Egypt. J. Agric. Res., 75 (3),1997.

STUDIES ON YIELD, YIELD COMPONENTS, QUALITY AND VARIABILITY IN SOME FLAX GENOTYPES

EL-SHIMY, G.M., S.H.A. MOSTAFY AND S.Z. ZEDAN

Field Crops Research Section, Field Crops Resaerch Inst., Agric. Res. Centre, Giza, Egypt.

(Manuscript received 27 November 1996)

Abstract

Two field experiments were conducted at Giza Agric. Res. Stat. During 1994/95 and 1995/96 seasons to evaluate fourteen flax genotypes in relation to yield, yield components and technological characters in addition to some genetic parameters.

The results obtained can be summarized as follows:

1. Either straw or seed yield and their respective components showed highly significant differences in each character among the fourteen flax genotypes, where S.420/140 recorded maximum estimates for total plant height, technical length, straw yield/plant as well as per faddan, long fiber yield, fiber length and long straw yield/plant as well as per faddan, long fiber yield, fiber length and long fiber percentage. Meanwhile, Giza 8 cv. ranked first and surpassed the other flax genotypes in seed yield and its related traits. Moreover, S. 2465/1 reached high magnitude regarding oil percentage. On the other hand, Gawhar cv. was the lowest in all both yield and yield components.
2. Phenotypic and genotypic variance reached highest estimates concerning fiber fineness, number of seed/plant, total plant height, fiber length and technical length.
3. Estimates of genetic coefficient of variation (G.C.V.) as well as phenotypic coefficient of variation (P.C.V.) and genetic advance expected from selection as a percentage of general mean, revealed high values in fiber fineness, straw yield/plant, main stem diameter, fiber length and seed yield/plant.
4. Heritability ratios were higher in all fourteen flax characters except characters number of seed/ plant and number of seed/capsule which recorded lowest heritability ratios.

INTRODUCTION

Flax (Liman usitatissimum L.) is considered the most important bast fiber crop in A.R.E. Meny industries established is on the flax production in relation to straw and seed yields.

With regard to the limited cultivating flax area in Egypt nowadays, it becomes very necessary to increase flax productivity from relatively small area, therefore the main solution for increasing the flax yield must be through using new varieties characterized by high yielding ability in addition to quality. Varietal differences and varibability among various flax genotypes were recorded by many investigators such as Vasilica (1976), Momtaz *et al* (1980 and 1989), El-Farouk *et al* (1982), Zahran *et al* (1984), El-Shimy *et al* (1986, 1990 and 1993), Hella *et al* (1987), Nasr El-Din *et al* (1991), Mostafa (1994) and Nada (1995).

The main objective of the present investigation was to evaluate fourteen flax genotypes including the commercial varieties through comparative analysis in addition to find out some genetic parameters for the important and economical flax traits in order to select the best one for the highest fiber and seed production as well as their quality.

MATERIALS AND METHODS

Tow field experiments were carried out at Giza Agric. Res. Station during the two successive seasons 1994/95 and 1995/96 to study the varietal differences and variability between fourteen flax genotypes in relation to yield, yield components and quality. These genotypes included the local four commercial varieties Giza 5, Giza 6, Giza 7, and Giza 8, three imported varieties namely Viking, Irian and Gawher in addition to the seven promising strains; S.402/2, S.421/3, S.2465/1, S.162/12, S.420/140, S.282/98 and S.329/2. Sowing date was Nov. 12th, 1994 and Nov. 8th 1995. The experimental design was complete randomize block in four replications, the plot size was 6 m2 (2x3m) or 1/700 fad., the above flax genotypes represent the three different flax types (dual purpose, oil and fiber). Normal cultural practices for flax production as recommended were followed. At full maturity, ten individual guarded plants were taken at random to record the following characters.

1. Yield and yield components :

A- Straw yield and its related characters:

1- Total plant height (cm)
2- Technical length (cm)
3- Upper branching zone length (cm).
4- Main siem diameter (cm)
5- Straw yield per plant (g)
6- Straw yield per faddan (tons)
7- Long fiber yield per faddan (kg) .

B- Seed yield and its related characters:

1- Number of capsules per plant.
2- Number of seeds per capsule.
3- Number of seeds per plant.
4- Seed index (g).
5- Seed yield per plant (g).
6- Seed yield per faddan (kg).

C- Technological characters :

1- Fiber length (cm)
2- Long fiber percentage.
3- Fiber fineness (Nm).
4- Oil percentage.

Analysis of variance was computed according to Senedecor and Cochran (1982) and means were compared by Least Significant Differences (L.S.D.) at 5% and 1% levels, combined analysis was performed for all characters over the two seasons (Le Clerg *et al* 1966).

II Genetic parameters :

Statistical analysis was made on plot mean basis to obtain estimates of phynotypic, genotypic and environmental variances by equating the mean sum of squares for genotypes and error.

1- Genotypic variance

$$\sigma 2g = \frac{(\sigma 2E + r\sigma 2g) - \sigma 2E}{r}$$

(Burton and De Vane 1953 and Virk *et al* 1971).

