Kenaf Varietal Evaluations in the High Desert of Southeastern Arizona

L.J. Clark and E.W. Carpenter

Abstract

Several Kenaf varieties have been grown at the Safford Agricultural Center over a period of 5 years. Plants harvested green have produced yields in excess of 40 tons per acre. Air dried stems that would be useful for commercial products have yielded as high as 9.5 tons per acre and two varieties, Tainung 2 and Everglades 71, have averaged nearly 7 tons per acre. In addition to yields and other agronomic values of the varieties tested, an economical discussion is made on the feasibility of Kenaf production on southeastern Arizona.

Introduction

Interest in Kenaf, as an alternative crop for the production of fiber, has increased over the past several years due to the increasing pressure by environmentalists to close the forests to the lumber industry. Because of this interest, varieties of Kenaf were acquired from the USDA group in Weslaco, TX and grown in small, replicated test plots at the University of Arizona Safford Agricultural Center for evaluation. The plots were grown using the same planting and irrigation schedule as cotton, which is grown in abundance in the area. The harvests were done by hand. Several varieties have been tested since our initial variety trial in 1992. The results of these trials are shown in this paper.

Materials and Methods

This trial was designed as a replicated small plot trial with four replications. The plots were planted with a cone-type planter which distributes a given weight of seed uniformly over the length of the plot. Six pounds of seed were planted per acre for each variety and the seed was placed approximately one and a half inches below the surface of the soil, the plots were then irrigated to sprout the seed. The plots were planted on 36" row spacings. The following crop history provides the information on how the test plots were managed:

Crop Histories

Inputs	1992	1994	1995	1996
Date of Planting	May 14, 1992	April 6, 1994	May 2, 1995	April 22, 1996
Pre-pl Herbicides	–	Prowl	–	Triflurilin
Fertilizer	–	200 lbs/ac Urea	–	200 lbs/ac Urea
Irrigation	29.8"	33.6"	36.8"	32.7"
Date of Harvest	October 21, 1992	January 25, 1995	January 16, 1996	January 21, 1997

The intended date of planting was the same as for cotton grown in the region, namely, during the month of April. In 1992, the stand was not complete, so the plots were replanted on the 14th of May. In 1994 the planting date was in early April, in 1995 the planting date was delayed to the first part of May and in 1996 the planting date was the optimal date for planting upland cotton in this location. In 1994 and 1996 the plots were on land that had been prepared for cotton and pre-plant herbicides had been incorporated three months prior to planting. Approximately 92 pounds of nitrogen was added to each plot each year in the form of split applications of urea. The dashes in the table indicate our historical field files were incomplete. Irrigation amounts between 30 and 36 inches of water were applied to the crop each year in the form of furrow irrigation. No runoff was allowed from the plots, but, some deep percolation undoubtably occurred. Figure 1 shows the plots in 1992 a couple of months prior to harvest. Figure 2 shows the harvest in 1996, where the crop was allowed to defoliate before harvest. A twenty four square foot subplot was harvested by cutting the plants off at ground level using pruning loppers for each plot and the plants harvested were counted to determine a plant population. The plants were weighted using a tripod scale as shown in Figure 3. In 1994 and 1996 one-foot sections were cut from the plants at ground level and between 4 and 5 foot level. The diameter of these sections were measured so volumes could be determined. Figure 4 shows bundles of these foot-long sections in the back of a pickup truck.

Results and Discussions

In 1992 we harvested the crop in late October, before the first frost, and the results are found in Table 1. The yields were high and would compete with silage corn yields if the crop were grown as a forage. The stems and leaves were separated and the stems were set aside to dry to determine dry weight. The stems dried well, but rodents ate the identification tags so dry weights could not be determined. An assumption of 70% moisture was used to estimate dry weights. Varieties are listed in order of Green Stem Yields. Tainung 2 was the highest yielding variety with an estimated dry weight yield of 9.5 tons per acre and Indian the lowest with just under 6 tons per acre. It was interesting to note the high percentage of leaves on the Indian variety.

