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RESPONSE OF SOME FLAX GENOTYPES UNDER DIFFERENT PLANT DENSITIES

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ABSTRACT

Appropriate plant densities is a key for maximizing flax productivity due to its main role in fixing energy. Two field experiments were conducted at the Experimental Farm of Gemmeiza Agriculture Research Station, Agricultural Research Center (ARC), Egypt, during the growing seasons of 2011/2012 and 2012/2013 to study the response of some fax genotypes; Sakha 3, Giza 10, strain 22 and Sakha 2 to different plant densities; 1500, 2000, 2500 and 3000 plants/m^2 and their effect on seed and long fiber yields and its components. The experiments were carried out in a split-plot design with three replications. The main-plots were assigned to flax genotypes. The sub-plots were allocated to plant densities. The results showed that the studied flax genotypes significantly differed in all studied characters in both seasons, except number of fruiting branches in the first season only. Using flax plant density of 2500 plants/m^2 significantly recorded the highest values of all studied characters, followed by flax plant density of 2000 plants/m^2, then 1500 plants/m^2 and lastly 3000 plants/m^2 in both seasons.

It could be concluded that planting the genotypes Giza 10 and Strain 22 with plant density 2500 plants/m^2 in order to maximize straw and seed yields per feddan. While, for obtaining higher long fiber yield/fed, planting Sakha 3 cultivar with plant density 2500 plants/m^2 under the environmental conditions of Gemmeiza district, El-Gharbia Governorate.

Keywords: Flax, Genotypes, Cultivars, Varieties, Plant densities, Seeding rates, Yields.

INTRODUCTION

Flax (*Linum usitatissimum* L.) is one of the oil seed plants and demand for its valuable oil and fatty acids, is increasing all over the world. The seed contain 40-45% oil and 23-34 % protein. Besides it`s valuable oil, seed meal with high percent of protein 42-46 percent, is also used in the animal diet. Besides, fiber produced from flax is used in making high-grade paper, upholstery tow, insulating materials, rugs, yarn, linen, and other textiles. Hence, flax is a dual purpose crop that is grown for fiber and oil production. The gap between the production and local requirements increased because it is difficult to increase flax area due to great competition from other major winter crops. The gap could be minimized partly by increasing flax yield per unit area. To increase crop yields are needed agricultural practices aimed at maximizing yield per unit area through sowing high yielding genotypes with suitable plant density coming from appreciate seeding rate.

There are wide variations among fax genotypes in seed and fiber yields, yield components and fiber quality. Thus, choosing the best flax genotype is one of the most critical components of flax production. In this respect, Abd Eldaiem (2004) indicated that Sakha 2 variety produced the highest yields of seeds, while the highest fiber yield was obtained from growing Escalina flax variety. Abd Eldaiem (2008) reported that flax genotypes significantly differed in all studied characters. Sakha 1 cultivar gave the highest straw, seed and oil yields/fed. Whereas Herma and Marlin cultivars recorded the highest fiber yield compared to Sakha 1 cultivar. Al-Doori (2012) and Bakry et al. (2012) showed that flax crop genotypes significantly differed for all studied yield and it`s component. The highest number of capsules/plant, 1000-seed weight, seed and oil yield/ha were produced from strain genotype. Abd El-Mohsen et al. (2013) found that the two tested flax cultivars; Sakha 1 and Sakha 2 exhibited significant differences for almost traits. Wadan (2013) reported that the two tested cultivars; Sakha 1 and Sakha 2 exhibited significant differences for almost traits. Bakry et al. (2014) revealed that high significant difference among all flax varieties in all the studied characters. Letwania-9 and Evelen cultivars surpassed all other varieties in seed yield/fed. Blanka variety recorded the lowest values of straw yield/fed and biological yield/fed, while, Posna variety gave the lowest values of technical stem length. Gallardo et al. (2014) indicated that significant differences among flax Genotypes were found for all studied characters. The best seed yields were observed in Prointa Lucero and Carap´e INTA varieties. Bakry et al. (2015) reported that Sakha-2 variety significantly surpassed Amon variety in plant height, technical length, seed yield/plant, straw yield/plant, 1000 seed weight, seed yield/fed, straw yield/fed and fiber yield/fed. While, Amon variety surpassed Sakha-2 in fruiting zone length and number of capsules/plant.

