
Putting It In Context

*Theodore L. Hullar
Chancellor, University of
California, Davis
(pictured on right)*



Biotechnology' is, without doubt, one of the most precocious of discoveries, quickly moving into the center of biological sciences. It is providing for new products which promise to add much to commerce and industry, including specific biomedical therapies and dramatically improved agricultural practices and products. At the same time, biotechnology spawns strong, even fierce, controversy about manipulation of genome and environment alike. The annual meeting of the National Agricultural Biotechnology Council (NABC) addressed issues which confront our understanding of biotechnology, especially for agriculture. The purpose of this paper is to offer perspective on major features of this contentious terrain and to suggest some specific actions which might be usefully taken to clarify understanding and resolve issues.

THE CENTRALITY OF OUR SOCIAL ENVIRONMENT

Biotechnology engages the social environment, it would seem as fully as it engages the study of the investigator. The principle issue today with biotechnology is with the social environment within which it must necessarily function.

¹ Biotechnology, as used in this paper, is used generically to describe all manipulations at the molecular or cellular level that affect genetic material in a specific manner. Agricultural biotechnology, as used in this paper, refers to biotechnology on organisms and practices of importance to agriculture. It also refers, in the appropriate context, to biotechnology applied to food products and processes and also to environmental biotechnology.

We struggle to rationalize public concern about manipulating a single gene with the easy public acceptance of manipulating the whole plant or animal genome, such as it is, that has long been done in the traditional plant and animal breeding. We wonder how can it be that the possibilities of major manipulation by traditional breeding—where many genes are manipulated in unknown ways—are more socially acceptable than specific changes in a single gene or small set of related genes? Is it that we believe that an “undesirable” combination of genes in the traditional breeding will result in a lethal cross, and thus preclude socially “bad” crosses, whereas a nonlethal insertion of a single gene from a phylogenetically distant-related organism will give a nonlethal, but necessarily “bad” cross? Or is it something more?

Whatever it may be, the social issues of biotechnology were very early with us, starting with the Asilomar Conference in which scientists voluntarily agreed to monitor and control dissemination of their biological research, requiring their products and processes to pass voluntary government review, first with the Recombinant DNA Advisory Committee of the National Institutes of Health, and then for a counterpart committee for agricultural biotechnology managed by the U.S. Department of Agriculture (USDA). By all accounts, these methods are working very well. But, notwithstanding the obvious success, there is still broad social concern. And this concern leads to understandable frustration and steady struggle for understanding. It is likely true that these social concerns will continue to be with us until a body of experience and knowledge builds substantially further.

But I believe there is much more to these concerns.

BROADER DIMENSIONS OF THE CONTEXT FOR AGRICULTURAL BIOTECHNOLOGY

Biotechnology does not function in isolation. It is now an intimate part of our international technological fabric. It is part of our technological context, and it is thus afflicted by the same concerns besetting other technologies. Agricultural biotechnology, especially, has the potential to be pervasive through no effort once released into the environment. And the effects can be irreversible. It has the very real potential to create new life forms, possibly to obliterate old forms, and to spread its effects without control. In all of these ominous qualities it is similar to nuclear energy. More positively, it also has powers akin to those of the information revolution, the other molecular revolution in which we are engaged: powers to permit rapid, molecular-level changes: to give exceptionally high specificity and rapidity of effect; to tailor crops and agricultural practices in ways heretofore only dreamed about; to provide for major productivity increases, increasing the quality of produce in ways believed not

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possible. Because agricultural (and environmental) biotechnology is international, with the potential of affecting all manner of peoples and practices, it also becomes part of our cultural fabric. So biotechnology inextricably weaves itself through our technology and culture and like the information revolution, is seen as doing so unchecked by the normal forces guiding technological progress.

Agricultural biotechnology can, and likely soon will, focus on all the crops of the world; on most, if not all, of the cultural practices; and in virtually myriad environments. In all of this, it is much more complex and pervasive, and thus likely more vexatious, than biomedical biotechnology which focuses only on humankind, a single species with but little variation among its parts. This is a large part of our confounding context.

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But there is more. Biotechnology gets to life itself. Its technological focus is control of genetic codes, of restructuring the genome, of making new forms of life, of tailoring life as we would have it be. Never before has there been this technological power, nor the number of expert practitioners working it.

It is no surprise, then, given the power of biotechnology over that which is most sacred—individual identity and character—that our skeptics are so troubled. They should be. Ours (scientists) is a trust that is, itself, sacred.

And this trust, itself, is wrapped in puzzlement. Discovery always is. What is being studied anyway? What value does it have? Who will control the results? And discovery in biotechnology, and the more difficult field of agricultural biotechnology, is even more vexatious because of the exceptional speed and specificity with which results can come. And control of the results is vested with the scientists themselves, or they are vested with the industrial laboratories that have, presumably, at least some self-interest in mind. So the cloak of silence of discovery roils the social context yet further. And this is exacerbated by the lack of personal control, perceived and real, over the results of biotechnology such as evidenced by concerns for the possible spread of genetic characteristics to unwanted organisms or to environments which are desired free of such interventions.

