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**EFFECT OF SOME CULTURAL TREATMENTS ON YIELD AND
QUALITY OF KENAF CROP (*Hibiscus cannabinus*, L.)
BY**

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ABSTRACT

Two field experiments were conducted during the two successive seasons, 2004 and 2005 in Etay El-Baroud Agricultural Station El-Behira Governorate to investigate the effect of five nitrogen levels (0, 15, 30, 45 and 60 kg N/faddan) and four numbers of plants per hill (1, 2, 3 and 4 plants per hill) on green, yield and yield fiber quality of kenaf (variety koba). Results could be summarized as follows:-

1. There were increments in all green yield characters as total plant height, technical length, length of top capsules zone, stem diameter, green yield per plant and per faddan also. Similar increases were found in seed yield characters such number of capsules per plant, number of seeds per plant, seed index and seed yield per plant as well as per faddan.
2. The results showed a significant decrease in fiber characters with increased nitrogen levels, except fiber length.
3. There were increments in chemical properties of fibers (cellulose and lignin in fiber) with increasing nitrogen levels from zero to 60 kg/faddan.
4. Total plant height, technical length, green yield per plant and per faddan, fiber percentage, fiber length, and fiber fineness percentage increased with increasing number of plants per hill.

INTRODUCTION

Kenaf (*Hibiscus cannabinus* L.) belongs to family *Malvaceae* and is considered as an important member of the bast fiber crops group, fibers are extracted from the technical stem length by retting process. Kenaf ranks the third fiber crop after the cotton and flax in Egypt.

The present study aims to study the effect of nitrogen levels and number of plants per hill on kenaf productivity and fiber quality. Many investigators such as McKinstry (1960) Khan *et al.*, (1968), Boonklinkjorn and Visuttipitakul (1970), El-Sonbaty (1974), Amankwatia and Takyi (1975), Gad *et al.* (1976), Hassan (1977), Momtaz *et al.* (1977), Momtaz *et al.* (1978), El kholy *et al.* (1984) and Sahseh *et al.* (1985) reported that there was remarkable increase in kenaf characters i.e., green yield and its components, fiber yield and seed yield with increasing nitrogen level, except for fiber fineness and fiber ash content which were decreased. Moreover, other workers pointed out that increasing number of plants per hill increased green yield/faddan, fiber yield/faddan and seed yield/faddan, but decreased fiber and seed yield per plant.

MATERIALS AND METHODS

The present investigation was carried out at Etay El. Baroud Agric. Res. Station, Agric. Res. Cen., during the two successive seasons 2004 and 2005. The soil of the experimental field was clay in texture with pH value of 8.00 and 1.57 % organic matter. Treatments were arranged in split plot design in four replications to study the effect of five levels of nitrogen (0,15,30,45 and 60 kgs N/faddan) and four plant numbers per hill 1,2,3 and 4 plant/hill on yield and fiber quality of kenaf. The five levels of nitrogen were assigned to the main plots. The sub-plots contained the 4 number of plant per hill. In both seasons, the sub-plot size was 3.5 meters long and 3.0 meters wide (1/400 faddan). There were 8 ridges, 60 cms apart in each plot every hill was thinned after 21 days from sowing and before fertilization, according to the numbers of plants per hill as mentioned before. At full-maturity, ten guarded plants were taken at random from each sub-plot to record the following data:

I: Green yield and its components:

- 1- Plant height in cms.
- 2- Technical length in cms.
- 3- Length of capsules zone in cms.
- 4- Stem diameter in mm.
- 5- Green yield per plant in gms.
- 6- Green yield per faddan in tons.

II- Fiber yield and its technological characters:

- 1- Fiber yield per plant in gms.
- 2- Fiber yield per faddan in tons.
- 3- Fiber percentage %
- 4- Fiber length in cms
- 5- Fiber fineness (N.m). determined by using Radwan and Momtaz's method (1966) according to the following formula:

$$N.m = \frac{N \times L}{G} \text{ where: } N.m = \text{metrical number.}$$

N = number of fiber L = length of fibers in m.m

G = weight of fibers in mgs

III- Seed yield and its components:

- 1- Number of capsules per plant.
- 2- Number of seeds per plant.
- 3- Seed index in gms (weight of 100 seeds).
- 4- Seed yield per plant (gms).
- 5- Seed yield per faddan (kgs).

