

The decision depends on the type of cotton and when it was planted.

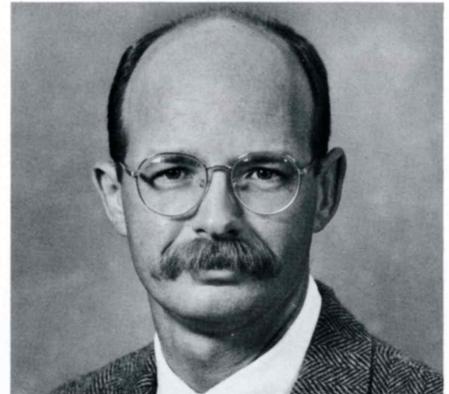
Silvertooth and other cotton researchers have issued guidelines for farmers to follow in deciding when to halt irrigations and harvest the crop. Crop production costs for extra irrigations, defoliation and insect control all affect this decision.

"The bottom line is you can get more yield if you stay in the field longer, but how much will it cost?" Silvertooth said. "The trend now is to go through the fruiting cycle as quickly as possible, terminate the irrigations and get out."

Silvertooth acknowledges that it is a long, slow process to educate people in the use of these monitoring tools, but says that about 60 percent of the cotton growers in the state are now familiar with the techniques.

"I've had very positive feedback from consultants, managers, farmers and producers," Silvertooth said.

"I think right now we have the basic set of tools. It's a process of refinement and modification from here." ♦



Robert Walker

Contact Jeff Silvertooth at (602) 621-7616.

An Alternative Paper Crop from the Southwest

Not all paper comes from trees. Some desert plants also can produce fibers suitable for paper making.

Steven McLaughlin, an assistant professor in the University of Arizona Office of Arid Lands Studies, is working with private industry to domesticate two rare species of *Hesperaloe* as a source of fiber for the specialty paper market.

Native to northern Mexico, *Hesperaloe funifera* and *Hesperaloe nocturna* are related to the century plant. Both feature a rosette of strap-like leaves yielding long, thin, tough fibers suitable for filters, tea bags, currency and other specialty papers.

They differ in their leaf size: *H. funifera* produces wide, stiff leaves, but *H. nocturna*'s are narrow, pliable and more numerous.

Paper made from *Hesperaloe* fibers is strong, bright without bleaching and recyclable.

"It's a really strong, but soft, paper," McLaughlin said. "It feels like felt, but it's nowhere near as thick." He was the first to investi-

gate *Hesperaloe* fibers for paper.

Paper companies normally import specialty fibers, sisal in particular, at high prices and in quantities that fluctuate unpredictably from year to year. Some of the companies, and the U.S. Department of Agriculture, are funding McLaughlin's work because they're looking for a way to produce paper fibers more cheaply and consistently in the United States.

Although sisal and kenaf are fibrous plants already grown for their pulp in other parts of the country, neither does well in Arizona's climate. Sisal does not tolerate frost, and kenaf uses too much water. In contrast, *Hesperaloe* species use only two to three acre feet of water and actually prefer lower nighttime temperatures.

Tucson's full sun, cool nights and long, dry growing season ideally suit this perennial. Although requiring a lot of light, they belong to a group of plants capable of photosynthesizing at night, when evaporation is lower.

McLaughlin chose *Hesperaloe* after analyzing the fiber content of 28

plants native to the arid Southwest. Both *Hesperaloe* species had the longest and thinnest fibers, indicating fiber strength. He also included agaves, yuccas and beargrass in his research.

"The fibers of *Hesperaloe* are extraordinarily strong, so we are targeting specialty papers that have many rigid regulations for strength and fiber," McLaughlin said.

