

EVALUATION OF SOME FLAX GENOTYPES IN RELATION TO GROWTH, YIELD AND YIELD COMPONENTS UNDER SALINE SOIL CONDITIONS

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ABSTRACT

Two field experiments were conducted at Om-Sin Village, El-Ryade Sector, Kafr El-Sheikh Governorate during 2000/2001 and 2001/2002 seasons, to evaluate growth, yield and its components for 12 genotypes (i.e. Giza 7; Giza 8; Sakha 1; Sakha 2; Belinka; Strain 6; Strain 7; Strain 8; Strain 12; Strain 13; Strain 16 and Strain 19). Growth measurement were recorded at 60, 90 and 120 days after planting date.

Data revealed that plant height and dry weight per plant continued to increase until the last sampling date. Significant differences were found between flax genotypes for the three growth characteristics at all sampling dates. Significant differences were found between genotypes in yield and its components and technological characters of straw.

INTRODUCTION

Evidences showed that plant growth is highly affected by salts. Successful agriculture on saline and alkali soils requires the use of crops capable of producing a satisfactory yield under moderate intensities of salt or alkali accumulation. Moreover, plant varieties respond differently to different climatic conditions and salt constituents as found by Magistad *et al.* (1943). So, need arises to investigate the tolerance of the most popular crops under the Egyptian conditions and where salinity prevails.

Flax is a crop cultivated in Egypt for both its fiber and seeds. The present investigation is designed to gain some information on the relative variation in growth, yield and its components between the twelve flax genotypes. The purpose of this investigation was to study the effect of some flax genotypes under saline soil conditions on the growth, yield and its components. Several investigators reported that the vegetative growth and yield of flax show obvious response to varietal differences (Momtaz *et al.*, 1979 and 1990; Hella (1983); Mourad *et al.*, 1990; Zahran *et al.*, 1995 and Kineber and El-Kady, 1996 and 1998). They found that general means of total dry weight per flax plant and plant height continued to increase as the plant advanced in age, the varieties differed significantly in yield and its components.

MATERIALS AND METHODS

The present investigation was carried out at Om-Sin Village, El-Ryade Sector, Kafr El-Sheikh Governorate during 2000/2001 and 2001/2002 seasons. The experimental soil was clay in texture and soil analysis are shown in the Table 1.

Season	Depth cm.	E.C	Cations meq/L				Anions meq/L				SAR
			Na ⁺	K ⁺	Ca ⁺⁺	Mg ⁺⁺	CO ₃ ⁻	HCO ₃ ⁻	Cl ⁻	SO ₄ ⁻	
2000/2001	0-30	7.88	43.8	0.9	14.1	19.2	0	3.0	25.5	49.5	10.7
2001/2002	0-30	10.00	60.0	1.1	21.3	27.0	0	2.5	35.7	71.2	12.2
Irrigation	-	0.86	3.5	0.2	2.9	2.0	0	5.0	1.9	1.7	2.24

A complete randomized block design with four replications was used. The preceding crop was rice in both seasons. The materials consisted of seven flax strains which were selected by Fiber Crops Research Section and four local commercial cultivars Giza 7, Giza 8, Sakha 1 and Sakha 2 in addition to the imported variety Belinka as shown in the following Table 2.

Ser.	Material	Source
1	Giza 7	Selected by pedigree method from the cross (Giza 5 x New River)
2	Giza 8	Selected by pedigree method from the cross (Giza 6 x Santa Catalina)
3	Sakha 1	Selected by pedigree method from the cross (Bombay x I. 1485)
4	Sakha 2	Selected by pedigree method from the cross (I. 2348 x Hera)
5	Belinka	Fiber type imported from Holland
6	Strain 6	Selected by Pedigree method from the cross (I. 2096 x I. 2569)
7	Strain 7	Selected by Pedigree method from the cross (S. 2465/1 x Giza 7)
8	Strain 8	Selected by Pedigree method from the cross (I. 1145 x I. 1150)
9	Strain 12	Selected by Pedigree method from the cross (Giza 5 x Bombay)
10	Strain 13	Selected by Pedigree method from the cross (I. 2096 x Belinka)
11	Strain 16	β Selected by Pedigree method from the cross (Giza 8 x S. 2419/1)
12	Strain 19	Selected by Pedigree method from the cross (Giza 6 x I. 2348)

Seeds of each flax genotype were sown on 6 November 2001 and 5 November 2002 in ten rows, 3 meters long and 20 cms. apart. Plot size was 6 m² (3 x 2 m). Seeding rate used was 60 kgs/feddan. Other cultural practices were carried out as usual. The central six rows in each plot were harvested to determine seed and straw yields per plot and then adjusted to seed and straw yields per feddan. The outer two rows adjacent to the border ones in each plot were used to collect samples for growth analysis and to study yield per plant and its components at the end of the season. Growth analysis was performed on five individual plants taken sequence from outer two rows, sampling commenced 60 days after sowing and continued at 30 days intervals up to 120 days after planting. The characters studied for growth rate were: 1. plant height, in cms. 2- total dry weight per plant, in grams.

