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# INFLUENCE OF SOWING DENSITY AND RETTING METHODS ON FIBER YIELD AND QUALITY OF TWO FLAX CULTIVARS

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## ABSTRACT

Two field trials were conducted at Sakha Agric. Res. Station Farm, during the two successive seasons of 2003/2004 and 2004/2005. This investigation included two flax genotypes (Sakha 1 and Escalina) as affected by sowing density (1500, 1800, 2100 and 2400 seeds/$m^2$) and some retting methods (still water; water changed every 48 hours and streaming water). The treatments were arranged in cv. split-split design with four replications. The results obtained could be summarized as follows:

1. The differences between cultivars were highly significant in, fineness, strength, fiber yield per fed and total fiber percentage.
2. Escalina cultivar was superior in these above characters compared with Sakha 1, whereas Sakha 1 was superior in fiber length than Escalina.
3. Increasing sowing density from 1500 upto 2400 seeds/$m^2$ increased fiber yield and its quality.
4. The highest values of fiber fineness and fiber strength, fiber yield per fed and fiber percentage were obtained by retting in streaming water.
5. Still water gave the lowest value in fiber fineness and fiber strength.
6. Effect of all interactions between cultivars, sowing density and retting methods were highly significant on all technological characters and fiber yield/fed.

## INTRODUCTION

Flax is one of the ancient crops grown for its fibers and oil. In Egypt, flax is grown as a dual purpose crop for both seed and fiber. Flax ranks second after cotton as a fiber crop in Egypt. The fibers in the flax plant are situated in the cortex of the stem as bundles of bast-cells. Separation of the fibers from the harvested straw is performed by a mechanical process called scutching. Before scutching the straw is generally subjected to an attack by microorganisms, which is called retting, and the purpose of this is to destroy the plant materials pectins that bind the fibers to the other parts of the stem.

Several investigators studied the influence of retting methods on fiber yield Pallesen (1996) reported that the best fiber and its quality of Escalina flax cultivar was obtained with moderately retted flax. Radesh *et al.* (1999), compared between controlled tank retting, retting in free flowing water, spraying water and covering with a polyethylene sheet. He found that controlled tank retting gave higher fiber yield and its quality than other retting methods. Sharma and Faughey (1999) retted four cultivars by dew retting. They found that significant differences in some of the parameters were identified where cv. Laura produced the best fiber. Easson (2001) found that dew retting produced fine fibers. Fila *et al.* (2001) found that dew retting is not suitable in dry weather but retting with microbiological aspects was suitable in this conditions. The aim of this work was to study the effect of sowing density and retting method on fiber yields and its quality of some flax cultivars.

## MATERIALS AND METHODS

The present investigation was conducted at Sakha Agricultural Research Station, Kafr El-Sheikh Governorate, during the two successive seasons of 2003/2004 and 2004/2005.

The aim of this work was to study the effect of sowing density and retting methods on fiber yield and its quality in two flax cultivars.

The two flax cultivars used in this study were:

1. Sakha 1: Local commercial cultivar, a dual purpose (a cross between Bombaby x I 1485).
2. Escalina (A fiber type, imported form Holland).

**Table (1): Mechanical and chemical analysis of the experimental soil in the two growing seasons.**

| ne chemical analysis | | | The mechanical analysis | | | |
|---|---|---|---|---|---|---|
| Variable | 2003/ 2004 | 2004/ 2005 | Variable | | 2003/ 2004 | 2004/ 2005 |
| pH | 8.11 | 7.58 | Clay | % | 37.56 | 37.32 |
| Total soluble salt % | 0.09 | 0.085 | Fine silt | % | 40.68 | 37.53 |
| Organic matter % | 1.78 | 2.10 | Rough silt | % | 16.14 | 19.56 |
| Total N% | 0.07 | 0.04 | Fine sand | % | 1.67 | 1.85 |
| Available N "ppm" | 33.6 | 21.00 | Medium sand | % | 0.89 | 0.47 |
| Available P "ppm" | 16.9 | 23.6 | Course sand % | | 3.06 | 3.27 |
| Available K "ppm" | 509.00 | 420.00 | | | | |

