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LINE X TESTER ANALYSIS FOR COMBINING ABILITY IN SOME KENAF GENOTYPES

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ABSTRACT

This study was conducted with the objective of estimating combining ability and gene action for yield and its components in kenaf. This was achieved via evaluating 15 progenies of the line x tester analysis consisting of five females (P_1=H.119, P_2=Coba, P_3=S.96/20, P_4=S.38 and P_5=New Indian) and three males (P_6=Giza3, P_7=S.108/9, and P_8=Tianing). In 2005, the eight parents and their 15 F_1's progenies were evaluated in a randomized complete block design with four replications at Ismailia Agric. Res. Station Farm, Ismailia Governorate, Egypt.

The collected data indicated that the predominant role of additive gene action involved in the expression of all studied characters except for both of stem diameter and seed weight / plant Therefore, selection should be possible in the F_2 and subsequent generations for all studied characters, except for both of stem diameter and seed weight / plant. P_3 and P_7 exhibited significant and positive GCA effects for green weight and most of its components as well as P_2 for three important components (plant height, technical stem length and fiber length), indicating that the use of these parents in kenaf breeding programs could increase green weight and consequently increasing fiber yield. Concerning, seed weight / plant results indicated that the P_5 followed by P_6 showed significant positive $\hat{g}_i$ values. Therefore, it could be concluded that these two parents (P_5 and P_6) in addition to P_3 and P_7 appeared to be best combiners for seed weight. Correlation coefficients between GCA values and parental means for all studied characters indicated that selection of parental crosses in kenaf breeding program could be depended on their higher mean performance for these traits. Two crosses ($P_3\times P_8$, and $P_5\times P_7$) exhibited significant and positive SCA effects for two important components viz., fiber weight, fiber percentage in addition to seed weight per plant. These crosses involved high x low general combiners for these traits exception $P_5\times P_7$ involved high x high for only seed weight per plant.

Phenotypic (r_p) and genotypic (r_g) correlation coefficients concluded that green weight, plant height, technical stem length, fiber percentage and fiber length are the major components contributing to fiber weight / plant in kenaf. Therefore, selection for these traits will improve the fiber yield in kenaf. On the other hand, fruiting zone length as selection indices to improve seed yield in kenaf.

Keywords: Combining ability, Gene action, Line x tester, Kenaf***.***

INTRODUCTION

Kenaf (*Hibiscus cannabinus* L) in Egypt cultivated 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 which extracted from cotton seeds but free from gossiboll (poison material) as edible for human.

One of the most important objectives of kenaf breeding in Egypt is to improve, simultaneously, fiber yield, green stalk yield and high technical stem length. To select high-yielding genotypes in kenaf, an understanding of the combining ability and the type of gene action for yield and its components of the entries of the reference population is of great importance. If additive gene action is predominant, then the breeder can effectively succeed in getting progress by selection at various levels of inbreeding, since additive effects are readily transmissible from one generation to another.

The concept of line x tester analysis was developed by Kempthorne in 1957. at is a modified from of top cross scheme. Singh and Narayanan (1993) concluded that the line x tester mating design provides almost the same genetic information as the diallel analysis. As well as, this technique like diallel and partial diallel, and also help in the identification of good general combiners and specific cross combinations as well as in the choice of breeding procedure for genetic improvement of various polygenic characters. A knowledge of relative magnitude of additive and non-additive gene effects would be very 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) and Mourad *et al*.,(1989), who found that the additive type gene action of relatively greater importance for fiber yield/plant, technical stem length, stem diameter and fruiting zone length. On the other hand, many investigators studied the differences between kenaf genotypes e.g.,Osman and Momtaz,1982; Xiao *et al*.,1993; Webber,1993 and El-Kady and El-sweify,1995. Many 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 (Chaudhury *et al.*,1981; Mourad *et al*.,1987; Padmaja,1989; El-Shimy *et al*.,1990; Subramanyam *et al.,*1995, El-Farouk and El-Sweify,1998 and Mostafa, 2003).

