Can Biotech and Organic Farmers Get Along?

The U.S. Department of Agriculture has been taking a closer look at the impact of biotech crops on organic farms. Research is providing tools to help them thrive side by side, but the politics are tricky.

FOR PROONENTS OF AGRICULTURAL BIO-technology, getting new crops to farmers has become a lot more complicated in the past few years. Take alfalfa, genetically modified (GM) to resist herbicides. This long-awaited variety was introduced in 2005, and within a year, farmers snapped up all the available seed and sowed 250,000 hectares. But in 2007, all planting was halted after opponents persuaded a federal judge to order the U.S. Department of Agriculture (USDA) to conduct a more comprehensive environmental review—one that was completed only this past December.

And then there are sugar beets. USDA approved herbicide-resistant sugar beets in 2005. About 3 years later, environmental groups and seed producers sued USDA, again claiming an inadequate environmental impact assessment. In August 2010, the court prohibited planting until the agency completes a more detailed review next year. In February, the court lifted the ban, but the confusion and uncertainty have thrown the industry into turmoil. Both of these cases have meant extra uncertainty have thrown the industry into turmoil.

This terrain is a stark contrast to the boom years of the 1990s, when varieties of GM crops quickly spread across the United States. Although opponents raised concerns about safety and ecological impacts, USDA approved variety after variety. Philosophical objections to biotech crops haven’t diminished, but the current spate of lawsuits and delays now hinges on economic damages; the issue is how to keep the transgenes in GM crops from spreading to organic crops, which can be costly for organic farmers to prevent. Failure can mean they give up the premium price that organic products fetch.

Enter Tom Vilsack, head of USDA, whose new mantra is “coexistence.” In his vision, biotech continues to innovate, organic farmers are protected from unwanted transgenes, and no one is tied up in costly litigation. In December, Vilsack electrified the debate by proposing the agency’s first restrictions on biotech growers—specifying isolation distances between GM and organic alfalfa to prevent gene flow—and hosting a high-level discussion of how to achieve coexistence. For the organic community, the moves were long overdue. Although to the community’s dismay, USDA subsequently reapproved GM alfalfa without any restrictions, the agency pledged to fund research on coexistence and to reinstate a key advisory committee on biotechnology to provide advice on the issue.

Experts say without question that GM and organic farmers can coexist—if there is an achievable, agreed-upon standard of how pure is pure enough to receive the organic label or to be accepted by overseas markets. At this stage, with so much of U.S. fields planted with GM crops—93% for soybeans—everyone agrees it’s impossible to completely exclude transgenes from organic fields, but they can be kept to minimal levels. “As long as zero tolerance is insisted upon, you can forget about coexistence,” says Patrick Byrne, a plant geneticist at Colorado State University in Fort Collins.

With a defined threshold, say the presence of 0.1% or 0.9% transgenic seeds, depending on the crop, scientists can figure out the appropriate distances between fields to minimize gene flow. In the future, computer models of pollinator behavior may help provide recommendations tailored to particular landscapes. Another approach to prevent the spread of transgenes is to breed crops that can’t be fertilized by transgenic pollen; the first commercial varieties of corn with this protection should be released this fall.

Harmony isn’t likely anytime soon, however. The sides remain split on key issues. Organic groups demand more government oversight, that the biotech industry share the cost of preventing gene flow, and the creation of a compensation fund for damages if their crops cannot be sold as organic. The biotech industry opposes all of these goals. So far, USDA seems to continue to lean toward the industry in how it approves GM crops. “The public face of USDA is changing, but their actions are business as usual,” says A. Bryan Endres, an expert in agriculture law at the University of Illinois, Urbana-Champaign.

A changed landscape

Coexistence has been a part of agriculture for a long time. Neighboring farmers have had...
To figure out what isolation distances and farming practices to recommend to farmers dealing with GM crops, scientists typically sow a field with plants that have a genetic marker, such as herbicide tolerance. Then they plant nontransgenic seeds in “study plots” at various distances. The transgenic crops will survive when sprayed with herbicide; if any plants in the study plot are still living, then they have acquired the resistance gene from the original field.

Although such experiments are straightforward in principle, they rarely encompass the diversity and complexity of agricultural practices, geography, and weather can all influence the spread of pollen. This is especially true for the dynamics of insect-pollinated crops, such as alfalfa. Seed producers may bring in hives full of honeybees or leafcutter bees, which fly different distances, to pollinate their crops. Native pollinators such as bumblebees may also influence how far the pollen travels. Researchers with the University of California, Davis, led by Larry Teuber, and USDA recently spent 3 years tracking pollinators (see photos, above) and sampling seed to measure gene spread via pollen. The results are being used to verify and refine isolation distances and environmental conditions.

Coexistence strategies are based on how pollen moves, which varies dramatically by crop. Soybeans, for example, are self-pollinating, and insects only rarely spread their pollen. Corn, which is outcrossing and wind-pollinated, is another matter entirely. And economic impact of approved GM crops. How-
GA2, was first researched in the 1970s by Jerry Kermicle of the University of Wisconsin (UW), Madison. Kermicle has taken a first step at breeding TCB into regular corn, but so far there hasn’t been much interest from corn breeders. “There’s nothing in it for the biotech firms,” he says, “and the small players in the organic community, they’re not organized or centralized.”

