Varietal differences in kenaf yield components

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Kenaf is a warm-season annual in the family Malvaceae and is closely related to cotton (*Gossypium hirsutum* L.) and okra (*Abelmoschus esculentus* L.). Initial interest in kenaf in the United States was as a domestic supply of cordage fiber for use as a jute substitute in the manufacture of rope, twine, carpet backing, and burlap (*1*). Agricultural research starting in the early 1940s focused on the development of harvesting machinery, high-yielding anthracnose-resistant cultivars, and cultural practices promoting kenaf as a cordage crop (*1-3*).

In 1956, research was initiated to evaluate nonwood plant species for use in paper production (*2, 3*), and kenaf was identified as a promising fiber source (*3*). Researchers subsequently studied the cultivar Everglades 71 to determine the effect of plant populations and harvest dates on yield components (*4, 5*). Additional research was conducted to study differences among cultivars based on a limited number of yield components (*6-9*). However, there is limited published research concerning kenaf cultivars and yield components for Oklahoma.

While kenaf is recognized as a potential source of fiber for cordage and pulp, there are other possible uses. Kenaf is being investigated as an animal feed (*10-13*), a poultry litter (*14*), and as a bulking agent for sewage sludge (*15*). Additional information is required to determine whether specific cultivars are better adapted for particular end uses.

A high-yielding kenaf cultivar with a greater percentage of core material would be better suited for use as a poultry litter or as a bulking material in sewage composting. A cultivar with a greater percentage of leaf material would be preferred for use as a livestock feed. A cultivar with a greater percentage of bark, or a higher bark-to-core ratio, would be better suited for use in producing cordage or in specialty papers requiring bark fiber.

Determining differences in yield components for various cultivars is an important preliminary step in identifying the best kenaf crop for a specific end use. The objective of the research presented here was to identify differences in yield components for five kenaf cultivars.

Materials and methods

The study was conducted at Lane, OK, on a Bernow fine sandy loam (fine-loamy, siliceous, thermic Glossic Paleudalf), 0-3% slope. Five kenaf cultivars (Tainung #2, Everglades 71, Everglades 41, Cuba 108, and Guatemala 51) were planted on May 8, 1989, and harvested on Oct. 24, 1989. Plots were 3 m wide (four 76-cm rows) and 6 m long, and oriented in a north-south direction. Fertilizer (N-P-K) was applied and incorporated prior to planting at a rate of 168-72-139 kg/ha. All plots received a pre-emergence application of metolachlor [2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl) acetamide] at a rate of 1.12 kg/ha. The experiment was a randomized complete-block design with four replications.

A 2.25-m^2 (1.5 m × 1.5 m) quadrant was harvested from the center of the second and third row of each plot. Plant counts from the harvest quadrant were used to determine plant populations. Harvested plants were cut at ground level and weighed to determine the fresh weight of plants.

Three plants of each cultivar were randomly selected from those harvested and used to determine plant heights and stalk diameters. Calipers were used to measure stalk diameters at 5 cm, 1 m, and 2 m above ground level. Percent bark, percent core, and bark-to-core ratios were determined at 1 m above ground by cutting a 10-cm segment of stalk from each of the three plants, removing the bark, and oven drying the bark and core material.

Leaves and reproductive parts (flowers and flower buds) were removed from the kenaf stalks. Leaves, reproductive parts, and stalks were weighed separately to determine their fresh weights. Plant samples were then oven dried at 66°C for 48 h to determine their oven-dry weights. All yield components, except plant populations, stalk diameter, and plant heights, were based on oven-dry weights.

All data were analyzed using statistical procedures described by Snedecor and Cochran (*16*). Mean differences were determined using a least significant difference (LSD) test level of 0.05.

Results and discussion

Table I summarizes all of the data obtained for the five kenaf cultivars examined in this study.

I. Mean values of yield components for five kenaf cultivars

Cultivars	Harvest population, 1000 plants/ha	Plant height, cm	Stalk diameter, mm, at three heights			Plant content, %		Yield, metric tons/ha		Stalk content, %		Bark:core ratio
			5 cm	1 m	2 m	Stalks	Leaves	Stalks	Leaves	Bark	Core	
Tainung #2	120.6	316	23.6	16.8	11.2	73.7	26.2	17.8	4.1	31.3	68.7	0.46
Everglades 71	237.9	249	18.3	12.5	8.0	76.8	23.2	14.9	3.2	36.0	64.0	0.56
Everglades 41	246.5	249	16.3	11.5	6.7	82.5	17.5	14.4	2.4	34.8	65.2	0.53
Cuba 108	163.6	257	18.0	14.0	9.6	74.6	25.4	13.0	2.9	38.6	61.4	0.63
Guatemala 51	117.3	273	20.3	15.2	10.0	69.4	30.6	14.9	4.0	33.5	66.5	0.51
LSD (0.05)*	47.6	31	2.4	2.1	3.2	7.1	7.1	3.9	1.1	3.5	3.5	0.09

*Least significant difference test level of 0.05.

