FLAX PLANTS PERFORMANCE AS INFLUENCED BY PLANTING METHODS AND SEEDING RATE

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ABSTRACT

Two field experiments were carried out at Sakha Agricultural Research Station during 2000/2001 and 2001/2002 seasons, to study the effect of planting methods (strip method, drilling method 12.5, 10.0 and 7.5 cm. apart and manual broadcast) and seeding rates (60, 70, 80 and 90 kg seeds/fed.). The treatments were arranged in a split-plot design with four replications. The main plots were assigned to application methods of planting and the sub-plot to seeding rates. The results obtained can be summarized as follows:

1. The differences between planting methods were significant for all straw and seed characters and strip method recorded the highest values.
2. A gradual and significant increments in technical stem length, straw yield per plant as well as per fed., fiber yield per plant as well as per fed. and long fiber percentage were obtained with increasing seeding rate from 60 up to 90 kg seeds/fed.
3. A gradual and significant reduction had occurred in all seed character and mean stem diameter with increasing seeding rate from 60 up to 90 kg seeds/fed.
4. The interaction among the experimental factors had significant effect on all characters under study. It could be concluded that the highest values for all straw characters under study were obtained when using strip methods and seeding rate of 90 kg/fed., whereas the highest values for all seed characters were obtained when using strip method and 60 kg seeds/fed.

INTRODUCTION

Flax is considered a very important bast fiber crop, it is grown in Egypt for its fiber and seeds. In general, yield of flax and its quality are affected by several agricultural practices such as planting method and plant population and distribution treatments. The suitable planting method is an essential factor for raising germination percentage, increasing number of plants/unit area. Therefore, the present investigation was carried out to find out the optimum seeding rate and planting method for increasing fiber and seed yields of local flax variety Sakha 1. With respect to the effect of

seeding rates, response of flax genotypes to seeding rates had been studied by several workers El-Kady *et al.* (1988); Abdalla *et al.* (1989); El-Shimy *et al.* (1993); El-Kady *et al.* (1995); Esmail and Moursy (1994); Mohamed (1996) reported that the highest seeding rate caused a significant increment for each of technical length, straw and seed yield/fed. and fiber percentage, but led to significant reduction in main stem diameter, and number of capsules/ plant and Kineber *et al.* (1997) found that the differences between planting methods were insignificant for all straw and seed characters and broadcasting recorded the highest values, but without significant difference.

MATERIALS AND METHODS

The present investigation was carried out at Sakha Agricultural Research Station, Agric. Res. Center, Kafr El-Sheikh, Egypt, during the two successive seasons of 2000/2001 and 2001/2002. The soil of the experimental field were clay in texture with pH value of 8.33 and 1.51% organic matter. Treatments were arranged in split plot design in four replications. Planting methods i.e. strip method (was done by small metal plates to distribute seed, to give distance of about 12.5 cm between rows); three drilling methods 12.5, 10.0 and 7.5 cm apart and manual broadcasting. Occupied the main plots, whereas the seeding rates (60, 70, 80 and 90 kg/fed.) were allocated in sub-plots. Each plot size was 56 m^2 (2.24 m x 25 m). The seeds of the flax variety Sakha 1 were sown on Nov. 13 and Nov. 11 in the two successive seasons, respectively. Pre-sowing calcium supper phosphate at the rate of 15.5 kg P_2O_5/fed. Nitrogen fertilizer at the rate of 45 kg N/fed. was divided into two parts, the first and second part were applied at 4 and 8 weeks after sowing. Other cultural practices were carried out as usual. At full maturity, sample of ten guarded plants was randomly taken from each plot to record the following data:

1) Technical stem length (cms).
2) Upper branching zoon length (cms).
3) Mean stem diameter (mm).
4) Straw yield per plant (gm).
5) Straw yield per fed. (tons).
6) Number of capsules/plant.
7) Number of seeds/plant.
8) Seed yield/plant (gm).
9) Seed index, (weight of 1000 seeds) (gm).
10) Seed yield/fed. (kgs).
11) Fiber yield/plant (gm).
12) Long fiber percentage.
13) Fiber yield per fed. (kgs).