Where :

$\sigma 2g$ = genotypic variance.

$\sigma 2E$ = error variance.

r = number of replications

2- Phenotypic variance

$\sigma 2ph = \sigma 2g + \sigma 2e$

(Suggested by Mathur *et al*, 1971 and Verma and Singh 1971).

3- Environmental variance ($\sigma 2E$) = $\sigma 2ph - \sigma 2g$ (Mathur *et al*, 1971).

4- Heritability in the broad sense was estimated by the formula suggested by Hanson *et al*, (1956).

$$\text{Heritability} = \frac{\sigma 2g}{\sigma 2ph} \times 100$$

5- The genetic coeffient of variance. (G.C.V.).

G.C.V. $= \sqrt{\sigma 2g} / \bar{\chi} \times 100$ (Burton, 1951).

6- The phenotypic coefficient of variance (P.C.V.).

P.C.V. $= \sqrt{\sigma 2ph} / \bar{\chi} \times 100$

7- The genetic advance expected from selection (G.A.).

G.A. = $\sigma 2g / \sigma 2ph \times K$ (2.06 at a 5% selection intensity according to Miller *et al* (1958).

8- G.A. %, calculated as a percentage between G.A. and the general mean ($\bar{x}$) of each character.

RESULTS AND DISCUSSION

1- Yield and yield components :

A- Straw yield and its related characters :

Mean values of the seven straw yield traits i.e., total plant height, technical length, upper branching zone length, main stem diameter, straw yield/plant as well as per faddan and long fiber yield per faddan for each of the fourteen flax genotypes as the combined analysis over the two successive seasons 1994/95 and 1995/96 are presented in Table (1).

Statistical analysis showed highly significant differences within each of the seven above mentioned characters concerning all 14 flax genotypes.

Results obtained indicated that the measurements of total plant height ranged from 53.38 cm. to 114.35 cm. with the excess ratio of 114.22%, where the S.402/140 recorded the maximum magnitude in this case (114.35 cm.) and the descending order as follows; S.402/2 (108.23 cm.), S.329/2 (102.75 cm.). Giza 7 cv. (95.64

Table 1. Means of straw yield and its related characters among fourteen flax genotypes as combined analysis of 1994/95 and 1995/96 season.

Characters / Genotypes	Total plant height (cm)	Technical stem length (cm)	Upper branching zone length (cm)	Main stem diameter (mm)	Straw yield/ plant (g)	'Straw yield/ fad. (t)	Long fiber yield/fad. (kg)
Viking	72.70	60.56	12.14	2.03	1.26	2.51	279.57
Iriana	84.09	69.31	14.78	1.66	3.46	2.89	324.41
Gawher	53.38	41.59	11.79	2.65	1.24	2.40	237.34
Giza 7	95.64	79.48	16.16	1.56	4.46	3.35	423.89
S.402/2	108.23	94.06	14.17	1.36	4.64	3.55	452.41
S.2465/1	83.13	65.00	18.13	2.12	2.58	2.73	303.00
S.2465/1	79.69	64.58	15.11	1.88	2.10	2.72	297.67
Giza 8	83.37	69.17	14.20	2.11	2.96	2.77	322.94
S.162/12	84.60	71.85	12.75	2.81	3.10	2.86	352.46
S.420/140	114.35	98.56	15.79	1.31	5.22	3.65	485.12
S.282/98	91.44	78.40	13.04	2.02	3.88	3.05	397.67
Giza 5	76.92	63.04	13.88	1.71	2.08	2.61	285.51
Giza 6	76.08	62.60	13.48	1.67	2.08	2.60	283.66
S.329/2	102.75	85.76	16.99	1.44	4.51	3.40	438.70
Grand mean	76.18	71.69	14.46	1.88	3.11	2.94	348.85
S.E. of mean ±	4.14	3.94	0.49	0.12	0.354	0.11	20.57
C.V. %	18.15	20.55	12.72	23.84	41.50	13.67	22.05
L.S.D 5 %	6.46	6.38	3.44	0.28	0.39	0.06	13.52
L.S.D. 1%	7.90	7.80	4.21	0.29	0.44	0.08	22.86

cm.), S.282/98 (91.44 cm.), S. 162/12 (84.60 cm.), Iriana cv. (84.09 cm.), Giza 8 cv. (83.37 cm.), S.421/3 (83.13 cm.), S.2465/1 (79.69 cm.), Giza 5 cv. (76.92 cm.), Giza 6 cv. (76.08 cm.), Viking cv. (72.70 cm.) and the shortest one was Gawhar cv. (53.38 cm.). The grand mean of this character was 86.18 ± 4.14 cm. and the c.v. % was 18.15% .

For technical stem length character, the flax genotypes significantly differed and ranged from 41.59 cm. to 98.56 cm. With the superiority percentage of 136.98%, where the tallest estimate obtained by S.420/140 and the shortest one obtained by Gawhar cv. Meanwhile, the remain twelve flalx genotypes ranked intermediate position between them with a similar trend as obtained in the previous total plant height trait. Conerning the grand mean of technical stem length was 71.69 ± 3.94 cm., while c.v. % was 20.55%.

