J. Plant Production, Mansoura Univ., Vol. 6 (11): 1877 - 1886, 2015

DIALLEL CROSS ANALYSIS FOR YIELD AND ITS COMPONENTS IN SIX FLAX GENOTYPES

Maysa S. Abd Al-Sadek
Fiber Crops Res. Dep., Field Crops Res .Inst., A.R.C., Giza, Egypt.

ABSTRACT

This study was conducted with the objective of estimating combining ability and gene action for both of seed and straw yields as with as their components in six flax genotypes. This was achieved via evaluating six parents (P_1= Giza 8, P_2= Sakha 2, P_3= S.413/1/2/3, P_4= S.420/12, P_5= Cizar and P_6 = Bombay) with their 15 F_2's progenies. In 2014/2015 season, the six parents and their 15 $F_2{}^{'s}$ crosses were planted in a randomized complete block design with three replications at Giza Res. Station Farm.

The collected data indicated that the additive effects were more important than non-additive effects for each of straw yield, plant height, technical stem length, seed yield, no. of capsules per plant, 1000-seed weight and no. of seeds per capsule indicating that effective selection should be possible within these F_2 and subsequent generations for these characters. While, both additive and non-additive effects were the same almost effect in inheritance of no. of basal branches per plant.

P_3 and P_4 showed high general combining ability for each of straw yield per plant, plant height and technical stem length. Also, P_1 proved to be good combiner for seed yield and its two important components, no. of capsules per plant and 1000-seed weight in addition P_5 exhibited high general combiner for all seed yield characters except 1000-seed weight, suggesting the importance of these parents for increasing the previous traits in flax breeding programs. The simple correlation between GCA values and parental means for all characters studied were significantly positive. These results indicated that the parents showing higher mean performance proved to be the highest general combiners for these traits. One cross (P_3xP_5) exhibited significant and positive SCA effect for each of straw yield, plant height and technical stem length as well as this cross included high x low general combiners parents for GCA effects for straw yield. For seed yield, one cross (P_1xP_5) showed significant positive SCA values for both seed yield and no. of capsules per plant as well as this cross involved high x high general combiner for these two traits in addition one cross (P_1xP_2) had high x high general combiner parents for 1000-seed weight. Therefore, these crosses (P_3xP_5, P_1xP_5 and P_1xP_2) may prove useful for simultaneous improvement of the above-mentioned traits.

Straw yield per plant was significantly positively correlated with both of plant height and technical stem length. Also, plant height exhibited high positive correlation with technical stem length. On the other hand, seed yield per plant exhibited highly significant and positive correlation with each of no. of capsules, 1000-seed weight and no. of basal branches. Therefore, the possibility of using the two traits (plant height and technical stem length) as selection indices for improving straw yield per plant as well as, using 1000-seed weight and capsules number per plant as selection indices for improving seed yield per plant.

Keywords: *Combining ability, Gene action, Diallel cross, Correlation, Flax*.

INTRODUCTION

Flax (*Linum usitatissimum* L.) has always had industrial uses; recently its uses have widened to include a range of new possibilities such as cigarette papers, car door panels and compressed boards. But more and more, flax is carving a niche as a health food. Alpha-linolenic acid (an omega-3 fatty acid found in seed flax) is essential in the human diet. It can reduce heart disease and lower cholesterol. Flax is cultivated in Egypt for two purposes, seeds and fibers.

The diallel cross technique proposed by Griffing (1956) has been widely used for evaluation of general combining ability which is due to additive gene action and specific combining ability which is due to non-additive gene effects. The difficulty in producing enough F_1 hybrid seeds in some self pollinated crops have limited the use of diallel analysis, and in such cases, F_2 diallels may be more appropriate (Shehata and Comstock , 1971 and Patil and Chopde,1981). However F_2 diallels estimate dominance with only half the efficiency of F_1 diallels (Allard 1960).

