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PERFORMANCE OF SOME PROMISING FLAX LINES FOR YIELD AND ITS COMPONENTS UNDER NORMAL AND SANDY SOIL CONDITIONS

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ABSTRACT

Twenty-four flax genotypes {21 promising lines and 3 check varieties, Giza 8 (oil type), Sakha 1 (dual purpose type) and Sakha 3 (fiber type)} were evaluated for straw, seed, oil yields and their related traits under two different environments (Sakha Exp.Station, Kafr El-Sheikh Governorate "clay soil" and Ismailia Exp.Station, Ismailia Governorate "sandy soil") through two successive seasons, 2008/09 and 2009/10. These materials were evaluated in a randomized complete block design with three replications at the two above-mentioned locations.

The collected data indicated that, Genotypes mean squares were highly significant for straw, seed, yields/fed and their related traits. The genotype x year variance (σ^2gy) was less than the genotype x location variance (σ^2gl) for all characters, except plant height and oil percentage. Consequently evaluation should probably stress using more locations but testing over a shorter period of times. Heritability values (H%.) in broad sense were high for plant height and two important components of seed weight (seed index and No. of capsules/plant). Also, the observation of narrow range between phenotypic (PCV) and genotypic (GCV) coefficients of variability, which gave almost similar values of PCV and GCV in plant height was mainly due to genetic differences as evidenced from the very high heritability. Also, straw weight per plant and long fiber percentage as well as the two important components of seed showed similar results, indicating possibility of using these yield components (seed index and No. of capsules per plant) in selection index for improving seed weight per plant as well as plant height to improve straw weight per plant.

Concerning mean performance and susceptibility index as affected by environmental stress for sandy soil, line 541-C/3 exhibited high yielding potential with high tolerance for straw and fiber yields per fed, but this line exhibited moderate tolerance for both seed and oil yields per fed. Also, line 541-D/10 exhibited high yielding ability with moderate tolerance to sandy soil conditions for each of straw, fiber, seed, and oil yields per fed. Hence the two promising lines, 541-C/3 and 541-D/10 may be consider good substitutes for the low yielding ones, Giza 8, Sakha 1 and Sakha 3 in future after evaluation in more location before releasing as a new Egyptian flax cultivar and may be useful as potential breeding material for releasing cultivars to sandy soil conditions (suitable to grown in sandy soil) for fiber and oil "dual purpose".

Keywords: Flax, variability, sandy soil conditions, stress susceptibility index.

INTRODUCTION

The extension of flax (*Linum usitatissimum* L.) cultivation in Egypt is hampered by several factors. During the winter season the land is occupied by wheat, berseem, fababean …*etc*, which need to be cultivated in the ancient Valley lands. Therefore, the extension of the flax cultivated area in sandy soil has become essentially. But, such soil has low water-holding capacity and irrigation water is limited. Flax investigators try to solve this problem by releasing drought tolerant cultivars and/or select flax genotypes has suitable to sandy soil conditions (which characteristic by low each of available water, organic matter and available nitrogen). Therefore, any breeding program must be initiated and evaluated in sandy areas, before releasing a flax cultivar for sandy reclaimed soil. Also, it necessary to release new promising lines of flax that adapted to sandy soil conditions.

Many investigations studied variance components, GxE interactions and stability in flax genotypes under different environments, and recorded different results for their stability across different environments in flax under normal conditions, *i.e.* Patil, *et al.,* (1997), Foster *et al.,* (1998), Abo El-Zahab and Abo-Kaied (2000), El-Hariri *et al*., (2004) and Abo-Kaied *et al*., (2007). The ultimate goal of flax breeding program in Egypt is to select genotype, which has high yielding potentiality, early mature, diseases resistant and tolerant to abiotic stresses (drought and salinity).

Therefore, the major objectives of this study to (1) studying performance of 21 promising flax lines compared with the three commercial cultivars, Giza 8, Sakha 1 and Sakha 3, (2) estimating genetic components of yield traits and used these parameters to aid in planning more efficient improvement program by selection and (3) determine the best lines, which can be used as useful genetic sources in flax breeding programs and/or releasing some these lines as a new flax varieties adapted to sandy soil conditions.

MATERIALS AND METHODS

Twenty four flax genotypes were evaluated for straw, seed, oil yields and their related traits under two different locations viz: Sakha Exp.Station, Kafr El-Sheikh Governorate {normal environment (clay, organic matter of 1.76%, available nitrogen 31.96 ppm, E.C. 1.95 and pH = 8.07)} and Ismailia Exp.Station, Ismailia Governorate {stress environment (sandy soil, organic matter of 0.045 %, available nitrogen 6.61 ppm, E.C. 0.13 and pH value of 7.52)} through two successive seasons, 2008/09 and 2009/10. These genotypes included the three commercial cultivars (Giza 8, Sakha 1 and Sakha 3) as check cultivars and 21 promising local strains (the full details of these strains were tested by Abo-Kaied, 2003 and Abo-Kaied, *et al*.,2008). Identification of 24 flax genotypes under study are present in Table 1.

Four experiments were carried out in randomized complete block design with three replications. Sowing date was at the first week of November in both seasons, the plot size was 3.0 x 2.0 m and consisted of 10 rows, 20 cm apart and 3 m long. Plant density of 2000 seeds/m^2 was used. Recommended agronomic practices were followed.

At harvest, data on ten randomly guarded plants were recorded to determine the averages of the individual plant traits. Straw, seed and fiber yields/fed. was calculated on plot area basis. Oil percentage (%) was determined as an average of two random seed samples/plot using Soxhlet apparatus (A.O.A.C. Society, 1995). The following characters were recorded:

Straw yield, fiber yield and their related characters:

(1) Straw yield t / fed (fed=0.42 ha), (2) long fiber yield t / fed, (3) straw weight (g)/ plant, (4) plant height (cm), (5) technical stem length (cm) and (6) long fiber percentage.

Table 1: Pedigree of the 24 flax genotypes (21 lines and 3 check varieties) under study

No.	Genotypes	Pedigree	No.	Genotypes	Pedigree
1	S.541-C/1	Giza 8 x S.2419/1	13	S.541-C/12	Giza 8 x S.2419/1
2	S.541-C/2	" " " " " " "	14	S.541-D/1	S.2419/1 x S.148/6/1
3	S.541-C/3	" " " " " " "	15	S.541-D/4	" " " " """" " " " " "
4	S.541-C/3/2	" " " " " " " "	16	S.541-D/5	" " " " " " " " " "
5	S.541-C/3/31	" " " " " " "	17	S.541-D/7	" " " " " " " " " "
6	S.541-C/3/119	" " " " " " "	18	S.541-D/8	" " " " " " " " " "
7	S.541-C/4	" " " " " " "	19	S.541-D/10	" " " " " " " " " "
8	S.541-C/5	" " " " " " "	20	S.541-D/11	" " " " " " " " " "
9	S.541-C/6	" " " " " " "	21	S.541-D/12	" " " " " " " " " "
10	S.541-C/7	" " " " " " "	22	Giza 8	Giza 6 x I. Santa Catalina 6
11	S.541-C/8	" " " " " " "	23	Sakha 1	I. Bombay x I.1485
12	S.541-C/9	" " " " " " "	24	Sakha 3	I. Belinka x I. 2569

Seed yield, oil yield and their related characters:

(1) Seed yield (kg)/fed, (2) oil yield (kg)/fed, (3) seed weight (g)/plant, (4) No. of capsules/plant, (5) seed index, as measured by 1000-seed weight in gram, (6) oil percentage.