At full maturity a sample of ten representative plants were taken at random for each plot to study yield per plant and its components, viz:

I. Characters studied for yield and its components were as follows:

I. Characters studied for yield and its components were as follows:

1. Technical stem length (cms).
2. Mean stem diameter (mms).
3. Straw yield per plant (gms).
4. Straw yield per fed. (tons).
5. Fruiting zone length (cms).
6. Number of capsules per plant.
7. Number of seeds per plant.
8. Seed yield per plant (gms).
9. Seed index. (The weight of 1000 seeds in grams).
10. Seed yield per feddan (kgs).

II. Technological character of straw:

1. Fiber yield per plant (gms).
2. Fiber percentage.
3. Fiber yield per feddan (kgs).
4. Fiber length (cms).
5. Fiber fineness (Nm).

All data were subjected to the analysis of variance according to the procedures outlined by Gomez and Gomez (1984) and treatment means were compared by Duncan's multiple range test, (Duncan, 1955).

RESULTS AND DISCUSSION

A. Growth rate:

Table (3) presents the mean values of plant height and dry weight per plant of some promising flax strains at three growth intervals during 2000/2001 and 2001/2002 seasons. Means of plant height and dry weight per plant continued to increase until the last sampling date. Significant differences were detected among some promising flax strains for plant height and dry weight per plant at all sampling dates. Strain 13 gave the highest means for plant height and dry weight per plant at all sampling dates. On the other hand, strain 8 showed the lowest estimate of plant height and dry weight per plant at all sampling dates. The present results revealed clearly marked differences in the genetical constitution of the tested genotypes. Similar findings were reported by Mourad *et al.* (1990) who found that cultivars Giza 8 exceeded Giza 7 in dry matter/plant; Kheir *et al.* (1991) and Kineber and El-Kady (1998).

B. Yield and yield components:

Data presented in Tables (4 and 5) revealed high significant different among the flax-genotypes in yield and its components.

The means of technical stem length ranged from 86.84 to 115.56 cms in 2000/2001 season and 89.78 to 109.78 cms. in 2001/2002 season. Strain 13 gave the highest technical length in both seasons, whereas the strain 8 gave the shortest technical length.

Table (3): Means of growth rate characters of some promising flax strains during 2000/2001 and 2001/2002 seasons.

Characters	Treatments	Growth stage	2000/2001 season										Sig		
			Giza 7	Giza8	Sakha1	Sakha2	Belinka	Strain6	Strain7	Strain8	Strain12	Strain13		Strain16	Strain19
Plant height (cms.)		A60	35.216de	33.998ef	37.473c	38.808b	36.751cd	35.889d	36.011d	34.818e	36.138d	39.781a	38.181b	37.891bc	**
Total dry weight per plant (gm.)			0.188d	0.185de	0.203b	0.205b	0.197c	0.192d	0.199bc	0.184de	0.191d	0.211a	0.203b	0.202b	**
Plant height (cms.)		90	73.440c	72.129c	75.913b	75.225b	77.812a	70.238d	69.147d	63.951e	70.054d	78.981a	76.321ab	75.981b	**
Total dry weight per plant (gm.)			0.591cd	0.582de	0.603bc	0.600cd	0.628a	0.563f	0.553g	0.519h	0.568f	0.640a	0.617ab	0.614b	**
Plant height (cms.)		120	88.541d	87.553de	90.413cd	89.181d	98.760b	87.348de	86.998de	83.457f	88.711d	101.781a	93.891c	92.711c	**
Total dry weight per plant (gm.)			0.814de	0.804e	0.832d	0.823d	0.906b	0.810de	0.801e	0.775f	0.813de	0.932a	0.860c	0.852c	**
2001/2002 season															
Plant height (cms.)		60	34.817e	32.781f	38.210b	39.213a	36.081d	35.132de	35.997d	34.321e	36.012d	39.581a	38.011b	36.996c	**
Total dry weight per plant (gm.)			0.182f	0.179fg	0.213ab	0.216a	0.201c	0.190e	0.195d	0.183f	0.189e	0.219a	0.201c	0.199c	**
Plant height (cms.)		90	71.967c	70.811c	76.967b	76.310b	78.967a	68.788d	67.891d	61.787e	68.996d	79.632a	76.967b	76.381b	**
Total dry weight per plant (gm.)			0.601d	0.596d	0.607bc	0.603d	0.631b	0.598d	0.567e	0.522f	0.573e	0.653a	0.621b	0.631b	**
Plant height (cms.)		120	89.670d	88.112d	92.380c	90.123cd	99.321b	88.031d	87.121de	84.302f	89.321d	109.711a	94.581c	93.671c	**
Total dry weight per plant (gm.)			0.821f	0.813f	0.843e	0.863c	0.912b	0.813f	0.809fg	0.796h	0.823f	0.940a	0.873c	0.861cd	**

