COMBINING ABILITY AND GENE ACTION FOR YIELD AND YIELD COMPONENTS IN KENAF (*HIBISCUS CANNABINUS* L.)

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Abstract

This study was conducted with the objective of estimating combining ability and gene action for green stalk yield, fiber yield and their related characters in kenaf. This was achieved via evaluating six parents (P_1=Giza3, P_2=S.8, P_3=S.103/4, P_4=S.105/2, P_5=S.108/9 and P_6 =S.116) and their 15 F_1's progenies. In 2004 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. In 2005 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 collected data indicated that the ratio of general to specific combining ability variance for plant height, technical stem length, fiber weight, fiber percentage, fiber length, seed weight, and fruiting zone length, indicated that the additive effects were more important than non-additive effects. Consequent, effects selection should be possible within these F_2 and subsequent populations for these characters. On the other hand, for both of stem diameter and green weight per plant showed that the non-additive effects were more important than additive effects. For green weight, P_4 exhibited significant and positive GCA effects for green weight per plant and the most of its components as well as P_1 and P_3 for two important components (technical stem length and fiber length), indicating that the use of these parents in kenaf breeding programs could be increase green weight and consequent increasing fiber yield. For seed weight, the results indicated that P_4 followed by P_2 showed significant positive general combining ability values. The simple correlation between GCA Values and parental means for all traits were significantly positive with exception stem diameter. These results indicated that the parents showing higher mean performance proved to be the highest general combiners for these traits. The cross (P_1xP_4) exhibited significant and positive SCA effects for green weight per plant and the most of its components. This cross involved two parents of high x high GCA effects for both of technical stem length and fiber percentage. The cross (P_3xP_4) was exhibited the best second combiner for green weight and its three importance components (plant height, technical stem length and fiber weight). This cross (P_3xP_4) involved high x high general combiner parents for technical length and high x low for each of plant height, green weight and fiber weight per plant. For seed weight, one cross (P_2xP_4) only included high x high general combiner parents for all traits and three crosses (P_2xP_3, P_2xP_6 and P_3xP_5) included high x low general combiner parents. The correlation between cross means and their SCA values was significant and positive indicating that the crosses showing higher mean performance proved to be the highest specific combiners for mentioned characters. Therefore, the choice of promising cross combination would be based on mean performance of the crosses.

The results of phenotypic (r_p) and genotypic (r_g) correlation coefficients concluded that plant height, technical length, green weight, fiber percentage and fiber length are the major components contributing to fiber weight per plant in kenaf. Therefore, selection for these traits will improve the fiber yield in kenaf. Also, fruiting zone length as selection index to improve seed yield in kenaf.

Key words: *Combining ability, Gene action, Correlation, kenaf.*

INTRODUCTION

Kenaf (*Hibiscus cannabinus* L.) crop belongs to family Malvaceae. It is produced in many countries of the world as a successful substitute of jute. It proved to be adaptable to a wide variation of kenaf fiber enable to be applicable in early all applications where jute is mow used. Kenaf, a bast fiber is cultivated in Egypt to be used alone or mixed with jute fiber to manufacture bags, twine, ropes and other products. It would be expected as a raw material to be alternative to wood fiber in pulp and paper industry to avoid destruction of forestry. As well as, kenaf seeds contain similar oil which extracted from cotton seeds as edible for human, it is better than cotton seed oil because it is free from Gossypol which found in cotton seed oil. Kenaf in Egypt is cultivated now on small scale due to the great competition with the other summer crops in the ancient valley lands. The extension of the kenaf cultivation in reclaimed sandy soil has become a must. Therefore, in Egypt, the biggest challenge in breeding new cultivars has been to produce a cultivar that is adapted to the sandy soil conditions. So, any breeding program of kenaf breeding must be initiated and evaluated in sandy nursery, before releasing a kenaf cultivar for sandy reclaimed soil.

The success of any breeding program depends mainly on the selection of parents which, when crossed, will 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 to show 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. 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 very limited. Diallel analysis of fiber yield and its components in kenaf was studied by Adamson (1980) and Mourad *et al.*,(1989). Subramanam *et al.*,(1995) studied the heritability in eight kenaf hybrids. They found that, fiber weight per plant and green plant weight showed high heritability, indicating that selection in early generations would be effective. Li Defag *et al.*, (2000) found that two hybrids (H305 and H306 in F_2) performed very high potential in fiber and stalk yields comparing with other hybrids and best new varieties in these trials. On the other hand, many investigators studied the differences between kenaf genotypes e.g., Osman and Momtaz,1982, Xiao *et al.*,1993, and Webber,1993.

