HETEROSIS, INBREEDING DEPRESSION AND CORRELATIONS OF YIELD TRAITS IN SOME FLAX CROSSES

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Abstract

The present investigation was carried out at Giza Agric. Res. Farm, Agric. Res. Center (A.R.C.) during 2003/04, 2004/05 and 2005/06 seasons. The main objective was to evaluate five parental genotypes {Giza 4 (P_1), Belinka (P_2), S.2465/1 (P_3), S.533/39 (P_4) and Sakha 1 (P_5)}, in addition to four possible crosses (P_1xP_3, P_1xP_4, P_1xP_5 and P_2xP_5) in the F_1 and F_2 generations for yield, heterosis, inbreeding depression, genetic parameters, phenotypic (r_p) and genotypic (r_g) correlations. Results showed that the cross F_2 (P_2xP_5) was superior to other entries in plant height and technical stem length but it ranked second for fiber percentage. The cross F_2 (P_1xP_5) recorded the highest straw and fiber yields/plant, while the strain 2465/1 ranked first in seed yield / plant followed by F_2 (P_1xP_3) and F_1 (P_1xP_3).The majority of studied crosses showed positive heterosis values over mid-parents, but few ones over the better parent for straw and seed traits. The cross P_1xP_3 performed inbreeding gain in most seed characters, while the two crosses P_1xP_5 and P_2xP_5 exhibited inbreeding advancement in F_2 generation for six straw traits and five seed characters. The estimates of r_p coefficient were significant and positive between plant height and each of technical stem length, fiber yield/plant and fiber percentage with r_g positive values. The estimates of r_p coefficient between no. of capsules/plant and each of no. of seeds/plant, seed index and seed yield/plant recorded significant positive correlation with r_g values.

INTRODUCTION

Flax (*Linum usitatissimum* L.) ranked first among the bast fiber crops grown in Egypt. Many industries had been established on flax products i.e., fiber and seeds, in addition to a high protein linseed cake which remains after the seed oil extraction for dairy cattle feed. As the area cropped to flax is limited, it becomes necessary to direct research efforts toward improving flax productivity. Many investigators found differences among flax genotypes in yield and its components such as Abo El-Zahab *et al.* (1994), Abo-Kaied *et al.* (2006) and El-Shimy *et al.* (2006). Heterosis in flax had been studied by Momtaz *et al.* (1978), Seehuber (1984), El-Farouk *et al.*(1998), El-Sweify (2002) and El-Refaie (2003). Moreover, phenotypic and genotypic correlations were also studied by Abo El-Zahab *et al.* (1994) and Abo-Kaied *et al.* (2006).

The present investigation aimed to evaluate five parental flax genotypes, four possible crosses in F_1 and F_2 generations regarding straw and seed yields and some related characters. In addition, heterosis, inbreeding depression, genetic parameters, phenotypic and genotypic correlations were also studied.

MATERIALS AND METHODS

This study was carried out at Giza Agric. Res. Station Farm, A.R.C., during three successive seasons, 2003/04, 2004/05 and 2005/06. Five parental flax genotypes, four possible crosses in F_1 and F_2 generations were used. Four of these genotypes, Giza 4 (P_1), S.2465/1 (P_3), S.533/39 (P_4) and Sakha 1 (P_5) were evolved by Fiber Crops Res. Department, while Belinka variety (P_2) was imported from Holland. The soil texture was clay loamy and the normal cultural practices of growing flax were followed up to maturity stage.

In the first season, the five parental genotypes were sown on 12 November 2003. Four possible crosses were made as follows, P_1xP_3, P_1xP_4, P_1xP_5 and P_2xP_5. In the second season, parental and hybrid seeds were sown on 15 November 2004, at the same time four crosses were repeated to obtain new hybrid seeds. In the third season, seeds of parental genotypes, F_1 and F_2 of the four possible crosses were sown on 11 November 2005. A randomized complete block design with three replicates was used. Plots size was 2x3 m, each plot contained 10 rows 20 cm apart and three meters long. Seeds were sown 5 cm apart. At maturity, samples of 90 random guarded plants from each parent, F_1 and F_2 generations were collected and the following data were recorded on individual plant basis:

A- Straw and seed yields

1- Straw yield and related characters

Plant height (cm), technical stem length (cm), apical branch zone length (cm), number of basal branches, straw yield/plant (g), fiber yield/plant (g) and fiber percentage.

