

## **'Green' rice on menu**

### **Farmers could profit from carbon offsets**

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**Published 12:00 am PST Sunday, February 17, 2008**

The war on global warming has entrepreneurs racing to find new ways to trim the carbon emissions linked to everything from wine to washing machines.

But Eric Rey was the first to see the promise of low-emissions rice.

In Davis, Rey's Arcadia Biosciences is crafting genetically modified rice that thrives on just half the typical dose of nitrogen fertilizer – a source of greenhouse emissions on a par with all the world's passenger vehicles.

By growing rice that needs less nitrogen, farmers would save money on fertilizer and plug into the booming global market in carbon offsets. Rey would be able to price his rice seed the same as conventional varieties and make a profit by taking a share of the carbon-credit revenue.

The environmental benefits of the rice would be enough to win over biotech skeptics, said Rey, a life member of the Sierra Club. In addition to cutting greenhouse gases, the rice has the potential to reduce nitrate pollution, a scourge of rivers and aquifers worldwide.

On the farms in rural China where he hopes to launch the plan and where he is focusing his efforts, Rey figures each acre planted with Arcadia's rice could yield close to one metric ton of carbon offsets, now trading at \$22 a ton on European markets and expected to climb in the future. Even at current rates, the offsets alone would boost farmers' profits by as much as 25 percent.

But Rey can't count his money just yet.

Arcadia's rice is at least five years from commercialization, and unforeseen hiccups could make the wait much longer. Farmers and rice processors around the world now shun genetically modified rice, fearful of a backlash in export markets. In California, the rice industry is so leery of the technology that it has forced Arcadia to

test-plant its creations in Fresno County, more than 100 miles from prime rice-growing areas.

What's more, the future value of the carbon offsets is uncertain. If global emissions-cutting efforts fizzle, demand for carbon offsets will evaporate.

But that isn't enough to deter Rey, for one key reason: The market potential is huge. Rice is the planet's third most widely planted crop, grown on roughly 390 million acres. China grows more rice than any other country.

"If you win, you win really big," said Andrew Baum, a biotech industry veteran who chairs the food and agriculture committee of the Biotechnology Industry Organization, a trade group.

Rey's timing has proved just right. His plan meshes with efforts in California, Europe and the rest of the world to cut greenhouse emissions. Those regulations are driving a booming trade in carbon credits, now a \$5 billion-a-year global business.

Rey's big idea for nitrogen-efficient rice has boosted him onto the international media stage: He's been the subject of a front-page feature in the Wall Street Journal and scored a spot on a list of "50 people who could save the planet" in the United Kingdom's Guardian newspaper.

Biotech seed giants Monsanto Co. and Pioneer Hi-Bred International Inc. are also working on nitrogen efficiency, but they're focusing on corn. In rice, Arcadia is out front: It's the only U.S. company that has progressed to the level of outdoor test plantings for nitrogen efficiency, according to U.S. Department of Agriculture records.

Still, while Arcadia's field trials of rice in California and China are promising, it has yet to breed the nitrogen-efficiency gene, borrowed from barley, into the commercial rice varieties popular in China. At best, Rey hopes to have seeds ready by 2013.

Skeptics say it could take much longer to work out the kinks. "It's unusual for a gene to just do one isolated thing in an organism. We can expect that there will be some unintended consequences," said

Doug Gurian-Sherman, a senior scientist with the Union of Concerned Scientists in Washington, D.C.

Even if Arcadia clears the technical hurdles, genetically engineered rice may be a hard sell to farmers.

While genetically engineered corn and soy are now planted widely, virtually no such rice is grown commercially because of opposition from key markets in Europe, Japan, South Korea and Taiwan. Keeping buyers in those markets happy is especially important to California growers, who frequently export more than one half of their rice.

So Rey is piloting his emissions-reduction plans in north-central China, where nitrogen use is especially high and farmers and government officials appear open to genetically modified rice.

There, Arcadia is monitoring the nitrous oxide gas that burbles from fertilized rice paddies. The measurements will provide baseline data needed to demonstrate that large-scale plantings of Arcadia's rice would actually reduce emissions. That's important, because while researchers have estimated the climate impact of fertilizer on a global scale, international emissions traders don't yet recognize offsets generated by reductions in nitrous oxide emissions from a particular farm field.

"It's one of the harder things to quantify accurately," said Mark Trexler, a director with EcoSecurities Group, a leading player in the global carbon market.

Rey, a fit, ruddy-faced 51-year-old with close-cropped hair, is a veteran of the long biotech haul. He spent 17 years with Davis biotech pioneer Calgene, starting as a greenhouse manager in 1982 and rising to vice president.

Calgene shot into world headlines in 1994 when it launched the Flavr Savr tomato, the first biotech crop to reach supermarkets. But the Flavr Savr flopped, dragged down by low crop yields and a fragile skin. By fall 1996, Calgene had lost roughly \$150 million on the program. It sold out to Monsanto in early 1997.

Rey didn't work directly on the Flavr Savr, but he says its rise and fall taught him, among other things, to place his bets widely.

"These types of products take a long time to get to the marketplace, and there's risk all the way along the line," he said.

So Arcadia, which employs about 80 people in Davis, Seattle and Phoenix, is working on other technologies besides nitrogen efficiency. It is breeding salt-tolerant varieties of rice, cotton and tomatoes, has a Department of Defense contract to develop vegetables with longer shelf life, and is breeding wheat so that it can be tolerated by people on gluten-free diets.

This summer, fields in the Sacramento Valley are scheduled to bear Arcadia's first commercial harvest - safflower engineered to contain extremely high levels of a key omega-6 fatty acid valued as a nutritional supplement. Rey says producing the fatty acid with the company's safflower will cut production costs roughly 15-fold compared with current sources.

Rey traces his interest in agriculture and the environment to his childhood. Growing up in Oxnard, he often visited his uncle's nearby vegetable and citrus farm and spent summers in the Sierra. He came to the University of California, Davis, to study plant science.

Staying afloat through the painstaking process of breeding new plant varieties has been one of the most difficult challenges for small biotech companies.

"It presents a return-rate problem," said David Collier, managing director of San Francisco-based CMEA Ventures, an Arcadia investor.

Rey solved that problem early.

Arcadia was founded in 2002 with majority backing from billionaire John Sperling, the now 86-year-old founder of the University of Phoenix.

Sperling, also known for his financial support of causes ranging from medical marijuana to human cloning, hired Rey as a consultant

in 2000. The two began talking about business prospects. Sperling, Rey said, was interested in ways to turn recent laboratory advances in crop biotechnology into environmentally friendly commercial ventures.

"He said, 'Find me the opportunities,' " Rey said.

Sperling's backing, said several industry experts, has given Arcadia the freedom to innovate.

Rey "has had the chance to do something off the beaten path because he doesn't have to always raise money," said Baum.

Rey sees Arcadia's work as helping to settle the long-running debate between the biotech industry and its critics over the environmental benefits of crop biotechnology.

While the global acreage planted to genetically modified crops reached 282 million acres last year, resistance to the technology remains strong in many countries, including the United States. Critics point out that 80 percent of all biotech crops are designed to withstand certain herbicides, a trait that has led to herbicide-resistant weeds, in turn prompting farmers to spray more chemicals, according to some studies.

Rey is convinced that the water-quality and greenhouse-gas benefits of Arcadia's rice have a shot at winning over critics. Global warming, he reckons, may have changed the game.

"I think the public is looking at the world with a different set of glasses," he said.