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DIALLEL CROSSES ANALYSIS FOR SOME QUANTITATIVE CHARACTERS IN FLAX.

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ABSTRACT

This study was conducted with the objective of estimating combining ability and gene action for some quantitative characters in flax. In season 2004/2005, the six parents (P_1=S.413/3/3/1, P_2=S. 400/4/4/2, P_3=S.402/1, P_4=S.421/6/4/5, P_5= Romania10 and P_6= Romania 20) and their 15 F_1's progenies were evaluated in a randomized complete block design with three replications at Giza Res of the ARC. Station Farm. The collected data indicated that the additive effects were more important than non-additive effects for both of plant height, technical length and No. of basal branches per plant indicating that possible response to selection for these traits. P_5 and P_6 provide to be the best general combiner for most characters of straw yield and its components except for No. of basal branches. The next high combiner was P_1 for plant height, technical length and No. of basal branches. From these results, it could be noticed that these parents are consider good parents to improve straw yield/plant. The specific combining ability estimates indicated that there was no cross combination which was consistently good for all the straw yield per plant and its components, except for one cross only (P_5xP_6) exhibited highly significant and positive SCA effects for all traits of straw yield and its components. Therefore, the cross P_5xP_6 may prove useful for simultaneous improvement of these traits.

The mean squares due to general and specific combining ability were highly significant for seed yield and all its components. These results revealed that the inheritance of these characters were mainly controlled by additive genetic effects of genes. The parents, P_1, P_2 and P_3 showed highly significant and positive general combining ability effects for seed yield and most of its components (No. of capsules and 1000-seed weight). Indicating that the use of these parents in flax breeding programs could increase seed yield per plant. The specific combining ability estimates indicated that there was no cross combination which was consistently good for all characters. Three crosses, P_1xP_2 (for seed yield), P_1xP_3 and P_2xP_3 (for 1000-seed weight and No. of seeds per capsule) included high x high general combiner parents. indicated that these crosses would be interesting and prospective for the future in flax breeding program for improving seed yield per plant.

Phenotypic (r_p) and genotypic (r_g) correlation coefficients between straw yield and both of plant height and technical length were significant and positive. Also, the significant positive correlation among plant height and technical length was present, indicating that the breeder can utilize such correlated response to obtain high straw yielding genotypes through selection for one or more of these characters. On the other hand, seed yield per plant was significant positively correlated with No. of basal branches. Also, No. of capsules per plant exhibited highly significant and positive correlation with 1000-seed weight.

Keywords: Diallel analysis, Gene action, correlation, Flax.

INTRODUCTION

The expression of most quantitative characters depend on many genes with minor effects. It has generally not been possible to study the individual genes, but economic significance of many quantitative characters has stimulated research workers to devise methods for the analysis of the genetic background of such characters. Diallel crossed have recently been used extensively for studies of quantitative characters. Information on the relative importance of general (GCA) and specific (SCA) combining abilities is essential for this reason. Generally, GCA is associated with additive genes, while SCA is attributed primarily to non-additive (dominance and epistasis). It is very essential that the breeder should evaluate the potentialities of the available germplasm for new recombinations and eventually combining ability have proved to be of considerable use in crop plants. In this regard, several studies have been reported in flax, i.e. Murty and Anand (1966), Badwal and Gupta (1970), Shehata and Comstock (1971), Badwal *et al* (1972), Patil and Chopde (1983), Singh *et al* (1983), Sharma *et al* (1986), Rao and Singh (1987), Thakur and Rana (1987), Thakur *et al* (1987), Mishra and Rai (1996), Patil *et al* (1997), Foster *et al* (1998), Abo-Kaied (1999), Singh (2000) and Abo-Kaied (2002).

The present study aimed 1) to estimate the combining ability and type of gene action for eight quantitative characters related to straw and seed yields in a 6x6 diallel cross of flax, and 2) to estimate the phenotypic and genotypic correlation coefficients between straw, seed yields and other related characters.

MATERIALS AND METHODS

This investigation was carried out during the two successive seasons 2003/2004 and 2004/2005. In the first season all possible crosses were made, excluding reciprocals, in a diallel mating design involving six parental flax genotypes at Giza Agricultural Research Station, Agricultural Research Center (ARC). The genotypes used included; four promising strains (S.413/3/3/1, S.400/4/4/2,420/1, S.402/1 and S.421/6/4/5) and two introduced fiber cultivars (Romania10 and Romania 20). Genotype characteristics of the material used according to their pedigree and origin are presented in Table (1). These parents were selected on the basis of the presence of wide differences between them with respect to certain economic flax traits.

