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Combining ability for yield and yield components in some kenaf (*hibiscus cannabinus* l.) Genotypes

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Abstract

This study was conducted with the objective of estimating combining ability and gene action for yield and yield components in kenaf. In 2013 season, the six parents {P_1(Giza 3), P_2(New Indian), P_3(S.108/9), P_4(S.29/45), P_5 (S. 40) and P_6 (S.11)} were crossed in a diallel mating design excluding reciprocals to obtain 15 F_1 crosses at Giza Agric Res. Sta. of. Res. Center. In 2014 season, the six parents and their 15 F_1's progenies were evaluated in a randomized complete block design with three replications at Ismailia Agric. Res. Station Farm, Ismailia Governorate, Egypt. The ratio of general to specific combining ability variances for green stalk weight per plant and related characters, revealed that the inheritance of these traits was mainly controlled by additive gene effects. Therefore, selection could be possible within these F_2 and subsequent populations for these characters. While, stem diameter showed that the non-additive effects were more important than additive effects. P_3 exhibited significant positive GCA effects for green weight and most of its components; P_4 for two important components of fiber weight (technical stem length, and fiber length), indicating that the use of these parents (P_3, P_4) in kenaf breeding programs could increase green weight and consequent increasing fiber yield. Concerning, seed weight/plant, results indicated that P_2 (New Indian) showed significant positive $\hat{g}_i$ values. Therefore, this parent appeared as best combiner for seed weight. Out of eight crosses exhibiting significant and positive SCA effects for fiber weight/plant, five crosses ($P_1 \times P_2$, $P_1 \times P_6$, $P_2 \times P_3$, $P_4 \times P_5$ and $P_4 \times P_6$) involved two parents of high x low GCA effects with exception of cross ($P_1 \times P_3$) that involving high x high GCA effects. Also, the cross ($P_1 \times P_3$) involved high x high general combiner parents for green stalk weight/plant. Only one cross ($P_2 \times P_4$) involved high x high GCA effects for all seed characters (seed weight/plant, no. of capsules/plant, no. of seeds/capsule and fruiting zone length). Therefore, this cross ($P_1 \times P_3$) is suitable in breeding program for increasing the previous characters. Phenotypic and genotypic correlation coefficients among twelve traits indicate that, green weight, fiber percentage, plant height and technical stem length are the major components contributing to fiber weight per plant in kenaf. Therefore, selection for these traits would improve the fiber yield in kenaf.

Key words: *Kenaf, Diallel analysis, Combining ability, Gene action, Correlation.*

Introduction

Kenaf (*Hibiscus cannabinus* L) is cultivated in Egypt to produce bast fiber, which used alone or mixed with jute fiber to manufacture bags, twine, ropes and other products. Moreover, kenaf seeds contain similar oil to that extracted from cotton seeds but free from gossypol (toxic substance) as edible for human consumption. The success of any breeding program depends mainly on the selection of parents which, when crossed, result in higher proportion of transgressive segregates. This necessitates the investigation of combining ability before initiating any varietal improvement program. Griffing (1956) presented a model showing that variance for general combining ability involves mostly additive gene effects. Specific combining ability, on the other hand, depends upon dominance and epistatic components of genetic variation. Knowledge of relative magnitude of additive and non-additive gene effects would be useful in designing efficient breeding program. Such information in kenaf is limited. Diallel analysis of yield and its components in kenaf was studied by Adamson (1980), Mourad *et al*.,(1989), Abo-Kaied (2007) and Amany El-Refaie (2012) who found that the additive type gene action was of relatively greater importance for all characters studied with exception of plant height, technical stem length and fiber length. On the other hand, many investigators studied the differences between kenaf genotypes namely, Xiao *et al*.,1993; Webber,1993, El-Kady and El-sweify,1995. Several correlation studies indicated that basal stem diameter, green plant weight, fiber length and plant height were the major components contributing to fiber weight in kenaf (El-Shimy *et al*.,1990; Subramanyam *et al.*,1995 and Mostafa, 2003). Kenaf in Egypt is cultivated on small scale due to the great competition with the other summer crops in the ancient valley lands. Therefore, the biggest challenge in breeding new varieties is to produce a variety that is adapted to the sandy soil conditions. For this reason, this study aimed to estimate the combining ability of six kenaf parents and to estimate the type of gene action for yield and yield components under sandy soil conditions, in addition to estimate the phenotypic and genotypic correlation coefficients between fiber yield and related characters.