Plant densities is critical practice for determining the productivity of flax. Where, adjusting planting density is important tools to optimize crop growth and maximize seed yield and quality. Plant density influences modulating crop environment and help to improve disease avoidance, thus adjusting plant density is an important tool to optimize crop growth and the time required for canopy closure and to achieve maximum biomass and seed yield. In this concern, Casa et al. (1999) and Hassan and Leitch (2000) reported that plant height was increased by increasing seed rate per feddan while, stem diameter was decreased. Abd Elwahed (2002) and Kinber (2003) revealed that increasing seeding rate found to increase seed and straw yields/m^2. On the other hand, straw and seed yields/plant were decreased by increasing seeding rate. Burton (2007) showed that sowing flax at a seeding rate of 30 or 45 kg/ha resulted in high straw and fiber yields without reducing other important characters such as seed yield. Abd El-Mohsen et al. (2013) pointed out that maximum seed, straw and fiber yields/ha were produced when seeding rate was 180 kg/ha. Delesa and Choferie (2015) indicated that significant effects of seed rates were observed on all yield components reflecting the importance of seeding rate for flax growth, yield and yield components. Emam and Dewdar (2015) showed that increasing seeding rate significantly increased straw and seed yields in most cases in both seasons. The favorable straw yield and its components (plant height, technical length, stem diameter and straw yield/plant) were observed when flax plants were applied with seeding rate of 2250 seed/m^2.

Therefore, this study was aimed to find out the response of some flax genotypes to different plant densities under the environmental conditions of Gemmeiza district, El-Gharbia Governorate.

MATERIALS AND METHODS

Two field experiments were conducted at the Experimental Farm of Gemmeiza Agriculture Research Station, Agricultural Research Center (ARC), Egypt, during the growing seasons of 2011/2012 and 2012/2013 to study the response of four flax genotypes to different plant densities and their effect on seed and Long fiber yields and its components.

The experiments were carried out in a split-plot design with three replications. The main-plots were assigned to the four flax genotypes *i.e.* Sakha 3, Giza 10, Strain 22 and Sakha 2. That genotypes were obtained from Fibers Research Section, Field Crops Research Institute, Agricultural Research Center, Giza, Egypt and its pedigree was shown in Table 1.

Table 1: Type and pedigree of studied flax genotypes.

Genotype	Type	Pedigree
Sakha 3	Fiber	Belinka2E × I.2096
Giza 10	Fiber	S 420/140/5/10 × Bombay
Strain 22	Oil	I.370 × I.2561
Sakha 2	Oil	I.2348 × Hera

The sub-plots were allocated to four plant densities as follows:
1- 1500 plants/m^2.
2- 2000 plants/m^2.
3- 2500 plants/m^2.
4- 3000 plants/m^2.

Each experimental unit area was 2 × 3 m occupying an area of 6.0 m^2 *i.e.* 1/700 feddan. The preceding summer crop was maize (*Zea mays* L.) in both seasons. Soil samples were taken at random from the experimental field area at a depth of 0 - 30 cm from soil surface before the growing seasons to measure the physical and chemical soil properties as shown in Table 2.

Flax genotypes were sown at the first week of November month in the two growing seasons by using broadcasting method at the different rates as shown in Table 3 to obtain studied plant densities. The mineral phosphorus fertilizer in the form of calcium superphosphate (15.5% P_2O_5) at the recommended rate and mineral potassium fertilizer in the form of potassium sulphate (48.0% K_2O) at the recommended rate were added before sowing and during seed bed preparation (after ploughing and before division).The mineral nitrogen fertilizer in the form of ammonium nitrate (33.5 % N) at the recommended rate was applied into two equal doses at 30 and 45 days from sowing, respectively. The common agricultural practices for growing flax according to the recommendations of Ministry of Agriculture were followed, except the factors under study.

Table 2: Some physical and chemical properties of the experimental site during 2011/2012 and 2012/2013 seasons.

Soil analysis		2011/2012	2012/2013
A: Mechanical analysis			
Clay (%)		36.44	37.06
Silt (%)		48.58	47.83
Sand (%)		14.65	15.11
Texture class		Silty clay loam	Silty clay loam
B: Chemical analysis			
pH		7.94	7.90
E.C. (mho/cm at 25 °C)		1.37	1.41
$CaCO_3$ (%)		3.55	3.49
Available nitrogen (ppm)		28.17	28.29
Available P (ppm)		9.76	9.94
Available K (ppm)		338.00	350.00
Cations (meq./100 g soil)	Ca^{++}	4.14	4.18
	Mg^{++}	4.30	4.33
	Na^{+}	4.73	5.04
	K^{+}	0.53	0.55
Anions (meq./100 g soil)	HCO_3^{-}	3.95	4.01
	Cl^{-}	6.58	6.50
	SO_4^{--}	3.17	3.59

Table 3: Seeding rates (kg/fed) of studied flax genotypes that obtained studied plant densities.

