

Communicating biotechnology

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Few subjects get more attention in agricultural circles these days than "biotechnology." Genetic engineering through the use of recombinant DNA is being heralded as a biological revolution, with untold potential benefits for agriculture and society as a whole. Government sources estimate that, by the end of the century, the field of biotechnology and genetic engineering will be a \$40 to \$100 billion dollar industry.

For some, genetic engineering is the agricultural equivalent of "Star Wars." Visionaries foresee in the science embodied in biotechnology the capability to resolve or mitigate many of the most critical problems facing agriculture: conservation of natural resources, enhanced productivity to maintain the profitability and competitiveness of U.S. agriculture in world markets, amelioration of environmental pollution resulting from high-tech production systems, elimination of plant diseases, insect control, new product development, and many more.

Others see biotechnology as more evolutionary than revolutionary. They point out that the plants and animals that constitute our agricultural system are genetically complex and are not amenable to rapid, intrusive changes. Whatever changes biotechnology brings about are therefore likely to occur at a pace that permits farmers and consumers to adapt to them just as they have to conventional technological achievements in the past.

There is no doubt in my mind that biotechnology has tremendous potential for agriculture, but the millennium is not yet at hand. It will require many millions of dollars and a purposeful resolve on the part of scientists if we are to achieve the lofty goals of this new innovation in science.

I have frequently stressed the need for balance in agricultural research, for a balance between basic research in which knowledge is created, and the application and implementation of research findings to field conditions. Never has this concept of teamwork, traditional though it may be in land-grant universities, been more vital than in this new high technology. If we are to make the most of the opportunities biotechnology represents, the linkage between basic and applied researchers will have to be renewed and strengthened.

There are many obstacles that will have to be dealt with. Public awareness and understanding of genetic engineering is painfully low. A survey by the *Los Angeles Times* revealed that four out of every five Americans could neither define genetic engineering nor grasp enough about the science to understand the moral and ethical issues involved. This lack of understanding is not just a matter of passing academic interest: It can seriously undermine our ability to develop and put to practical use the products of biotechnology. We have already seen in the "ice minus"

project an example of how misinformation and misunderstanding can jeopardize research in genetic engineering.

This case involved a scientifically simple and benign genetic alteration of a naturally occurring bacterium. A scientist at the University of California at Berkeley discovered that he could reduce the frost-forming characteristics of the bacterium *Pseudomonas syringae* by altering a single gene that produces a protein responsible for the formation of ice crystals. After extensive laboratory experimentation, clearance was requested to field-test the altered bacteria on potato plants at a site in northern California. It took nearly five years and the expenditure of significant sums of public funds to complete environmental impact assessments, conduct public hearings, and obtain the necessary permits. In a last desperate attempt to block the experiment, vandals tried to destroy the test plot.

Opponents of genetic manipulation had created public distrust of the experiment and raised fears that the modified bacteria would reproduce wildly in nature and change weather conditions in the region.

Other examples could be cited to demonstrate the existence of a widespread lack of knowledge about biotechnology that leads to apprehension, fear, and moral indignation that can quickly be generated about "tampering with nature."

If the benefits of biotechnology are to be realized in even small measure, public acceptance and support are imperative. In the face of strong demands for accountability by scientists and the prospect of public demand for strict monitoring and perhaps over-regulation, an intensified effort to "communicate science" is needed.

University of California President David Gardner's establishment of a University-wide Biotechnology Research and Education Program is a strong move in that direction. In addition, I suggest that communication be made a part of the research-application continuum—not passive communication, but a carefully planned and executed program in which researchers actively participate, and whose responsibility it would be to demystify a complex new field. That communication should include consideration of the potential social and economic effects of the technology as well as the productivity effects.

The use of recombinant DNA techniques in agriculture is surely one of the most spectacular new technologies that have come along in many years and it has opened many doors. Biology will never be the same. But along with this new technology comes a new urgency to maintain and strengthen the teamwork concept that has worked so well in agriculture for over a century, and an urgent need to keep the public on our side.