Owing to the small kenaf cultivating area annually in Egypt by reason of the great competition with the other summer crops in the ancient valley land. Therefore, the biggest challenge in breeding new varieties has been to produce a variety that is adapted to the sandy soil conditions. For this reason, this study aimed to estimate the combining ability of eight 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 23 kenaf genotypes (8 parents, 15 F_1,s). Genotype characteristics of the material used according to their pedigree, origin, generation and year released are presented in Table 1. The parents from 1 to 5 were used as female (line) and from 6 to 8 as male (tester) parents in a line x tester mating design**.** These eight parents represent a wide genetic variability for yield, yield component and other related characters of kenaf.

In 2004 season, each of the 3 male parents was crossed to the 5 female parents to obtain 15 F_1 crosses at Giza Res. Station Farm. In 2005 season, the eight parents and their 15 $F_{1'}$s were planted in a randomized complete block design with four replications at Ismailia Agric. Res. Station Farm, Ismailia Governorate, Egypt. The soil type was sandy soil with coarse sand 62.87%, fine sand 26.75%, silt 1.22%, clay 0.50%, organic matter 0.05

%, available nitrogen 6.61 ppm and pH value of 7.24. Seeds of each parent and F_1 were sown in single rows. The rows were 3 m long and 50 cm apart. The distance between hill was 25 cm and planting date was the second week of May.2005. The seedling were thinned after four weeks from sowing to leave two plants per hill. The recommended cultural practices for kenaf were applied. Five random guarded plants were chosen from each row, by means that five plants for each parent and for each F_1 from each replication were used for measuring data. The following traits were recorded:
(1) green weight (g) / plant, as weight in grams of kenaf stalk plant during and at most 48 hours from harvesting, (2) plant height (cm), (3) technical stem length in cm, (4) fiber length (cm), (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) fruiting zone length in cm, (8) stem diameter in mm and (9) seed yield per plant (g).

Table 1. Identification of eight kenaf genotypes used, pedigree, origin, generation and year released.

Genotypes	Pedigree	Origin	Generation	Year released*
1-H. 119	Selected from H.119 (G.4 x 16/63-2)	Advanced strain	F_9	2000
2-Coba	Selected from I. 4/29-26	Coba	introduction	1959
3-S.96/20	Giza 3 x 17/64-2	Advanced strain	F_7	2002
4- S.38	Giza 3 x 4/59-27	Advanced strain	F_9	1976
5-New Indian	Selected from I. New Indian	I. India	introduction	1996
6- Giza 3	Selected from farmer fields	Local cultivar	landraces	1961
7- S.108/9	Giza 3 x S.27/127	Advanced strain	F_9	1996
8-I. Tianning	Introduction from Nigeria	I. Nigeria	introduction	1995

*** Year released, selected or introduced.**

STATISTICAL ANALYSIS

Analysis of variance of the data was performed on plot means bases. Line x tester design is employed for studying genetic variation in a fifteen-family population for F_1 generations .The variation among families within generation is further divided into genetic variation components attributable to general (GCA) and specific combining ability (SCA) following the method suggested by Singh and Chaudhary (1985). Variances due to general (GCA) and specific (SCA) combining ability and due to combining ability variances and effects were estimated according to line x tester analysis as per Kempthorne (1957).

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

1- Analysis of variances:

Analysis of variance showed that mean squares due to entries (parents and F_1,s) are highly significant for green weight / plant and its related characters (Table2). This indicates that those parental genotypes and their crosses showed a reasonable degree of variability for these traits. Also, mean squares due to parents and crosses were highly significant for all traits. Such variability among different kenaf genotypes in green stalk weight and its components was also reported by Osman and Momtaz,1982; Xiao *et al*.,1993; Webber,1993 and El-Kady and El-Sweify,1995. Mean squares of parents *vs.* crosses as an indication to average heterosis over all hybrids was significant, revealing that heterotic effect was pronounced for these characters, while parents *vs.* crosses for fruiting zone length was non-significant. Mean squares due to males and females were significant for all characters under study except for stem diameter for female. These results indicated that most of the variability expressed in crosses for every trait was due to the effect of both male and female parents. Mean squares due to males x females interaction also were significant for all studied characters except for technical stem length.

