Chapter Six—Genetically Modified Organisms

"Genetically engineered potatoes and other crops already cover 45 million acres of American farmland. Biotechnology is agriculture's most carefully cultivated secret—and maybe the root of the next farm crisis."[1]

"Joe Williams, a Virginia tobacco farmer, has been forced to cut his production nearly in half over the last three years as people have kicked the smoking habit. But he is hoping that a small experimental plot he just planted will hold the key to his staying on the farm. That tobacco has been genetically engineered to produce not cigarettes but pharmaceuticals.

Plants containing drugs could, indeed, represent a new high-priced crop. 'If we can actually find a medical use for tobacco that saves lives, what a turnaround for the much-maligned tobacco plant,' said Christopher Cook, chief executive of ToBio, a company recently formed by Virginia tobacco farmers like Mr. Williams to grow drugs in cooperation with the CropTech Corporation of Blacksburg, Va.

The production of drugs in genetically altered plants—called molecular farming or biopharming—seems poised to represent the next wave in agricultural biotechnology. . . ."[2]

"Washington, D.C.—Six farmers are suing biotechnology giant Monsanto, claiming the company skipped safety tests in its rush to bring genetically engineered seeds to the marketplace. The lawsuit, handled by a cadre of powerful environmental and antitrust lawyers, also accuses Monsanto of conspiring to control the world market in corn and soybean seeds.

The class action lawsuit, filed in Federal District Court in Washington, D.C., is the latest attack on bioengineered seeds. The seeds proved so popular among American farmers that, by some estimates, up to one-third of U.S. cornfields were planted this year with genetically modified corn, and half the soybean fields held modified soybeans.

But those figures could drop dramatically next year, as farmers react to intense pressure from European consumers and environmentalists who say the crops could harm humans and the environment."[3]

Introduction

The introduction of *genetically modified organisms* (GMOs) in the early 1990s has been marked from the beginning with extensive controversy, as typified by this smattering of newspaper coverage. Proponents claim biotech developments herald the next agricultural revolution that promises the alleviation of **a)** mass starvation and global turmoil in the face of massive population growth, and **b)** environmental damage due to the overuse of pesticides and soil. Opponents argue that **a)** mass starvation results from inequitable distribution rather than inadequate food supply, **b)** sustainable agriculture is a much better alternative, **c)** GMOs may well be unsafe for human consumption, and **d)** high volume biotechnology risks numerous disasters to the global food system, the family farm, the environment, and the economy. Besides such social contentions, GMOs are prompting other unusual questions, such as: Could genetically modified food be kosher and is it suitable for Holy Communion?

GMOs
For the purposes of this discussion, a *genetically modified organism* (GMO) refers to plants produced by inserting a sequence of foreign DNA into the nucleus of a recipient organism. The new DNA thus becomes part of the recipient's genome, and the now-modified recipient produces a totally new protein in the host. Genetically engineered foods represent a sub-category of GMOs since they are modified plants grown for direct human consumption.

The aggravated intensity of these debates is perhaps understandable since this technology affects the pillars of life: food supply and environment. As "bread and butter" matters, they affect everyone, even though farm communities and impoverished nations are most immediately aware of the problems. The complexities, then, are not simply about new forms of technology, but they involve human health, trade, the environment, global corporations, government regulation, the farm crisis, and the world food supply—just to name a few!

We can only begin to scratch the surface of such a multitude of issues, especially since very little has been written about them from a specifically theological standpoint. The goals of this chapter are, therefore, modest. It intends to give the reader a brief tour of several key aspects of this important controversy—a controversy that largely has lacked sustained public attention. In this way, the reader should be more prepared for the extended public debate that everyone—on all sides of the issues—agrees is needed.

GMO Packet
The ELCA's Rural Ministry Resources and Networking Office has prepared a *GMO Packet* that includes a variety of documents (non-theological) on this topic. It can be obtained by contacting the ELCA Rural desk (800-638-3522 ext. 6556, e-mail rural_web@elca.org, or online at www.elca.org/do/ruralhome.html).

Several key questions will guide this tour of GMOs. What does "genetic modification" mean and how is it possible? What are some of the primary issues? How do these issues affect the average American citizen? How should these concerns be evaluated? What are some of the theological and moral principles useful for analyzing these issues? This chapter examines these matters and presents ideas for reflection and discussion.

Personal Experience and Values

Such bread-and-butter matters affect everyone at a deep level. Consider your pre-understandings on several of these matters before you begin to read. *Are you comfortable with the idea of modifications to the foods you eat?* Why or why not? How much modified food do you believe you currently ingest? How much assurance do you want that modifications are safe? Do you trust the adequacy of current regulatory practices?

