To Aid the Everglades Ecosystem, Scientists Are . . .

CHANGING SUGARCANE

Tasseled sugarcane growing near Canal Point, Florida.

SCOTT BAUER (K7153-3)

It's 3 a.m., in late summer, but the lights are on in a research greenhouse at Canal Point, Florida. The stars burn bright white points in a night sky, and it's already about 75°F and climbing. An owl's eerie moan punctuates a crickets' chorus. Mice scamper.

Welcome to the laboratory of USDA plant geneticist Peter Y. Tai.

Tai has to be at work early to collect pollen from the wild sugarcane he will cross with domestic lines. It must be dried and put in cold storage before the coming daylight's heat and humidity kill it.

Tai has to rise early on these summer mornings because wild and domestic sugarcane are reproductively out of sync. The wild male plants flower several months earlier than the domestic female varieties. That's why he must store the pollen at –180°C until the domestic variety plants are ready to cross.

Just a brush from Tai's hands causes a shower of gold to fall on the white collection paper. The night before, he tied the sugarcane stalks down so their blooms would be easy to reach.

"One of the interesting aspects of my work is how close it is to nature," says Tai. "I like to see the pollen grains falling like gold dust; it's pretty. I also like it when a seedling pops up. It holds the promise of a new hybrid."

Finding an effective storage protocol for pollen took Tai 2 years, and he says it's one of his major successes as a researcher.

Nature, and its preservation, is one reason Tai is studying wild sugarcane at the Sugarcane Research Field Station operated by USDA's Agricultural Research Service. In fact, it's an important goal of the entire ARS sugarcane program, along with enhancing yields and reducing losses from disease and pests.

Raising Sugar—and More

Agronomist Barry Glaz, also at the Canal Point station, has worked with a joint state, federal, and tribal task force established to restore the south Florida ecosystem. As a member of a science committee that supports the task force, Glaz assisted in identifying research that would help sustain agriculture and natural Everglades ecosystems.

Glaz's main recommendation, which has won support from growers and environmentalists, is to develop sugarcane varieties that can thrive when underground water tables are high. Water tables are the belowground levels that are completely saturated with water. He is also working to develop sugarcane varieties that can produce high yields with less phosphorus fertilizer or varieties that actually remove phosphorus from the soil.

"This is an exciting opportunity," says Glaz. "Florida sugarcane symbolizes many of agriculture's benefits—as well as growers' responsibility to protect the environment. ARS' work with Everglades' restoration is a positive example of how

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SCOTT BAUER (K5601-4)

Plant geneticist Peter Tai examines a sugarcane plant selected from a cross between a commercial variety and wild sugarcane.

science can find solutions that serve both goals."

Tourism and fishing in the Everglades' 4 national parks and 10 national wildlife refuges provide $500 million annually. The Everglades is also South Florida's only fresh water source and the only home for many kinds of wildlife, including a hawk known as the sand kite.

The Florida Sugarcane League estimates that the sugar industry provides $2 billion in revenue for the state and directly employs 11,200 people. In fact, Florida ranks first in the nation as a sugar producer, providing 24 percent of the sugar produced in the United States.

Change in the 'Glades

Originally, the Florida Everglades spread from Lake Okeechobee to the state's southern shores. In the 1940s, northern parts of the Everglades were drained by canals to create a farmers' paradise known as the Everglades Agricultural Area. However, the canal draining and farming in the EAA were soon causing serious sustainability issues for the natural Everglades. The agricultural area's phosphorous fertilizers, one of several concerns, may have contributed to changes in natural habitat—most notably, a change in the balance of plant life from sawgrass, a native plant that is the staple of the ecosystem, to cattail.

Glaz and University of Florida scientists Christopher Deren and George Synder have found differences in phosphorus uptake among sugarcane varieties that could lead to the annual removal of a million pounds of phosphorus from the Everglades. Jim Miller, who heads the ARS Canal Point research group, works with Glaz to genetically enhance the phosphorus-removing trait in sugarcane.

There's also work under way aimed at meeting the other research goal: water-tolerant sugarcane. Why do growers need sugarcane that doesn't mind getting its feet wet? In a word: subsidence.

Slowing Soil Disappearance

Most soil subsidence in the Everglades results from oxidation, which causes the soil to disappear. It's caused by microbes such as fungi and bacteria that eat away the organic matter and

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A tassel of wild sugarcane, *Saccharum spontaneum,* shows anthesis, or release of pollen from the plant's anthers.

convert it to carbon dioxide and water.

"This is a big problem in the Everglades, where much of the soil is more than 85 percent organic matter," says Glaz.

For about 5,000 years, this region was under water from 7 to 12 months a year. The resulting balance of aerobic and anaerobic conditions kept microorganisms in check, allowing organic soils to build at rates up to 3 inches per century. Now, with drained conditions, some soils subside as much as an inch annually.

The short-term goal of the work is to identify commercial sugarcane varieties that yield well when water tables are high enough to reduce subsidence to 0.3 inch annually. Ultimately, the goal is to completely control subsidence.

As it happens, Tai may have water-tolerant sugarcane varieties in his greenhouse. At first, he was looking at wild varieties to find one that could stand up to winter cold snaps that occasionally occur in Florida and still produce sugar. But Tai suspects there are wild varieties that are also water tolerant.

"India and Bangladesh are low-lying countries that have monsoons that can last 2 or 3 months," says Tai. "The wild sugarcane from those regions, which we looked at for cold tolerance, may also thrive in high water."

But it's no easy matter to get wild sugarcane genes into domestic lines.

"It takes about 8 to 10 years using domestic varieties as parental clones to develop new improved varieties. But it would take nearly twice that long to transfer wild sugarcane genes to domestic lines," says Tai.

That's because not everything about wild sugarcane is suitable for commercial growers. The hybrids also have to have economically sufficient yields to be accepted.

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Harvesting sugarcane in south Florida, where scientists in the ARS Sugarcane Production Research Unit are identifying research to help sustain both agriculture and natural Everglades ecosystems.

And even if Tai's research provides varieties that are more environmentally sound, much more work will have to be done to help the Everglades.

"What's needed is an integrated approach," says Glaz. "Sugarcane varieties that tolerate flooding from June through September are only part of the solution. The genetic research must integrate with studies in agronomy, microbiology, hydrology, and ecology if we are to one day grow sugarcane profitably—minus subsidence."—By **Jill Lee,** ARS.

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An experimental ARS sugarcane field near Canal Point, Florida.