The results from the 1994 season are listed in Table 2. The yields were a couple of tons lower than in 1992 and the same three varieties were at the top of the list, only in a different order. Everglades 71 was the highest yielding variety with a yield of 5.8 tons per acre. Stem diameters were determined at the 1-foot and 4-5 foot levels in the plants. These numbers are listed in the table and will be discussed later. It is also noted that the plant population was 26,000 plants less than in 1992.

Table 3 contains the results of the 1995 trial. The seed for Everglades 71 did not germinate, but the other varieties germinated well and the plant population was the highest of all the studies. Tainung 2 had the highest yield at 6.8 tons per acre.

The study in 1996 contained two new experimentals developed by the USDA group in Weslaco, TX, namely, C118-92K and C617-92. C118-92K was the highest yielding variety with a yield of 7.4 tons per acre. It is interesting to note the low plant population in this study. Kenaf can, however, compensate for low plant populations by sending out more side branches (see Figure 2). Whether the fiber from these side branches of equivalent value to that of the main trunk must be determined. Plant heights were measured in this study and it is interesting to note that C118-92K was the tallest of the cultivars tested with a height over 12 feet. Stem diameters were again measured at the one-foot and 4-5 foot levels.

The appropriate equipment was not available at this site to separate bast and core fiber. Instead a volumetric calculation was made using the stem diameters measured in 1994 and 1996 and the bark or bast fiber thickness measured from two lots of stem sections similar to those seen in Figure 4.

	Average Stem Diameter (cm)		Average Bark Thickness (cm)	Volumetric Fiber Percent (calculated)					
	1994	1996		1994		1996		Average	
				Bast	Core	Bast	Core	Bast	Core
Bottom one-foot section	1.70	2.31	0.143	16.1	83.9	12.0	88.0	14.1	85.9
4-5 foot section	1.19	1.61	0.085	13.7	86.3	10.3	89.7	12.0	88.0

Rymsza (1) has reported that kenaf fiber consists of approximately 60% core fiber and 40% bast fiber, on a gravimetric basis. Cook (2) indicated that 26 to 28% bast fiber (gravimetric basis) was commonly seen in the 1996 harvests in Texas and Georgia. Given the density difference between the bast and core fiber (with the core fiber being much lighter), our calculated fiber percentage figures are probably in the right ball park.

Figure 5 shows Air Dry Yields of Tainung 2 and Everglade 71 compared with the average yield of the studies over the years of the study. This graph show little advantage of one variety over the other, even though they both have normally exceeded the average value of the trials. It will be interesting to track the new experimental to see if it can continue to produce better than the two standard varieties in these trials.

Figure 6 shows the air dry yields plotted against planting dates over the years of the study. The trend shown here is the opposite of the trend shown by Hallmark, et.al. (3). The weakness of the data from this study is that it came from four different years with the weather and growing conditions in each year being different. A similar weakness is seen with a single date of planting study done one year at one site. Further studies need to be done to determine the best planting date for the high deserts of southeastern Arizona.

The overwhelming question to answer is: can Kenaf be grown economically in the high deserts of southeastern Arizona? The answer depends on how much will it cost to grow the crop and how much money will be realized from the sale of the crop. We will use basic costs of land preparation and growing expenses generated in the 1996-97 Arizona Field Crop Budgets - Graham County (4) for Upland Cotton. We will, then, subtract the costs of insecticides and herbicides from that budget. This leaves $250 per acre for growing the crop. To this we must add a cost for harvesting and land ownership. We will assume that the harvest costs will be similar to the Crop Budget cost for harvesting silage, namely, $108 per acre. Land ownership costs for cotton ground in Graham County are $104 per acre. This gives a total cost of $462 per acre. The value of the crop is, again, difficult to determine. The average yield of Everglade 71 throughout the study was 6.9 tons per acre and new varieties give the hope that a better variety will soon be available. Dividing $462 per ton by 6.9 tons, we find that the breakeven price for the product must be $67 per ton. Up to this point prices have not been this high. An individual farmer would have to pencil his particular costs of crop production and land ownership carefully to make sure that a profit could be made prior to planting this crop.

Conclusions

Kenaf can be successfully grown in the high desert areas of southeastern Arizona. Varietal evaluations over the past five year period have shown that yields of the best cultivars have averaged nearly 7 tons of air dry stems per acre. Whether the crop will be economically feasible will depend on the value of the crop and the cost of production for a particular grower.

