# The Myths of Agricultural Biotechnology: Some Ethical Questions

**By Miguel A. Altieri, Department of Environmental Science, Policy and Management, University of California, Berkeley**
**July 7, 2000**

For years academicians have assumed that agriculture poses no special problem for environmental ethics, despite the fact that human life and human civilization depend on the intentional artificialization of nature to carry out agricultural production. Even critics of the environmental impacts of pesticides and of the social implications of agricultural technology have failed to conceptualize a coherent environmental ethics applicable to agricultural problems (Thompson 1995). In general, most proponents of sustainable agriculture, driven by a technological determinism lack of understanding of the structural roots of the environmental degradation linked to capitalist agriculture. Therefore, by accepting the present socioeconomic and political structure of agriculture as a given, they became constrained from implementing an alternative agriculture that challenges such structure (Levins and Lewontin 1985). This is worrisome, especially today, as profit motivations rather than environmental concerns, shape the type of research and modes of agricultural production prevalent throughout the world (Busch et al. 1990).

Herein we contend that the key problem facing agroecologists, is that modern industrial agriculture, today epitomized by biotechnology, is founded on philosophical premises that are fundamentally flawed, and that precisely those premises are the ones that need to be exposed and criticized in order to advance towards a truly sustainable agriculture.

This is particularly relevant in the case of biotechnology, where the alliance of reductionist science and a multinational monopolistic industry which jointly perceive agricultural problems as genetic deficiencies of organisms and treat nature as a commodity, will take agriculture further down a misguided route (Levidow and Carr 1997).

The objective of this paper is to challenge the false promises made by the genetic engineering industry that it will move agriculture away from a dependence on chemical inputs, that will increase productivity, as well as decrease input costs and help reduce environmental problems (OTA 1992). By challenging the myths of biotechnology, we expose genetic engineering for what it really is; another "technological fix" or "magic bullet" aimed at circumventing the environmental problems of agriculture (which themselves are the outcome of an earlier round of technological fix), without questioning the flawed assumptions that gave rise to the problems in the first place (Hindmarsh 1991). Biotechnology develops single-gene solutions for problems that derive from ecologically unstable monoculture systems, designed on industrial models of efficiency. Such unilateral approach was already proven ecologically unfit in the case of pesticides (Pimentel et al. 1992).

## Ethical Questions About Biotechnology

Environmentalists critical of biotechnology, question the assumptions that biotechnological science is value free, and that it cannot be wrong or misused and call for an ethical evaluation of genetic engineering research and its products (Krimsky and Wrubel 1996). Proponents of

biotechnology are perceived as having a utilitarian view of nature and as favoring the free trading of economic gains for ecological damage with indifference to the human consequences (James 1997). At the very heart of the critique are biotechnology's effects on social and economic conditions and religious and moral values giving rise to questions such as:

- Should we alter the genetic structure of the entire living kingdom in the name of utility and profit?
- Is there something sacred about life, or should life forms, including humans, be viewed simply as commodities in the new biotechnological marketplace?
- Is the genetic makeup of all living things, the common heritage of all, or it can be appropriated by corporations and thus become private property of a few?
- Who gave individual companies the right to the monopoly over entire groups of organisms?
- Do biotechnologists feel as masters of nature? Is this an illusion constructed on scientific arrogance and conventional economics, blind to the complexity of ecological processes?
- It is possible to minimize ethical concerns and reduce environmental risks while keeping the benefits?

There are also questions that arise specifically from the nature of the technology, while others such as the domination of agricultural research agendas by commercial interests, the uneven distribution of benefits, the possible environmental risks and the exploitation of the poor nations' genetic resources by rich ones demand a deeper inquiry:

- Who benefits from the technology? Who loses?
- What are the environmental and health consequences?
- What have been the alternatives forgone?
- To whose needs does biotechnology respond?
- How does the technology affect what is being produced, how it is being produced and for what and for whom?
- What are the social goals and ethical criteria that guides research problem? Choices?