The additive genetic variance had more important role in the inheritance of straw yield, plant height, technical stem length, seed index as reported by Foster *et al* (1998), Abo-Kaied *et al* (2007), Abo-Kaied and El-Refaie,Amany (2008) and El-Kady, Eman and Abo-Kaied (2010). ON the other hand, non-additive variance had an important role in the inheritance of no. of basal branches per plant, seed yield per plant and no. of capsules per plant as reported by Shehata and Comstock (1971), Roa and Singh (1987), Mishra and Rai (1996), El-Kady and Abo-Kaied (2010) and Abdel-Moneam (2014).

This study aimed to estimate the combining ability and the type of gene action for yield and yield components traits for six flax genotype and their 15 crosses in F_2 generations with an ultimate goal of selecting suitable parents and the superior crosses which can be used in breeding program.

MATERIALS AND METHODS

The materials used for the present study consisted of (6 parents and 15 F_2,s). These six parents represent a wide genetic variability for yield and yield component traits of flax. Genotype characteristics of these parents used according to their pedigree, classification and origin are presented in Table 1.

Table1.Identification of parental genotypes used,pedigree, classification (dual, oil, fiber types) and origin.

Genotypes	Pedigree	Type	Origin
P_1=Giza 8	Giza 5 x Santa Catalina 6	oil	Local variety
P_2=Sakha	I. 2348 x Hera	dual	Local variety
P_3=S.413/1/2/3	S.5281/1 x S.40/9	dual	Local strain
P_4= S.420/12	S.162/12 x S.2467/1 (Hira)	dual	Local strain
P_5=Cizar	Introduction from Holland	fiber	Holland
P_6=Bombay	B12 x C.I. 42	fiber	USA

In 2012/2013 season, the six parents were crossed in a diallel mating design excluding reciprocals to obtain 15 F_1 crosses at Giza Res. Sta. of Agric. Res. Center. The F_1 seed were sown in 2013/2014 for obtaining F_1 hybrid plants and consequently to obtain F_2 seeds by selfing. In 2014/2015 season, the six parents and 15 F_2's were planted in a randomized complete block design with three replications at Giza Res. Station Farm. Seeds of each parent and F_2 was sown in two rows. The rows were 2 m long and 20 cm apart. Single seeds were hand drilled in 5 cm spacing within rows. Ten random guarded plants from each row (twenty plants for each parent and each F_2) used for measuring data. The following traits were recorded: (1) straw weight per plant (g), (2) plant height (cm),(3) technical stem length (cm), (4) no. of basal branches, (5) seed yield per plant (g), (6) 1000-seed weight (g), (7) no. of capsules per plant, and (8) no. of seeds per capsule.

Statistical Analysis

Plot means were used for statistical analysis. Combining abilities, general (GCA) and specific (SCA) were calculated according to Griffing's method 2, model 1 (fixed effects). Phenotypic correlation coefficients were calculated according to the formula suggested by Al-Jibouri et al., (1958).

RESULTS AND DISCUSSION

Straw yield and its components :

Analysis of variances:

Analysis of variance exhibited that mean squares due to entries (parents and F_2,s) are highly significant for straw yield/plant and its components (Table 2). This indicates that those parental genotypes as well as the F_2,s crosses showed a reasonable degree of variability for these traits. Also, mean squares due to parents and crosses were highly significant for all characters with exception for no. of basal branches/plant was significant only. 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. The ratio of general to specific (GCA/SCA) combining ability variances for each of straw yield/plant, plant height and technical stem length showed that the additive effects were more important than non-additive effects. While, both additive and non-additive effects were the same almost effect in inheritance of no. of basal branches/plant. Although SCA mean squares were significant for plant height and technical stem length, the magnitude of GCA mean squares were greater than SCA mean squares for these two important components of straw yield (plant height and technical stem length). Therefore, the magnitude of additive genetic effects must be of considerable value for both characters. Consequently, effective selection should be possible within these F_2 and subsequent populations for these two traits which indicate to high yielding ability for straw yield. Similar results were reported by Gaafar *et al* (1992) Foster *et al* (1998), Zahana, Afaf (2006), Abo-Kaied *et al* (2007), Abo-Kaied and El-Refaie, Amany (2008), El-Kady, Eman and Abo-Kaied (2010) and Abdel-Moneam (2014).

