

Two leading figures in the debate over genetic engineering defend their stances

Interviews by Sasha Nemecek

YES

Does the World **Need** GM Foods?

ROBERT B. HORSCH, vice president of product and technology cooperation at Monsanto Company, received the 1998 National Medal of Technology for his pioneering experiments in the genetic modification of plant cells. He talks about the promise of GM crops.

How did you become interested in the genetic modification of plants?

I started in this field with a strong interest in plants but with what you might call an academic interest in agriculture. I had this vague, naive notion that if we could genetically improve plants with the new tools of molecular biology, we would find a way to make biotechnology relevant to agriculture.

That has now happened. Biotechnology is a great tool that will allow us to produce more food on less land and with less depletion or damage to water resources and biodiversity. I am convinced that biotechnology is not just relevant but imperative for helping us meet the rapidly

growing demand for food and other agricultural products. The combination of more people and rising incomes will increase the demand for food by at least 50 percent in the next 25 years.

But critics of genetically modified foods point out that companies are not going to start giving products away. Can a corporation like Monsanto make biotechnology affordable for farmers in the developing world?

Cultivating commercial markets and applying technology to help the developing world are not mutually exclusive at all. One approach that works very well is to segment the market into three different areas. One is the pure commercial market. It makes economic sense, as a for-profit company, for us to invest in products and market developments in places where we can sell our products and where we think we can make a profit.

The other end of the spectrum is noncommercial technology transfer, which is largely focused on public-sector collaboration. Take, for example, our collaboration to put virus-resistance genes in the sweet potato. We will never have a commercial business in the sweet potato because it's just not a market economy crop. But by sharing our intellectual property and our technical knowledge with scientists from Kenya, we have helped them develop sweet potatoes that show resistance to the most serious sweet potato disease in Africa, which can cause the loss of 20 to 80 percent of the crop.

Then there's a third area, what I call a transitional market, where we have less experience related to biotechnology but that in the long run I think may be more powerful and beneficial for development efforts. We have used this approach with our older, nonbiotech products,



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such as high-yielding corn hybrids, and I think we can use it in the future with biotech products. Small farmers can see results in a demonstration plot and, if they want, try it themselves on a portion of their farm. If it works for them, they can expand or repeat it the next year. We have programs like this in Mexico, India and parts of Africa. By the third or fourth year, if it's working, the farmers will have made enough money from the experimentation phase to be able to run essentially on their own.

And what about profits for Monsanto?

We sell the seeds and the herbicide at market prices, and we subsidize the learning, the testing and the development of distribution channels so that we don't actually make a profit in the first several years. Only if the project is successful enough to become self-sustaining will we start making a profit. At this point, we haven't gotten that far with any of these programs.

Let's turn to the environmental effects of GM crops. What do you consider the most important benefits of the technology?

Lower use of pesticides is the environmental benefit that people relate to immediately, and it's huge for a product like Bt cotton. [Editors' note: Bt crops have been genetically modified to produce a bacterial protein that kills certain insect pests.] According to a recent report, 2.7 million pounds of pesticides have not been used in the past four years, and many, many more won't be used in the future as biotech expands in acreage and in traits.

Beyond that there are also yield benefits. The Bt corn we have today doesn't displace a whole lot of insecticides, but what it does do is boost the yields by a noticeable margin. It depends on the year and on the region, but the increase in yield can range from 5 to 15 percent. If you think about it, that leverages land use, water use, fertilizer use and all the pesticides that go into growing corn. You get a 10 percent greater corn harvest with the same resources that you were going to use anyway. You're getting more out of your resources.

Getting more from really good farmland, then setting aside land that is of marginal quality and returning it to habitat for wildlife is very beneficial to the environment. We can't continue to indefinitely expand our old practices—of chemical use, of water diversion, of plowing wild lands and converting them to farms, of nonagricultural sprawl and of the production of industrial waste.

One of the benefits of biotech that we first heard about was nutritionally enhanced foods. But despite promises of healthier broccoli, we have Bt corn. The famous "golden rice" is not available to consumers yet and is still in very early stages of testing. Will we ever have nutritionally enhanced foods?

We're seeing progress across industry, academia and the non-profit community. For example, we are collaborating with a non-profit group, TERI [Tata Energy Research Institute] in India, on development of a product related to golden rice—golden mustard oil—that, like golden rice, is high in beta-carotene, a pre-

cursor of vitamin A. This may help alleviate vitamin A deficiencies in places where mustard oil is a staple in the local diet.

