

Beakers to the Rescue

Scientists say a new green revolution could head off future food crises.

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Pity the papaya. odd-shaped and orange-fleshed, it lacks the iconic status of the apple or the stage presence of the banana. Lately, though, it has become something of an agronomic superstar. Last month a team of international researchers led by the University of Hawaii finished mapping the genome of a variety of papaya engineered to withstand ringspot virus. Ringspot is a killer; it nearly wiped out Hawaii's \$17 million-a-year papaya industry. Then, in the late '90s, scientists came to the rescue by plucking a gene from the virus itself and splicing it into the papaya plant, like a vaccine. Today, Hawaii's papaya groves are flourishing and, with the genome in hand, scientists now believe they will be able to replicate similar harvest-saving technology for different crops around the world. Chalk one up for the second green revolution: the triumph of gene splicing.

When high-tech agriculture first hit the headlines, back in the 1960s and 1970s, it was all about applying conventional farming techniques in innovative ways: precision irrigation, chemical fertilizers and intensive crossbreeding to create high-yielding varieties of maize, rice and wheat for hungry nations like India, Latin America and Southeast Asia. Modern biotech got its liftoff in the 1980s, when a team of U.S. scientists discovered how to isolate genes from the DNA of one life form and then insert them into the cells of another. The green revolution became the gene revolution, and it has yielded a whole new suite of supercrops, from vitamin-packed corn to rice programmed for droughts. Some, such as a transgenic potato that requires just one eighth of the water of a normal spud, are still on the drawing board in test plots. Others, like golden rice, which comes bundled with an extra dose of vitamin A (the lack of which causes blindness around the world), are waiting to hit the supermarket, but have to pass muster with the health bureaucrats. According to industry analysts, biotech crops have already expanded from practically nothing a decade ago to 282 million hectares in 23 countries in 2007. The market for GM seeds has more than doubled since 2001, from \$3 billion to \$7 billion, says Gautam Sirur, head of Cropnosis, a U.K.-based agricultural consultancy. Although no one is projecting miracle yields, biotech enthusiasts say that once such products are unleashed on the marketplace, farmers will be able to grow more nutritious food at lower costs using less water and pesticides, and even in the most punishing weather.

The problem is that the second green revolution is encountering resistance more fierce than the first one ever saw. In key markets like France, Italy, Germany, Spain and Poland, most genetically modified

fruits, vegetables and grains are still taboo. Environmental militants trample them in the fields. A mere trace of them in the cargo holds is enough for port authorities to turn away entire shiploads. According to a recent poll, two thirds of Europeans still disapprove of GM goods, even when they are cheaper than conventional or organic foods and require no chemical pesticides.

Of course, there's nothing like a food crisis to shift attitudes. Already, the reflexive rejection of GM crops appears to be easing. Mexico, looking to pump up crop yield, has just lifted a longtime ban on genetically modified maize. The message has not been lost on biotech champions. "There are industry lobbyists walking around Brussels," grumbles Geert Ritsema from Greenpeace, a critic of GM food. Apparently, they've had some success. Importers in the United States, Asia and even Europe are beginning to relax their restrictions on buying biotech as conventional grains grow scarcer and dearer. One recent convert is Japanese buyer Nihon Shokuhin Kako Co., and some other food makers are expected to follow suit.

When the dust finally settles, much more than disease-resistant papaya is waiting in the plant nurseries. Numerous varieties of corn, cotton, soybeans and canola have already been bioengineered to resist pests and herbicides. But the breakthroughs in genome sequencing promise to reinvent the modern farm. "With computer tools we can decode genomes at lightning speed," says Jay Lehr, scientific director at the Heartland Institute of Chicago, a policy think tank. "Now we can crossbreed in months instead of years."

Lately, biotech companies are planning to ramp up world output by designing crops to thrive on weak soils and under extreme heat, with a view to bringing millions of hectares of degraded and marginal land in the poorest countries under the plow. One of the most promising frontiers of agriculture is biopharming, or the art of inserting medicinal properties into food and plants. California company Ventria has won an award for placing two proteins in rice, which in trials drastically reduced childhood diarrhea in Peru.

In the shorter term, those worried about the current food crisis are pinning their hopes on six variations of popular strains of rice that have been painstakingly crossbred over decades by the International Rice Research Institute, in Manila, to thrive even after two weeks or more underwater, a dousing that would kill conventional rice. Technically, these new rice strains are not GM crops but they are the product of cutting-edge research known as marker-assisted selection. This method allows breeders to identify seeds that are likely to pass along a desired trait (say, water resistance) and then crossbreed them. In places like Bangladesh or Vietnam's Mekong Delta, where the biggest threat to the rice crop is flooding, Asian farmers will no longer lose up to 50 million metric tons annually from submerged paddies.

India is already field-testing new strains in seven locations, and similar programs are getting started across the region. "We'd like to see 100,000 farmers growing these strains within two or three years," says David Mackill, a team leader at IRRI's Plant Breeding, Genetics and Biotechnology division. "From there it could ramp up quickly." Not quickly enough to ease the current crisis, but perhaps in time to ward off the next one.

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