As with many issues involving genetic engineering, corporate practices have become sources of controversy. *Should bioag corporations be regulated or restrained more closely than other kinds of agricultural business?* Why or why not? At what point do you believe that normal business practice should yield to public concerns? What are the criteria? Would you be willing to pay higher prices in the grocery store in order to compensate for the cost of greater regulation or less efficient production?

Gathering Input

Scientific Information

How exactly are GMOs created? The process is complicated and involves numerous steps. Yet, the key technological advancement, greatly simplified, is much like cutting and pasting a string of letters from one document into another. Technicians isolate a genetic sequence and "snip it" at both ends, using what is called a *restriction enzyme*. This removes a portion of the original DNA sequence from its chromosome and leaves several unmatched A- or -T, C- or -Gs "hanging." A "molecular glue" enzyme (*Ligase*, for example) is then used to splice a section of a foreign genetic sequence at the snipped site by matching it with the missing A-T and C-G bonds on both ends. A new sequence now exists, one with instructions for producing within a cell what was previously a foreign protein. If the engineered organism is a plant seed, the new protein becomes a feature of the plant as it grows since the new DNA sequence is duplicated every time the engineered cells replicate.

The *B.t.* potato offers an illustration. A portion of the DNA of a soil bacterium called *Bacillus thuringiensis* (B.t.) has been spliced successfully into the potato genome. In its natural environment, this bacterium is a naturally occurring insect killer considered harmless to humans and wildlife. B.t. has, in fact, been applied externally for many years as a biopesticide. With a part of its genetic code now spliced into the potato genome, it becomes internal to the plant. Whenever an insect nibbles the genetically modified plant, the bacterium's poison is produced in its belly, and the insect dies.

B.t. crops now include corn and cotton, and many others are being tested. There seems to be great promise, and yet, signs for caution. On the positive side, the uses of B.t. in these crops have definitely increased crop yield.[4] However, documented cases of evolving resistance among targeted insect populations are now appearing. Further, the effects of B.t. plants sometimes seem not to be limited to target insect populations. For example, cases of high mortality rates for Monarch butterflies (discussed below) have been documented in the vicinity of B.t. fields.

Weighing the Pros and Cons

The arguments about GMOs can be broken down into five categories, and each with its own contested pros and cons. These are: *food safety; environmental protection; consumer benefits; producer (farmers) benefits; and economic consequences*. One common way to weigh a multitude of pros and cons is through risk versus benefit analysis. This kind of thinking compares how much benefit is gained against the significance of risk involved. Readers may gain a sense of the kind of arguments that need to be weighed from considering the partial review here of the first two on that list—food safety and environmental protection.[5]

Food Safety

Are GMO foods safe? Proponents of GMOs ask what harm has been demonstrated by GMO foods already on grocery shelves. In the United States, GMO crops were first commercially harvested in the mid-1990s and by the year 2000 nearly 55 percent of all soybeans, 35 percent of corn, and 50 percent of potato acreage hosted genetically modified crops. (The U.S. Department of Agriculture—USDA) has approved more than 50 genetically modified crop plants and dozens of others are being developed.) Roughly 60 to 75 percent of all processed foods on supermarket shelves now contain GMO ingredients. Proponents point out that no large-scale human health problems have been reported. Opponents counter that the degree of harm is actually unknown since many GMO products have been designated "substantially equivalent" (see sidebar) by the USDA. This designation means that no significant testing has been required and no monitoring is employed. The minimal data available concerning safety, therefore, comes from corporations that market the product. Opponents thus hold that the lack of known safety problems in genetically engineered food now on the market does not prove them safe.

Existing U.S. law does not require GMOs to be labeled because the USDA has determined that they meet the twin requirements of U.S. regulation: substantial equivalence and familiarity. This dual designation means that GM foods are marketed like any other product because they are not substantially different from traditional products with which consumers are familiar.