2- Seed yield and related characters

Number of apical branches, number of capsules/plant, number of seeds/capsule, number of seeds/plant, seed index (1000-seed weight in g) and seed yield/plant (g).

Statistical analysis

Data were subjected to statistical analysis as proposed by Snedecor and Cochran (1982) and means were compared by least significant difference (LSD) at 0.05 and 0.01levels of probability.

B- Heterosis and inbreeding depression

Heterosis was calculated as a percentage of F_1 mean for each character and either the corresponding mid - parents or better parent means according to the following formula:

Heterosis over mid parents (%) = $((F_1\text{-MP}) / \text{MP}) \times 100$

Heterosis over better parent (%) = $((F_1\text{-BP}) / \text{BP}) \times 100$

The inbreeding depression equation for studied characters was as follow:

The inbreeding depression (%) = $((F_1\text{-}F_2) / F_1) \times 100$.

C- Phenotypic and genotypic correlation coefficients:

Phenotypic (r_p) and genotypic (r_g) correlation coefficients were calculated according to the formula suggested by Al-Jibouri et al. (1958).

RESULTS AND DISCUSSION

A- Straw and seed yields

1- Straw yield and related characters

Data in Table 1 indicate the mean values of straw yield and related characters for five parental flax genotypes and their possible four crosses in F_1 and F_2 generations. The thirteen entries (5 parents, 4 F_1'S and 4 F_2'S) differed significantly in all studied traits viz., plant height, technical stem length, apical branching zone length, number of basal branch, straw and fiber yields/plant as well as fiber percentage. Plant height was maximal (115.93 cm) in the cross P_2xP_5 in F_2 generation, followed by the cross P_1xP_5 in F_2 (106.47 cm), Belinka (105.70 cm) and the cross P_2xP_5 in F_1 generation (105.07 cm). S.2465/1 recorded the shortest plants (83.07), whereas the remaining genotypes were intermediate. The grand mean over all genotypes was 99.87±2.28 cm with C.V. value of 8.23%. Technical stem length ranged from 55.20 cm for S.2465/1 to 91.60 cm for the cross P_2xP_5 in F_2 generation, the grand mean over all genotypes was 74.46±2.56 cm with C.V. value of 12.39%. The apical branching zone length ranged from 21.53 cm for S.533/39 to 28.23 cm for the cross P_1xP_3 in F_2 generation, the grand mean over all genotypes was 25.33±0.54 cm with C.V. value of 7.65%. Number of basal branch ranged from 1.20 for the cross P_1xP_4 in F_1 generation to 2.47 for S.2465/1, the grand mean over all genotypes was 1.65±0.11 with C.V. value of 23.83%. Straw yield / plant ranged from 2.38 g for Belinka to 4.98 g for F_2 (P_1xP_5), the grand mean over all genotypes was 3.65±0.20 with C.V. value of 19.35%. Fiber yield / plant ranged from 0.40 g for Giza 4 to 0.83 g for F_2 (P_1xP_5), while the grand mean over all genotypes was 0.57±0.03 with C.V. value of 20.63%. The minimum estimate for fiber percentage was recorded by S.2465/1 (12.16%), while the maximum one was recorded by Belinka (20.03%), the grand mean over all genotypes was 15.76±0.67% with C.V. value of 15.24%. These results are in agreement with those obtained by Abo El-Zahab *et al.* (1994), Abo-Kaied *et al.* (2006) and El-Shimy *et al.* (2006).

Generally, results indicated that F_2 (P_2xP_5) produced the tallest plants height with larger technical stem length and ranked the second in fiber percentage (19.07%) after Belinka. The cross F_2 (P_1xP_5) recorded high estimates for straw yield/plant, fiber yield/plant and somewhat for fiber percentage. Meanwhile, the flax strain 2465/1 produced more number of basal branch, but it recorded the shortest plants, the lowest technical stem length and fiber percentage.

2- Seed yield and related characters

Results in Table 1 indicated that the studied flax genotypes significantly differed in all seed characters viz. number of apical branch, number of capsules/plant, number of seeds/capsule, number of seeds/plant, seed index and seed yield/plant.