The data obtained for each season were subjected to analysis of variance (Gomez and Gomez,1984), therefore homogeneity test (Bartlett, test) was performed for error terms of each season. Error terms were homogeneous enabling combined analysis of variance over years and locations. The estimates of these variance components and the expected composition of the mean squares were determined by the procedures described by Miller *et al.,* (1958).

Such estimates of variance components were obtained from the mean squares of the analysis of variance by using the following formulae:

$\sigma^2 p$ (phenotypic variance)= M5/rly

$\sigma^2 g$ (genotypic variance) =(M5+M2-M3-M4)/rly

$\sigma^2 gy$=(M4-M2)/ry, $\sigma^2 gl$=(M3-M2)/ry $\sigma^2 gly$=(M2-M1)/r $\sigma^2 e$=M1

Where, M1,…M5 are the values of the appropriate mean squares as indicated in Table 2; and r, l and y are the number of replicates, locations and years, respectively.

Table 2: Form of variance analysis and mean square expectations.

Sov	df	MS	Expected MS
Years (Y)	1		
Locations (L)	1		
Y x L	1		
Rep./ LY	8		
Genotypes (G)	23	M_5	$\sigma^2 e + r\sigma^2 gly + ry\sigma^2 gL + rl\sigma^2 gy + rly\sigma^2 g$
G x Y	23	M_4	$\sigma^2 e + r\sigma^2 gly + rl\sigma^2 gy$
G x L	23	M_3	$\sigma^2 e + r\sigma^2 gly + ry\sigma^2 gL$
G x Y x L	23	M_2	$\sigma^2 e + r\sigma^2 gly$
Error	184	M_1	$\sigma^2 e$

Susceptibility analysis:

A stress - susceptibility analysis index (S) was used to characterize each genotype in the stress environments and the index was calculated using genotype means and a generalized formula (Fisher and Maurer 1978) in which

S = (1-YS/YN)/D, where YS = mean yield with stress environment, YN = mean yield with normal environment, and D = environment stress intensity = 1- (mean YS of all genotypes/mean YN of all genotypes).

The “S” was used to characterize the relative drought stress tolerance of the various genotypes, where S<0.50 indicated highly stress tolerant, S>0.50<1.00 designated moderately stress tolerant and S>1.00 referred to susceptible.

RESULTS AND DISCUSSION

Variability:-

Straw yield, fiber yield and their related characters:

Mean square values presented in Table (3), show highly significant for straw yield/fed, long fiber yield/fed and their components viz.: straw weight (g)/plant, plant height (cm), technical stem length (cm) and long fiber percentage due to 21 promising flax lines as well as the three check varieties (Giza 8, Sakha 1 and Sakha 3) for combined analysis over normal (E_1= Sakha Exp.Station) and stress (E_2= Ismailia Exp.Station) environments. Genotypes mean squares were highly significant for straw yield/fed, long fiber yield/fed, straw weight/plant and its components (plant height and technical length) as well as long fiber percentage, this result indicated that genotypes (G) differed in their genetic potential for the previous characters. Such variability among different flax genotypes in straw yield and its components was also reported by Abo El-Zahab *et al* (1994) and Abo-Kaied *et al* (2006 and 2008). Splitting the environmental effects into the main sources, years (Y) and locations (L) revealed that years, locations and their interaction had highly significant effect on all characters studied except straw yield/fed, indicated the presence of significant differences between years as well as between locations for the above mentioned traits. The first order interactions, GY and GL were highly significant for all characters studied. Main squares of GL interaction were comparable in magnitude to those of GY for straw yield, fiber yield and their related characters except plant height, indicating that locations had the major effect on the previous mentioned traits. This means that for reliable evaluation of straw yield, fiber yield and their related traits it would be necessary to test genotypes in more than two locations with in few numbers of years (seasons).

The highly significant second order interactions GLY for straw yield, long fiber yield and their related traits indicate the presences of fluctuations in the ranking of genotypes for their potential of these traits. In other words, it indicates that some of the most first order interactions involving two of the variables were inconsistent over the third variable. For plant breeding point of view it supports the evidence for the necessity of testing at multiple locations over time for accurate characterization of genetic performance over a divergent geographical regions. This finding is in line with that obtained by Abo El-Zahab *et al* (1994) regarding straw yield, fiber yield and their related traits.

Estimates of the variances components among 24 flax genotypes for straw weight/plant and its components as well as long fiber percentage are shown in Table (4). The genotype x year variance (σ^2gy) was less than the genotype x location variance (σ^2gl) for all characters, except plant height. These results supported the previously mentioned conclusion, that the biased introduced by year was small, concerning beneficial selection for most yield components, plant height and technical stem length. Heritability values (H%.) in broad sense were high except for technical stem length (53.14) followed by long fiber percentage (78.00) and plant height (87.65)%. Also, the observed narrow range between phenotypic (PCV) and genotypic (GCV) coefficients of variability, which gave almost similar values of PCV (12.08) and GCV (11.31) in plant height was mainly due to genetic differences as evidenced from the very high heritability. Also, straw weight and long fiber percentage showed similar results, indicating possibility of using these yield components (long fiber percentage and plant height) in selection index with giving more weight for plant height for improving straw weight/plant. The conclusions obtained from comparison of components were the same as these derived on with that reported by Abo El-Zahab *et al* (1994) and Abo-Kaied *et al* (2006 and 2008).

