

Meeting Report

The thin end of the rice grain?

By the second day of BIO 2001, San Diego's conference center was buzzing with activity. Inside the barricades were 14,000 registered participants and almost as many police officers; outside was a single raggedy group of seven protestors (two toddlers; five adults), one of whom looked like he had dropped way too much acid in the sixties.

This was the biotechnology industry's showcase, and nothing was going to disrupt it—there was to be no repeat of the chaos in Seattle during the 1999 meeting of the World Trade Organization. After a mild protest on the first day, Kelli Gray, a food-science major at San Diego State University and member of the Greenpeace True Food Network, was one of the few dissenters left.

"It's not really biotech that I have a problem with; it's the government," she said. Inadequate testing and labeling of genetically modified (GM) foods was her issue, and one that got support from a surprising quarter. Craig Venter of Celera Genomics (Rockville, MD), receiving a joint award with Francis Collins (National Human Genome Research Institute, Bethesda, MD) for coordinating efforts to sequence the human genome, called GM food safety issues "answerable questions. The research has not been funded to answer these questions."

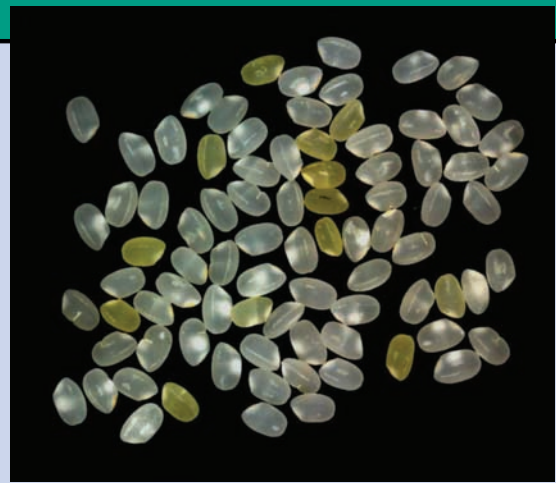
GM foods were the most vital thread

in the sprawling meeting, and the new battleground appears to be the developing world. Stories from Africa and Asia were put forward as models for how biotechnology could benefit poorer countries. The alternative—that the agricultural biotechnology industry is using poorer countries as a way to force GM foods into reluctant markets—was vehemently denied, but in the end, the true story was difficult to ascertain. In this debate, it comes down to determining motivations, and those motivations may well vary depending on which person from a particular project (from research scientist to company CEO) is doing the talking.

A glowing grain

Golden rice has become the poster child for agricultural biotechnology. The rice has three genes added to it so that it now makes β -carotene (otherwise known as pro-vitamin A) and turns yellow. Vitamin A deficiency has been estimated to cause at least 500,000 cases of irreversible blindness per year, and between 1 and 2 million deaths per year, mostly in very young children. Golden rice has the potential to supply many of these people with pro-vitamin A in their food.

"We need more projects like golden rice," said Shanthu Shantharam of seed



Golden rice, here mixed with regular rice, is a source of pro-vitamin A.

giant Syngenta. "In this way society will understand some of the benefits of biotechnology." Shantharam introduced Peter Beyer (University of Freiburg, Germany), who with Ingo Potrykus (Swiss Federal Institute of Technology, Zurich, Switzerland) spearheaded the scientific effort to create golden rice.

The project started in academia with nonprofit funding, but when a new source of funding was needed, Beyer and Potrykus turned to the European Union, which requires that grantees have a commercial partner. This requirement, and the need to get access to multiple agricultural biotechnology patents, resulted in a partnership with Zeneca, now part of Syngenta.

The Syngenta partnership and a Greenpeace campaign led to some negative publicity. In Potrykus' opinion, the anti-golden rice campaign "has little to do with facts. It is a pseudo-religious

Whole-genome shuffling

Maxygen, Inc. (Redwood City, CA) was founded on the technology of gene shuffling, in which test-tube experiments yield the sort of genetic reassortment normally seen as a result of sexual reproduction. In brief, multiple variants of a gene are subjected to cycles of cutting, reannealing, ligation, and testing for increased or novel activities based on the new combinations of genetic variants now found in the same molecule.