## Biotechnology for achieving what social and agronomic goals?

### The Biotechnology Myths

The agrochemical corporations which control the direction and goals of agricultural innovation

through biotechnology claim that genetic engineering will enhance the sustainability of agriculture by solving the very problems affecting conventional farming and will spare Third World farmers from low productivity, poverty and hunger (Molnar and Kinnucan 1989, Gresshoft 1996). By matching myth with reality the following section describes how and why current developments in agricultural biotechnology do not measure up to such promises and expectations.

**Myth 1:**
**Biotechnology will benefit farmers in the US and in the developed world.**

Most innovations in agricultural biotechnology are profit driven rather than need driven, therefore the thrust of the genetic engineering industry is not to solve agricultural problems as much as it is to create profitability. Moreover, biotechnology seeks to industrialize agriculture even further and to intensify farmers' dependence upon industrial inputs aided by a ruthless system of intellectual property rights which legally inhibits the right of farmers to reproduce, share and store seeds (Busch et al. 1990). By controlling the germplasm from seed to sale and by forcing farmers to pay inflated prices for seed-chemical packages, companies are determined to extract the most profit from their investment.

Because biotechnologies are capital intensive they will continue to deepen the pattern of change in US agriculture, increasing concentration of agricultural production in the hands of large-corporate farms. As with other labor saving technology, by increasing productivity biotechnology tends to reduce commodity prices and set in motion a technology treadmill that forces out of business a significant number of farmers, especially small scale. The example of bovine growth hormone confirms the hypothesis that biotechnology will accelerate the foreclosure of small dairy farms (Krimsky and Wrubel 1996).

**Myth 2:**
**Biotechnology will benefit small farmers and will favor the hungry and poor of the Third World.**

If Green Revolution technology bypassed small and resource-poor farmers, biotechnology will exacerbate marginalization even more as such technologies are under corporate control and protected by patents, are expensive and inappropriate to the needs and circumstances of indigenous people (Lipton 1989). As biotechnology is primarily a commercial activity, this reality determines priorities of what is investigated, how it is applied and who is to benefit. While the world may lack food and suffer from pesticide pollution, the focus of multinational corporations is profit, not philanthropy. This is why biotechnologists design transgenic crops for new marketable quality or for import substitution, rather than for greater food production (Mander and Goldsmith 1996). In general, biotechnology companies are emphasizing a limited range of crops for which there are large and secured markets, targeted at relatively capital-intensive production systems. As transgenic crops are patented plants, this means that indigenous farmers can lose rights to their own regional germplasm and not be allowed under GATT to reproduce, share or store the seeds of their harvest (Crucible Group 1994). It is difficult to conceive how such technology will be introduced in Third World countries to favor the masses of poor farmers. If biotechnologists were really committed to feeding the world, why isn't the scientific genius of biotechnology turned to develop varieties of crops more tolerant to weeds rather than to herbicides? Or why aren't more promising products of biotechnology, such as N fixing and drought tolerant plants being developed?

Biotechnology products will undermine exports from the Third World countries especially from small-scale producers. The development of a thaumatin product via biotechnology is just the beginning of a transition to alternative sweeteners which will replace Third World sugar markets in the future (Mander and Goldsmith 1996). It is estimated that nearly 10 million sugar farmers in the Third World may face a loss of livelihood as laboratory-processed sweeteners begin invading world markets. Fructose produced by biotechnology already captured over 10% of the world market and caused sugar prices to fall, throwing tens of thousands of workers out of work. But such foreclosures of rural opportunities are not limited to sweeteners. Approximately 70,000 vanilla farmers in Madagascar were ruined when a Texas firm produced vanilla in biotech labs (Busch et al. 1990). The expansion on Unilever cloned oil palms will substantially increase palm-oil production with dramatic consequences for farmers producing other vegetable oils (groundnut in Senegal and coconut in Philippines).