The partitioning of genetic variance into general (GCA) and specific (SCA) combining ability variances is shown in Table (3). GCA variances were significant for all studied characters except for stem diameter. On the other hand, SCA variances were not significant for all studied characters except for both of stem diameter and seed weight / plant. Also, GCA variances were larger than the corresponding SCA variances as well as the values of additive and dominance as well as, the ratio of GCA/SCA variances for all studied characters were exhibited in the same direction, except for both of stem diameter and seed weight / plant. These results indicating the predominant role of additive gene action involved in the expression of these characters. Therefore, selection should be possible in the F_2 and subsequent generations for all studied characters, except for both of stem diameter and seed weight / plant. Mourad *et al*.,(1989) found that the additive type gene action of relatively greater importance for fiber yield/plant, technical stem length, stem diameter and fruiting zone length. On the other hand, the major part of genetic variance for seed yield/plant was due to non-additive effects.

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Table 3. The partitioning of the genetic variance into general and specific combining ability variances for green weight and its related characters for eight kenaf parents and their 15 F1 crosses.

Characters	S.O.V.					
	GCA	SCA	Additive	Dominance	Error	GCA/SCA ratio
Green weight / plant (g)	619.95**	3.34	1239.90	3.34	11.30	185.45
Plant height/plant (cm)	25.39**	1.84	50.78	1.84	3.70	13.84
Technical stem length (cm)	15.69**	0.33	31.38	0.33	2.98	48.13
Fiber length (cm)	15.52**	1.05	31.04	1.05	3.12	14.80
Fiber weight / plant (g)	12.56**	1.02	25.11	1.02	0.81	12.28
Fiber percentage (%)	0.19**	0.11	0.37	0.11	0.07	1.70
Fruiting zone length (cm)	5.20*	2.24	10.40	2.24	2.46	2.32
Stem diameter (mm)	0.17	0.39**	0.34	0.39	0.13	0.44
Seed weight / plant (g)	0.18**	0.40**	0.36	0.40	0.07	0.45

*,** Indicate significant and highly significant, respectively.

2- GCA effects:

The estimates of general combining ability effects of female and male parents are shown in Table (4). P_3 (S.96/20) and P_7 (S.108/9)showed highly significant and positive general combining ability effects for all studied characters except for fruiting zone length due to only P_3. The parents, P_2 (Coba)and P_5 (New Indian) exhibited significant and positive GCA effect for technical stem length and fiber length and P_6 (Giza 3) revealed significant and positive GCA effects for stem diameter and seed weight/plant. Also, P_1 (H.119)and P_4 (S.38) exhibited significant and positive GCA effect for fruiting zone length and P_2 for stem diameter as well as P_5 for seed weight/plant.

Table 4. Estimates of general combining ability effects ($\hat{g}_i$) for studied green weight / plant and its related traits in 8 kenaf parents (5 females and 3 males).

Parents	Characters								
	Green weight / plant (g)	Plant height/ plant (cm)	Technical stem length (cm)	Fiber length (cm)	Fiber weight / plant (g)	Fiber percentage (%)	Fruiting zone length (cm)	Stem diameter (mm)	Seed weight / plant (g)
Females									
1-H. 119	-12.757	-6.757	-9.548	-9.442	-2.453	-0.425	2.792 **	-0.768	-0.995
2-Coba	-3.207	1.685*	2.927 **	2.442 **	-1.962	-0.433	-1.242	0.798**	-0.028
3-S.96/20	15.818 **	8.843 **	9.793 **	10.033 **	5.330 **	1.125 **	-0.942	0.232*	0.963 **
4- S.38	-4.873	-4.623	-5.798	-5.583	-1.112	-0.183	1.167 *	-0.085	-0.412
5-New Indian	5.018**	0.852	2.627 **	2.550 **	0.197	-0.083	-1.775	-0.177	0.472 **
S.E. $_{(gi-gi)}$	1.372	0.785	0.705	0.722	0.367	0.111	0.640	0.145	0.105
Males									
6-Giza3	-30.758 **	5.090 **	-1.452 **	-1.115 **	-3.243 **	-0.132 **	-3.643 **	0.098**	0.437 **
7-108/9	72.337 **	12.800 **	6.328 **	6.265 **	9.612 **	0.958 **	6.477 **	0.928**	0.572 **
8-Tinning	-41.578 **	-7.710 **	-4.877 **	-5.150 **	-6.368 **	-0.827 **	-2.833 **	-1.027**	-1.008 **
S.E. $_{(gi-gi)}$	1.063	0.608	0.546	0.559	0.284	0.086	0.496	0.112	0.082
r	0.859**	0.828**	0.890**	0.891**	0.862**	0.883**	0.828**	0.720*	0.756*

