha 3 and the local strain 16.

The origin of the studied flax cultivars was as follows:

Sakha 1 Commercial flax variety selected by pedigree method from the cross (Bombay x I. 1485).

Sakha 2 Commercial flax variety selected by pedigree method from the cross (I. 2348 x Hera).

Sakha 3 Commercial flax variety selected by pedigree method from the cross (Belinka 2 E x I. 2096).

Strain 16 A local strain selected from the cross (Giza 8 x S. 2419/1).

Two experiments were conducted at Sakha Agriculture Research Station through the two successive seasons 2005/06 and 2006/07. The experiments were carried out in a randomized complete block design with four replication. The plot size was 6 m² (2 x 3 m). Seeding rate was 60 kgs/feddan. All agronomic practices were applied at the proper stage of development. Seeds of the four flax cultivars were sown in ten rows, 3 meters long and 20 cm apart. The central six rows in each plot were harvested to determine seed and straw yields/plot and then adjusted to seed and straw yields/feddan. straw obtained from the six central rows was retted to obtained fiber yield/plot which was adjusted to fiber yield/feddan. The outer two rows adjacent to the border ones in each plot were used to collect samples for growth analysis, anatomical studies and to study yield/plant and its components at the end of the season. Growth analysis was performed on ten plants chosed at random from each plot, sampling commenced 60 days after sowing and continued at 90, 120, 150 days later. The samples were carefully uprooted and separated to leaves, stems, flowers, capsules and recovered roots. These different plant organs were dried in an air forced oven at 90°C to obtain constant weight for each fraction, then sum of dried plant fractions was used to calculate the total dry weight/plant. The characters studied in growth analysis were:

1. Total dry weight/plant, in grams.
2. Percentage of dry leaves/total dry weight/plants.
3. Percentage of dry stems/total dry weight/plant.
4. Percent age of dry apical branches/total dry weight/plant.
5. Percentage of dry flowers/total dry weight/plant.
6. Percentage of dry capsules/total dry weight/plant.
7. Percentage of recovered roots/total dry weight/plant.

At full maturity a sample of ten representative plants were taken at random from each plot to study yield/plant and its components. Straw of the sample taken at random from each plot was retted to obtain fiber yield of samples which is divided by ten to get fiber yield/plant. The characters studied for yield and its components were as follows:

1. Total stem length in cms.

2. Technical stem length (cm).
3. Stem diameter (mm).
4. Number of apical branches/plant.
5. Number of basal branches/plant.
6. Straw yield/plant (g).
7. Straw yield per feddan (ton).
8. Fiber yield per plant (g).
9. Fiber yield/feddan (ton).
10. Fiber length (cm).
11. Fiber fitness in metrical number (N.M) according to the technique described by Radwan and Momtaz (1966).
12. Number of capsules/plant.
13. Number of seeds/plant.
14. Number of seeds/capsule.
15. Seed yield/plant (g).
16. Seed yield/feddan (ton).
17. Seed index expressed as 1000-seed weight (g).

All data were subjected to the analysis of variance according to the procedures outlined by Snedecor and Cochran (1967). Differences between means were tested by L.S.D. and combined analysis was performed as described by LeClerc *et al.* (1966). All statistical analysis were performed using analysis of variance technique using "IRRISTAT" computer software package.

RESULTS AND DISCUSSION

A.Growth analysis:

Table (1) shows combined analysis of the two successive seasons 2005/2006 and 2006/2007 for distribution of total dry matter accumulation in different plant organs of four flax cultivars at four growth stages. Dry matter (%) accumulated in different plant organs was transformed into arcs in scale before statistical analysis. The following seven characters were analysed to study growth behaviour of the two commercial flax varieties Sakha 1, Sakha 2 and Sakha 3 and local strain 16.

1.Total dry weight/plant in grams:

Total dry weight/plant of four flax cultivars sampled 60, 90, 120 and 150 days after sowing is presented in (Table 1). Total dry weight in grams/plant continued to increase until the last sampling date. Statistical analysis showed significant differences in total dry weight/plant among cultivars at the second, third and fourth sampling dates. The local strain 16 gave the highest dry weight/plant at 60, 90, 120 and 150 days followed by Sakha 2 commercial variety. On the other hand, Sakha 3 commercial variety showed the lowest values of dry weight/plant in each of the four sampling dates. These results suggest that there was a definite trend between varieties for dry matter accumulation and distribution. Similar findings were reported by Momtaz *et al.* (1979) & (1981), Hella (1983), Mourad *et al.* (1990); Kineber and El-Kady (1998) and El-Kady and Kineber (2004).