Mean performance for straw yield/fed, fiber yield/fed and their related traits as well as fiber percentage of 24 flax genotypes average two seasons, 2008/09 and 2009/10 at two locations (E_1=Sakha and E_2=Ismailia) are presented in Table (5). The promising line 541-C/3 gave highest values (5.288, 4.622 and 4.955) for straw yield (ton)/fed in each of E_1 and E_2 and combined data, respectively, followed by line 541-D/10 (E_1=5.362, E_2=4.433 and C=4.898 ton/fed) and line 541-D/7 (E_1=4.970, E_1=4.225 and C=4.598 ton/fed) when compared with the other lines as well as the three check varieties (Giza 8, Sakha 1 and Sakha 3). Concerning fiber yield (ton)/fed, the lines 541-D/10 (E_1=0.916, E_2=0.794 and C=0.855 ton/fed) followed by line 541-C/3 (E_1=0.854, E_2=0.787 and C=0.820 ton/fed) and line 541-C/2 (E_1=0.763, E_2=0.640 and C=0.702 ton/fed) were superior than most other lines as well as the check varieties in all cases (E_1, E_2 and combined data) except line 541-C/2 which was non-significant different with Sakha 3. Also, line 541-D/10 (E_1=3.810, E_2=2.283 and C=3.047 g) followed by line 541-C/3 (E_1=3.330, E_2=2.298 and C=2.814) and line 541-C/6 (E_1=3.127, E_2=2.367 and C=2.747 g) which gave highest values for straw weight/plant than other genotypes under study. Four lines {541-D/10 (E_1=135.65, E_2=106.02 and C=120.83 cm), 541-C/3 (E_1=119.17, E_2=103.35 and C=111.26 cm), 541-C/3/2 (E_1=112.6, E_2=104.67 and C=108.63 cm) and 541-D/5 (E_1=113.03, E_2=103.17 and C=108.10 cm)} gave highest mean taller than the other genotypes for plant height. Whereas, three lines {541-D/10 (E_1=107.93, E_2=85.40 and C=96.67 cm), 541-C/3/2 (E_1=100.47, E_2=81.33 and C=90.90 cm) and 541-C/3 (E_1=95.03, E_2=76.65 and C=85.84 cm)} gave the highest taller technical stem length than other lines as well as the three check varieties. Concerning long fiber percentage the three lines {541-D/10

(E_1=17.09, E_2=17.92 and C=17.50 %), 541-D/11 (E_1=17.2, E_2=17.66 and C=17.43 %) and 541-C/2 (E_1=16.98, E_2=17.31 and C=17.15 %)} gave the highest values than other genotypes. These results indicated that the two promising lines, 541-D/10 and 541-C/3 may be consider good substitutes for the low yielding ones, Giza 8, Sakha 1 and Sakha 3 in future after evaluation in more locations before releasing as a new Egyptian flax cultivars for straw and fiber production.

Seed yield, oil yield and their related traits:-

Mean squares due genotypes for seed yield, oil yield and their related characters are presented in (Table 3). Data indicated that these genotypes showed reasonable degree of variability for these traits. Also, the results clearly indicated that environments (E), expressed separately as locations and years; exhibited highly significant for all characters studied except mean square of years for both seed yield/fed and No. of capsules/plant. The main square values of location were greater than mean square of year for all characters except oil percentage. Consequently evaluation should probably stress by using more locations but testing over a shorter period of times. These findings are in line with those of Shehata and Comstock (1971) and Abo El-Zahab *et al* (1994) who found significant effects for locations and years on both seed yield and oil content in flax.

Also, GL and GY interactions were highly significant for all characters except GY interaction for oil percentage. Mean square of GL greater than YL interaction for all characters except seed weight/plant which had almost equal values. This reveals the necessity of increasing the test locations but not the season in conducting seed traits in Egypt. Such small magnitude and insignificant GY interaction for oil percentage, however, indicate that these were no consistent and substantial year effects on differential genotypic response. The relatively GYL interaction was small and insignificant as GY and GYL interactions for oil percentage clearly demonstrate that seed yield of the genotypes may be predictable over years. On the other hand, GYL was highly significant for seed yield, oil yield, seed weight/plant, No. of capsules/plant and seed index, indicating that some of the first order interactions involving two of the variables were inconsistent over third variable. These results are in harmony with those reported by Abo El-Zahab *et a*l (1994) and Abo-Kaied *et al* (2008).

Estimates of the variances components among 24 flax genotypes for seed weight/plant and its components as well as oil percentage are shown in Table (4). The genotype x location variance (σ^2gl) was greater than the genotype x year variance (σ^2gy) for seed weight and its components. This result indicated that location has the major effect on the previous mentioned traits. Thus for reliable evaluation of seed weight and its components it would be necessary to test genotypes in more than one environment with great emphasis on multi-location testing. Estimates of the variance components and heritability, phenotypic (PCV) and genotypic (GCV) coefficient of variability exhibited high values for both seed weight/plant and No. of capsules/plant. These results indicated that, the high range of variability might be useful in selecting lines characterized by high-yielding potential for both seed weight and No. of capsules/plant in this material. Such results support the view that the expected gain from selection would be valid and that a substantial improvement for this variable could be expected by selecting superior genotypes. Similar finding regarding high coefficient of variation of seed weight/plant and No. of capsules/plant with high heritability estimates have reported by Kumar and Chauhan (1982), Frank and Hollosi (1985), Abo El-Zahab *et al,* (1994), Zahana and Abo-Kaied (2007) and Abo-Kaied *et al*, (2008). On the other hand, the low of PCV and GCV values in addition to the slight discrepancy between PCV (11.24%) and GCV (10.98%) values for seed index was reflected in the high heritability estimate (95.54%) for this trait. These result support the point of view of improving seed weight/plant via using the component breeding for two yield components seed index and No. of capsules/plant, giving more weight to seed index. These results are in harmony with that reported by Abo El-Zahab *et al,* (1994) and Abo-Kaied *et al*, (2008).

Mean performance for seed yield/fed, oil yield/fed and their related traits as well as oil percentage of 24 flax genotypes average two seasons, 2008/09 and 2009/10 at two locations (E_1=Sakha and E_2=Ismailia) are presented in Table (6). The line 541-C/3 (E_1=0.965, E_2=0.495 and C=0.730 ton seed/fed), (E_1=415.82, E_2=216.91 and C=316.36 kg oil/fed) followed by line 541-D/4 (E_1=0.836, E_2=0.542 and C=0.689 ton seed/fed), (E_1=338.62, E_2=222.43 and C=280.52 kg oil/fed) and line 541-D/10 (E_1=0.839, E_2=0.462 and C=0.651 ton seed/fed), (E_1=349.19, E_2=192.94 and C=271.07 kg oil/fed) out of 21 promising flax lines as well as the three check varieties had high yielding potentiality for both seed and oil yield/fed, respectively. Concerning seed weight/plant, line 541-C/3 followed by 541-C/9, 541-D/11 and 541-D/10 were superior than most other lines as well as the three check varieties. Also, five lines (541-C/3 followed by 541-C/5, 541-C/8, 541-D/10 and 541-D/11) for No. of capsules/plant, three lines (541-C/3 followed by 541-C/6 and 541-D/10) for seed index and four lines (541-C/3/119 followed by 541-C/3, 541-C/3/31 and 541-D/11) for oil percentage were superior when compared with the other lines in addition to the three check varieties for the above mentioned characters. These results indicated that the line 541-C/3, 541-D/10 and541-D/11 should be subjected to further test in other locations before releasing as a dual purpose cultivar for high seed and oil yields as well as oil percentage.

It could be concluded that the two promising lines, 541-D/10 and 541-C/3 may be consider good substitutes for the low yielding ones, Giza 8, Sakha 1 and Sakha 3 in future after evaluation in more locations before releasing as a new Egyptian flax cultivars for straw, fiber, seed and oil yields (dual purpose type).

