Mike Ottman

Sweet Sorghum into Ethanol

By Susan McGinley

Adapting an alternative fuel crop for Arizona

The first thing you notice about mature sweet sorghum is its height. At 12 to15 feet, this tall, leafy plant that resembles corn sports thick stalks with a lot of biomass and high sugar content. Scientists at the University of Arizona are exploring ways to breed and cultivate different varieties of sweet sorghum and turn its sugar into ethanol as an energy source.

Native to Africa, sweet sorghum thrives in high heat and produces under low amounts of water. These characteristics make it more suitable to Arizona's desert climate than corn, the feedstock most widely used for producing ethanol as an alternative fuel.

"The point is to find the feedstock that is best suited for our environment," says Dennis Ray, a plant geneticist in the UA College of Agriculture and Life Sciences (CALS). "Corn wasn't bred for the desert; it takes more water, and requires one more step in processing than if you use sweet sorghum—which won't work as well in Iowa. You use what's best adapted to your area."

Over the past two years, Ray and his colleagues have grown and evaluated more than 50 lines of sweet sorghum at the Campus Agricultural Center in Tucson. They are determining the best characteristics to use in a breeding program, taking into account biomass, sugar content and type of sugar, time to maturity, susceptibility to lodging (tipping over) and other traits.

The search for desirable traits also includes finding out how susceptible different sweet sorghum varieties are to insect damage and pathogens, and searching for strains that are resistant to infection. A planting date study will determine how many heat units sweet sorghum varieties need to reach maturity. Earlier maturing lines are more desirable because growers would be able to achieve their yields with less expense. The goal is to develop a strain of sweet sorghum that suits industry needs for a local biofuel feedstock in Arizona.

"Petroleum is a finite resource," Ray says. "Having a renewable domestic source of fuel is a good thing. Most gasoline is already 10 to 15 percent ethanol. Right now ethanol is expensive because it's a relatively small effort (compared to petroleum), but as it grows, the processing will become more efficient and the price will come down."

Launched by Colin Kaltenbach, director of the Arizona Agricultural Experiment Station, the sweet sorghum project involves a large interdisciplinary team of UA scientists from CALS and from the College of Engineering—agronomists, agricultural and chemical engineers, animal scientists, geneticists—along with business and industry professionals.

The team members are exploring every aspect of breeding, cultivating and processing sweet sorghum as a new crop for ethanol production, supported by experiment station seed money and grants secured for various aspects of the study. Ray's focus is on the genetics.

"It all starts with the plant material—taking sweet sorghum and changing it through selection and breeding to grow what yields best

in this environment," he says. "We're really just learning about the plant and how to change it to our best advantage." Ultimately, it comes down to ethanol yield per acre.

"This is where the business people have to tell us how much yield they need for biomass and sugar," Ray says. "The sugar is in the stem and we can use that directly to change into ethanol. We squeeze the juice out and go from there."

Consultant Mike Kazz, a professional chemical and environmental engineer for Zelen Environmental, is the project's lead contact with Pinal Energy, an ethanol plant in Maricopa, Arizona. He says the plant has been using corn railed in from other states, but would like to use locally produced feedstocks like sweet sorghum to save time and reduce transportation costs.

"We estimate that the eight acres of UA-grown sweet sorghum grown in 2007 contained approximately 32,000 gallons of juice—that could represent 3,700 gallons of ethanol. Unfortunately, we were only able to ship Pinal Energy around 500 gallons of juice due to technical problems," Kazz says.

"Next year we want to provide them with a substantial amount of sweet sorghum on a larger scale. We'd like the yield to be about 5,000 gallons of juice per acre, which would convert to about 500 gallons of ethanol per acre. It all depends on how well our juicing and preservation operation goes."

Kazz, who graduated from the UA in 1989 with a bachelor's degree in plant sciences and genetics, and later earned a graduate degree in agricultural and biosystems engineering, is working with the UA on the economic feasibility of producing sweet sorghum from a technology transfer standpoint.

"We can really make a positive dent in our petroleum dependency, and offer a boost to the Arizona economy, with this crop," Kazz says.

The engineering team is still developing the best mechanism for harvesting and processing the stalks to extract the maximum amount of juice. And to reduce waste by making sure all parts of the plant are used, UA animal scientist Glenn Duff has been evaluating the suitability of the leftover biomass—called "bagasse"—as a cattle feed additive.

In response to concerns about sweet sorghum displacing food crops on agricultural land, Ray says the plant thrives in poorer soil than grain or vegetables and could be grown as a niche crop using wastewater.