Number of apical branch ranged from 17.53 for Belinka to 38.64 for F_2 (P_1xP_3), the grand mean over all flax genotypes was 28.74±1.45 with C.V. value of 18.26%. Number of capsules/plant, which mostly affect, seed yield/plant, ranged from 14.53 in Belinka to 30.63 in S.2465/1, the grand mean over all genotypes was 23.96±1.17 with C.V. value of 17.65%. Number of seeds/capsule ranged from 6.67 in S.2465/1to 9.43 in Belinka, the grand mean over all genotypes was 8.06±0.20 with C.V. value of 8.95%. Number of seeds/plant ranged from 136.88 in Belinka to 233.96 in F_2 (P_1xP_3), where S.2465/1 was one of the two parents created this cross that characterized by large seed number/plant (204.01), the grand mean of this trait was 190.67±6.66 with C.V. value of 12.61%. Seed index (1000-seed weight) ranged from 5.45 g in Belinka to 11.91 g in S.2465/1, the grand mean over all genotypes was 8.51±0.47 g with C.V. value of 20.09%. Seed yield/plant ranged from 0.73g in Belinka to 2.35 g in S.2465/1, the grand mean over all genotypes was 1.57±0.13 g with C.V. value of 28.99%. The differences between flax genotypes concerning seed yield and its components were confirmed by Abo El-Zahab *et al.* (1994), Abo-Kaied *et al.* (2006) and El-Shimy *et al.* (2006).

It can be concluded that the F_2 (P_1xP_3) and S.2465/1 (P_3) were superior to other genotypes in seed characters. The variation among over all means as shown in C.V.% for each character was in high magnitude for seed yield/plant (28.99%), followed by seed index (20.09%), number of apical branch (18.26%), number of capsules/plant (17.65%) and to some extent number of seeds/plant (12.61%).

B- Heterosis and inbreeding depression

1- Heterosis study

Results in Table 2, show the estimates of heterosis percentage in four F_1 hybrids over both mid-parent and better parent for flax straw yield and its related characters. The cross P_2xP_5 achieved significant and positive heterosis over mid-parents by 5.63% with a grand heterosis mean of 0.31% for technical stem length. The cross P_1xP_4 exhibited heterosis value of 11.88% over the mid-parent and 4.56% over better parent for apical branch zone length. The two crosses (P_1xP_3 and P_2xP_5) indicated significant heterosis and superiority over mid-parents for number of basal branch with the values of 13.00 and 2.98%, respectively. Negative heterosis, however, was found in all the four crosses over the better parent. The four studied crosses displayed significant heterosis over the mid-parents in straw yield/plant. P_1xP_3 recorded 10.81%, P_1xP_4 (5.02%), P_1xP_3 (20.83%) and P_2xP_5 (8.48%) with a grand heterosis mean of 11.29%. Meanwhile, cross (P_1xP_5) was the only, which showed significant heterosis over the better parent with the value of 4.91%. All crosses exhibited significant heterosis over the mid- parent for fiber yield / plant in the following manner, P_1xP_3 (15.79%), P_1xP_4 (13.04%), P_1xP_5 (20.39%) and P_2xP_5 (10.71%) with the grand heterosis mean of 14.98%. The two crosses (P_1xP_3 and P_1xP_4) exhibited significant heterosis over the mid-parent in fiber percentage with the values of 1.71 and 7.87%, respectively. Moreover, the cross (P_1xP_4) recorded significant heterosis over the better parent (2.82%) for fiber percentage.

Results in Table 3, show heterosis estimates in four F_1 hybrids either over the mid-parent or the better parent regarding seed yield and its related characters. Results exhibited significant positive heterosis in three crosses over the mid-parent for number of apical branch viz. P_1xP_3 (7.92%), P_1xP_4 (9.08%) and P_2xP_5 (13.84%) with grand heterosis mean of 5.64%. Meanwhile, only one cross (P_1xP_4) showed significant heterosis over the better parent. The two crosses P_1xP_4 and P_1xP_5 displayed significant heterosis (3.61%) over the mid - parent in number of capsules/plant with the values of 4.49 and 14.55%, respectively. The grand heterosis mean in this case was 2.15%, but all other four crosses exhibited negative heterosis effects over the better parent were detected. The three crosses P_1xP_3, P_1xP_4 and P_1xP_5 achieved significant heterosis over the mid-parents for number of seeds/capsule with the values of 5.09, 6.16 and 0.92%, respectively with grand heterosis mean of 3.01%. On the other hand, negative heterosis values were observed in all crosses when compared with the better parent. The cross P_2xP_5 had significant heterosis over mid-parents in number of seeds/plant, while the other two crosses P_1xP_3 and P_1xP_4 exhibited slight positive heterosis without significance over the mid-parent with grand heterosis mean of 6.44%. Seed index trait exhibited significant heterosis in the four crosses over the mid-parent. Values were 0.85, 4.11, 2.65 and 7.89% for the crosses P_1xP_3, P_1xP_4, P_1xP_5 and P_2xP_5 with a grand heterosis mean of 3.88%, respectively, but negative heterosis was observed over the corresponding better parent. The three crosses (P_1xP_3, P_1xP_4 and P_2xP_5) exhibited significant positive heterosis over the mid-parents for seed yield / plant with grand heterosis mean of 9.68%. Moreover, the cross P_1xP_4 recorded significant positive heterosis over the better parent. It could be concluded that the cross P_1xP_4 would be efficient and prospective in flax breeding program for improving seed yield/plant. Many investigators found heterosis effect in flax such as Momtaz *et al.* (1978), El-Farouk *et al.* (1998), El-Refaie (2003) and El-Sweify (2002).