IV- Chemical properties of fibers:

- 1- Fiber cellulose %.
- 2- Fiber pectin %.
- 3- Fiber lignin %.
- 4- Fiber wax %.
- 5- Fiber ash %.

Fiber cellulose %, fiber pectin % and fiber lignin % were determined according to A.O.A.C. (1965).

The statistical analysis was carried out according to the procedures mentioned by Snedecor and Cochran (1967). The individual comparisons among means followed L. S. D. at 0.05 level. A combined analysis was carried out for each character over the two seasons (Le Clerg *et al.* 1966).

RESULTS AND DISCUSSION

* Green yield and its components:

- Effect of nitrogen levels:

Data presented in Table (1) revealed that green yield and its components significantly differed as affected by application of nitrogen fertilizer from 0 up to the highest dose at 60 kg N/faddan. Moreover, the six characters studied in this case were gradually increased with increasing nitrogen level. The mean values of total plant height ranged from 47.30 to 497.8 cm, technical length from 412.3 to 428.6 cm, length of top capsule zone ranged from 58.00 to 71.40 cm, stem diameter ranged from 19.30 to 28.70 m.m, green yield/plant from 848.20 to 915.70 gms and green yield per faddan from 21.013 to 23.300 tons for the untreated control and the highest nitrogen level of 60 kg/faddan, respectively. It must be mentioned here, that these increments in green yield and its related traits occurred due to nitrogen as an essential element for building up protoplasm and proteins which induce cell division and meristematic activity, such effect resulted in an increase in plant growth. Similar results were reported by Gad *et al.* (1976), Momtaz *et al.* (1977), El-kholy (1984) and Sahseh *et al.* (1986).

Regarding the effect of plant numbers per hill, results indicated that green yield and its components differed significantly in all characters under study. Total plant height, technical length and from green yield/fad were increased towards maximum number of plant per hill (4 plants). The average of these traits ranged from 478.7 to 511.5 cm for total plant length, from 426.20 to 455.00 cm for technical length and from 22.049 to 23.180 ton for green yield/faddan concerning the plants number/hill one and 4 plants, respectively. On the other hand, the three other characters showed the opposite direction. The mean values decreased with increasing the number of plants/hill. The respective average ranged from 59.4 to 56.5 cm for length of capsules zone, from 20.13 to 17.85 m.m for stem diameter and from 878.8 to 812.3 gm for green yield/plant in relation to one and 4 plants /hill, respectively. These results agree with those obtained by Shasah (1973), Hassan (1977), Sahseh *et al.* (1986), Bukhtiar *et al.*, (1990), Nafees and Shah (1993) and Mostafa (2003).

- Effect of the interaction:-

Summary of the significant interaction effects of Nitrogen levels and number of plants per hill is given in Table (2). The interaction between 60 kg N/faddan and four plants per hill gave the highest values for total plant height, technical length and green yield per faddan. On the other hand, interaction between 60 kg N/faddan with one plant hill gave the highest values for length of top capsules zone, stem diameter and green yield per plant.

Table (1): Means of green yield and its components as affected by N. levels and number of plants per hill from the combined analysis of two seasons.

Characters Treatments	Total plant height (cm)	Technical length (cm)	Length of top capsule zone (cm)	Stem diameter (mm)	Green yield per plant (gms)	Green yield per faddan (ton)
Nitrogen levels						
Zero	470.30	412.30	58.00	19.30	848.20	21.013
15 kgs/fad	475.70	413.90	61.80	21.40	871.00	21.581
30 kgs/fad	481.30	416.70	64.60	22.50	875.00	21.851
45 kgs/fad	490.09	422.50	67.59	23.10	885.60	22.500
60 kgs/fad	497.80	428.60	71.40	28.70	915.70	23.300
L.S.D (5%)	20.55	19.30	11.30	1.34	61.20	1.20
Number of plant per hill						
1 plants	478.70	426.20	59.40	20.13	878.80	22.049
2 plants	492.30	439.80	52.50	18.80	854.00	22.489
3 plants	499.00	445.10	53.90	18.12	842.40	23.100
4 plants	511.50	455.00	46.50	17.85	812.30	23.180
L.S.D (5%)	30.00	23.70	6.00	1.28	64.00	1.55
Interaction	**	**	*	*	**	*

Note: in this table and the similar succeeding tables:

* and ** indicate significant and highly significant, respectively.

