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Position Paper On Genetic Engineering

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Midwest Sustainable Agriculture Working Group member groups:

- Center for Rural Affairs
- Columbia Area Food Circle
- Illinois Stewardship Alliance
- Institute for Agriculture and Trade Policy
- Kansas Rural Center
- Land Stewardship Project
- Michael Fields Agricultural Institute
- Minnesota Project
- National Catholic Rural Life Conference
- Nebraska Wildlife Federation
- Ohio Ecological Food and Farm Association
- Sierra Club

Other groups:

- Consortium for Sustainable Agriculture Research and Education
- Organic Farming Research Foundation

Introduction

The recommendations contained in this paper are intended to guide public policy and to inform the debate surrounding Genetic engineering (GE). Genetic engineering originated in the 1970s following the discovery of several key techniques in molecular genetics. As genetically engineered products have become more prevalent in the food system, the topic of genetic engineering has become a controversial issue. In the Midwest, farmers are increasingly faced with the decision to use genetically engineered organisms to raise their crops and livestock. In the Midwest, farmers face increasing pressure to decide whether or not to use genetically engineered products in both crop and livestock operations. Corporations are generating new genetically engineered products, and public universities are being tapped to participate in the research. Meanwhile, Consumers throughout the world are demanding GE-free food.

The Midwest Sustainable Agriculture Working Group, and many of its members, as well as other organizations have supported the development of this document. Our aim is to describe the issues and the state of genetic engineering as it pertains to family farmers, rural communities, religious and consumer groups, the environment and our access to a healthy food system. There is broad consensus among the groups endorsing this document that the eleven recommendations we propose herein should serve as a starting point for the debate on GE technologies. We hope that this document helps increase public understanding about issues and trends in genetic engineering and what this means for various constituencies that have, until now, been underrepresented in the debate on GE. Our recommendations serve to guide policy and inform the debate.

Genetic Engineering and Risk

As farmers look for tools to deal with pest problems and increase their yields, genetic engineering is promoted by agribusiness as the solution to their problems. According to the National Center of Food and Agricultural Policy, 14.4 million acres of Bt corn were planted in 1998, accounting for 18 percent of the total corn acreage in the U.S. Genetically engineered soybean, cotton and corn together accounted for 20 - 44 percent of acreage planted in 1998[1]. Genetic engineering is seen as a beacon of hope for some, but the poorly understood ecological dynamics of GE pose more questions than answers for sustainable and organic farming.

Genetic engineering differs radically from traditional breeding. When referring to genetic engineering, industry tends to utilize the more benign term of biotechnology. Industry often explains that genetic engineering is simply an extension of selective breeding practices that have occurred since the dawn of agriculture 10,000 years ago. This is not the case. Traits can be manipulated across species, kingdom, and even phylum lines; thus genetic engineers create combinations of genes not possible in nature. Genes are moved from one organism to another void of their stable genomic (genetic material) context. These new combinations of genes create novel organisms and also create novel risks. These novel risks pose potential threats to ecological stability, sustainable agriculture and human health. Some of these risks are examined below.

GE Impacts on the Environment

While there are many examples and issues that can be brought forward, the following points outline major concerns of the use of GE in agriculture production and its impact on the environment:

1) The transfer of engineered genes (via pollen) to related "wild" species (and in some cases even unrelated species).

> When engineered genes are transferred via pollen to related "wild" or unrelated species, the engineered traits are conferred on an undesirable plant or weed. This could allow the undesired plant or weed a competitive advantage via enhanced fitness or greater reproductive capacity, thereby creating "**super weeds**." In effect, they are plants that have the capacity to overwhelm a given ecosystem.[2]

The Union of Concerned Scientists cites the spread of rice engineered for salt tolerance into nearby estuaries as a hypothetical example. While the tolerance to salt for growing rice in a given area might be desirable, the spread of salt tolerant plants might also choke out native plants and eventually destroy the estuary.