While making improvements to food for the industrial world is not a priority for Monsanto, other companies and university researchers are working hard in this area. For example, Du Pont has developed a modified oil with an increased amount of the fatty acid oleic acid. This product has reduced levels of polyunsaturated fatty acids and is more stable upon storage. Efforts are under way to modify other fatty acids to make oils more healthy for consumers. Also, there is research ongoing elsewhere to increase the amount of vitamin D in soybean oil.

Monsanto and other scientists have also been involved in research that may help reduce the likelihood of allergic responses to foods. We have been able to take a protein that is currently an allergen and modify specific amino acids in the protein to dramatically reduce the allergenic nature of the protein. Other scientists are using this and other methods to reduce the allergenic nature of some foods, such as peanuts and soybeans, which cause allergic reactions in a significant number of people.

Monsanto has been one of the most criticized, even despised, corporations because of its role in the development of genetically modified foods. Has it ever been hard to tell people you're an employee of Monsanto?

I've had a few people react negatively, but my experience is that when people meet you as a person, their reactions are very different than when they are commenting on the big nameless, faceless company.

I think the company is making an effort to address people's concerns about GM foods more openly. We've recognized that some genetic modifications are particularly bothersome. Among vegetarians, for instance, the idea of eating a vegetable that has an animal gene in it might raise questions. For certain cultures or religious groups, there could be similar concerns. So we decided it was better to avoid using animal genes in food crops.

I don't think it serves anybody's interest—including Monsanto's—to discount the potential risks of biotechnology. But for where we are today, and for what I see in the pipeline for the next few years, I really don't see a measurable risk from the GM products we are selling or developing. There have been numerous national and international scientific organizations that have reached this same conclusion, including the American Medical Association, the National Academy of Sciences, the World Health Organization and many others.

We at Monsanto have recently pledged to listen better to and engage in dialogue with concerned groups, to be more transparent in the methods we use and the data we have about safety, to respect the cultural and ethical concerns of others, to share our technology with developing countries, and to make sure we deliver real benefits to our customers and to the environment. I think this new attitude and new set of commitments will help improve both our company's image and the acceptance of this new technology.

NO

Does the World Need GM Foods?

MARGARET MELLON, director of the agricultural and biotechnology program of the Union of Concerned Scientists in Washington, D.C., holds a law degree and a Ph.D. in molecular biology. She explains her concerns about the effects of GM foods on human health and the environment.

How did you become interested in genetically modified foods?

I became aware of genetic engineering while running a program on toxic chemicals at the Environmental Law Institute in the 1980s. I was initially more positively disposed toward biotechnology than I came to be over the years. Like a lot of folks, I wasn't very critical. But the more I knew about the technology and the deeper the questions I asked about it, the less likely I was to accept at face value the extravagant promises made on its behalf.

I should also say, however, that my colleagues and I at the Union of Concerned Scientists are not opposed to biotechnology. We

think its use in drug manufacture, for example, makes a lot of sense. The therapeutic benefits of the new drugs outweigh the risks, and often there aren't any alternatives. But in agriculture, it's different. So far, at least, there are only modest benefits associated with biotechnology products, and it has yet to be shown that the benefits outweigh the risks. And there are exciting alternatives to solving agricultural problems that we are simply ignoring.

Agriculture isn't like medicine. We in the U.S. produce far more food than we need. And we are so wealthy that whatever we can't produce we can buy from somebody else. As a result, there are about 300,000 food products on our grocery shelves and 10,000 new ones added every year. The notion that consumers in the U.S. fundamentally need new biotechnology foods isn't persuasive.

But, of course, many scientists and policy experts argue that we *do* need biotechnology to feed the world, especially the developing world.

That is an important question to ask because so many people—about 800 million—are undernourished or hungry. But is genetic engineering the best or only solution? We have sufficient food now, but it doesn't get to those who need it. Most hungry people simply can't afford to buy what's already out there even though commodity prices are at all-time lows. How does genetic engineering address the problems of income disparity?

The real tragedy is that the debate about biotechnology is diverting attention from solving the problem of world hunger. I'd like to see people seriously asking the question, "What can we do to help the world's hungry feed themselves?" and then make a list of answers. Better

technology, including genetic engineering, would be somewhere on the list, but it would not be at the top. Trade policy, infrastructure and land reform are much more important, yet they are barely mentioned.