Table (2): Highest values of green yield and its components as affected by significant interaction between the experimental factors in two seasons

Characters	Highest value	Treatments
Total plant height (cm)	522.00	60 kg N x 4 plant/hill
Technical length (cm)	479.00	60 kg N x 4 plant/hill
Length of capsules zone (cm)	88.00	60 kg N x 1 plant/hill
Stem diameter (mms)	29.80	60 kg N x 1 plant/hill
Green yield per plant (gms)	975.30	60 kg N x 1 plant/hill
Green yield per faddan (ton)	24.50	60 kg N x 4 plant/hill

**** Fiber yield and its technological characters:-**

Results from Table (3), illustrated significant reductions in fiber yield /plant as well as per faddan, fiber percentage and fiber fineness with increasing nitrogen level towards the highest dose of 60 kg/faddan. Meanwhile, fiber length character was increased with increasing nitrogen level. It must be mentioned that the differences between the mean values obtained by increasing nitrogen levels from 0 up to 45 kg/ faddan did not reach the level of significance for fiber yield / plant as well as per faddan, fiber fineness, but fiber percentage was not affected by increasing nitrogen from 0 to 60 kg/faddan. The maximum mean values occurred by application of 15 kg N/faddan i.e., 59.66 gms, 1.482 ton, 6.85 % and

165.40 Nm for fiber yield / plant, fiber yield / faddan, fiber percentage and fiber fineness. But the greatest fiber length (408.5 cm) was obtained by adding 60 kg N/faddan respectively. These results were in harmony with those obtained by El-kholy *et al.* (1984) and Sahсах *et al.* (1986).

Table (3): Means of fiber yield and its technological characters as affected by N. levels and number of plants per hill from the combined analysis of two seasons

Characters Treatments	Fiber yield per plant (gms)	Fiber yield per faddan (ton)	Fiber (%)	Fiber length (cm)	Fiber fineness (N.m)
Nitrogen levels:					
Zero	59.00	1.472	6.58	386.22	162.30
15 kgs/fad	59.66	1.482	6.85	390.17	165.40
30 kgs/fad	59.06	1.470	6.75	396.13	161.70
45 kgs/fad	57.52	1.462	6.50	403.66	155.40
60 kgs/fad	55.81	1.421	6.10	408.50	148.20
L.S.D. 5 % level	3.05	0.045	NS	18.9	12.00
Number of plant per hill:					
1 plants	65.933	1.469	6.66	396.60	160.20
2 plants	63.400	1.527	7.10	399.70	170.00
3 plants	60.960	1.560	7.19	409.10	188.00
4 plants	58.371	1.620	7.33	414.00	190.10
L.S.D. 5 % level	NS	0.142	0.25	15.30	12.30

Concerning plant numbers per hill, data revealed significant differences in fiber yield / faddan, fiber percentage, fiber yield and fiber fineness as number of plants/hill increase from 1 to 4 plants, while fiber yield / plant was not affected. The highest estimates were obtained by 4 plants/hill in all fiber characters i.e., fiber yield / plant (65.933 gms), fiber yield / faddan (1.62 ton), fiber percentage (7.33%), fiber length (414.0 cm) and fiber fineness (190.1 Nm). But the lowest mean values were recorded by 1 plant / hill with the respective averages of 58.371 gms, 1.469 ton, 6.66 %, 396.6 cm and 160.6 Nm for the same characters previously mentioned and their arrangement, respectively. These results are in accordance with those obtained by Sahсах *et al.* (1986), Amaducci *et al.*, (1990), Nafees *et al.* (1998) and Mostafa (2003).

- Effect of the interaction:-

The highest values of fiber characters as affected by nitrogen levels and number of plant per hill are given in Table (4). It is clear that the highest values of fiber yield and its technological characters were recorded by 15 kg N/faddan combined with four plant per hill, except fiber length which recorded the highest value by 60 kg N/faddan with four plants per hill.