Plant densities	Genotypes			
	Sakha 3	Giza 10	Strain 22	Sakha 2
1500 plants/m^2	34.70	37.79	40.82	52.10
2000 plants/m^2	46.20	50.39	54.40	69.47
2500 plants/m^2	57.80	62.99	68.04	86.84
3000 plants/m^2	69.30	75.58	81.65	104.90

Studied characters:

At full maturity, ten guarded plants were taken at random from each sub- plot to be used in recording the flax yields components. Biological yield/fed, straw yield/fed, seed yield/fed and long fiber yield/fed were recorded from the whole sub-plot area basis.

1- Total plant height (cm). It was measured in cm from the soil surface up to the top of flax pant.
2- Technical length (cm). The length of main stem in cm from cotyledonary node to the lowest branching zone.
3- Stem diameter (mm). It was measured at the middle of technical length.
4- Number of fruiting branches.
5- Number of capsules/plant.
6- Number of seeds/capsule.
7- Straw yield/plant (g). As the total weight in grams of the air dried straw per plant after removing the capsules.
8- Seed yield/plant (g).
9- Biological yield (t/fed).

10- Straw yield/fed (ton). It was estimated from the rest area of each plot.
11- Seed yield/feddan (kg).
12- Long fiber yield/feddan (kg).

All obtained data were statistically analyzed according to the technique of analysis of variance (ANOVA) for the split– plot design as published by Gomez and Gomez (1984) by using MSTAT statistical package (MSTAT-C with MGRAPH version 2.10, Crop and Soil Sciences Department, Michigan State University, USA). Least significant difference (LSD) method was used to test the differences between treatment means at 5 % level of probability as described by Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

1. Genotypes performance:

The results indicated that studied flax genotypes *i.e.* Sakha 3, Giza 10, Strain 22 and Sakha 2 significantly differed in total plant height, technical length, stem diameter, number of fruiting branches, number of capsules/plant, number of seeds/capsule (Table 4), straw yield/plant, seed yield/plant, biological yield/fed, straw yield/fed, seed yield/fed and long fiber yield/fed (Table 5) during 2011/2012 and 2012/2013 seasons, except number of fruiting branches in the first season only. It could be observed that Giza 10 cultivar surpassed other studied genotypes; Sakha 3, Strain 22 and Sakha 2 in total plant height, technical length, stem diameter, number of seeds/capsule, straw yield (g/plant), biological yield (t/fed) and straw yield (t/fed) during the two growing seasons. Whereas, Sakha 3 cultivar exceeded other studied flax genotypes in long fiber yield (kg/fed) only and came in the second rank after Giza 10 cultivar in total plant height, technical length, stem diameter, number of fruiting branches and number of capsules/plant in both seasons. It could be noticed that Strain 22 genotype exceeded Sakha 3, Giza 10 and Sakha 2 cultivars in number of fruiting branches, number of capsules, /plant, seed yield (g/plant) and seed yield (kg/fed) in both seasons. However, Sakha 2 cultivar came in the second rank concerning most yield characters (straw yield/plant, seed yield/plant, biological yield/fed, straw yield/fed and seed yield/fed) in the two growing seasons. The superiority of some flax cultivars in some growth, yields and its components might be related to genetic factors which resulted from genetic makeup relations for the cultivars. The obtained results of this study are partially agreement with those noticed and discussed by Abd Eldaiem (2008), Al-Doori (2012), Bakry et al. (2012), Abd El-Mohsen et al. (2013), Wadan (2013), Bakry et al. (2014), Gallardo et al. (2014) and Bakry et al. (2015).

T-4

2. Effect of plant densities:

The results showed that studied plant densities *i.e.* 1500, 2000, 2500 and 3000 plant/m^2 showed a significant effect on total plant height, technical length, stem diameter, number of fruiting branches, number of capsules/plant, straw yield/plant, seed yield/plant, biological yield/fed, straw yield/fed, seed yield/fed and long fiber yield/fed in both seasons, with exception stem diameter and number of fruiting branches in the first seasons only (Tables 4 and 5). It can be observed that planting flax with plant density of 2500 plants/m^2 significantly recorded the highest values of all studied characters *i.e.* total plant height, technical length, stem diameter, number of fruiting branches, number of capsules/plant, number of seeds/capsule, straw yield/plant, seed yield/plant, biological yield/fed, straw yield/fed, seed yield/fed and long fiber yield/fed in both seasons. Whereas, planting flax with plant density of 2000 plants/m^2 came in the second rank after planting flax with plant density of 2500 plants/m^2 and followed by planting flax with plant density of 1500 plants/m^2 with regard all studied character in the two growing seasons of this study. On the other hand, the lowest values of all studied characters were resulted from planting flax with plant density of 3000 plants/m^2 in the first and second seasons of this dissertation. These results may be due to the fact that individual plants at low plant densities adjust to low populations by increasing the vegetative growth and this support producing more accumulation of dry matter due to chlorophyll content, so increased branches and capsules per plant and other yield attributes. While, the individual plants at high plant densities may be exposed to considerable competition, which lead to reduction in vegetative growth and produce fewer branches, capsules and seeds per plant. Maximum yields of straw, seed and fiber per plant and unit area could be obtained at moderate plant density (2500 plants/m^2) possible due to early canopy closure, reaching maximum leaf area consequently increasing dry matter accumulation per unit area. These results are in partial agreement with those reported by Abd Elwahed (2002), Kinber (2003), Abd El-Mohsen et al. (2013), Delesa and Choferie (2015) and Emam and Dewdar (2015).

