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Comparison of Yield, its Components and Chemical Composition of Some Flax Genotypes

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ABSTRACT

Two field experiments were carried out at Sakha Agriculture Research Station, during 2014/2015 and 2015/2016 to investigate the performance of different flax genotypes namely Sakha 1, Sakha 3, Sakha 5, Sakha 6 (two new flax varities),e Giza 10, Giza 11, Giza 12(two new flax varities), Ilona, S.421/3/6/4, S.533/39/5/3, S.5 and S. 402/1. The experimental design was a complete randomized block with four replications. The preceding crop was rice and sunflower in 2014/2015 and 2015/2016 seasons, respectively. The results revealed that highly significant was found among flax genotypes in straw yield and its related characters whereas new flax cultivar Giza 12 gave higher technical length. The new flax varity Giza 11 was superior in stem diameter and straw yield/plant, while Giza 12 gave higher straw yield/fed. On the other hand, Ilona cultivar gave the lowest means for straw yield and its components with respect to seed yield and its related data showed highly significance among flax genotypes whereas the Giza 11 variety gave the higher results in fruiting zone length, number of capsules/plant, seed index and seed yield/fed. Sakha 5 variety record the second in seed yield/fed. after Giza 11. Meanwhile, the new flax varity Sakha 6 gave high seed yield/plant in both seasons. On the other hand, the Ilona cultivar gave the lowest mean values for seed yield and its components. With respect to chemical composition of flaxseed genotypes the highest value in moisture content was observed by new flax variety Sakha 6 ,while the highest value in oil content was recorded with Sakha 5 .On other hand the lowest values in oil content and moisture content were observed by Sakha 3 and Ilona. While the highest value in protein content was obtained by Sakha 3 and Ilona . Sakha 3 variety gave the highest values in Ash and crude fiber, while Giza 10 gave the lowest values in Ash and crude fiber. Higher Total carbohydrate were found in S.533/39/5/3 and S.402/1. From the resultes and under the conditions of this study,it could be concluded that for producing highest straw yield it can be recommended by Giza 12 varity,while for high seed yield and oil used Giza 11 and Sakha 5 respectively.

INTRODUCTION

In Egypt, flax (*Linum usitatissimum* L.) is an ancient crop, which is grown as dual purpose for its fiber and oil, flax ranks second fiber crop after cotton,as fiber crop, where it plays an important role in the national economy due to local industry and contribute in increasing flax exports. The cultivated area in Egypt is very limited; therefore, increasing flax yield per unit area is very important. This could be achieved through improving the agronomic practices such as sowing new cultivars werehighly yielding

Many investigators indicating that there are significant differences due to flax genotypes in growth and yields. Hussein (2012), showed that flax genotypes significantly differed for all studied yield and its components. Gholamhosein *et al*. (2013), found that flax genotypes reveal significant differences in plant height, capsules number, seed yield and biological yield. El-Borhamy *et al*. (2015), showed that significant differences among the flax genotypes in straw and seed yield and its components. Kineber *et al*. (2015) found that new flax varieties Sakha 5 and Sakha 6 were significantly higher in straw, seed, fiber, and oil yields, fiber percentage and oil content than the commercial check variety Sakha 2.

Several stdies were carried out to estimate the chemical composition of flaxseed i.e.moisture %,oil%,crude protin,crude fiber,ash and carbohydrate.In this respect many workers studied that El-sweify (2003),El-Kady,Eman, and A.A.E.AbdEl-Fatah (2009)

The present investigation was carried out to determine the yield and its components and chemical composition of flax genotypes under this study.

MATERIALS AND METHODS

Two field experiments were carried out at experimental Farm in Sakha Agric. Res. Station, Kafr El-Sheikh, Egypt during two successive seasons of 2014/2015 and 2015/2016.to evaluate some flax genoytpes for straw seed yield and its components and chemical composition of flax seed genotypes.The experimental soil analysis are shown in Table (1) .The materials consisted of seven local cultivars,ane imported cultivar and four flax promising strains which released by Fiber Crops Res.Dept. (Table2). The experimental soil analysis are shown in Table1.

The flax genotypes were planted in randomized complete block design, with four replicates. The preceding crop was rice and sunflower in the first and second seasons, respectively.