Materials and Methods

The materials used for the present study consisted of 21 kenaf genotypes (6 parents, 15 F_1,s). Characteristics of the material used according to their pedigree, origin and year released are presented in Table 1. The six parents represent a wide genetic variability for yield, yield components and other related characters of kenaf.

Table 1. Pedigree of six kenaf genotypes used, origin and year released.

Genotype	Pedigree	Origin	Year released*
1- Giza 3	Selected from farmer fields	Local cultivar	1961
2- New Indian	Selected from I. New Indian	Indian	1996
3- S.108/9	Giza 3 x S.127/130	Advanced strain	1996
4-S.29/45	40/59 x 17/1064	" " " " " " "	1972
5- S. 40	4/59-28 x 18/64	" " " " " " "	1976
6-S.11	36/3064 x 8161-1	" " " " " " "	1968

* Year released, selected as promising line.

In 2013 season, the six parents were crossed in a diallel mating design excluding reciprocals to obtain 15 F_1 crosses. In 2014 season, the parents and their crosses were evaluated at Ismailia Agric. Res. Station Farm, Ismailia Governorate, Egypt. The soil type was sandy soil with coarse sand 64.15%, fine sand 28.43%, silt 4.75%, clay 1.45%, organic matter 0.61 %, available nitrogen 6.87 ppm and pH value of 7.19. Seeds of each parent and F_1 were sown in single rows, 3 m long and 50 cm apart. The distance between hill was 25 cm. Planting date was the third week of May 2014. The seedlings were thinned after four weeks from sowing to two plants per hill. The recommended cultural practices for kenaf were applied. At harvest, individual guarded plants were taken at random from each row; 10 plants from each parent and F_1 per replication. These plants were used for recording:1) green weight (g)/ plant, as weight in grams of kenaf stalk plant after 48 hr from harvesting, 2) plant height (cm), 3) technical stem length in cm, 4) stem diameter in mm, 5) fiber weight (g)/plant, as the weight in grams of the air-dried fibers extracted from retted green stalk weight of kenaf plant, 6) fiber percentage = (fiber weight/plant ÷ green weight/plant) x 100, 7) fiber length (cm), 8) seed yield /plant (g), 10) No. of capsules/plant, 11) No. of seeds/capsule and 12) fruiting zone length in cm.

Statistical Analysis

General (GCA) and specific (SCA) combining ability sum of squares were calculated according to Griffing's 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 (rp) and genotypic (rg) correlation coefficients were calculated according to the formula suggested by Al-Jibouri *et al*., (1958).

Results and Discussion

Analysis of variances:

Mean squares due to 21 kenaf entries (6 parents and 15 crosses) were highly significant for green stalk weight per plant and its related characters, viz., plant height, technical stem length, and stem diameter, fruiting zone length as well as fiber weight, fiber percentage, fiber length, seed weight/plant, no. of capsules/plant and no. of seeds/capsule (Table2). This indicates that parents and F_1's crosses showed reasonable degree of variability for these characters. Such variability among different kenaf genotypes in green weight and its components was previously reported by Xiao *et al*., (1993) and Webber (1993). Mean squares of parents *vs.* crosses as an indication of average heterosis over all hybrids was significant, revealing that heterotic effect was pronounced for all characters, except that parents *vs.* crosses for stem diameter, fiber percentage, seed weight/plant and fruiting zone length were non-significant. Also, general (GCA) and specific (SCA) combining ability variances for all traits were significant, indicating the presence of both additive and non-additive type of genetic variance.