2.Percentage of leaves:

Percentage of dry matter distributed in leaves of the four flax cultivars decreased greatly during the period from 90 to 120 days after sowing (Table 1). Significant differences in percentage of leaves were found among the four flax cultivars at 90 and 120 days from sowing. The local strain 16 exhibited the highest leaves percentage at the four growth stages followed by Sakha 1 commercial variety in most cases. It could be noticed that Sakha 2 commercial variety gave the lowest leaves percentage at the four sampling dates. Momtaz *et al.* (1979); Mourad *et al.* (1990); Kineber and El-Kady (1998); Kineber and Eman El-Kady (2002) and El-Kady and Kineber (2004), Found that percentage of flax leaves decreased as the plant advanced towards maturity.

Table (1): Averages of dry mater (g/plant) accumulation and distribution in different plant organs for different varieties (combined of 2005/06 and 2006/07 seasons).

Variables	Growth stage (days)	Cultivars				L.S.D 5%
		Sakha 1	Sakha 2	Sakha 3	Strain 16	
Dry weight (g/plant)	60	0.483	0.185	0.079	0.325	NS
Leaves (%)		35.190	34.610	30.910	36.130	NS
Stem (%)		33.590	38.950	33.620	33.830	NS
Recovered roots (%)		31.790	28.730	35.470	30.410	NS
Dry weight (g/plant)	90	0.470	0.612	0.552	1.069	0.04*
Leaves (%)		35.230	34.060	35.090	36.625	1.05*
Stem (%)		39.000	43.650	40.320	40.825	3.40**
Recovered roots (%)		25.520	22.310	24.210	22.750	NS
Dry weight (g/plant)	120	1.950	1.991	1.200	2.579	1.07*
Leaves (%)		12.330	10.370	12.500	14.475	4.66*
Stem (%)		32.250	30.720	40.350	32.610	6.22*
Apical branches (%)		9.000	16.920	4.000	14.090	8.42*
Flowers (%)		8.730	7.080	8.000	8.340	0.97*
Capsules (%)		15.810	11.015	12.000	11.775	3.81*
Recovered roots (%)		22.560	23.555	23.480	19.405	NS
Dry weight g/plant		150	3.890	3.905	2.759	4.229
Leaves (%)	8.463		7.585	7.660	10.640	NS
Stem (%)	42.030		41.880	52.100	34.190	5.42*
Apical branches (%)	5.400		8.660	-	12.765	5.670*
Flowers (%)	-		-	-	-	-
Capsules (%)	28.750		29.790	26.000	30.430	2.30*
Recovered roots (%)	15.965		12.315	14.280	12.710	NS

3. Percentage of stems:

Significant difference in percentage of stems were observed among cultivars at the three growth stages (90, 120 and 150 days from sowing) as shown in Table (1). Generally, accumulation of dry matter in stems of the three flax cultivars Sakha 1, Sakha 2 and Strain 16 fluctuated at the four growth stages. However, stem dry matter percentage of the four flax cultivars increased during the growth period from 60 to 150 days after sowings. Sakha 3 variety gave the highest increase in stem dry matter percentage followed by Sakha 1 cultivars. Momtaz *et al.* (1979) & (1981); Hella (1983) and El-Kady and Kineber (2004) reported that, percentage of flax stems continued to increase as the flax plant advanced in age until 150 days from planting.

4. Percentage of apical branches:

Table (1) shows percentage of dry matter accumulated in apical branches of four flax cultivars. Statistical analysis revealed significant differences in apical branches percentages among flax cultivars at the third and fourth growth stage. Dry matter accumulated in apical branches of flax cultivars decreased during growth period from 120 matter percentage in apical branches at the third growth gave the highest dry matter percentage in apical branches at the fourth growth stage. Similar results were detected by Hella (1983).