Table 1. Chemical analysis of experimental soil in 2014/2015 and 2015/2016 seasons,

Variables	Season	
	2014/15	2015/16
pH	8.00	8.11
Organic matter	1.75	1.72
Available N (ppm)	22.41	20.70
Available P (ppm)	15.78	17.07
Available K (ppm)	248.41	243.12

Table 2. The pedigree of different flax genotypes

Genotypes	classification	Source
1- Sakha 1	D	Bomby x I.1489
2- Sakha 3	F	Belinka2E x I.2096
3- Sakha 5	O	I.370 x I.2561 (New variety)
4- Sakha 6	D	Giza 8 x S.2419/1 (New variety)
5- Giza 10	F	S. 420x Bombay
6- Giza 11	D	Giza 8 x S.2419/1 (New variety)
7- Giza 12	D	S.2419 x S.148/6/11 (New variety)
8- Ilona	F	Imported from Holland
9- S.421/3/6/4	D	S.162/2xS.6/2
10- S.533/39/5/3,	D	S. 420x Bombay
11- S.5.	D	I.2351xS.2681/1
12- S.402/1	D	I.235xGiza5

D, Dual purpose types **F,Fiber purpose type**
O,Oil purpose types

Seeds of flax genotypes were planted at 10th and 12th in 2014/2015 and 2015/2016 seasons, respectively. Plot size was 6 m2 (2 x 3 m) seed was uniformly broadcast. The nitrogen fertilizer was added at the rate of 45 kg/fed., at two equal doses in the form of urea, the first dose added before first irrigation and the second dose at the second irrigation. Ten guarded plants were randomly taken to estimate technical length, stem diameter, straw yield/plant, fruiting zone length, number of capsules/plant, and seed index, while to estimate straw yield and seed yield/fed., flax plants were pulled manually from the central area of one square meter and left one week for complete air drying to determine seed and straw yields per (1m2) and then adjusted to seed and straw yield per feddan.

Data Collected as follows:

I. Straw yield and its related parameters:

1. Technical length.,(cm) measured the distances from the cotyledon node to the first apical branch.
2. Stem diameter (mm), the middle region of technical length by using biocles.
3. Straw yield/plant (g)
4. Straw yield/fed. (ton)

II. Seed yield and its related parameters:

1. Fruiting zone length (cm)
2. Number of capsules/plant
3. Seed index (g)
4. Seed yield/plant (g)
5. Seed yield/fed. (kg)

Chemical composition of flaxseed genotypes:

Moisture content, crude protein, crude fiber and ash were determined according to the method described by A.O.A.C.(1990)

All collected data were subjected to statistical analysis for each season and the homogeneity of experimental error in both seasons was done by Bartlett test.Then,the results for each season are discussed separately, as described by Gomez and Gomez(1984).Treatment means were compared by Duncan's multiple range test according to Duncan (1955).

RESULTS AND DISCUSSION

1.Straw yield and its related parameters:

Data in Table (3) and (4) indicated that the differences among flax genotypes were highly significant in technical length (cm), stem diameter (mm), straw yield/plant (g) and straw yield/fed. (ton) in both seasons. New flax variety Giza 12 gave the highest mean value in technical length in both seasons followed by Sakha 3, Giza 10 and Giza 11. On the other hand, Sakha 5 and Ilona varieties gave the lowest value in both seasons. New flax Giza 11 variety gave higher value in stem diameter and straw yield/plant while new flax Giza 12 variety gave the highest straw yield/fed. in both seasons. Generally,it must be observed that the flax Giza12 variety recorded the highest mean values of technical length (97.27 and 102.11cm) and straw yield/fed. (4.497 and 5.297tons) in both seasons ,respectively While Ilona was the lowest in these two previous trait in addition to stem chracters in the two successive seasons. meanwhile the differences between means vaules of Giza12 and Giza11 regarding technical length, straw yield/plant and straw yield/fed. did not reach the level of significance.

Table 3. Means of straw yield and its related parameters as affected by flax genotypes during 2014/2015 season.

