Effects of age at harvest on the growth and fibre yield of kenaf, *Hibiscus cannabinus* L.

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SUMMARY

Experiments were conducted at Kwadaso, Kumasi, Ghana for 3 years to determine the optimum age of harvest of kenaf (*Hibiscus cannabinus* L.) for high yield of dry retted fibre. Results showed that kenaf variety Ghana Type 2 gave maximum yield of retted fibre when harvested at 105 days of crop-cycle, while Cuba 108 produced highest fibre yield after 105 days of harvesting. Similarly, A63-440 yielded maximum retted fibre after 150 days of crop cycle.

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RÉSUMÉ

ASANTE, A. K. & AMANKWATIA, Y. O.: *Effets de d''age de la récole sur la croissance et le rendement d'Habiscus cannabinus L.* Des études ont été conduites à Kwadaso, Kumasi-Ghana pour une période de trois ans dans le but de déterminer l'age optimum pour la récole d' *Hibiscus cannabinus* L. afin d'obtenir de plus haut rendement de la fibre roui sèche. Les résultats montraient que la variété Ghana Type 2 à donnée un rendeement maximum de la fibre roui lorssque il a été récolté à 105 jours du cycle de la culture, tandis que Cuba 180 a produite le plus haut rendement aprés 105 jours du cycle de la culture. L' A63-440 a aussi donné un rendement maximum de la fibre roui aprés 150 jours du cycle de la culture.

Introduction

Kenaf (*Hibiscus cannabinus* L.) is grown as a commercial jute substitute crop in Ghana. Cultural factors which affect fibre production in kenaf include time of sowing, age at harvest and seeding methods. Age at which the crop is harvested influences the yield of dry retted fibre, proportion of dry fibre in fresh stalks, and the quality of the fibre (Wilson & Joyner, 1969; Seale *et al.*, 1954). However, factors which have been used by many workers to determine the optimum time of harvest for fibre include age of plant, height and stage of flowering (Crane, 1945; Wilson & Joyner, 1969).

In an experiment carried out in the Kenana area of the Sudan, using kenaf cv. Cuba 108, Salih (1980) reported that plants continued to grow up to 147 days but highest dry ribbon yields were obtained after 117 days when plants were in full bloom.

Trials with six cultivars of *Hibiscus cannabinus* harvested on different dates in India showed that fibre yield was positively correlated with the height and base diameter of plants at harvest (Iruthayaraj, Rajendran & Marachan, 1981).

In the Oyo State of Nigeria, kenaf cultivars start flowering at 80 days after sowing but are harvested about a month later when about 25 per cent of the plants are in flower (Baker, 1970).

Results of these studies indicate that type of variety, time of planting and local conditions as influenced by photoperiod seem to have some influence on time of harvesting kenaf for fibre.

In Ghana, some types of kenaf stop growing in height when they produce flowers (determinate cultivars), while others continue to grow in height after flowering (indeterminate cultivars). Varieties in use in the country are mixtures of all these types (Amankwatia, 1987).

The objective of this study was, therefore, to

determine the optimum age at which some of the commercial varieties of kenaf in Ghana could be harvested for a high yield of fibre.

Materials and methods

Seeds of three varieties of kenaf, Ghana Type 2, Cuba 108 and F. D. Wilson's selection A63-440, were planted at Kwadaso in the forest zone of Ghana on 3 Apr 78, 31 Mar 79 and 24 Mar 80. The design used was a completely randomized block replicated five times in all 3 years. The seeds were drilled at the rate of 45.4 kg/ha with the aid of a single row hand-pushed Planet Junior Seed/fertilizer drill. The plants were spaced at 25 cm between rows and 5 cm within the plants. The harvested plot size was 1.8 m × 2.4 m. Before planting, compound fertilizer (NPK) 15-15-15 was broadcast on the plots at the rate of 68 kg/ha. Sulphate of ammonia was applied as side dressing at the rate of 35 kg/ha when plants were 6 weeks old. The harvesting dates which varied with the years were treatments.