Table 1. Identification of parental genotypes used, pedigree, classification (dual, oil, fiber types) and origin.

Genotypes	Pedigree	Type	Origin
P_1= S.413/3/3/1	S.5282/1 x S.40/9	dual	Local strain
P_2= S.400/4/4/2	S.2106/3 x Reina (Netherland)	oil	Local strain
P_3= S.402/1	Giza 5 x I.235 (USA)	dual	Local strain
P_4= S.421/6/4/5	S.162/12 x S.6/2	dual	Local strain
P_5= Romania 10	An Introduction	fiber	Romania
P_6= Romania 20	An Introduction	fiber	Romania

In the second season 2004/2005, the seeds of 21 entries (six parents and their fifteen F_1 hybrids) were planted in the breeding nursery of Fiber Crops Res. Section, ARC at Giza. The experiment was laid out in a randomized complete block design with three replications with restricted randomization where each plot consisted of single F_1 row, which were guarded by their two respective parents of the cross. Rows were 3 m long, spaced 20 cm apart. Single seeds were hand drilled in 10 cm spacing within rows. Normal recommended agronomic practices were applied. Observations and measurements were recorded for parents and F_1 hybrids on 10 guarded plants chosen at random from each plot for the following characteristics:

1- Straw yield per plant and its components:

1-Straw yield per plant: Total weight in grams of the air dried straw per plant after removing the capsules.

2- Plant height (cm): Measured as the distance from the cotyledonary nodes up to uppermost capsule.

3- Technical stem length (cm): The length of the main stem between the cotyledons and the apical branching point.

4-No. of basal branches: Measured for stems at the base more than 10 cm in length and bearing at least one capsule.

1- Seed yield per plant and its components:

1- Seed yield per plant (gm).

2-No. of capsules per plant.

3-Seed index: expressed as 1000-seed weight (gm).

4-No.of seeds per capsule: Measured as average number of seeds per capsule from 5 random capsules per plant.

Statistical Analysis

Plot means were used for statistical analysis. Combining abilities, general (GCA) and specific (SCA) were calculated according to Griffing's (1956) method 2 (parents and one set of F_1's are included but not reciprocal F_1's, i.e., (P (P+1)/2) combination, model 1 (fixed effects).

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

Straw yield per plant and its components :

Analysis of variance showed that mean squares due to 21 flax genotypes (6 parents and 15 F_1 crosses), crosses and parents were significant different for straw yield and its components viz., plant height, technical length and No. of basal branches per plant (Table 2).

Table 2. Mean Squares for 21 flax genotypes (6 parents and 15 crosses), general (GCA) and specific (SCA) combining ability for straw and seed yields and their components.

		Straw yield and its components				Seed yield and its components			
S.O.V.	df	Straw yield / plant(g)	Plant height (cm)	Technical length (cm)	No. of basal branches	Seed yield/ plant (g)	No. of capsules/ plant	1000-seed weight	No. of seeds/ capsule
Reps	2	3.680**	13.440ns	14.03ns	0.090**	0.180*	4.93ns	0.030ns	0.010ns
Genotypes	20	4.600**	290.16**	221.63**	0.050**	0.420**	131.67**	5.360**	1.670**
crosses(C)	14	5.690**	309.03**	286.64**	0.051**	0.310**	78.507**	4.469**	1.204**
parents (P)	5	1.935*	285.76**	81.693**	0.052*	0.789**	306.12**	8.605**	3.137**
P.vs.C	1	2.616*	47.947**	11.041ns	0.025ns	0.028ns	3.650ns	1.608**	0.811**
GCA	5	2.130**	235.75**	154.27**	0.023**	0.498**	156.70**	6.156**	0.997**
SCA	15	1.333**	50.377**	47.077**	0.015**	0.019ns	6.287**	0.330**	0.409**
Error	40	0.200	1.725	2.122	0.005	0.012	1.234	0.005	0.027
GCA/SCA %		1.60	4.68	3.28	1.58	26.41	24.925	18.64	2.44

