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RESPONSE OF KENAF (*Hibiscus cannabinus* L.) TO NITROGEN FERTILIZER AND PLANT POPULATION UNDER BASRAH ENVIRONMENTAL CONDITIONS

Majid, H. R.; K. H. Huthily and D. S. Kareem
Field Crop Dept. Agriculture College , Basrah University

ABSTRACT

In order to grow kenaf crop in a large scale for manufacturing paper pulp for paper industry, many agronomics factors need to be known, among them nitrogen fertilizer levels and plant population density for maximum yield. Thus, experiments were conducted to determine the effect of four nitrogen levels (0,75,150, and 225kg N/ha) and two plant population (15 and 25 plants/m^2) on seasons kenaf crop (Var. India) during the two growing of 2009 and 2010 at the field of General company for Paper Industry located 25 km North Basrah town. Increasing nitrogen fertilizer resulted levels in increases in plant height and stem diameter. Application of 255 kg N/ha gave highest bark percentage (38.9 %) and consequently increased bark yield (6.36 ton/ ha). Planting 25 plants/m^2 gave highest plant height (307.9 cm.), bark percentage (34.33 %) and bark yield (5.54 ton/ha) but reduced stalk diameter . The interaction between highest nitrogen fertilizer (255 kg N/ha) and highest plant population density (25 plants/m^2) gave highest stalk yield (18.03 ton/ha) and bark percentage (41.94%). It was concluded that kenaf crop has good potential to be planting on large scale by increasing nitrogen fertilizer to 255 kg N/ha and highest plant population (25 plants/m^2) under Basra environmental conditions.
Keywords: Kenaf , nitrogen fertilizer levels, plant population density

INTRODUCTION

Kenaf (*Hibiscus cannabinus* L.) is a warm season annual crop , it is a fast growing and a multi-purpose crop since the two stem fractions (bark & core) can be used for a number of industrial application such as (paper, insulation mats, oil chemical absorbent, energy production, etc.) Alexopoulou *et al*. (2007) In Iraq it is used as a source of fiber that can be used for making high quality of paper and other related products. The State Company for Paper Industry located 25 km north Basrah town used wild cane(*Phragmites cormmunis*) as a source of pulp for paper making. Kenaf crop has better quality and has been suggested by several researchers for use as both fiber and fodder crop (Danalatos and Archontoulis (2004), Alexopoulou *et al*. (2007) and Hossain *et.al* (2011). Data from different parts of the world have found good potential of becoming an excellent source of fiber in the manufacturing of pulp for paper and other products such as poultry litter at cattle feed (Kugler, 1988 and Perry *et al.* 1992). Kenaf crop has been planted by farmers in south of Iraq in limited area as fences or use it to produces robs and twin. In order to produce kenaf crop as a commercial crop on a large scale in Iraq, many scientific information about its production need to be known like plant population and nitrogen fertilizer recommendations. Acreche *et al* (2005) in Argentine found that combination of 35 cm row spacing and 25 plants/m lineal density of 714286 plants/ha, resulted in the

best dry bark yield. Between the two plant population used by Alexopoulou *et al*, (2000),showed that the high plant population (320000 plant/ha) was more productive than the low one (170000 plant ha^{-1}) but this difference was statistically significant only until flowering phase . In Spain it was reported that the best density was 400000 plant /ha (Manzanares *et al*, 1997) Generally high plant population have been reported to exhibit higher fresh and dry matter yields up to 50 plant /m^2 (Manzanares *et al*, 1997 and Kipriotis *et al*,1998), however the greater at plant density the lower the stem diameter (Naffes *et al*, 1983 and Salish 1983). Reports and researches on nitrogen effect on kenaf stalk yield are inconsistent, some found positive effects (Lakshminarayana *et al*,1980) and other no benefits (Webber, 1996). Danalatos and Archontoulis (2004) studied the growth and biomass productivity of tow kenaf variety (Tainnung 2 and everglades 41) under four levels of N doss (0, 50, 100 and 150 kg N/ ha) and two plant population (20 and 30 plnt/m^2) they reported that N-fertilization in the studied range didn't affect significantly growth and productivity while plant population in the study range had a minor effect on biomass accumulation in both cultivars. In the San Joaquin valley , California , Bhangoo *et al*, (1986) studied the effect of row spacing (38 and 76 cm) plant population (86459 , 172900 and 345800 plants ha^{-1}) and (0, 45, 90, 135 and 180 kg N/ha) using the cultivars tainnung 1 and Cuba 2032 they found that narrow spacing (38 cm) resulted in higher yield than 76 cm spacing for both cultivars. Danolatos and Archontoulis (2004) found in western Thessaly, Greece no effect of fertilization in the range of 0-150 kg N/ha apparently due to the low N needs of the crop and high fertilely status of the study soil. Abdul-Hamid *et al* (2009) reported increasing trends with increasing the rate of fertilizer specially in wet season, a significant effect where only observed for diameter, height, leaf number area and biomass .

The objective of this investigation was amid study the effect of nitrogen fertilizer level and plant population density on fiber yield and edit component under Basrah environmental conditions.