5.Percentage of flowers:

Significant differences were noted for dry mater percentage of flowers among flax cultivars at 120 days from planting (Table 1). Commercial variety Sakha 1 gave the highest percentage of dry matter accumulated in flowers, whereas Sakha 2 commercial variety exhibited the lowest percentage of dry matter in flowers. Hella (1983), reported varietal differences in percentage of dry mater accumulated in flax flowers.

6.Percentage of capsules:

Percentage of dry matter in capsules at the third and fourth growth stages for each of the four cultivars were presented in (Table 1). Significant differences were observed among flax cultivars for percentage of dry matter in capsules. Sakha 1 commercial variety gave the highest percentages of capsules at the third growth stage (120 days from planting) whereas 16 Strain gave the highest percentage of capsules at the fourth growth stage (150 days from planting). These results are in accordance with those obtained by Momtaz *et al.* (1979) and Hella (1983).

7.Percentage of recovered roots:

Percentage of dry matter accumulated in recovered roots at different growth stages for each of the four flax cultivars are given in (Table 1). The differences in percentage of dry matter in recovered roots among flax cultivars were insignificant. However, it could be noticed that percentage of dry matter in recovered root for the different cultivars decreased gradually, after 60 days from planting, through subsequent growth stages. These results are in harmony with those obtained by Momtaz *et al.* (1979) and Hella (1983).

B.Yield and yield components:

1.Straw characters:

Analysis of variance revealed significant differences between means of the four flax cultivars for technical stem length, length of fruit zone, stem diameter, number of apical branches/plant, number of basal branches/plant, straw yield/plant and straw yield/feddan as shown in Table (2). On the other hand, differences between means of flax cultivars for total stem length did not reach the level of significance. It could be noticed from Table (2) that Sakha 3 variety showed the highest mean for total stem length and technical stem length followed by Sakha 1, S. 16 and Sakha 2, respectively. Flax strain 16 gave the highest mean in stem diameter, number of apical branches and number of basal branches/plant followed by Sakha 2, Sakha 1 and Sakha 3, respectively. Sakha 2 variety surpassed all other cultivars in straw yield/plant, whereas Sakha 1 cultivar gave the highest mean of straw yield/feddan. Varietal differences in flax straw yield and its components were noticed by

Momtaz *et al.* (1979); Kinebr and Eman-El-Kady (2002) and El-Kady and Kineber (2004).

2.Fiber characters:

Statistical analysis showed significant differences among means of the four flax cultivars in fiber characters i.e. fiber yield/plant, fiber yield/feddan, fiber length and fiber fineness (Table 2). As shown in Table (2), Sakha 3 variety exhibited the highest means for fiber yield/feddan, fiber length and fiber fineness. Momtaz *et al.* (1979) & (1981), Hella (1983) and Gaafar *et al.* (1985), reported varietal differences in their studies on fiber characters in flax.

Table (2): Mean values of yield and its components obtained from the combined analysis of 2005/2006 and 206/2007 seasons for different varieties.

Characters	Cultivars				L.S.D. 5%
	Sakha 1	Sakha 2	Sakha 3	Strain 16	
Total stem length (cm)	95.60	93.50	96.60	94.88	N.S
Technical stem length (cm)	83.73	68.70	88.95	80.00	5.16**
Length of fruiting zone (cm)	11.46	17.94	6.05	13.83	4.33**
Stem diameter (mm)	1.81	1.87	1.26	1.88	0.10*
Number of apical branches/plant	11.04	15.53	9.32	19.58	8.15*
Number of basal branches/plant	1.04	1.70	1.02	1.80	0.52*
Straw yield/plant (cm)	3.26	2.96	2.17	2.95	2.13**
Straw yield/feddan (ton)	2.90	2.63	2.84	2.63	0.15*
Fiber yield/plant (g)	0.31	0.28	0.33	0.26	0.81*
Fiber yield/feddan (ton)	0.31	0.25	0.33	0.24	0.09*
Fiber length (cm)	71.50	60.33	80.15	72.13	6.06**
Fiber fineness	125.15	122.15	178.80	110.15	42.17*
Number of capsules/plant	32.63	31.28	12.63	33.40	9.18*
Number of seeds/plant	248.49	280.69	98.39	205.49	85.75*
Number of seeds/capsules	7.92	8.94	7.65	8.89	N.S
Seed yield/plant (g)	2.11	2.57	0.44	1.93	0.91*
Seed yield/feddan (ton)	0.78	0.79	0.23	0.85	0.31*
Seed index (gm)	8.50	9.16	4.50	9.48	4.67*