**,*Significant at 0.05 and 0.01 levels of probability, respectively.

This indicated that those parental genotypes as well as the F_1's crosses showed a reasonable degree of variability for these characters. On the other hand, P. *vs*. C. mean squares as an individual of heterosis over all hybrids was significant, indicating that average heterosis over all crosses was existed for two characters only (straw yield and plant height). Also, general (GCA) and specific (SCA) combining ability variances for these traits were highly significant, indicating the presence of both additive and non- additive type of genetic variance. A comparison of the magnitudes of the mean sum of squares due to GCA and SCA as well as the ratio of GCA/SCA variance for all characters showed that, the additive effects were more important than non-additive effects. Indicating possible response to selection for these traits. Similar results were reported by Thakur *et al* (1987), Patil *et al* (1997), Foster *et al* (1998), Abo-Kaied (1999), Singh (2000) and Abo-Kaied (2002).

The estimates of general combining ability effects for each parent are present in Table (3).

Table 3. Estimation of general combining ability effects (ĝi) for Straw and seed yields and their components in 6 flax genotypes.

	Straw yield and its components			
Parents	Straw yield / plant(g)	Plant height (cm)	Technical length (cm)	No. of basal branches
P1=S.413/3/3/1	0.197 ns	1.825 **	1.822 **	0.056 *
P2=S.400/4/4/2	0.302 *	-5.358 **	-6.169 **	0.064 **
P3=S.402/1	-0.164 ns	-5.675 **	-1.669 **	0.006 ns
P4=S.421/6/4/5	-0.982 **	-2.350 **	-3.111 **	-0.078 **
P5=Romania10	0.339 *	3.458 **	3.889 **	-0.019 ns
P6=Romania20	0.308 *	8.100 **	5.239 **	-0.028 ns
LSD(gi-gi)				
5%	0.452	1.327	1.472	0.074
1%	0.605	1.776	1.969	0.099
r	0.840 *	0.940 **	0.910 *	0.930 **
	Seed yield and its components			
Parents	Seed yield/plant (g)	No. of capsules/plant	1000-seed weight	No. of seeds/capsule
P1=S.413/3/3/1	0.221 **	2.182 **	0.361 **	0.058ns
P2=S.400/4/4/2	0.152 **	2.420 **	0.678 **	-0.348 **
P3=S.402/1	0.251 **	5.780 **	1.155 **	-0.519 **
P4=S.421/6/4/5	-0.032 ns	-0.034 ns	-0.287 **	0.185 **
P5=Romania10	-0.295 **	-4.738 **	-0.840 **	0.315 **
P6=Romania20	-0.297 **	-5.609 **	-1.066 **	0.309 **
LSD(gi-gi)				
5%	0.112	1.123	0.075	0.167
1%	0.150	1.502	0.100	0.223
r	0.990 **	0.996 **	0.970 **	0.950**

*,** Significant at 0.05 and 0.01 levels of probability, respectively.
r : Simple correlation coefficients between GAC values and parental means

The data indicated that P_5 (Romania 10) and P_6 (Romania 20) provide to be the best general combiner for most characters except for No. of basal branches. The next high combiner was P_1 (S.413/3/3/1) for plant height, technical length and No. of basal branches. Using such parents in varietal important programs may result in isolating desirable sergeants for straw yield per plant. The correlation coefficient between mean performance of parents and their GCA values was significant and positive, indicating that the superiority of a parent in cross combinations could be directly predicted its *per se* performance. Whereas, P_3 (S.402/1) and P_4 (S.421/6/4/5) showed low general combiner for most characters of straw yield.

The specific combining ability (Table 4) estimates indicated that there was no cross combination which was consistently good for all the straw yield per plant and its components, except for one cross only ($P_5 \times P_6$) exhibited highly significant and positive SCA effects on all traits. $P_1 \times P_2$ indicated high SCA effect for both of straw yield and technical length, $P_1 \times P_5$, $P_1 \times P_6$ and $P_3 \times P_6$ for both of plant height and technical length, $P_2 \times P_4$ for each of straw yield, plant height and No. of basal branches and $P_4 \times P_6$ for technical length. In general, one cross (P_5xP_6) exhibited significant and positive SCA effects for straw yield and its components. Therefore, the cross P_5xP_6 may prove useful for simultaneous improvement of these traits. The correlation between cross means and their SCA values was significant and positive for all characters, indicating that high performing crosses were high specific combinations. Therefore, the choice of promising cross combination would be based on SCA effects.

Table 4: Estimation of specific combining ability ($\hat{s}ij$) effects for straw, seed yields and their components in 15 flax crosses.