***,** Indicate significant and high significant, respectively**
r = Simple correlation coefficient between GCA values and parental means .

In general, P_3 (S.96/20) and P_7 (S.108/9) exhibited significant and positive GCA effects for green weight and most of its components as well as P_2 (Coba) for three important components (plant height, technical stem length and fiber length), indicating that the use of these parents in kenaf breeding programs could increase green weight and consequent increasing fiber yield. Concerning, seed weight / plant results indicated that the P_5 (New Indian) followed by P_6 (Giza 3) showed significant positive $\hat{g}_i$ values. Therefore, it could be concluded that these two parents (P_5 and P_6) in addition to P_3 and P_7 appeared to be best combiners for seed weight.

The simple correlation between GCA values and parental means for all studied characters were significantly positive (Table 4). These results indicated that, the parents showing higher mean performance (Table 6) 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.

3- SCA effects:

Table (5) shows specific combining ability effects for green weight / plant and its related characters. Out of the 15 F_1 crosses, only two crosses: $P_3\times P_8$, and $P_5\times P_7$ showed highly significant positive SCA effects for each of fiber weight, fiber percentage and seed weight per plant as well as P_2xP_6 for seed weight per plant only. P_4xP_7 also, showed high SCA effects in the desirable direction for each of plant height, fruiting zone length and stem diameter. Also, $P_5\times P_6$ for fruiting zone length, $P_1\times P_7$ and $P_3\times P_6$ for stem diameter and $P_1\times P_8$ and $P_2\times P_6$ for seed weight per plant indicated high SCA effects.

Table 5. Selected crosses on the basis of specific combining ability effects ($\hat{s}_{ij}$) for green weight / plant and its related traits.

Crosses	Plant height/plant (cm)	Fiber length (cm)	Fiber weight / plant (g)	Fiber percentage (%)	Fruiting zone length (cm)	Stem diameter (mm)	Seed weight / plant (g)
1x7 #	-1.408	-0.648	0.688	0.225	-0.727	0.363 *	-0.230
1x8	0.127	-0.433	-0.782	-0.290	-0.067	-0.432	0.300 *
2x6	0.440	-0.977	0.752	0.148	0.627	-0.273	0.763 **
3x6	-0.868	-0.168	0.110	0.090	-1.048	1.068 **	-0.403
3x8	0.227	-0.408	0.835*	0.410 **	0.842	-0.032	0.892 **
4x6	-1.352	1.848 *	0.102	-0.002	-1.832	-0.540	0.022
4x7	2.983 **	-0.857	-0.403	-0.017	2.998 **	0.455 *	0.187
5x6	0.498	-1.785	-1.057	-0.302	1.460 *	-0.323	-0.312
5x7	-1.292	1.110	1.788 **	0.508 **	-1.710	0.047	0.828 **
S.E. ($s_{ij}-s_{ik}$)	1.360	1.250	0.635	0.193	1.108	0.251	0.182

***,** Indicate significant and highly significant, respectively.**

 # Number refer to parent codes, Table 3.

Table 6. Mean performances of 23 kenaf genotypes (8 parents and 15 F_1's crosses)for green weight/plant and its related traits.

