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EFFECT OF NUMBER OF PLANTS PER HILL ON YIELD AND YIELD COMPONENTS IN SOME KENAF (*HIBISCUS CANNABINUS L.*) GENOTYPES

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Abstract

This investigation was carried out in the farm of Ismaelia Agric. Res. Station, A.R.C. during the two successive seasons 2000 and 2001 to study the effect of number of plants per hill on yield and its related characters among four kenaf genotypes. Results indicated that: the promising strain 105/16-5 recorded the highest estimates in plant height, technical length, green and fiber yield/ fad. , followed by the imported variety Tyaning . But the lowest estimates for the above mentioned characters were recorded for Giza 3 variety. Increasing number of plants / hill caused gradual increment in each of plant height, technical length, green and fiber yield / fad. also it resulted in significant decline in fruiting zone length, stem diameter and green yield/plant .Giza 3 variety ranked first in number of capsules /plant, number of seeds/ capsule, seed index, seed yield / plant as well as per fad, and the imported variety Tyaning ranked second. The lowest estimates were recorded for S.16. Increasing the number of plants/hill caused an increase in seed yield/ faddan, while there was reduction in no. of capsules/plant, no. of seeds/ capsule and seed yield per plant. S. 105/16-3 recorded the highest estimates for fiber length, fiber percentage, and fiber fineness, while Giza 3 variety was the lowest one for the mentioned characters, and the second position in seed oil percentage after S.16. There was significant increase in fiber length, fiber percentage, fiber fineness and seed oil percentage with increasing number of plants/ hill. Correlation coefficient values were significant and positive between fiber yield and plant height, technical length, stem diameter and green yield/ plant for all kenaf genotypes, in addition to (r) value in number of capsules/plant for Tyaning variety. Significant and positive correlation coefficients were observed between seed yield/plant and fruiting zone length, no. of capsules/plant in all kenaf genotypes in addition to seed index for Giza 3 variety and S.105/16-3.

INTRODUCTION

Kenaf (*Hibiscus cannabinus L.*) belongs to family Malvaceae is an important member of the bast fiber crops group, where its fibers are isolate from other actual stem

length tissues by a retting process. Kenaf crop is grown to obtain fibers which are used alone or after mixing with Jute fiber, for manufacturing burlap, sacks and twine. Moreover, kenaf seeds contain similar oil which extracted from cotton seeds as edible for human.

Kenaf seeds contain 18-20 % edible oil for human use, it is better than cotton seed oil because it is free from Gossipole which found in cotton seed oil.

At present, Egypt promotes culture kenaf to minimize hard currency paid annually for Jute fiber importation. In addition, kenaf is more tolerant to high soil salinity and is more adapted to these soil than most other summer crops.

The main target of this study is to evaluate the effect of four kenaf genotypes under three plant numbers per hill, on fiber quantity and quality. Moreover, this work included interrelationships between fiber and seed yields and some kenaf characters. Many investigators studied the differences between kenaf genotypes such as Salih (1981), Osman and Momtaz (1982), Sij and Turner (1988), El-Kady *et al.*(1990), Xiao *et al.*, (1993), Webber (1993) and El-Kady and El-sweify (1995), and reported that the genotypes differed in their traits.

Concerning number of plants per hill, Sahsah *et al.*, (1986), Amaducci *et al.*, (1990), Bukhtiar *et al.*, (1990), Nafees *et al.*, (1993) and El-Farouk and El-Sweify (1998) reported that plant population had a great effect on kenaf yield, yield components and technological characters.

The interrelationships between fiber yield or seed yield and agronomic characters were studied by several investigators Mourad *et al.*, (1987), El-Shimy *et al.*, (1990), Bunpromma (1992) and El-Farouk and El-Sweify (1998) energy reserve compounds and survival and infectivity of IJ via antijuvenile hormone.