MATERIALS AND METHOD

Two field experiments were conducted on field belong to the Paper Industry Company located 25 Km North of Basrah town. The experiments were set to determine the effect of nitrogen fertilizer levels (0, 75, 150 and 225 kg N/ha as urea 46% N) and plant population density (15 and 25 plant/ m^2) on yield and quality of kenaf crop. The experiment was planted at 25^{th} of march and 20^{th} of march for year 2009 and 2010, respectively on soil their physical and chemical properties are presented in Table 1. The experiment design was randomized complete block for both years and each one replicated three times. The seed of India variety was planted on row spaced 60 cm and spacing between the plant 15 and 25 cm. Each experimental unit consisted of four rows 6 meters long. All plants received full irrigation and maintained weed free by hand weeding after sowing whenever necessary. All plots had received a based dressing with 50 kg P_2O_5 was incorporated in the

soil at planting. Nitrogen fertilizer was added according to the treatment in a split application when the plant stands reached 40-50 cm height. The kenaf stalk were harvested at the onset of the flowering for both seasons.

The measurement were taken on stalk yield which taken from the central two rows 3 m long from each and calculated on dry weight basis with no leaves or branches. Five plants were taken from each plot harvest and the other the following measurement were taken on plant height, bark percentage, stem diameter and bark yield (counted from multiplied bark% and stalk yield).

For analysis of variance, year were considered as random effect while nitrogen levels and plant population were considered as fixed effect. Error variance from separate analysis of the data was tested for homogeneity following procedure in Gomez and Gomez (1984) and found homogenous, thus, a combined analysis across year were calculated . Treatment means were compared using L.S.D. at $p < 0.05$ of significant.

Table 1: Soil characteristics (to depth 25 cm) and weather growing season data at 2009 and 2010 seasons

Year	Available N	P	K	OM $gmkg^{-1}$	EC $dS.m^{-1}$	pH	Clay	sand	silt	texture
	ppm						%			
2009	29	15.2	17.50	10.3	5.3	7.62	28.4	13.2	58.4	Silt loam
2010	31	21.41	19.40	9.8	6.1	7.74	269	125	606	Silt loam

Month	2009		2010	
	Mean temp. ^{o}C	Rain fall (mm)	Mean Temp. ^{o}C	Rain fall (mm)
March	20.7	18.3	22.3	-
April	27.1	14.3	25.9	19.2
May	30.3	-	32.1	3.2
June	35.4	-	34.3	-
July	37.6	-	38.1	-
Aug.	40.1	-	39.8	-

RESULTS AND DISCUSSION

The results of soil analysis and weather are presented in Table1 showed little variation in soil characteristics except in the season 2009 where the E.C. was lower (5.3 dS/m) than the season 2010 (6.1 dS/m) and the climate were mostly similar during the growing season.

Plant height and stem diameter:

The combined analysis showed that there was a significant effect of nitrogen fertilizer levels and plant population density on plant height and stem diameter. Increasing nitrogen fertilizer levels from 0 to 150 kg N/ha increased plant height from 276 to 311.5 cm (Table 2). Application of 150 kg N /ha and 225 kg N/ha had no differences on plant . height stem diameter showed a similar results as plant height in such that increasing nitrogen fertilizer levels

from 0 to 150 kg N/ha increased stem diameter by 63% from 1.62 to 2.65 cm (Table 2) .

Plant height and stem diameter are yield components , thus nitrogen should be applied to encourage vegetative growth leading to increased yield. Similar results have been reported by Sij and Turner (1988) in Texas, and Ching and Webber (1993) in Missouri.

Increasing plant population density from 15 to 25 plant /m^2 increased plant height significantly from 289.5 to 307.9 cm (Table2). Increasing plant population reduce stem diameter by 14% (from 2.29 to 1.98 cm (Table 2) , this may be due to increased plant height and was at the expanse of stem diameter ,similar result reported by Naffes *et al.* (1983) and Salish (1983).

Table 2: Effect of nitrogen fertilizer levels, plant population density as affected of means of plant height, stem diameter and bark yields combined data

Nitrogen kg/ ha	Plant height (cm)	Stem diameter (cm)	Bark yield (t/ ha)
0	276.0	1.62	3.31
75	296.5	2.06	4.78
150	311.5	2.65	5.57
225	311.0	2.21	6.36
$L.S.D_{(0.05)}$	17.2	0.31	0.61
Population $pl.m^{-1}$			
15	289.5	2.29	4.47
25	307.9	1.98	5.54
$L.S.D_{(0.05)}$	12.1	0.22	0.43
Year			
2009	302.9	2.21	5.04
2010	294.5	2.06	4.97
$L.S.D_{(0.05)}$	N.S.	NS	NS

Stem yield :

Nitrogen fertilizer levels and plant population density had significant effect on stem yield. Increasing nitrogen fertilizer from 0 to 150 kg N/ha increased stem yield from 11.31 to 17.50 ton/ha (55 %) (Table 3).This increased in stem yield may be due to increased plant height and stem diameter as shown in Table 2. Similar results reported by Alexopoulou *et al.*(2007b) and Lakshminarayana *et al*,(1980).Increasing nitrogen fertilizer above 150 kg N/ ha reduced stem yield and that may be due to variation in yield component stem height and stem diameter (Table 2). Plant population density had significant effect on stem yield. Increasing plant population density from 15 to 25 plant ha /m^2 increases stem yield from 14.34 to 15.79 ton/ha. Increased stem yield due to increased population may be due to increasing plant height (Table2).Increased plant height with increased plant population also compensated for the reduction in stem diameter. Increases in stem yield with increased plant population also reported by Muchow (1979) and Kipriotis *et al*. (1998).