In relation to upper branching zone length, data revealed that the mean values ranged from 11.79 to 18.13 cm, with the superiority ratio 53.77% and the results showed that S.421/3 ranked first with the tallest fruit length zone (18.13 cm.) followed by S.329/2 (16.99 cm.), Giza 7 (16.16 cm.), S.420/140 (15.79 cm.), S.2465/1 (15.11 cm.), Iriana (14.78 cm.), Giza 8 (14.20 cm.), S.402/2 (14.17 cm.), Giza 5 (13.88 cm.), Giza 6 (13.48 cm.) and the following four shortest upper bransching bransching recorded by S.282/98 (13.04 cm.), S.162/12 (12.75 cm.), Viking (12.14 cm.) and Gawhar (11.79 cm.). The grand mean overall these genotypes was 14.46 ± 0.49 and c.v. % was 12.72%.

For the mean values of main stem diameter, results revealed that the thicker diameter was obtained by S.162/12 (2.81 mm.), followed by Gawhar (2.62 mm.), S.41/3 (2.12 mm.), Viking (2.03 mm.), S.282/98 (2.02 mm.), but the thinner stem diameter was obtained by S.420/140 (1.31 mm.), S.402/2 (1.36 mm.), S.329/2 (1.44 mm.) and Giza 7 (1.58 mm.). The remain genotypes ranked intermediate position between the thicker and thinner estimates. Grand mean value of the above mentioned character was 1.88 ± 0.12 and c.v. % was 23.84%.

With respect to straw yield/plant as well as per faddan, similar trend was noticed in both characters concerning the descending regularity among the 14 flax genotypes. The mean values for the respective two traits ranged from 1.24 to 5.22 g and from 2.40 to 3.65 tons, respectively. Where the superiority ratios of 320.97 and 52.08% between the highest and lowest mean values. In addition, S.420/140 gave the maximum straw yield/plant as well as per faddan which recorded 5.222 g and 3.65 tons, followed by S.402/2 (4.64 g. and 3.55 tons), respectively. Mean-

while, S.162/12 and Giza 8 ranked intermediate in relation to straw yield/plant and straw yield/faddan which recorded 3.10, 2.96 g. for straw yield/plant and 2.86, 2.77 tons straw yield per faddan, respectively. On the other hand, the minimum two flax genotypes in this case were Gawhar (1.24 g. and 2.40 tons) and Viking (1.26 g. and 2.51 tons) for straw yield per plant and per faddan respectively. The grand means for the two characters were 3.11 ± 0.35g. and 2.94 ± 0.11 tons with the respective c.v. % values of 41.50 and 13.67%, respectively.

Regarding long fiber yield per faddan, the mean value reached its maximum measurement by S.420/140 (485.12 kg.) which ranked first in comparison with the other flax genotypes, the desending regularity was S.402/2 (452.41 kg.), S.329/2 (438.70 kg.), Giza 7 (423.89 kg.), S.282/98 (397.67 kg.), S.162/12 (352.46 kg.), Iriana (324.41 kg.) and Giza 8 (322.94 kg.). While the minimum long fiber yield/faddan was observed in Gawhar (237.40 kg.), Viking (279.67 kg.) and S.421/3 (303.00 kg.). The mean values of this trait ranged from 237.40 kg./fad. obtained by Gawhar cv. to 485.12 kg./fed. obtained by S.420/140, the grand mean was 348.85 ± 20.57 kg./fad. with c.v.% value of 22.05%. The excess ratio between highest and minimum long fiber yield/fad. was 104.35%.

For straw yield and its related characters, it is clear that S.420/140 recorded the maximum estimates concerning the more important economic traits as total plant height, technical length, straw yield per plant as well per faddan and long fiber yield per faddan. Vice-versa, Gawhar cv. yielded the minimum estimates for the above mentioned characters.

The variability values as shown from the standard error (S.E.) and coefficient of variation (c.v.%), illustrated that all of the seven straw yield characters studied were relatively high among the fourteen flax genotypes especially straw yield/plant, main stem diameter and long fiber percentage.

The above mentioned results were in harmony with those obtained by Momtaz *et al.*, (1980) and 1989), El-Shimy *et al.*, (1990 and 1993) and Mostafa (1994) who found varietal differences among various flax genotypes regarding straw yield and its components.

B- Seed yield and its related charaters :

Mean values of seed yield and its related characters of fourteen flax genotypes from the combined analysis over the two successive seasons 1994/95 and

1995/96 are presented in Table (2).

Analysis of variance showed that flax genotypes significantly differed in all the six seed characters i.e., no. of capsules /plant, no. of seeds/capsule, no., of seeds/plant, seed index and seed yield/plant as well as per faddah.