Crosses	Straw yield and its components				Seed yield and its components			
	Straw yield / plant(g)	Plant height (cm)	Technical length (cm)	No. of basal branches	Seed yield/ plant (g)	No. of capsules/ plant	1000-seed weight	No. of seeds/ capsule
P_1xP_2 $	1.92 **	-0.32 ns	2.96 **	0.07 ns	0.19 *	0.593 ns	-0.52 **	0.11 ns
P_1xP_3	0.60 ns	-4.54 **	-8.00 **	-0.07 ns	0.01 ns	-0.007 ns	0.49 **	0.61 **
P_1xP_4	-0.75 *	-4.87 **	-3.96 **	-0.12 *	-0.18 *	-4.780 **	-0.15 **	0.81 **
P_1xP_5	0.03 ns	11.53 **	11.31 **	-0.12 *	-0.07 ns	0.294 ns	0.03 ns	0.11 ns
P_1xP_6	-0.66 ns	6.29 **	8.96 **	0.09 ns	0.13 ns	2.125 *	0.73 **	-1.07 **
P_2xP_3	-0.02 ns	-0.09 ns	-3.61 **	-0.08 ns	0.07 ns	1.282 ns	0.30 **	0.55 **
P_2xP_4	1.19 **	3.85 **	1.83 ns	0.27 **	-0.22 *	-2.905 **	-0.10 ns	0.22 ns
P_2xP_5	-0.57 ns	3.71 **	1.83 ns	-0.12 *	-0.02 ns	0.632 ns	0.92 **	-0.8 5 **
P_2xP_6	-0.53 ns	-4.87 **	-9.72 **	-0.12 *	0.06 ns	0.441 ns	0.76 **	-0.65 **
P_3xF_4	0.16 ns	7.24 **	1.66 ns	-0.07 ns	0.04 ns	1.355 ns	0.47 **	-0.78 **
P_3xP_5	-1.05 **	-8.44 **	0.06 ns	0.00 ns	-0.17 *	-2.018 *	-0.53 **	-0.35 **
P_3xP_6	-0.13 ns	10.05 **	5.98 **	0.01 ns	-0.19 *	-5.069 **	-0.17 **	0.66 **
P_4xP_5	-1.34 **	-12.97 **	-11.43 **	0.02 ns	0.12 ns	1.910 *	-0.71 **	-0.38 **
P_4xP_6	0.28 ns	-1.21 ns	2.62 *	-0.11 ns	-0.07 ns	1.168 ns	0.31 **	-0.21 ns
P_5xP_6	2.78 **	2.92 **	3.49 **	0.17 **	0.10 ns	2.695 **	-0.30 **	0.16 ns
LSD(Sij-Sii)								
5%	0.90	2.65	2.94	0.15	0.22	2.245	0.15	0.33
1%	1.21	3.55	3.94	0.20	0.30	3.004	0.20	0.45
r	0.898 **	0.775**	0.867**	0.872**	0.376	0.163	0.522 *	0.766 **

$ = Number refer to parent codes, Table 3.

*,** Significant at 0.05 and 0.01 levels of probability, respectively.

r : Simple correlation coefficients between SAC values and means of crosses.

The mean performance of 6 parents and 15 F_1's crosses for straw yield and its components are presented in Table (5). P_5 (Romania 10) recorded the highest mean values for straw yield and its two impotent components (plant height and technical length), followed by P_6 (Romania 20) for plant height and technical length. While P_1 (S.413/3/31) and P3 (S.402/1) for straw yield and No. of basal branches. On the other hand, the highest mean values of straw yield and its most component were obtained by flax crosses of P_5 x P_6, followed by P_1 x P_2 and P_1 x P_3. From these results, it could be noticed that the parents Romania 10, S.413/3/3/1 and S.400/4/4/2 are considered good parents to improve straw yield/plant .

Table 5. Mean performances of 21 flax genotypes (6 parents and 15 F1's crosses) for straw, seed yield and their components.