T-5

3. Effect of the interaction:

The interaction between flax genotypes and plant densities showed significant effect on most of studied characters during 2011/2012 and 2002/2013 seasons as presented in Tables 4 and 5.

From obtained results graphically illustrated in Figs. 1, 2, 3, 6, 8 and 9 show that the highest values of total plant height (cm), technical length (cm), stem diameter (mm), straw yield (g/plant), biological yield (t/fed) and straw yield (t/fed), respectively were obtained from planting Giza 10 cultivar with plant density 2500 plants/m^2. The second best interaction treatments between both studied factors was planting Sakha 2 cultivar with plant density 2500 plants/m^2, and followed by planting Sakha 3 cultivar with plant density 2500 plants/m^2.

The highest values of number of fruiting branches, number of capsules/plant and seed yield/plant (Figs. 4, 5 and 7, respectively) were obtained from planting Strain 22 genotype with plant density 2500 plants/m^2, followed by planting Giza 10 cultivar with plant density 2500 plants/m^2 and then planting Sakha 2 cultivar with plant density 2500 plants/m^2 in both seasons.

With regard the highest values of seed yield/fed, it were obtained from planting Strain 22 genotype with plant density 2500 plants/m^2, followed by planting Strain 22 genotype with plant density 2000 plants/m^2 and then planting Giza 10 cultivar with plant density 2500 plants/m^2 in both seasons (Fig. 10).

As seems to appear from illustrated data in Fig 11 the highest values of long fiber yield (kg/fed) were obtained from planting Sakha 2 cultivar with plant density 2500 plants/m^2, followed by planting Sakha 2 cultivar with plant density 2000 plants/m^2 and then planting Giza 10 cultivar with plant density 2500 plants/m^2 in both seasons.

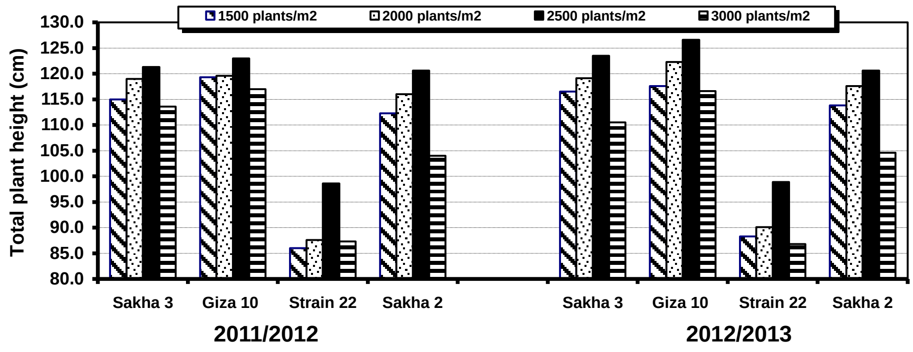

Fig. 1: Total plant height (cm) as affected by the interaction between flax genotypes and plant densities during 2011/2012 and 2012/2013 seasons.

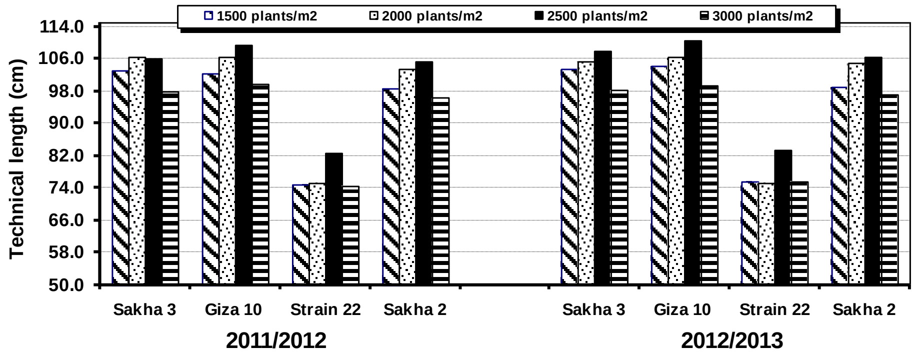

Fig. 2: Technical length (cm) as affected by the interaction between flax genotypes and plant densities during 2011/2012 and 2012/2013 seasons.