Table (4): Highest value of fibers yield and its component as affected by significant interaction between the experimental factors in two seasons

Characters	Highest value	Treatments
Fiber yield per plant (gms)	72.95	15 kg N x 4 plant/hill
Fiber yield per faddan (tons)	1.552	15 kg N x 4 plant/hill
Fiber (%)	7.20	15 kg N x 4 plant/hill
Fiber length (cms)	422.50	60 kg N x 4 plant/hill
Fiber fineness (N.m)	210.13	15 kg N x 4 plant/hill

**** Seed yield and its components:-**

Date presented in Table (5) show that the differences between nitrogen levels were significant for seed yield and its components. The 60 kg N/faddan treatment surpassed other nitrogen levels for all seed characters under study i.e., number of seeds per plant and number of capsules per plant. These results agree with those obtained by Gad *et al.* (1976), El- kholy *et al.* (1984) and Sahseh *et al.* (1986).

The results in Table (5) show that seed yield and its components were significantly affected by number of plants per hill. Significant reductions in number of seeds per plant, seed index, seed yield per plant and number of capsules per plant with increasing number of plants / hill. That may be due to more competition among relatively more plants per hill for nutrients and water. On the other hand, there was significant increase in seed yield per faddan as a result of increasing number of plants per hill up to four plants per hill. These results are in general agreement with those obtained by Sahseh *et al.*, (1986), Amaducci *et al.*, (1990), Bukhtiar *et al.*, (1990), Nafees and Shah (1993) and Mostafa (2003).

Table (5): Means of seed yield and its components as affected by N levels and number of plants per hill from the combined analysis of two seasons

Characters Treatments	No. of capsules/plant	No. of seeds per plant	Seed index 1000 weight of seeds in (gms)	Seed yield per plant (gms)	Seed yield per faddan (ton)
Nitrogen levels					
Zero	49.11	931.00	21.00	19.55	0.987
15 kgs/fad	55.22	1104.40	22.30	24.62	1.165
30 kgs/fad	59.30	1239.00	24.80	29.75	1.206
45 kgs/fad	66.20	1452.00	25.30	31.20	1.375
60 kgs/fad	69.10	1587.00	26.10	39.00	1.420
L.S.D. 5 % level	4.50	70.35	0.60	3.75	0.0754
Number of plant per hill					
1 plants	59.78	1357.00	24.10	28.00	0.990
2 plants	51.12	1122.00	23.20	26.80	1.101
3 plants	41.30	826.00	22.60	24.90	1.123
4 plants	35.10	775.00	21.75	23.10	1.230
L.S.D. 5 % level	5.20	72.33	1.10	4.03	0.0670

- Effect of Interaction:-

Analysis of variance indicated that the interaction between nitrogen levels and number plants per hill was significant on all characters under study as shown in Table (6), where the highest values of the studied characters are listed. This Table showed that all seed characters were affected significantly by the interaction (N. levels X No. plants / hill).

Table (6): Highest values of seed yield and its component as affected by significant interaction between the experimental factors in two seasons

Characters	Highest value	Treatments
No. of capsules/ plant	77.39	60 kg N x 1 plant/hill
No. of seeds per plant	1662.00	60 kg N x 1 plant/hill
Seed index weight of 100 seeds in (gms)	28.30	60 kg N x 1 plant/hill
Seed yield per plant (gms)	45.30	60 kg N x 1 plant/hill
Seed yield per faddan (kgs)	1.55	60 kg N x 1 plant/hill

**** Chemical properties of fibers:-**

Cellulose, pectin, lignin, wax and ash content, for kenaf fibers as affected by N levels and number of plants per hill from the combined experiments of the two seasons are shown in Table (7).