A split-plot design with four replicates was used. The main plots were devoted to the two flax cultivars, whereas the sowing densities were allocated to the sub-plots (1500, 1800, 2100 and 2400 seeds/$m^2$). While split-split plot design was used in retting methods to determine fiber yield/fed and its quality whereas sub-sub plots were designed to three retting methods i.e. still water, water changed every 48 hours and streaming water. Sowing density of the two flax cultivars (seeds/$m^2$) and the corresponding seeding rate (kg/fed).

**Table (2): Sowing density (seeds/$m^2$) i.e. (seed rate kg/fed) for cultivars.**

| Sowing density | Seeding rate (kg/fed) | |
|---|---|---|
| seeds/$m^2$ | Sakha 1 | Escalina |
| 1500 | 60 | 30 |
| 1800 | 72 | 36 |
| 2100 | 84 | 42 |
| 2400 | 96 | 48 |

Each plot size was 6 $m^2$ (1.5 x 4 m). The two experiments were planted on 7th November 2004 and 5th November 2005. Seeds were sown on rows 4 meters long and 12.5 cm apart with drilling machine. Phosphorus was added at the rate of 100 kg/fed super phosphate (15.5 $P_2O_5$) before sowing and potassium sulphate (48% $K_2O$) was applied at the rate of 50 kg/fed before sowing as one dose. Nitrogen was added at the rate of 45 kg N/fed in

the form of urea (46% N) as two doses, half of N amount before the 1st irrigation and half before the 2nd irrigation. Other normal cultural practices for growing flax were used. Harvesting was carried out manually during the first week of May in both seasons. Retting was carried out on July in both seasons. All of retting methods were carried out on cement basins. Still water retting was used for 7 days, water changed every 48 hours was used for 10 days and streaming water was used for 15 days. The end point of retting operation was obtained when fibers were easily separated from the internal core of flax plants. After retting had been completed, retted straw was cleaned with water and left in open air to complete drying. Next steps in flax preparation are breaking and scutching, respectively, to obtain fiber.

At full maturity, a sample of ten plants were taken at random from each plot to determine fiber yield and its quality as follows:

1. **Fiber yield per fed (kg/fed):**
   Calculated from plot fiber yield.
2. **Fiber length (cm):**
   Ten fiber ribbons from each treatment were spread out and each ribbon was measured, then the average fiber length was recorded.
3. **Fiber fineness (N.m):**
   In metrical number (N.m) determined according to Radwan and Momtaz (1966) using the following formula:

$$N.m = \frac{NxL}{G}$$

**Where:**

N.m. = Metrical number.
N = Number of fibers (20 fibers each 10 cm).
L = Length of fiber in mm (2000).
G = Weight of fibers in mg.

4. **Fiber strength (R.K.M):**
   Determined as breaking length in kilometer (R.K.M) according to Radwan and Momtaz Formula (1966).

**P.K.M. = Nm x m.B.P.**

**Where:**

Nm = Metrical number
M.B.P. = Mean of the breaking point for individual flax fiber.

5. **Fiber percentage:**

It was calculated from the following formula:

Fiber percentage = (fiber yield)/(straw yield) x 100

**Statistical analysis:**

Data of the two experiments were subjected to proper statistical analysis of variance according to Snedecor and Cochran (1982).

Duncan's multiple range test (Duncan, 1955) was used for comparison among means.

## RESULTS AND DISCUSSIONS

**Fiber yield and its technological characters:**

Mean values of fiber yield and its quality of two flax cultivars as affected by sowing density and retting methods during 2003/2004 and 2004/2005 seasons are presented in Table (3).