2- Inbreeding depression

The estimates of inbreeding depression in four flax crosses for thirteen studied characters (Table 4). Results show that the cross P_1xP_3 achieved superiority in F_2 population over F_1 according to the significance of inbreeding depression estimates in apical branch zone length (-11.27), number of apical branch (-15.00), number of capsules / plant (-8.77), number of seeds/capsule (-5.38), number of seeds/plant (-14.82) and seed yield/plant (-11.68). The cross P_1xP_4 recorded inbreeding gain value for only number of basal branch (-16.67), while the cross P_1xP_5 revealed significant inbreeding gain values for all straw characters except with number of basal branch and all seed traits, except seed index, where F_1 generation surpassed F_2 one in this case. The cross P_2xP_5 performed inbreeding gain in all straw characters except number of basal branch. This cross (P_2xP_5) also revealed inbreeding advance in F_2 generation for all seed characters, except for seed index. Therefore, the two crosses P_1xP_5 and P_2xP_5 may be recommended for isolating superior inbred lines as shown from inbreeding gain concerning straw and seed characters as was mentioned above, While the cross P_1xP_3, however, may be promising for apical branches zone length and seed characters in later generations. These results were in agreement with those obtained by Rao and Singh (1983), Saraswat and Kumar (1993) and El-Sweify (2002).

C-Phenotypic (r_p)and genotypic (r_g) correlation

Result in Table 5 showed that plant height recorded significant and positive r_p values with technical stem length, fiber yield/plant, fiber percentage and number of seeds/capsule. The corresponding r_g correlation between plant height and each of the previously characters showed also positive correlation. The r_p values were significant and positive between technical stem length and each of fiber yield/plant and number of seeds/capsule with high r_g estimates for both characters. The phenotypic association between apical branch zone length and each of number of basal branch, number of apical branch, number of capsules/plant, number of seeds/plant, seed index and seed yield/plant showed significant and positive estimates. The respective r_g values for each of the character mentioned were also positive. The r_p estimates among number of basal branch and each of number of apical branch, number of capsules/plant, number of seeds/plant, seed index and seed yield/plant were significant and positive. The r_g estimates were also positive. The relationships as $r_{p,}$ between straw yield/plant and each of fiber yield/plant, number of apical branch, number of capsules/plant, number of seeds/plant, seed index and seed yield/plant were significant and positive. The respective r_g estimates for each trait mentioned before were positively correlated. The r_p values between number of apical branch and each of number of capsules/plant, number of seeds/plant, seed index and seed yield/plant were significant and positive with also high positive r_g values. The r_p between number of capsules/plant and each of number of seeds/plant, seed index and seed yield/plant recorded significant and positive values, in addition to high and positive r_g estimates. The r_p between number of seeds/plant and each of seed index or seed yield/plant and between seed index and seed yield/plant were significant and positive with high r_g positive values. These results are in accordance with those obtained by Abo-Kaied *et al.* (2006).

It can be concluded that the r_p and r_g results in this investigation promote principal knowledge to flax breeder about the possibility for selecting genotypes having distinguished marks such as tallest plants (plant height) trait for high straw yield, fiber yield and fiber percentage. Moreover, the more number of capsules/plant gave indication for higher seed production.

Table 1 . Mean values of straw and seed yields as well as their related characters of parents, F_1 and F_2 generations.