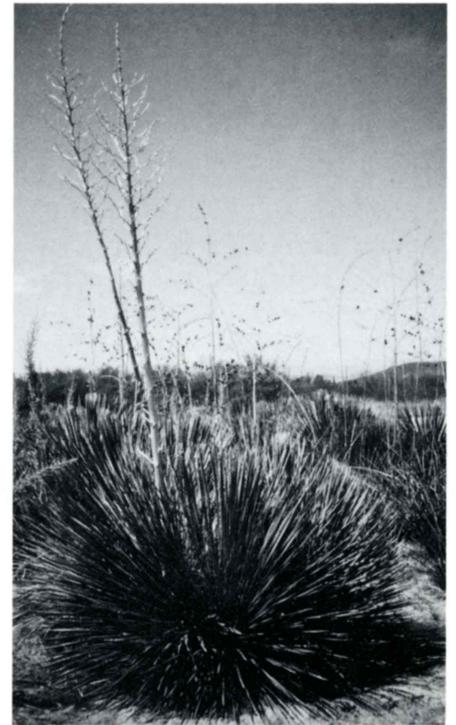
A five-year-old experimental farm at the UA Bioresources Research Facility in Tucson has two acres of *H. funifera* and *H. nocturna* cultivated in rows on drip-irrigated plots. McLaughlin and his associates are testing plant spacings, fertilizer needs, water requirements, weed problems, and growth and yield differences between the two species.

Initially slow-growing, the *H. funifera* crop was large enough after three years for the first harvest. The plants' four-foot leaves were hand-cut nearly to the ground, then chopped and processed to reduce the fibers into a pulp ready for making into paper. The fibers are pulped wet.



Hesperaloe funifera

Susan McGinley



Hesperaloe nocturna

Susan McGinley

Each 18-pound plant yielded about 200 sheets of standard letter-size paper. On a fresh-weight basis, this corresponds to 35 percent harvested material per plant. If allowed to grow larger before harvest, each plant could produce enough pulp for several reams of paper.

The plants then regrow from the crown area, allowing subsequent cuttings about every two years. McLaughlin has set a growth target of five tons dry-weight per acre, annually.

Insects and diseases don't threaten the plants, yet. It may be too early to conclude that they are pest-free, since both *Hesperaloe* species are growing away from their natural range.

Although the *H. nocturna* crop is only two years old, McLaughlin thinks it may be the better plant since it has a denser leaf canopy and regrows more quickly from the cut crown.

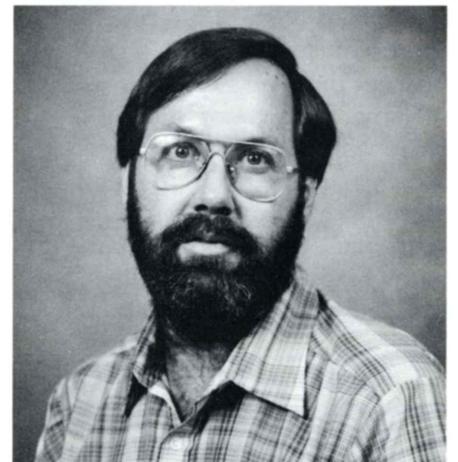
The next step in the research moves to the paper companies. Making good, clean pulp has been a problem. They need to refine their paper-making process to get rid of impurities that so far appear regularly in trial batches of *Hesperaloe* pulp.

Once a method for eliminating impurities is found, McLaughlin wants to try *Hesperaloe* on a demonstration farm of 40 to 100 acres. A farm-scale trial would provide information on commercial production to prospective growers.

Once production expands to the commercial level, at least 100,000 tons of fiber per year would be needed to justify building a paper mill in Arizona.

McLaughlin acknowledges that other plants produce greater amounts of inexpensive fibers for paper, and that *Hesperaloe* will never replace newsprint pulp from trees.

"This paper would be for a specialty market, because it's a high-value product," he said. "Competing fibers sell for \$2000 to \$3000 per ton." ❖



Contact Steven McLaughlin at the Office of Arid Lands Studies, 845 N. Park, Tucson, AZ 85719 or call (602) 621-1955. At the Bioresources Research Facility the phone number is 741-1691.