GCA effects:

The estimates of GCA effects are presented in Table 3. P_3 (S.413/1/2/3) and P_4 (S.420/12) showed high general combining ability for each of straw yield/plant, plant height and technical stem length, suggesting the importance of these two parents (P_3 and P_4) for increasing straw yield, plant height and technical length in flax breeding programs. Also, P_1 (Giza 8) and P_6 (Bombay) showed significant and positive GCA effects for no. of basal branches per plant. The simple correlation between GCA values (Table 3) and parental means (Table 5) for straw yield and its components were significantly positive. Similar findings were reported by Abo-Kaied and El-Refaie, Amany (2008) in flax. 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 hybrids in such cases. For mean performances, P_3 gave high mean value for each of straw yield/plant, plant height and technical stem length (Table 5).

SCA effects:

Specific combining ability (SCA) effects for 15 F_2's crosses of straw yield per plant and its components are present in Table (4). Out of the 15 F_2 crosses, six crosses ($P_1 \times P_3$, $P_1 \times P_4$, $P_2 \times P_3$, $P_2 \times P_6$, $P_3 \times P_5$ and $P_4 \times P_5$) for straw yield/plant, five crosses ($P_2 \times P_4$, $P_2 \times P_5$, $P_2 \times P_6$, $P_3 \times P_5$ and $P_3 \times P_6$) for plant height, four crosses ($P_1 \times P_4$, $P_1 \times P_6$, $P_2 \times P_3$ and $P_3 \times P_5$) for technical stem length and one cross (P_1xP_6) for no. of basal branches /plant were exhibited significant and positive SCA effect**.** In general one cross (P_3xP_5) exhibited significant and positive SCA effect for each of straw yield, plant height and technical stem length as well as this cross (P_3xP_5) included high x low general combiners parents for GCA effects for straw yield, however, one cross ($P_1 \times P_6$) included two high general combiner parents for GCA effects for no. of basal branches. For mean performances, two crosses (P_1xP_3 and P_3xP_4) showed high mean performances for all straw characters traits with except no. of basal branches/plant (Table 5).

From the breeding point of view as suggested by Bhatada and Bahale (1983) for crosses exhibiting significant and positive SCA effects which resulted from high x high general combiners, the breeding procedure which utilize both additive and non-additive genetic variance would be more useful for improvement of straw yield. The available additive genetic variance should be exploited by adopting mass selection in early generations and some form of *inter-se* mating may be followed among elite selections in later generations, which may help in fixing non-additive effects.

