



**Vigilant.** State inspectors in California collect psyllids (*inset*) from a kumquat tree near where they detected citrus greening disease.

educating the public about the dangers of moving fruit trees, for example.

With the help of the U.S. Department of Agriculture (USDA), state inspectors also

began monitoring for the psyllids. Plant pathologists suspect that the bacterium first arrives when residents unwittingly bring back infected twigs from other states or countries to graft onto their own trees. The psyllids

probably arrive separately, on small plants or fruit. And when they do, they spread the disease from tree to tree. It's easier to test for the bacterium in psyllids than in leaves, because trees often don't show symptoms at first.

When the insects turned up in San Diego and Imperial counties in 2008, the California Department of Food and Agriculture went yard by yard spraying insecticides, and also quarantined nurseries. Despite these efforts, Asian citrus psyllids have become established in Los Angeles County and in southern Texas. Since 2005, researchers in both California and Texas have tested tens of thousands of psyllids for the bacterium. They found a *C. Liberibacter*-positive psyllid in January in Texas, in a small orange grove near the border with Mexico, where the disease is rapidly spreading north. About 60 trees in that orchard and a nearby grapefruit grove have since been confirmed infected. Some 20 trees have already been destroyed, with more culling planned, says John da Graça, who directs the Texas A&M University Kingsville Citrus Center in Weslaco: "The disease is here and everyone is taking it very seriously." Late last month, California inspectors found an infected psyllid in Los Angeles County. They raced back to the neighborhood and found a diseased lemon-pomelo tree, which they have destroyed. "We fully expect to find more infected trees," says Ted Batkin of the California Citrus Research Board in Visalia. "I get little sleep these days."

After these detections, both states have ramped up their monitoring. Researchers in California are releasing parasitoid wasps imported from Pakistan to help control the psyllids in urban areas, where widespread spraying isn't feasible. "It's not a silver bullet," says Mark Hoddle of the University of California, Riverside, who is leading the effort. Other experts put more stock in quarantines

## AGRICULTURE

## Dread Citrus Disease Turns Up in California, Texas

When the worst disease of citrus plants was detected in Florida in 2005, growers and researchers elsewhere in the country watched with trepidation. Citrus greening, also known as huanglongbing, turns fruit sour and kills trees within a few years. There is no cure. Transmitted by a tiny insect, the bacterial disease rapidly conquered Florida, doubling the cost of citrus production and raising questions about the future of the industry. Fred Gmitter of the University of Florida says, "The dilemma for Florida is: Where do we go from here?"

Now citrus greening has turned up in California and Texas, the second- and third-largest citrus producers in the United States. "We've been waiting for this and searching for it," says Beth Grafton-Cardwell of the University of California, Riverside's Lindcove Research and Extension Center in Exeter. She and other researchers are hoping that rapid action—hunting for and destroying infected trees and battling the sap-sucking insect vector—can contain the disease, buying enough time to develop treatments or even resistant trees.

Citrus greening afflicts most countries that grow the fruits. First seen in China at the end of the 19th century, it has become

endemic in many parts of Asia, Africa, and Latin America, disrupting citrus production. The 4-mm-long psyllids, which are related to aphids and whiteflies, transmit the bacterium *Candidatus Liberibacter* between trees when they feed on new leaves. Several months to 2 years later, as the bacterium damages the vascular system, leaves start to turn yellow (*Science*, 28 April 2006, p. 523). Trees are infectious even before they show symptoms, which makes it hard to halt the disease's spread. So far, only Brazil, the world's largest producer of citrus, has succeeded, thanks to intensive surveillance, relentless removal of sick trees, and aggressive insecticide spraying.

The Asian citrus psyllid turned up in Florida in 1998. Even though it was known to be the vector for citrus greening, growers were not very concerned. "We got caught with our eyes closed," Gmitter says. The psyllid soon reached most of the

citrus-growing counties in the state, hitchhiking on orange jasmine, an ornamental plant used in landscaping. By the time citrus greening was detected in Miami-Dade County in 2005, it was already too late to stop the disease. Plant pathologists in Texas and California immediately took action,

### Online

sciencemag.org

Podcast interview with author

Erik Stokstad.

[http://scim.ag/pod\\_6079](http://scim.ag/pod_6079)

and in monitoring and spraying commercial groves. “We’ve been successful in slowing down the whole process,” says Grafton-Cardwell. “We know we’re just buying time until a solution comes about.”

Researchers are pursuing a variety of approaches to combat the disease. One is to treat infected trees with antibiotics. USDA’s Yongping Duan and colleagues reported in September that the combination of streptomycin and penicillin will eliminate the bacterium, but the U.S. Food and Drug Administration is unlikely to allow the use of penicillin in plants. Last year, the Citrus Research and Development Foundation (CRDF) in Florida offered a cash prize for new antibiotics; now it is funding Duan and others to test more than 50 candidates. Other researchers are trying to develop “plantibodies” to fight the bacterium, to find RNAs that will prevent the psyllid from transmitting the bacterium, and to develop ways to repel psyllids from citrus trees.