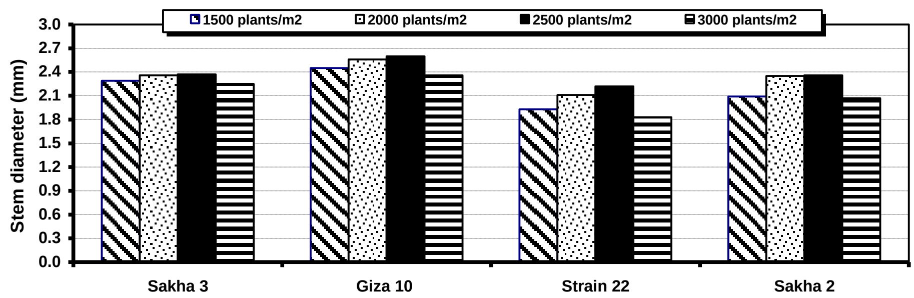

Fig. 3: Stem diameter (mm) as affected by the interaction between flax genotypes and plant densities during 2012/2013 season.

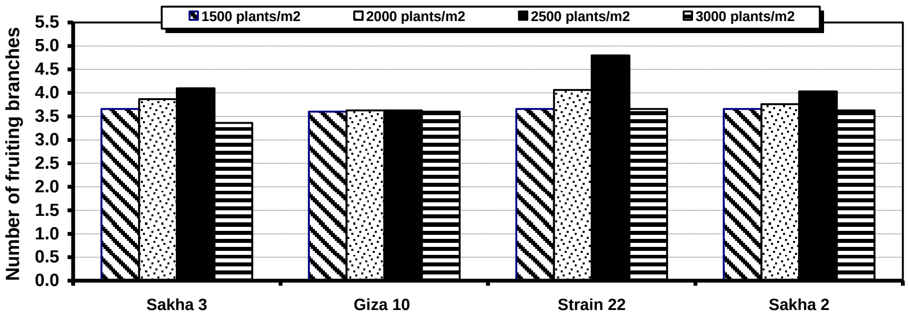

Fig.4:Number of fruiting branches as affected by the interaction between flax genotypes and plant densities during 2012/2013 season.

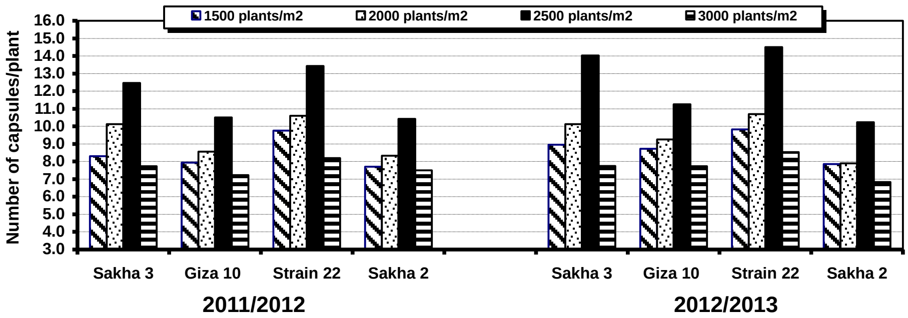

Fig.5:Number of capsules/plant as affected by the interaction between flax genotypes and plant densities during 2011/2012 and 2012/2013 seasons.

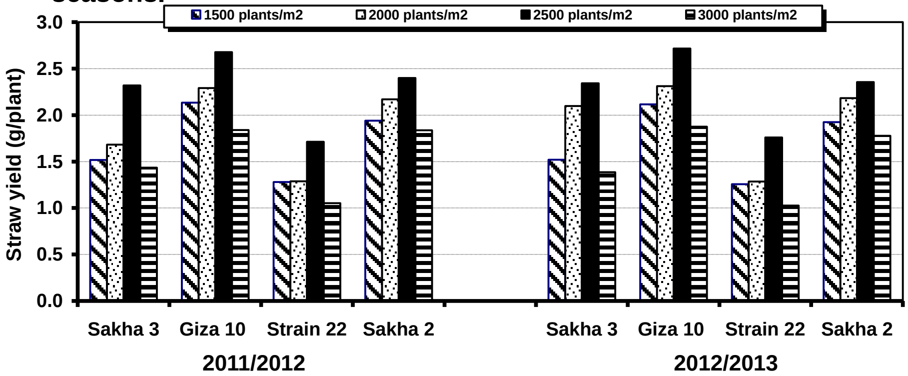

Fig. 6: Straw yield (g/plant) as affected by the interaction between flax genotypes and plant densities during 2011/2012 and 2012/2013 seasons.