Concerning number of capsules per plant, its mean value ranged from 25.18 for Giza 8 cv. to 10.95 for Gawhar with superiority ratio of 129.95%. The other flax genotypes which recorded higher number of capsules per plant (over 20 capsules) are namely S.2465/1, S.421/3, Giza 6, S.420/140 and Giza 7.While the another flax genotypes yielded less than 20 capsules/plant and more than Gawhar capsules number, where the ascending regularity of these genotypes was as frollow : Viking (16.22), Iriana (16.55), S.162/12 (18.17), S.282/98 (18.69), S.329/2 (19.69), S.402/2 (19.71) and Giza 5 cv. (19.78). The grand mean for this trait was 19.84 ± 1.001 with c.v. % value of 18.86%.

For number of seeds per capsule, results obtained illustrated that Giza 8 variety had the highest mean value (8.42) and the descending regularity was as follows, S.2465/1 (8.26), S.421/3 (7.38), Giza 6 (7.32), S.420/140 (7.04), Giza 7 (7.00), Giza 5 (677), S.402/2 (6.74), S.3292 (6.69), S.282/98 (6.52), S.162/12 (6.37), Iriana cv. (6.30), Viking cv. (6.28) and the lowest number of seeds/capsule was Gawhar (5.67).

Regarding number of seeds per plant, results indicated that this character ranged from 81.70 to 190.25 seed/plant for Gawhar and Giza 8, respectively. The remainder flax genotypes recorded mid estimates between the lowest and highest seeds/plant and the arrangement was in the following manner; S.2465/1 > S.421/3> Giza 8> S.420/140 > Giza 7> Giza 5 > S.402/2 > S.329/2 > S.282/98 > S.162/12 > Iriana > Viking.

In respect with seed index trait, results showed that S.2465/1 was superior and ranked first in its seed index (11.797 g.) followed by Giza 8 cv. (9.537 g.), (S.421 g.), Giza 6 (9.014 g.), 420/140 (8.818 g.), Giza 7 (8.713 g.), Giza 5 (8.411 g.), S.421/3 (8.404 g.), S.329/2 (8.371g.) and S.282/98 (8.09g.) and the lowest four values of this trait obtained by Iriana (4.879 g.), Viking (5.003 g.), Gawhar (7.726 g.) and S.162/12 (8.020 g.).

In relation to seed yield per plant as well as per faddan, similar trend was observed in this concern among the flax genotypes. Data revealed that Giza 8 variety

Table 2. Means of seed yield and its related charactres among fourteen flax genotypes as combined analysis of 1994/95 and 1995/96 seasons .

Characters / Genotypes	No. of capsules/ plant	No. of seeds/ capsules	No. of seeds/ plant	Seed index (g)	Seed yield/ plant (g)	Seed yield/ fad (kg)
Viking	72.70	6.28	111.56	5.003	0.517	428.53
Iriana	84.09	6.3	114.12	4.879	0.604	435.54
Gawhas	53.38	5.67	81.7	7.726	0.507	419.17
Giza 7	95.64	7.00	145.8	8.713	0.754	522.35
S.402/2	108.23	6.74	134.32	8.404	0.694	511.3
S.2465/1	83.13	7.38	164.99	9.537	1.488	632.1
S.2465/1	79.69	8.26	165.21	11.797	1.763	634.54
Giza 8	83.37	8.42	190.25	9.537	1.982	642.27
S.162/12	84.60	6.37	121.3	8.02	0.65	447.68
S.420/140	114.35	7.04	150.81	8.818	1.00	603.33
S.282/98	91.44	6.52	128.32	8.09	0.654	499.76
Giza 5	76.92	6.77	137.84	8.411	0.749	514.53
Giza 6	76.08	7.32	164.26	9..014	1.195	608.55
S.329/2	102.75	6.69	132.91	8.371	0.674	504.32
Grand mean	76.18	6.91	138.81	8.309	0.945	528.88
S.E. of mean ±	4.14	0.20	7.40	0.465	0.128	21.74
C.V. %	18.15	10.89	19.94	20.93	50.658	15.37
L.S.D 5 %	6.46	1.41	53.46	0.066	0.79	70.78
L.S.D. 1%	7.90	1.73	65.41	0.081	0.96	86.60

had the highest mean values of the two previous characters with the estimates of 1.982g. and 642.27kg., respectively, the descending regularity was S.2465/1 (1.763 g. and 634.54 kg.), S.421/3 (1.488 g. and 632.10 kg.), Giza 6 (1.195 g. and 608.55 kg.), S.420/140 (1.00 g. and 603.33 kg.), Giza 7 (0.754 and 522.35 kg.), Giza 5 (0.749g. and 514.53 gk.), S.402/2 and (0.694 g. and 511.30 kg.), S.329/2 (0.674g. and 504.32 kg.), S.282/98 (0.654 g. and 499.76 kg.), S.162/12 (0.650 g. and 447.68 kg.), Iriana (0.604 g. and 435.54 kg.), Viking (0.517 g. and 428.53 kg.) and the last one was Gawhar (0.507 g. and 419.17 kg.).