MATERIAL AND METHODS

This investigation was carried out at Ismaelia experimental Station during the summer seasons of 2000 and 2001 to evaluate four kenaf genotypes (Giza 3, S.105/16-3, S.16 and Tyaning imported from Nigeria) under three plant populations (1,2 and 3 plants/hill). The experimental soil was sandy in texture and sprinkler irrigation was used. A split plot design with four replications was utilized, the four kenaf genotypes as main plots and the three plant populations as sub-plots. The sub-plot area was 10.5 m^2 (3 x 3.5 m) including 7 ridges, 20 cm between hills. Cultivation was on one side of the ridge. Each hill was sown with about five seeds and it was thinned after 30 days

from sowing according to the following experimental factors:

1- One plant/hill; a plant density of 42000 plants/fad.

2- Two plants/hill; a plant density of 84000 plants/fad.

3- Three plants/hill; a plant density of 126000 plants/fad.

Normal agricultural practices were applied as usually done in the ordinary kenaf fields. At maturity, ten random guarded plants from each sub plot were used in measurements of yield components.

Characters studied:

Green yield and its components: plant height (cms), technical length (cms), fruiting zone length (cms), stem diameter (mms), green yield/plant (gs), green yield/fad. (tons) and fiber yield/fad. (tons).

Seed yield and its components: no. of capsules/plant, no. of seeds/capsule, seed index (gs), seed yield/plant(gs) and seed yield/fad. (tons)

Fiber and seed properties: fiber length (cms), fiber percentage (%), fiber fineness (Nm) and seed oil content.

The statistical analysis was carried out according to the procedures mentioned by Snedecor and Cochran (1982). Combined analysis was performed for each character over two growing seasons as described by Le Clerg et al., (1966). The differences between means were tested according to L.S.D. method at 5% level.

Correlation studied:

Correlation coefficients were computed between fiber yield/plant and each of plant height, technical length, branching zone length, stem diameter, green yield/plant, no. of capsules/plant and seed yield/plant.Correlation coefficients were also estimated between seed yield/plant and each of plant height, technical length, branching zone length, stem diameter, green yield/plant, no. of capsules/plant, seed index and fiber yield/plant.

RESULTS AND DISCUSSION

Green yield and its components:

Data presented in Table (1) show mean values of the four kenaf genotypes as affected by the number of plants per hill combined over seasons.

Effect of genotypes:

Analysis of variance indicated that kenaf genotypes differed significantly in green yield characters, whereas, the promising strain 105/16-3 gave the highest values among investigated genotypes which could be arranged in descending order as follow: S. 105/16-3, Tyaning, S.16 and finally Giza 3 variety concerning plant height, technical length, green and fiber yield per faddan. But for green yield/plant, Tyaning and S.105/16-3 changed their position without significant differences, where Tyaning was the first. On the other hand, Giza 3 recorded the highest estimate for fruiting zone length and superior over Tyaning by 0.98%; S.105/16-3 by 9.92% and S.16 by 22.82%. However, S.105/16-3 was the lowest one (11.20 mm) and Giza 3 gave the highest value for stem diameter (13.03mm), while Tyaning and S. 16 had intermediate position in this case (11.85 and 11.85 mm)

The present results are might be due to differences in genetic constitution of studied genotypes. Similar results were obtained by Sij and Turner (1988), Webber (1993) and El-Kady and El-sweify (1995).

Effect of number of plants/hill:

Data presented in Table (1) revealed that number of plants/hill significantly affected all characters studied. Plant height significantly increased by increasing number of plants/hill, a similar trend was obtained with technical length. On the other hand, fruiting zone length, stem diameter and green yield per plant showed significant decreases with increasing number of plants/hill from one to three plants per hill. In spite of these decline in green yield components there were significant increases in green yield/fad. and fiber yield/fad. with increasing number of plants/hill. Moreover, these increases in green yield/fad. as well as fiber yield/fad. may be due to the increases in number of plants per unit area. Similar findings were obtained by Sahsah *et al.*, (1986), Bukhtiar *et al.*, (1990) and Nafees *et al.*, (1993).

Seed yield and its components:

Mean values of seed yield and its components of four kenaf genotypes as affected by number of plants/hill from the combined analysis over seasons are presented in Table (2).