A partial list of foods that tested positive for genetically modified ingredients in a 1999 study from the Center for Food Safety in Washington, D.C.: Aunt Jemima Pancake Mix • Ball Park Franks • Betty Crocker Bac-Os Bacon Flavor Bits • Bravos Tortilla Chips • Duncan Hines Cake Mix • Enfamil ProSobee Soy Formula • Gardenburger • General Mills Total Corn Flakes • Heinz 2 Baby Cereal • Jiffy Corn Muffin Mix • Kellogg's Corn Flakes • McDonald's McVeggie Burgers • Morningstar Farms Better 'n' Burgers • Nabisco Snackwell's Granola Bars • Nestle Carnation Alsoy Infant Formula • Old El Paso Taco Shells • Ovaltine Malt Powdered Beverage Mix • Ultra Slim Fast • Post Blueberry Morning Cereal • Quaker Chewy Granola Bars • Quaker Yellow Corn Meal • Quick Loaf Bread Mix • Similac Isomil Soy Formula[6]

Do genetically modified foods increase the risk of allergens in the food supply? The industry holds that the relatively few ingredients (such as peanut proteins) which account for 90 percent of all food allergies in humans should, of course, receive special review.[7] All other ingredients, however, do not require such review or justify labeling. Opponents counter that, again, the absence so far of widespread problems does not prove that other engineered food products will or will not introduce allergens. All engineered ingredients, therefore, should require review. As evidence for the needed caution, they point to previous cases, such as one involving soybeans and Brazil nuts. Plans had been made to market, for animal feed, a soybean engineered to produce a nutritionally valuable amino acid. However, commercialization was cancelled after it was discovered that the protein produced by the gene was a Brazil nut allergen capable of causing severe reactions in humans.

Is labeling food the answer? Many urge that labeling is the solution to questions of safety and consumer worries since it would give consumers their choice. The industry is reluctant to label for fear of consumer misunderstanding and because of the complexities involved. They ask such questions as: What is to be labeled? What is the target of the label? What are the methods to determine the labeling? What is the threshold? How will international harmonization of labels be handled? What about the additional costs involved?[8]

What is the nutritional benefit to consumers? In terms of risk versus benefit assessment, opponents ask whether GM foods actually benefit consumers. Are GM foods more nutritious or less costly? The industry agrees that the current answer is largely no. They believe, however, that this assessment will change in the near future and, therefore, no restrictions are justified now or in the future.[9]

Environmental Protection

Proponents of "bioag" products argue that they will benefit the environment.[10] They contend that modified seeds can encourage the use of environmentally friendly pesticides and even reduce pesticide use completely. For example, modified crops can allow farmers to plant with only one herbicide treatment and also eliminate the need for cultivation, retaining precious moisture in the soil and reducing erosion potential. Anticipated bio-applications will also increase fertilizer efficiency.

Opponents cite environmental difficulties. The dominate concern here is the creation of "super" weeds or pests in the target population. For example, when the herbicide Roundup was first introduced 15 years ago, it effectively killed every plant. Documented cases now exist of plant species building resistance and becoming largely unaffected by this herbicide. Secondly, there is concern about gene flow from an engineered plant species to wild, related species through cross pollination, although the scientific data are still being assessed. A third area of concern involves the impact of genetically engineered crops on non targeted insect populations. Critics here point to documented cases of harm to monarch butterflies and ladybugs.[11] Finally, there are also concerns about long-term negative effects on biodiversity since the handful of already limited food crops will receive the greatest share of attention from this expensive technology.

Are there alternatives? Opponents believe that sustainable agriculture offers benefits similar to those proposed by biotech proponents, but without the risk. Further, they note that biotech practices effect nearby organic fields whenever GMO plants or herbicides are introduced into the local ecological system. Those in favor of biotechnology doubt that sustainable agriculture can be practiced on a large enough or successful enough scale to handle the looming reality of dramatic population growth.

Conclusion

Clearly there is much to ponder on both sides of GMO issues in trying to establish a risk versus benefit analysis. Beyond such calculations, though, Christians will want to factor in commitments from a faith perspective. We now turn to those convictions.

Theological Themes and Moral Guidelines

Christian thinking about GMOs, agribusiness, farming, and the food supply need to be framed by our understanding of the meaning of God's creation and the human role in it. Christian thought—and, indeed, western thought in general—has often pointed to key passages in Genesis as the basis for such understanding. Genesis 2:7 indicates the close relation between human beings and the earth by poetically pointing to humans as created from "the dust of the ground." Likewise, Genesis 1:26 records God giving dominion over his handiwork to the human creature. Such dominion has often been interpreted to mean that humans may do largely what they want. If so interpreted, few restraints on wholesale genetic modification would seem warranted.