**Myth 3:**
**Biotechnology will not attempt against the ecological sovereignty of the Third World.**
Ever since the North became aware of the ecological services performed by biodiversity of which the South is the major repository, the Third World has witnessed a "gene rush" as multinational corporations aggressively scour forests, crop fields and coasts in search of the South's genetic gold (Kloppenburg1988). Protected by GATT, MNCs freely practice "biopiracy" which the Rural Advancement Foundation (RAFI) estimates it costing developing countries US $ 5.4 billion a year through lost royalties from food and drug companies which use indigenous farmers' germplasm and medicinal plants (Levidow and Carr 1997).
Clearly, indigenous people and their biodiversity are viewed as raw materials for the MNCs which have made billions of dollars on seeds developed in US labs from germplasm that farmers in the Third World had carefully bred over generations (Fowler and Mooney 1990). Meanwhile, peasant farmers go unrewarded for their millenary farming knowledge, while MNCs stand to harvest royalties from Third World countries estimated at billions of dollars. So far biotechnology companies offer no provisions to pay Third World farmers for the seeds they take and use (Kloppenburg 1988).

**Myth 4:**
**Biotechnology will lead to biodiversity conservation.**
Although biotechnology has the capacity to create a greater variety of commercial plants and thus contribute to biodiversity, this is unlikely to happen. The strategy of MNCs is to create broad international seed markets for a single product. The tendency is towards uniform international seed markets (MacDonald 1991). Moreover, the MNC-dictated provisions of the patent system prohibiting farmers to reuse the seed yielded by their harvests, will affect the possibilities of in-situ conservation and on-farm improvements of genetic diversity.
The agricultural systems developed with transgenic crops will favor monocultures characterized by dangerously high levels of genetic homogeneity leading to higher vulnerability of agricultural systems to biotic and abiotic stresses (Robinson 1996). As the new bioengineered seeds replace the old traditional varieties and their wild relatives, genetic erosion will accelerate in the Third World (Fowler and Mooney 1990). Thus the push for uniformity will not only destroy the diversity of genetic resources, but will also disrupt the biological complexity that underlines the sustainability of traditional farming systems (Altieri 1994).

**Myth 5:**

**Biotechnology is ecologically safe and will launch a period of a chemical-free sustainable agriculture.**

Biotechnology is being pursued to patch-up the problems that have been caused by previous agrochemical technologies (pesticide resistance, pollution, soil degradation, etc.) which were promoted by the same companies now leading the bio-revolution. Transgenic crops developed for pest control follow closely the pesticide paradigm of using a single control mechanism which has proven to fail over and over again with insects, pathogens and weeds (NRC 1996). Transgenic crops are likely to increase the use of pesticides and to accelerate the evolution of "super weeds" and resistant insect pest strains (Rissler and Mellon 1996). The "one gene - one pest" resistant approach has proven to be easily overcome by pests which are continuously adapting to new situations and evolving detoxification mechanisms (Robinson 1997).

There are many unanswered ecological questions regarding the impact of the release of transgenic plants and micro-organisms into the environment.

Among the major environmental risks associated with genetically engineered plants are the unintended transfer to plant relatives of the "transgenes" and the unpredictable ecological effects (Rissler and Mellon 1996).

Given the above considerations, agroecological theory predicts that biotechnology will exacerbate the problems of conventional agriculture and by promoting monocultures will also undermine ecological methods of farming such as rotation and polycultures (Hindmarsh 1991). As presently conceived, biotechnology does not fit into the broad ideals of a sustainable agriculture (Kloppenburg and Burrows 1996).

**Myth 6:**

**Biotechnology will enhance the use of molecular biology for the benefit of all sectors of society.**

The demand for the new biotechnology did not emerge as a result of social demands but it emerged out of changes in patent laws and the profit interests of chemical companies of linking seeds and pesticides. The supply emerged out of breakthroughs in molecular biology and the availability of venture capital as a result of favorable tax laws (Webber 1990). The danger is that the private sector is influencing the direction of public sector research in ways unprecedented in the past (Kleinman and Kloppenburg 1988).