Biotechnology is also afflicted by the lack of trust in traditional leaders, such as scientists, government officials, major industries and university professors. We are perceived as out of touch, concerned with issues other than those of concern to society, unwilling or even unable to understand. Not much of that may be true, but it is widely believed, nonetheless.

Our agricultural biotechnology clearly has a complicated, intertwined, vexed context within which must be developed and used. And its human dimensions are especially important.

SEARCHING FOR PARADIGMS

Given the challenges, we must, foremost, be humbled by our knowledge and tools, and we must be awed by the responsibilities that are ours. And then we must necessarily consider carefully what to do to make progress, to create understanding, to make wise decisions, to be responsible stewards of that with which we have been entrusted. What are we to do?

First, we must never forget that individuals make a difference. Each has concerns and a life history that matter. We need to get information through the appropriate information channels to each of those who need and wish to know, and we must do so in ways each person can individually understand. Trust be engendered through straight talk, humility, and concern for truth and understanding.

Second, we need to understand what the relevant social structures are for agricultural biotechnology. Are they that of biomedical biotechnology? A patient-doctor relationship? An individual, willful undertaking? Or are they something different? I believe it much different because of the dramatic differences between biomedical biotechnology and agricultural biotechnology already referred to, such as pervasiveness in the environment, multiple and difficult-to-understand effects on many organisms, and evolutionarily permanent, at least in potential. This brings us directly to the importance of ecosystems and their functioning and stability, understandings we unfortunately know too little about, but which are so crucial to agricultural biotechnology.

Third, we need to do better at joining social science, values and ethics to our biological, physical and technological societies. Biotechnology proves to us that the separations between values and technology are nonexistent, or at least artificial. We had best fuse our concerns. The competitive grants program in the U.S. Department of Agriculture provides a new, significant avenue for making these connections.

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Fourth, we must recognize that biotechnology is often a surrogate for other issues such as unchecked productivity increases, manipulation of the natural environment, changes in the structure of agriculture, continuation of technology-based agriculture as contrasted to some persons definition of sustainable agriculture, vertical integration and industrial hegemony in a heretofore highly decentralized and individualistic enterprise, unnatural means of producing food, and the like. What makes this so difficult is that each of these issues has plenty enough grist for the discussion and resolution mill without admixing them with biotechnology.

Fifth, to aid our understanding and decision-making we need to continue to work out the logical similarities and differences between analogies. Two

such analogies are: 1. traditional plant and animal breeding (which could be called organismal biotechnology) as compared with biotechnology as now practiced (which could be called molecular and cellular biotechnology); and 2. biomedical biotechnology as compared to agricultural biotechnology.

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Sixth, progress in product development should be continued, with tough-minded but scientifically and procedurally fair reviews of products such as for approving genetically engineered fruits like the tomato and for changes in cultural practices as for herbicide-resistant plants and genetically engineered biological control agents.

Seventh, the NABC itself should continue to focus on being a crucible for testing similarities and differences of views, for finding common threads, for increasing understanding thereby.

Eighth, the USDA has some special opportunities and responsibilities which should be addressed forthwith: 1. The surrogate issues, outlined above, should be energetically and comprehensively dealt with, to the extent that is not already being done; 2. The relationships between agriculture and environment should be a special, ongoing emphasis. The two need not be in conflict. Indeed, they are not in inherent conflict. They are only made so by partisan adherents. Nowhere can this be more easily and productively addressed than in biotechnology for agricultural practice, concomitant with environmental improvement. A focused, integrated set of studies to this end—mutually undertaken by USDA, the Department of the Interior and the Environmental Protection Agency—should be established as soon as feasible, but not later than October 1, 1994; 3. The social science, ethics, and values issues embodied within agricultural biotechnology, as well as within the total agricultural enterprise, should be addressed through both basic and applied research convoked through the Department's competitive grants program; 4. evaluation protocols appropriate for agricultural and food (and environmental) biotechnologies should be developed distinct from those used for biomedical biotechnology, as has been oft-noted at this conference. This study could effectively be done by the National Research Council through its Board on Agriculture in collaboration with the Council's Food and Nutrition Board and its Commission on Life Sciences.

Lastly, these issues can, and must, be considered at the intellectual, even abstruse level, which university faculty enjoy. But, the issues are real and they are ultimately felt by all humankind the world over. Our challenge, then, must be to deal with theory and rational analysis, as is our wont, but we must also be sure we deal, ultimately, with the issues in the fundamentally human and individual terms that are, after all, the real focus of our attention.