Now Russell Howard, CEO of Maxygen, has announced that the company has successfully extended the technique to whole genomes. Starting with related bacterial strains, Maxygen scientists shuffled the genomes in the test tube, then reconstituted organisms that now thrived in acidic conditions (pH 3.8) that the parent organisms could not tolerate. Howard said that the technique allows the company to optimize parameters even when the underlying biology is not understood. ■



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war—very emotional. A few groups that are antiglobalization, antitechnology, and antisience see this as a very efficient battleground. They use the fear from incidents like BSE to spread the feeling that transgenic plants are something very dangerous. There are really no data to support that view.”

The first transfer of golden rice varieties to a local research institute happened in January 2001, at the International Rice Research Institute (IRRI; Los Baños, Philippines). The recipient was Ronald Cantrell, IRRI’s director, who estimates that transferring the genes to local cultivars and boosting the levels of pro-vitamin A production will take 3 to 5 years. As for the protests, “I don’t have a lot of time for people who don’t have something they can come up with that is a better alternative,” he said.

But Cantrell has more in mind for



Ingo Potrykus (left) handing over golden-rice seeds to Ronald Cantrell (right) of IRRI in the Philippines.

golden rice than a fix for vitamin A deficiency—he hopes it will stimulate commerce. “Today there is no seed market [in Asia], but it can be big,” he said. “I want that subsistence farmer, I want him to be able to purchase seed.”

Under the agreement with Syngenta, any farmer producing less than \$10,000 per year of grain has access to the technology for free. For those in the poorer countries, said Cantrell, “at some point they will start purchasing products, but it will not be golden rice.”

The African story

Florence Wambugu has been working in agricultural biotechnology for many years, but lately she has become the biotech industry’s favorite spokesperson. She puts a forceful case that food-poor Africa is not interested in the West’s skittishness about GM foods, and that it resents outsiders telling it that it should not make use of this technology. Her views have been backed by the recent United Nations (UN) Human Development Report 2001, which concludes that the possible benefits of GM food outweigh the risks for developing countries.

Wambugu, director of the ISAAA Africa-Center in Nairobi, Kenya, agrees with

Cantrell’s economic arguments. “Nobody gets out of poverty by begging,” she said. “The African community has to get into the market economy. This technology is going to enable people not only to become consumers but also . . . part of a global community.”

Agriculture sustains Africa, and yet production per hectare in Africa is less than half the average seen worldwide. Jocelyn Webster, executive director of the South African biotech organization AfricaBio, said that GM foods can work in Africa. “The benefits are packaged in a seed,” she said, “and that means the farmers can have access to the technology.”

Unfortunately for Wambugu and Webster, opposition to GM foods exists both in Africa and its trading partners. A 1999 AfricaBio survey found that 26% of South Africans were in favor of GM food, 19% were opposed, and 55% were unsure, and Webster said the opposed and unsure numbers have increased further following negative press in South Africa. Furthermore, Namibia recently stopped buying South African maize to feed its cows, because it was concerned that the 6% GM content in the feed would jeopardize their share of the European beef market.

Despite these problems, there were over 70 applications for GM plant trials in South Africa last year alone, and Webster is not about to give up on GM technology. “Africa needs this technology,” she said. “There’s no doubt about it. There’s no debate about it. We need it.” ■

Forgetful flies

Tim Tully (Cold Spring Harbor Laboratory, NY) has raised the stakes in fly memory research. It took ten calendar years, and approximately 50 person years, for Tully and others to isolate the first three *Drosophila* genes implicated in memory and learning. But now in a large-scale screen, Tully and his colleagues have isolated 55 genes involved in fly learning and memory in just the last nine months.

Tully pairs certain odorants with electric shocks, then tests his mutants for their ability to learn to avoid the odorants. In normal flies, multiple, spaced training sessions are needed to cement an odorant–shock pair into long-term memory; multiple training sessions without intervening gaps do not work. Tully has reported previously that he can override this system

by expressing an activated form of the cAMP response element binding protein (CREB), yielding flies that form a long-term memory after a single training session.

Remembering is all very well, but will a CREB-stimulated brain overload? This is not just a question for the flies—Tully is involved with Helicon Therapeutics, Inc. (Uniondale, New York), which hopes to exploit CREB and other memory proteins to treat brain degenerative disorders and perhaps to increase memory abilities in normal individuals. But the answer may come first in flies. A fly brain can learn only five odor–shock pairings before additional pairs displace the first set. Tully is now looking into whether CREB or the newly isolated genes affect this finite brain capacity. ■