Many correlation studies indicated that stem diameter, green stalk weight, fiber length and plant height were the major components contributing to fiber weight in kenaf (Mourad *et al.*,1987, El-Shimy *et al.*,1990, Subramanam *et al.*,1995 and Mostafa, 2003).

The present investigation aims are 1) estimating the combining ability of six kenaf parents and their crosses as well as the type of gene action for fiber yield and yield components, 2) selecting suitable parents and the superior crosses which can be used in kenaf breeding program and 3) estimating the phenotypic and genotypic correlation coefficients between yield and its related characters.

MATERIALS AND METHODS

The materials used for the present study consisted of six kenaf genotypes i.e. one local cultivar (P_1=Giza3) and five advanced strains (P_2=S.8, P_3=S.103/4, P_4=S.105/2, P_5=S.108/9 and P_6 =S.116). Genotype characteristics of the material used according to their pedigree, origin, generation and year released are presented in Table 1.

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

Genotypes	Pedigree	Origin	Generation	Year released
1- Giza 3	Selected from farmer fields	Local cultivar	Landraces	1961
2- S. 8	Selected from H.106 (G.5 x 77/68-1)	Advanced strain	F_7	1993
3- S.103/4	Giza 4 x S.77/68-1	" " " " " " "	F_9	1995
4- S.105/2	Giza 5 x S.87/68-1	" " " " " " "	F_9	1994
5- S.108/9	Giza 3 x S.127/130	" " " " " " "	F_9	1996
6- S.116	S.4/59 x S.29/1451	" " " " " " "	F_9	1998

* Year released, selected or introduced.

In 2004 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. In 2005 season, the parents and their 15 F_1's seeds were evaluated in a randomized complete block design with three replications at the breeding nursery of Ismailia Agric.

Res. Station Farm. The soil texture was sandy (coarse sand 64.13%, fine sand 33.24%, silt 2.21%, clay 1.31%, organic matter of 0.045 %, available nitrogen 6.53 ppm and pH value of 7.22.). Seed of each entry (parents with F_1 crosses) were sown in single rows, 5 m long, 50 cm apart. Seeds were planted in hills 25 cm within row and planting date was at the second week of May.2005. Thinning to two plants / hill was taken place four weeks after sowing. The recommended cultural practices for kenaf were applied under sprinkler irrigation system (The number of sprinklers per faddan were 35 and the discharge water for each sprinkler was 1.3 cubic meter per hour. One irrigation every two days was applied. Thus, the amount of water added during season for the experiment was 2730 cubic meters per feddan). Five random guarded plants from each plot were screened for the following traits:

(1) green weight (g) / plant, as weight in grams of kenaf stalk plant after 48 hours from harvesting, (2) plant height (cm), measured as the distance from the two cotyledonary nodes up to uppermost capsule, (3) technical stem length in cm, measured as the distance from the two cotyledonary nodes to the first apical branch, (4) fruiting zone length in cm, measured as the distance from the first apical branch to uppermost capsule, (5) stem diameter in mm, at the middle part of technical length, (6) fiber weight (g) / plant, as the weight in grams of the air-dried fibers extracted from retted green stalk of kenaf plant (7) fiber length (cm), (8) fiber percentage = (fiber weight/plant ÷ green weight/plant) x 100, and (9) seed weight (g)/plant.

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 (r_p) and genotypic (r_g) 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 genotypes (6 parents and 15 crosses), were significant for green weight / 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 and seed weight / plant (Table2). This indicated that those 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 also reported by Osman and Momtaz, (1982), Xiao *et al.*, (1993) and Webber (1993). 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 stem diameter was non-significant. Mean squares due to general (GCA) and specific (SCA) combining ability variances for all characters studied were significant, indicating the presence of both additive and non-additive type of genetic variances. The ratio of general to specific combining ability variance for plant height, technical stem length, fiber weight, fiber percentage, fiber length and seed weight / plant indicated that the additive effects were more important than non-additive effects. Therefore, selection should be possible within these F_2 and subsequent populations for these characters. On the other hand, the ratio of general to specific combining ability for both of stem diameter and green weight / plant 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 of relatively greater importance for fiber yield/plant, technical stem length, stem diameter and fruiting zone length.