A potential Midwestern example is canola, a member of the Cruciferae (mustard) family. Canola is used for oil production. Suppose that a canola cultivar genetically engineered for herbicide resistance (Roundup Ready) out-crossed with wild mustard, thereby creating a weed resistant to Roundup. Two studies raise intriguing questions about this and similar scenarios:

- *Using a mustard species (Arabidopsis thaliana) to study the likelihood of GE crops outcrossing, researchers found that the transgenic varieties of the mustard were 20 times more likely to out-cross (breed) than their "un-engineered" cousins. According to research team member, ecologist Joy Bergelson, University of Chicago, "We're still trying to find the mechanism that drives the pattern we saw. There's a lot we don't understand, including how common [out-crossing] is."*[3]
- *New research by British botanists shows that pollen blown from large fields of GE oilseed rape remains fertile over greater distances than expected. Using male-sterile plants and examining a "worst-case scenario" researchers found that even at sites 400 meters away from transgenic plots, as many as 7 per cent of the seeds (from non-GM oilseed rape plants) were herbicide resistant.*[4]

2) Genetic erosion.

The National Plant Germplasm System (NPGS) in this country was built in response to the broad introduction of hybrids and the subsequent loss of genetic variability when so many crops of the same hybrid were planted. Similarly, many scientists are concerned about loss of genetic variation due to widespread plantings and uniformity of GE crops. The corn-blight epidemic of 1970 was traced to the broad distribution of a single genetic character. In response to problems like corn-blight plant breeders have had to, in the past, seek out "landraces" in order to replenish the genetic material of commercial stocks. Landraces are populations with genetic variability lending different responses to diseases, pests and environmental conditions. There is concern by some scientists and plant breeders that this natural "warehouse" of genetic material could be destroyed by the out-crossing potential or genetic pollution from GE crops. In *First the Seed*, Jack Kloppenburg warns, "Though the capacity to move genetic material between species is a means for introducing additional variation, it is also a means for engineering genetic uniformity across species."[5]

3) The spread of viral pathogens via GE plants.

Viruses are used as vectors or "gene carrying" mediums in the gene engineering process. The fear among farmers and consumers alike is that crops containing viral pathogens may exchange genes with other viral pathogens, creating more viral strains with unknown properties and attacking unknown plants, further disrupting a given ecosystem. An epidemic of African Cassava Mosaic Virus devastated cassava, a major food crop in East Africa. This virus is thought to be a result of natural recombination (breeding) of virus carrying plants.[6]

4) The potential effects on soil ecology.

New studies on the impacts of Bt corn on soil communities have not concluded whether Bt corn and the resulting toxins pose a risk to non-target insects and organisms.[7] Integrated pest management consultant, Charles Benbrook, states "laboratory studies exploring direct Bt impacts on non-target organisms are an inadequate basis from which to project – and dismiss—longer-run soil ecosystem impacts of Bt - transgenic crops."[8] Bts originating from transgenic crops are more active than conventional foliar Bt sprays which are in a more inactive form. Likewise, with densely planted transgenic Bt crops there is a much greater volume of Bt entering the soil than naturally occurring or spray forms of Bt. Thus, it is inappropriate to extrapolate from foliar Bt research to research on the long-term soil ecosystem and soil health impacts of Bt-transgenics. Further study is needed into the longer-term impacts of transgenic Bt crops on soil health and ecosystems.

5) Impacts on wildlife and ecosystems.

The experiments at Cornell University and Iowa State University (both in 1999), in which monarch butterfly larvae had a high mortality rate after ingesting genetically engineered (Bt) corn pollen from milkweed, is a potent reminder of the potential impact on biodiversity. This impact is in most cases not well understood and therefore not easily anticipated. As Dr. Neal Stewart, a biologist at the University of North Carolina puts it, "we know very little about the community ecology and virtually nothing about the ecosystem ecology of what these [engineered] genes will do."

Overall, we don't know and can't anticipate many of the effects of genetically engineered plants on ecological systems (and therefore on biodiversity). This uncertainty requires proceeding with caution with the introduction of such life forms. Moreover, these uncertainties show the need for further public dialogue, research and inquiry into the risks and benefits of biotechnology, particularly those related to genetic engineering.

GE Impacts on Sustainable and Organic Farmers

Although the first commercialized GE product for agriculture was recombinant bovine growth hormone (rBGH) -- marketed to increase milk production -- the next wave of commercialized GE products focused on:

- Crops engineered to express Bt (bacillus thuringiensis), a naturally occurring pesticide long used by organic farmers in spray form, and;
- Crops engineered to withstand heavy applications of certain herbicides (herbicide resistant crops or hrcs), thereby allowing most plants or weeds around them to be destroyed while the crop remains unaffected.