Characters / Genotypes	Technical length (cm)	Stem diameter (mm)	Straw yield/plant (g)	Straw yield/fed. (ton)
Sakha 1	86.34 bc	2.25 c	1.21 ef	3.185 e
Sakha 3	93.20 ab	1.87 c	0.922 fg	3.538 de
Sakha 5	69.45 d	1.45 d	0.772 g	3.786 cd
Sakha 6	88.82 bc	2.27 c	1.991 bg	3.946 bc
Giza 10	92.49 ab	2.02 c	1.620 cde	3.189 e
Giza 11	92.80 ab	3.25 a	2.450 a	4.194 ab
Giza 12	97.27 a	2.80 b	2.351 ab	4.497 a
Ilona	70.37 d	1.25 d	0.691 g	2.330 f
S421/3/6/4	81.15 c	2.15 c	12.011 bc	3.964 bc
S533/39/5/3	83.70 c	2.05 c	1.842 cd	3.564 cde
S.5	85.53 bc	2.25 c	1.490 de	3.204 e
S.402/1	91.54 c	2.75 b	1.803 cd	3.215 e
F-test	**	**	**	**

**** indicate P<0.01. Means of each treatment followed by the same letter are not significantly different at 5% level of probability according to Duncann's multiple range test**

Table 4. Means of straw yield and its related parameters as affected by flax genotypes during 2015/2016 season.

Characters / Genotypes	Technical length (cm)	Stem diameter (mm)	Straw yield/plant (g)	Straw yield/fed. (ton)
Sakha 1	91.34 bc	2.35 c	2.401 c	3.985 e
Sakha 3	98.20 ab	1.97 c	2.021 c	3.338de
Sakha 5	70.54 e	1.55 d	1.600 d	4.586cd
Sakha 6	93.82 bc	2.37 c	2.421 bc	4.746bc
Giza 10	97.80 ab	2.10 c	2.170 c	4.914e
Giza 11	94.16 bc	3.35 a	3.401 a	4.094ab
Giza 12	102.11 a	2.91 b	2.951 b	5.297a
Ilona	76.37 d	1.32 d	1.402 d	3.133f
S421/3/6/4	76.15 d	2.23 c	2.301 b c	4.764bc
S533/39/5/3	88.70 c	2.11 c	2.200 bc	4.364de
S.5	76.48 d	2.34 c	2.400 bc	4.004e
S.402/1	86.57 c	2.80 b	2.009 c	4.015e
F-test	**	**	**	**

**** indicate P<0.01. Means of each treatment followed by the same letter are not significantly different at 5% level of probability according to Duncann's multiple range test**

The differences between flax genotypes may be due to the differences in their genetical factor and their differed response to the environmental conditions. These results are in harmony with those obtained by Abuldahab (2002), El-Borhamy (2003), El-Sweify *et al.* (2003), El-Kady and Kineber (2004), El-Sweify *et al*. (2003), Kineber and El-Sayed, (2004), El-Kady and Abd El-Fatah (2009), Bakry *et al*. (2012), Wadan (2013), Jasminka *et al*. (2014) and Abo-Kaied *et al*. (2015).

II.Seed yield and its related parameters:

Table (5) and (6) indicated highly significant difference among flax genotypes on seed yield and its related parameters in 2014/15 and 2015/16 seasons.

Table 5. Mean values for flax genotypes in seed yield and its related parameters during 2014/15 season

Characters / Genotypes	Fruiting zone length (cm)	No. of capsules/ plant	Seed index (g)	Seed yield/plant (g)	Seed yield fed./(kg)
Sakha 1	16.17 bc	15.30 c	9.16 bc	1.281 b	657.06 c
Sakha 3	7.77 d	8.64 d	4.72 d	0.527 ef	417.91 f
Sakha 5	19.95 abc	19.05 ab	7.11 c	0.997 c	727.85 ab
Sakha 6	17.34 bc	16.85 bc	10.32 a	1.607 a	710.79 abc
Giza 10	15.45 c	11.45 d	9.89 ab	0.721 de	494.85 e
Giza 11	23.73 a	20.13 a	11.47 a	1.498 ab	777.67 a
Giza 12	20.85 ab	18.03 abc	9.95 ab	1.032 c	680.60 bc
Ilona	5.87 d	4.17 e	3.95 d	0.312 f	291.14 g
S421/3/6/4	18.75 bc	11.23 d	8.70 bc	0.885 cd	577.81 d
S533/39/5/3	17.87 bc	9.45 d	9.30 abc	1.005 c	495.14 e
S.5	15.75 c	10.92 d	8.70 bc	0.897 cd	526.33 de
S.402/1	16.30 bc	10.23 d	8.48 bc	0.901 cd	479.77 ef
F-test	**	*	**	**	**