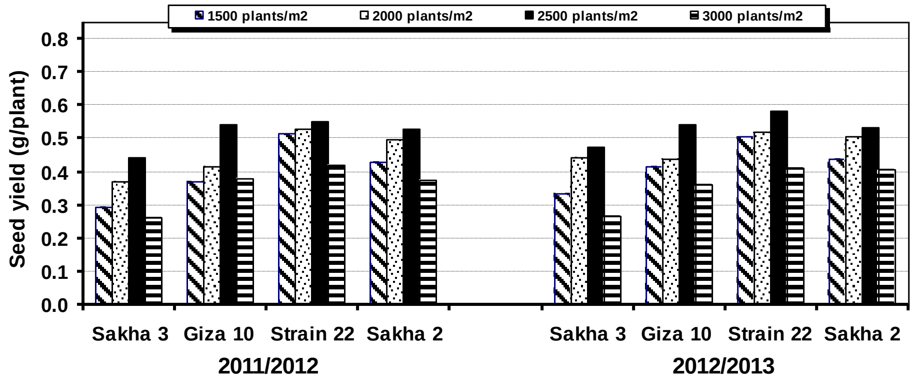

Fig. 7: Seed yield (g/plant) as affected by the interaction between flax genotypes and plant densities during 2011/2012 and 2012/2013 seasons.

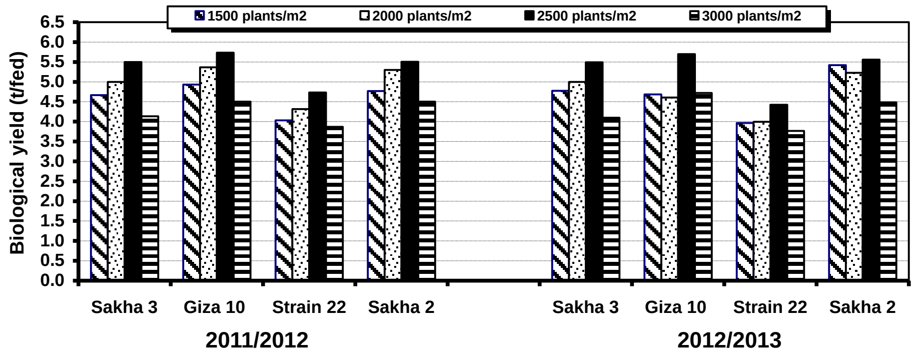

Fig. 8:Biological yield (t/fed) as affected by the interaction between flax genotypes and plant densities during 2011/2012 and 2012/2013 seasons.

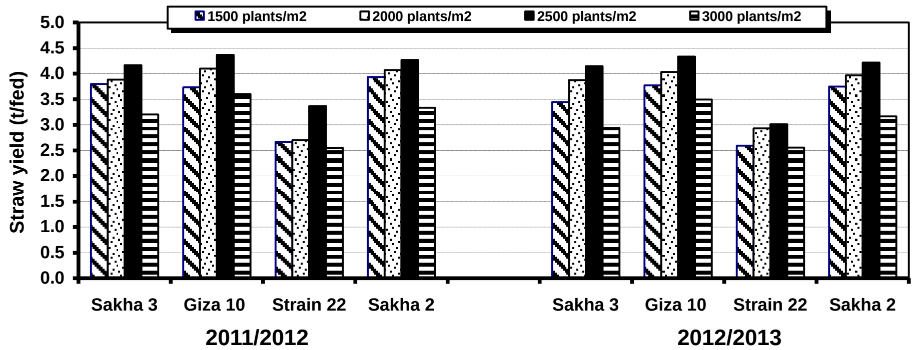

Fig. 9 : Straw yield (t/fed) as affected by the interaction between flax genotypes and plant densities during 2011/2012 and 2012/2013