The ratio of GCA/SCA variances for green stalk weight per plant and its related characters were higher than unity, revealing that the inheritance of these traits were mainly controlled by additive effects of genes. Therefore, selection should be possible within the F_2's and subsequent populations for the characters. While, stem diameter showed that the non-additive effects were more important than additive effects. These results are in harmony with that reported by Mourad *et al*., (1989) who found that the additive type gene action was relatively of greater importance for fiber yield/plant, technical stem length, stem diameter and fruiting zone length.

GCA effects:

Estimates of GCA effects ($\hat{g}_i$) are presented in Table (3). P_1 (Giza 3) exhibited significant positive GCA effects for green weight/plant, fiber weight and no. of seeds/capsule, also, P_2 (New Indian) for seed weight and no. of capsules/plant.

Table 2. Mean Squares for 21 kenaf genotypes (6 parents and 15 F_1's crosses), general (GCA) and Specific SCA) combining ability for green stalk weight per plant and its components.

Characters	S.O.V.									GCA/SCA
	Reps. 2#	Entries 20#	Error 40#	crosses (C) 14#	parents (P) 5#	P.vs.C 1#	GCA 5#	SCA 15#	Error 40#	
Green stalk weight (g)	**2632.95****	**5599.83****	**486.09**	**2259.38****	**10052.96****	**30100.38****	**2548.35****	**1639.36****	**162.03**	1.55
Plant height (cm)	**336.76 ns**	**7929.28****	**478.35**	**8986.39****	**5821.91****	**3666.53****	**3533.73****	**2346.21****	**159.45**	1.51
Tecnical stem length (cm)	**81.74 ns**	**3699.28 ****	**200.85**	**4390.45****	**1350.32****	**5767.62****	**1887.27****	**1015.03****	**66.95**	1.86
Stem diameter (mm)	**5.21****	**3.34****	**0.96**	**3.42****	**3.352****	**1.20ns**	**0.93***	**1.17****	**0.32**	0.79
Fiber weight (g) plant	**5.06 ns**	**100.67 ****	**4.33**	**68.61 ****	**168.26 ****	**211.62 ****	**69.09****	**21.71****	**1.44**	3.18
Fiber percentage %	**0.22 ns**	**2.81 ****	**0.18**	**1.98 ****	**5.70 ****	**0.03 ns**	**1.85****	**0.63****	**0.06**	2.94
Fiber length (cm)	**95.60 ns**	**3706.24****	**203.49**	**4386.17 ****	**1355.28 ****	**5941.99****	**1866.92****	**1024.91****	**67.83**	1.82
Seed weight/plant (g)	**0.04 ns**	**3.12****	**0.12**	**2.92 ****	**4.22 ****	**0.39 ns**	**1.90****	**0.75****	**0.04**	2.53
No. of capsules/plant	**1.85 ns**	**24.68****	**0.90**	**21.45****	**25.87****	**63.91****	**9.74****	**7.72****	**0.30**	1.26
No. of seeds /capsule	**0.95 ns**	**14.51****	**0.96**	**10.95****	**25.91**	**7.28****	**7.63****	**3.90****	**0.32**	1.96
Fruiting zone length (cm)	**102.65ns**	**1367.17****	**162.78**	**1292.13****	**1803.46****	**236.38ns**	**483.46****	**446.48****	**54.26**	1.08

*, ** Significant at 0.05 and 0.01 levels of probability, respectively.
#= The degrees of freedom.

Table 3. Estimation of general combining ability effects(ĝi) for green stalk yield and its Components for 6 kenaf genotypes.