It could be mentioned that the grand means ± S.E. and c.v.% for the six seed characters i.e., no . of capsules / plant (19.84 ± 1.001 g. and 18.86%), no. of seeds/capsule (6.91 ± 0.20 and 10.89%), no. of seeds/plant (13.81 ± 7.40 and 19.94 %), seed index (8.309 ± 0.465 g. and 20.93%), seed yield/plant (0.945 ± 0.128 g. and 50.658%) and seed yield/faddan (528.88 ± 21.740g. and 15.37%), respectively. Moreover, there wase a remarkable variation on the above mentioned triats among the studied flax genotypes.

Generally, it was found that Giza 8 variety ranked first and outyielded all other flax genotypes in respect with seed yield and its related characters. Similar results were obrtained by Momtaz *et al* (1980), Zahran *et al* (1984), E.L. Shimy *et al* (1990 and 1993), Mostafa (1994) and Nada (1995), who reported varietal differences in flax seed yield and its components.

C. Technological characters :

Mean values of flax technological characters i.e. fiber length, long fiber percentage, fiber fineness and oil percentage from the combined analysis over the two successive seasons among 14 flax genotypes are presented in Table (3).

Analysis of variance showed that flax genotypes significantly differed in each of these characters, where S.420/140 was superior over the other genotypes concerning fiber length trait (95.11 cm.) followed by S.402/2,S.329/2, Giza 7, S.162/12, Iriana, Giza 8, S.421/3, S.2465/1, Giza 5, Giza 6, Viking and the lowest one was Gawhar (37.19 cm.). The measurements of this character ranged from 37.19 to 95.11 cm. and the grand mean for the fourteen flax genotypes was 66.94 ± 3.93 cm. and c.v. ratio was 21.95%.

Regarding long fiber percentage, mean values ranged from 9.46% for Gawhar to 13.93% for S.420/140 and the rest flax genotypes ranked intermediate sites.

The descending regularity was in the same trend which mentioned before in relation to the fiber length. The grand mean overall genotypes was 11.78 ± 0.34% and c.v. was 10.74%.

For fiber fineness as a metrical number, results indicated that Iriana ranked first in this trait (194.67), followed by Giza 7 (193.80), S.420/140 (190.91), S.282/98 S.421/3 (175.22), S.2465/1 (165.97), Giza 6 (162.75), S. 162/12 (144.26), Viking (121.24) and finally Gawhar cv. (75.58). The grand mean in this character was 167.12 ± 8.91 and c.v. % value was 19.94%.

Table 3. Means of technological charactres among fourteen flax genotypes as combined analysis of 1994/95 and 1995/96 seasons .

Characters / Genotypes	Fiber length (cm)	Long fiber (%)	Fiber fineness (Nm)	Oil percentage (%)
Viking	55.85	10.44	121.24	37.30
Iriana	64.33	11.60	194.67	36.75
Gawhas	37.19	9.46	75.58	40.01
Giza 7	74.00	12.69	193.80	40.25
S.402/2	89.49	13.68	180.23	39.50
S.2465/1	60.38	11.33	175.22	43.75
S.2465/1	59.61	11.14	165.97	43.91
Giza 8	64.31	11.51	181.88	43.30
S.162/12	65.96	11.92	144.26	40.30
S.420/140	95.11	13.93	190.91	41.50
S.282/98	72.64	12.05	187.34	38.98
Giza 5	95.38	10.97	183.92	41.75
Giza 6	58.72	10.92	162.75	42.90
S.329/2	80.24	13.32	181.98	38.65
Grand mean	66.94	11.78	167.12	40.63
S.E. of mean ±	3.93	0.34	8.91	0.62
C.V. %	21.95	10.74	19.94	5.69
L.S.D 5 %	9.62	0.25	2.05	2.03
L.S.D. 1%	11.76	0.31	2.51	3.15

In relation to oil percentage, obtained results revealed that S.2465/1 had the highest mean value of oil percentage (43.91%) followed by S.421/3 (43.75%), Giza 8 (43.30%), Giza 6 (42.90%), Giza 5 (41.75%), S.420/1 (41.50%), S.162/12

(40.30%), Giza 7 (40.25%) and Gawhar (40.01%). Meanwhile, the following five genotypes which recorded less oil ratios under 40% were S.402/2 (39.50%), S.282/98 (38.65%), Viking (37.30%) and Iriana (36.75%). The grand mean of this character was 40.63±0.62 and the c.v. % was relatively in low value of (5.69%). Several investigatiors recorded varietal differences in technological characters either for fiber or seed oil such as El-Farouk *et al* (1982), El-Shimy *et al* (1993), Nasr El-Din *et al* (1991), Mostafa (1994) and Nada (1995).

It could be concluded that S.420/140 ranked first in fiber length and long fiber percentage, while it ranked third in fiber fineness and sixth in oil ratio. On the other hand, the flax strain S.2465/1 ranked first concerning oil percentage.

IV- Genetic parameters :

Estimates of phenotypic, genotypic and environmental variances for fausteen traits in flax genotypes obtained from the analysis of variance are presented in Table (4).