Stress-susceptibility index (S):

Straw yield, fiber yield and their related characters:

A stress susceptibility index (S) proposed by Fisher and Maurer (1978) can be used as indicator for measuring drought tolerance under stress conditions and could help for isolating improved tolerant genotypes (Winter *et al.*, 1988).

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Table (5) shows mean performance of 24 flax genotypes for straw yield, fiber yield and their related traits under normal (E_1) and sandy soil conditions (E_2) as well as their combined data and susceptibility index (S). out of 24 flax genotypes, two (541-C/3 and 541-D/11) for straw yield/fed, four (541-C/3, 541-C/7, 541-D/5 and 541-D/11) for long fiber yield/fed, two (541-C/7 and 541-D/12) for straw/plant, two (541-C/1 and 541-C/3/31)for plant height and six genotypes (541-C/2, 541-C/3/31, 541-C/6, 541-D/7, 541-D/12 and sakha 3) for long fiber percentage exhibited high tolerance to sandy soil conditions. While, the three promising lines (541-D/10, 541-D/7 and 541-C/7) for straw yield/fed, two (541-C/2 and 541-D/10) for fiber yield/fed, three (541-C/3, 541-C/3/2 and 541-D/5) for plant height, three (541-C/3, 541-C/3/2 and 541-D/10) for technical stem length and one (541-D/11) for fiber percentage exhibited moderate tolerance to sandy soil conditions.

In general, line 541-C/3 exhibited high yielding potential with high tolerance for important yields, straw and fiber yields/fed. On the other hand, line 541-D/10 exhibited high yielding ability with moderate tolerance to sandy soil conditions for each of straw yield/fed, fiber yield/fed, straw weight/plant and technical stem length. Hence the two promising lines (541-C/3 and 541-D/10) may be useful as potential breeding material for releasing cultivars to sandy soil conditions (suitable to grown in sandy soil) for the above mentioned traits.

Seed yield and oil yield and their related traits:-

Table (6) shows mean performance of 24 flax genotypes for seed yield, oil yield and their related traits under normal (E_1) and sandy soil conditions (E_2) as well as their combined data and susceptibility index (S). out of 24 flax genotypes, three (541-C/3, 541-D/4 and 541-D/10) for both seed yield/fed and oil yield/fed, two (541-C/3 and 541-D/10) for both seed weight and seed index, two (541-C/3 and 541-C/8) for No. of capsules/plant and one (541-C/3) for oil percentage exhibited high yielding ability with moderate tolerance for the above mentioned traits. On the other hand, three (541-C/3/2, 541-C/9 and 541-D/8) for No. of capsules/plant, three (541-C/3/119, 541-C/6 and 541-D/7) for seed index and six genotypes (541-C/3/31, 541-C/3/119, 541-D/8, 541-D/10, 541-D/11 and Giza 8) for oil percentage exhibited tolerance to sandy soil conditions with high or moderate yield for the previous traits. It concluded that, the line 541-C/3 gave high mean performance for seed and oil yield and other related characters under sandy soil conditions. Also, the two lines (541-D/4 and 541-D/10) exhibited high yielding ability with moderate tolerance to sandy soil conditions for both seed yield/fed and oil yield/fed.

In general, the three lines (541-C/3, 541-D/4 and 541-D/10) exhibited high yielding ability with moderate tolerance to sandy soil conditions for both seed yield/fed and oil yield/fed. Hence these three promising lines (541-C/3, 541-D/4 and 541-D/10) may be useful as potential breeding material for releasing cultivars to sandy soil conditions for the two yields (seed and oil yields/fed).

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أداء بعض سلالات الكتان المبشرة للمحصول ومكوناته تحت ظروف الأراضي العادية و الرملية

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تم تقييم ٢٤ تركيبا وراثيا من الكتان (٢١ سلالة مبشرة + ٣ أصناف تجارية استخدمت كأصناف قياسية للمقارنة وهي جيزة ٨ "طراز زيتي"، وسخا ١ "طراز ثنائي"، وسخا ٣"طراز ليفي") لمحصول القش والبذور والصفات المكونة لهما، وذلك في موقعين (محطة بحوث سخا "أراضي طينية"- م كفر الشيخ، ومحطة بحوث الإسماعيلية "أراضي رملية"- م الإسماعيلية) وذلك خلال موسمين متتاليين (٢٠٠٨/٠٩، ٢٠٠٩/١٠) وذلك في تجربة قطاعات كاملة العشوائية ذات ثلاثة مكررات، وأشارت النتائج إلي أن تباين التراكيب الوراثية كان عالي المعنوية لصفات محصولي القش والبذور والصفات المكونة لهما. كذلك تباين التفاعل بين الأصناف والسنوات (GxY) كان أقل من تباين التفاعل بين الأصناف والمواقع (GxL) لكل الصفات تحت الدراسة فيما عدا الطول الكلي والنسبة المئوية للزيت، لذلك يجب عند تقييم مواد التربية التركيز علي زيادة عدد المواقع علي حساب عدد السنوات. كما أشارت النتائج إلي أن درجة التوريث في المعنى الواسع كانت عالية لصفات الطول الكلي للنبات وكذلك لأهم مكونين من مكونات محصول البذور (معامل البذرة وعدد الكبسولات للنبات). كذلك تقارب قيم معامل الاختلاف الظاهري والو راثي لصفة الطول الكلي للنبات أعطت نتائج مماثلة مما يشير إلي إمكانية استخدام كل من معامل البذور وعدد الكبسولات للنبات كدليل انتخابي لتحسين محصول البذور للنبات وكذلك الطول الكلي لتحسين محصول القش للنبات.
كذلك أشارت النتائج الخاصة بتحمل الظروف المعاكسة للأراضي الرملية إلى أن السلالة ٥٤١- جـ/٣ أظهرت قدرة محصولية عالية لصفتي محصول القش والألياف للفدان وكذلك قدرة عالية لتحمل الظروف المعاكسة للأراضي الرملية، ولكنها أظهرت قدرة متوسطة لتحمل الظروف المعاكسة لصفتي محصول البذور والزيت للفدان. كذلك السلالة ٥٤١- د/١٠ أعطت أعلي محصول لصفات محصول القش والألياف والبذور والزيت للفدان مع تحمل متوسط للظروف المعاكسة، لذلك هاتان السلالتان ٥٤١- جـ/٣، ٥٤١- د/١٠ يمكن إحلالهما في المستقبل محل الأصناف التجارية والمنخفضة نسبيا في المحصول وهي جيزة ٨، وسخا ١، وسخا ٣ وذلك بعد تقيمهما في عدد أكبر من المواقع قبل إطلاقهما كصنفين جديدين. "ثنائي الغرض" من أصناف الكتان التجارية المصرية والتي تتناسب مع ظروف الأراضي الرملية للصفات المحصولية سالفة الذكر.

قام بتحكيم البحث

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Table 3: Combined analysis for straw yield, fiber yield and their related characters of 24 flax genotypes based on data of four environments (two years x two locations).