Effect of genotypes:

The statistical analysis showed significant differences among kenaf genotypes in all studied characters. It is clear that Giza 3 kenaf variety ranked first in all seed characters except number of seeds per capsule where it laid the second position. Moreover, the order of kenaf genotypes was Giza 3, Tyaning, S.105/16-3 and S.16 for number of capsules/plant, seed index, seed yield per plant as well as per faddan. On the contrary, the imported kenaf variety (Tyaning) ranked first in number of seeds/capsule followed by Giza 3, S. 105/16-3 and S.16. It could be concluded that these differences between kenaf genotypes may be due to variability in genetic constituents. These results are in harmony with those obtained by Osman and Momtaz (1982), El-Kady *et al.*,(1990) and El-Shimy *et al.*, (1990).

Effect of number of plants/hill:

Data presented in Table (2) showed significant reduction in number of capsules/plant, number of seeds/capsule, seed index and seed yield/plant with increasing number of plants/hill, that may be due to more competition among relatively more plants per hill. On the other hand, there were significant increase in seed yield per faddan with increasing number of plants/hill that may be due to the increases in number of plants per faddan as a result of increasing number of plants per hill up to three plants per hill. These results are in general agreement with those obtained by Sahsah *et al.*, (1986), Amaducci *et al.*, (1990), Bukhtiar *et al.*, (1990) and Nafees et al., (1993).

Fiber and seed properties:

Means of fiber and seed properties for the four kenaf genotypes as affected by three number of plants per hill (combined analysis over two seasons) are presented in Table (3).

Effect of genotypes:

Data showed significant effect of genotypes on fiber and seed properties. The promising strain 105/16-3 was the best one for technological properties of kenaf fiber

with mean values of 284.50 cm, 5.15% and 129.30 Nm for fiber length, fiber percentage and fiber fineness, respectively. S. 16 surpassed the other genotypes for seed oil percentage being 20.38%. Moreover, the superiority ratios between the first genotype (S. 105/16-3) and the last one (Giza 3) were 20.35 %, 17.16 % and 12.05 % for fiber length, fiber percentage and fiber fineness, respectively. However, these superior ratio reach to 24.65 % for seed oil percentage between S. 16 and Tyaning. These results are in harmony with those obtained by Salih (1981), Xiao *et al.*, (1993) and El-Farouk and El-Sweify (1998).

Effect of number of plants/hill:

Results indicated that the number of plants per hill significantly affected fiber properties i.e., fiber length, fiber percentage and fiber fineness, while the differences in seed oil percentage were insignificant as shown in Table (3). It is clear that there were gradual increments in the mean values of all fiber and seed properties with increasing number of plants/hill. The best quality for fibers and seed could be achieved by planting three plants per hill. These results are in accordance with those obtained by Sahsah *et al.*, (1986), Amaducci *et al.*, (1990) and Nafees *et al.*, (1998).

Effect of the interaction:

Analysis of variance indicated that the interaction between kenaf genotypes and number of plants per hill was significant in all characters under study i.e., green, seed yields and their components as well as fiber and seed properties.

Correlation studies:

Simple correlation coefficients between fiber yield per plant and some agronomic characters for each of four kenaf genotypes are presented in Table (4).

Data showed positive and significant correlation between fiber yield per plant and each of plant height, technical length, stem diameter and green yield per plant and no. of capsules/plant for only Tyaning. While number of capsules per plant for the other three genotypes and seed yield per plant for all genotypes appear to be only positive for the 4-kenaf genotypes i.e., Giza 3, S.105/16-2, S. 16 and Tyaning.

The above mentioned results mean that each of studied kenaf characters contribute to increasing fiber yield/plant. Thus, the kenaf breeder must consider these correlation in selection to improve kenaf fiber yield production.

Table (1): Mean values of green yield and its components for four kenaf genotypes as affected by number of plants per hill (combined analysis of 2000 and 2001 seasons)