Data revealed that similar phenotypic and genotypic variances trend concerning the three characters categories, I. Straw yield and its related characters. II. Seed yield and its related characters and III. Technological characters. The fiber fineness ranked first and reached maximum estimates (1110.26 and 1109.55), followed by number of seeds/plant (840/76 and 364.05), total plant height (246.90 and 229.84), fiber length (225.98 and 204.125) and technical length (223.305 and 206.74) for the phenotypic and genotypic variances, respectively. The lowest variance estimates obtained by straw yield/plant, main stem diameter, seed yield/plant and number of seeds/capsule, where the two kinds of variance; phenotypic and genotypic ranged from 0.208 to 0.652 and from 0.268 to 1.548, respectively. Moreover, the remain flax characters such as long fiber percentage, seed index, oil percentage, number of capsules / plant and upper branching zone length occupied the intermediate site in this case.

Regarding variance due to the environmental effect results showed that the number of seeds/plant was the highest character affected by the environmental conditions with the variance estimate of 476.71, the descending regularity after this was total plant hight (17.06), fiber length (16.855) and technical length (16.565). On the other hand, the minimum environmental effects were remarkably appeared in seed index (0.003) followed by main stem diameter (0.006), long fiber percentage (0.015), seed yield/plant (0.103) and straw yield/plant (0.168). The other flax

Table 4. Estimates of phenotypic, genotypic and environmental variances for 14 traits of fourteen flax genotypes.

	Characters	Variance		
		Phenotypic	Genotypic	environmental
A	Total plant height (cm)	246.9	229.84	17.06
	Technical length (cm)	223.305	206.74	16.565
	Upper branching zone length (cm)	15.86	10.45	5.32
	Main steem diameter (mm)	0.208	0.202	0.006
	Straw yield / plant (g)	1.716	1.548	0.168
B	Number of capsules / plant	14.97	9.10	5.87
	Number of seeds / capsule	0.652	0.267	0.384
	Number of seeds / plant	840.76	364.05	476.71
	Seed index (g)	3.025	3.002	0.003
	Seed yield / plant (g)	0.261	0.159	0.103
C	Fiber length (cm)	225.98	209.125	16.855
	Long fiber (%)	1.61	1.595	0.015
	Fiber fineness (Nm)	1110.26	1109.55	0.71
	Oil percentage (%)	5.813	5.263	0.55

Where :
A = Straw yield and its releated characters.
B = Seed yield and its releated characters.
C = Technological characters.

characters under study showed relatively slight responsibility to the environmental effect. It is clear also that the flax characters which did not affected by the environmental conditions and had minimum variances due to be more affected by genetical system.

Estimates of genetic coefficient of variation (G.C.V.), heritability %, genetic advance expected from selection as % of general mean, phenotypic coefficient of variation (P.C.V.) and G.C.V. as % of P.C.V. for 14 traits of fourteen flax genotypes are presented in Table (5).

Results obtained for genetic coefficient of variation were greatly varied among the fourteen flax characters, where the G.C.V. estimates ranged from 6.42% for the oil percentage to 335.28 for fiber fineness. The descending regularity after the latest above mentioned character was straw yield/plant with G.C.V. value of 40.004, followed by main stem diameter (23.91), upper branching zone length (21.27), fiber length (21.147), seed yield/plant (20.626), seed index (20.503) and technical length (20.035). On the other hand, the minimum G.C.V. values were noticed in long fiber percentage (10.487), no. of seeds/capsule (7.158), and finally oil percentage (6.42), while the other remain characters ranked intermediate site.

For heritability ratio estimates, eight traits recorded highest heritability ratios over 90% heritability such as fiber fineness (99.935%), seed index (99.933%), long fiber percentage (99.123), main stem diameter (97.325%) total plant height (93.00%), technical length (92.490%), fiber length (92.403) and straw yield/plant (91.386%). Meanwhile, four characters illustrated relatively high heritability ratios as oil percentage (85.350%), seed yield/plant (68.233%), upper branching zone length (67.565%) and no. of capsules/plant (60.913). The lowest heritability ratios obtained by no. of seeds/plant (45.228%) and no. of seeds/capsule (45.105%).

Concerning the genetic advance expected from selection as a percentage of general mean (G.A%), the following is the flax characters which the plant breeder have more chance for flax yield development among the flax genotypes under study. Seed yield/plant (69.379), straw yield/plant (58.879), seed index (42.316), fiber length (41.991) and fiber fineness (40.318.) while the flax characters which had less opportunity in this case are total plant height (32.175), technical length (28.970), no. of capsules/plant (24.039), long fiber percentage (21.600) and no.of seeds/plant (18.547). The latest third division was the minimum G.A.% estimates

Table 5. Estimates of genetic coefficient of variation (G.C.V.), heritability %. genetic advance expected from selection as % of general mean (G.A. %), phenotypic coefficient of variation (P.C.V.) and G.C.V. as % of P.C.V. for 14 traits of fourteen flax genotypes.