A sample of 10 plants from each plot was carried out for retting and the fibers were separated for the following data; fiber yield/plant and per feddan and fiber percentage. The obtained data were subjected to the proper

statistical procedures for analysis of variance according to that outlined by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

I. Straw yield and its related characters:

I.1. Effect of planting method:

Data in Table (1) show the effect of planting methods on straw yield and its related characters in the two seasons. Results indicated that there were significant difference between the five planting methods on straw yield and its components in both seasons. Manual broadcasting method gave the highest value for technical stem length and thinner flax plants. On the other hand, the strip method gave the highest value for straw yield per feddan. These results may be due to good distribution in plant numbers per unit area. On the contrary, the lowest values was obtained by drilling methods 12.5, 10.0 and 7.5 cm respectively, for all characters under studying. These results agree with those of Attia (1978); El-Farouk *et al.* (1982); Abdel-Gawad (1983); El-Gazzar (1990); Sorour *et al.* (1992) and Kineber *et al.* (1997). they found that the differences between planting methods were insignificant for all straw characters and broadcasting method recorded the highest values, but without significant difference.

I.2. Effect of seeding rates:

The results in Table (1) show that straw yield and its components were significantly affected by seeding rates. A gradual and significant increment in the mean values of technical stem length and straw yield per fed. were obtained with increasing seeding rates from 60 up to 80 kg/fed. On the contrary, the lowest seeding rate (60 kg/fed.) gaves the highest value for straw yield per plant and gave thicker stems than other seeding rates. This trend may be due to the low competition for edaphic factors between plants due to low number per unit area in case of low seeding rate, which led to higher straw yield per plant. Moreover, higher seeding rate of 90 kg/fed. produced thinner flax plants. This trend might be due to the high competition and consequently flax plants tended to elongate searching for light. similar results were obtained by El-Shimy *et al.* (1993); Lafond (1993); Tomar *et al.* (1993); Esmail and Morsy (1994), Kineber (1994); Kineber *et al.* (1997), they found that straw yield and its components were increased significantly with increasing seeding rate from 40 up to 80 kg/fed., whereas stem diameter and straw yield per plant were decreased significantly; El-Kassaby *et al.* (1999) and Abuldahab (2002).

Table (1): Straw yield and its related characters during 2000/2001 and 2001/2002 seasons.

Character	Technical stem length (cm)		Mean steam diameter (mm)		Straw yield/plant (gm)		Straw yield/fed. (tons)	
	2000/2001	2001/2002	2000/2001	2001/2002	2000/2001	2001/2002	2000/2001	2001/2002
A: Planting methods								
1. Strip method	91.612	90.574	2.032	1.992	1.684	1.681	4.365	4.500
2. Drilling method 12.5 cm. a part	87.524	87.844	2.096	2.105	1.691	1.685	3.999	4.019
3. Drilling method 10.0 cm. a part	88.601	88.447	2.086	2.057	1.654	1.646	4.065	3.987
4. Drilling method 7.5 cm. a part	89.656	89.837	2.036	2.030	1.581	1.576	4.038	4.027
5. Manual broadcasting	93.966	93.936	1.056	1.052	0.933	0.932	4.308	4.309
F. test	**	**	**	**	**	**	**	**
B: Seeding rates:								
1. 60 kg/fed.	85.608	85.672	2.188	2.189	1.994	1.988	3.789	3.823
2. 70 kg/fed.	73.393	73.286	1.817	1.773	1.501	1.518	3.492	3.500
3. 80 kg/fed.	90.838	90.460	2.025	2.024	1.583	1.606	4.536	4.505
4. 90 kg/fed.	77.023	76.926	1.578	1.570	0.941	0.908	3.457	3.530
F. test	**	**	**	**	**	**	**	**
L.S.D. (5%)	2.149	2.57	0.152	0.138	0.116	0.113	0.229	0.212
L.S.D. (1%)	3.369	4.03	0.238	0.212	0.181	0.158	0.359	0.332