Table (7): Means of chemical properties of fibers as affected by N. levels and number of plants per hill from the combined analysis of two seasons

Characters Treatments	Cellulose %	Pectin %	Lignin %	Wax %	Ash %
Nitrogen levels					
Zero	75.90	8.42	5.44	1.47	0.92
15 kgs/fad	76.20	8.75	5.62	1.53	0.98
30 kgs/fad	76.40	8.99	5.83	1.64	0.91
45 kgs/fad	76.95	9.10	5.98	1.79	0.87
60 kgs/fad	79.22	9.23	6.10	1.88	0.82
L.S.D. 5 % level	0.44	NS	0.13	NS	NS
Number of plant per hill					
1 plants	76.99	8.89	5.54	1.66	0.92
2 plants	76.91	8.72	5.47	1.61	0.96
3 plants	76.82	8.71	5.36	1.57	0.98
4 plants	76.66	8.62	5.29	1.51	1.00
L.S.D. 5 % level	0.19	NS	0.17	NS	NS

Fiber cellulose content and lignin content increased significantly as nitrogen fertilizer increased from 0.0 to 60 kg N/faddan. While, pectin content and wax content increased slightly as nitrogen fertilizer increased from 0.0 to 60 kg N/faddan. Significant decrease in cellulose content and lignin content was obtained as number of plants per hill.

While, there was a slight and insignificant increase in ash content as number of plant per hill increased from one to four plants. This agreed with El-Sonbaty (1974) El- kholy *et al.* (1984), Sahseh *et al.* (1986), Xiao *et al.* (1993) and Mostafa (2003).

CONCLUSION

In conclusion, for high production of fiber yield of kenaf with good Quality, 60 kg N/faddan and 4 plants per hill would be recommended and for high production of seed yield 60 Kg N/faddan and 1 plant per hill is recommended.

REFERENCES

- A.O.A.C. (1965): Official Methods of Analysis of Association of Official Agricultural Chemists. Ed. 10. Washington D. C. 20044
- Amankwatia, X.O. and Takyi, S.K. (1975): Some fertilizer experiments b with kenaf (*Hibiscus cannabinus*. L). In Ghana. 1-Preliminary studies on the effects of fiber yield of kenaf. Ghana J. of Agric. Sci., 8 (2); 127-134.
- Amaducci, M.T.; Venturi, G. and Bentai, R. (1990): Effect of kenaf plant density. Informatore-Agrario. 46 (25): 27-32. Italy.
- Bukhtiar, B.A.; Iqbal, M.A.; Iddris, M.; Ahmad, I. and Kausar, A.G. (1990): Effect of sowing date and plant population on fiber yield of kenaf (*Hibiscus cannabinus* L.) J. of Agric. Res. Lahor. 28 (2): 99 – 105.
- Boonklinkajorn, P. and Visuttipitakul, S. (1970): Responses of kenaf (roselle) to fertility soil series. Report on research projectNo. 1/4, Cooperative Research programme, No. 1, Applied Scientific Research Cooperation of Thailand No. 6, 12 pp
- El- Kholy, S.A.; Sahseh, A.I. and Mohamed, M.A. (1984): Varietal response of *Hibiscus sabdariffa*, L. to increasing nitrogen fertilization. Minufiya Jour. Agric. Res. V. 8: J., 347 - 362.
- El- Sonbaty, M.M.A. (1974): Effect of some cultural. Treatments on technological prosperities of kenaf fibers. M.Sc. thesis, (Agric.), Al-Azhar Univ. Egypt.
- Gad, A.Y.; Shalaby, I.A.; Abo El-Saad, I.A., Momtaz A. and El Farouk, M. (1976): Requirements of kenaf (*Hibiscus cannabinus*, L.) to various levels of fertilizers. Jour. Agric Res., Tanta Univ., 2 (3): 50-63.
- Hassan, T.N. (1977): Effect of some cultural practices on kenaf (*Hibiscus cannabinus*, L.). M. Sc. Thesis. Fac. of Agric., Kafr El-Sheikh, Tanta Univ. Egypt.