Characters	Parents						r	LSD(gi-gi)	
	Giza 3 (P1)	New Indian (P2)	S.108/9 (P3)	S.29/45 (P4)	S. 40 (P5)	S.11 (P6)		0.05	0.01
Green stalk weight (g)	**21.281****	**4.428**	**14.261****	**0.926**	**-14.132****	**-26.763****	**0.925****	**12.863**	**17.210**
Plant height (cm)	**-4.943**	**-7.822**	**34.938****	**5.603**	**-29.463****	**1.687**	**0.350**	**12.760**	**17.072**
Tecnical stem length (cm)	**-4.049**	**-10.040****	**26.139****	**9.139****	**-16.557****	**-4.632**	**0.329**	**8.268**	**11.062**
Stem diameter (mm)	**0.053**	**0.453***	**-0.214**	**0.349**	**-0.301**	**-0.339**	**0.822**	**0.568**	**0.760**
Fiber weight(g) /plant	**1.978****	**0.354**	**2.676****	**2.242****	**-3.043****	**-4.207****	**0.937****	**1.214**	**1.624**
Fiber percentage %	**0.073**	**0.005**	**0.419**	**0.607**	**-0.536**	**-0.568**	**0.894****	**0.238**	**0.319**
Fiber length (cm)	**-4.203**	**-10.082****	**26.018****	**9.085****	**-16.382****	**-4.436**	**0.315**	**8.323**	**11.135**
Seed yield/plant (g)	**-0.143***	**0.340****	**-0.004**	**0.757****	**-0.350****	**-0.599****	**0.83***	**0.200**	**0.268**
No. of capsules/plant	**-0.433***	**1.107****	**-0.357***	**1.619****	**-0.807****	**-1.129****	**0.683**	**0.553**	**0.740**
No. of seeds /capsule	**1.340****	**-0.158**	**0.348**	**0.471***	**-0.448***	**-1.552****	**0.94****	**0.573**	**0.766**
Fruiting zone length (cm)	**-0.897**	**2.215**	**8.799****	**-3.535**	**-12.906****	**6.324***	**0.614**	**7.443**	**9.959**

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

Table 4. Estimation of specific combining ability (Ŝij) effects for green stalk weight and its components for 15 kenaf crosses.

Crosses	Green stalk weight and its components														Seed yield and its components							
	Green stalk weight/ plant (g)		Plant height (cm)		Tecnical stem length (cm)		Stem diameter (mm)		Fiber weight per plant (g)		Fiber percentage %		Fiber length (cm)		Seed weight per plant (g)		No. of capsules per plant		No. of seeds per capsule		Fruiting zone length (cm)	
P_1xP_2 $	-7.118	ns	-15.204	ns	-4.195	ns	0.626	ns	3.178	**	0.942	**	-4.037	ns	-0.597	**	-0.313	ns	-0.307	ns	-11.005	ns
P_1xP_3	7.469	ns	3.869	ns	1.426	ns	-0.407	ns	5.192	**	1.045	**	1.496	ns	-0.152	ns	-0.065	ns	-0.914	ns	2.445	ns
P_1xP_4	13.194	ns	16.805	ns	17.959	*	0.397	ns	1.593	ns	0.041	ns	17.996	*	-0.383	*	-3.354	**	-2.103	**	-1.155	ns
P_1xP_5	-2.854	ns	-44.697	**	-24.379	**	2.380	**	-1.512	ns	-0.260	ns	-24.838	**	0.460	*	3.298	**	0.749	ns	-20.318	**
P_1xP_6	24.077	*	-50.740	**	-25.237	**	-1.782	**	3.845	**	0.549	*	-25.450	**	-0.741	**	-0.906	ns	1.520	**	-25.514	**
P_2xP_3	25.296	*	12.259	ns	9.917	ns	0.460	ns	2.266	*	0.002	ns	9.908	ns	0.574	**	3.475	**	0.318	ns	2.332	ns
P_2xP_4	-66.766	**	47.818	**	12.484	ns	-0.003	ns	-8.720	**	-0.908	**	12.275	ns	1.477	**	2.712	**	1.378	**	35.332	**
P_2xP_5	13.336	ns	5.376	ns	7.846	ns	-1.520	**	4.132	**	0.861	**	7.742	ns	-0.806	**	-0.846	ns	1.680	**	-2.464	ns
P_2xP_6	14.274	ns	-20.400	ns	-11.512	ns	0.518	ns	-2.594	*	-0.943	**	-11.638	ns	1.513	**	4.944	**	-4.516	**	-8.893	ns
P_3xP_4	16.154	ns	51.144	**	54.838	**	-0.703	ns	-0.912	ns	-0.652	**	55.042	**	-1.079	**	-0.614	ns	-0.078	ns	-3.685	ns
P_3xP_5	17.539	ns	99.259	**	55.367	**	0.214	ns	-0.940	ns	-0.540	*	55.442	**	0.121	ns	1.662	**	0.207	ns	43.886	**
P_3xP_6	24.561	*	13.213	ns	16.309	*	0.051	ns	-2.213	*	-1.017	**	16.696	*	-0.156	ns	-0.422	ns	1.978	**	-3.076	ns
P_4xP_5	57.724	**	-31.209	**	-18.199	*	0.285	ns	4.990	**	0.086	ns	-17.125	*	-0.566	**	1.939	**	-0.749	ns	-13.014	ns
P_4xP_6	41.575	**	-24.209	*	-13.824	ns	-0.578	ns	4.291	**	0.246	ns	-13.938	ns	-0.777	**	-1.605	**	0.955	ns	-10.376	ns
P_5xP_6	28.904	*	9.090	ns	11.971	ns	1.372	**	4.793	**	0.758	**	12.563	ns	0.370	*	-0.349	ns	3.107	**	-2.872	ns
LSD(Sij-Sii)																						
0.05	34.032		33.759		21.875		1.503		3.211		0.631		22.020		0.529		1.463		1.515		19.693	
0.01	45.533		45.168		29.268		2.011		4.296		0.844		29.461		0.708		1.957		2.027		26.348	
r #	0.698	**	0.907	**	0.920	**	0.926	**	0.691	**	0.724	**	0.921	**	0.807	**	0.870	**	0.808	**	0.894	**