**a. Effect of cultivars:**

Data show highly significant differences between flax cultivars in fiber yield per fed, total fiber percentage, fineness and strength; whereas Escalina cultivar was superior in these characters compared with Sakha 1. Sakha 1 was superior in fiber length than Escalina. These differences among genotypes could be attributed to genetical effects. Similar results were, also, obtained by Kheir *et al.* (1991); Kineber (1991) and (1994), Kineber and El-Kady (1998) and Kineber and Eman El-Kady (2002).

**b. Effect of sowing density:**

There were significant differences between the four sowing densities in all studied characters (Table 3). Increasinsowing density from 1500 seeds/$m^2$ upto 2400 seeds/$m^2$ increased fiber yield and its quality. The greatest values in these traits were obtained by using 2400 seeds/$m^2$, while the lowest values were obtained by using 1500 seeds/$m^2$ in both seasons.

This trend of results was similar to that of straw yield and its related characters, which due to the high competition and consequently flax plants tended to elongate searching for light. Similar results were obtained by Momtaz *et al.* (1981); Esmail and Morsy (1994); Kineber (1994); Kineber *et al.* (1997); Abuldahab (2002) and Kineber (2003).

**c. Effect of retting methods:**

The obtained data presented in Table (3), revealed that retting methods exhibited significant effects on fiber yield (kg/fed.) and its quality during both seasons. Retting with water changed every 48 hours gave the tallest fiber in the first season, while in the second season the differences between retting methods were not significant. The highest values of fiber fineness, fiber strength, fiber yield per fed and fiber percentage were obtained by retting in streaming water. Still water gave the lowest value in fiber fineness and fiber strength. These results agree with those of Radesh *et al.* (1999), compared with controlled tank retting, retting in free flowing water and spraying water and covering with a polyethylene sheet. He found that controlled tank retting gave higher fiber yield, fiber fineness than other retting methods.

**Table (3): Means of fiber yield ((kg/fed) and its quality of the two flax cultivars as affected by sowing density and retting methods during 2003/2004 and 2004/2005 seasons.**

| Variable | Sig. | Cultivar at | | Sig. | Sowing density (seeds/m²) B | | | | Sig. | Retting method C | | | Interaction | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sakha 1 | Escalina | | 1600 | 1800 | 2100 | 2400 | | Still water | Water change every 48 h. | Streaming water | AB | AC | BC | ABC |
| **2003/2004 season** | | | | | | | | | | | | | | | | |
| Fiber length (cm) | ** | 83.45 a | 81.75 b | ** | 75.02 d | 81.50 c | 84.89 b | 88.98 a | ** | 82.26 b | 84.16 a | 81.37 b | N.S | N.S | N.S | N.S |
| Fiber fineness (Nm) | ** | 296.34 b | 329.62 a | ** | 295.30 d | 306.63 c | 320.42 b | 329.58 a | ** | 268.44 c | 319.09 b | 351.41 a | ** | ** | ** | ** |
| Fiber strength (R.K.m) | ** | 55.16 b | 62.75 a | ** | 53.32 d | 56.96 c | 61.29 b | 64.25 a | ** | 49.55 c | 62.40 b | 64.92 a | ** | ** | ** | ** |
| Fiber yield/fed (kg) | ** | 694.653b | 785.07 a | ** | 707.14 b | 723.20 b | 774.55 a | 754.56 a | ** | 734.47 b | 736.78 b | 748.34 a | ** | ** | * | * |
| Fiber percentage | ** | 18.04 b | 22.38 a | ** | 19.44 d | 19.86 c | 20.65 b | 20.88 a | ** | 20.131 b | 20.134 b | 20.358 a | ** | ** | ** | * |
| **2004/2005 season** | | | | | | | | | | | | | | | | |
| Fiber length (cm) | ** | 83.64 a | 81.56 b | ** | 76.63 d | 81.69 c | 83.72 b | 88.37 a | NS | 82.50 | 83.36 | 81.95 | NS | NS | NS | NS |
| Fiber fineness (Nm) | ** | 296.78 b | 327.67 a | ** | 295.49 d | 305.00 c | 321.53 b | 327.47 a | ** | 266.89 c | 318.74 b | 351.49 a | ** | ** | ** | ** |
| Fiber strength (R.K.m) | ** | 54.51 b | 62.59 a | ** | 52.21 d | 57.44 c | 60.64 b | 63.89 a | ** | 48.39 c | 62.25 b | 64.99 a | * | ** | ** | ** |
| Fiber yield/fed (kg) | ** | 692.28 b | 790.71 a | ** | 711.36 b | 723.52 b | 772.61 a | 758.49 a | ** | 736.37 b | 738.31 b | 749.80 a | ** | ** | * | * |
| Fiber percentage | ** | 18.07 b | 22.32 a | ** | 19.42 d | 19.85 c | 20.65 b | 20.86 a | ** | 20.04 b | 20.05 b | 20.39 a | ** | ** | ** | * |