References

1. Rymsza, T.A. 1997. Developing Kenaf for commercial-scale pulping and papermaking. Evergreen, Vol. 2 No. 1, February, 1997. A publication of the New Uses Council.

2. Cook. C.G. 1997. Personal communication.

3. Hallmark, W.B., L.P. Brown, H.P. Viator, R.J. Habetz, W.D. Caldwell, and C.G. Cook. 1994. Kenaf: a new crop for Louisiana. Louisiana Agriculture, Vol. 37, No. 2, Spring 1994.

4. Daugherty, L. and R. Cluff. 1996. 1996-97 Arizona field crop budgets - Graham County. The University of Arizona College of Agriculture Extension Bulletin # 196013.

Acknowledgments

Appreciation is expressed to Dr. Charlie Cook for providing seed for these studies and encouragement to look at Kenaf as a crop in the high deserts of southeastern Arizona.

Table 1. Kenaf variety yields and other agronomic data, Safford Agricultural Center, 1992.

Variety	Green Whole Plant Yield (T/ac)	Green Stem Yields (T/ac)	Percent Green Stems	Estimated Dry Wt (T/ac)	Plants per Acre
Tainung 2	42.7 a	31.7 a	73.8 ab	9.5	130,090 a
45-9	40.9 a	27.9 ab	68.2 abc	8.4	88,340 b
Everglades 71	36.0 a	27.7 ab	77.1 a	8.3	101,652 ab
Everglades 41	36.1 a	24.3 ab	67.8 bc	7.3	77,449 b
Cubano	35.2 a	22.9 ab	63.9 c	6.9	85,920 b
Indian	37.1 a	19.8 b	54.1 d	5.9	101,652 ab
Average	38.0	25.7	67.5	7.7	97,517
LSD(05)	11.3	8.15	8.6	–	36,144
CV(%)	16.4	17.4	7.0	–	20.4

Table 2. Kenaf variety yields and other agronomic data, Safford Agricultural Center, 1994.

Variety	Air Dry Yield (T/ac)	Plants per Acre	Stem Diameter Bottom 1' (cm)	Stem Diameter 4-5' (cm)
Everglades 71	5.8 a	91,431 a	1.63 a	1.14 a
Tainung 2	5.3 a	77,364 ab	1.68 a	1.24 a
SF 459	5.3 a	82,129 ab	1.75 a	1.19 a
7N	5.0 a	74,415 b	1.70 a	1.22 a
Average	5.32	81,334.7	1.70	1.19
LSD(05)	0.74	15,448.0	0.20	0.15
CV(%)	8.7	11.9	7.3	7.38

Table 3. Kenaf variety yields and other agronomic data, Safford Agricultural Center, 1995.

Variety	Air Dry Yields (T/ac)	Plants per Acre
Tainung 2	6.8 a	139,755 a
SF 459	6.3 a	119,790 a
7N	5.2 a	143,839 a
Everglades 71	--	--
Average	6.1	134,461.3
LSD(05)	2.64	48,523.4
CV(%)	25.0	20.9

Table 4. Kenaf variety yields and other agronomic data, Safford Agricultural Center, 1996.

Variety	Air Dry Yield (T/ac)	Plants/Acre	Plant Height (in)	Stem Diameter 1' (cm)	Stem Diameter 4-5' (cm)
C118-92k	7.4 a	44,921 a	149.8 a	2.21 a	1.64 ab
Everglades 71	6.7 a	35,166 b	139.0 a	2.39 a	1.77 a
C617-92	5.8 a	33,578 b	137.3 a	22.5 a	1.54 ab
Tainung 2	5.2 a	18,831 c	137.9 a	2.38 a	1.48 b
Average	6.23	33,123.8	140.97	2.31	1.61
LSD (05)	2.44	9091.1	18.53	0.39	0.232
CV(%)	24.4	17.2	8.2	10.6	9.04