*, ** indicated $P < 0.05$, $P < 0.01$, respectively.

Means designate by the same letter not significantly different at 5% level according to Duncan's multiple range test.

Table (4): Means of straw, seed yields and its components as affected by genotypes of flax during 2000/2001 season.

Characters	Treatments	Giza 7	Giza 8	Sakha 1	Sakha 2	Belinka	Strain 6	Strain 7	Strain 8	Strain 12	Strain 13	Strain 16	Strain 19	Sig.
Technical stem length (cms.)		93.93 d	92.37 d	100.62 b	98.36 bc	100.46 b	90.99 de	88.77 f	86.84 f	96.33 c	115.56 a	100.84 b	100.56 b	**
Mean stem diameter (m.m.)		2.02 c	2.14 ab	2.00 c	2.00 c	1.39 e	1.97 c	2.16 a	2.20 a	2.00 c	1.44 e	1.81 d	1.78 d	**
Straw yield per plant (gm.)		1.12 b	1.23 a	0.96 d	1.02 c	0.44 g	0.95 d	1.23 a	1.26 a	1.06 c	0.60 f	0.88 e	0.87 e	**
Straw yield per feddan (tons)		3.525 d	3.509 d	4.202 ab	4.009 b	3.390 d	3.294 de	3.267 e	3.200 e	3.805 c	4.407 a	4.289 a	4.201 ab	**
Upperbranchingzone length (cm.)		8.88 bc	8.67 bc	9.96 b	10.98 a	6.78 d	9.12 b	9.19 b	9.18 b	8.28 bc	6.13 d	8.40 bc	8.38 bc	**
Number of capsules per plant		9.59 f	9.78 e	11.38 b	13.16 a	6.06 k	10.21 d	10.67 c	11.16 b	8.31 g	6.30 h	9.58 f	9.78 e	**
Number of seeds per plant		66.94 f	70.51 e	85.81 b	100.54 a	38.85 k	70.45 e	74.80 d	80.60 c	57.41 g	49.28 h	96.96 e	69.88 e	**
Seed yield per plant (gm.)		0.570 d	0.620 d	0.778 b	0.952 a	0.183 g	0.599 d	0.688 c	0.787 b	0.505 e	0.253 f	0.791 b	0.634 c	**
Seed index		8.52 e	8.80 d	9.07 c	9.47 b	4.72 g	8.50 e	9.20 c	9.72 b	8.79 d	5.13 f	10.98 a	9.07 c	**
Seed yield per feddan (kgs.)		609.11 h	688.60 e	892.11 b	918.71 a	376.71 k	639.71 g	780.11 d	886.31 b	631.51 b	400.58 k	870.40 c	661.11 f	**

*, ** indicated $P < 0.05$, $P < 0.01$, respectively.

Means designate by the same letter not significantly different at 5% level according to Duncan's multiple range test.

Table (5): Means of straw, seed yields and its components as affected by genotypes of flax during 2001/2002.