Crops genetically engineered to express Bt are marketed by "life-science" companies as having the advantage of reduced pesticide use to control targeted insects and increased yields. In some instances, this has apparently occurred, although there is general agreement that the advantage will disappear as insects develop resistance to Bt.[9] Entomologists and other scientists agree that it is only a matter of time before targeted insects develop resistance to Bt expressed in GE crops, despite strategies of planting refuges of non-GE crops next to fields of Bt crops in order to discourage the development of Bt resistant insects. Organic producers will be faced with the loss of a valuable pest management tool (Bt spray) once insects develop resistance to Bt.

Crops genetically engineered to express resistance to popular herbicides (herbicide resistant crops or hrcs) are marketed with the same claims as Bt crops—that chemical use will be decreased and yields increased. However, many critics charge that despite the large number of acres planted with hrcs, overall use of herbicides has not notably diminished in the U.S.[10] In the case of herbicide resistant soybeans, there is a "yield drag" -- a decrease in bushels per acre. Yield drag is attributed to inferior production genetics of soybeans genetically engineered for resistance to herbicides.[11] Farmers are faced with an increasingly uncertain economic risk vis-à-vis GE crops in that:

1. GE seeds are more expensive to purchase;
2. Herbicide use may not be reduced;
3. Yields may be less, and;
4. Prices paid for GE crops are likely to be less in the face of global consumer resistance to foods containing GE products.

Farmers who use sustainable or organic techniques and do not plant GE crops or invest in heavy chemical inputs have a decided economic advantage if they can keep their crops free of genetic pollution from genetically engineered crops.

On the national level, the American Corn Growers and the National Family Farm Coalition have developed a resolution on genetic engineering demanding that corporations be held liable for damage to farmers, human health and the environment resulting from the use of GE crops and livestock. The "Farmer’s Declaration on GE in Agriculture," also demands suspension of all further environmental releases and government approvals of GE seeds and agricultural products. The 33 groups signing the declaration argue that American farmers have serious concerns with the economic impacts GE seeds and products will have on producers. The loss of markets has been a blow to farmers during an already hard time in the farm economy. The groups assert that the independence of farmers is threatened by corporate control of seeds and other agricultural products.

Concern expressed by consumers and scientists in Europe and elsewhere over potential health and environmental effects of GE crops and food has resulted in a loss of markets and devaluing of GE grains and beans. Producers growing non-GE crops are promised a premium but must prove (and hope) that their commodity has not been genetically polluted, either during the growing period (pollen drift) or by improper segregation of non-GE from GE commodities during the storage/transport/distribution process.

Genetic pollution has resulted in hardships for food producers as well as food distributors. For example, farmers who plant conventional seed are faced with the threat of lawsuit if GE plants somehow show up in their fields. For example, T to ensure that farmers do not hold back seed for next season, corporations such as Monsanto are searching out and suing those producers who have Monsanto patented technology in their fields but haven't signed a contract and/or been authorized to use those seeds. Thus, the unfortunate farmer who finds GE seeds mixed in his/her non-GE seeds or experiences pollen drift into a field is vulnerable to lawsuits.[12]

In addition, this kind of contamination makes it difficult for food distributors to ensure that food is GE-free. Moreover, when genetic pollution is discovered, it can be costly. A Wisconsin food company specializing in organic foods had an entire shipment of corn chips to Europe destroyed when it was discovered that GE corn adulterated its organic chips. The adulteration was traced back to a Texas farmer whose organic corn had been polluted by pollen drift from a neighboring field of GE corn.

Organic producers and sustainable farmers are confronted with the prospect of not being able to plant crops which might be subject to pollution from neighboring fields of GE crops. For example, this past year, several producers in North Dakota decided not to plant organic canola for fear of drift from GE canola grown prevalently in their area. It should be noted that some crops, such as canola and corn, because they are open-pollinated crops, are more subject to pollen drift than self-pollinators like soybeans. Thus the problem of genetic pollution is more serious for some crops than for others. For growers of such crops, there is more a chance for liability -- and more of a chance that an organic grower could lose certification. For sustainable as well as organic producers, the potential exists for loss of premium markets if their harvest is not GE free. The fear of planting crops that may be affected by genetic pollution via pollen drift prevents normal crop rotations, a major practice of sustainable farmers.