Genetic engineering has a place and should not be taken off the table, but I don't believe it is a panacea for world hunger. Treating it as if it is distorts this important debate. It is also amazing to me how quickly some have dismissed the virtues of traditional breeding—the technology that, after all, made us into an agricultural powerhouse.

Can we turn to another potential benefit that people claim for GM foods: agriculture that is more environmentally friendly?

Let's ask a question: What is a green agriculture? Is it one that doesn't depend on pesticides? I think it's a lot more than that, actually. But if we just consider avoiding pesticide use, we now have some data on the impacts of engineered crops. Surveys of American farmers by the Department of Agriculture show that the use of Bt [pest-resistant] corn aimed at the corn borer, for example, hasn't done much to reduce the application of pesticides to corn, because the vast majority of corn acreage isn't treated with pesticide to control that pest.

The introduction of Bt cotton, however, has resulted in a measurable drop in pesticide use. That's good for the environment and good for the farmers who cut their input costs. But this benefit will last only as long as the Bt trait keeps working. I think most scientists expect that the way Bt crops are being deployed will lead—sooner rather than later—to the evolution of resistance in the target pests, which means that the Bt cotton won't work anymore. We are likely to run through Bt cotton just like we ran through all the pesticides before it. So it isn't a durable path to a greener agriculture.

And there are environmental risks out there. Most scientists agree now that gene flow will occur—genes *will* go from engineered crops to nearby relatives. That means pollen will carry novel genes from the agricultural settings into neighbors' fields or into the wild. Gene flow from herbicide-resistant GM crops into the wild is already leading to the creation of herbicide-resistant weeds in Canada.

What about the health risks of GM foods? Do you see any looming problems?

I know of no reason to say the foods currently on the market are not safe to consume. But I don't have as much confidence as I should in that statement. There was a letter published in the journal *Science* last June from someone who had searched the literature for peer-reviewed studies comparing GM food to non-GM food. The researcher found something like five studies. That's not enough of a basis on which to claim, from a scientific standpoint, that we know enough to assure ourselves that these foods are going to be safe.

With the little we know about the food safety issue, I would say the biggest concern is allergenicity. Introducing new tox-

ins into food is also a risk. Of course, breeders are going to try to avoid doing that, but plants have lots of toxins in them; as scientists manipulate systems that they don't completely understand, one of the unexpected effects could be turning on genes for toxins. There are rules that govern how genes come together and come apart in traditional breeding. We're not obeying those rules.

So you don't see genetic engineering of crops to be an extension of traditional breeding?

No, not at all. You just can't get an elephant to mate with a corn plant. Scientists are making combinations of genes that are not found in nature.

From a scientific standpoint, there is no dispute that this is fundamentally different from what has been done before. And that it is unnatural. Now, because it's new and unnatural doesn't *necessarily* mean that it will prove to be more risky. But it is certainly a big enough break with what we have done before to demand an extra measure of caution.

And caution is particularly appropriate where the technology involves our food supply. Lots and lots of people—virtually the whole population—could be exposed to genetically engineered foods, and yet we have only a handful of studies in the peer-reviewed literature addressing their safety. The question is, do we *assume* the technology is safe based on an argument that it's just a minor extension of traditional breeding, or do we *prove* it? The scientist in me wants to prove it's safe. Why rest on assumptions when you can go into the lab?

Science can never prove that any technology is 100 percent safe. Will you ever be satisfied that we've tested GM foods enough? And how much risk is acceptable?

Sure, I could be satisfied that GM foods have been adequately tested. But it's premature to address that question now. Nobody is saying, "Look, we've got this large body of peer-reviewed experimental data comparing GM with non-GM foods on a number of criteria that demonstrate the food is safe."

When we have generated such a body of evidence, *then* there will be an issue of whether what we have is enough. And eventually, if things go well, we'll get to a point where we say, we've been cautious, but now we're going to move ahead—we need to fish or cut bait. But we're nowhere near that point now.

Obviously, we take risks all the time. But why are we taking these risks? If we didn't have an abundant food supply, if we didn't have something like 300,000 food products on our shelves already, then we would have an argument for taking this society-wide risk. But we've got plenty of food. In fact, we've got too much. And although we have many problems associated with our food system, they are not going to be solved by biotechnology.

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