Characters	Year (y) (1) #	Location (l) (1)#	Y x l (1)	Reps/(y x l) (8)#	Genotype (g) (23) #	G x y (23) #	G x l (23)	G x y x l (23)	Error (184)
Straw yield, fiber yield and their related characters									
Straw yield t / fed	16.037**	83.723**	0.107 **ns**	1.202	5.868**	0.362**	0.56**	0.45**	0.087
Long fiber yield t / fed,	0.684**	1.529**	0.173**	0.025	0.269**	0.015**	0.023**	0.017**	0.003
Straw weight / plant (g),	19.024**	53.337**	14.374**	0.023	1.895**	0.283**	0.449**	0.341**	0.071
plant height (cm)	177.50**	13190.90**	647.10**	68.98	1548.00**	167.90**	104.70**	81.49**	15.95
Technical stem length (cm)	249.2**	23365.80**	467.92**	60.50	818.30**	116.99**	393.10**	126.61**	49.98
Long fiber percentage	12.442**	56.215**	109.101**	3.075	23.883**	3.127**	4.066**	1.938**	0.469
Seed yield, oil yield and their related characters									
Seed yield kg/fed	0.004 **ns**	13.552**	0.230**	0.029	0.061**	0.008**	0.010**	0.010**	0.003
oil yield kg /fed.	5415.8**	2216582.7**	29163.1**	5840.6	13016.7**	1681.2**	2825.1**	1600.4**	766.4
Seed weight/plant (g)	0.556**	3.747**	0.406**	0.025	0.108**	0.024**	0.018**	0.024**	0.003
No. Of capsules/plant	0.000 **ns**	347.161**	0.000 **ns**	7.023	31.389**	0.264**	3.486**	0.264**	0.995
seed index	3.41**	68.816**	37.541**	1.756	14.818**	0.552**	0.761**	0.652**	0.137
oil percentage(%)	48.364**	41.39**	7.226 **ns**	3.493	19.854**	4.14 **ns**	7.451**	3.023 **ns**	3.334

***,** = indicate significance at the 0.05 and 0.01 levels of probability, respectively.**
 # =values designated the corresponding degrees of freedom .

Table 4: Variance components estimates, phenotypic (pcv) and genotypic (gcv) coefficients of variability and broad sense heritability (h%) in the combined analysis for straw weight, and seed weight and their components as well as fiber percentage and oil percentage of 24 flax genotypes based on data of 4 environments (2 years x 2 locations).

Characters	Σ^2ph	Σ^2g	Σ^2gy	Σ^2gl	Σ^2gyl	Σ^2e	H%	Pcv%	Gcv%
Straw weight and its components as well as long fiber percentage									
Straw weight / plant (g),	0.16 **	0.13 **	-0.01 **	0.02 **	0.09 **	0.07	79.37	92.20	82.14
Plant height (cm)	129.0**	113.1***	14.40 **	3.88 **	21.85 **	15.95	87.65	12.08	11.31
Technical stem length (cm)	68.19 **	36.24 **	-1.61 **	44.41 **	25.55 **	49.98	53.14	10.81	7.88
Long fiber percentage	1.99 **	1.55 **	0.20 **	0.35 **	0.49 **	0.47	78.00	8.81	7.78
Seed weight and its components as well as oil percentage									
Seed weight/plant (g)	0.01 **	0.01 **	0.00 **	0.00 **	0.01 **	0.00	83.33	23.72	21.65
No. Of capsules/plant	2.62 **	2.33 **	0.00 **	0.54 **	-0.24 **	1.00	88.89	23.10	21.78
Seed index	1.23 **	1.18 **	-0.02 **	0.02 **	0.17 **	0.14	95.54	11.24	10.98
Oil percentage	1.65 **	0.94 **	0.19 ns	0.74 ns	-0.10 ns	3.33	56.84	3.11	2.34

 # Negative estimate for which most reasonable value is zero.

Table 5: Continued.

NO.	Genotype	Plant Height (Cm)				Technical Length (Cm)				Long Fiber Percentage			
		E_1	E_2	C.	S	E_1	E_2	C.	S	E_1	E_2	C.	S
1	**S.541-C/1**	103.12 E-H	96.58 B	99.85 C-E	**0.47**	90.67 B-F	75.83 A-C	83.25 B-D	**0.78**	16.16 A-G	17.68 AB	16.92 A-D	**2.19**
2	**S.541-C/2**	109.73 C-E	102.37 A	106.05 BC	**0.50**	96.78 A-D	70.08 C-F	83.43 A-D	**1.31**	16.98 A-C	17.31 A-C	17.15 A-D	**0.45**
3	**S.541-C/3**	119.17 B	103.35 A	111.26 B	**0.99**	95.03 A-D	76.65 A-C	85.84 A-C	**0.92**	16.14 A-G	17.02 A-D	16.58 A-F	**1.26**
4	**S.541-C/3/2**	112.6 B-D	104.67 A	108.63 B	**0.53**	100.47A-C	81.33 AB	90.90 AB	**0.90**	15.69 D-H	16.72 B-D	16.20 C-G	**1.51**
5	**S.541-C/3/31**	100.85 F-G	95.43 B	98.14 D-F	**0.40**	87.57 C-G	73.58 B-D	80.58 B-F	**0.76**	16.81 A-D	16.39 CD	16.60 A-F	**-0.59**
6	**S.541-C/3/119**	102.08 E-H	87.75 DE	94.92 D-G	**1.05**	90.35 B-F	69.73 C-F	80.04 B-F	**1.08**	15.42 F-I	17.20 A-D	16.31 C-G	**2.67**
7	**S.541-C/4**	100.93 F-G	77.90 H-J	89.42 G-K	**1.70**	78.72 E-I	69.63 C-F	74.18 D-G	**0.55**	14.56 H-K	16.19 D	15.37 G-J	**2.59**
8	**S.541-C/5**	92.32 I-K	83.70 D-G	88.01 H-L	**0.70**	77.47 F-I	61.90 F-H	69.68 FG	**0.95**	15.50 E-I	15.92 DE	15.71 E-I	**0.62**
9	**S.541-C/6**	104.05 E-G	84.37 D-F	94.21 E-H	**1.41**	76.17 G-I	71.90 B-E	74.03 D-G	**0.27**	16.69 A-E	14.05 G	15.37 G-J	**-3.67**
10	**S.541-C/7**	86.38 K	69.13 K	77.76 N	**1.49**	73.62 HI	65.33 D-H	69.48 FG	**0.53**	13.98 JK	14.94 E-G	14.46 I-K	**1.60**
11	**S.541-C/8**	90.40 JK	72.15 K	81.28 MN	**1.50**	74.85 G-I	58.33 GH	66.59 G	**1.05**	15.94 B-G	17.59 AB	16.76 A-E	**2.41**
12	**S.541-C/9**	87.15 K	78.33 H-J	82.74 I-N	**0.75**	70.58 I	59.08 GH	64.83 G	**0.77**	15.64 D-H	16.55 CD	16.09 D-H	**1.35**
13	**S.541-C/12**	86.22 K	69.87 K	78.04 N	**1.41**	70.98 I	55.58 H	63.28 G	**1.03**	13.60 K	15.26 D-F	14.43 JK	**2.83**
14	**S.541-D/1**	96.87 H-J	87.97 DE	92.42 F-J	**0.68**	86.35 D-H	62.58 E-H	74.47 C-G	**1.31**	15.64 D-H	17.04 A-D	16.34 B-G	**2.08**
15	**S.541-D/4**	105.05 D-G	92.97 BC	99.01 DE	**0.86**	91.58 B-E	69.98 C-F	80.78 B-F	**1.12**	13.40 K	14.47 FG	13.94 K	**1.85**
16	**S.541-D/5**	113.03 BC	103.17 A	108.10 B	**0.65**	101.53 AB	38.33 I	69.93 FG	**2.95**	15.81 C-G	16.41 CD	16.11 D-H	**0.88**
17	**S.541-D/7**	106.87 C-F	95.57 B	101.22 CD	**0.79**	93.67 B-D	72.15 B-E	82.91 B-D	**1.09**	14.99 G-J	15.08 EF	15.04 H-K	**0.15**
18	**S.541-D/8**	90.52 JK	78.65 G-J	84.58 K-M	**0.98**	76.37 G-I	70.33 C-F	73.35 D-G	**0.37**	16.34 A-F	17.92 A	17.13 A-D	**2.26**
19	**S.541-D/10**	135.65 A	106.02 A	120.83 A	**1.63**	107.93 A	85.40 A	96.67 A	**0.99**	17.09 AB	17.92 A	17.50 A	**1.12**
20	**S.541-D/11**	103.12 E-H	88.35 CD	95.73 D-G	**1.07**	87.65 C-G	76.58 A-C	82.12 B-E	**0.60**	17.20 A	17.66 AB	17.43 AB	**0.62**
21	**S.541-D/12**	89.78 JK	73.73 J	81.76 L-N	**1.33**	77.63 F-I	63.88 D-H	70.76 E-G	**0.84**	15.87 C-G	15.23 D-F	15.55 F-I	**-0.94**
22	**GIZA 8**	98.38 G-I	77.53 IJ	87.96 H-L	**1.58**	86.92 D-G	58.65 GH	72.78 D-G	**1.54**	14.37 I-K	14.87 E-G	14.62 I-K	**0.81**
23	**SAKHA 1**	91.80 I-K	83.07 E-H	87.43 I-M	**0.71**	79.58 E-I	65.90 D-G	72.74 D-G	**0.82**	15.27 F-I	15.90 DE	15.59 F-I	**0.95**
24	**SAKHA 3**	91.32 I-K	80.42 F-I	85.87 J-M	**0.89**	78.47 E-I	65.80 D-G	72.13 D-G	**0.77**	17.28 A	17.28 A-C	17.28 A-C	**0.00**
MEAN		**100.72**	**87.21**	**93.97**		**85.46**	**67.44**	**76.45**		**15.68**	**16.36**	**16.02**	