$ = 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.

P_3 (S.108/9) showed highly significant positive $\hat{g}_i$ for green weight/plant, plant height, technical stem length, fiber weight, fiber length and fruiting zone length. P_4 (S. 29/45) exhibited significant positive $\hat{g}_i$ for technical stem length, fiber weight/plant, fiber length, seed weight, no. of capsules/plant and no. of seeds/capsule as well as P_6 (S.11) for fruiting zone length.

In general, P_3 (S.108/9) exhibited significant positive GCA effects for green weight and most of its components as well as P_4 (S.29/45) for two important components to fiber weight (technical stem length, and fiber length), indicating that the use of these parents (P_3, P_4) in kenaf breeding programs could increase green weight and consequently increasing fiber yield. Concerning, seed weight/plant results indicated that the P_2 (New Indian) showed significant positive $\hat{g}_i$ values. Therefore, this parent appeared to be good combiner for seed weight.

Simple correlation coefficient between GCA values and parental means for green stalk weight, fiber weight, fiber percentage, seed weight and no. of seeds/capsule were significantly positive. These results indicate that the parents showing higher mean performance (Table 5) proved to be the highest general combiners for these traits. Therefore, selection of parental population for initiating any proposed breeding program could be practiced either on their respective mean performance or on the basis of $\hat{g}_i$ effects. Such agreement might add another proof to the preponderance of additive genetic variance in these cases.

SCA effects:

Specific combining ability (SCA) effects for 15 F1's crosses of green weight per plant and its components are present in Table (4). Out of the 15 F1 crosses, only six crosses (P1×P6, P2×P3, P3×P6, P4×P5, P4×P6 and P5×P6) showed highly significant positive SCA effects for green stalk weight/plant, three crosses (P2×P4, P3×P4, and P3×P5) for plant height, four crosses (P1×P4, P3×P4, P3×P5 and P3×P6) for technical stem length, two crosses (P1×P5, and P5×P6) for stem diameter, eight crosses (P1×P2, P1×P3, P1×P6, P2×P3, P2×P5, P4×P5, P4×P6 and P5×P6) for fiber weight/plant, five crosses (P1×P2, P1×P3, P1×P6, P2×P5 and P5×P6) for fiber percentage, four crosses (P1×P4, P3×P4, P3×P5 and P3×P6) for fiber length, five crosses (P1×P5, P2×P3, P2×P4, P2×P6 and P5×P6) for seed weight/plant, six crosses (P1×P5, P2×P3, P2×P4, P2×P6, P3×P5 and P4×P5) for no. of capsules/plant, five crosses (P1×P6, P2×P4, P2×P5, P3×P6 and P5×P6) for no. of seeds/capsule and two crosses (P2×P4, and P3×P5) showed high SCA effects for fruiting zone length.