Characters	Treatments		2001/2002 season										Sig.			
	Giza	Giza	Sakha	Sakha	Belinka	Strain	Strain	Strain	Strain	Strain	Strain	Strain		Strain	Strain	Strain
	7	8	1	2		6	7	8	12	13	16	19				
Technical stem length (cms.)	95.13 d	91.42 de	106.10 b	99.67 c	104.32 b	92.78 d	91.11 de	89.78 de	98.01 c	109.78 a	101.12 c	100.89 c	**			
Mean stem diameter (m.m.)	2.07 b	2.20 a	2.03 bc	2.05 b	1.52 e	1.98 c	2.20 a	2.21 a	2.09 b	1.48 e	1.82 d	1.80 d	**			
Straw yield per plant (gm.)	1.21 c	1.37 a	1.02 e	1.13 d	0.58 h	1.01 e	1.33 b	1.42 a	1.18 c	0.83 g	0.90 f	0.93 f	**			
Straw yield per feddan (tons)	3.321 d	3.182 d	4.389 a	4.100 b	3.581 c	3.321 d	3.296 d	3.311 d	3.907 b	4.531 a	4.300 ab	4.271 ab	**			
Upper branching zone length (zcm.)	9.12 b	9.32 b	9.80 b	11.21 a	8.00 c	9.67 b	9.29 b	9.33 b	8.67 bc	7.38 c	8.96 b	9.32 b	**			
Number of capsules per plant	10.03 f	10.21 f	12.42 b	14.32 a	6.32 h	11.03 e	11.32 d	12.07 c	9.72 f	7.82 g	10.00 f	11.00 e	**			
Number of seeds per plant	69.14 g	81.88 d	104.95 b	124.44 a	37.79 k	76.99 de	79.35 d	96.32 c	68.14 g	52.38 h	70.21 g	73.61 f	**			
Seed yield per plant (gm.)	0.681 d	0.728 c	0.973 b	1.186 a	0.175 g	0.657 d	0.736 b	0.928 b	0.591 e	0.278 f	0.771 c	0.662 d	**			
Seed index	8.60 e	8.89 d	9.28 c	9.53 b	4.63 g	8.53 e	9.37 c	9.63 b	8.67 e	5.31 f	11.30 a	8.99 d	**			
Seed yield per feddan (kgs.)	590.78 f	667.38 d	831.71 b	890.31 a	396.71 g	651.31 e	792.71 c	890.38 a	653.31 d	401.21 g	881.32 b	671.32 d	**			

*, ** indicated $P < 0.05$, $P < 0.01$, respectively.

Means designate by the same letter not significantly different at 5% level according to Duncan's multiple range test.

The means of stem diameter ranged from 1.39 to 2.20 mm. In the first season and 1.48 to 2.20 mm in the second season. The imported Belinka gave thinnest plants in the first season, whereas the strain 13 gave thinnest plants in the second season. The means of straw yield per plant, ranged from 0.44 for the imported Belinka to 1.23 gm. for Giza 8 and strain 7 in 2000/2001 season, whereas 2001/2002 season ranged from 0.58 gm for the imported Belinka to 1.37 gm for Giza 8. The strain 13 was significantly highest in straw yield per feddan. On the other hand, the cultivar Giza 8 produced the lowest yield of straw per feddan. The highest length of upper branching zone length was obtained from Sakha 2 in both seasons. The mean number of capsules per plant for 12 genotypes ranged from (6.06) for imported Belinka to (13.16) for Sakha 2, in the first season and from (6.32) from imported for Belinka to (14.32) for Sakha 2 in the second season.

It could be stated from Table (4), that the same trend mentioned above in the case of capsule number/plant could be implied in the number of seeds per plant since both characters are more or less related to each other. These means ranged from (38.85) for imported Belinka to (100.54) for Sakha 2 in the first season and from (37.79) for Belinka to (124.44) for Sakha 2 in the second season.

The differences in seed yield per plant between the 12 flax genotypes show that Sakha 2 had the highest seed yield per plant in both seasons. On the contrary, imported Belinka was significantly lowest in seed yield per plant. Seed yield per feddan ranged from 376.71 kgs. for imported Belinka to 918.71 kgs for Sakha 2 and 396.721 kgs for imported Belinka to 890.31 kgs for Sakha 2 in both seasons, respectively. The means of seed index, ranged from 4.72 gm for Belinka to 10.98 gm for strain 16 and from 4.63 gm for Belinka to 11.30. for strain 16 in both seasons, respectively. 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. Easson and Long (1992), showed that cv. Belinka produced higher straw yield than cv. Hera; Verma and Pathak (1993) reported that the flax cv. "Garim" out-yielded cv. Neelum and cv. "Shubhra"; Dixit *et al.* (1994) found that the variety "R552" gave the highest yield compared with "Jawahar 23" and "R 17" varieties; Kineber (1994); Kienber and El-Kady (1996) and (1998) showed that there were large difference in yield and its components among genotypes.

C. Technological characters of straw:

The data presented in Table 6 show significant differences among the 12 genotypes studied in all characters under study (fiber yield per plant; fiber percentage, fiber yield per feddan, means fiber length and fiber fineness). It could be noticed from data given in Table 6 that the highest value for (fiber percentage; fiber yield per feddan and fiber fineness) were recorded by imported Belinka, and strain 13 produced the highest value for means fiber length and fiber fineness in both seasons. On the other hand, strain 8 produced the lowest value for fiber percentage, fiber yield per feddan and means fiber length, and

Table (6): Means of technological characters of straw as affected by genotypes of flax during 2000/2001 and 2001/2002 seasons.