Genotype	straw yield and its related characters							seed yield and its related characters					
	Plant height (cm)	Technical stem length (cm)	Apical branch zone length (cm)	Basal branch number	Straw yield/Plant (g)	Fiberyield / plant (g)	Fiber percentage (%)	Apical branch number	Capsules / plant	Seeds /capsule	Seeds/plant	Seed index (g)	Seed yield / plant (g)
Parents													
1- Giza 4	99.13	74.37	24.77	1.30	2.85	0.40	14.13	26.90	24.37	7.47	181.87	8.00	1.38
2- Belinka	105.70	80.97	24.73	1.43	2.38	0.48	20.03	17.53	14.53	9.43	136.88	5.45	0.73
3- S.2465/1	83.07	55.20	27.87	2.47	4.55	0.55	12.16	35.37	30.63	6.67	204.01	11.91	2.35
4- S.533/39	102.60	81.07	21.53	1.37	3.32	0.52	15.59	24.20	19.27	8.60	165.79	6.35	0.99
5- Sakha 1	101.60	74.10	27.50	1.93	3.87	0.63	16.38	30.73	26.03	7.73	200.87	9.75	1.79
F_1 generation													
1*3	90.70	65.33	25.37	2.13	4.10	0.55	13.37	33.60	27.47	7.43	203.76	10.04	1.97
1*4	98.77	72.87	25.90	1.20	3.24	0.52	16.03	27.87	22.80	8.53	194.22	7.47	1.40
1*5	100.80	74.97	25.83	1.50	4.06	0.62	15.19	26.43	22.60	7.67	173.14	9.11	1.47
2*5	105.07	81.90	23.17	1.73	3.39	0.62	18.29	27.47	23.23	8.57	199.20	8.20	1.54
F_2 generation													
1*3	92.53	64.30	28.23	2.10	3.75	0.47	12.51	38.64	29.88	7.83	233.96	9.84	2.20
1*4	95.90	72.27	23.63	1.40	3.08	0.48	15.44	26.87	22.13	8.03	177.69	7.19	1.21
1*5	106.47	79.00	26.47	1.30	4.98	0.83	16.67	29.23	24.56	7.97	195.74	9.00	1.70
2*5	115.93	91.60	24.33	1.57	3.88	0.74	19.07	28.80	23.96	8.83	211.57	8.27	1.66
Grand mean	99.87	74.46	25.33	1.65	3.65	0.57	15.76	28.74	23.96	8.06	190.67	8.51	1.57
LSD 0.05	**5.20**	**3.94**	**4.62**	**0.31**	**1.03**	**0.15**	**0.94**	**2.95**	**2.44**	**0.68**	**19.29**	**0.47**	**0.21**
0.01	**7.05**	**5.34**	**6.27**	**0.42**	**1.40**	**0.21**	**1.27**	**4.00**	**3.30**	**0.93**	**26.14**	**0.64**	**0.29**
S.E. 0.05	2.28	2.56	0.54	0.11	0.20	0.03	0.67	1.45	1.17	0.20	6.66	0.47	0.13
C.V. %	8.23	12.39	7.65	23.83	19.35	20.63	15.24	18.26	17.65	8.95	12.61	20.09	28.99

Table 2. Heterosis (%) estimates in F_1 hybrids over mid- parent (MB) and better parent (BP) for straw yield and its related characters.

Cross	Plant height (cm)		Technical stem length (cm)		Apical branch zone length (cm)		Basal branch number		Straw yield/Plant (g)		Fiberyield / plant (g)		Fiber percentage (%)	
	MB	BP	MB	BP	MB	BP	MB	BP	MB	BP	MB	BP	MB	BP
Giza 4 x S.2465/1	-0.44	-8.50**	0.84	-12.16**	-3.61	-8.97**	13.00**	-13.77**	10.81**	-9.89**	15.79**	0.00	1.71**	-5.38**
Giza 4x S.533/39	-2.08	-3.73	-6.24**	-10.11**	11.88**	4.56	-10.11**	-12.41**	5.02**	-2.41**	13.04**	0.00	7.87**	2.82**
Giza 4x Sakha 1	0.43	-0.79	0.99	0.81	-1.17	-6.07	-7.12**	-22.28**	20.83**	4.91**	20.39**	-1.59	-0.43	-7.26**
Belinka x Sakha 1	1.37	-0.60	5.63**	1.15	-11.28**	-15.75**	2.98**	-10.36**	8.48**	-12.4**	10.71**	-1.58**	0.44	-8.69**
Mean	**-0.34**	**-3.41**	**0.31**	**-5.08**	**-1.05**	**-6.56**	**-1.25**	**-14.71**	**11.29**	**-4.95**	**11.98**	**-0.79**	**2.4**	**-4.63**

** Indicate highly significant at 0.01level of probability.

Table 3. Heterosis (%) estimates in F_1 hybrids over mid- parent (MB) and better parent (BP) for seed yield and its related characters.