In general, out of the eight crosses exhibiting significant and positive SCA effects for fiber weight/plant, only five (P1×P2, P1×P6, P2×P3, P4×P5, and P4×P6) involved two parents of high x low GCA effects with the exception one cross (P1×P3) that involved high x high GCA effects. Also, the cross (P1×P3) involved high x high general combiner parents for green stalk weight/plant. Only one cross (P2×P4) involved high x high GCA effects for all seed characters studied (seed weight/plant, no. of capsules/plant, no. of seeds/capsule and fruiting zone length).

From the breeding point of view as suggested by Bhatade and Bhale (1983) for crosses exhibiting significant SCA effects which resulted from high × high good GCA combiners, the breeding procedure which may mop up both additive and non- additive genetic variance would be more useful for improvement of character(s). 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. Therefore, the one cross (P1xP3) is 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 as to maximize the desirable characteristics.

The correlation between cross means (Table 5) and their SCA values (Table 4) was significant and positive for all characters studied, indicating that the crosses showing higher mean performance (Table 5) proved to be the highest specific combiners for mentioned characters. Therefore, the choice of promising cross combination would be based on SCA effects or mean performance of the crosses.

Correlation studies:

Phenotypic (rp) and genotypic (rg) correlation coefficients among twelve traits of 21 kenaf genotypes (6 parents and 15 F1's crosses) are shown in Table (6), these results indicated that fiber weight/plant was significantly positive correlated with each of green weight, fiber percentage and no. of seeds/capsule. Plant height was positively correlated with each of technical stem length, fiber length and fruiting zone length. Also, green weight/plant was significantly positive correlated with both fiber weight/plant and no. of seeds/capsule. Seed weight/plant was positive correlated with no. of capsules/plant and stem diameter. These results are in agreement with those obtained by Mourad *et al.*,1987; El-Shimy *et al.*,1990; Subramanam *et al.*,1995 and Mostafa, 2003.

In general, it can be concluded that green weight, fiber percentage, plant height and technical stem length are the major components contributing to fiber weight / plant in kenaf. Therefore, selection for these traits will improve the fiber yield in kenaf.

Table 5. Mean performances of 21kenaf genotypes (6 parents and 15 F1's crosses) for stalk weight, seed weight and their components.