I.3. Interaction effect:

Summary of the significant interaction effects of planting methods and seeding rates is given in Table (2). In this Table the highest values of the studied characters are given. Technical stem length; thinner flax plants and straw yield/fed. represent the sequence in the order of the planting practices (planting method x seeding rate). From the Table it is clear that the highest values of technical stem length, thinner flax plants and straw yield per fed. were recorded by strip method at the rate of 90 kg seeds/fed. The interaction between manual broadcasting method and the seeding rate 60 kg/fed. gave the highest value for straw yield per plant.

Table (2): Highest values of flax straw yield and its components as affected by the significant interaction between the experimental factors in 2000/2001 and 2001/2002 seasons.

Characters	Highest values		Treatment
	2000/2001	2001/2002	
Technical stem length (cms)	94.575	99.752	Strip method x 90 kg seeds/fed.
Stem diameter (mm).	1.792	1.768	Strip method x 90 kg seeds/fed.
Straw yield/plant (gm)	2.022	2.015	Manual broadcast method x 60 kg seeds/fed.
Straw yield/fed. (Tons)	5.160	4.706	Strip method x 90 kg seeds/fed.

These results are in good agreement with those reported by El-Gazzar (1990); Easson and Long (1992); Sorour *et al.* (1992); Kineber (1994); El-Kady *et al.* (1995); Mohamed (1996) and Kineber *et al.* (1997).

II. Seed yield and its related characters:

II.1. Effect of planting method:

Data presented in Table (3) show that the differences between planting methods were significant for seed yield and its components. The strip method surpassed other planting methods for all seed characters under study, except upper branching zone length, which recorded highest value due to drilling method 12.5 cm apart. These results may be due to perfect distribution of plant numbers per unit area. On the other hand, the manual broadcast method gave the lowest values for all characters studied. These results agree with those obtained by El-Gazzar (1990) and Kineber *et al.* (1997).

II.2. Effect of seeding rates:

There were significant differences between the four seeding rates in all studied characters (Table 3). The seed characters (upper branching zone length, number of capsules per plant; number of seeds per plant, seed index and seed yield per fed.) significantly decreased by increasing seeding rate of flax up to 90 kg/fed. in both seasons. The greatest values in these traits were obtained by using 60 kg/fed., while the lowest values were obtained by using 90 kg seeds/fed. in both seasons. This may be attributed to the fact that high seeding rate created a high competition between plants for nutrients, moisture and light. These results are in harmony with those obtained by Sorour *et al.* (1992); Esmail and Morsy (1994); Kineber (1994); Kineber *et al.* (1997) and Abuldahab (2002), he found that a gradual and significant reduction had occurred in all seed characters with increasing seeding rate up to 70 kg/fed.

II.3. Interaction effect:

Summary of the significant interaction effects is shown in Tables (4), where the highest values of the studied characters are listed. This Table showed that all seed characters were affected significantly by the interaction (planting methods x seeding rate), except seed index. The highest values of upper branching zone length were achieved by the interaction between broadcast method and the lowest rate 60 kg seeds/fed.

Table (3): Seed yield and its related characters during 2000/2001 and 2001/2002 seasons.

