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The effect of spacing and population on the performance of Kenaf (*Hibiscus cannabinus* L.)

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ABSTRACT: An experiment was conducted to determine the performance of Kenaf cultivars under different spacings viz: 25cm x 10cm, 50cm x 10cm and 75cm x 10cm. Although the spacing 50cm x 10cm earlier recommended is still in use, it was observed that there was a linear relationship between spacing, fibre and core weight yields and that the maximum yields were from the 75cm x 10cm spacing. Conversely, the relationship between spacing, Kenaf height and stem diameter were not consistent.

Key Words: Kenaf cultivars; *Hibiscus cannabinus;* Plant spacing; Plant population.

Introduction

In 1956, when non-woody plant species were evaluated for use in paper production, (Nieschlag *et al*., 1960; White *et al*., 1970), kenaf (*Hibiscus cannabinus* L.) was identified as a promising source of fibre for paper pulp production (Nieschlag *et al*., 1960; Adamson and Bagby, 1975 and Watson *et al*., 1976). In many African countries, kenaf has been utilized for centuries. It is a source of cordage fibre that can be used in making rope, twine, carpet backing and burlap (Wilson *et al*., 1965). It originated from Sudan although it is quite common in West Africa, (Agency for Int. Development, 1968). it is highly self fertile and belongs to the family Malvaceae.

The gradual diminishing of hardwoods and soft woods in the world and the increasing per capita consumption of paper and paper board materials have elevated kenaf as an economically important crop. By 1987, newspaper publishers in the U.S.A. alone used 12 million tons of newsprint, with two thirds of it imported at a cost of nearly $4000 million. In 1996, the demand was expected to reach 14.5 million tons a year (Bosisio, 1988). Since it is not possible for forests to produce an annual quantity of fibres to meet domestic demands, the greatest potential source rests with the production of annual species, such as kenaf to meet demand. Kenaf is 3-5 times more productive per unit than pulp wood trees and produces a pulp that is equal or superior to many wood pulps (Theisen *et al*., 1978). Also, paper produced from kenaf has excellent ink-retention characteristics and its high tensile strength is ideal for high-speed press (Robinson, 1988). kenaf stem has two distinct fibres, the bast or outer back fibres and the inner core which has short, woody fibres.

In Nigeria, kenaf cultivation began in the early sixties but nose-dived in the late seventies due to the emergence of cheaper synthetic fibres from petroleum products. However, due to the turn around of the economy such that the synthetic fibres have become highly more expensive, kenaf cultivation is now being encouraged. Also, it has been realized that kenaf cultivation and its use in newsprint industry will discourage the depletion of forests while the volume of fibre importation for industrial use will also decline. In Africa, the principal areas of production are Dahomey, Egypt, Ethiopia, Ghana, Cote d'Ivoire, Morocco, Mozambique and Nigeria (FAO, 1968). Their estimated total production in 1967 was 11,700 metric tons. With the recent importation of breeder seeds of different varieties from different ecologies, there is the need to assess the optimum spacing in order to achieve high yields in terms of fibre and core weights that are highly needed in commerce and industries. This study therefore seeks to evaluate the performance of some kenaf cultivars under the current and new spacings in a forest zone of south western Nigeria.

Materials and Methods

Seeds of kenaf cultivars Cuba 108, K-1882, S75-1-117, K-3431-29 and AU159 were planted at the Institute of Agricultural Research Station, Moor Plantation, Ibadan for two years. The spacings used were 20cm x 10cm, 30cm x 10cm, 40cm x 10cm and 50cm x 10cm for each variety. The plot size was 4m x 4.5m and each treatment was replicated four times in a Randomized complete Block design. Gramoxone and Galex were applied as herbicides at the rate of 7.5 mls/litre and 12.5mls/litre of water immediately after planting to control weeds. NPK 15-15-15 fertilizer at 200kg/ha was applied at one week after planting. Two hand weeding operations were carried out before harvesting. Agronomic data on kenaf plant height and stem diameter were recorded before plant harvests. Kenaf was harvested when 25.0% of the plants flowered by cutting at the bottom of the stem at the soil surface level. Each stem was then decarpitated. Harvested plants were then tied with nylon rope on plot basis, labelled and then dipped into flowing stream for retting. After two weeks, the fibres had separated from the core and were removed, rinsed with waterand then sundried. The core and fibres were separately weighed on plot basis after drying.