Genotypes	Straw yield and its components				Seed yield and its components			
	Straw yield / plant(g)	Plant height (cm)	Technical length (cm)	No. of basal branches	Seed yield/plant (g)	No. of capsules/ plant	1000-seed weight	No. of seeds/ capsule
				Parents				
P1=S.413/3/3/1	9.59 ab	97.93 b	71.47 b	2.40 a	2.28 ab	34.67 b	8.44 c	7.65 c
P2=S.400/4/4/2	9.38 b	86.47 bc	64.47 c	2.33 ab	2.14 bc	34.24 b	8.68 b	7.43 c
P3=S.402/1	9.66 ab	84.87 c	72.07 b	2.33 ab	2.50 a	43.21 a	10.04 a	6.43 d
P4=S.421/6/4/5	8.04 c	97.60 b	71.87 b	2.07 c	1.96 c	30.98 c	7.53 d	8.37 b
P5=Romania10	10.52 a	106.87 a	78.60 a	2.20 bc	1.30 d	18.19 de	6.62 e	9.10 a
P6=Romania20	9.52 b	107.93 a	78.27 a	2.13 c	1.27 d	17.52 e	5.21 f	8.99 a
				Crosses				
P_1xP_2	12.19 b	94.47 ef	72.07 f	2.40 ab	2.44 a	34.61 d	8.52 d	7.63 fg
P1xP3	10.40 c	89.93 g	65.60 hi	2.20 cd	2.35 ab	37.37 bc	10.01 a	7.97 c-f
P1xP4	8.24 i-k	92.93 f	68.20 gh	2.07 de	1.88 d	26.79 e-g	7.93g h	8.87 a
P1xP5	10.34 d	115.13 a	90.47 a	2.13 de	1.73 d-f	27.16 e-g	7.56 i	8.30 bc
P1xP6	9.62 d-g	114.53 a	89.47 a	2.33 bc	1.93 cd	28.12 ef	8.03 fg	7.11 h
P2xP3	9.89 de	87.20 gh	62.00 j	2.20 cd	2.34 ab	38.90 a	10.14 a	7.50 gh
P2xP4	10.29 de	94.47 ef	66.00 h	2.47 a	1.78 d-f	28.90 e	8.29 ef	7.87 ef
P2xP5	9.85 de	100.13 c	73.00 ef	2.13d e	1.71 d-g	27.73 ef	8.76 c	6.93 hi
P2xP6	9.86 de	96.20 de	62.80 ij	2.13 de	1.79 d-f	26.67 e-g	8.38 de	7.13 h
P3xP4	8.79 g-j	97.53 d	70.33 fg	2.07 de	2.14 bc	36.52 cd	9.34 b	6.70 i
P3xP5	8.90 f-i	87.67 fg	75.73 e	2.20 cd	1.66 e-g	28.44 ef	7.79 h	7.27 gh
P3xP6	9.79 d-f	110.80 b	83.00 c	2.20 cd	1.64 fg	24.52 g	7.92 gh	8.27 cd
P4xP5	7.79 k	86.47 h	62.80 ij	2.13 de	1.66 e-g	26.56 fg	6.17 k	7.93 d-f
P4xP6	9.38 e-g	102.87 c	78.20 de	2.00 de	1.48 gh	24.94 g	6.96 j	8.10 c-e
P5xP6	13.20 a	112.80 ab	86.07 b	2.33 bc	1.38 h	21.77 h	5.80 l	8.60 ab
G. Means	9.77	98.32	73.45	2.21	1.87	29.42	8.01	7.82

The values identified by the same letter are not significantly different at 5 % level of probability .

Seed yield per plant and its components:

Analysis of variance showed that mean squares due to genotypes, parents and crosses were highly significant for seed yield and its components viz., No. of capsules per plant, 1000-seed weight and No. of seeds per capsule (Table2). These results indicated that the parental genotypes and $F_1^{,S}$ crosses showed reasonable degree of variability for these traits. Also, both mean squares due to general (GCA) and specific(SCA) combining abilities were highly significant for all characters except with SCA for seed yield/plant which was not significant. High ratio of GCA/SCA were also detected. These results revealed that the inheritance of these characters were mainly controlled by additive genetic effects of genes. Similar results were reported by Murty and Anand (1966), Badwal and Gupta (1970), Shehata and Comstock (1971), Badwal *et al* (1972), Patil and Chopde (1983), Singh *et al* (1983), Roa and Singh (1987), Thakur and Rana (1987), Mishra and Rai (1996).

