
Biotechnology: Evolution or Revolution, Friend or Foe?

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ABSTRACT

The debate over the value of biotechnology is polarized and impassioned. In the early days of modern biotechnology, dealing with challenged environments in agriculture (drought conditions, cold weather, and others) seemed within reach. These solutions have not yet materialized, and the search continues. The product base developed to date includes herbicide-tolerant and pest-resistant plants, and public support for these products and the direction of biotechnology is sometimes uncertain. Belief systems, the way information has been communicated and the way decisions are made, affect perception and public support or opposition to a new technology. This paper approaches this issue by asking questions about some of the folklore and information on biotechnology and challenges people to examine the rationale for their position on biotechnology.

INTRODUCTION

What is biotechnology's role for agriculture in challenged environments?

The National Agriculture Environment Committee (NAEC) is a farm forum for leaders from 22 Canadian farm organizations. The NAEC's purpose is to develop and implement proactive and interactive solutions and strategies for environmental issues facing agriculture. Biotechnology is one of many such issues. Membership in the NAEC is broad-based and includes commodity groups, general farm organizations, organic producer groups, and national associations and councils. We are, therefore, privileged to have a spectrum of opinions from those who embrace biotechnology with open arms and see it as the way of future farming to those who will not use genetically modified products. In fact, in the current draft of a standard for organic production in Canada under development, organic producers would be prohibited from using "genetically modified organisms that have been altered using recombinant nucleic acid techniques, somaclonal variation, electroporation, artificially induced mutagenesis, and similar techniques."

Last fall, NAEC members met with environmental representatives to discuss biodiversity and agriculture. At the meeting and at several subsequent meetings, we discovered a great deal of common ground and learned that we did not want to be separate communities, but rather a unified people concerned about doing a good job in and for the environment. For farmers, that is to provide safe, abundant, and nutritious food while ensuring that the environment on which their livelihood is based and on which the future of humanity relies is protected. At NAEC, we recognize a diversity of methods for farmers to care for the environment on the farm and also differing opinions about the use of biotechnology products. All have a common goal of sustainable agriculture, doing their jobs in a way that preserves the land, biodiversity, water, and air on which farming is dependent now and will be in the future. Given the diversity at NAEC, I will approach this talk in as schizophrenic a way as possible and try to answer questions with questions. I will also come at it from an NAEC perspective, that of a friendly forum where all opinions are considered.

Biotechnology has added an interesting dimension to farmers' lives and decisions. Farmers are on the front line of food production. On issues concerning biotechnology they are being pulled in several directions. Farmers need good clear information about biotechnology so they can make informed choices, understand the consequences, and, with long-term vision and planning, meet individual needs to farm in a sustainable way.

THE CHALLENGES

As you read on, ponder the implications of the title of this paper. Is biotechnology an evolution of what has come before, or is it a revolution in the form we know of in the 1990s as being disastrous and destructive? Is it a friend or a foe? I leave that up to you to ponder and decide.

Biotechnology appears to be the subject of one of the most polarized debates ever, and it joins an interesting gallery of issues that similarly inflame and impassion, such as politics, religion, sports, nuclear energy, and pesticides. Why do these issues impassion and polarize? Let us examine this question from the perspective of biotechnology.

The pursuit of knowledge, and in particular the application of science, has resulted in innovations to improve our lot in life, provide us with a safer existence and good food, and allows us to discover and appreciate nature and what makes life, life. We humans have been modifying our environment for as long as we have existed. We build places to rest our weary bones at the end of a long day, and we select animals and plants we find valuable. We use biological entities to make value-added items such as yogurt, cheese, and bread and to harness the power of the biological co-inhabitants and physical aspects of the planet to provide us with food, energy, and shelter. Human ingenuity often means that we are attracted to new things, new ideas, and new products.

Biotechnology in its early days seemed to be a perfect innovative fit for the

challenged environment — providing ways to combat drought, salinity, and the increasing march of pests, pest resistance, filling hungry bellies, and enabling nitrogen fixation in crop plants. Is it a dream come true? So far, there have only been peripheral nibbles at these problems. Not all the dreams have become reality. At present, most of the innovations are in the areas of herbicide tolerance, insect and virus resistance, and nutritional or process improvements such as slowing the ripening process. Jane Rissler and Margaret Mellon in their recent book *The Ecological Risks of Engineered Crops* noted: “Limits and other difficulties have led the biotechnology industry to sharply scale back its expectation for plant genetic engineering — at least for the foreseeable future. Increased yield, drought resistance, salt tolerance . . . have been set aside in favor of alterations with less sweeping implications . . . no longer mention ideas like nitrogen-fixing corn.” The potential is still there, but it will take longer to unzip the “ladder of life” — the DNA helix — and discover how it works.