Efforts are also under way to modify biotech crops so that they can’t spread pollen. This would essentially “fence in” the transgenes. Several approaches are being investigated in labs, such as using RNAi to make transgenic plants sterile. But such approaches are fairly far away from development and implementation, largely for commercial reasons, says Henry Daniell, a molecular biologist at the University of Central Florida College of Medicine in Orlando: “The biotech companies have no incentive unless they get a strong product advantage.”

At least one company is pursuing a technology that would, as a side benefit, prevent gene flow in pollen. That approach, which Bayer CropScience has researched in soybeans and other plants, is to engineer chloroplasts to express transgenic traits. Because chloroplasts are maternally inherited, pollen very rarely carries the transgene. And traits placed into chloroplasts can be expressed at levels higher than those put into the nuclear genome, Daniell says, although it is a more difficult approach. Steven Strauss of OSU notes that this approach would be most useful as part of a suite of containment tools for biopharmaceuticals rather than food crops.

Some in the organic community are skeptical in any case. “We do not believe there exists a technological silver bullet to the multiple challenges that genetically engineered crops present,” says Kristina Hubbard, director of advocacy for the Organic Seed Alliance in Port Townsend, Washington.

Entrenched positions

Even if gene flow from GM to organic crops could be prevented in the field, there are ample opportunities for it to occur after harvest, for instance, through accidental mixing. This occurred with dramatic consequences in September 2000 with biotech corn called StarLink. Approved only for animal feed, StarLink was detected in taco shells and then found in more than 10% of the corn supply. Massive recalls resulted. The debacle was estimated to have cost Aventis, the developer of StarLink, hundreds of millions of dollars.

Commingling of approved biotech varieties won’t lead to recalls of organic food in the United States. That’s because, even though most consumers are unaware, organic products in the United States are allowed to contain transgenics. To earn the organic label, USDA specifies that farmers can’t plant GM crops. But if transgenics accidentally end up in their fields, the harvest can still be called organic.

That’s unacceptable to some buyers, who have zero tolerance for GM organisms (GMOs). But others recognize that a little contamination is inevitable, which underscores the importance of agreeing on quantitative standards for how pure is pure enough.

Such standards can be set in a variety of ways. Some countries decide what percentage of transgenes is acceptable in imported commodities, say 1% in soybeans. But in the United States, the government has not set a standard for organic labels.

In the absence of a federal standard, a private labeling scheme, the Non-GMO Project, set its own targets of 0.25% for seeds and 0.9% for food and ingredients in 2008 for all participating products. Manufacturers who are certified as testing their ingredients for transgenics can use the Non-GMO Project label. “Doing this proactively with a high level of transparency was [decided to be] the best way to win and sustain consumer confidence” in organic products, says Charles Benbrook of the Organic Center in Boulder, Colorado, who is a technical adviser to the Non-GMO Project.

In addition, some agricultural trade groups in the United States have agreed on realistic standards for specific crops. Before GM alfalfa was first approved, for example, industry funded research into gene flow and determined that organic seed producers would be able to easily achieve a goal of less than 0.1% transgenics in their fields. Forage Genetics International (FGI) in Nampa, Idaho, which commercialized biotech alfalfa with Monsanto, will require farmers who buy its seed to agree to its list of best practices. “The stewardship programs are mandatory,” says FGI President Mark McCaslin.

But such agreements aren’t enough for some organic groups, which would like to see the government, relying on a scientific advisory committee, set such standards and create penalties for breaking them. USDA doesn’t seem headed in that direction. In its January decision on alfalfa (Science, 4 February, p. 523), the agency opted to leave regulation up to industry, as it did the next month when it approved the first corn variety designed for ethanol producers. “At the place we are now politically, I don’t think we’ll see strict standards put in place” by USDA, says Alison Peck of the West Virginia University College of Law in Morgantown.

The organic community may yet get at least a discussion of its most controversial wish: a liability fund that would compensate growers who can’t sell to markets that reject biotech. This idea is anathema to the biotech industry, which argues that shifting this cost to technology developers would stifle innovation. Vilsack, however, has asked the newly reestablished USDA Advisory Committee on Biotechnology and 21st Century Agriculture to explore the concept.

As for Vilsack’s goal of reducing litigation, most observers say there’s probably no way to stop the lawsuits against USDA, which are filed by advocacy groups—such as the Center for Food Safety, the lead plaintiff in the alfalfa and sugar beet lawsuits—that remain vehemently opposed to new GM crops and want existing varieties yanked as well. “Expect to see more litigation,” the University of Illinois’s Endres says.

Even so, many are hopeful that the new discussions, taking place among farmers, seed producers, and buyers, will lead to concessions that lower the risk for organic farmers. “I’m optimistic that a lot of people in places of influence are thinking about this,” says Manjit Misra of Iowa State University in Ames. Molly Jahn of UW Madison is also sanguine, based on recent discussions with stakeholders involved in the alfalfa guidelines. “It’s possible for reasonable people to commit to a way forward, grounded in science, with reasonable standards,” she says.

—ERIK STOKSTAD