GCA effects:

The estimates of general combining ability effects ($\hat{g}_i$) are presented in Table (3). P_4 (S.105/2) showed highly significant positive $\hat{g}_i$ for green weight / plant and its components with exception stem diameter. P_3 (S. 103/4) exhibited significant positive $\hat{g}_i$ for fiber percentage, suggesting the importance of these two parents (P_1 and P_3) for increasing technical stem length and fiber length. In general, P_4 (S.105/2) exhibited significant positive GCA effects for green weight and most its components as well as P_1 (Giza 3) and P_3 (S.103/4) for two important components (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_4 (S.105/2) followed by P_2 (S.8) showed significant positive $\hat{g}_i$ values. Therefore, it could be concluded that these two parents appeared to be best combiners for seed weight.

The simple correlation coefficient between GCA values and parental means for all traits were significantly positive with exception stem diameter. These results indicated 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 F_1's crosses of green weight per plant and its components are present in Table (4). Out of the 15 F_1 crosses, only one cross ($P_1 \times P_4$) showed highly significant positive SCA effects for all characters expect for stem diameter, fruiting zone length and seed weight / plant. P_3xP_4 also, showed high SCA effects in the desirable direction for each of plant height, technical stem length, green weight and fiber weight / plant. $P_5 \times P_6$ showed highly significant positive SCA effects for all characters expect for stem diameter, and seed weight / plant. $P_1 \times P_3$ showed highly significant positive SCA effects for fiber percentage. Three crosses ($P_1 \times P_5$, $P_3 \times P_5$ and $P_4 \times P_5$) exhibited significant positive SCA effects for both of green weight per plant and fiber percentage. $P_1 \times P_6$ for fiber weight / plant, fiber percentage and stem diameter, $P_2 \times P_3$ for green weight and fiber weight, $P_2 \times P_4$ for plant height, green weight and fiber weight and $P_2 \times P_6$ for green weight per plant only.

In general, the cross (P_1xP_4) exhibited significant and positive SCA effects for green weight and the most of its components. This cross (P_1xP_4) involved two parents of high x high GCA effects for both of technical stem length and fiber percentage. The cross ($P_3 \times P_4$) was exhibited the best second combiner for green weight and its three importance components (plant height, technical stem length and fiber weight). This cross ($P_3 \times P_4$) involved high x high general combiner parents for technical length and high x low for each of plant height, green weight and fiber weight / plant. Three crosses ($P_1 \times P_3$, $P_1 \times P_6$ and $P_5 \times P_6$) involved low x low for fiber percentage.

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 cross P_1xP_4 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 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 (r_p) and genotypic (r_g) correlation coefficients among nine traits of 21 kenaf genotypes (6 parents and 15 F_1's crosses) are shown in Table (6). these results indicated that fiber weight / plant was highly significantly positive correlated with each of plant height, technical stem length, green weight, fiber percentage and fiber length / plant. Concerning, green weight / plant was significantly positive correlated with each of plant height, fiber weight and fruiting zone length. Regarding, seed weight / plant was highly positive correlated with fruiting zone length, but it was only significant correlated with both of plant height 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 plant height, technical stem length, green weight, fiber percentage and fiber length / plant are the major components contributing to fiber weight / plant in kenaf. Therefore, selection for these traits will improve the fiber yield in kenaf.

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 weight / plant and its components.

Characters	S.O.V.									GCA/SCA ratio
	Reps. (2)#	Entries (20)	Error (40)	Crosses (c) (14)	Parents (P) (5)	P. *vs.*S (1)	GCA (5)	SCA (15)	Error (40)	
Plant height (cm)	788.81**	1881.91**	107.61	1706.82**	1389.86**	6793.48**	1138.98**	456.75**	35.87	2.49
Technical stem length (cm)	558.06*	905.04**	123.90	918.79**	542.63**	2524.52**	643.32**	187.80**	41.30	3.43
Stem diameter (mm)	8.06**	3.14**	0.91	3.11**	3.83 Ns	0.97 Ns	0.92*	1.11**	0.30	0.83
Green weight/plant (g)	1479.46Ns	24418.01**	1414.98	16864.91**	6711.15**	218695.71**	6121.32**	8812.01**	471.66	0.70
Fiber weight / plant (g)	17.95 Ns	209.12**	7.14	151.45**	83.24**	1645.90**	89.39**	63.15**	2.38	1.42
Fiber percentage (%)	0.04 Ns	2.30**	0.24	2.49**	1.69**	2.58**	1.47**	0.53**	0.08	2.77
Fiber length (cm)	259.84 Ns	965.34**	181.35	1036.28**	583.91*	1879.30**	635.44**	217.23**	60.45	2.93
Seed weight / plant (g)	0.09 Ns	3.23**	0.09	3.02**	4.25**	1.11**	2.12**	0.73**	0.03	2.904
Fruiting zone length (cm)	27.00 Ns	1037.20**	69.33	1104.79**	848.30**	1035.27**	718.61**	221.44**	23.11	3.25