Even biotechnology will have its limits, should the dire predictions of climate change leading to an increase in extreme weather conditions such as hail, tornadoes, and floods become reality. Waterlogging tolerance would be good as long as the plant does not float away. For hail control, my science fiction mind sees a field of broccoli programmed, upon the first hail stone, to work in harmony to produce a force field that repels the hail.

Humans continue to be innovative. The question is not so much whether we can do it, but whether we should: we need to weigh the risks and benefits. Humans have been engaged in risk assessment and management for ages: do I drive my car or take a plane? Do I go out on the field today or wait until it is not raining? Do I take this drug or not? It is this weighing of the risks and benefits that has polarized biotechnology because there is no universal understanding of acceptable risks or a meaning of benefits.

Much of the debate centers around

- belief systems,
- the way information is communicated, and
- the way decisions are made.

Let's look at a few illustrations.

BELIEF SYSTEMS AND PERCEPTION

The Tool Itself

Biotechnology as knowledge — is it good or evil? Is it forbidden fruit or a gift from God? Is it the latest or greatest or a doomsday technology? Is it the devil or a savior? Knowledge is normally viewed as neutral, not good or evil. How it is applied or sought can be good or evil. But the knowledge itself, even when it is discovered under wrong circumstances, can be neutral or lead to good things. Does knowing about the genes make life more interesting or does it take away

from the mystery and the beauty of it — does it make us see “fearfully and wonderfully made” in a more beautiful light, or does it cast a pall that cannot be cleared away? Is it a forbidden fruit or a gift from God? Or is knowledge a gift from the intelligence of human beings? Should we pluck it or leave it on the tree? Is it hanging there because we are supposed to grasp it, or is it just there to tempt us? I leave you to decide whether the “tool” of biotechnology is innately good or evil; is it like a hammer, a tool to be used, or is it somehow different? Is it objective or subjective?

The Application of the Tool

Is using the tool playing God, or is it responsible science? Are we treading on holy or unholy ground or at least unconsecrated ground? Are there rules and principles that should not be broken or violated? I, for one, cannot pretend to be able to read the mind of God. I try in my own way to connect, to get direction, but like most limited humans I have only moments of oneness and the rest is a fog, but a comfortable fog, because I know that God is present. A few questions to ponder, then — either unanswerable or answerable, depending on your own paradigm and circumstances. If a scientist thinks of a unique way to make a new food or genetically modify a plant, do you treat that spark of genius as aberrant in all cases and discard it, or in some cases treat it as a logical and acceptable extension of other thoughts or as an inspiration? Is discarding it playing God? Is using it playing God? Do we consider it a gift from God or a result of human creativity and act on it? Do we consider it a thought from a brain created by God and, as good stewards of a gift, try to make use of it? Is it a risk to ignore it, to not be in the will of God, or is it a risk to seize it and take action and also possibly not be in the will of God? I heard a minister ask recently, after the story of the cloning of Dolly the sheep hit the news, why people thought that this was unique; had they not read Genesis? An interesting perspective.

DNA is essentially the staff and stuff of life. If God is in fact in control, then there may be limitations that will become obvious and perhaps may already have. If a scientist can get nowhere with a project, is that a tacit message that this is the wrong tree to bark up or a path not to be trod? Is complexity a protective measure put in place on purpose? A mystery or a puzzle we are not meant to crack? Or is it just that more elbow grease and thought are needed?

If we act on a technology that should not be used, then the sin of commission is exercised. Yet, if we do not act on a technology that we should have, then we commit the sin of omission. Which is worse? What are the consequences? If, as one speaker said at a recent Food Biotechnology Communications Network meeting, a scientist discovers through biotechnology a way to eliminate the allergenic component of peanuts or the aflatoxin in corn, and the idea is buried and people continue to die from allergic reactions, is this an abuse of the knowledge or is it an acceptable consequence because the technology changes the genetic code of a plant and therefore is not considered allowable to some?

OTHER CONCERNS AND MYTHS

An In-Your-Face Technology

Unlike many other technologies, modern biotechnology is perceived to be always on one side of contrasting pairs — direct versus indirect; unnatural versus natural; internal versus external, integral versus peripheral; invasive rather than noninvasive — mainly because it deals with the genetic makeup of biological beings. Other technologies can be indirect, external, or peripheral. Chemicals are unnatural in many cases, but their effect is often indirect. Perception is important and not to be ignored. One-sidedness gives an appearance of imbalance, a lack of a level playing field, and can lead to nonacceptance. Some are not bothered by uncertainty and may even see it as an interesting challenge. It is still a matter of perception. Natural versus unnatural? Is unnatural necessarily good or evil, or vice versa, is natural good only? Of course not: needles are unnatural but they provide a means to deliver medicine or inoculations effectively; tornadoes and natural toxins are natural and they can kill.