seasons

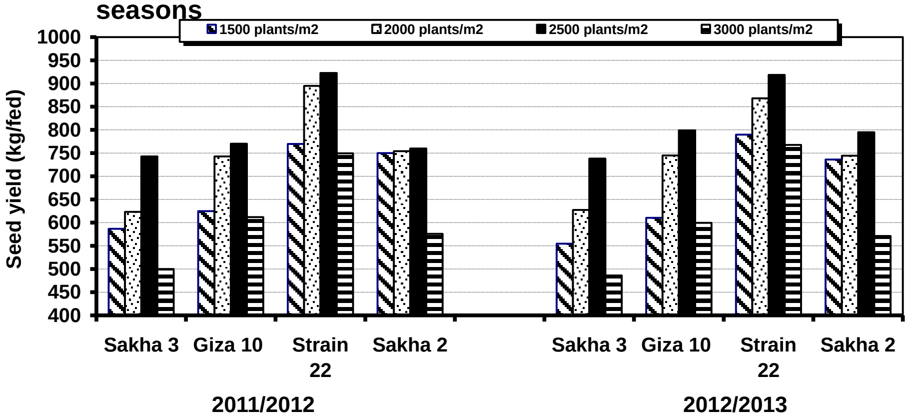

Fig. 10 : Seed yield (kg/fed) as affected by the interaction between flax genotypes and plant densities during 2011/2012 and 2012/2013 seasons.

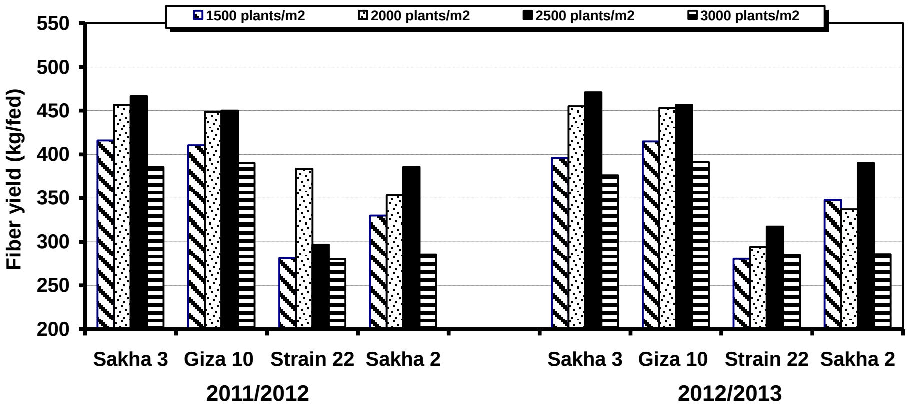

Fig. 11 : Fiber yield (kg/fed) as affected by the interaction between flax genotypes and plant densities during 2011/2012 and 2012/2013 seasons.

CONCLUSION

It could be concluded that planting Strain 22 genotype or Giza 10 cultivar with plant density 2500 plants/m^2 in order to maximize straw and seed yields per feddan. While, for obtaining the highest long fiber yield/fed, planting Sakha 2 cultivar with plant density 2500 plants/m^2 under the environmental conditions of Gemmeiza district, El-Gharbia Governorate.

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إستجابة بعض التراكيب الوراثية من الكتان للكثافات النباتية المختلفة

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قسم بحوث محاصيل الألياف – معهد بحوث المحاصيل الحقلية –- مركز البحوث الزراعية – مصر.

تعد الكثافة النباتية المناسبة همن أهم العوامل لتحقيق أقصى إنتاجية لمحصول الكتان لما لها من دور رئيسي في تثبيت الطاقة الضوئية في النبات. لذلك أجريت تجربتان حقليتان بالمزرعة البحثية بمحطة الجميزة للبحوث الزراعية، مركز البحوث الزراعية - مصر، خلال الموسمين ٢٠١٢/٢٠١١ و ٢٠١٣/٢٠١٢ لدراسة استجابة بعض التراكيب الوراثية للكتان وهى؛ الصنف التجارى سخا ٣، الصنف التجارى جيزة ١٠ ، سلالة ٢٢ و الصنف التجارى سخا ٢ للكثافات النباتية المختلفة (١٥٠٠، ٢٠٠٠، ٢٥٠٠ و ٣٠٠٠ نبات / م٢) وتأثيرها على محصول البذور والألياف ومكوناتهما. أجريت التجارب في تصميم القطع المنشقة مرة واحدة ذو ثلاثة مكررات. تم تخصيص القطع الرئيسية للتركيب الوراثية للكتان. بينما تم تخصيص القطع الشقية للكثافات النباتية. أشارت النتائج إلى أن التراكيب الوراثية للكتان تحت الدراسة اختلفت فيما بينها معنوياً بالنسبة لجميع الصفات المدروسة في كلا الموسمين، باستثناء عدد الأفرع الثمرية في الموسم الأول فقط. أدت زراعة الكتان بكثافة نباتية ٢٥٠٠ نبات/م٢ للحصول على أعلى القيم لجميع الصفات المدروسة، تليها زراعة الكتان بالكثافة النباتية ٢٠٠٠ نبات/م٢ ثم ١٥٠٠ نبات/م٢ وأخيرا ٣٠٠٠ نبات/م٢ في كلا الموسمين.