The ultimate hope is to create resistant trees, which many groups are trying to do. Erik Mirkov of Texas A&M University’s AgriLife Research unit in Weslaco is the furthest along. He has added two genes from spinach that code for antimicrobial proteins into several types of citrus. After growing the transgenic trees for more than a year in a greenhouse with infected psyllids, Mirkov says he can’t detect the bacterium in the trees. Field testing in Florida should begin later this year, but regulatory approval for commercial release is years away.

In the meantime, Florida growers are trying to make the best of the miserable situation. Many have begun coordinating insecticide spraying to better control the psyllids. But most growers no longer remove infected trees for fear that they won’t have enough left to stay in business. Instead, they are trying to keep the trees productive as long as possible by applying extra fertilizer. David Hall of USDA is now testing whether this approach really works. The fundamental problem, however, is that the sick trees will infect any new ones that are planted.

Florida growers may have to move to a new type of agriculture in which they plant dense orchards and optimize the growth of young trees before citrus greening starts to damage the fruit. That may just keep citrus growing in Florida economical, says CRDF’s Harold Browning, who urges continued funding of research. “It’s difficult for an industry facing disaster to be patient,” he says. Growers in the West have their fingers crossed that their dollars—and heightened vigilance—will pay off in time.

—ERIK STOKSTAD

## STEM CELLS

# Texas Medical Board Approves Rules for Controversial Treatment

Last week, the Texas Medical Board signed off on what’s said to be the first state-level policy imposing oversight on experimental treatments using adult stem cells. The scientific community has mixed views on whether this is a good way to raise standards.

Some experts say the rule will allow unscrupulous doctors to avoid U.S. Food and Drug Administration (FDA) reviews. “They’re acting as though there’s no federal policy around stem cells,” says bioethicist Leigh Turner of the University of Minnesota, Twin Cities. But others say it’s a good-faith effort to bring oversight to controversial treatments that clinics around the world offer for diseases including arthritis and multiple sclerosis.

Texas has become a flashpoint thanks in part to Governor Rick Perry, who last summer received treatment from a Houston physician for a back injury that consisted of an injection of his own fat stem cells. Meanwhile, the company that prepared Perry’s cells, Celltex Therapeutics of Sugar Land, Texas, has come under fire for allegedly charging patients to bank their cells for experimental treatments.

Perry asked the Texas Medical Board for a review; last summer it began drafting a rule governing physicians’ use of “investigational agents,” including stem cells. The final rule would require patients’ informed consent for stem cell treatments. The cells’ proposed use would also have to be part of a National Institutes of Health or FDA-approved protocol or study, or be approved by an ethics panel known as an Institutional Review Board (IRB).

Critics say most stem cell treatments offered at clinics clearly fall under FDA’s purview. They note that stem cells are considered a biologic drug if they are more than “minimally manipulated” (by expanding the cells in culture, for example) or are meant to perform a function different from their original one. The rule “opens up a lot of opportunities for abuse or fairly lax regulation,”

says science policy expert Douglas Sipp of the RIKEN Center for Developmental Biology in Kobe, Japan.

Turner, who testified before the Texas board last week, also warns that the proposed rule would permit review by private, for-profit IRBs, which he argues can be under financial pressure to approve protocols. And stem cell researcher Irving Weissman of Stanford University in Palo Alto, California, told the *Houston Chronicle* that the draft rule is “a clever way around the FDA’s appropriate role overseeing clinical trials” and violates

guidelines from the International Society for Stem Cell Research (ISSCR). However, ISSCR hasn’t taken a position. Its science director, Heather Rooke, says, “We’ve generally heard positive things about the intent” of the rule.

Sean Morrison, an ISSCR member at the University of Texas Southwestern Medical Center in Dallas, says the Texas board cannot require FDA oversight, noting that many legitimate U.S. clinical trials test treatments that don’t meet FDA’s defini-

tion of a regulated product. But the draft rule wouldn’t stop FDA from stepping in, Morrison says, because “federal laws trump state laws.”

Morrison does share concerns that the draft rule’s requirements for IRB review are “weak.” But he says the medical board “should be congratulated for trying to impede the proliferation of unproven stem cell therapies.” Texas, he says, “has done more to address this problem than most other states.”

The medical board’s 10-to-4 vote, says Executive Director Mari Robinson, reflects a feeling that the FDA guidelines aren’t clear and that, given that some doctors are already offering stem cell treatments, the board felt that it needed “to create a safety setup.” She said the board expects to consider refinements to the rule at its June meeting.

—JOCELYN KAISER



**Case study.** Governor Rick Perry asked for new rules after receiving therapy for back pain.