Means identified by the same letter are not significantly different at 0.05 level of probability according to flsd.

Table 5: Mean values for straw and long fiber yields as well as their related characters of 24 flax genotypes (combined over two years (2008/09 and 2009/10) at two locations (e1= sakha and e2=ismailia).

N0.	GENOTYPE	STRAW YIELD T / FED				LONG FIBER YIELD T / FED				STRAW WEIGHT (G)/ PLANT			
		E_1	E_2	C.	S	E_1	E_2	C.	S	E_1	E_2	C.	S
1	**S.541-C/1**	4.228 C-F	2.608 GH	3.418 E	**1.43**	0.683 CH	0.461 F-H	0.572 D-G	**1.38**	2.628 C-E	1.678 BD	2.153 D-G	**1.05**
2	**S.541-C/2**	4.494 C-E	3.700CD	4.097 CD	**0.66**	0.763 B-D	0.640 B	0.702 B	**0.68**	3.138 B	1.797 BC	2.468 B-D	**1.24**
3	**S.541-C/3**	5.288 A	4.622 A	4.955 A	**0.47**	0.854 A	0.787 A	0.820 A	**0.33**	3.330 AB	2.298 A	2.814 AB	**0.90**
4	**.541-C/3/2**	4.919 AB	3.706 CD	4.313 BC	**0.92**	0.772 BC	0.619 BC	0.696 B	**0.84**	2.870 B-D	1.343 DE	2.107 D-H	**1.55**
5	**.541-C/3/31**	4.036 D-G	2.604GH	3.320 E-G	**1.33**	0.679 CH	0.427 G-J	0.553 D-G	**1.57**	2.178 E-I	1.493 B-E	1.836 G-J	**0.92**
6	**.541-C/3/119**	3.872F-H	2.935 FG	3.404-E	**0.91**	0.597 H-K	0.505 E-G	0.551 D-G	**0.65**	2.573 D-F	1.638 BD	2.106 D-H	**1.06**
7	**S.541-C/4**	3.925 F-H	2.55 GH	3.238 E-H	**1.31**	0.571 I-K	0.413 H-K	0.492 F-J	**1.18**	2.548 D-F	1.772 BC	2.160 D-G	**0.89**
8	**S.541-C/5**	4.008 DG	2.775 FG	3.392 EF	**1.15**	0.621 G-J	0.442 F-I	0.531 E-H	**1.22**	2.488 D-G	1.813 BC	2.151 D-G	**0.79**
9	**S.541-C/6**	4.245 C-F	3.109 E-F	3.677 DE	**1.00**	0.708 B-G	0.437 G-I	0.573 D-F	**1.62**	3.127 BC	2.367 A	2.747 A-C	**0.71**
10	**S.541-C/7**	3.192 I	2.638 GH	2.915 F-H	**0.65**	0.446 M	0.394 H-L	0.420 IJ	**0.49**	2.097 F-J	1.868 B	1.983 E-I	**0.32**
11	**S.541-C/8**	3.733 F-I	2.120 H	2.927 F-H	**1.62**	0.595 H-K	0.373 I-L	0.484 G-J	**1.58**	2.192 E-I	1.582 B-E	1.887 G-J	**0.81**
12	**S.541-C/9**	3.581 G-I	2.134 H	2.858 GH	**1.51**	0.560 J-L	0.353 J-L	0.457 H-J	**1.56**	2.468 D-G	1.357 DE	1.913 F-I	**1.31**
13	S.541-C/12	3.403 HI	2.242 H	2.823 H	**1.28**	0.463 L-M	0.342 KL	0.402 J	**1.10**	1.622 J	1.325 DE	1.474 J	**0.53**
14	S.541-D/1	4.262 C-F	3.052 E-F	3.657 DE	**1.06**	0.666 D-I	0.520 D-F	0.593 DE	**0.93**	2.142 E-I	1.408 B-E	1.775 G-J	**1.00**
15	S.541-D/4	4.957AB	3.772 CD	4.365 BC	**0.90**	0.664 D-I	0.546 C-E	0.605 C-E	**0.76**	2.310 E-H	1.497 B-E	1.904 G-J	**1.02**
16	S.541-D/5	4.661BC	4.025 BC	4.343 BC	**0.51**	0.737 B-F	0.660 B	0.699 B	**0.44**	2.89 B-D	1.812 BC	2.351 C-E	**1.09**
17	S.541-D/7	4.970 AB	4.225 AB	4.598 AB	**0.56**	0.745 B-E	0.637 B	0.691 BC	**0.61**	2.392 D-H	1.575 B-E	1.984 E-I	**0.99**
18	S.541-D/8	3.983 E-G	2.800 FG	3.392 EF	**1.11**	0.651 E-J	0.502 E-G	0.576 D-F	**0.97**	2.270 E-I	1.467 B-E	1.869 G-J	**1.03**
19	S.541-D/10	5.362 A	4.433 AB	4.898 A	**0.65**	0.916 A	0.794 A	0.855 A	**0.56**	3.810 A	2.283 A	3.047 A	**1.17**
20	S.541-D/11	3.746 FH	3.383 DE	3.565 E	**0.36**	0.644 F-J	0.597 BD	0.621 B-D	**0.31**	3.248 B	1.553 B-E	2.401 B-D	**1.52**
21	S.541-D/12	3.903 FH	2.860 FG	3.382 EF	**1.00**	0.619 G-J	0.435 G-I	0.527 E-H	**1.26**	1.788 I-J	1.568 B-E	1.678 H-J	**0.36**
22	GIZA 8	3.536 G-I	2.175 H	2.856 GH	**1.44**	0.508 K-M	0.323 L	0.416 IJ	**1.54**	2.037 G-J	1.190 E	1.614 IJ	**1.21**
23	SAKHA 1	3.851FH	2.627 GH	3.239 E-H	**1.19**	0.588 H-K	0.418 H-K	0.503 F-J	**1.23**	1.935 H-J	1.475 B-E	1.705 H-J	**0.69**
24	SAKHA 3	4.532CD	2.704 FG	3.618 E	**1.51**	0.783 B	0.467 E-H	0.625 B-D	**1.71**	2.035 G-J	1.300 DE	1.668 IJ	**1.05**
MEAN		**4.195**	**3.075**	**3.635**		**0.660**	**0.504**	**0.582**		**2.505**	**1.644**	**2.074**	