2-3

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 #	0.188ns	2.199ns	-0.847ns	0.135ns	0.140ns	1.100ns	0.261**	-0.008ns
P_1xP_3	0.292**	1.955ns	-6.051**	0.159ns	0.201*	3.315*	0.179ns	-0.312ns
P_1xP_4	0.369**	2.194ns	2.237*	0.161ns	0.241**	2.069ns	0.192ns	0.128ns
P_1xP_5	0.025ns	1.253ns	0.932ns	0.180ns	0.213**	2.966*	0.094ns	-0.047ns
P_1xP_6	0.096ns	1.801ns	3.004**	0.193*	0.232**	0.247ns	0.746**	-0.048ns
P_2xP_3	0.438**	-7.293**	4.362**	0.118ns	0.134ns	6.878**	-0.032ns	-1.051**
P_2xP_4	-0.022ns	3.342**	1.397ns	0.120ns	0.124ns	-0.34ns	0.359**	0.231ns
P_2xP_5	-0.112ns	2.401*	-1.441ns	0.139ns	0.188*	0.564ns	0.415**	0.057ns
P_2xP_6	0.226*	2.685*	1.057ns	0.152ns	0.200*	2.208ns	0.083ns	0.056ns
P_3xP_4	-0.145ns	1.537ns	-5.911**	0.144ns	0.089ns	6.930**	-0.507**	-0.847**
P_3xP_5	0.325**	3.940**	3.854**	0.163ns	0.247**	-0.072ns	0.392**	0.287ns
P_3xP_6	-0.224*	2.394*	-8.674**	0.177ns	0.196*	0.196ns	0.284**	0.286ns
P_4xP_5	0.268**	0.992ns	0.000ns	0.165ns	0.162*	1.252ns	0.296**	0.000ns
P_4xP_6	-0.018ns	1.224ns	1.022ns	0.178ns	0.157*	1.847ns	0.187ns	0.000ns
P_5xP_6	0.174ns	1.248ns	1.907ns	0.039ns	-0.31**	-2.129ns	-0.417**	-0.093ns
$LSD_{Sij-Skl}$								
5%	0.295	3.400	3.143	0.284	0.229	4.304	0.289	0.514
1%	0.395	4.549	4.205	0.379	0.307	5.758	0.387	0.688
r	0.364	0.215	0.135	0.609*	0.620*	0.407	0.370	0.654**

 # = Number refer to parent codes, Table 3.
***,** Significant at 0.05 and 0.01 levels of probability, respectively.**
r : Simple correlation coefficients between SCA values and means of crosses.

Seed yield and its components:
Analysis of variances:

Analysis of variance showed that mean squares due to entries (6 parents and 15 F_2,s) were highly significant for seed yield/plant and its components (Table 2). Also, parents and crosses mean squares were significant for all characters. These results indicated that the parental genotypes as well as F_2,s crosses possess a reasonable degree of variability for these characters. 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. Also, analysis of variances due to combining ability showed highly significant mean squares for both general and specific combining ability, revealing the important role of both additive and non-additive effects in the expression of seed yield and its components. The ratio of GCA/SCA for seed yield and its components, revealed that the inheritance of these traits were mainly controlled by additive genes effects. Abo-Kaied *et al* (2007),Abo-Kaied and El-Refaie, Amany (2008), El-Kady, Eman and Abo-Kaied (2010) and Abdel-Moneam (2014) reported similar results in combining ability for these traits in flax.

Table 5. Mean performances of 21 flax genotypes (6 parents and 15 F_2'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 (g)	No. of seeds/ capsule
Parents								
P1 #	1.83	94.90	66.18	1.77	2.44	42.84	9.08	6.32
P2	1.38	83.84	64.03	1.28	1.70	24.63	9.12	7.56
P3	3.43	124.00	97.60	1.57	1.80	22.46	9.32	8.60
P4	2.89	111.10	85.20	1.59	1.71	26.23	8.21	7.94
P5	1.61	86.95	59.53	1.58	2.33	38.38	7.34	8.26
P6	2.18	99.79	71.35	1.74	1.39	30.23	5.26	8.72
Crosses								
P_1xP_2	2.21	94.75	65.21	2.03	2.66	39.86	10.00	6.68
P_1xP_3	3.34	114.39	72.55	2.23	2.79	42.70	9.83	6.67
P_1xP_4	3.09	109.87	77.43	2.24	2.77	41.97	9.34	7.06
P_1xP_5	2.16	96.99	64.92	2.23	2.98	46.65	8.87	7.22
P_1xP_6	2.41	103.84	71.17	2.34	2.52	39.80	8.51	7.45
P_2xP_3	3.20	98.09	83.20	1.90	2.29	37.34	9.54	6.44
P_2xP_4	2.41	103.97	76.83	1.91	2.22	30.63	9.43	7.68
P_2xP_5	1.73	91.09	62.78	1.90	2.52	35.32	9.11	7.84
P_2xP_6	2.25	97.67	69.46	2.01	2.06	32.83	7.76	8.06
P_3xP_4	3.30	122.04	82.07	2.10	2.25	38.53	8.47	6.89
P_3xP_5	3.19	112.51	80.63	2.10	2.65	35.31	9.00	8.36
P_3xP_6	2.82	117.26	72.27	2.21	2.12	31.45	7.87	8.59
P_4xP_5	2.80	104.80	73.36	2.11	2.50	37.14	8.40	8.03
P_4xP_6	2.70	111.33	78.56	2.22	2.02	33.61	7.28	8.25
P_5xP_6	2.42	99.35	67.14	2.21	1.88	32.96	6.80	8.42
G. Means	*1.91*	*75.14*	*52.27*	*1.51*	*1.73*	*26.48*	*6.20*	*5.41*
$LSD_{0.05}$	0.38	4.45	4.12	0.36	0.30	5.64	0.38	0.67