Dominion as Stewardship

The ELCA social statement *Caring for Creation: Vision, Hope and Justice* insists upon a more careful and nuanced meaning of *dominion*.[12] It suggests that the biblical word "dominion" means to steward the earth, not exploit it. Humans are responsible for keeping God's "garden," the earth, just as God would. Further, this stewardship is to be modeled after Christ's servanthood (Philippians 2:7). The ELCA statement notes that science and technology can help us to discover how to live according to God's creative wisdom, but that they must be carried out in humility and in an awareness of the web of life for which humans are responsible. The social statement also states that human responsibility for creation has often been faulty or weak. It calls upon Christians to recognize that the environmental crisis is both a serious reality and is caused by sinful human practices. The statement ends with a proclamation of the hope for restoration of

all creation rooted in God's mercy. Such a biblical understanding does not present immediate answers to specific questions like whether we should use B.t. corn or not. Yet, it can guide thinking and does rule out certain convictions, such as the belief that actions may be guided by sheer profit motive or sole attention to human wants alone.

Guiding Principles

What these ideas mean in terms of biotechnology need to be worked out into more specific recommendations. Richard Crossman of the Evangelical Lutheran Church in Canada has done such thinking in a chapter of a report commissioned and published by the United Church of Canada.[13] He delineates some policy guidelines helpful for specifying concerns in biotechnology matters.

The first is the acceptance of the *Precautionary Principle*. This principle was formalized at the 1992 United Nations Conference on Environment and Development as a guide for research and other biotechnology activity. It can be defined as the dictum "to act in such a way as to not make the planet a laboratory in a trial and error experiment."[14] The primary point is that precaution should have the upper hand whenever questions of human or environmental health are involved. This principle counsels restraint until all cause and effect relationships are fully and safely established. Moreover, Crossman suggests that the parties proposing the activity, or those benefitting financially, must bear the burden of proof. This practice would reverse the current situation in which the burden falls largely upon the public to react to and deal with any negative consequences after they arise. He recognizes that such a cautious approach is contrary to much current research or business practice and may slow down or temporarily halt it. He emphasizes that Christian care for creation, however, justifies such caution and he notes signs of its implementation.[15]

His second guideline might be called the *Involvement Principle*. It insists that biotechnology projects require close monitoring and public accountability. Good decision making, he argues, can occur only when there is full knowledge of both the activities and their implications. As a result, public agencies should be encouraged and empowered to monitor not only safety concerns, but also the impact of the processes generated in bringing the product to market.

To accomplish all of this, he suggests that the following steps will need to be taken to:

- Support the labeling of genetically modified food.
- Give keen attention to monitoring economic and political activity regarding the development and approval of biotech processes and products (both short and long-range).
- Encourage public participation in and awareness of public debate on biotech concerns.
- Press government and corporations to pursue activities that benefit the whole of creation (including those who are marginalized) rather than only those activities that will generate a large profit.
- Press for a period of time in all biotech processes that gives space for ethical reflection as a part of any biotech development activity. This would be a requisite time in which research, education, and global monitoring would allow large numbers of people to understand the problems they face and offer them the means to [ethically] address these problems.[16]

Crossman argues that such steps are justified because large numbers of people are impacted by biotech activity. He recognizes the difficulties and likely resistance, but believes such steps are the only way to recover effective levels of moral impact in biotechnology decisions.

Deliberation

The following recommendations regarding biotechnology are selected from a set of remarks made by a respected authority on agriculture in the developing world. They were made to an agribusiness corporation's board of directors with the explicit purpose of encouraging responsible business practices that reduce environmental risk and encourage the acceptance of biotechnology (see sidebar on next page).

Evaluate these recommendations in light of the ideas presented in this chapter. Use moral imagination to think about what a Christian businessperson on such a board would need to think through. In this process, apply what you know about GMOs, risk-benefit analysis, and stewardship of creation principles. Where are these recommendations adequate or inadequate? What sort of board action might be needed in light of them?

Recommendations

- Seek corporate actions that are "doubly green;" that is, they are successful in productivity, but are also environmentally friendly.
- Advocate labeling as a response to food and environmental safety concerns. Support the notion that customers should have the choice of being informed whether or not they are eating GM foods.
- Develop and require extensive greenhouse and field testing for all GM plants before being released to farmers and the public. This would include supporting the establishment of effective national and international biosafety protocols and facilities.
- Add a broad concern for the well-being of the poorest as a goal shared by this company (with private and public agencies). This would entail seeking a balanced set of ground rules to ensure that everyone in the world can have the possibility of improving their lives and livelihoods. The justification is that the future of the poor is an important part of the context in which a company does business.

These recommendations are drawn from remarks made by Gordon Conway to the Monsanto Corporation Board in June of 1999. Conway was invited to address that group on behalf of the Rockefeller Foundation, which has devoted significant resources to biotechnology research in developing countries.

Conway is a noted authority and author of *The Doubly Green Revolution: Food for All in the Twenty-First Century*,[17] a book on global food security. He is the former vice-chancellor of the University of Sussex.