genotypes	Green weight / plant (g)	Plant height/plant (cm)	Technical stem length (cm)	Fiber length (cm)	Fiber weight / plant (g)	Fiber percentage (%)	Fruiting zone length (cm)	Stem diameter (mm)	Seed weight / plant (g)
					parents				
1-H.113	308.90 g	194.28 h	152.38 h	148.58 g	19.13 g	6.20 e	41.90 b	9.60 f	1.93 f
2-Coba	319.33 f	216.28 e	178.13 d	173.38 d	21.23 ef	6.63 d	38.13 de	11.28 d	3.25 d
3-S.20/96	362.20 b	225.83 b	187.98 b	182.80 b	32.20 b	8.88 b	37.88 e	12.60 b	4.60 a
4-I.38	315.28 f	205.18 g	163.78 f	158.98 f	20.80 f	6.60 d	41.40 b	9.80 f	2.23 e
5-New Indian	335.20 d	217.33 d	178.13 d	172.40 d	24.48 d	7.30 c	39.20 de	10.73 e	4.03 b
6-Giza3	345.88 c	223.08 c	183.23 c	177.88 c	27.98 c	8.08 b	39.83 cd	12.00 c	3.40 cd
7-108/9	547.38 a	260.18 a	195.23 a	191.40 a	51.23 a	9.35 a	64.93 a	13.13 a	4.68 a
8-Thianing	324.30 e	212.03 f	171.78 e	165.83 e	22.18 e	6.83 d	40.28 bc	10.50 e	3.60 c
					Crosses				
1x6	321.10 h	210.48 i	167.50 h	162.78 i	24.18 h	7.53 e	42.98 d	11.20 gi	4.00 g
1x7	428.98 d	225.68 c	174.10 f	168.43gh	37.63 c	8.78 c	51.58 a	12.33 cd	3.98 g
1x8	311.98 i	206.70 j	163.78 j	157.23 k	20.18 k	6.48 g	42.93 d	9.58 j	2.93 i
2x6	333.20 g	218.08 ef	179.30 d	172.60 e	25.33 g	7.60 e	38.78 f	12.43 c	5.80 b
2x7	437.10 c	234.60 b	187.10 b	180.78 c	36.30 d	8.33 d	47.50 bc	13.70 a	4.88 f
2x8	320.40 h	215.50 gh	176.40 e	170.70 ef	21.83 j	6.83 f	39.10 f	11.68 ef	3.13 i
3x6	351.48 e	223.93 cd	186.53 b	181.00bc	31.98 e	9.10 b	37.40 f	13.20 b	5.63 bc
3x7	456.88 a	243.33 a	194.58 a	189.13 a	43.78 a	9.60 a	48.78 b	11.93 de	5.68 bc
3x8	339.43 f	222.40 de	182.30 c	176.73 d	29.58 f	8.73 c	40.10 e	10.98 hi	5.48 cd
4x6	332.80 g	209.98 i	171.23 g	167.40 h	25.53 g	7.70 e	38.73 f	11.28 fh	4.68 f
4x7	431.40 d	232.20 b	178.53 d	172.08 ef	37.88 c	8.78 c	53.68 a	13.10 b	4.98 ef
4x8	321.50 h	207.08 j	166.88 i	160.53 j	22.60 ij	7.03 f	40.20 e	10.78 i	3.00 i
5x6	341.50 f	217.30 fg	178.23de	171.90 ef	25.68 g	7.50 e	39.08 f	11.40 fg	5.23 de
5x7	441.20 b	233.40 b	187.38 b	182.18 b	41.38 b	9.40 ab	46.03 c	12.60 c	6.50 a
5x8	332.68 g	214.98 h	176.30 e	170.33 fg	22.88 i	6.90 f	38.68 f	10.88 i	3.58 h
Means	363.48	220.42	177.42	171.96	28.95	7.83	43.00	11.59	4.22

The values identified by the same letter are not significantly different at 5 % level of probability .
 # = Parents from 1 to 5 were used as female and from 6 to 8 as male parents.

In general, two crosses ($P_3\times P_8$, and $P_5\times P_7$) exhibited significant and positive SCA effects for two important components viz., fiber weight, fiber percentage in addition to seed weight per plant. These crosses involved high x low general combiners for these traits exception $P_5\times P_7$ involved high x high for seed weight per plant only. Therefore, the crosses $P_3\times P_8$, and $P_5\times P_7$ 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 as to maximize the desirable characteristics.