Harvesting was done when the plants were 75, 90, 105 and 120 days old in 1978. In 1979 and 1980, harvesting was done when the plants were at the ages of 70, 90, 110, 130 and 150 days old. Ten plants per plot were chosen from the middle row for plant height and stem diameter measurements. Plant height was measured from the cut butt end to the growing tip. Stem diameter was measured at 25 cm from the cut butt end (cotyledonary node point) with a caliper, and yield of fresh green stalks, as well as yield of dry retted fibre. Data were statistically analysed.

Results and discussion

Plant height, stem diameter and flowering

Results of plant height, stem diameter and percentage of plants that flowered at harvest are presented in Tables 1 and 2.

Plant height increased progressively with each cultivar until last harvest. Ghana Type 2 (GT2) whose last harvest was done at an earlier date (120 days) produced the tallest plants while Cuba 108 (C108) and A63-440 which were harvested at 150 days attained lower heights.

Although GT2 produced the tallest plants at last harvest, its stalks were the thinnest. Cuba 108 produced the biggest stalks at last harvest. At 110 days, A63-440 stem diameter measured 1.41 cm but decreased thereafter until last harvest when plants were only 1.28 cm in diameter. Apart from A63-440, stem diameter of C108 and GT2 increased with each delay in harvesting.

Number of stalks harvested and percentage of

TABLE 1

Average Plant Height (cm) and Stem Diameter (cm) of Kenaf Plants Harvested at Different Ages

Ages of plants	*Plant height (cm)*			*Stem diameter (cm)*		
	1978	*1979*	*1980*	*1978*	*1979*	*1980*
(days)	*GT2*	*C108*	*A63-440*	*GT2*	*C108*	*A63-440*
70		153.15	155.19		1.05	1.15
75	196.08			0.22		
90	239.52	178.30	203.75	0.46	1.12	1.15
105	252.98			0.48		
110		204.47	223.26		1.23	1.41
120	274.06			0.59		
130		220.47	229.61		1.28	1.22
150		235.45	240.55		1.38	1.28
Mean	195.32	198.37	211.07	0.69	1.21	1.24
LSD (0.05)	29.15	25.65	30.86	0.21	0.07	0.08

TABLE 2

Number of Stalks and Plants (per cent) in Flower at Harvest

Age of plant (days)	No. of stalks harvested per plot 1978 GT2	1979 C108	1980 A63-440	Per cent of plants flowered at harvest/plot 1978 GT2	1979 C108	1980 A63-440
70		237.50	108.80		7.68	11.48
75	87.25			20.05		
90	133.00	232.25	107.60	24.43	12.66	17.05
105	131.50			63.68		
110		189.00	102.20		90.11	77.44
120	87.50			97.14		
130		179.75	112.62		93.18	90.92
150		172.00	98.80		98.63	96.35
LDF (0.05)	28.12	93.49	37.04	9.95	3.89	7.15

plants that were in flower at harvest are presented in Table 2. As harvesting delayed, more plants of all the three cultivars came into flower until last harvest when over 97, 98 and 96 per cent plants of GT2, C108 and A63-440 respectively were in flower.

In terms of plant height and stem diameter, the three kenaf cultivars studied must not be harvested between 70 and 90 days after sowing. At these early ages, the plants would not have attained the maximum height and base diameter to enhance high yield of fibre since the two are the yield components and have been found to be positively correlated with yield (Nelson & Wilson, 1965; Iruthayaraj, Rajendran & Marachan, 1981).

Flowering in kenaf is one positive indicator of fibre content of the plant and as harvesting delayed after flowering, fibre content also increased (Oraby, 1967; Iltis, 1962).

Yield of fresh green stalks

Results of fresh green stalks (with branches and leaves) are presented in Table 3. Significant (P=0.05) differences were obtained for yield of fresh stalks among harvesting times.