Character	Upper branching zone length (cm)		Number of capsules per plant		Number of seeds per plant		Seed yield per plant (gm)		Seed index (weight 1000 seeds) (gm)		Seed yield per fed. (kgs)	
	2000-2001	2001-2002	2000-2001	2001-2002	2000-2001	2001-2002	2000-2001	2001-2002	2000-2001	2001-2002	2000-2001	2001-2002
A: Planting methods												
1. Strip method	10.820	10.812	10.259	10.209	73.331	72.619	0.695	0.691	9.466	9.475	545.958	543.07
2. Drilling method 12.5 cm. a part	12.327	12.492	9.411	9.444	64.591	63.593	0.610	0.602	9.453	9.452	487.830	4783.99
3. Drilling method 10.0 cm. a part	12.124	11.950	8.968	8.996	60.513	60.104	0.572	0.568	9.437	9.438	443.97	443.85
4. Drilling method 7.5 cm. a part	12.339	12.430	8.778	8.713	57.334	57.091	0.542	0.540	9.442	9.444	421.91	420.22
5. Manual broadcasting	6.644	6.636	4.698	5.331	39.841	39.986	0.377	0.378	9.445	9.450	378.90	379.41
F. test	**	**	**	**	**	**	**	**	n.s	n.s	**	**
B: Seeding rates:												
1. 60 kg/fed.	14.360	14.281	11.757	12.174	94.82	94.33	0.901	0.897	9.504	9.504	590.51	587.99
2. 70 kg/fed.	10.4432	10.642	8.730	8.741	55.619	55.24	0.527	0.525	9.487	9.589	497.01	498.40
3. 80 kg/fed.	11.389	11.317	8.638	8.591	57.240	56.98	0.538	0.537	9.415	9.409	476.57	476.45
4. 90 kg/fed.	8.432	8.365	5.667	5.658	36.851	36.58	0.346	0.345	9.378	9.468	3337.46	334.73
F. test	**	**	**	**	**	**	**	**	n.s	n.s	**	**
L.S.D. (5%)	1.061	1.072	1.861	1.678	3.250	3.181	0.817	0.198	-	-	19.306	18.762
L.S.D. (1%)	1.664	1.781	2.918	2.819	5.098	5.112	0.451	0.321	-	-	30.273	28.771

With regard to other characters (number of capsules/plant; number of seeds/plant; seed yield/plant and seed yield/fed.), it is clear that the best combination was planting by strip method at the rate of 60 kg/fed. similar results were obtained by El-Gazzar (1990); Sorour *et al.* (1992); Singh *et al.* (1993); Kineber (1994); El-Kady *et al.* (1995); Mohamed (1996) and Kineber *et al.* (1997), they found that the highest seed yield was achieved when planting broadcasting at the rate of 60 kg/fed. and Abuldahab (2002).

Table (4): Highest values of flax seed yield and its components as obtained due to the significant interaction between the experimental factors in 2000/2001 and 2001/2002 seasons.

Characters	Highest values		Treatment
	2000/2001	2001/2002	
Upper branching zone length (cms)	14.810	14.375	Manual broadcast method x 60 kg seeds/fed.
Number of capsule per plant	13.475	13.453	Strip method x 60 kg x seeds/fed.
Number of seed per plant	105.9840	105.302	Strip method x 60 kg x seeds/fed.
Seed yield per plant (gm)	1.009	1.005	Strip method x 60 kg x seeds/fed.
Seed yield per fed. kgs.	675.410	672.515	Strip method x 60 kg x seeds/fed.

III. Technological characters:

III.1. Effect of planting method:

The obtained data from Table (5), revealed that planting method exhibited significant effects on fiber yield per plant, long fiber percentage and fiber yield/fed. during both seasons. Manual broadcasting method and drilling method 12.5 cm. apart gaves the highest values for fiber yield per plant. On the other hand, the strip method gave the highest value for fiber yield per fed. and long fiber percentage. These results agree with those of Attia (1978), Sorour *et al.* (1992); Kineber (1994); Kineber *et al.* (1997).

III.2. Effect of seeding rate:

The results in Table (5) show that technological characters (fiber yield/plant; long percentage and fiber yield/fed.) were significantly affected by seeding rates. A gradual and significant increment in the mean values of all characters were obtained with increasing seeding rates from 60 up to 90 kg/fed. Similar results were obtained by Esmail and Morsy (1994); Kineber (1994); El-Kady *et al.* (1995); Kineber *et al.* (1997) and Abuldahab (2002).

Table (5): Technological characters of straw during 2000/2001 and 2001/2002 seasons.