The History of Technology

People sometimes look backward to look forward. In so doing, they will confront both the triumphs and the concerns from the past, especially the litany of technology. Historically, humans can be xenophobic and afraid of the unknown. Ancient maps often portrayed the end of the charted areas as an abyss, with dragons lurking over the edge and the legend “there be dragons there.” Both proponents and opponents of biotechnology point to the history of technology and highlight either the advances or the mistakes. Some see it as a litany of events that has led us down a path we should have avoided. Others see technology as liberating humans from the drudgery of heavy labor into a more joyful existence. People often view biotechnology as the latest generation of technologies that will change the world. Below is a listing of often-cited technological developments that have affected human existence.

Agricultural

Humans began the agricultural revolution by the action of selecting plants and animals that provided food or a service to humans. Other plants, animals, and microbes were not selected. We caused a dichotomy in the creation from there on — those useful to us and others.

Metal Age

The discovery of the utility of metals such as copper, bronze, iron, and others brought weapons, coinage as the beginning of trade without real goods, nails, wheel rims that could stand the rigors of travel, beauty (jewelry), and numerous other useful objects. A mixed blessing?

Industrial

The discovery of new sources of power and other devices raised humans above the drudgery of backbreaking labor but also polluted the world. A liberating event that changed peoples lives but started us on the rat race to have more possessions?

Chemical

The discovery of chemicals and products would make our lives better, but not without problems. DDT caused eggshell thinning in birds at the top of the food chain, but it also saved countless lives during the World War II, and continues to save lives from malaria in developing countries. The green revolution was a subset of the chemical revolution, with increased fertilizer use, the advent of pesticides, and new crops that promised to feed millions.

Information

The computer has been a powerful tool for business and personal communications. It also may present unique medical and social challenges — carpal tunnel syndrome, vision problems, cocooning, and unlimited access to the world from your home.

Biotechnology

The biotechnology movement or revolution promises new products and a brave new world unlike one we can imagine. Is it harnessing the power of biology or ruining the beauty of the world or nature?

No wonder there are skeptics and that we tend to be wary. On the one hand, the industrial revolution brought us smog in London and coal miners' lung; the green revolution and chemical products brought us *Silent Spring*, toxic lakes, contaminated soil and waterways, and garbage dumps that became toxic waste sites. What will biotechnology bring? Science fiction and Hollywood tingle our imaginations with stories based on biotechnology run rampant — *Jurassic Park*, *The Island of Dr. Moreau*, *The Attack of the Killer Tomatoes*, *The Day of the Triffids* — into reality, plagues (Outbreak).

On the other hand, will biotechnology be a sparkling introduction to a marvelous new world? Knowledge has been on the increase and has provided us with some wonderful things that have enriched us and given us safer and more fulfilled lives. Vaccines have taken away the scare of killer or debilitating diseases such as smallpox, measles, diphtheria, and polio. Plastics, though much maligned in some circles, provide an incredible and flexible building and manufacturing material. Synthetic fabrics have reduced allergies in some people. Computers. Need we say more about them? And techniques to preserve structural materials.

Knowledge Brokering and Communications

Scientists, regulators, industry representatives, and others have been for years describing biotechnology as a continuum or stepwise approach, building on uses of biotechnology from ancient to modern times. This is meant to engender acceptance of modern biotechnology by connecting it to comfort foods such as bread and cheese and beverages such as beer and wine. Companies also sell biotechnology products as brand new, glitzy, and important advancements that will make your life better and that you would be remiss to ignore. People don't buy this. Why? Because it doesn't matter. The comfort zone logic implies that leaps in logic are somehow bad or wrong or do not lead to anything useful. And it implies that stepwise development is safe. Neither of these is true 100 percent of the time.

In fact, leaps in logic are good sometimes and provide a means of grasping a new idea that is far ahead of the mainstream and offers new opportunities. One stellar example is actually an ancient one — that of fire. We have adopted and adapted this discovery to great benefit. It gave us light, warmth and a way to cook our food so that our poor set of teeth could last a bit longer. It gave us pleasure — fireplaces, bonfires, and meeting places. We have developed it in derived forms to provide the same light, warmth, and heat for our time. Yet it is dangerous. This brings me to the third point, decision making.