Means identified by the same letter are not significantly different at 0.05 level of probability according to flsd.

Table 6: Mean values for seed and oil yields as well as their related characters of 24 flax genotypes (combined over two years (2008/09 and 2009/10) at two locations (E1= Sakha and E2=Ismailia).

No.	Genotype	Seed yield t / fed				Oil yield (kg)/fed				Seed weight (g)/plant			
		E1	E2	C.	S	E1	E2	C.	S	E1	E2	C.	S
1	S.541-C/1	0.711 e-g	0.354 c-g	0.533 ef	0.91	289.38 de	149.02 c-d	219.2 d-g	0.89	0.44 g-i	0.25 f-h	0.34 f-h	0.99
2	S.541-C/2	0.707 fg	0.306 d-i	0.507 f	1.02	281.90 de	129.47 c-d	205.68 fg	0.99	0.44 g-i	0.25 f-h	0.34 f-h	0.99
3	S.541-C/3	0.965 a	0.495 a	0.730 a	0.88	415.82 a	216.91 a	316.36 a	0.88	0.68 ab	0.46 a	0.57 a	0.74
4	S.541-C/3/2	0.789 b-g	0.331 c-i	0.560 d-f	1.05	329.15 c-e	140.10 c-d	234.62 c-g	1.05	0.45 g-i	0.24 f-i	0.34 f-h	1.06
5	S.541-C/3/31	0.768 c-g	0.331 c-i	0.550 d-f	1.03	326.40 c-e	139.91 c-d	233.16 c-g	1.05	0.47 e-h	0.35 c-e	0.41 d-f	0.58
6	S.541-C/3/119	0.797 b-g	0.292 f-i	0.545 ef	1.14	239.10 de	124.49 c-d	252.68 b-e	0.88	0.56 c-f	0.25 f-h	0.40 d-f	1.26
7	S.541-C/4	0.795 b-g	0.379 c	0.587 c-f	0.94	321.94 c-e	158.35 b	240.14 b-g	0.93	0.50 d-g	0.31 df	0.40 d-f	0.86
8	S.541-C/5	0.767 c-g	0.367 cd	0.567 c-f	0.94	305.21 de	150.57 b-d	227.89 c-g	0.93	0.59 b-d	0.34 c-e	0.46 c-e	0.96
9	S.541-C/6	0.764 c-g	0.347 c-g	0.556 d-f	0.98	304.44 de	148.00 c-d	226.22 d-g	0.94	0.55 c-f	0.38 a-d	0.47 cd	0.69
10	S.541-C/7	0.811 b-f	0.341 c-h	0.576 c-f	1.05	329.41 c-e	145.22 c-d	237.32 b-g	1.02	0.61 bc	0.24 f-i	0.43 d-f	1.37
11	S.541-C/8	0.783 c-g	0.276 hi	0.530 ef	1.17	312.79 c-e	116.09 c-e	214.44 d-g	1.15	0.57 c-e	0.40 a-c	0.48 b-d	0.68
12	S.541-C/9	0.79 b-g	0.335 c-h	0.563 c-f	1.04	319.10 c-e	137.56 c-d	228.33 c-g	1.04	0.75 a	0.40 a-c	0.57 a	1.04
13	S.541-c/12	0.896 ab	0.379 c	0.638 b-d	1.04	357.44 a-c	156.26 bc	256.85 b-d	1.03	0.47 e-h	0.24 f-i	0.35 f-h	1.13
14	S.541-D/1	0.785 c-g	0.352 c-g	0.569 c-f	0.99	310.35 de	142.17 c-d	226.26 d-g	0.99	0.37 i	0.17 hi	0.27 h	1.20
15	S.541-D/4	0.836 bc	0.542 a	0.689 ab	0.63	338.62 a-d	222.43 a	280.52 ab	0.63	0.43 g-i	0.31 d-g	0.37 e-g	0.63
16	S.541-D/5	0.691 g	0.333 c-i	0.512 f	0.93	281.00 de	138.78 c-d	209.89 e-g	0.93	0.46 f-i	0.23 g-i	0.34 f-h	1.13
17	S.541-D/7	0.841 bc	0.391 c	0.616 b-e	0.96	333.54 a-d	162.91 b	248.23 b-f	0.94	0.44 g-i	0.24 f-i	0.34 f-h	1.04
18	S.541-D/8	0.795 b-g	0.358 c-f	0.577 c-f	0.99	330.44 b-d	148.39 c-d	239.42 b-g	1.01	0.68 ab	0.29 d-g	0.48 b-d	1.29
19	S.541-D/10	0.839 bc	0.462 b	0.651 a-c	0.81	349.19 a-d	192.94 ab	271.07 bc	0.82	0.63 bc	0.45 ab	0.54 a-c	0.66
20	S.541-D/11	0.822 b-d	0.363 c-e	0.593 c-f	1.01	360.05 ab	153.69 bc	256.87 b-d	1.05	0.75 a	0.37 b-e	0.56 ab	1.14
21	S.541-D/12	0.728 d-g	0.287 g-i	0.508 f	1.09	287.97 de	118.85 c-d	203.41 g	1.07	0.38 hi	0.23 g-i	0.31 gh	0.89
22	Giza 8	0.747 c-g	0.264 i	0.506 f	1.17	311.69 c-e	110.09 de	210.89 e-g	1.18	0.42 g-i	0.16 i	0.29 gh	1.41
23	Sakha 1	0.817 b-e	0.294 e-i	0.556 d-f	1.15	331.62 b-d	121.10 c-d	226.36 c-g	1.16	0.38 hi	0.2 hi	0.29 gh	1.08
24	Sakha 3	0.537 h	0.187 j	0.362 g	1.18	202.49 e	73.41 e	137.95 h	1.17	0.42 g-i	0.19 hi	0.31 gh	1.24
Mean		0.783	0.349	0.566		321.28	145.70	233.49		0.52	0.29	0.40	