Cross	Apical branch number		Capsules / plant		Seeds /capsule		Seeds/plant		Seedindex (g)		Seed yield / plant (g)	
	MB	BP	MB	BP	MB	BP	MB	BP	MB	BP	MB	BP
Giza 4 x S.2465/1	7.92**	-5.00**	-0.11	-10.32**	5.09**	-0.54	5.61	-0.12	0.85**	-15.70**	5.63**	-16.17**
Giza 4x S.533/39	9.08**	3.61**	4.49**	-6.44**	6.16**	-0.81*	11.73	6.79	4.11**	-6.63**	18.14**	1.45**
Giza 4x Sakha 1	-8.28**	-13.99**	-10.32**	-13.18**	0.92**	-0.78*	-9.53	-13.80	2.65**	-6.56**	-7.26**	17.88**
Belinka x Sakha 1	13.84**	-10.61**	14.55**	-10.76**	-0.12	-9.12**	17.96*	-0.83	7.89**	15.90**	22.22**	-13.97**
Mean	**5.64**	**-8.30**	**2.15**	**-10.18**	**3.01**	**-2.81**	**6.44**	**-1.99**	**3.88**	**-11.20**	**9.68**	**-11.64**

*,** Indicate 0.05 and 0.01 level of probability.

Table 4. Estimates of inbreeding depression (%) in four crosses for thirteen flax characters.

Cross	straw yield and its related characters							seed yield and its related characters					
	Plant height (cm)	Technical stem length (cm)	Apical branch zone length (cm)	Basal branch number	Straw yield/Plant (g)	Fiberyield / plant (g)	Fiber percentage (%)	Apical branch number	Capsules / plant	Seeds /capsule	Seeds/plant	Seed index (g)	Seed yield / plant (g)
Giza 4 x S.2465/1	-2.02	1.58	-11.27**	1.41**	8.54**	14.55**	6.43**	-15.00**	-8.77**	-5.38**	-14.82*	1.99**	11.68**
Giza 4x S.533/39	2.91	0.82	8.76**	-16.67**	4.94**	7.69**	3.68**	3.59**	2.94**	5.86**	8.51	3.75**	13.57**
Giza 4x Sakha 1	-5.63*	-5.38**	-2.48	13.33**	-22.65**	-33.87**	-9.74**	-12.59**	-8.67**	-3.91**	-13.05*	1.21**	-15.65**
Belinka x Sakha 1	-10.34**	-11.84**	-5.01*	9.25**	-14.45**	-19.35**	-4.26**	-4.84**	-3.14**	-3.03**	-6.21	7.60**	-7.79**

*,** Indicate 0.05 and 0.01 level of probability.

Table 5. Estimates of phenotypic (r_p) and genotypic (r_g) correlation coefficients among thirteen flax characters.