DECISION MAKING: THE KEY IS SAFETY

Safety is determined by asking the right questions. It has traditionally been left to regulators to develop and set up systems to ask the right questions, review the information, and examine the results of the use of a technology. Regulators have been grappling for the past decade or so with what questions to ask regarding safety considerations for biotechnology — questions based on science: about the organism and how it interacts with the environment or with humans. Farmers have traditionally, perhaps wrongly in some cases, relied on and trusted scientists to judge whether a product should be on the market and whether it is safe. Farmers have the option to choose and use an approved and available product as they see fit, bearing in mind the rules for operation and the limitations of the product itself. Farmers are frankly confused about the breakdown in trust surrounding the regulation of biotechnology products. People who mistrust the process or the questions being asked have the option to get to know the regulatory groups, tell them about the uncertainty and concerns about the questions being asked, and get involved. They are willing to listen.

This leads us to the issue of the right to know, another hotly contested subject in biotechnology being discussed internationally as a labeling issue. Some questions are in order. Do we know everything about what we consume? Are we aware of the ingredients in the products we use to wash with and apply to our skin? We do not know what pesticides were used on imported goods,

only that limits are set via international guidelines. Clothes are labeled, less for allergenicity and more for washing instructions. We don't know the recycled content of newspapers, plastic toys, and other goods or whether an animal has been treated with antibiotics. In agriculture, this issue will come to a head soon. Labeling of food is one of the most highly developed labeling processes in Canada.

A related issue may be what to do with a shipment of, for example, grain that is commingled (biotechnology and nonbiotechnology products together). Separation is considered to be, in most cases, impossible or very expensive to maintain. This issue is being peripherally considered by the Biosafety Protocol under the Convention on Biological Diversity. Commingled products could be subject to advance informed agreement as a living modified organism when many consider the product as safe and not requiring such action. Labeling such as "may contain genetically modified organisms" may also be used, adding to the expense and possible confusion for the public. There are already genetically modified soybeans, wheat, and canola that could be mixed with the general pool of grain crops.

Of primary interest in decision making is the predicted food crisis. In his book, *Who Will Feed China*, Lester Brown describes the need for water resources and the ramifications of the lack of them in Africa and other food-related issues. We need to examine this; we need to look for answers to some tough questions. Can we feed the world without biotechnology? Or is biotechnology, carefully weighed for risks and concerns, an important tool to feed the world? We need to ponder this.

Finally, where do we go from here?

- It is time that we were all more honest. We need to examine our hearts for what we say and do and be careful that they are honest and from good intentions, not selfish or self-righteous.
- We need to cut the rhetoric. Stop dragging out old stories that are unsubstantiated and examine facts carefully. Bust the myths. Stop using folk stories to illustrate opinions. Check the facts and get the right message out. Stop using only bad things to illustrate a negative litany about technology and industry development. Tell the good stories as well. But if a story is bad and the public needs to know, then we all should take on the role of being a whistle blower.
- Check that the right questions are being asked. This is everyone's duty.
- Check your motives. When objecting to a new solution for an urgent problem, remember that omission is also an ethical choice and can be considered ethically unacceptable. Are your goals noble? Are actions frivolous or value-added and needed? Are objections or support based on fact or fiction? Are you blocking or upholding something for no good reason (greed is not a good reason)?

- Is there truly concern for the future? Does the product offer a valuable addition or alternative for a consumer to choose? Are objections or support based on a philosophy that stands the test of fire and logic, or are they fanciful and modified by less noble things? Does or should a philosophy of local versus globalization, big versus small, multinationals as bad or good color opinions? Is there a reason to keep a product off the market or put it on the market? Is your view of consumerism wrongly affecting your judgement about a product or about how it is being marketed? In summary, is your belief system incorrectly affecting your choice when it shouldn't be?
- Weigh the risks and benefits in as wide a way as possible. Farmers are realizing the need to look at the big picture of sustainable agriculture, which includes social, economic, and environmental issues where practical and possible.

BE AGENTS OF CHANGE

We need to be agents of change if we understand the needs, concerns, and desires of all. We all need some perspective on what we do. Consider the results of a survey of people over 90 years old who were asked, If you could do it (your life) all over again what would you do more of? They replied: reflect more, risk more, do more things that would live on. Stephen Covey, author of *Seven Habits of Highly Effective People* and *First Things First*, suggests these guideposts: to live, love, learn, and leave a legacy. I challenge you with these watchwords today, for the rest of the day and for the rest of your life.