**** indicate P<0.01. Means of each treatment followed by the same letter are not significantly different at 5% level of probability according to Duncann's multiple range test**

Data illustrated that the new flax variety Giza 11 gave the highest values(23.73 and26.03cm)for fruiting zone length,no of capsules(20.13 and22.43),,seed index (11.47 and 11.57g) and seed yield/fed (777.67 and 847.87kg) for the both seasons,respectively.Concerning seed yield/plant character, the flax varietySakha6 ranked the first with the mean values of 1.607 and 1.709g in corresponding two successive seasons. On the other hand,the flax variety Ilona was the lowest one. In all the seed traits under study. These results are in harmony with those obtained by Abuldahab (2002), El Sweify *et al*. (2006), El-Borhamy (2011), Bakkry *et al*. (2012), Wadan (2013), Abo-Kaied *et al*., (2015) and Kieneber *et al*. (2015).

Table 6. Mean values for flax genotypes in seed yield and its related parameters during 2015/16 season

Genotypes	Fruiting zone length (cm)	No. of capsules/ plant	Seed index (g)	seed yield/plant (g)	seed yield/fed. (kg)
Sakha 1	18.47 b	17.50 c	9.26 bc	1.383 bc	687.36 d
Sakha 3	10.07 c	10.87 d	4.82 d	0.628 e	448.21 h
Sakha 5	22.25 ab	21.25 ab	7.21 c	1.099 d	778.05 b
Sakha 6	19.63 ab	19.05 bc	10.42 ab	1.709 a	760.99 bc
Giza 10	17.75 b	13.65 d	9.99 ab	0.823 e	479.05 fg
Giza 11	26.03 a	22.43 a	11.57 a	1.600 ab	847.87 a
Giza 12	19.03 ab	20.23 abc	9.65 bc	1.134 cd	750.70 c
Ilona	7.50 c	6.37 e	4.05 d	1.87 f	263.89 i
S421/3/6/4	21.05 ab	13.41 d	8.80 bc	1.685 e	550.56 e
S533/39/5/3	20.14 ab	11.65 d	8.40 abc	0.805 e	467.89 gh
S.5	18.04 b	13.13 d	8.80 bc	0.697 e	499.08 f
S.402/1	18.45 ab	12.43 d	8.5 bc	0.835e	452.52 h
F-test	**	**	*	**	**

**** indicate P<0.01. Means of each treatment followed by the same letter are not significantly different at 5% level of probability according to Duncann's multiple range test**

Chemical composition of flaxseed genotypes:-

As show in Table (7) there are significant difference in all chemical composition characters between flaxseed genotypes.

Regarding moisture content in seeds two varieties Sakha1 and Sakha6 recorded the highest values in both seasons (6.81% , 6.9%) and (5.98%, 6.2%), respectively.On the other hand S.421/3/6/4 gave the lowest value in the first season (5.1%). These results are in agreement with those obtained by El-kady (1995 and 2000), Siemens and Daun (2005) and El-Kady and abd El-Fatah (2009). Reported that moisture content of flaxseed varied from (5.12% to 5.73%) depending on the variety.

Data showed that the highest mean value of oil content was recorded by Sakha5 variety (45.55%-46.9%) in both seasons, on the other hand Ilona variety gave the lowest oil content in both seasons (35.2% and 36.8%) respectively Oil content of different varieties of flax seed found to be in the range of (34.3% -47.6%) as reported by Oomah and Kenaschuk(1995), Lukas zewicz *et al*. (2004) , Abd El-fatah and El-Essawy (2006) and El-Kady and Abd El-Fatah(2009). While in Canadion flaxseed cultivars contained (44.2-48.3%) oil, Kenaschuk and Rashid (1999).

Dealing with crude protein content of flaxseed genotypes, it can be seen from Table (7)that two flax varieties Sakha 3 and Ilona contain a relatively higher level of crud protein in both seasons. (23.9- 24.0%)-(24.0-23.9%), respectively . on the other hand, Sakha 5 contents the lowest level of crude protein in both seasons (15.53- 16.0%). The recorded by Oomah and Mazza (1995),El-Kady (2000) , Kineber and El-Sayed (2004) and El-Kady and Abd El-Fatah(2009). They found that values of crude protein of flaxseed ranged between (16.3 to 24.90%).