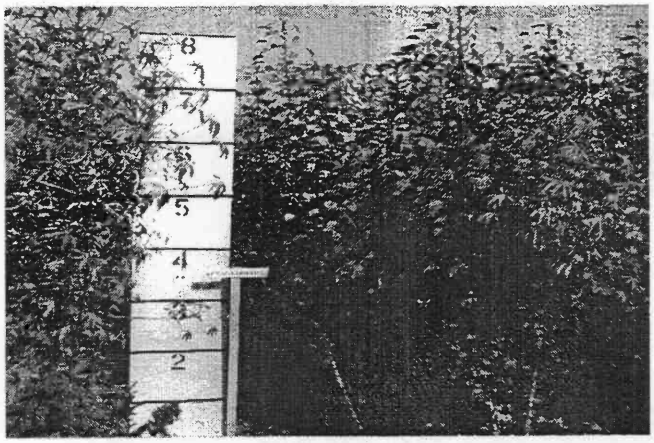

Figure 1. Kenaf varieties grown on Safford Agriculture Center, 1992.

Figure 2. Hand harvest and stand count on Safford Agricultural Center, 1996.

Figure 3. Weighing Kenaf at Safford Agricultural Center, 1996.

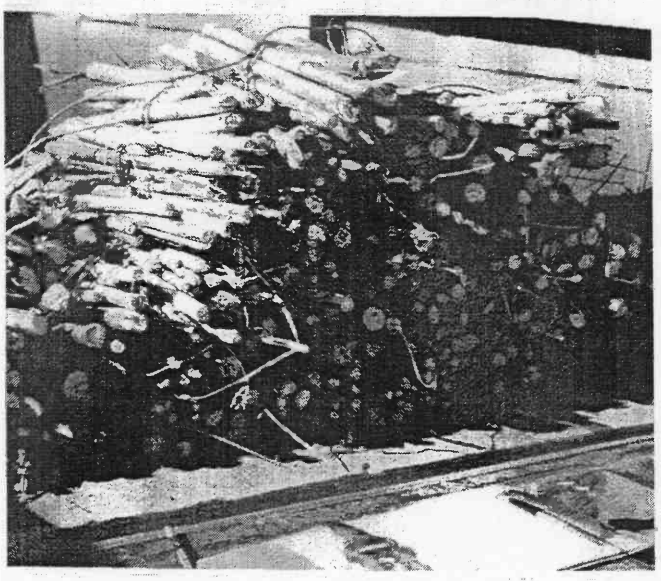

Figure 4.One-foot sections of Kenaf on Safford Agricultural Center, 1996.