 # = Number refer to parent codes, Table 3.

GCA effects:

Estimates of GCA effects for each parent are presented in Table 3. The data indicated that P_1 (Giza 8) and P_5 (Cizar) showed significant and positive GCA effects for seed yield and no. of capsules/plant also P_1, P_2 (Sakha 2) and P_3 (S.413/1/2/3) for 1000-seed weight as well as P_5 and P_6 (bombay) for no. of seeds/capsule. In general, P_1 proved to be good combiner for seed yield and its two important components (no. of capsules/plant and 1000-seed weight). Also, P_5 exhibited high general combiner for all seed yield characters except 1000-seed weight. Therefore, using such parents in varietal improvement programs my result in isolating desirable segregates for these traits owing to the breeders desire. The correlation coefficient between GCA values (Table 3) and parental means for seed yield and its characters (Table 5) were significantly positive. These results indicated that the superiority of a parent in cross combinations could be directly predicted its per se performance.

SCA effects:

Specific combining ability effects calculated for each cross are presented in Table (4). The data showed that positive significant SCA values have been registered in ten crosses for seed yield/plant, four crosses for no. of capsules per plant and seven crosses for 1000-seed weight. In general, one cross (P_1xP_5) showed significant positive SCA values for both seed yield and no. of capsules/plant as well as this cross involved high x high general combiner for these two traits in addition one cross (P_1xP_2) had high x high general combiner parents for 1000-seed weight. Therefore, these crosses (P_1xP_5 for seed yield and no. of capsules as will as P_1xP_2 for 1000-seed weight) are likely to throw good segregates for these traits if the allelic genetic systems are present in good combination and epistatic effects present in the crosses act in the same direction to maximize the desirable characteristics. Therefore, these crosses (P_1xP_5 and P_1xP_2) may prove useful for simultaneous improvement of the above-mentioned traits. As well as, the cross (P_1xP_5) gave high mean performance for both seed yield/plant and no. of capsules/plant (Table 5). The correlation between cross means (Table 5) and their SCA values (Table 4) was significant and positive for seed yield and no. of seeds/capsule indicating that high performing crosses were high specific combinations. Therefore, the choice of promising cross combinations would be based on SCA effects or mean performance of a cross.

Correlation studies

Phenotypic correlation coefficients among eight traits in flax are shown in Table 6. straw yield /plant was significantly positively correlation with both of plant height and technical stem length. Also, plant height exhibited high positive correlated with technical stem length. On the other hand seed yield/plant exhibited highly significant and positive correlation with each of no. of capsules and 1000-seed weight. The no. of basal branches showed highly r values with each of seed yield and no. of capsules/plant. Therefore, the possibility of using the two traits (plant height and technical stem length) as selection indices for improving straw yield/plant as well as, using 1000-seed weight, capsules number per plant and no. of basal branches as selection indices for improving seed yield/plant. While, no. of seeds/capsule exhibited highly significant and negative correlation with each of seed yield/plant, no. of capsules/plant and 1000-seed weight. These results are in harmony with that reported by Momtaz *et al*.(1977), Mourad *et al*.(1987) and Abo-Kaied and El-Refaie,Amany (2008).