Table 7. Mean values of chemical composition of twelve flaxseed genotypes during 2014/2015 and 2015/2016 seasons.

Characters	Moiusture content%		Oil content%		Crude protein%	
Genotypes	2014	2015	2014	2015	2014	2015
Sakha 1	6.81a	5.98ab	42.5bc	40.8bcd	20.98abc	21.5abc
Sakha 3	5.5b	5.1c	40.2bcd	37.23cd	23.9a	24.0a
Sakha 5	5.3bc	5.0cd	45.55a	46.9 a	15.53d	16.0e
Sakha 6	6.9a	6.2a	42.9bc	44.2 bc	16.0abc	21.5abc
Giza 10	5.5bc	4.9d	39.8cd	40.0bcd	22.89ab	23.00ab
Giza 11	5.3bcd	5.0c	43.2b	42.8b	20.5bc	20.0bcd
Giza 12	5.60b	5.3b	42.9bc	42.0bc	20.89ab	21.0abc
Ilona	5.60b	5.0c	35.2e	36.8d	24.0a	23.9a
S. 421/3/6/4	5.1d	4.9d	42.24bcd	42.02bc	17.9cd	18.2cde
S.533/39/5/310	5.6cd	4.8e	38.5e	39.5cd	19.2c	19.5cd
S.5	5.3cd	5.0cd	39.2de	40bcd	18.8cd	19.30cde
S.402/1	5.5cd	5.2c	38.5e	39cd	17.9cd	18.0de
F test	**	**	**	**	**	**

**** indicate P<0.01. Means of each treatment followed by the same letter are not significantly different at 5% level of probability according to Duncann's multiple range test**

Regarding crude fiber (Table 8) revealed significant differences between flaxseed varieties sakha1 and Sakha3 gave the highest value of crude fiber (12.5,12.6% and 12.8,12.4%)while Sakha1 variety and S.421/3/6/4 recorded the lowest values(10.9-10.7) and (10.9-11.1) in both seasons respectively, similar results were obtained by EL-Kady (2000), Kineber and EL-Sayed (2004) and EL-Kady and abd El-Fatah (2009).

Table 8. Mean values of chemical composition of twelve flaxseed genotypes during 2014/2015 and 2015/2016 seasons.

Characters	Crude fiber%		Ash %		Total carbohydrate%	
Genotypes	2014/2015	2015/2016	2014	2015*	2014	2015
Sakha 1	12.5a	12.8a	4.04ab	4.0a	26.98bc	28.40c
Sakha 3	12.6a	12.4a	4.29a	4.1a	23.51e	27.27d
Sakha 5	10.9e	10.7e	3.0c	2.9e	27.22c	27.40d
Sakha 6	11.54b	11.8d	3.90bc	3.9ab	23.51e	27.60d
Giza 10	11.3e	11.0e	3.7bc	4.0a	23.81e	23.71e
Giza 11	11.9ab	11.8cd	4.0b	3.8bc	27.40c	28.60c
Giza 12	11.5ab	11.6d	3.9bc	3.98ab	27.51c	28.42c
Ilona	12.5a	12.3ab	4.02ab	4.1a	29.28c	29.90bc
S. 421/3/6/4	10.9e	11.1f	3.2c	3.81bc	32.06ab	31.88ab
S.533/39/5/310	11.5d	11.3d	4.0b	3.9ab	33.80a	32.92a
S. 5	12ab	11.8cd	4.0b	3.7c	33.10a	32.02ab
S402/1	11.8c	11.2f	4.0b	4.08a	34.80a	34.72a
F-test	**	**	**	**	**	**

**** indicate P<0.01. Means of each treatment followed by the same letter are not significantly different at 5% level of probability according to Duncann's multiple range test**

For ash content, the data given in Table (8) revealed a significant difference between flaxseed genotypes, where Sakha1 and Sakha 3 variety had the highest value of ash content (4.04-4.29% and 4.0-4.1%) in both seasons respectively, On other hand Sakha5 and S.421/3/6/4 give the lowest value in both seasons (3.0-3.2% and 2.9 -3.7%) .Similar findings were reported by Madhusudhan and Snigh (1983), EL-Kady (2000), Kineber and El-Sayed (2004) and EL-Kady *and AbdEl-Fatah*. (2009). They mentioned that flaxseed varietals differences in ash content and ranged between (2.60% to 6.31%).