3.Seed characters:

As shown in Table (2) significant differences were obtained between means of the four flax cultivars for number of capsule/plant, number of seeds/plant, seed yield/plant, seed yield/feddan and seed index. On the other hand, varietal differences for number of seeds/capsule were insignificant. Flax Strain 16 gave the highest mean for seed yield/plant seed yield/feddan, number of seeds/capsule and seed index followed by Sakha 2 cultivar. Sakha 1 commercial variety exhibited the highest mean for number of capsules/plant whereas Sakha 2 commercial variety revealed the highest mean for number of seeds/plant. It could be noticed from Table (2) that Sakha 3 variety (fiber flax variety) gave the lowest means for seed yield and its components. Hella (1983) and El-Kady and Kineber (2004), reported varietal differences in their studies on seed yield and its components.

C.Correlation coefficient studies:

Simple correlation coefficients were estimated between straw yield, seed yield and eight agronomic characters within each of the four flax cultivars as shown in Tables (3 & 4), respectively.

1. Correlation between straw yield and some characters:

Simple correlation coefficients between straw yield and total stem length, number of apical branches/plant, number of capsules/plant, seed yield/plant and fiber yield/plant were positive and significant in all cultivars studied Table (3). Straw yield exhibited positive and significant correlation coefficients with number of basal branches/plant and number of seeds/plant in all cultivars except Sakha 3. These results are in agreement with those obtained by Hella (1978), who found that correlation coefficients between straw yield and each of fiber and seed yield/plant were positive and significant.

2. Correlation between seed yield and some characters:

Simple correlation coefficients between seed yield and other agronomic characters are presented in Table (4). Positive and significant correlation coefficients were obtained between seed yield and number of apical branches/plant, straw yield/plant, fiber yield/plant, number of capsules/plant and number of seeds/plant in all cultivars studied. Seed yield exhibited significant and positive associations with stem diameter and number of basal branches/plant in all cultivars studied except Sakha 3. These results agreed with those obtained by Momtaz (1965) and Hella (1983).

REFERENCES

- El-Kady, E.A. and M.E.A. Kineber (2004). A comparative study on some flax genotypes. *J. Agric. Res. Tanta Univ.* 30(3): 587-600.
- Hella, A.M. (1978). Variation and response of selection of fiber and seed yield characters in diploid and autotetraploid flax cultivars. M.Sc. Thesis Fac. Agric. Cairo, Univ.
- Hella, A.M. (1983). Analytical studies on flax types under different environmental conditions. Ph.D Thesis Fac. Agric. Cairo, Univ.
- Kineber, M.E.A. and Eman, A. El-Kady (2002). Evaluation of some flax genotypes in relation to growth, yield and yield components, under saline soil conditions. *J. Agric. Sci. Mansoura Univ.*, 237(10): 6533-6542.
- Kineber, M.E.kA. and E.A.F. El-Kady (1998). Analytical studies on strains. Proc. 8th Conf. Agron. Suez Canal Univ., Ismailia, Egypt, 28-29 Nov.: 5605-512.
- Leclerg, F.; W.H. Leonard and A.C. Clark (1966). Field plot technique. Burgross Publishing Co. Minneopollis, Minnesots, U.S.A.
- Momtaz, A.; M. Zahjran and M. El-Farouk (1979). Analytical studies on growth and yield of some flax varieties. *Agr. Res. Tanta Univ.* 5(2).
- Momtaz, A.; T.A. Shalaby and M. El-Farouk (1981). Influence of varieties and gibberellic acid on growth, yield and fiber quality of Flax. *Agr. Res. Tanta, Univ.* 7(1): 259-268.
- Mourad, N.K.M.; A.A.A. Hella and E.A. El-Kady (1990). Analytical studies on growth and its relation to yield of some flax genotypes. *J. Agric Res. Tanta Univ.*, 16(4): 715-726.