4- Correlation studies:

Phenotypic (r_p) and genotypic (r_g) correlation coefficients among 9 characters of 23 kenaf genotypes (8 parents and 15 F_1's crosses) are shown in Table (7). these results indicated that fiber weight / plant was significantly positive correlated with each of green weight, plant height, technical stem length, fiber percentage, fiber length, fruiting zone length and stem diameter. Concerning, seed weight / plant was significantly positive correlated with fruiting zone length. These results are in agreement with those obtained by Mourad *et al*.,1987; Padmaja,1989; El-Shimy *et al*.,1990; Subramanyam *et al*.,1995, El-Farouk and El-Sweify,1998 and Mostafa, 2003.

Table 7. Phenotypic (r_{ph}) and genotypic (r_g) correlation coefficients among nine characters for 23 Kenaf genotypes (8 parents and 15 F_1's crosses).

Characters		1	2	3	4	5	6	7	8
1-Green weight / plant (g)									
2-Plant height/plant (cm)	rph	0.912 **							
	rg	0.753							
3-Technical stem length (cm)	rph	0.864 **	0.992 **						
	rg	0.725	0.921						
4-Fiber length (cm)	rph	0.868 **	0.992 **	0.998 **					
	rg	0.543	0.847	0.901					
5-Fiber weight / plant (g)	rph	0.919 **	0.718 *	0.665 *	0.672 *				
	rg	0.631	0.772	0.798	0.784				
6-Fiber percentage (%)	rph	0.732 *	0.557	0.535	0.542	0.912 **			
	rg	0.571	0.442	0.664	0.632	0.817			
7-Fruiting zone length (cm)	rph	0.952 **	0.860 **	0.787 *	0.790 **	0.829 **	0.577		
	rg	0.624	0.347	0.260	0.327	0.302	0.147		
8-Stem diameter (mm)	rph	0.790 **	0.709 *	0.700 *	0.703 *	0.821 **	0.806 **	0.646 *	
	rg	0.541	0.517	0.346	0.101	0.427	0.119	0.441	
9-Seed weight / plant (g)	rph	-0.239	-0.463	-0.455	-0.452	0.115	0.364	0.679*	0.109
	rg	0.333	0.207	0.112	-0.057	0.321	0.258	0.454	0.351

***, ** : Significant at 0.05 and 0.01 level of probability, respectively.**

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

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تحليل الأب الكشاف × سلالة لتقدير القدرة علي الائتلاف للمحصول ومكوناته لبعض التراكيب الوراثية في التيل

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أجريت هذه الدراسة بهدف تقدير القدرة علي الائتلاف والفعل الجيني لبعض التراكيب الوراثية في التيل باستخدام تحليل الأب الكشاف في السلالة من خلال تقييم ١٥ هجين ناتجة من التهجين بين خمسة تراكيب وراثية (١ = هـ ١١٩ ، ٢ = كوبا ، ٣ = ٢٠/٩٦ ، ٤ = س ٣٨ ، ٥ = هندي جديد) استخدمت كأمهات ، وثلاثة تراكيب وراثية (٦=جيزة٣ ، ٧ = س ٩/٤٣٥١٠٨ ، ٨ = تيانتج) استخدمت كآباء كشافة. في موسم ٢٠٠٤ تم إجراء التهجينات بين الأباء الكشافة مع الأمهات وذلك بمحطة البحوث الزراعية بالجيزة. وفي موسم ٢٠٠٥ تم تقييم الـ٨ آباء ، ١٥ هجين في الجيل الأول في محطة البحوث الزراعية بالإسماعيلية في تجربة قطاعات كاملة العشوائية ذات الأربعة مكررات .