Characters		G.C.V	Heritability %	G.A. as % of general mean	P.C.V.	P.C.V.
A	Total plant height (cm)	17.65	93.00	32.18	18.20	96.48
	Technical length (cm)	20.04	92.49	28.97	20.89	59.93
	Upper branching zone length (cm)	21.27	67.56	5.29	25.93	82.04
	Main steem diameter (mm)	23.91	97.33	48.89	24.09	99.27
	Straw yield / plant (g)	40.00	91.39	58.88	41.99	95.28
B	Number of capsules / plant	14.96	60.91	24.04	19.16	78.07
	Number of seeds / capsule	7.16	45.11	9.67	10.98	65.22
	Number of seeds / plant	13.54	45.23	18.55	20.55	65.86
	Seed index (g)	20.50	99.93	42.32	20.57	99.68
	Seed yield / plant (g)	20.63	68.23	69.38	52.15	39.55
C	Fiber length (cm)	21.15	92.40	41.99	22.05	95.92
	Long fiber (%)	10.49	99.14	210.60	10.56	99.36
	Fiber fineness (Nm)	335.28	99.94	40.32	335.58	99.92
	Oil percentage (%)	6.42	85.35	9.80	7.30	98.95

Where :
A = Straw yield and its releated characters.
B = Seed yield and its releated characters.
C = Technological characters.

which appeared in oil percentage (9.800), no.of seeds/capsule (9.667) and upper branching zone length (5.285).

The estimates of phenotypic coefficient of variation indicated that the straw yield/plant ranked first with P.C.V value of 41.987, by mean that the flax genotypes differences were in great magnitude in comparison with the technical length (20.885)or total plant height (18.200) in relation to straw yield and its components. Meanwhile, the variability values as shown in seed yield and its related characters revealed that seed yield/plant reached highest estimate (52.151) followed by seed index (20.569) and no.of seeds/plant (20.550). but the minimum variability recorded by no.of seeds/capsule (10.976). Moreover, fiber fineness trait reached highest p.c.v estimate (335.580) as well as in the previous G.C.V. (335.280) and the lowest value in technological four traits was oil percentage (7.300).

Regarding the percentage ratio between G.C.V. and P.C.V. data revealed that the greatest values were obtained in fiber fineness (99.918%). On the opposite direction, seed yield/plant recorded minimum ratio (39.551), no.of seeds/capsule (65.215) and no.of seeds/plant (65.864). The results of the genetic parameters studied were in agreement with those obtained by Panse (1957), Frank and Hollosi (1985), Ingale (1985) and Satapathi *et al.*, (1987).

REFERENCES

1. Burton, G.W. 1951. Quatitative inheritance in pearlmillet (pennisetum glaucum). Agron. JJ. 43 : 409-417 .
2. Burton, G.W. 1951 and E.M, De Vane. 1953) : Estimating heritability in tall Fescue (Fescue arundinaceae L.) from replicated clonal material. Agron. J. 45 : 478-481.
3. El-Farouk, M.M.A., E.A., Mahmoud, A.I. Sahsah and H.M., Eid. 1982. Water strees and plant density in relation to yield and some technological properties fo flax fibers. Res. Bull. 470, Fac. of Agric., Zagazig Univ.
4. El-Shimy, G.H.T. Naser El-Din and A.M.A., Halla. 1986. Effect of seeding rates and microelements on the yield of some flax varieties. J. Agric. Res. Tanta Univ., 12 (3) : 678-689 .

5. El-Shimy, G.H.T, M, Abd-El-Hamid and L, M, Zaky. 1990. Comparative analysis of certain genotypes of flax (Linum usitatissimum L.) Ann. Agric. Sci., Moshtohor, 28 (2) : 879-905 .

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

7. Frank, J. and S.Hollosi. 1985. Results of linseed breeding in Hungrie. Informations Techniqes, No. 90 : 13-16 .

8. Hanson, G.H., H.F., Robinson and R.E., Comstock. 1956. Biometrical studies of yield and in segregating population of Korean Lespedeza. Agron J. 48: 268-272 .

9. Halla. A.M., N.K.M., Mourad and S.M., Gaffer. 1987. Effect of NPK fertilizer application on yield and its components in flax (Linum usitatissimum L.) Agric. Res. Rev. 66 (3) : 399-406 .

10. Ingale, B.V. 1985. An analysis of association of characters of value in breeding linseed J. of Maharashira Agric. Univ. 10 (3) : 287-289 .

11. Le Clerg, E.L., W.H., Leonard and A.G., Clark. 1966. Field plot technique. Burgtoss Publishing Co. Minneapolis, Minnesota U.S.A .

12. Mathur, S.C., P.K. Mathur and R.P., Chandola. 1971. Genetic variability in Cumin (Cuminum cyminum L.) Indian, J. Agric. Sci. 41 : 513-515.

13. Miller, D.A., J.C., Williams; H.F., Robinson and R.F., Comstock. 1958. Estimates of genotypic and environmental variance and convariances and their implication in selection. Agron. J. C., Williams; H.F., Robinson and R.F., Comstock. 1958. Estimates of genotypic and environmental variance and covariances and their implication in selection. Agron. J. 50 : 126-131 .