Table 6.Simple 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
1-Straw yield/plant (g)							
2-Plant height (cm)	0.89**						
3-Technical stem length (cm)	0.83**	0.80**					
4-No. of seeds/capsule	0.40	0.37	-0.03				
5-Seed yield/plant (g)	0.12	-0.02	-0.25	0.58**			
6-No. of capsules/plant	-0.01	-0.15	-0.42	0.61**	0.85**		
7-1000 seed-weight (g)	0.22	0.07	0.16	0.03	0.61**	0.26	
8-No. of seeds /capsule	-0.04	0.16	0.12	-0.14	-0.56**	-0.64**	-0.66**

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

REFERENCES

Abdel-Moneam, M.A. (2014). Diallel cross analeysis for yield and its related traits in some genotypes of flax (*Linum usitatissimum* L.). Int. J. Plamt Breed. Gent.,10: 1:11.

Abo-Kaied H.M.H.; Afaf E. A. Zahana and M.M.M. Hussein (2007). Diallel cross analysis for some flax genotypes under normal and saline environments. . J. Agric. Sci. Mansoura Univ., 32(12) : 9857- 9874.

Abo-Kaied H.M.H. and Amany, M.M. El-Refaie (2008). Genetic studies on yield and its attributes in some flax hybrids under different environmental conditions. J. Agri. Sci. Mansoura Univ., 33(7) : 4697-4715.

Al-Jibouri, H.A.: P.A.Miller and H.F.Robinson. (1958). Genotypic and environmental variances and covariances in an upland cotton cross of interspecific origin. Agron.J.50: 633-636.

Allard,R.W. (1960).Principles of Plant Breeding. Jon Wiley and Sons Inc., New York.

Bhatade , S.S. and N.L.Bhale (1983). Combining ability for seed and fiber characters and its interaction with locations in *Gossypium arboreum* Linn.Indian J.Agric . Sci. 53: 418-22 .

EL-KADY, Eman A.A. and H.M.H. Abo-Kaied (2010). Diallel cross analysis for straw, seed yields and their components in flax. J. Plant Production, Mansoura University Vol. 1 (9): 1219 - 1231.

Foster, R.; H.S.Pooni and I. J. Mackay. (1998). Quantitative analysis of *Linum usitatissimum* crosses for dual-purpose trait. J. of Agric. Sci.131 : 285-292.

Gaafar,S.M.; Aleia. A.El-Seodi; G.El Shimy: A.M. Omar and Naglaa Ashry (1992). Combining ability studies on some flax hybrids (*Linum usitatissimum*). Egypt. J. Agric. Res. 70(4): 1-12.

Griffing , B. (1956). Concept of general and specific combining ability in relation to diallel crossing systems. Aust . J . biol . Sci. 9: 436-93.

Mishra, V.K. and M.Rai (1996). Combining ability analysis for seed yield and quality components of seed and oil in linseed (*Linum usitatissimum* L.). Indian J. Genet. 56: 155-161.

Momtaz, A.; A.K.A.Selim and G.H.El-Shimy (1977). Association studies between flax seed yield and some other characters. Agric. Res. Rev., 55:45-55.

Mourad, N.K.M. ; A.M.Hella.and A.I.Sabash (1987). variability, correlation and path coefficient analysis of yield and its components in flax *(Linum.usitatissimum, L.)* . J.Agric.Res. Tanta, Univ., 13(1) : 38-50.

Patil, V.D. and P.R.Chopde (1981). Combining ability analysis over environments in diallel crosses of linseed (*Linum usitatissimum* L.).Theor. Appl. Genet. 60: 339-343.