*, ** and NSare significant at 5%, 1% level and not significant, respectively.
Means followed by the same letter are not significantly different at 5% level according to Duncan's multiple range test (1955)

**d. Interaction effect:**

The highest values of technological characters as affected by interactions between cultivars, sowing densities and retting methods ware presented in Table (4). From the Table, it is clear that the highest values of fiber yield per fed and fiber percentage were recorded by Escalina cultivar sown at the rate of 2100 seeds/$m^2$ using streaming water method for retting, while the highest values of the fiber fineness and fiber strength were recorded due to the best combination of Escalina cultivar x 2400 seeds/$m^2$ x streaming water for retting.

**Table (4): Highest values of interaction between cultivars, sowing densities and retting methods on fiber yield (kg/fed) and its quality.**

| Characters | Highest values | | Sources |
|---|---|---|---|
| | 2003/2004 | 2004/2005 | |
| Fiber yield (kg/fed) | 821.76 | 800.91 | Escalina x 2100 seeds/$m^2$ x streaming water |
| Fiber percent | 23.12 | 23.11 | Escalina x 2100 seeds/$m^2$ x streaming water |
| Fiber fineness | 370.66 | 371.73 | Escalina x 2400 seeds/$m^2$ x streaming water |
| Fiber strength | 69.65 | 69.76 | Escalina x 2400 seeds/$m^2$ x streaming water |

## REFERENCES


Abuldahab, A.A. (2002). Effect of seeding rate on yield of some flax cultivars. J. Agric. Sci. Mansoura Univ., 27(4): 2005-2017.

Duncan, D.B. (1955). Multiple range and multiple F test. Biometrics, 11: 1-42.

Easson, D.L. (2001). Method of retting flax and linseed and their effects on fibre yield and quality. Aspects of applied Biology, 65: 117-122.

Esmail, S.E. and M.R. Morsy (1994). Flax plants performance as influenced by seeding rate and harvesting date and their response curves. Menofiya J. Agric. Res. Vol. 19(5): 2243-2255.

Fila, G.; L.M. Manici and F. Caputo (2001). *In vitro* evaluation of dew retting of flax by fungi from southern Europe. Annals of Applied. Biology, 138(3): 343-351.

Kheir, N.F.; E.Z. Harb; H.A. Moursi and S.H. El-Gayar (1991). Effect of salinity and fertilization on flax plants (*Linum usitatissimum* L.). 1- Growth, yield and technical properties of fibers. Bull. Fac. Agric., Cairo Univ., 42(1): 39-56.

Kineber, M.E.A. (1991). Evaluation of some new promising flax varieties in relation to yield and quality. M.Sc. Thesis, Fac. Agric. Moshtohor Zagazig Univ., Egypt.

Kineber, M.E.A. (1994). Evaluation of some new promising varieties strains under soil condition. Ph.D. Thesis, Fac. Agric. Moshtohor Zagazig Univ., Egypt.

Kineber, M.E.A. (2003). Flax plants performance as influenced by planting methods and seeding rate. J. Agric. Res. Tanta Univ., 29(1): 64-73.