Means identified by the same letter are not significantly different at 0.05 level of probability according to FLSD.

Table 6. Continued.

No.	Genotype	No. of capsules/plant				Seed index (g)				Oil percentage			
		E1	E2	C.	S	E1	E2	C.	S	E1	E2	C.	S
1	S.541-C/1	9.0 c-e	6.7 c-e	7.9 b-e	0.95	10.76 d-f	9.54 de	10.15 e-g	1.21	40.70 c-e	42.10 a-c	41.40 b-e	1.86
2	S.541-C/2	7.8 eh	5.7 d-g	6.8 e-j	0.99	10.44 f-i	9.70 d	10.07 fg	0.75	39.87 de	42.31 a-c	41.09 b-e	3.31
3	S.541-C/3	11.8 ab	8.8 a	10.3 a	0.95	12.30 a	11.34 a	11.82 a	0.83	43.09 a-c	43.82 a	43.46 ab	0.92
4	.541-C/3/2	5.4 j	5.3 f-i	5.3 i-k	0.12	9.87 i	8.65 gh	9.26 h	1.31	41.72 a-d	42.33 a-c	42.02 b-d	0.79
5	.541-C/3/31	8.3 d-g	6.9 c-e	7.6 c-g	0.63	10.50 e-i	9.08 e-g	9.79 f-h	1.44	42.50 a-d	42.27 a-c	42.39 a-c	-0.29
6	.541-C/3/119	6.8 g-i	4.5 g-j	5.7 h-k	1.25	10.07 g	9.78 d	9.93 fg	0.31	44.79 a	42.64 ab	43.71 a	-2.60
7	S.541-C/4	8.8 c-f	6.2 c-f	7.5 c-g	1.10	11.35 bd	10.50 b	10.92 b-d	0.80	40.50 c-e	41.78 a-c	41.14 b-e	1.72
8	S.541-C/5	12.3 a	8.1ab	10.2 a	1.26	10.10 g	9.56 de	9.83 f-h	0.57	39.79 de	41.03 b-d	40.41 c-e	1.68
9	S.541-C/6	9.5 c-e	6.0 c-f	7.8 b-f	1.36	11.11 b-e	11.55 a	11.33 ab	-0.42	39.85 de	42.65 ab	41.25 b-e	3.81
10	S.541-C/7	6.2 h-j	4.3 h-j	5.3 i-k	1.13	10.48 e-i	9.80 d	10.14 e-g	0.69	40.62 c-e	42.59 a-c	41.60 b-d	2.63
11	S.541-C/8	10.3 a	8.5 ab	9.4 ab	0.66	10.04 f-i	8.46 h	9.25 h	1.67	39.95 de	42.06 a-c	41.01 b-e	2.87
12	S.541-C/9	7.6 e-h	6.9 c-e	7.3 d-h	0.32	11.44 bc	9.91 cd	10.67 c-e	1.42	40.39 c-e	41.06 b-d	40.73 b-e	0.90
13	S.541-c/12	7.0 f-j	5.3 f-i	6.1 g-k	0.93	10.62 e-h	9.48 d-f	10.05 fg	1.14	39.89 de	41.23 b-d	40.56 b-e	1.82
14	S.541-D/1	5.6 ij	3.8 j	4.7 k	1.22	10.46 f-i	9.38 d-f	9.92 fg	1.10	39.54 de	40.39 d	39.96 de	1.17
15	S.541-D/4	6.7 g-i	5.7 d-g	6.2 f-k	0.55	10.44 f-i	9.39 d-f	9.91 fg	1.07	40.51 c-e	41.04 b-d	40.77 b-e	0.71
16	S.541-D/5	5.9 h-j	4.1 i	5.0 jk	1.14	10.87 c-f	9.85 cd	10.36 d-f	1.00	40.67 c-e	41.68 a-c	41.17 b-e	1.35
17	S.541-D/7	6.8 g-j	5.3 f-i	6.0 j-k	0.83	9.91 h	9.69 d	9.80 f-h	0.23	39.66 de	41.67 a-c	40.66 b-e	2.74
18	S.541-D/8	6.8 g-j	6.0 c-f	6.4 e-j	0.44	10.64 e-h	9.04 e-g	9.84 f-h	1.60	41.57 b-d	41.45 b-d	41.51 b-d	-0.15
19	S.541-D/10	10.1 b-d	7.3 bc	8.7 a-d	1.04	11.54 b	10.75 b	11.14 bc	0.73	41.62 b-d	41.76 a-c	41.69 b-d	0.18
20	S.541-D/11	10.7 a-c	7.3 bc	9.0 a-c	1.19	11.01 b-f	10.38 bc	10.70 fg	0.61	43.80 ab	42.34 a-c	43.07 a-c	-1.81
21	S.541-D/12	6.6 g-i	4.9 f-j	5.7 h-k	0.96	10.42 f-i	8.92 f-h	9.67 gh	1.53	39.56 de	41.41 b-d	40.48 c-e	2.54
22	Giza 8	6.8 g-j	3.9 j	5.3 i-k	1.58	8.76 j	7.45 ij	8.10 i	1.58	41.73 a-d	41.70 a-c	41.71 b-d	-0.03
23	Sakha 1	8.1 d-g	5.6 e-h	6.9 e-i	1.12	8.85 j	7.19 j	8.02 i	1.99	40.59 c-e	41.19 b-d	40.89 b-e	0.80
24	Sakha 3	10.3 a	5.6 e-h	8.0 b-e	1.68	7.05 k	6.18 k	6.61 j	1.32	37.71 e	39.26 d	38.48 e	2.23
Mean		8.1	5.9	7.0		10.38	9.40	9.89		40.98	41.74	41.30	

Means identified by the same letter are not significantly different at 0.05 level of probability according to FLSD.