The estimates of general combining ability effects for each parent are shown in Table (3). The parents, P_1 (S.413/3/3/1), P_2 (S.400/4/4/2) and P_3 (S.402/1) only showed highly significant and positive general combining ability effects for seed yield and most of its components (No. of capsules and 1000-seed weight), indicating that the use of these parents in flax breeding programs could increase seed yield. The simple correlation between GCA values and parental means for seed yield/plant and all its components were highly significant and positive. These results indicated that the parents showing higher mean performance proved to be the highest general combiners for these traits. Therefore, high mean performance of the parents could be transferred to crosses in such cases. On the other hand, P_5 (Romania10) and P_6 (Romania 20) showed low general combiner for most seed yield characters showed highly significant and negative general combining ability effects for seed yield and most of important components (No. of capsules per plant and 1000-seed weight).

Table (4) showed specific combining ability effects for seed yield per plant and its components. Out of the 15 F_1 crosses, one cross ($P_1 \times P_2$) showed highly significant positive SCA effects for seed yield/plant, three crosses (P_1xP_6, P_4xP_5 and P_5xP_6) for No. of capsules/plant, seven crosses (P_1xP_3, P_1xP_6, P_2xP_3, P_2xP_5, P_2xP_6, P_3xP_4 and P_4xP_6) for 1000-seed weight and four crosses (P_1xP_3, P_1xP_4, P_2xP_3 and P_3xP_6) for No. of seeds per capsule. In general, the specific combining ability estimates indicated that there was no cross combination which was consistently good for all characters. Out of the mentioned crosses, three crosses, P_1xP_2 (for seed yield), P_1xP_3 and P_2xP_3 (for 1000-seed weight and No. of seeds per capsule) included high x high general combiner parents. Whereas, five crosses (P_1xP_6, P_2xP_5, P_2 xP_6, P_3xP_4, and P_3xP_6) included high x low for 1000-seed weight. On the other hand, two crosses (P_4xP_5 and P_5xP_6) included low x low general combiner parents for No. of capsules per plant. For the breeding point of view as suggested by Thakur and Rana (1987) the SCA effects include dominance and epistatic effects and can be related with heterosis. In self-pollinated crops, however, the additive x additive type of interaction component is fixable in the latter generations. The correlation between cross means and their SCA values was significant and positive for both 1000-seed weight and No. of seeds per capsule indicating that high performing crosses were high specific combinations for the two traits.

Data in Table (5) showed the mean performance values of parents and their crosses for seed yield and its components. P_1 (S.413/3/3/1), P_2 (S.400/4/4/2) and P_3 (S.402/1) recorded the highest mean values for seed yield and two important components (No. of capsules and 1000-seed weight). Whereas, the highest mean values of seed and its most important components were obtained by flax crosses of P_1xP_3, P_2xP_3 and P_3xP_4. It could be concluded that the above mentioned crosses and their parents would be interesting and prospective for the future in flax breeding program for improving seed yield and its most components.

Phenotypic and genotypic correlations:

Phenotypic (r_p) and genotypic (r_g) correlation coefficients among eight traits in flax are shown in Table (6). The correlation between straw yield and both of plant height and technical length were significant and positive. Also, the significant positive correlation among plant height and technical length was present, indicating that the breeder can utilize such correlated response to obtain high straw yielding genotypes through selection for one or more of these characters. Similar results were reported by El-Shimy (1975), Abo-Kaied (1992) and Zahana (1999). On the other hand, seed yield per plant was significant positively correlated with No. of basal branches. Also, No. of capsules per plant exhibited highly significant and positive correlation with 1000-seed weight. These results are in harmony with those reported by Kumar and Chauhan (1979), Rai (1981), Abo-Kaied (1992) and Zahana (1999).

Table 6. Phenotypic (r_p) and genotypic (r_g) correlation coefficients among eight traits in 21 flax genotypes.

Characters		Straw yield / plant(g)	Plant height (cm)	Technical length (cm)	No. of basal branches	Seed yield/plant (g)	No. of capsules/ plant	1000-seed weight
Plant height (cm)	r_p	0.846 **						
	r_g	0.632						
Technical length (cm)	r_p	0.826	0.970 **					
	r_g	0.722	0.801					
No. of basal branches	r_p	-0.707	-0.871 **	-0.828 *				
	r_g	0.345	0.121	-0.123				
Seed yield/plant (g)	r_p	-0.746	-0.913 **	-0.873	0.887 **			
	r_g	0.265	0.156	-0.302	0.721			
No. of capsules/plant	r_p	0.470	0.337	0.351	-0.511 *	-0.175		
	r_g	0.347	0.247	0.234	0.423	0.565		
1000-seed weight	r_p	0.106	-0.073	-0.073	-0.091	0.261	0.788 **	
	r_g	-0.258	-0.327	-0.117	0.347	0.543	0.458	
No. of seeds/capsule	r_p	0.021	0.131	0.086	-0.017	-0.238	-0.584 **	-0.691 **
	r_g	0.432	0.214	0.241	0.165	-0.187	-0.432	-0.258