TABLE 3

Yield of Fresh Green Stalks of Kenaf Harvested at Different Stages of Growth

Age of plant (days)	Yield of fresh green stalks (kg) 1978 (GT2)		1979 (C108)		1980 (A63-440)	
	Mean	Kg/ha	Mean	Kg/ha	Mean	Kg/ha
70			18.52	4201.77	16.52	3748.90
75	9.62	4364.77				
90	7.49	3400.46	17.07	3872.62	13.62	3089.47
105	12.93	5870.22				
110			18.30	4284.25	16.16	3666.05
130			21.15	4881.63	16.07	3533.29
150			22.79	5376.49	12.62	2862.47
Mean	10.21		19.93		14.98	
SSD (0.05)	2.76		3.91		2.76	

With GT2, yield of green stalks decreased from 9.6 kg at 75 days to 7.49 kg at 90 days. However, the highest yield was obtained at 105 days harvest. Similarly, A63-440 had the highest green yield at 70 days and decreased from there to the last harvest. Green yield of C108, however, increased with delay in harvesting until the last harvest when the highest yield was obtained. Green yield increase was, therefore, more consistent with each delay in harvesting of C108 than the other two varieties.

Early high yield of fresh green stalks of GT2 and A63-440 might be due to high proportion of leaves on the stalks and high moisture content in the plants, since growth of the two cultivars at these stages was very vigorous. However, as harvesting delayed, these plants lost some of their leaves and moisture in the stalks due to old age and the advent of dry weather conditions.

High fibre yield obtained from late harvesting supports the reports made by Salih (1980) and Oraby, (1967) that harvesting at a later stage increased the green yield and the fibre yield, since plant height continued to increase up to full maturity and accounted for differences in yield.

Iltis (1962) also found that with delay in harvesting after full flowering, fibre finess decreased but yield increased.

Percent fibre content of stalks

Percent fibre content of plants harvested between 75 and 105 days in 1978 was lower than the last harvest (120 days). However, in 1979, fibre yield per plant increased steadily to 110 days after which the fibre content declined till the last harvest at 150 days. In 1980, percent fibre content of the plants increased with every delay in harvesting until the last harvest at 150 days. Between 70 and 90 days, the fibre had not developed fully and this might have caused the lower fibre content than the more mature stalks in which fibre production had developed to its maximum (Barvinok, 1969; Kirby, 1963).

Yield of dry retted fibre

Yield of dry retted fibre and fibre content on green weight basis are presented in Table 4. Significant differences (P=0.05) in fibre yield were obtained for plants harvested at different stages of growth.

Early harvesting resulted in very low yield of dry

TABLE 4

Yield of Dry Retted Fibre and Percent Fibre Content of Green Kenaf Plants at Different Stages of Harvest

Age of plant (days)	*1978 (GT2)*			*1979 (C108)*			*1980 (A63-440)*		
	Mean yield of retted fibre (g)	*Yield kg/ha (estimated)*	*Fibre (%/stalk)*	*Mean yield of retted fibre (g)*	*Yield kg/ha (estimated)*	*Fibre (%/stalk)*	*Mean yield of retted fibre (g)*	*Yield kg/ha estimated*	*Fibre (%/stalk)*
70				287.41	987.45	2.35	253.61	576.01	1.54
75	458.33	2082.48	2.05						
90	359.17	1631.42	2.76	470.05	1089.60	2.81	464.42	1054.75	3.01
105	633.33	2876.82	3.12						
110				621.11	1407.40	3.28	491.20	1115.57	3.44
120	547.33	2486.10							
130				763.28	1571.97	3.22	571.41	1297.75	3.56
150				603.09	1337.02	2.49	594.24	1349.50	4.71
Mean	499.54			548.98			474.91		
LSD (0.05)	112.10			123.19	412.00		106.57		

retted fibre. In 1978, harvesting of GT2 at 90 days produced the lowest yield, while the highest yield was obtained from 105 days harvest.

In 1979, fibre yield of C108 increased progressively with delay in harvesting until 130 days after which fibre yield decreased. Similarly, fibre yield in 1980, increased with delay in harvesting until the last harvest when the highest fibre yield was obtained.

The low fibre yield obtained from 70 to 90 days harvest with the three cultivars might be due to premature harvesting, since at these stages kenaf plants had not reached maximum development, and many fibre strands were likely to be destroyed when separating them from the stalks (Puentes, 1958).

The results have shown that for high yield of dry retted fibre, the three kenaf varieties should be harvested at different times since they have different maturity periods.

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