لتحقيق أعلى إنتاجية لمحصول القش والبذور يوصى بزراعة الكتان الصنف التجارى جيزة ١٠ أو السلالة ٢٢ بكثافة نباتية ٢٥٠٠/م٢. كما أوضحت النتائج بأن الصنف التجارى سخا ٣ حقق أعلى إنتاجية لمحصول الألياف الطويلة للفدان والسلالة ٢٢ حققت أعلى إنتاجية لمحصول البذور للفدان عند زراعتهما بكثافة نباتية قدرها ٢٥٠٠ نبات/م٢ تحت الظروف البيئية لمنطقة الجميزة، محافظة الغربية.

Table 4: Flax total plant height, technical length, stem diameter, number of fruiting branches, number of capsules/plant and number of seeds/capsule as affected by four plant densities of four flax genotypes and their interaction during 2011/2012 and 2012/2013 seasons.

Characters / Treatments	Total plant height (cm)		Technical length (cm)		Stem diameter (mm)		Number of fruiting branches		Number of capsules /plant		Number of seeds/capsule	
Seasons	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013
Genotypes (G):												
Sakha 3	116.5	117.05	102.6	103.4	2.31	2.31	3.74	3.80	9.39	9.94	7.19	7.27
Giza 10	119.7	120.82	104.3	105.0	2.50	2.49	3.59	3.61	9.30	9.25	7.55	7.58
Strain 22	89.9	91.05	76.9	77.4	1.94	2.02	3.83	4.00	9.89	10.67	7.25	7.35
Sakha 2	114.0	114.56	102.4	102.6	2.20	2.22	3.73	3.77	8.62	8.69	7.15	7.23
LSD at 5 %	1.8	1.0	1.2	1.0	0.11	0.06	NS	0.12	0.74	0.51	0.16	0.21
Plant densities (P):												
1500 plants/m^2	110.2	111.5	96.0	96.4	2.25	2.27	3.68	3.75	8.59	8.75	7.24	7.26
2000 plants/m^2	111.3	112.9	97.9	98.9	2.26	2.28	3.72	3.84	9.85	10.43	7.29	7.38
2500 plants/m^2	111.5	113.9	99.0	99.0	2.29	2.31	3.85	3.86	10.50	11.10	7.42	7.53
3000 plants/m^2	107.0	105.0	93.3	94.1	2.13	2.20	3.63	3.72	8.26	8.28	7.18	7.26
LSD at 5 %	1.5	0.7	0.8	1.1	NS	0.05	NS	0.07	0.49	0.55	NS	NS
Interaction: G×P (F. test)	*	*	*	*	NS	*	NS	*	*	*	NS	NS

Table 5: Flax straw yield/plant, seed yield/plant, biological yield/fed, straw yield/fed, seed yield/fed and long fiber yield/fed as affected by four plant densities of four flax genotypes and their interaction during 2011/2012 and 2012/2013 seasons.

Characters / Treatments	Straw yield (g/plant)		Seed yield (g/plant)		Biological yield (t/fed)		Straw yield (t/fed)		Seed yield (kg/fed)		Long fiber yield (kg/fed)	
Seasons	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013
Genotypes (G):												
Sakha 3	1.827	1.930	0.370	0.423	4.943	4.925	3.813	3.595	613.1	601.6	431.1	449.6
Giza 10	2.135	2.113	0.401	0.432	5.025	5.001	3.941	3.906	686.4	683.3	424.6	428.7
Strain 22	1.333	1.332	0.491	0.495	4.238	4.101	2.821	2.772	834.0	835.8	310.5	319.2
Sakha 2	2.097	2.108	0.469	0.473	5.008	4.947	3.859	3.781	710.0	711.7	338.5	340.1
LSD at 5 %	0.083	0.145	0.27	0.12	0.227	0.198	0.202	0.216	27.0	20.3	8.3	7.1
Plant densities (P):												
1500 plants/m^2	1.739	1.724	0.422	0.427	4.908	4.851	3.604	3.551	718.8	719.5	379.5	382.2
2000 plants/m^2	1.867	1.974	0.431	0.465	4.960	4.927	3.672	3.603	752.7	744.0	381.7	398.5
2500 plants/m^2	2.105	2.110	0.474	0.526	5.029	4.930	3.817	3.672	754.5	762.8	393.7	407.0
3000 plants/m^2	1.682	1.675	0.404	0.404	4.317	4.267	3.341	3.228	617.5	606.0	349.8	349.9
LSD at 5 %	0.082	0.127	0.29	0. 11	0.182	0.200	0.270	0.229	15.3	25.4	7.8	6.2
Interaction: G×P (F. test)	*	*	*	*	*	*	*	*	*	*	*	*