Parents	**Green stalk weight (g)**	**Plant Hight (cm)**	**Technical stem length (cm)**	**Stem diameter (mm)**	**Fiber percentage**	**Seed weight (g)**	**No. of capsules/plant**	**No. of seeds/capsule.**	**Fiber weight/plant (g)**	**Fiber length (cm)**	**fruiting zone length (cm)**
P1=	408.8	315.6	225.5	11.4	7.2	3.5	8.4	21.3	29.5	221.2	90.1
P2=	403.0	249.9	189.0	12.7	8.3	2.6	5.9	18.5	33.3	184.9	60.9
P3=	366.6	260.5	199.7	11.6	9.6	3.4	5.9	18.1	35.3	195.0	60.8
P4=	354.5	261.5	208.0	12.9	10.0	5.2	12.3	19.4	35.5	203.3	53.5
P5=	298.0	202.7	166.9	9.9	6.7	2.5	4.2	14.7	19.9	162.6	35.7
P6=	263.4	320.4	218.2	11.4	7.3	1.7	5.6	13.5	19.2	214.2	102.2
Crosses											
P_1xP_2	402.2	252.5	198.1	13.0	9.2	2.6	9.0	19.0	37.2	193.9	54.5
P_1xP_3	426.6	314.4	239.9	11.3	9.8	2.7	7.8	18.9	41.5	235.5	74.5
P_1xP_4	419.0	298.0	239.4	12.7	8.9	3.3	6.5	17.8	37.5	235.1	58.6
P_1xP_5	387.9	201.4	171.4	14.0	7.5	3.0	10.7	19.8	29.1	166.8	30.0
P_1xP_6	402.2	226.5	182.4	9.8	8.3	1.6	6.2	19.5	33.3	178.1	44.1
P_2xP_3	427.6	319.9	242.4	12.6	8.7	3.9	12.9	18.6	37.0	238.1	77.5
P_2xP_4	322.2	326.1	227.9	12.7	7.9	5.6	14.1	19.8	25.6	223.5	98.2
P_2xP_5	387.3	248.6	197.6	10.5	8.6	2.2	8.1	19.2	33.1	193.5	51.0
P_2xP_6	375.6	254.0	190.2	12.5	6.7	4.3	13.6	11.9	25.2	186.1	63.8
P_3xP_4	415.0	372.2	306.5	11.3	8.6	2.7	9.3	18.9	35.7	302.4	65.7
P_3xP_5	401.3	385.2	281.3	11.6	7.6	2.8	9.1	18.2	30.4	277.3	103.9
P_3xP_6	395.7	330.3	254.2	11.4	7.1	2.3	6.7	18.9	27.9	250.5	76.2
P_4xP_5	428.1	225.4	190.7	12.2	8.4	2.9	11.4	17.4	35.9	187.8	34.7
P_4xP_6	399.4	263.6	207.0	11.3	8.5	2.4	7.5	18.0	34.0	202.9	56.6
P_5xP_6	371.6	261.8	207.1	12.6	7.9	2.5	6.4	19.2	29.2	204.0	54.7
Means	**383.62**	**280.50**	**216.35**	**11.88**	**8.23**	**3.03**	**8.65**	**18.12**	**31.68**	**212.22**	**64.15**
L.S.D. 5%	**44.56**	**44.20**	**28.64**	**1.96**	**0.83**	**0.69**	**1.92**	**1.98**	**4.20**	**28.84**	**25.79**
1%	**59.62**	**59.14**	**38.32**	**2.62**	**1.11**	**0.92**	**2.57**	**2.65**	**5.62**	**38.59**	**34.50**

Table 6. Phenotypic (r_{ph}) and genotypic (r_g) correlation coefficients among twelve characters for 21 Kenaf genotypes (6 parents and 15 F_1's crosses).

	Character		1	2	3	4	5	6	7	8	9	10
1	Green stalk weight (g)											
2	Plant hight	rph	0.115									
		rg	0.491									
3	Technicalo length (cm)	rph	0.288	0.947**								
		rg	0.503	0.742								
4	Stem diameter (mm)	rph	0.154	-0.043	-0.045							
		rg	0.202	0.324	0.272							
5	Fiber percentage	rph	0.370	0.011	0.115	0.160						
		rg	0.463	0.404	0.524	0.302						
6	Seed weight (g)	rph	-0.074	0.129	0.067	0.523*	0.163					
		rg	0.118	0.352	-0.117	0.511	0.362					
7	No. of apsules/plant	rph	0.175	0.136	0.123	0.543*	0.069	0.762**				
		rg	0.208	0.404	0.202	0.503	0.206	0.713				
8	No. of seeds/capsule	rph	0.631**	-0.057	0.102	-0.041	0.379	-0.392	-0.304			
		rg	0.332	0.107	0.113	0.218	0.237	0.102	0.602			
9	Fiber weight/plant (g)	rph	0.807**	0.071	0.228	0.180	0.844**	0.043	0.129	0.588*		
		rg	0.662	0.432	0.546	0.244	0.693	0.236	0.049	0.232		
10	Fiber length (cm)	rph	0.290	0.947**	0.998**	-0.045	0.111	0.063	0.122	0.102	0.237	
		rg	0.498	0.807	0.732	0.211	0.543	0.222	0.302	-0.302	0.515	
11	Fruiting zone length	rph	-0.195	0.850**	0.636**	-0.029	-0.163	0.201	0.126	-0.305	-0.220	0.635**
		rg	0.202	0.662	0.563	0.115	0.133	0.499	0.606	0.552	0.219	0.512