: The degrees of freedom are indicated in parentheses.
Ns, *, ** : Non-significant, significant at 0.05 and 0.01 levels of probability, respectively.

Table 3. Estimation of general combining ability effects ($\hat{g}_i$) for green weight / plant and its components of six kenaf parents.

Characters	Parents						r	L.S.D (gi-gi) 0.01
	P1=Giza3	P2=S.8	P3=S.103/4	P4=S.105/2	P5=S.108/9	P6=S.116		
Plant height (cm)	-7.81 ** b-d	3.12 b	2.59 bc	21.20 ** a	-8.50 ** cd	-10.61 ** d	**0.91 ** **	8.10
Technical stem length (cm)	4.40 * bc	-10.03** ab	6.19 ** bc	12.04 ** a	-3.16 c	-9.43 ** a	**0.93 ** **	8.69
Stem diameter (mm)	0.23 a	0.13 ab	-0.37 * bc	0.26 a	-0.94 ** c	0.24 a	**0.75 * **	0.74
Green weight/plant (g)	-18.32 * cd	5.84 b	-30.44 ** d	49.74 ** a	-7.45 bc	0.64 b	**0.80 * **	29.36
Fiber weight / plant (g)	-0.66 b	-1.15 * bc	-1.16 * bc	6.71 ** a	-2.47 ** c	-1.27 * bc	**0.87 ** **	2.09
Fiber percentage (%)	0.17 b	-0.31 ** cd	0.32 ** ab	0.59 ** a	-0.53 ** d	-0.25 ** c	**0.71 * **	0.38
Fiber length (cm)	5.48 * a	-8.36 ** bc	7.50 ** a	9.62 ** a	-2.25 b	-11.98** c	**0.91 ** **	10.51
Seed weight / plant (g)	-0.14 * cd	0.38 ** b	0.00 c	0.78 ** a	-0.42 ** de	-0.61 ** e	**0.82 * **	0.25
Fruiting zone length (cm)	-12.21 ** e	13.16 ** a	-3.59 * cd	9.17 ** a	-5.35 ** de	-1.18 c	**0.94 ** **	6.50

*, **: Significant at 0.05 and 0.01 levels of probability, respectively.
r : Simple correlation coefficients between GCA values and means of parents.
The values identified by the same letter are not significantly different at 0.05 level of probability.

Table 4. Estimation of specific combining ability ($\hat{s}_{ij}$) effects for green weight / plant and its components of 15 F_1's crosses in kenaf.