Rao, S.K. and S.P. Singh. (1987). Additive, dominance and epistatic effects in linseed (*Linum usitatissimum* L.). Indian J. Agric. Sci. 57(3): 208-211.

Shehata, A. H. and V.E. Comstock (1971). Heterosis and combining ability estimates in F2 flax populations as influenced by plant density. Crop Sci. 11: 534-536.

Zahana, Afaf E. A. (2006). Diallel crosses analysis for some quantitative characters in flax. J. Agri. Sci. Mansoura Univ., 31(6) : 3285-3294.

تحليل الهجن الدائرية للمحصول ومكوناته في ستة تراكيب وراثية من الكتان

مايسة سعيد عبدالصادق

معهد بحوث المحاصيل الحقلية - مركز البحوث الزراعية- الجيزة

أجريت هذه الدراسة بهدف تقدير القدرة علي الائتلاف والفعل الجيني لمحصولي القش والبذور ومكوناتهما في الكتان من خلال تقييم ١٥ هجين في الجيل الثاني ناتجة من التهجين بين ستة تراكيب وراثية (١(جيزة٨) ، ٢ (سخا٢) ، ٣ (س ٣/٢/١/٤١٣)، ٤(س ١٢/٤٢٠)، ٥(سيزار)، ٦ (بمباي)) باستعمال نظام الهجن نصف الدائرية واجري تقييم الـ٦ آباء ، ١٥ هجين في الجيل الثاني خلال موسم ٢٠١٤ /٢٠١٥ في محطة البحوث الزراعية بالجيزة في تجربة قطاعات كاملة العشوائية ذات الثلاث مكررات.

وتشير النتائج إلى أن تأثير العوامل الوراثية المضيفة أكبر من الغير مضيفة في توريث صفات محصول القش للنبات والطول الكلي والطول الفعال وعدد الكبسولات للنبات ،ووزن الألف بذرة ، وعدد البذور بالكبسولة، لذلك يمكن ممارسة الانتخاب بكفاءة لتلك الصفات بدايةً من الجيل الثاني والأجيال التالية له. بينما كان تأثير العوامل الوراثية المضيفة والغير مضيفة تقريبا متساوي في توريث صفة عدد الأفرع القاعدية للنبات.

كما تشير النتائج إلى أن كل من س ٣/٢/١/٤١٣، س ١٢/٤٢٠ أظهرتا قدرة عامة عالية علي الائتلاف لمحصول القش للنبات والطول الكلى والطول الفعال وكذلك الأب جيزة ٨ له قدرة عالية علي الائتلاف لصفة محصول البذرة للنبات واهم مكونين من مكوناته (ووزن الألف بذرة وعدد الكبسولات للنبات)، أيضا المستورد سيزار اظهر قدرة عالية علي الائتلاف لصفات محصول البذرة للنبات ماعدا وزن الألف بذرة ، لذلك يمكن استخدام هذه الآباء لتحسين تلك الصفات في برامج تربية الكتان، كما أن الارتباط الموجب الذي ظهر بين القدرة العامة علي الائتلاف وسلوك الآباء لكل الصفات تحت الدراسة يشير إلى إمكانية اختيار الآباء في برنامج التربية لهذه الصفات معتمداً علي متوسطاتها العالية ، كما تشير النتائج إلى أن هجين واحد فقط (س ٣/٢/١/٤١٣ × سيزار) أظهر تفوق في القدرة الخاصة علي الائتلاف لصفات محصول القش والطول الكلي والطول الفعال وأن هذا الهجين آبائه (عالي × منخفض) في القدرة العامة علي الائتلاف لصفة محصول القش للنبات ، كما تشير النتائج الخاصة بمحصول البذرة ومكوناته إلى أن هجين واحد فقط (جيزة ٨× سيزار) أظهر تفوق في القدرة الخاصة علي الائتلاف لصفتي محصول البذور للنبات وعدد الكبسولات للنبات وأن هذا الهجين آبائه كانت (عالي × عالي) في القدرة العامة علي الائتلاف لتلك الصفتين، كذلك الهجين (جيزة ٨× سخا ٢) كانت آبائه (عالي × عالي) في القدرة العامة علي الائتلاف لصفة وزن الألف بذرة.