Illustrated data in Table (8) indicated that total carbohydrate content of flaxseed genotypes ranged from (23.51 to 34.80%) .S402/1 had the highest value of total carbohydrate (34.80-34.72%) in both season resbectively while Sakha 3 and Sakha 6 varieties ranked the lowest values (23.51-23.51) and (27.27-27.6) in both seasons respectively.The differences in carbohydrate content could be related to the variation that found in the chemical composition of the tested genotypes of flaxseed. Similar results were obtained byMadhusudhan and Singh (1983) and EL-Kady *et* and AbdEl-Fatah (2009).

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مقارنة المحصول ومكوناته والتركيب الكيماوى لبعض التراكيب الوراثية من الكتان

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أجريت تجربتان حقليتان بمزرعة محطة البحوث الزراعية بسخا ـ خلال موسمى 2015/2014 ، 2016/2015 لدراسة مقارنة بعض التراكيب الوراثية من الكتان وهى سخا 1 ، سخا 3 ، سخا 5 ، سخا 6 ، جيزة 10 ، جيزة 11 ، جيزة 12 ، إيلونا ، سلالة 3/5/39/335 ، سلالة5 وسلالة 402/ 1من حيث المحصول ومكوناته والتركيب الكيماوى للبذرة. أستخدم تصميم القطاعات كاملة العشوائية فى أربعة مكررات وكان المحصول السابق هو محصول الأرز موسم 2015/2014 ومحصول عباد الشمس موسم 2016/2015. من النتائج يتضح الآتى:- وجود اختلافات عالية المعنوية بين التراكيب الوراثية المختلفة من الكتان فى محصول القش والصفات المتعلقة به حيث تفوق الصنف الجديد جيزة 12 فى صفة الطول الفعال فى كلا الموسمين بينما تفوق الصنف الجديد جيزة 11 فى كل من قطر الساق ومحصول القش للنبات فى كلا الموسمين.- أعطى الصنف الجديد جيزة 12 أعلى محصول قش للفدان.- سجل الصنف المستورد إيلونا أقل القيم فى كل من الطول الفعال ، قطر الساق ، محصول القش للنبات وللفدان فى كلا الموسمين.- بالنسبة لمحصول البذور والصفات المرتبطة به يتضح من البيانات وجود اختلافات عالية المعنوية بين التراكيب الوراثية من الكتان حيث أعطى الصنف الجديد فى جيزة 11 أعلى القيم لصفات طول المنطقة الثمرية ، عدد كبسولات النبات ،وزن 1000 بذرة ومحصول البذور للفدان بينما يأتى الصنف الجديد سخا5 فى المرتبة الثانية بعد الصنف جيزة 11 فى محصول البذور للفدان.- تفوق الصنف الجديد سخا 6 فى صفة محصول البذور للنبات فى كلا الموسمين.- أعطى الصنف المستورد إيلونا أقل القيم فى محصول البذرة والصفات المتعلقة بة.- اعطى الصنف سخا6 اعلى محتوى رطوبة والصنف سخا 5 اعلى نسبة زيت بينما الصنفان سخا3 وايلونا اقل محتوى رطوبى واقل محتوى للزيت فى حين تفوق الصنفان سخا3 وايلونا فى محتوى البذور من بروتين فى كلا الموسمين .اعطى الصنف سخا3 اعلى نسبة فى الألياف والرماد بينما أعطى الصنف جيزة 10 والسلالة 4/6/3/421 اقل القيم فى كلا الموسمين.- ويعتبر سلالة 3/5/39/533 و سلالة 1/402 اعلى فى محتوى البذور من الكربوهيدرات الكلية فى كلا الموسمين واقلهم جيزة 10 فى كلا الموسمين - من النتائج السابقة ينصح بزراعة الصنف الجديد جيزة 12 للحصول على محصول من القش وزراعة الصنفان جيزة 11 وسخا 5 للحصول على اعلى محصول من البذور و الزيت.