Characters / Treatments	Plant height (cm)	Technical length (cm)	Branching zone length (cm)	Stem diameter (mm)	Green yield/plant (g)	Green yield/fad. (ton)	Fiber yield/fad. (ton)
Genotypes							
Giza 3	312.60	240.60	72.00	13.03	163.27	16.23	0.657
S. 105/16-3	355.30	289.80	65.50	11.20	202.60	18.85	0.971
S. 16	334.20	275.60	58.62	12.10	185.80	16.74	0.795
Tyaning	351.80	280.50	71.30	11.85	210.35	18.15	0.962
L.S.D. (5%)	3.50	4.20	6.10	0.41	8.20	0.55	0.03
Interaction	*	*	*	*	*	*	*
Number of plants/hill							
1 plant/hill	340.20	264.90	75.30	13.33	207.10	17.81	0.842
2 plants/hill	254.50	284.50	70.00	11.05	183.50	18.25	0.914
3 plants/hill	362.70	299.30	63.40	10.71	175.40	18.91	0.981
L.S.D. (5%)	5.90	2.50	3.03	0.28	7.40	0.43	0.04
Interaction	*	*	*	*	*	*	*

Table (2): Mean values of seed yield and its components for four kenaf genotypes as affected by number of plants per hill (combined analysis of 2000 and 2001 seasons)

Characters / Treatments	No. capsules/plant	No. of seeds/capsule	Seed index (g)	Seed yield/plant (g)	Seed yield/fad. (ton)
Genotypes					
Giza 3	55.30	20.90	25.10	28.30	435.65
S. 105/16-3	41.00	18.50	24.45	21.55	383.70
S. 16	36.80	17.30	21.63	18.30	349.20
Tyaning	50.40	21.60	24.75	25.90	404.90
L.S.D. (5%)	2.80	2.04	1.80	2.30	11.50
Interaction	*	*	*	*	*
Number of plants/hill					
1 plant/hill	58.60	18.30	23.80	25.40	385.75
2 plants/hill	50.00	17.10	23.55	20.06	410.84
3 plants/hill	36.20	15.90	23.50	18.50	431.20
L.S.D. (5%)	3.60	2.30	N.S.	2.00	15.70
Interaction	*	*	*	*	*

Table (3): Mean values of fiber and seed properties for four kenaf genotypes as affected by number of plants per hill (combined analysis of 2000 and 2001 seasons)

Characters / Treatments	Fiber length (cm)	Fiber (%)	Fiber fineness (Nm)	Seed oil (%)
Genotypes				
Giza 3	236.40	4.05	115.40	19.75
S. 105/16-3	284.50	5.15	129.30	19.02
S. 16	270.00	4.75	119.00	20.38
Tyaning	273.80	4.20	125.60	16.35
L.S.D. (5%)	8.20	0.34	8.93	0.41
Number of plants/hill				
1 plant/hill	259.30	4.73	121.33	18.65
2 plants/hill	268.14	5.01	126.50	19.01
3 plants/hill	281.65	5.19	129.40	19.24
L.S.D. (5%)	6.7	0.32	3.30	N.S.
Interaction	*	*	*	*

Table (4): Simple correlation coefficients between fiber yield and some characters of four kenaf genotypes

Characters / Treatments	Giza 3	S. 105/16-3	S.16	Tyaning
Plant height (cm)	0.641*	0.528*	0.569*	0.613*
Technical length (cm)	0.633*	0.585*	0.604*	0.621*
Stem diameter (mm)	0.546*	0.631*	0.608*	0.703*
Green yield/plant (g)	0.662*	0.649*	0.633*	0.647*
No. capsules/plant	0.422	0.355	0.419	0.498*
Seed yield/plant (g)	0.384	0.396	0.315	0.308

Table (5): Simple correlation coefficients between seed yield and some characters of four kenaf genotypes

Characters / Treatments	Giza 3	S. 105/16-3	S.16	Tyaning
Plant height (cm)	0.418	0.383	0.362	0.422
Technical length (cm)	0.451	0.438	0.425	0.392
Fruiting zone length (cm)	0.722*	0.619*	0.678*	0.745*
Stem diameter (mm)	0.295	0.343	0.411	0.439
Green yield/plant (g)	0.418	0.365	0.472	0.439
No. capsules/plant	0.707*	0.631*	0.596*	0.722*
Seed index (g)	0.655*	0.740*	0.783	0.661
Fiber yield/plant (g)	0.325	0.416	0.427	0.435

In general, it is clear that all characters under study affected each other in positive manner allowing kenaf breeders alternatives in selection to raise kenaf fiber yield in different genotypes. These results agreed with those obtained by Mourad *et al.*, (1987) and El-Shimy *et al.*, (1990)

Correlation coefficient values between seed yield per plant and some agronomic characters for each of four kenaf genotypes are presented in Table (5).