14. Momtaz, A., M., El-Farouk, G., El-Shimy, A., Ibrahim, S., Soliman, A. Mohamed and A, El-Atter. 1980. New flax varieties Giza 5 and Giza 6. Agric. Res. Rev., (8) : 24-40 .

15. Momtaz, A., El-Farouk, G.K.M., Mourad, T., El-Din and A.M.A., Hella. 1989. New flax varieties Giza 7 and Giza 8. Agric. Res. Rev. 68 (7) : 1461-1475 .

16. Mostafa, S.H.A. 1994. Yield and quality of flax as affected by variety and some environmental factors. Ph.D.Thesis, Fac Agric., Moshtohor, Zagazig Univ. Egypt .

17. Nada, S.A.S. 1995. Yield and quality response of certain flax varieties to nitrogen fertilization and plant density. M.Sc. Thesis, Fac. Agric. Ain Shams Univ. Egypt .

18. Nasr El-Din, T., E.A.F., El-Kady and A.M.Hella. 1991. Response of someflax strains and Giza 5 cultivar to nitrogen and its effects on yield and quality. Egypt. J. Appl. Sci. 6 (6) : 178-185 .

19. Panse, V.G. 1957. Genetics of qualitative characters in relation to plant breeding. Indian, J. Genet. 17 : 318-328 .

20. Satapathi, D., R.C., Misra and B.S. Panda. 1987. Variability correlation and path-coefficeint analysis in linseed, J. of oil seed Res. 4 (1) : 28 - 34 .

21. Snedecor G.W. and W.G. Cochran. 1982. Statistical Method. 7th. Edition lawa State Univ., Press. Ames., lawa, U.S.A. : 325-330.

22. Vasilica, C. 1976. Effect of sowing density on yield of fiber flax. Agronomic-Horticulture, 41-43, Romania. (C.F. Field Crop Abst., 32 (2) : 1139).

23. Verma, G. and K.P., Singh. 1971. Selection based on multiple characters in barnyard millet (Echinochloa aestivum L.) Madras Agric. J. 58 : 194-198.

24. Virk, D.S., S.C. Anand and A.S., Khehra. 1971. Heritability of some quantative characters in wheat (Triticum aestivum L.) Madras Agric. J. 58 : 199-201.

25. Zahran, M. S. Abou-Khadrah, F.A., Sorour and T., Nasr El-Din. 1984. Effect of row spacing and seeding rate on growth and yield of two flax (Linem usitatissimum L.) cultivars. The 2nd General Conf. A.R.C., 9-11 April.

دارسات على المحصول ومكوناته والتباين فى بعض التراكيب الوراثية للكتان

جمال الدين حسن الشمى ، صابر حسين مصطفى ، سعيد زكى زيدان

قسم بحوث محاصيل الالياف – معهد بحوث المحاصيل الحقلية – مركز الزراعة.

تم اجراء تجربتين حقليتين فى محطة بحوث الجيزة الزراعية خلال الموسمين المتعاقبين ١٩٩٤ ١٩٩٥ ، ١٩٩٥ ، ١٩٩٦ وذلك لتقييم أربعة عشر تركيبة وراثية من الكتان فيما يختص بالمحصول والصفات المكونة له بالاضافة الى تقدير بعض الثوابت الوراثية ويمكن تلخيص النتائج المتحصل عليها كما يلى :

١ – كلا من محصولى القش والبذور ومكونات كل منهم اظهرت اختلافات معنوية جدا (١٪) فى كل صفة للمقارنة بين الاربعة عشر تركيبة وراثية حيث سجلت السلالة ٤٢٠ / ١٤٠ أعلى قيم فى صفات الطول الكلى / نبات . الطول الفعال/نبات . محصول القش / نبات. محصول القش/فدان، محصول الالياف الطويلة ، طول الالياف ، النسبة المئوية للالياف الطويلة. بينما تفوق الصنف جيزة ٨ فى محصول البذرة والصفات المكونة لها. فى حين اعطت السلالة ٢٤٦٥ / ١ أعلى متوسط لنسبة الزيت بالبذور. وعلى النقيض من ذلك فان الصنف جوهر كان أقل التراكيب الوراثية فى كل الصفات تحت الدراسة.

٢ – كان التباين الظاهرى والوراثى اقص ما يمكن بالنسبة لصفات نعومة الالياف، عدد البذور / نبات، الطول الكلى/نبات ، طول الالياف . الطول الفعال / نبات.

٣ – تقديرات معامل التابين الوراثى. معامل التباين الظاهرى وكذلك مدى التحسين الوراثى المتوقع من الانتخاب مرتفعة بالنسبة لصفات نعومة الالياف. محصول القش/ نبات . سمك الساق الرئيسى. طول الالياف . محصول البذور / نبات.

٤ – كانت قيمة معامل التوريث مرتفعة فى كل الصفات تحت الدراسة ماعدا صفتى عدد البذور/نبات عدد البذور بالكبسولة حيث وصلت نسبة التوريث الى أقل قيم لها.