***,** Significant at 0.05 and 0.01 levels of probability, respectively.**

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تحليل الهجن الدائرية لبعض الصفات الكمية في الكتان

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أجريت هذه الدراسة بهدف تقدير القدرة علي الائتلاف والفعل الجيني لبعض الصفات الكمية في الكتان من خلال تقييم ١٥ هجين ناتجة من التهجين بين ستة أباء(١= س١/٣/٣/٤١٣، ٢= س٢/٤/٤/٤٠٠، ٣= س ١/٤٠٢، ٤= س ٥/٤/٦/٤٢١، ٥= رومانيا ١٠، ٦= رومانيا ٢٠) باستعمال تحليل الهجن الدائرية . في موسم ٢٠٠٤ /٢٠٠٥ تم تقييم الـ٦ أباء مع ١٥ هجين في الجيل الأول في حقل تربية الكتان بمركز البحوث الزراعية بالجيزة في تجربة قطاعات كاملة العشوائية ذات ثلاثة مكررات . وتشير النتائج إلى أن تأثير العوامل الوراثية المضيفة أكبر من الغير مضيفة في توريث صفات الطول الكلي والطول الفعال وعدد الأفرع القاعدية للنبات ، مما يشير إلى إمكانية تحسين هذه الصفات عن طريق الانتخاب ، كما تشير النتائج إلى أن الأبويين رومانيا ١٠ و رومانيا ٢٠ أظهرا قدرة عامة عالية علي الائتلاف لمعظم صفات محصول القش ومكوناته ماعدا صفة عدد الأفرع القاعدية للنبات ، لذلك يعتبر هذين الأبوين مهمين لتحسين صفة محصول القش للنبات. كما تشير النتائج إلى انه لا يوجد هجين أظهر تفوق في القدرة الخاصة علي الائتلاف لكل الصفات الخاصة بمحصول القش ومكوناته ماعدا هجين واحد فقط (٥ x ٦) ، لذلك يعتبر هذا الهجين مهم في أن يستخدم في تحسين محصول القش ومكوناته في نفس الوقت.

كما تشير النتائج الخاصة بمحصول البذور ومكوناته إلى أن العوامل الوراثية المضيفة كانت هي المتحكمة في توريثها ، كما تشير تقديرات القدرة العامة علي الائتلاف أن الأباء س١/٣/٣/٤١٣ ، س٢/٤/٤/٤٠٠ ، س ١/٤٠٢ لها قدرة عالية علي الائتلاف لصفات محصول البذرة ووزن الألف بذرة وعدد الكبسولات/نبات. مما يشير إلى إمكانية استخدام هذه الآباء لتحسين صفة محصول البذرة للنبات. بينما تشير نتائج القدرة الخاصة علي الائتلاف للهجن انه ليس هناك هجين واحد أظهر تفوق لكل الصفات الخاصة بمحصول البذرة ومكوناته. بينما هناك ثلاثة هجن متميزة (مضيفX مضيف) وهي (١ x ٢) لصفة محصول البذور، (١ x ٣)؛ (٢ x ٣) لصفتي وزن الألف بذرة وعدد البذور بالكبسولة لذلك ممكن في المستقبل استخدامها في برنامج التربية لتحسين صفة محصول البذرة للنبات،

كما تشير نتائج الارتباط الظاهري والوراثي بين صفات محصول القش والبذرة ومكوناتهما إلى أن هناك ارتباط موجب ومعنوي عالي بين محصول القش وكلا من الطول الكلي والطول الفعال، وأيضا بين كلا من الطول الكلي والطول الفعال ، مما يشير إلى إمكانية استفادة المربي من هذا للحصول علي محصول قش عالي من خلال الانتخاب لواحد أو اكثر من المكونين السابقين، بينما محصول البذور/ نبات أظهر ارتباط معنوي وموجب مع عدد الأفرع القاعدية، كذلك كان الارتباط موجب ومعنوي بين عدد الكبسولات/ نبات ووزن الألف بذرة .