Character	Fiber yield/plant (gm)		Long fiber %		Fiber yield/F (tons)	
	2000/2001	2001/2002	2000/2001	2001/2002	2000/2001	2001/2002
A: Planting methods						
1. Strip method	0.202	0.199	13.387	13.306	0.469	0.452
2. Drilling method 12.5 cm. a part	0.212	0.213	12.759	12.757	0.385	0.387
3. Drilling method 10.0 cm. a part	0.204	0.205	12.644	12.589	0.389	0.390
4. Drilling method 7.5 cm. a part	0.794	0.194	12.452	12.460	0.397	0.395
5. Manual broadcasting	0.294	0.208	12.646	12.570	0.421	0.416
F. test	**	**	*	*	**	**
B: Seeding rates:						
1. 60 kg/fed.	0.124	0.122	11.192	11.197	0.332	0.329
2. 70 kg/fed.	0.191	0.190	10.516	10.420	0.330	0.327
3. 80 kg/fed.	0.209	0.210	11.910	11.900	0.390	0.381
4. 90 kg/fed.	0.237	0.236	13.114	13.056	0.463	0.461
F. test	**	**	**	**	**	**
L.S.D. (5%)	0.008	0.005	0.334	0.287	0.067	0.089
L.S.D. (1%)	0.100	0.089	0.524	0.316	0.092	0.119

III.3. Interaction effect:

The highest values of technological characters as obtained by interaction planting methods and seeding rates are presented in Table (6). From the Table it is clear that the highest values of fiber yield per plant as well as per fed. and long fiber percentage were recorded by strip method at the rate of 90 kg seeds/fed. These results are in harmony with those obtained by Sorour *et al.* (1992), Kineber (1994), El-Kady *et al.* (1995), Kineber *et al.* (1997) and Abuldahab (2002).

Table (6): Highest values of straw technological characters as obtained by the significant interaction between the experimental factors in 2000/2001 and 2001/2002 seasons.

Characters	Highest values		Treatment
	2000/2001	2001/2002	
Fiber yield/plant (gm)	0.242	0.241	Strip method x 90 kgs. seeds/fed.
Long fiber %	13.947	13.977	Strip method x 90 kgs. seeds/fed.
Fiber yield/fed. (kgs.)	0.591	0.593	Strip method x 90 kgs. seeds/fed.

REFERENCES

Abdalla, A.F.; M.S. Osman; T. Nasr El-Din and S.Z. Zedan (1989). Effect of nitrogen fertilization and seeding rates on yield and technological characteristics of two varieties in flax (*Linum usitatissmum* L.). Egypt. J. Appl. Sci., 4(3): 879-887.

Abdel-Gawad, I.A. (1983). Some agronomic studies on certain oil crops. M.Sc. Thesis, Fac. Agric., Cairo Univ., Egypt.

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

Attia, Z.M.M. (1978). Effect of some cultural practices on yield components of flax. M.Sc. Thesis, Fac. Agric., Cairo, Univ., Egypt.

Easson, D.L. and N.J. Long (1992). The effect of time of sowing, seed rate and nitrogen level on the fiber yield and quality of flax (*Linum usitatissimum* L.). Irish, J. of Agric. and Food Res., 31(2): 163-172.

El-Farouk, M.M.A.; E.A. Mahmoud; A.I. Sahsah and H.M. Eid (1982). Water stress and plant density in relation to yield and some technological properties of flax fibers. Res. Bull. 470, Fac. Agric., Zagazig Univ., Egypt.

El-Gazzar, A.AS. (1990). Effect of some cultural treatments on flax yield and quality. M.Sc. Thesis, Fac. Agric., Kafr El-Sheikh, Tanta Univ., Egypt.

El-Kady, E.A.F.; G.R.S. Sobhy and A.I. Sabsah (1988). Response of three flax cultivar to seeding rates Proc. 3rd. Egyptian Conf. Agron., Kafr El-Sheikh, 5-7 Sept., Vol. 11: 91-98.

El-Kady, E.A.F.; S.E. Shafshak; F.I. Gab-Allah and M.E.A. Kineber (1995). Effect of seeding rates on yield and its components of six promising flax genotypes under saline soil conditions. J. Agric. Sci. Mansoura Univ., 20(2): 593-602.