Sustainable and organic farmers are also concerned about the terminator seed technology, whereby crops are engineered to produce sterile seed, forcing farmers to buy seed every year. Sterile seed technology is one of a class of so-called "gene protection systems" in which important genetic traits (yield, pest resistance) are controlled or turned on only by the application of external chemical catalysts.[13]

Farmers who purchase seed with gene protection systems must also purchase and apply the external chemical catalyst in order for the crop to express a given trait. Critics argue that the technology, dubbed "traitor technology," would make farmers totally dependent on seed companies or turn them into "bioserfs." The "life-science" companies counter that the technology is necessary to control and protect their investments in genetically engineered crops.

Due to growing public pressure in the U.S. and abroad, Robert Shapiro, CEO of Monsanto, in an open letter to Gordon Conway, president of the international development aid giant, the Rockefeller Foundation, made a "public commitment not to commercialize sterile seed technologies, such as the one dubbed 'terminator.'" He did not rule out development of other types of trait-turn-off technologies, however.[14]

Furthermore, Monsanto's proposed acquisition of Delta and Pine Land, the company that developed terminator, has fallen through. USDA and Delta have offered no promises to abandon the so-called terminator technology they own. Monsanto is not the only research and development company working on gene protection systems. There are nearly 30 other patents pending on terminator type technologies.

Consumer Concerns about GE Foods

While corporations work to develop and market genetically engineered (GE) products for the food sector, it is important to ask if there is consumer demand for such products, which in turn determines whether producers will have a market for their GE crops.

Consumers around the world are expressing concerns about GE foods. As a result of this concern, the European Union, New Zealand, Australia, South Korea and Japan all require the labeling of food derived through GE. Europeans have taken the lead in consumer opposition to GE foods. Consumer demands have led to retailers shifting to GE free products. For example:

- Seven of Europe's largest supermarket chains (from six different countries) announced in March of 1999 that they have formed a consortium to jointly source GE free ingredients for their products.[15]
- McDonalds, Burger King and Kentucky Fried Chicken operating in the United Kingdom announced in February of 1999 that they would become GE free.

US consumers have lagged behind European and Asian consumers in expressing concern over GE foods. Yet, in July 1999 Gerber (Novartis AG of Switzerland is the parent company) and Heinz, the two leading US baby food manufacturers, announced that they would ban GE corn and soybeans from their baby foods. The same month Iams, the US based high-end pet food producer, announced it will not use GE corn in its pet food. In January 2000 Frito Lay asked its contract farmers not to grow GE corn.[16]

These decisions reflect the rising concern of US consumers about genetically engineered foods. Consumer concerns arise for a number of reasons including public health consequences and ethical, religious and cultural issues (including the desire to support environmentally sound agricultural practices and technologies that do not undermine family farmers).

Health Concerns

Health concerns that arise with genetic engineering include the potential for increased allergenicity, decreased efficacy of antibiotics and increased cancer risks.

1. *Increased allergens and toxins in the food system.*

   GE has the potential to increase allergens in the food system through the introduction of known allergens to a new food host where the allergens cannot be readily identified. The process of GE could create new toxins and increase the prevalence of allergens and toxins in the food system.

   A well-known example of the transference of a known allergen is Pioneer's use of GE to insert a gene from the Brazil nut into soybeans to increase their protein level. Although the transferred Brazil nut gene is a known allergen, the soybean had passed animal tests and was considered safe for consumption.[17] A study at the University of Nebraska revealed that people who were allergic to Brazil nuts also reacted to the transgenic soybeans.[18]

   This situation revealed some glaring deficiencies in regulatory procedures. First, it was the Nebraska study that kept the product off the market, not regulatory procedures. (Pioneer voluntarily kept the soybean off the market once the Nebraska study was published). Second, genetically engineered foods are not labeled, and people with Brazil nuts allergies would not be able to identify products containing the GE soybeans. Third, although Brazil nut allergiesy areis currently rare, adding the gene to soybeans could increase exposure and, most likely, reactivity.[19]