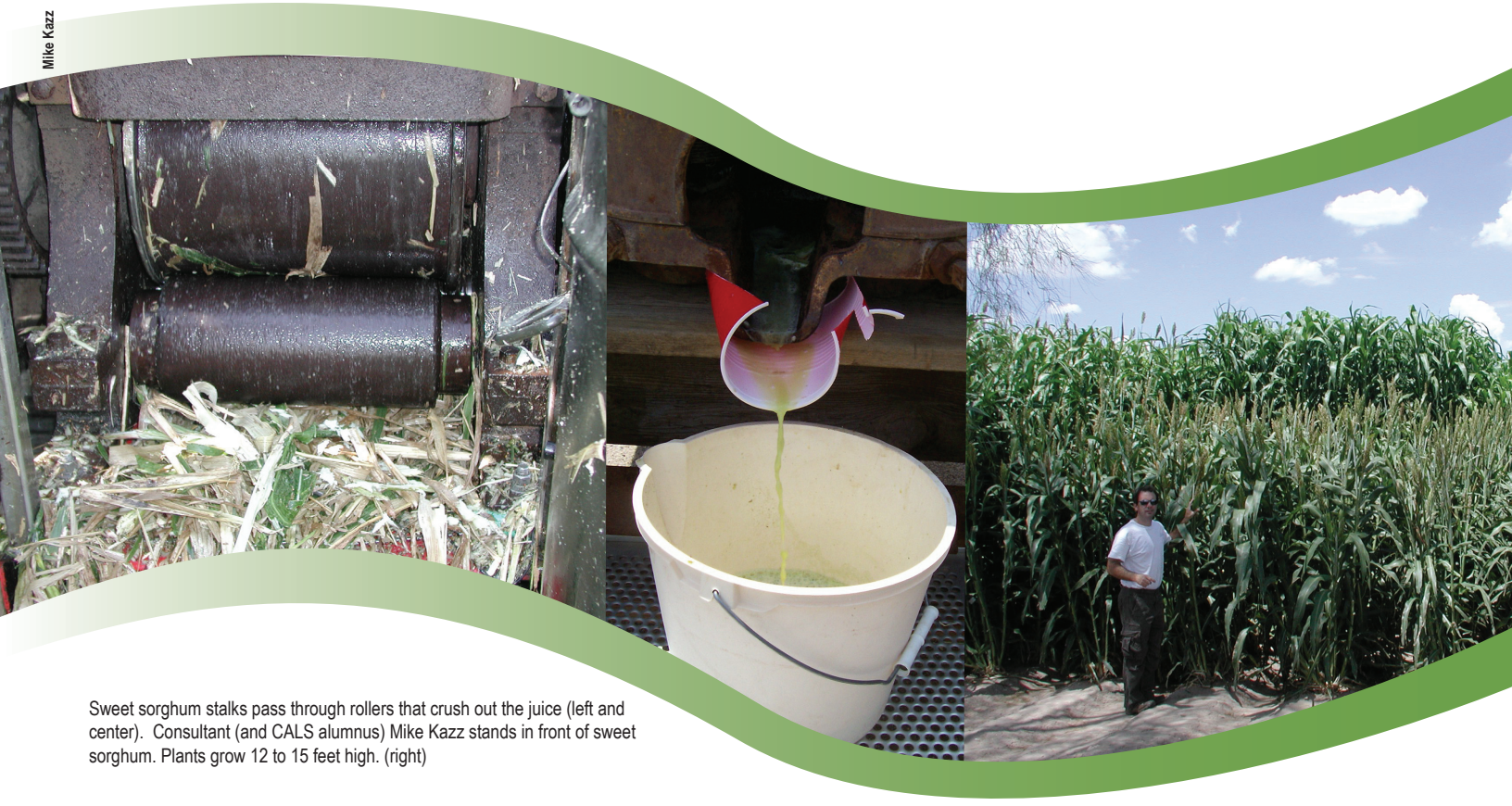
"We're looking at areas where agriculture is going out and we could add to rural development," he says. "This has potential sociological implications: the industry could be built around small processing plants, offering jobs and opportunities." As an added incentive, sweet sorghum prices have increased over the past few years.

"It gives growers an option for their crop mix," Ray suggests. "They could start off slowly, on a small scale, and see how it goes." ★

Contact

Dennis Ray
(520) 621-7612
dtray@u.arizona.edu

Mike Kazz



Sweet sorghum stalks pass through rollers that crush out the juice (left and center). Consultant (and CALS alumnus) Mike Kazz stands in front of sweet sorghum. Plants grow 12 to 15 feet high. (right)