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

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القدرة علي الائتلاف للمحصول ومكوناته في بعض التراكيب الوراثية في التيل

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أجريت هذه الدراسة بهدف تقدير القدرة علي الائتلاف والفعل الجيني للمحصول ومكوناته في التيل من خلال تقييم 15 هجين ناتجة من التهجين بين ستة تراكيب وراثية من التيـل (1= جيزة 3 ، 2= هندي جديد ، 3= س 9/108 ، 4=س 45/29، 5= س40 ، 6= س 11). في موسم 2013 تم إجراء كل الهجن الممكنة بين الستة آباء بدون الهجن العكسية بنظام التهجين الدائري وذلك بمحطة البحوث الزراعية بالجيزة. وفي موسم 2014 تم تقييم الـ6 آباء ،15 هجين في الجيل الأول في محطة البحوث الزراعية بالإسماعيلية في تجربة قطاعات كاملة العشوائية ذات الثلاثة مكررات .

وتشير النتائج إلى أن تأثير العوامل الوراثية المضيفة أكبر من غير المضيفة في توريث صفات وزن الساق الأخضر/نبات ومكوناته، أي أن العوامل المضيفة هي المتحكمة في توريث تلك الصفات . لذلك يمكن ممارسة الانتخاب بكفاءة لتحسين تلك الصفات بدايةً من الجيل الثاني والأجيال التالية ، بينما العوامل الوراثية غير المضيفة كانت أكثر أهمية في توريث صفة قطر الساق. كما تشير النتائج إلى أن س 108/ 9 أظهرت قدرة عالية علي الائتلاف لصفات وزن الساق الأخضر /نبات ومعظم مكوناته بالإضافة إلى س 45/29 أظهرت قدرة عالية علي الائتلاف لأهم مكونين (الطول الكلي ، وطول الألياف) . لذلك يمكن استخدام كل من س 108/ 9، س 45/29 لتحسين وزن الساق الأخضر /نبات ومن ثم زيادة محصول الألياف، كما تشير النتائج إلى أن هندي جديد أظهر قدرة عالية علي الائتلاف لمحصول البذور/ نبات لذلك يمكن استخدامه في تركيب هجن متميزة في محصول البذور.كما تشير النتائج إلى أن من بين الـ 8 هجن التي أظهرت قدرة خاصة علي الائتلاف لصفة وزن الألياف للنبات ، خمس هجن منها فقط (1×2 ، 1×6 ، 2×3 ، 4×5 ، 4×6) وأن هذا الهجين ناتج من آباء احدهما متفوق في القدرة العامة علي الائتلاف (عالي × منخفض) بينما

هجين واحد فقط (1×3) أظهر تفوق في القدرة الخاصة علي الائتلاف لتلك الصفة وأن هذا الهجين ناتج من أبوين متفوقة في القدرة العامة علي الائتلاف (عالي × عالي)، كذلك هذا الهجين (1×3) (عالي × عالي) لصفة ووزن الساق الأخضر /نبات . بالنسبة للصفات الخاصة بمحصول وزن البذور للنبات ومكوناته (عدد الكبسولات للنبات و عدد البذور بالكبسولة وطول المنطقة المثرية) أن هجين واحد (2×4) أظهر قدرة خاصة علي الائتلاف لتلك الصفات سالفة الذكر وأن هذا الهجين ناتج من آباء متفوقة في القدرة العامة علي الائتلاف (عالي × عالي) لذلك هذا الهجين مناسب لتحسين الصفات سالفة الذكر في برنامج تربية التيل.

كما تشير النتائج الخاصة بالارتباط الظاهري والوراثي بين الصفات المدروسة أن ووزن الساق الأخضر /نبات ، والنسبة المئوية للألياف، الطول الكلي ،والطول الفعال إنها مكونات رئيسية في تحسين وزن الألياف للنبات في التيل. لذلك يمكن الانتخاب لتلك الصفات لتحسين محصول الألياف للنبات.