FORUM

Lessons From a Decade of Genetically Engineered Crops

In May 1994, the Food and Drug Administration approved the Flavr-Savr tomato, the first whole food developed by genetic engineering. Approval came after more than 5 years of scrutiny, including extensive gathering of public comments. In this tomato, scientists had taken out a gene affecting softening and reinserted it backwards. The result was a tomato that ripened well and resisted spoilage longer.

We have come a long way since then. In 2001, U.S. farmers grew 88 million acres of genetically engineered crops, mostly soybean, corn, and cotton. Farmers liked the genetically engineered soybean and cotton varieties so much that they planted them on about 70 percent of each crop's acreage. For corn, the total was about 25 percent. Other genetically engineered crops have been approved for commercial use, including papaya, canola, tomato, potato, flax, squash, sugar beet, and radicchio. Notably, however, most of these other approved crops are not grown today— including the Flavr-Savr tomato—and some have never been grown, despite approval for release.

Why? What lessons can be drawn from this rather low success rate? One is that genetic engineering does not solve all problems. Virus-resistant squash was only partially resistant and thus did not replace the need to control insects carrying the virus. As a result, it was commercially unsuccessful. Another lesson is that the bottom line counts. The Flavr-Savr tomato was exactly as advertised. But with the heavy investment in research, it cost more than conventional tomatoes and didn't sell well enough to become profitable.

Probably the most important lesson is, "The customer is always right." This certainly pertains to the ongoing globalization of trade, which has increasingly thrown together consumers from diverse backgrounds in a marketplace that must serve them all. Especially in the European Union, consumers began to voice distrust of this technology and created a backlash against its large-scale use. Regulations quickly followed that require segregation and labeling of genetically engineered foods. This gives farmers a strong incentive not to grow genetically engineered crops whenever exports to Europe might be a significant part of sales.

Regardless of consumer concerns, it remains true that genetically engineered foods haven't made anybody sick. Debates over the last decade have focused instead on specific scientific questions about the massive introduction of genetically engineered crops.

Three major environmental questions were highlighted by recent reports from the National Academy of Sciences. Might insect pests develop resistance to genetically engineered "plant-incorporated protectants"? Will these agents cause unintended damage to beneficial insects? Could engineered genes spread to nearby vegetation?

Of course, all these questions can also be posed about non-engineered genes. But the genetically engineered traits have been the subject of controversy because they are presumed to be novel, without years of accumulated wisdom about their impact.

This issue of *Agricultural Research* carries an article about genetically engineered corn that resists rootworms (page 4). The corn rootworm enjoys the dubious distinction of triggering more insecticide use than any other single pest in U.S. agriculture. Genetic engineering may greatly reduce this insecticide use.

The objectives reported in the article typify one type of our agency's biotechnology risk assessment and risk mitigation research. Under this umbrella are objectives as diverse as developing ways to prevent the spread of engineered genes; confining the expression of engineered genes to specific, nonedible tissues—such as roots, to foil root-feeding pests; and documenting changes in pesticide movement into rivers and lakes.

The U.S. Department of Agriculture maintains a competitive grants program to support biotechnology risk-assessment research. Typically, the program has funded 2- to 3-year projects, mostly by university scientists. In contrast, the Agricultural Research Service carries out longer term projects, such as testing of cropping strategies to suppress development of resistant insects, and multiyear monitoring of the actual resistance level of pests occurring with current farm practices.

Both ARS and grant-supported research will document the benefits as well as the potential risks of genetically engineered crops. They both stress comparisons to real-world production systems that pose their own risks, such as heavy insecticide use to combat corn rootworm. The data, collected by spending public funds, will be made available for public scrutiny and provide a more complete foundation for science-based regulation of genetic engineering.

The future of genetic engineering is bright, with potential benefits perhaps not yet imagined. But like all new technologies, it must be deployed properly to prevent unintended consequences. Globally, consumers have clearly demonstrated a desire for more information about the risk of any unintended consequences, and this desire has limited markets for U.S. agricultural products.

Public confidence can arise only from public knowledge that regulatory agencies are overseeing the new technology comprehensively, fairly, and rigorously. USDA is playing an important role in the process through new research to provide high-quality data to help regulatory agencies make sound decisions. As a result of this lesson learned, the second decade of genetic engineering in agriculture is expected to have many more success stories than the first.

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