- Khan, A.H.; Hashmi, P.M. and Khan, K.A. (1968): Studies in lignin contents of jute, kenaf and other vegetable fibers as influenced by spacing, manures and growing periods. *Pakistan Jour. of Science*, 20 (5/6): 192-197.
- LeClerg, E.L.; Lenard, W.H. and Clark, A.G. (1966): *Field plot technique*. Burgross publishing Co. Minneapolis Minnesota, U.S.A.
- Mckinstry, A.H. (1960): Gatooma. Research Station, Kenaf spacing fertilizer trial. Rep. Sec. Fed. Minist. Agric. Phod. and Nyasland 1959 Salisbury.; 87-98.
- Momtaz, A.; Zahran, M.; El-Kredy, M.S. and Nasr El-Deen, T. (1978): Studies of some agronomic practices on kenaf (*Hibiscus cannabinus* L.) .1. Effect of nitrogen levels and plant population on kenaf yield and its components. *J. Agri. Res. Tanta Univ.* 4:1-69 – 76.
- Momtaz, A.; Shalaby, T.A.; Salim, O. and El-Farouk, M. (1977): Relationship between planting date and different levels of nitrogen and their effects on kenaf (*Hibiscus cannabinus* L.). *J. Agric. Res., Tanta Univ.*, V.3: (1): 51- 67.
- Mostafa, S.H.A. (2003): Effect of number of plants per hill on yield and yield components in some kenaf (*Hibiscus cannabinus* L.) genotypes. *Egypt J. Agric. Res.* 81 (2): 609 – 620.
- Nafees, M.K. and Shah, P. (1993): Effect of plant population on green stalk, dry stalk and fiber yields of jute and kenaf varieties. *Pakistan J. of Agric. Res.* 4(2): 111 – 115.
- Radwan, S.B.H. and Momtaz, A. (1966): The technological properties of flax fibers and methods of estimating them. *El- Felaha J.* 46 (3): 466- 476 (In Arabic).
- Sahsah, A.I.; El-Shimy, G.H. and Gaafar, S.M. (1986): Effect of nitrogen levels and number of plants per hill on growth, yield and quality of kenaf (*Hibiscus cannabinus* L.). *Annals of Agric. Sci., Moshtohor* 24 (2): 697 – 717.
- Snadecor, G.A. and Cochran, W.G. (1967): *Statistical methods*, sixth edition, Iowa State College Press., Amas., Iowa. U.S.A.
- Xiao, A.P.; Tian, X.L. and Leng, J. (1993): Analysis of kenaf seed composition. *Bast fiber Res. Inst. CAAS, Yuanjiang, China's Fiber Crops* 15 (3):16-17.

تأثير بعض المعاملات الزراعية على إنتاجية وجودة محصول التيل

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أجري هذا البحث بمزرعة محطة البحوث الزراعية بإيتاي البارود محافظة البحيرة موسمي ٢٠٠٤ و ٢٠٠٥ لدراسة تأثير خمس مستويات من التسميد الأزوتي (صفر، ١٥، ٣٠، ٤٥، ٦٠ كجم / ف) وعدد النباتات لكل جورة وهي (١، ٢، ٣، ٤ نبات/جورة) على محصول وجودة ألياف التيل للصنف كوبا المستورد. وكانت أهم النتائج:-

- ١ - كان هناك زيادة في كل صفات المحصول الأخضر (الطول الكلي - الطول الفعال - طول المنطقة الثمرية - سمك النبات - المحصول الأخضر لكل من النبات والفدان) وكذلك صفات البذرة (عدد الكبسولات للنبات - عدد بذور النبات - وزن ١٠٠٠ بذرة - ومحصول البذرة للنبات والفدان) مع زيادة مستويات التسميد الأزوتي من صفر إلى ٦٠ كجم / ف.
- ٢ - أشارت النتائج إلى نقص في صفات الألياف مع زيادة مستويات النيتروجين ما عدا صفة طول الألياف وقد زادت مع زيادة مستويات النيتروجين .
- ٣ - أما بالنسبة للتركيب الكيماوي للألياف أدت زيادة مستويات النيتروجين إلى زيادة التركيب الكيماوي (السيالوز واللجنين) مع زيادة مستويات النيتروجين من صفر إلى ٦٠ كجم / ف، بينما أدت هذه الزيادة إلى نقص في مكون الرماد للألياف .
- ٤ - أوضحت النتائج إلى زيادة معنوية في كل من (الطول الكلي - الطول الفعال - المحصول الأخضر للنبات والفدان - النسبة المئوية للألياف - طول الألياف - نعومة الألياف - نسبة الرماد) مع زيادة عدد النباتات من ١ إلى ٤ نباتات بالجورة.