El-Kassaby, A.T.; M.H. Ghoneima; M. El-Farouk and A.S. Mostafa (1999). Response of some flax genotypes to planting dates and seeding rates. J. Agric. Sci. Mansoura Univ., 24(4): 1541-1548.

El-Shimy, G.H.; E.A.F. El-Kady and N.K.M. Mourad (1993). Effect of seeding rates and nitrogen fertilizer levels on yield and anatomical manifestations of some flax genotypes. J. Agric. Res. Tanta Univ., 19(1): 92-104.

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. 19(5): 2243-2255.

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

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(30: 264-274.

Lafond, G.P. (1993). The effect of nitrogen, row spacing and seeding rate on the yield of flax under a zero-till production system. Canadian J. of Plant Sci. 73(2): 375-382.

Mohamed, A.A.E. (1996). Influence of seeding rate and nitrogen level on yield and some technological characters of flax. Proc. 7th Conf. Agron., Mansoura, (2): 379-389.

Singh, G.; O.P. Singh; K.A. Yaday; R.S. Singh and B.B. Singh (1993). Response of linseed to seed rates, fertility and weed control as utera after deep water rice. Crop Res. 6(3): 383-385.

Sorour, S.Gh.R.; S.H. Abou-Khadrah; S.A. Youssef; E.A.F. El-Kady and A.A. El-Gazzar (1992). Effect of planting pattern and seeding rate on growth, yield and quality of some flax varieties Proc. 5th Conf., Agron., Zagazig, (2): 836-850.

Tomar, R.K.S.; J.S. Raghu and L.N. Yaday (1993). Effect of row spacing and seed rates on the yield of linseed. Bhartiya Krishi Anusandhan Ptrika, 8(1): 39-42.

الملخص العربى

دراسة تأثير طريقة الزراعة ومعدل التقاوى على محصول نباتات الكتان

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أجريت تجربتان حقليتان فى محطة البحوث الزراعية بسخا ـ كفرالشيخ موسمى ٢٠٠٠/٢٠٠١م ، ٢٠٠١/٢٠٠٢م لدراسة تأثير طريقة الزراعة (الشرائحية ـ تسطير ١٢,٥ ، ١٠,٠ ، ٧,٥ مسافة بين السطور ، والبدار اليدوى). ومعدلات التقاوى ٦٠ ، ٧٠ ، ٨٠ ، ٩٠كجم/ف على محصول القش والبذره ومكوناتهما وجودة الألياف لصنف الكتان سخا١. استخدم تصميم القطع المنشقة مرة واحدة فى أربع مكررات حيث رتبت طريقة الزراعة فى القطع الرئيسية ومعدلات التقاوى فى القطع المنشقة.

ويمكن تلخيص أهم النتائج المتحصل عليها كما يلى:

١- كانت الاختلافات بين طرق الزراعة معنوية لكل الصفات المدروسة سواء القش أو البذره وأعطت طريقة الزراعة الشرائحية أعلى القيم.

٢- كانت هناك زيادة معنوية تدريجيا فى كل صفات القش المدروسة ماعدا قطر الساق بزيادة معدل التقاوى من ٦٠ إلى ٩٠كجم للفدان.

٣- كما كان هناك نقص معنوى تدريجي فى كل صفات البذور المدروسة وصفة قطر الساق بزيادة معدل التقاوى من ٦٠ إلى ٩٠ كجم/ف.

٤- كان للتفاعل بين عوامل الدراسة (طريقة الزراعة ومعدل التقاوى) تأثيرا معنويا على كل الصفات المدروسة.

ومن نتائج البحث يمكن التوصية بطريقة الزراعة الشرائحية وبمعدل تقاوى ٩٠كجم/ف للحصول على أعلى محصول من القش وجودته. بينما يمكن التوصية بطريقة الزراعة الشرائحية وبمعدل تقاوى ٦٠كجم/ف للحصول على أعلى محصول من البذور.