Crosses	Plant height (cm)	stem length	Stem diameter (mm)	Green weight/plant (g)	Fiber weight / plant(g)	Fiber percentage (%)	Fiber length (cm)	Seed weight/plant (g)	Fruiting zone length (cm)
$P_1xP_2\$$	6.485 de	6.062 b-d	-0.004 c-f	23.708 f	0.970 f-h	-0.196 e-h	4.843 b-d	-0.560** fg	0.420 e
P_1xP_3	4.381 d-f	9.176 a-d	-1.074 * fg	-93.801** g	-2.721 hi	1.310 ** a	8.287 a-d	-0.279 ef	-4.797 ef
P_1xP_4	20.038** b-d	24.429 ** a	-0.136 c-f	63.007 ** b-f	8.897 ** a-c	0.672 * a-d	27.434 **a	-0.325 ef	-4.397 ef
P_1xP_5	-4.521 e-g	-11.007 d	1.615 ** ab	81.543 ** a-e	3.033 * e-g	-0.420 f-h	-11.194 de	0.228 cd	6.490 de
P_1xP_6	-11.086 * fg	-6.070 b-d	1.667 ** a	17.958 f	5.337 ** b-d	0.818 ** a-c	-4.002 c-e	-0.639** fg	-5.014 ef
P_2xP_3	-10.186 fg	-3.063 b-d	0.958 a-d	122.144** a	8.201 ** a-d	-0.214 e-h	-3.079 c-e	0.654 ** bc	-7.126 f
P_2xP_4	14.938 **cd	-12.864 ** d	-0.054 c-f	56.868 ** b-f	4.326 ** d-f	0.022 d-f	-10.665 de	1.422 ** a	27.807 ** ab
P_2xP_5	-2.354 eg	9.920 a-d	-1.720 ** g	-58.629** g	-5.915** i	-0.410 f-h	9.073 a-d	-0.832** gh	-12.272** f
P_2xP_6	6.348 de	-5.309 b-d	-0.554 e-g	45.970 * c-f	-0.947 gh	-0.763 **h	-1.935 c-e	1.388 ** a	11.657 ** d
P_3xP_4	28.201**a-c	12.204 * a-c	-0.403 d-g	59.810 ** b-f	5.068 ** c-f	-0.026 e-g	14.912 *a-c	-1.281 ** h	15.990 **b-d
P_3xP_5	39.585** a	9.801 a-d	0.715 a-e	41.496 * d-f	3.940 ** ef	0.235 c-f	8.850 a-d	0.122 de	29.778 ** a
P_3xP_6	-13.223 * g	-4.528 b-d	-0.386 d-g	28.778 ef	-0.712 gh	-0.701** gh	-1.492 c-d	-0.145 d-f	-8.693 * f
P_4xP_5	-11.500 * fg	2.487 b-d	0.086 b-f	108.554** ab	9.018 ** ab	0.301 c-e	4.798 b-d	-0.491** f	-13.989 ** f
P_4xP_6	-1.502 eg	7.758 a-d	-0.709 e-g	-42.381 * g	-1.263 h	0.418 b-d	-18.91** e	-0.677** fg	-9.260 * f
P_5xP_6	32.909 ** ab	21.055 **a-b	1.169 a-c	103.922 **a-c	11.258 ** a	0.873 **ab	24.894 **a-c	0.155 de	11.861 ** cd
SD(s_{ij}-s_{ii}) 0.01 r	21.424 0.807 **	22.989 0.810 **	1.966 0.918 **	77.685 0.901 **	5.517 0.839 **	1.003 0.847 **	27.812 0.831 **	0.653 0.790 **	17.195 0.811 **

$:Number refer to parent codes, Table 1.
Significant at 0.05 and 0.01 levels of probability, respectively.
r : Simple correlation coefficients between SCA values and means of crosses.
The values identified by the same letter are not significantly different at 0.05 level of probability.

Table 5. Mean performances of 21 kenaf genotypes (6 parents and 15 F_1's crosses) for green weight / plant and its components.