- Radwan, S.R.H. and A. Momtaz (1966). The technological properties of flax fibers and the methods of estimating them El-Felaha Jour. 46(5): 466-476 (In Arabic).
- Snedecor, G.W. and W.G. Cochran (1967). Statistical methods, 6th. Edition, Iowa ST. Coll. Press. Ams. Iowa, U.S.A.
- Tihvinskij, S.F. (1968). Cultivars and anatomical structure of the stem. Leni Konoplya (flax & Hemp) No. 1: 35-37.
- Zahran, M.; M.A. Table; M.H. Ebrahim and A. Abd El-Fatah (1995). Effect of different seeding rates and nitrogen fertilization on growth, yield and its components and quality of two flax genotypes. J. Agric. Res. Tanta Univ., 21(2): 261-271.

دراسة مقارنة لبعض أصناف الكتان

أحمد عبد الحى عبد الفتاح

معهد بحوث المحاصيل الحقلية - مركز البحوث الزراعية

أجرى البحث بمحطة البحوث الزراعية بسخا خلال موسمى ٢٠٠٥/٢٠٠٦ ، ٢٠٠٦/٢٠٠٧ وذلك بهدف مقارنة معدلات النمو والمحصول ومكوناته لاربعة اصناف من الكتان هي: سخا ١ ، سخا ٢ ، سخا ٣ (أصناف تجارية) والسلالة المحلية ١٦ .
دللت النتائج على وجود فروق معنوية فى الوزن الجاف للنبات والنسب المئوية لكل من الأوراق والسيقان بعد ٩٠ ، ١٢٠ يوم من الزراعة كما كانت هناك فروق معنوية فى النسبة المئوية للافرع القمية للكبسول بعد ١٢٠ ، ١٥٠ يوما من الزراعة ، وتفوقت السلالة ١٦ فى الوزن الجاف للنبات فى جميع مراحل النمو متبوعة بالصنف التجارى سخا ٢ ثم الصنف سخا ٣ .
تفوق الصنف التجارى سخا ١ فى محصول القش للقدان ، بينما تفوق الصنف سخا ٣ فى كل من الطول الكلى والطول الفعال للساق وكذلك محصول الالياف للنبات وللقدان وطول الالياف ونعومتها فى حين اعطت السلالة ١٦ اعلى محصول بذور للنبات وللقدان وعدد البذور بالكبسولة ووزن الالف بذرة .

اظهرت دراسات الارتباط ان هناك ارتباط موجب ومعنوى فى جميع الاصناف بين محصول القش/نبات وكل من الطول الكلى وعدد الافرع القمية وعدد الكبسول/نبات ومحصول الالياف . كما كان هناك ارتباط موجب ومعنوى بين محصول البذرة/نبات وعدد الافرع القمية ومحصول القش/نبات ومحصول الالياف/نبات وعدد الكبسول/نبات وعدد البذور/نبات فى جميع الاصناف .

Table (3): Simple correlation coefficients between straw yield and other listed character for each one of four flax cultivars.

Characters Cultivars	Total stem length	Technical stem length	Stem diameter	Number of basal branches/plant	Number of apical branches/plant	Fiber yield /plant	Number of capsules /plant	Number of seeds /plant	Seed yield /plant
Sakha 3	0.372*	0.340*	0.870**	0.082	0.727**	0.725**	0.408**	0.305	0.339*
Sakha 1	0.414**	0.279	0.055	0.768*	0.626**	0.773**	0.332*	0.591**	0.694**
Sakha 2	0.317*	0.257	0.504	0.497**	0.621**	0.834**	0.375*	0.461**	0.612**
Strain 16	0.573**	0.365*	0.149	0.691**	0.712	0.854**	0.383*	0.595**	0.719**

Table (4): Simple correlation coefficients between seed yield and other listed character for each one of four flax cultivars.

Characters Cultivars	Total length	Technical length	Stem diameter	Number of basal branches /plant	Number of apical branches /plant	Straw yield /plant	Fiber yield /plant	Number of capsules/plant	Seed yield /plant
Sakha 3	0.260	0.270	0.115	0.080	0.473**	0.339*	0.457**	0.700**	0.847**
Sakha 1	0.301	-0.139	0.643**	+0.838**	0.547**	0.698**	0.581**	0.980**	0.520**
Sakha 2	0.203	-0.216	+0.562**	0.957**	0.411**	0.617**	0.542**	0.920**	0.688**
Strain 16	0.389	0.500**	0.708**	0.534-**	0.483**	0.723**	0.689**	0.945**	0.948**