Rainfall

Rainfall during the growing season (from planting to harvest) was 61.2 cm, compared with the 20-year-average rainfall for the location of 53.1 cm.

Plant populations

As seen in Table I, Everglades 41 and Everglades 71 had greater plant populations than the other three cultivars. Differences in harvest populations were due to seed germination and emergence. No disease or insect damage was observed that would have contributed to differences among plant populations.

Plant populations did not affect stalk yields. This is in agreement with Higgins and White (*5*), who reported that stalk yields were not affected by plant populations from 99,000 plants/ha to 395,000 plants/ha.

Plant heights and stalk diameters

Tainung #2 had greater plant height than the other four cultivars, all of which grew to about the same height. The superior height of Tainung #2 confirms previously reported results (*17*).

Stalk diameter at 5 cm above ground level was greatest for Tainung #2. At 1 m above ground level, stalk diameter for Tainung #2 was exceeded only by Guatemala 51. Higgins and White (*5*), studying Everglades 71, reported that basal stalk diameter increased with increasing plant height. Stalk diameters at 2 m was greatest for Tainung #2. Differences in plant heights had a decreasing effect on differences in stalk diameters as measurements moved from 5 cm to 2 m above ground level.

Percent stalks and percent leaves

Percent stalks for Everglades 41 (82.5%) was greater than for all other cultivars except Everglades 71. Clark and Wolff (*4*) reported an increased stalk percentage as plants matured. The increase in stalk percentage is the result of increased height and senescence of lower leaves (*16*). Everglades 41 had high percent stalks and the lowest plant height. This is evidence of a cultivar difference (*1*) and was reported in field tests in Oklahoma (*18*).

Guatemala 51 had the greatest percentage of leaves (30.6%) of the five cultivars. The consistently greater percentage of leaves for Guatemala 51 indicates that this cultivar either produces a greater percentage of leaves than the others or retains them longer.

Leaf yields

Guatemala 51 and Tainung #2 had the greatest leaf yields. Greater leaf yield results in greater production of crude protein, since the kenaf leaf has significantly greater crude protein in the leaf than in the stalk (*18, 19*). Thus leaf yield may be an important consideration when selecting a cultivar for a livestock feed.

Stalk content and bark-to-core ratio

Cuba 108 had a greater percentage of bark (lower percentage of core) and a higher bark-to-core ratio than all cultivars except Everglades 71. Tainung #2 had significantly lower percent bark (greater percent core) and bark-to-core ratio than the other four cultivars. These data indicate that Cuba 108 would be better adapted for use as a cordage crop, in specialty paper requiring only bark fiber, or a paper pulp requiring a greater percentage of bark fiber than the average kenaf cultivar.

Stalk yields

Stalk yield was greatest for Tainung #2. This is consistent with previously reported results (*17*), where it was shown that Tainung #2 had greater plant heights and stalk yields than Everglades 41.

Conclusion

Differences in yield components were associated with different kenaf cultivars. These differences could be an important consideration in selecting the best cultivar for a given end use.

Of the five cultivars, Tainung #2 had the greatest height, stalk diameter, and percent core material. These characteristics would make Tainung #2 an excellent choice for applications that require more core material and less bark. Kenaf with a high core content would be beneficial for use as a poultry litter or as a replacement for wood chips in composting of sewage sludge.

Everglades 41 had the greatest percent stalk production (and thus the lowest leaf production), which makes it attractive in applications requiring kenaf stalks with a mid-range in bark-to-core ratio with a minimum of foliage production.

Guatemala 51 had high leaf production and leaf yield, making it well suited for use as a livestock feed.

Cuba 108, with the greatest bark percentage and the highest bark-to-core ratio, would be well suited for specialty pulps requiring bark fibers or for cordage production (twine, rope, and sack cloth).

Additional studies are needed to determine under what range of cultural practices these five kenaf cultivars meet specific end uses.□

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