Genotypes	Plant height (cm)	Technical stem length (cm)	Stem diameter (mm)	Green weight/ plant (g)	Fiber weight / plant (g)	Fiber percentage (%)	Fiber length (cm)	Seed weight / plant (g)	Fruiting zone length (cm)
Parents									
P1= Giza3	220.30 c	177.74 b	11.30 b	390.71 b	25.76 c	6.59 b	172.91 b	3.33 b	42.57 c
P2= S.8	242.20 b	162.80 c	12.83 a	390.20 b	29.23 b	7.51 a	158.80 c	2.54 d	79.40 a
P3= S.103/4	224.38 c	180.82 ab	11.24 b	333.47 c	25.63 c	7.68 a	175.90 ab	3.28 c	43.57 c
P4= S.105/2	260.89 a	187.30 a	13.01 a	450.10 a	35.24 a	7.83 a	185.09 a	5.05 a	73.60 a
P5= S.108/9	199.50 d	157.79 c	9.96 c	320.22 c	19.23 d	6.00 c	151.92 c	2.39 d	41.70 c
P6= S.116	215.63 c	154.92 c	11.77 b	397.71 b	25.47 c	6.52 b	151.40 c	1.55 e	60.70 b
Crosses									
P_1xP_2	245.37 d	180.67 c-f	12.23 c-e	484.78 d	34.00 e	7.01 hi	176.60 d-f	2.50 d-f	64.70 cd
P_1xP_3	242.73 d	200.00 c	10.67 fg	331.00 f	30.30 f	9.14 a	195.90 be	2.40 d-f	42.73 h
P_1xP_4	277.00 b	221.10 a	12.23 c-e	567.98 b	49.79 a	8.77 a	217.17 a	3.13 c	55.90 ef
P_1xP_5	222.73 f	170.47 fg	13.23 ab	529.33 c	34.74 e	6.56 j	166.67 f	2.49 d-f	52.27 fg
P_1xP_6	214.07 f	169.13 g	14.03 a	473.83 d	38.25 d	8.08 cd	164.13 f-h	1.43 i	44.93 h
P_2xP_3	239.10 d	173.33 fg	12.60 b-d	571.10 b	40.74 cd	7.14 gh	170.70 f	3.85 b	65.77 cd
P_2xP_4	282.83 b	169.38 g	12.22 c-e	586.00 b	44.73 b	7.65 d-f	165.23 f-h	5.40 a	113.47 a
P_2xP_5	235.83 e	176.97 fg	9.80 g	413.32 e	25.31 g	6.10 k	173.10 ef	1.95 h	58.87 de
P_2xP_6	242.43 d	155.47 h	11.70 e	526.00 c	31.48 f	6.02 k	152.37 h	3.97 b	86.97 b
P_3xP_4	295.57 a	210.67 b	11.37 ef	552.67 b	45.46 b	8.23 bc	206.67 ab	2.32 e-g	84.90 b
P_3xP_5	277.24 b	193.07 cd	11.73 e	477.17 d	35.15 e	7.37 f-h	188.73 cd	2.52 d-f	84.17 b
P_3xP_6	222.33 f	172.47 fg	11.37 ef	472.53 d	31.70 f	6.71 ij	168.67 f	2.06 gh	49.87 f-h
P_4xP_5	244.77 d	191.60 cd	11.73 ef	624.40 a	48.10 a	7.71 c-f	186.80 d-f	2.69 d	53.17 f
P_4xP_6	252.66 c	190.60 c-e	11.67 e	481.55 d	39.02 d	8.10 b-d	153.37 gh	2.31 fg	62.07 cd
P_5xP_6	257.37 c	188.70 de	12.80 bc	570.67 b	42.36 c	7.44 e-h	185.30 c-e	1.94 h	68.67 c
Means	**243.57**	**180.24**	**11.88**	**473.56**	**34.84**	**7.34**	**174.64**	**2.81**	**63.33**

The values identified by the same letter are not significantly different at 0.05 level of probability.

Table 6. Phenotypic (r_p) and genotypic (r_g) correlation coefficients among nine characters for 21 Kenaf genotypes (6 parents and 15 F_1's crosses).

Characters		1	2	3	4	5	6	7	8
1-Plant height (cm)	r_p								
	r_g								
2-Technical stem length(cm)	r_p	0.679**							
	r_g	0.512							
3-Stem diameter(mm)	r_p	0.135	-0.042						
	r_g	0.333	0.214						
4-Green weight/plant(g)	r_p	0.545**	0.298	0.467*					
	r_g	0.674	0.467	0.454					
5-Fiber weight/plant(g)	r_p	0.698**	0.620	0.483*	0.880**				
	r_g	0.557	0.711	-0.112	0.537				
6-Fiber percentage (%)	r_p	0.516**	0.755**	0.269	0.123	0.569**			
	r_g	0.437	0.663	-0.138	0.434	0.654			
7-Fiber length (cm)	r_p	0.642**	0.915**	-0.006	0.299	0.567**	0.652**		
	r_g	0.703	0.873	0.432	0.328	0.543	0.553		
8-Seed weight/plant (g)	r_p	0.414*	-0.007	0.137	0.271	0.251	0.086	0.054	
	r_g	0.456	0.221	0.333	0.532	-0.254	0.347	0.227	
9-Fruiting zone length (cm)	r_p	0.705**	-0.041	0.222	0.454*	0.351	-0.027	-0.010	0.570**
	r_g	0.558	-0.211	0.258	0.472	0.223	0.321	0.256	0.617

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

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القدرة علي الائتلاف والفعل الجيني للمحصول ومكوناته في التيل

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مركز البحوث الزراعية – معهد المحاصيل الحقلية –قسم بحوث محاصيل الألياف – الجيزة