As more universities enter into partnerships with corporations, serious ethical questions emerge about who owns the results of research and which research gets done. The trend toward secrecy by university scientists involved in such partnerships raises questions about personal ethics and conflicts of interest. In many universities a professor's ability to attract private investment is often more important than academic qualifications, taking away the incentives for scientists to be socially responsible. Fields such as biological control and agroecology which do not attract corporate sponsorship are being phased out and this not in the public interest (Kleinman and Kloppenburg 1988).

**Conclusions**

In the late 1980's, a statement issued by Monsanto indicated that biotechnology would revolutionize agriculture in the future with products based on nature's own methods, making farming more environmentally friendly and more profitable for the farmer (OTA 1992). Moreover, plants would be provided with built-in defenses against insects and pathogens. Since

then many others have promised several more valuable rewards that biotechnology can bring through crop improvement. The ethical dilemma is that many of these promises are unfounded and many of the advantages or benefits of biotechnology have not or may not be realized. Although clearly biotechnology holds promise for an improved agriculture, given its present orientation it mostly holds promise for environmental harm, for the further industrialization of agriculture and for the intrusion of private interests too far into public interest sector research. Until now, the economic and political domination of the agricultural development agenda by MNCs has thriven at the expense of the interests of consumers, farm workers, small family farms, wildlife and the environment.

It is urgent for civil society to have earlier entry points and broader participation in technological decisions so that the domination of scientific research by corporate interests is dealt with more stringent public control. National and international public organizations such as FAO, CGIAR, etc., will have to carefully monitor and control the provision of applied non- proprietary knowledge to the private sector so as to protect that such knowledge will continue in the public domain for the benefit of rural societies. Publicly controlled regulatory regimes must be developed and employed for assessing and monitoring the environmental and social risks of biotechnological products (Webber 1990).

Finally, the trends towards a reductionist view of nature and agriculture set in motion by contemporary biotechnology must be reversed by a more holistic approach to agriculture, so as to ensure that agroecological alternatives are not foregone and that only ecologically-sound aspects of biotechnology are researched and developed. The time has come to counter effectively the challenge, and the reality, of genetic engineering. As it has been with pesticides, biotechnology companies must feel the impact of environmental, farm labor, animal rights and consumers lobbies, so that they start re-orienting their work for the overall benefit of society and nature. The future of biotechnology based research will be determined by power relations, and there is no reason why farmers and the public in general, if sufficiently empowered, could not influence the direction of biotechnology along sustainability goals.

---

**References**

Altieri, M.A. 1994. Biodiversity and pest management in agroecosystems. Haworth Press, New York.

Busch, L., W.B. Lacy, J. Burkhardt and L. Lacy 1990. Plants, Power and Profit. Basil Blackwell, Oxford.

Crucible Group 1994. People, Plants and Patents. IDRC, Ottawa.

Fowler, C. And P. Mooney 1990. Shattering: food, politics and the loss of genetic diversity. University of Arizona Press, Tucson.

Gresshoff, P.M. 1996. Technology transfer of plant biotechnology. CRC Press, Boca Raton.

Hindmarsh, R. 1991. The flawed “sustainable” promise of genetic engineering. The Ecologist 21: 196-205.
http://exacteditions.theecologist.org/read/resurgence/ecologist-vol-21-no-5-sep-oct-1991-6488/6/3

James, R.R. 1997. Utilizing a social ethic toward the environment in assessing genetically engineered insect-resistance in trees. Agriculture and Human Values 14: 237-249.

https://link.springer.com/article/10.1023/A:1007408811726

Kleinman, D.L. and J. Kloppenburg 1988. Biotechnology and university-industry relations: policy issues in research and the ownership of intellectual property at a land grant university. Policy Studies Journal 17: 83-96.
http://onlinelibrary.wiley.com/doi/10.1111/j.1541-0072.1988.tb01018.x/abstract

Kloppenburg, J. And B. Burrows 1996. Biotechnology to the rescue? Twelve reasons why biotechnology is incompatible with sustainable agriculture. The Ecologist 26: 61-67.
http://exacteditions.theecologist.org/read/resurgence/ecologist-vol-26-no-2-mar-apr-1996-6224/23/3

Kloppenburg, J.R. 1988. First the seed: the political economy of plant technology, 1492-2000. Cambridge University Press, Cambridge.