Character	1	2	3	4	5	6	7	8	9	10	11	12
1-Plant height (cm)												
2-Technical stem length (cm)	**0.980****											
	0.717											
3-Apical branch zone length (cm)	**-0.456**	**-0.622***										
	0.104	-0.265										
4-Basal branches	**-0.634***	**-0.673****	**0.547***									
	0.187	-0.417	0.613									
5-Straw yield/Plant (g)	**-0.188**	**-0.291**	**0.507**	**0.442**								
	0.-102	0.357	0.587	0.542								
6-Fiberyield / plant (g)	**0.516***	**0.417**	**0.108**	**-0.043**	**0.710****							
	0.413	0.204	0.254	0.247	0.658							
7-Fiber percentage (%)	**0.868****	**0.867****	**-0.459**	**-0.533***	**-0.364**	**0.382**						
	0.569	0.687	-0.478	-0.354	0.258	0.654						
8-Apical branch number	**-0.575***	**-0.651****	**0.654****	**0.730****	**0.635****	**0.084**	**-0.736****					
	-0.108	0.058	0.364	0.447	0.569	0.058	-0.417					
9-Capsules / plant	**-0.586***	**-0.665****	**0.671****	**0.729****	**0.663****	**0.103**	**-0.744****	**0.972****				
	-0.436	0.317	0.607	0.509	0.349	0.324	-0.504	0.723				
10-Seeds /capsule	**0.756****	**0.792****	**-0.556***	**-0.593***	**-0.571***	**0.085**	**0.861****	**-0.705****	**-0.809****			
	0.247	0.357	-0.347	-0.174	0.234	0.147	0.357	-0.574	-0.476			
11-Seeds/plant	**-0.242**	**-0.329**	**0.528***	**0.555***	**0.570***	**0.258**	**-0.453**	**0.916****	**0.879****	**-0.448**		
	-0.158	0.358	0.365	0.458	0.476	-0.247	-0.105	0.745	0.789	-0.287		
12-Seed index (g)	**-0.577***	**-0.671****	**0.729****	**0.800****	**0.778****	**0.242**	**-0.663****	**0.866****	**0.929****	**-0.847****	**0.722****	
	0.236	0.105	0.658	0.661	0.579	-0.101	-0.327	0.745	0.674	-0.473	0.514	
13-Seed yield / plant (g)	**-0.527***	**-0.626**	**0.727****	**0.799****	**0.736****	**0.229**	**-0.639****	**0.954****	**0.972****	**-0.734****	**0.872****	**0.957****
	-0.125	0.265	0.507	0.469	0.561	-0.201	-0.458	0.784	0.745	0.334	0.557	0.749

*,** Indicate 0.05 and 0.01 level of probability.

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قوة الهجين والتدهور الناتج عن التربية الداخلية والإرتباط بين صفات المحصول في بعض هجن الكتان

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

أجري هذا البحث بمزرعة محطة البحوث الزراعية بالجيزة – مركز البحوث الزراعية خلال ثلاثة مواسم متتالية ٢٠٠٤/٢٠٠٣ ، ٢٠٠٥/٢٠٠٤ ، ٢٠٠٦/٢٠٠٥ وذلك لتقيم خمسة آباء من الكتان هي جيزة ٤ (P_1) ،بلنكا (P_2) ، س ١/٢٤٦٥ (P_3) ، س ٣٩/٥٣٣ (P_4) ، سخا١ (P_5) بالإضافة إلى أربعة هجن في كل من الجيلين الأول والثاني وهي P_1xP_3 ، P_1xP_4 ، P_1xP_5 ، P_2xP_5 ، وذلك بالنسبة للمحصول ، وقوة الهجين ، والانخفاض الناتج عن التربية الذاتية ، والارتباط المظهري والوراثي للصفات تحت الدراسة ولقد أظهرت النتائج ما يلي. تفوق الهجين $F_2(P_2xP_5)$ في صفتي ارتفاع النبات ، والطول الفعال بينما احتل المركز الثاني في النسبة المئوية للألياف . كما سجل الهجين $F_2(P_1xP_5)$ أعلى تقديرات في محصول القش / نبات ، محصول الأليياف / نبات . بينما احتلت السلالة ١/٢٤٦٥ المركز الأول في محصول البذرة / نبات ثم يليها $F_2(P_1xP_3)$ ، $F_1(P_1xP_3)$.حققت الغالبية العظمى من الهجن تحت الدراسة قيم لقوة الهجين معنوية وموجبة فوق متوسط الأبوين وعدد قليل منها تفوق على الأب العالي ، وذلك لصفات القش والبذرة . تفوق الهجين P_1xP_3 في قيم الجيل الثاني على الجيل الأول في معظم صفات البذرة ، بينما تفوق الهجينين P_1xP_5 ، P_2xP_5 (تربية ذاتية) في معظم صفات القش والبذرة . كانت قيم معامل الارتباط المظهري معنوية وموجبة لكل من الطول الفعال ، ومحصول الألياف للنبات، والنسبة المئوية للألياف ، وأيضا كانت قيم معامل الارتباط الوراثي موجبة للصفات سابقة الذكر – أظهرت تقديرات معامل الارتباط المظهري معنوية موجبة بين عدد الكبسولات للبنات ، وكل من عدد البذور للنبات ، ودليل البذرة ، ومحصول بذرة النبات ، وكانت قيم معامل الارتباط الوراثي موجبة ومرتفعة في هذه الصفات .