Kineber, M.E.A. and E.A.F. El-Kady (1998). Analytical studies on growth and its relation to yield of some promising flax strains. Proc. 8th Conf. Agron., Suez Canal Univ. Ismailia, Egypt, 28-29 Nov., pp. 505-512.

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., 27(10): 6533-6542.

Kineber, M.E.A.; A.A.E. Mohamed and E.A.F. El-Kady (1997). Influence of planting method and seeding rate on yield and its components of some flax genotypes. J. Agric. Res. Tanta Univ., 23(3): 289-299.

Momtaz, A.M.; M. El-Farouk and T.A. Shalaby (1981). Studies of plant density and nitrogen fertilizer levels effects on yield and quality of flax. J. Agric. Res. Tanta Univ., 7(1): 211-222.

Pallesen, B.E. (1996). The quality of combine harvested fiber flax for industrial purpose depends on the degree of retting. Industrial Crop and Products, 5(1): 65-78.

Radesh, R.; K. Bassi; Badiyala and R. Singh (1999). Influence of nitrogen levels, harvesting and retting methods on fiber yield and quality of dual purpose linseed (*Linum usitatissimum* L.) varieties. Indian J. of Agric. Sciences 69(9): 668-669.

Radwan, S.R.H. and A. Momtaz (1966). The technological properties of flax fibers and the methods of estimating them. El-Falaha J. 46(5): 466-476 (In Arabic).

Sharma, H.S.S. and G.J. Faughey (1999). Comparison of subjective and objective methods to assess flax straw cultivars and fiber quality after dew-retting. Annals of Applied Biology. 135(2): 495-501.

Snedecor, G.W. and W.G. Cochran (1982). Statistical Methods, Six Edition, Iowa State Univ. Press, Ames., Iowa, USA.

## تأثير كثافة الزراعة وطريقة التعطين على محصول الالياف وجودته لصنفين من الكتان

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اجريت تجربتان حقليتان فى محطة البحوث الزراعية بسخا ـ كفرالشيخ موسمى ٢٠٠٣/٢٠٠٤، ٢٠٠٤/٢٠٠٥م لدراسة تأثير كثافة الزراعة (١٥٠٠ ، ١٨٠٠ ، ٢١٠٠ ، ٢٤٠٠ بذرة/م$^2$) وطريقة التعطين (ماء راكد ، تغير المياه كل ٤٨ ساعة وماء جارى) على محصول الالياف وجودته.

**ويمكن تلخيص أهم النتائج المتحصل عليها كالاتى:**

١- تفوق الصنف المستورد إسكالينا فى محصول الالياف/فدان كما ورد فى أول صفحة من البحث معنويا وايضا فى صفات النعومة ، المتانه ونسبة الالياف الكلية بينما تفوق الصنف المحلى سخا ١ فى صفة طول الالياف وذلك فى كل من الموسمين.

٢- ادت زيادت كثافة الزراعة من ١٥٠٠ الى ٢٤٠٠ بذرة/م$^2$ الى زيادة محصول وجودة الالياف ، بينما لم يظهر هناك اختلافات معنوية بين الكثافة ٢١٠٠ ، ٢٤٠٠ بذرة/م$^2$ لصفة محصول الالياف للفدان فى كل من الموسمين.

٣- وجدت اختلافات عالية المعنوية بين طرق التعطين تحت الدراسة فقد اعطت طريقة تغيير الماء كل ٤٨ ساعة أطول الالياف فى الموسم الاول بينما فى الموسم الثانى لم تكن هناك اختلافات معنوية بين طرق التعطين المستخدمة على هذه الصفة.

٤- أدى التعطين بالماء الجارى الى زيادة فى قيم النعومة ، المتانة ، محصول الالياف للفدان ونسبة الالياف الكلية فى كل من الموسمين.

٥- أعطى التعطين بالماء الراكد اقل القيم بالنسبة لصفتى نعومة ومتانة الالياف فى كل من الموسمين.