Krimsky, S. And R.P. Wrubel 1996. Agricultural biotechnology and the environment: science, policy and social issues. University of Illinois Press, Urbana.

Levidow, L. and S. Carr 1997. How biotechnology regulation sets a risk /ethics boundary. Agriculture and Human Values 14: 29-43.
https://eurekamag.com/pdf.php?pdf=002860725
https://www.academia.edu/3372558/How_biotechnology_regulation_sets_a_risk_ethics_boundary

Levins, R. And R. Lewontin 1985. The dialectical biologist. Harvard University Press, Cambridge.

Lipton, M. 1989. New seeds and poor people. The John Hopkins University Press, Baltimore.

MacDonald, D.F. 1991. Agricultural biotechnology at the crossroads. NABC Report 3. Union Press of Binghamton.

MacDonald, J.F. 1994. Agricultural biotechnology and the public good. NABC Report 6. Ithaca, NY.

Mander, J. And E. Goldsmith 1996. The case against the global economy. Sierra Club Books, San Francisco.

Molnar, J.J. and H. Kinnucan 1989. Biotechnology and the new agricultural revolution. Westview Press, Boulder, CO.

National Research Council 1996. Ecologically based pest management. National Academy of Sciences. Washington D.C.
https://www.nap.edu/read/5135/chapter/1

Office of Technology Assesment 1992. A new technological era for American agriculture. U.S. Government Printing Office. Washington. D.C.
http://ota.fas.org/reports/9201.pdf
https://www.princeton.edu/~ota/disk1/1992/9201/9201.PDF

Pimentel, D. et al. 1992. Environmental and economic costs of pesticide use. Bioscience 42: 750-760.
http://www.stopclearcuttingcalifornia.org/bca/research/Environmental%20and%20Economic%20Costs%20of%20Pesticide%20Use.pdf

Rissler, J. And M. Mellon 1996. The ecological risks of engineered crops. MIT Press, Cambridge, MA.

Robinson, R.A. 1996. Return to resistance: breeding crops to reduce pesticide resistance. AgAccess, Davis, CA.

Thompson, P.B. 1995. The spirit of the soil: agriculture and environmental ethics. Routledge, London.

Webber, D.J. (ed) 1990. Biotechnology: assessing social impacts and policy implications. Greenwood Press, Westport, CT.

---

**Miguel A. Altieri**is an Associate Professor and Associate Entomologistat Berkeley, University of California

Original article by Dr. Miguel A. Altieri was originally published on these two links, however, they are no longer valid:
https://nature.berkeley.edu/~miguel-alt/the_myths.html
AND:
https://www.CNR.Berkeley.EDU/~agroeco3/the_myths.html

These original links can now be found in the Internet Archive at these links:
https://web.archive.org/web/20160309145843/https://nature.berkeley.edu/~miguel-alt/the_myths.html
AND:
https://web.archive.org/web/20120121082108/https://www.CNR.Berkeley.EDU/~agroeco3/the_myths.html

This publication is can also be found in HTML format at these links:
https://www.saynotogmos.org/biotech_myths.htm
https://www.biosafety-info.net/article.php?aid=293
http://nwrage.org/content/myths-agricultural-biotechnology-some-ethical-questions

No changes to the original text have been made except for the addition of some updated links to a few of the publications that are referenced in the original text. The links provided were current as of April 2017.