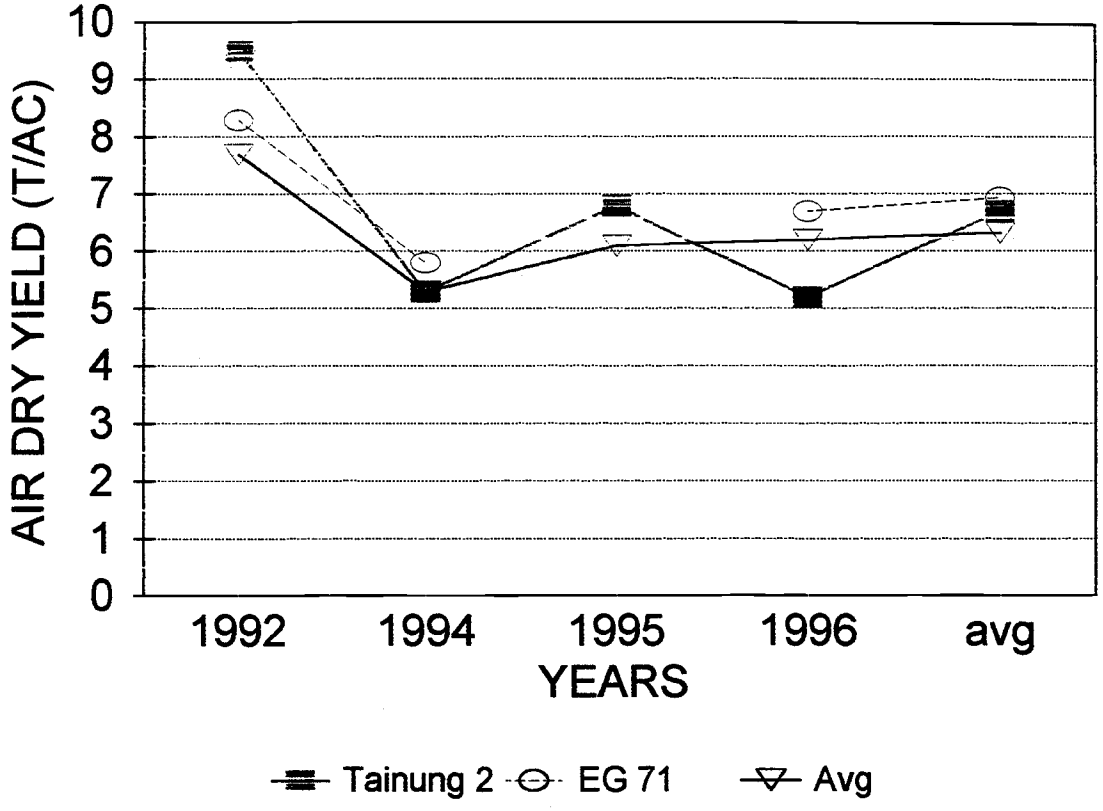

Figure 5. Yields of two varieties and the average from each test over the time of the experiment, Safford Agricultural Center.

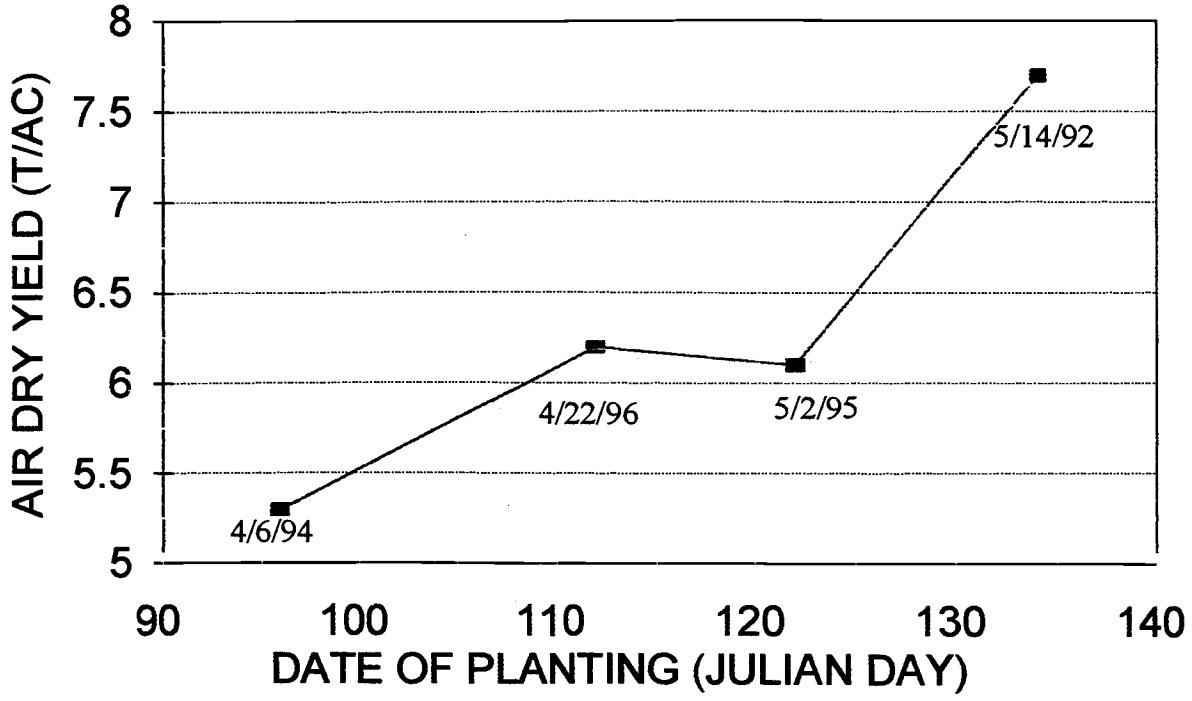

Figure 6. Air dry yields at different planting dates over the span of the experiment, Safford Agricultural Center.