Characters	2001/2002 season												
	Giza 7	Giza 8	Sakha 1	Sakha 2	Belinka	Strain 6	Strain 7	Strain 8	Strain 12	Strain 13	Strain 16	Strain 19	Sig.
Fiber yield per plant (gm)	0.158 a	0.162 a	0.141 a	0.149 a	0.102 b	0.126 a	0.168 a	0.142 a	0.153 a	0.100 b	0.130 a	0.130 a	**
Fiber percentage	13.62 d	13.17 d	14.69 c	14.61 c	22.50 a	13.55 d	13.66 d	11.64 e	13.91 d	17.24 b	14.94 c	15.66 b	*
Fiber yield per feddan (kg)	498.91 f	461.82 g	631.71 c	580.71 d	859.88 a	443.91 g	418.91 gh	405.81 h	539.61 e	818.11 b	649.91 c	632.01 c	**
Means fiber length cms.	85.96 cd	84.21 d	92.82 c	89.96 c	101.21 b	83.78 d	80.00 de	79.92 e	89.64 c	109.81 a	90.78 c	90.18 c	**
Fiber fineness Nm	151.00 g	132.18 h	188.78 d	162.71 e	290.77 a	129.07 k	118.98 L	120.07 L	158.96 f	291.00 a	235.81 b	218.81 c	**
2001/2002													
Fiber yield per plant (gm)	0.168 a	0.179 a	0.153 a	0.166 a	0.124 b	0.141 a	0.186 a	0.175 a	0.165 a	0.149 a	0.137 a	0.149 a	*
Fiber percentage	13.91 c	13.09 d	15.01 c	14.73 c	21.38 a	14.03 c	14.00 c	12.32 d	14.01 c	17.93 b	15.21 c	16.00 c	*
Fiber yield per feddan (kg)	478.32 e	452.31 ef	648.87 c	501.21 e	867.81 a	453.31 ef	421.11 g	400.32 g	548.71 d	831.31 b	638.96 c	641.13 c	**
Means fiber length cm. of fibers	86.96 bc	85.71 bc	96.32 b	91.23 b	100.31 a	85.78 bc	84.67 c	86.33 bc	91.21 b	103.21 a	95.67 b	95.32 b	**
Fiber fineness Nm	149.21 g	129.68 k	191.32 d	168.96 e	293.71 a	132.81 h	126.31 L	130.96 h	161.32 f	294.81 a	243.61 b	229.67 c	**

*, ** indicated P < 0.05, P < 0.01, respectively.

Means designate by the same letter not significantly different at 5% level according to Duncan's multiple range test.

strain 7 produced the lowest values for fiber fineness in both seasons. All differences among genotypes in both seasons were significant. These results are expected and followed the same trend of straw yield per feddan. These differences among genotypes could be attributed to genetical effects. Similar results were also obtained by Kheir *et al.* (1991); Kineber (1994), El-Kady *et al.* (1995); Kineber and El-Kady (1996) and (1998).

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تقييم بعض التراكيب الوراثية للكتان من حيث النمو والمحصول ومكوناته تحت ظروف الأراضي الملحية

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- أجريت تجربتين بقرية أم سن - مركز الرياض - محافظة كفرالشيخ خلال موسمي 2001/2000 ، 2002/2001 لتقييم النمو والمحصول ومكوناته لأثنى عشر تركيبة وراثية من الكتان (جيزه 7 ، جيزه 8 ، سخا 1 ، سخا 2 وبلينكا وسلالات مبشرة أرقام 6 ، 7 ، 8 ، 12 ، 13 ، 16 ، 19) وأخذت مقاييس النمو عند 60 ، 90 ، 120 يوم من الزراعة. وكانت أهم النتائج كالآتي:
- 1- استمرار الزيادة في طول النبات والوزن الجاف للنبات بزيادة عمر النبات.
 - 2- اختلاف التراكيب الوراثية تحت الدراسة معنويا في كل الصفات المدروسة (صفات تحليل النمو - المحصول ومكوناته ونوعيته).
 - 3- تفوق الصنف المستورد بلينكا والسلالة المبشرة رقم 13 في صفات محصول القش ومكوناته والصفات التكنولوجية المتعلقة بها.
 - 4- تفوق الصنف سخا 2 في محصول البذرة للنبات وللقدان بينما أعطى المستورد بلينكا أقل القسيم في محصول البذور.