Simple correlation coefficient values between seed yield/plant and each of fruiting zone length, number of capsules/plant for all genotypes and seed index for Giza 3 and S.105/16-3 were significant and positive, while the relationships appeared to be only positive for plant height, technical length, stem diameter and green yield/plant for the kenaf genotypes under study.

It could be concluded that the two characters i.e., fruiting zone length and no. of capsules / plant had great effect on seed yield. Seed index of only the two kenaf genotypes Giza 3 and S.105/16-3 was correlated with seed yield. Moreover, the breeder must take into consideration these character to increase seed yield production .These results are in harmony with those obtained by El-Farouk and El-Sweify (1998) and Bunpromma (1992).

Conclusion:

It could be concluded that a plant population of 126000 per fad. (3 plants/hill) from the promising strains 105/16-2 gave the best quantity and quality of kenaf fiber in the sandy soils like those of Ismaelia region. This requires about 14 kg seeds/fad.

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تأثير عدد النباتات بالجورة على المحصول ومكوناته لبعض التراكيب الوراثية من التيل

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أجرى هذا البحث بمزرعة محطة البحوث الزراعية بالإسماعيلية . موسمى ٢٠٠٠ / ٢٠٠١ لدراسة تأثير عدد النباتات بالجورة على المحصول وصفاته المرتبطة وبعض الصفات التكنولوجية لأربعة تراكيب وراثية من التيل وأشارت النتائج الى :

١ – حققت السلالة ١٠٥ / ١٦ – ٣ أعلى تقديرات فى الطول الكلى ، والطول الفعال ،المحصول الأخضر / فدان ، محصول الألياف / فدان ، يليها الصنف المستورد تيانتج ، بينما سجل الصنف جيزة ٣ أقل التقديرات للصفات سابقة الذكر . أدت زيادة عدد النباتات فى الجورة الى زيادة متدرجة فى كل من الطول الكلى، الطول الفعال، المحصول الأخضر / فدان، محصول الألياف / فدان . بينما حدث نقص فى طول المنطقة الثمر يه سمك النبات ، المحصول الأخضر / نبات .

٢ – إحتل الصنف جيزه ٣ المرتبة الأولى فى صفات عدد الكبسولات / نبات ، عدد البذور / كبسولة ، وزن الألف بذره ، محصول البذرة / نبات وللفدان ، واحتل الصنف تيانتج المرتبة الثانية وكانت أقل التقديرات قد تحصل عليها من السلالة ١٦ فى كل صفات البذرة الخمسة تحت الدراسة .

أدت زيادة عدد النباتات فى الجورة الى زيادة محصول البذور / فدان ونقصاً فى عدد الكبسولات للنبات ، عدد البذور / كبسولة ، محصول البذور / نبات .

٣ – حققت السلالة ١٠٥ / ١٦ – ٣ أعلى قيم لكل من طول الألياف والنسبة المئوية للالياف ونعومة الألياف ، بينما إحتل الصنف جيزه ٣ المركز الأخير بالنسبة للصفات السابقة والمركز الثانى فى النسبة المؤية للزيت بعد السلالة ١٦ ، كان هناك زيادة فى طول الألياف ، النسبة المئوية للألياف ، نعومه الألياف، النسبة المئوية للزيت بزيادة عدد النباتات فى الجورة .

٤ – كانت قيم معامل الإرتباط معنوية وموجبة بين محصول الألياف وكل من الطول الكلى والطول الفعال وسمك الساق والمحصول الأخضر / نبات فى كل التراكيب الوراثية من التيل تحت الدراسة بالأصناف الى معامل الإتباط فى صفة عدد الكبسولات / نبات للصنف تيانتج .

٥ – أظهرت قيم معامل الإرتباط بين محصول البذرة وكل من طول المنطقة الثمرية وعدد الكبسولات / نبات معنوية وموجبة فى كل التراكيب الوراثية من التيل تحت الدراسة بالإضافة الى صفة دليل البذرة لكل من الصنف جيزة ٣ ، س ١٠٥ / ١٦ – ٣ فقط .