Monsanto is a corporate leader in genetically modified agricultural products and has publicly argued for unfettered development of biotechnology. Their practices have also been at the center of several GMO controversies.

- Use a plant variety protection system in developing countries in cooperation with public breeding agencies, rather than using patents to protect crop lines. This system prevails in Europe and allows farmers to save seed for their own re-use. It also means plant breeders may use seeds in research designed to produce further improvement. These are advantageous for the common good.

Taking the Conversation With You

As always, an educational event in your congregation can help carry the conversation further. Arrange for a speaker or plan an additional study for your congregation on biotechnology issues. Most communities have local sources for speakers on this topic. These include local institutions of higher education, both religious and secular. Other sources include social action groups and businesses. These sources could provide scientific and technical knowledge or prompt moral and theological conversation.

For Further Investigation

Evangelical Lutheran Church in America, *A Social Statement on Caring for Creation: Vision, Hope and Justice*. 1991.

Commission on Christian Action, RCA. *Genetic Engineering: An Update by the Commission on Christian Action*. (Office of Social Witness, Reformed Church in America, New York, 1999). This pamphlet is written by a biologist and seminary professor and provides a brief look at "the very least we have to know about genetic engineering." It also features an excellent bibliography, including Web sites.

Taskforce on the Churches and Corporate Responsibility. *Biotechnology & Genetic Engineering: Current Issues, Ethics, and Theological Reflections*. Nancy Palardy, lead author and research associate. Etobiocoke, Ontario Canada. (Division of Mission in Canada, The United Church of Canada, Ontario, 2000). This small book represents an ecumenical effort to address biotechnology in an accesible way. It contains a significant emphasis on economic and social justice concerns. The first section provides a helpful introduction to genetic engineering (especially in its agricultural forms) that categorizes the issues, the economic players, and the nature of public debate.

Further information on this topic will also be found at:
<www.whybiotech.com/home.html>; <http://ccr.ucdavis.edu/biot/index.html>; and <www.ucsusa.org/>.

Citations

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2. Andrew Pollack, "New Ventures Aim to Put Farms in Vanguard of Drug Production." *The New York Times* (New York), May 14 2000, A.

3. Cat Lazaroff, "USA: Farmers Sue Monsanto Over Biotech Seeds." *Environment News Service* (December 15, 1999), 4.

4. Ronald E. Yates, "Gene-Altered Corn Resists Pest, but Sows Controversy." *Chicago Tribune* (Chicago), October 28, 1996, 4, 1-2.

5. I want to thank Dr. Deon Stuthman, professor of agronomy at the University of Minnesota, for mentioning this approach and for technical advice concerning this chapter.

6. "Bioengineering Pantry" *Chicago Tribune* (Chicago), August 2, 2000, 7-5.

7. Jim Zuiches, "Food Safety." *Biotechnology, Roadmap to the Future. Executive Summary and Recommendations of the Pacific Basin Economic Council Conference on Biotechnology*, March 16-17, 2000 (Washington, D.C.: The Pacific Basin Economic Council, 2000), 12.

8. *Ibid*.

9. *Ibid*.

10. Wilf A. Keller, "Environmental Protection." *Biotechnology, Roadmap to the Future. Executive Summary and Recommendations of the Pacific Basin Economic Council Conference on Biotechnology*, March 16-17, 2000 (Washington, D.C.: The Pacific Basin Economic Council, 2000), 13.

11. Nancy Palardy, "Biotechnology and Genetic Engineering." *Biotechnology & Genetic Engineering: Current Issues, Ethics, and Theological Reflections Taskforce on the Churches and Corporate Responsibility*. (Etobiocoke, Ontario, Canada: Division of Mission in Canada, The United Church of Canada, 2000), 26.

12. Evangelical Lutheran Church in America, *A Social Statement on Caring for Creation: Vision, Hope, and Justice*. 1991.

13. Dr. Crossman's work is not based on the ELCA's statement *Caring for Creation*, but his principled concerns bear a sufficient family resemblance that permits this connection at the level of middle axioms.

14. Richard Crossman, *Biotechnology and Genetic Engineering: Current Issues, Ethics, and Theological Reflections Taskforce on the Churches and Corporate Responsibility*. (Etobicocke, Ontario Canada: Division of Mission in Canada, The United Church of Canada, 2000), 58.

15. *Ibid*, 59.

16. *Ibid*, 61.

17. Gordon Conway, forward by Vernon W. Ruttan, *The Doubly Green Revolution: Food for All in the Twenty-First Century*. (Ithaca, New York: Cornell University Press, 1999.)