أجريت هذه الدراسة بهدف تقدير القدرة علي الائتلاف والفعل الجيني لمحصول الساق الأخضر و الألياف ومحصول البذرة ومكواتهم في التيل من خلال تقييم ١٥ هجين ناتجة من التهجين بين ستة تراكيب وراثية من التيل (١= جيزة ٣ ، ٢= س ٨ ، ٣= س ١٠٣/٤ ، ٤=س ١٠٥/٢ ، ٥= س١٠٨/٩ ، ٦= س ١١٦). في موسم ٢٠٠٤ تم إجراء كل الهجن الممكنة بين الستة آباء بدون الهجن العكسية بنظام التهجين الدائري وذلك بمحطة البحوث الزراعية بالجيزة. وفي موسم ٢٠٠٥ تم تقييم الـ٦ آباء ،١٥ 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 الطول الكلي ، الطول الفعال ، وزن الألياف /نبات ، النسبة المئوية للألياف ، طول الألياف ، وزن البذور للنبات وطول المنطقة الثمرية. لذلك يمكن إجراء الانتخاب بكفاءة لتلك الصفات بدايةً من الجيل الثاني والأجيال التالية ، بينما العوامل الوراثية غير المضيفة كانت أكثر أهمية في توريث صفتي قطر الساق ووزن الساق الأخضر/نبات ، كما تشير النتائج إلى أن الأب س ١٠٥/ ٢ اظهر قدرة عالية علي الائتلاف لصفات وزن الساق الأخضر /نبات ومعظم مكوناته بالإضافة إلى الأبويين جيزة ٣ ، س ١٠٣/٤ أظهرا قدرة عالية علي الائتلاف لأهم مكونين (الطول الكلي ، وطول الألياف) . لذلك يمكن استخدام هذه الآباء لتحسين وزن الساق الأخضر /نبات ومن ثم زيادة محصول الألياف ، كما تشير النتائج إلى أن الأب س ١٠٥/٢ يليه الأب س٨ أظهرا قدرة عالية علي الائتلاف لمحصول البذور/ نبات. كما أن الارتباط الموجب المعنوي الذي ظهر بين القدرة العامة علي الائتلاف وسلوك الآباء لكل الصفات ماعدا قطر الساق مما يدل علي إمكانية اختيار الآباء في برنامج التربية لهذه الصفات معتمداً علي متوسطاتها العالية ، كما تشير النتائج إلى أن هجين واحد فقط (جيزة ٣ X س ١٠٥/٢) أظهر تفوق في القدرة الخاصة علي الائتلاف لصفات وزن الساق الأخضر /نبات ومعظم مكوناته وأن هذا الهجين ناتج من آباء متفوقة في القدرة العامة علي الائتلاف (عالي X عالي) لصفتي الطول الفعال والنسبة المئوية للألياف ، بينما الهجين (س ١٠٣/٤ X س ١٠٥/٢) أظهر قدرة خاصة علي الائتلاف لأهم ثلاث مكونات (الطول الكلي ، الطول الفعال ، ووزن الألياف/ نبات) وأن هذا الهجين ناتج من آباء متفوقة في القدرة العامة علي الائتلاف (عالي X عالي) لصفة الطول الفعال و(عالي X منخفض) لصفات طول النبات ووزن الساق الأخضر /نبات ووزن الألياف/ نبات ، كما تشير النتائج إلى أن هجين واحد فقط (س٨ X س ١٠٥/٢) ناتج من آباء متفوقة في القدرة العامة علي الائتلاف (عالي X عالي) لصفة محصول البذور/نبات. بينما ثلاث هجن (س٨ X س ١٠٣/٤ ، س ٨ X س١١٦ ، س ١٠٣/٤ X س ١٠٨/٩) كانت آبائها (عالي X منخفض) لتلك

الصفة ، كما تشير النتائج إلى معنوية الارتباط الموجب بين القدرة الخاصة علي الائتلاف للهجن ومتوسطاتها مما يدل علي أن الهجن العالية في صفاتها المحصولية أظهرت قدرة خاصة علي الائتلاف عالية ، لذلك يمكن اختيار الهجن علي أساس متوسطاتها العالية.

كما تشير النتائج الخاصة بالارتباط الظاهري والوراثي بين الصفات إلى أن الطول الكلي ،والطول الفعال ، ووزن الساق الأخضر /نبات ، 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.