Table 3: Effect of nitrogen fertilizer levels and plant population density on stalk yield and bark percentage as combined of both seasons.

Plant population plant m^{-2}	Nitrogen fertilizer kg/ha				Mean
	Stalk yield(t/ ha)				
	0	75	150	225	
15	10.43	14.42	17.88	14.64	14.34 b
25	12.19	15.81	17.12	18.03	15.79 a
Mean	11.31 c	15.12 b	17.50 a	16.34 ab	
	Bark %				
15	28.28	30.19	31.58	35.85	31.48 b
25	30.21	33.03	32.12	41.94	34.33 a
Mean	29.25 c	31.61 b	31.85 b	38.90 a	

$L.S.D._{0.05}$ (N x Population) for stalk yield = 2.56
$L.S.D._{0.05}$ (N x Population) for bark % = 4.81

Crop quality:

Crop quality refer in this study by bark percentage and bark yield. Results showed that increasing nitrogen fertilizer levels from 0 to 225 kg N/ha increased bark percentage significantly from 29.25 to 38.90 % (Table 3) . The slight reduction in stem yield when nitrogen fertilizer increased from 150 to 255 kg N/ha was compensated by increased in bark percentage because bark yield is the product of stem yield times bark percentage.

Treatment interaction:

There was a significant interaction between nitrogen fertilizer levels and plant population density for bark percentage, bark yield and stalk yield, however all these interaction follow similar pattern to main effect but in different magnitude. Results presented in Table (3) showed that the interaction between nitrogen fertilizer levels and plant population density for stalk yield and bark percentage where is the compensation of highest levels of nitrogen (225 kg N/ha) and plant population (25 plant/ m^2) gave the highest stalk yield and bark percentage (18.03 t/ha and 41.94%), respectively.

CONCLUSION

The results of this research are important if intended to expand the production area and increase productivity under Basrah environment conditions, further research are needed to study other agronomic factors and locations, in order to generalized the production of this important industrial crop.

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استجابة محصول الجلجل(القنب) (*Hibiscus cannabinus* L.) لاضافة السماد النتروجيني والكثافات النباتية تحت ظروف محافظة البصرة.

هاشم رشيد مجيد ، كاظم حسن هذيلي و ضرغام صبيح كريم
جامعة البصرة – كلية الزراعة – قسم علوم المحاصيل الحقلية

نفذت تجربتين حقليتين خلال الموسمين ٢٠٠٩ و ٢٠١٠ في حقل تجريبي يتبع الشركة العامة للصناعات الورقية في الهارثة الواقعة على بعد ٢٥ كم شمال مدينة البصرة. تهدف لدراسة مدى استجابة محصول الجلجل او القنب (Kenaf) لمستويات التسميد النتروجيني بالمستويات (صفر و ٧٥ و ١٥٠ و ٢٢٥ كغم نتروجين للهكتار) وهي تحت دراسة مستويين من الكثافات النباتية (١٥ و ٢٥ نبات /م^{٢}) . تم تنفيذ التجربة في تصميم القطاعات العشوائية الكاملة بثلاثة مكررات في تربة مزيجية غرينية ذات ملوحة ٥-٦ ديسيسيمنز/ م .

١-أوضحت النتائج ان زيادة التسميد النتروجيني أدت الى زيادة في ارتفاع النبات وقطر الساق ،وسجل التسميد بمعدل ٢٢٥ كغم نتروجين للهكتار أعلى نسبة مئوية للحاء بلغت ٣٨.٩ % وبالتالي أعلى محصول لحاء بلغ ٦.٣٦ طن/ هـ .

٢-اشارت النتائج الى ان استخدام كثافة نباتية ٢٥ بمعدل نبات / م^{٢} أعطت اعلى ارتفاع نبات (٣٠٧.٩ سم) وأعلى نسبة مئوية للحاء (٣٤.٣٣ %) وأعلى حاصل للحاء (٥.٥٤ طن/ هـ) وبنفس الوقت قللت قطر الساق .

٣- أظهرت النتائج ان التفاعل بين معدلات التسميد النتروجيني ٢٢٥ كغم نتروجين للهكتار والكثافة ٢٥ بمعدل نبات/ م^{2} تأثيراً معنوياً في نسبة اللحاء (٤١.٩٤ %) وحاصل السيقان (١٨.٠٣ طن /هـ) .

توصي النتائج امكانية زراعة محصول الجلجل(القنب) وبإنتاج جيد تحت ظروف محافظة البصرة في جنوب العراق.