تشير النتائج إلى أن تأثير العوامل الوراثية المضيفة أكبر من غير المضيفة في توريث كل الصفات المدروسة باستثناء صفتي سمك الساق ووزن البذرة للنبات ، لذلك من الممكن ممارسة الانتخاب اعتبارا من الجيل الثاني والأجيال التالية له باستثناء تلك الصفتين. كما تشير النتائج أن الأبويين س ٢٠/٩٦، س ٩/١٠٨ أظهرا قدرة عامة علي الائتلاف لصفات محصول الساق الأخضر للنبات ومعظم مكوناته، كما أظهر الأب كوبا هذه القدرة لأهم ثلاث مكونات (الطول الكلي، الطول الفعال، وطول الألياف)، لذلك يمكن استخدام هذه الأباء في برنامج تربية التيل لتحسين محصول الساق الأخضر وبالتالي محصول الألياف ، كما تشير النتائج الخاصة بوزن البذور للنبات أن الأبويين س ٣٨ وهندي جديد أظهرا قدرة عامة علي الائتلاف ، لذلك يمكن استخدام هذين الأبويين بالإضافة إلى الأبويين س ٢٠/٩٦ و س ٩/١٠٨ لتحسين محصول البذور للنبات. كما تشير النتائج الخاصة بالارتباط الموجب بين قيم القدرة العامة علي الائتلاف ومتوسطات الأباء إلى إمكانية اختيار الأباء في برنامج التربية بناءا علي متوسطاتها لتلك الصفات. كما تشير النتائج أن هجينين (٢٠/٩٦ X تيانتج ، هندي جديد X س ٩/١٠٨) فقط اظهرا قدرة خاصة علي الائتلاف لأهم صفتين وهما وزن الألياف للنبات و النسبة المئوية للألياف بالإضافة لصفة محصول البذور للنبات، وأن هذا الهجين واحد الآباء فقط كانت متفوقة في القدرة العامة علي الائتلاف (عالي X منخفض) باستثناء هجين واحد (هندي جديد X س ٩/١٠٨) كان كلا أبويه كلاهما متفوقين في القدرة العامة علي الائتلاف(عالي X عالي) لصفة محصول البذور فقط.

كما تشير النتائج الخاصة بالارتباط الظاهري والوراثي بين الصفات إلى أن محصول الساق الأخضر والطول الكلي والطول الفعال والنسبة المئوية للألياف وطول الألياف أظهرت ارتباط موجب ومعنوي مع محصول الألياف/نبات لذلك يمكن الانتخاب لتلك الصفات لتحسين محصول الألياف في التيل. أيضا الارتباط كان موجب ومعنوي بين محصول البذور وطول المنطقة الثمرية لذلك يمكن استخدام هذه الصفة كدليل انتخابي لتحسين محصول البذور.

Table 2. Mean squares for green weight /plant and its related characters for eight kenaf parents (five females and three males) and their 15 F1 crosses.

Characters	S.O.V.									
	Reps	Entries	Error	Crosses	Parents	p. vs. c.	Female (f)	Male (m)	m x f	Error
	(3)#	(22)	(66)	(14)	(7)	(1)	(4)	(2)	(8)	(66)
Green weight / plant (g)	8.15	15433.05**	11.30	11715.13**	24806.41**	1870.45**	1416.50**	79074.26**	24.67*	11.30
Plant height/plant (cm)	0.38	790.93**	3.70	489.84**	1496.76**	65.48**	446.39**	2491.92**	11.04**	3.70
Technical stem length (cm)	3.55	428.20**	2.98	297.58**	742.19**	59.02**	708.50**	659.37**	1.70	2.98
Fiber length (cm)	7.35	424.92**	3.12	300.02**	733.27**	14.97*	700.35**	670.16**	7.32*	3.12
Fiber weight / plant (g)	0.39	300.41**	0.81	241.64**	444.01**	118.05**	118.65**	1434.59**	4.90**	0.81
Fiber percentage (%)	0.02	4.55**	0.07	4.04**	5.37**	5.98**	5.02**	16.19**	0.52**	0.07
Fruiting zone length (cm)	1.80	172.68**	2.46	109.51**	323.67**	0.18	44.20**	632.49**	11.42**	2.46
Stem diameter (mm)	0.03	5.51**	0.13	4.84**	6.60**	7.78**	3.96	19.26**	1.67**	0.13
Seed weight / plant (g)	0.12	5.83**	0.07	5.13**	4.03**	28.37**	6.93**	15.34**	1.68**	0.07

*,** Indicate significant and highly significant, respectively.
: The degrees of freedom are indicated in parentheses.