كما تشير نتائج الارتباط الظاهري بين الصفات المدروسة وجود ارتباط موجب ومعنوي بين محصول القش وكل من الطول الكلى والطول الفعال، كذلك كان هناك ارتباط موجب ومعنوي بين كل من الطول الكلى والطول الفعال. بينما أظهر محصول البذور للنبات ارتباطا موجبا ومعنوياٍ مع كل من عدد الكبسولات للنبات ووزن الألف بذرة وعدد الأفرع القاعدية. ونتائج الارتباط هذه تشير إلى امكانية الانتخاب لصفتي الطول الكلي والطول الفعال لتحسين صفة القش للنبات وكذلك الانتخاب لصفتي وزن الألف بذرة وعدد الكبسولات للنبات لتحسين وزن البذور للنبات.

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

Character	S.O.V.								
	Reps. 2#	Entries 20#	crosses (C) 14#	parents (P) 5#	P.vs.C 1#	GCA 5#	SCA 14#	Error 40#	GCA/SCA
Straw yield/plant (g)	0.34**	1.11**	0.73**	1.89**	2.47**	1.18**	0.10**	0.01	12.10
Plant height (cm)	18.62*	362.17**	245.62**	693.99**	334.88**	439.42**	14.49**	1.62	30.32
Technical stem length (cm)	7.64	246.09**	124.03**	635.68**	6.96	276.53**	17.20**	1.38	16.08
No.of basal branches	0.17*	0.24**	0.06*	0.09**	3.46**	0.08**	0.08**	0.01	1.01
seed yield/plant (g)	0.13**	0.53**	0.34**	0.50**	3.42**	0.42**	0.10**	0.01	4.31
No.of capsules/plant	18.27	118.37**	61.58**	198.77**	511.48**	98.20**	19.88**	2.59	4.94
1000seed-weight (g)	0.16*	4.20**	3.08**	7.28**	4.49**	4.99**	0.21**	0.01	24.30
No.of seeds /capsule	0.22	1.74**	1.56**	2.34**	1.30**	1.71**	0.20**	0.04	8.33

#= The degrees of freedom

Table 3. Estimation of general combining ability effects ($\hat{g}_i$) for straw and seed yields and their components in 6 flax genotypes.

	Straw yield and its components				Seed yield and its components			
Parents	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
P1=Giza 8	-0.110**	-2.071**	-3.819**	0.113**	0.346**	6.194**	0.671**	-0.748**
P2=Sakha 2	-0.399**	-9.118**	-3.581**	-0.175**	-0.086**	-2.734**	0.591**	-0.236**

P3=S.413/1/2/3	0.621**	10.762**	8.967**	-0.003ns	-0.016 ns	-2.108**	0.500**	0.055ns
P4= S.420/12	0.292**	6.001**	5.559**	0.006ns	-0.082**	-1.596**	-0.001ns	0.010ns
P5=Cizar	-0.291**	-5.938**	-5.652**	-0.017ns	0.158**	2.186**	-0.374**	0.347**
P6=Bombay	-0.113**	0.364ns	-1.475**	0.076*	-0.320**	-1.941**	-1.388**	0.573**
$LSD_{(gi-gi)}$								
0.0 5	0.112	1.285	1.188	0.107	0.087	1.627	0.109	0.194
0.01	0.149	1.719	1.589	0.143	0.116	2.176	0.146	0.260
r	0.988**	0.994**	0.994**	0.995**	0.976**	0.940**	0.992**	0.929**

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