Results and Discussion

Both spacing and cultivar differences did not significantly (P=0.05) increase fibre and core weight yields in the first year due to observed low yields resulting from moisture stress (Table 1). However, converse was true in the second year when yields were 3-4 times observed in the first year. In the first year, the 50cm x 10cm spacing produced the highest fibre yield which was only 5.2% higher than that from the 75cm x 10cm spacing. In the second year, the highest fibre yield was from the 75cm x 10cm spacing and was 47.0% higher than the fibre yield from the 50cm x 10cm. Fibre yields in the second year were 3 – 4 times higher than the first year due to optimum moisture condition. Over the years, fibre yield increased as spacing increased. However, spacing should not be greater than 75cm x 10cm since it encourages formation of branches, as undesirable trait when kenaf is cultivated for fibre and core yields. Cuba 108, an adapted variety had the highest mean fibre weight yield while variety AU159 had the lowest.

The core weight yields showed linear increases in both years (Table 2). There were significant differences in core weight yields with the maximum spacing (75cm x 10cm) resulting in the highest core weight yield. The maximum core yield was also from Cuba 108. It was 15.7% higher than the next to it and 20.4% higher than the lowest core weight yield. Both spacing and variety had significant effect on fibre and core weight yields.

The agronomic studies also indicate that there was some relationship between spacing, height and stem diameter (Table 3). Although the tallest variety (S75-1-117) did not have the highest fibre and core weight yields, its diameter was not significantly different from the maximum, which was obtained at 75cm x 10cm. The advantage derived from 75cm x 10cm spacing would explain the high fibre and core weight yields obtained at the same spacing. Thus, from the studies, 75cm x 10cm spacing is recommended for kenaf cultivation as opposed to 50cm x 10cm currently in use.

Table 1: The effect of spacing and population on fibre yield (Kg/ha) (Paper 99183).

Spacing (cm)	Approx. Population per hectare	VARIETY										
		1995					1996					
		Cuba 108	**1882**	**S75-1-117**	**3431-29**	**AU 159**	**Cuba 108**	**1882**	**S75-1-117**	**3431-29**	**AU 159**	**Mean**
25cmx10cm	40 x 10^6	537.5	300.5	417.5	580.0	487.5	1600.1	1600.7	2003.2	1675.7	2050.3	1125.3
50cmx10cm	20 x 10^6	397.5	392.5	525.0	377.5	713.0	2175.3	2250.0	2025.6	3050.4	2075.8	1398.3
75cmx10cm	10 x 10^6	622.5	430.0	467.5	467.5	300.0	3600.4	2200.1	3012.8	3050.2	3000.0	1715.1
Mean		519.17	374.33	470.00	475.00	500.17	2458.60	2016.93	2347.20	2592.10	2375.37	
S.E.		=30.08					15.20					

Table 2: The effect of spacing and population on core weight yield (Kg/ha).

Spacing (cm)	Approx. Population per hectare	VARIETY										
		1995					1996					
		Cuba 108	**1882**	**S75-1-117**	**3431-29**	**AU 159**	**Cuba 108**	**1882**	**S75-1-117**	**3431-29**	**AU 159**	**Mean**
25cmx10cm	40 x 10^6	1200.0	1190.0	680.0	1380.0	1300.0	3767.5	3502.5	2522.3	2557.5	3012	2111.2
50cmx10cm	20 x 10^6	1240.0	1230.0	1900.0	730.0	990.0	3512.5	3550.0	3015.3	3015.0	2775.4	2195.8
75cmx10cm	10 x 10^6	3330.0	1240.0	2210.0	1790.0	1310.0	3027.5	2562.6	3502.5	3762.5	2772.5	2541.7
Mean		1256.67	1220.00	1596.67	1270.0	1203.33	3435.830	3205.03	3013.37	3111.67	2853.40	
S.E.		85.68					29.8					

Table 3: The effect of spacing on plant height and stem diameter.

Variety	Height (m)							Stem diameter (cm)						
	1995			1996				1995			1996			
	S1	S2	S3	S1	S2	S3	Mean	S1	S2	S3	S1	S2	S3	Mean
V1	1.50	1.63	1.53	2.43	2.66	2.29	2.01	1.04	1.15	0.93	1.44	1.25	1.20	1.17
V2	1.77	1.49	1.58	2.39	1.95	2.36	1.63	0.86	1.05	1.07	1.26	1.28	1.41	1.15
V3	1.37	1.43	1.86	2.46	2.75	2.53	2.07	0.82	0.98	0.95	1.32	1.36	1.49	1.15
V4	1.48	1.52	1.55	2.38	2.49	2.39	1.97	0.78	0.97	0.01	1.37	1.38	1.48	1.16
V5	1.38	1.34	1.55	2.54	2.39	2.48	1.95	0.95	0.84	0.98	1.36	1.39	1.53	1.17
Mean	1.50	1.50	1.61	2.44	2.45	2.4		0.89	1.00	0.99	1.35	1.33	1.42	
S.E.	0.14			0.10					0.07		0.11			

S1 = 25cm x 10cm
S2 = 50cm x 10cm
S3 = 75cm x 10cm

V1 = Cuba 108
V2 = 1882
V3 = S.75-1-117
V4 = 3431-29
V5 = AU 159.

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