   Another unintended and unpredictable consequence of genetic engineering is the creation of new allergens or toxins. Even if the transferred gene itself is not allergen producing, it may cause an imbalance in the chemistry of the new genome and create new "bioactive compounds or change the concentration of those normally present."[20] As Dr. Marion Nestle points out in *The New England Journal of Medicine*, "Genes encode proteins; proteins can be allergenic."[21]

2. *Loss of effectiveness of antibiotics.*

   Many GE crops contain genes that code for resistance to antibiotics as well as the genes that code for agronomic traits. Antibiotic resistance is used during the development process as a "marker" to identify plants that have successfully incorporated the new traits. However, these antibiotic resistant genes may be inadvertently transferred to micro-organisms. This transfer could reduce the efficacy of existing antibiotics by creating resistant strains of bacteria. If more antibiotics lose their effectiveness due to resistant bacteria, consumers with antibiotic allergies have fewer safe choices and the chances of bacterial diseases becoming untreatable increases.

3. *Increase in exposure to hormones and antibiotics.*

   Many consumers choose not to purchase products that increase their exposure to hormones and antibiotics. A case in point is the GE hormone that is used to increase milk production in cows. Studies show that cows injected with this GE hormone, known as recombinant bovine growth hormone (rBGH or Rbst), have increased susceptibility to mastitis and other health problems.[22] Because of these bovine health problems associated with rBGH more antibiotics are often used to improve the health of the cows. Consumers have expressed concern over conflicting scientific evidence about the residue levels of rBGH, antibiotics, and Insulin Growth Factor –1 (a hormone known to increase risk of cancer in some humans when found in elevated levels) in dairy products from cows treated with rBGH.[23] As a result of consumer demand, some dairy manufacturers are labeling their dairy products as rBGH-free. Canada banned the use of BGH in 1999. Several studies were undertaken as part of the decision-making process on whether or not to ban rBGH in Canada. One of these studies, the "Gaps Analysis" found that insufficient evidence on oral absorption of rBGH and IGF-1 and procedural and data gaps were found which failed to properly address the human safety requirements of rBGH.[24] The United States remains the only developed country permitting the use of rBGH.

Ethical, religious and cultural concerns

There are also non-health reasons consumers have concerns about GE foods. Some consumers choose not to buy GE foods because they fundamentally believe that genetic manipulation of life forms constitutes tampering with the building blocks of divinely created life and is therefore immoral or blasphemous. Most major religions have food rules or traditions. Dietary preferences (for either religious or ethical beliefs) can be undermined with GE foods when, for example, someone wishing to avoid animal products eats a tomato which has had a flounder gene genetically engineered into it. Philosophical and ethical beliefs lead people to only consume food that supports particular production methods. The potential negative impacts genetic engineering can have on the environment (described above in "GE Impacts on the Environment") and the structure of the food system (described below in "GE's link to Corporate Control and Reduced Decision-Making") are the basis for some consumers' decisions to avoid GE foods.

Distrust of the Regulatory Processes

One reason for the extreme resistance to GE food shown by consumers in the European Union is the recent history and consequences of lax food safety regulations and of insufficient scientific caution. In the mid-1990s, British consumers were assured that their health was protected even when cows that were fed food which included parts of slaughtered animals developed Bovine Spongiform Encephalopathy (BSE or "Mad Cow Disease"). Yet regulators later recanted on their assurances and acknowledged that they had been insufficiently cautious when a link was proven between BSE and New Varient Crenzfeld - Jakobs Disease, a disease that has killed over 40 people in the UK/Europe. Another example occurred in Belgium in the spring of 1999. Scientists were very slow to report the illnesses and deaths of chickens due to the presence of dioxin in reprocessed animal fats used in chicken feed.

Many critics of genetically engineered GE foods in the United States say they see evidence of similarly insufficient Food and Drug Administration (FDA) regulatory oversight. They cite FDA's failure to set the regulatory bar higher for the donors of organisms of unknown allergenicity. They challenge the review protocols FDA uses for approvals of new agricultural biotechnologies.

In 1992 the FDA ruled that food derived through genetic engineering is "substantially equivalent" to conventionally grown food, and thus does not require testing or labeling. Through the discovery process in a civil action lawsuit against the FDA for its blanket approval of GE foods, internal reports and memos reveal that the FDA's own scientists' concerns about the safety of genetic engineering were ignored.[25] Furthermore, the revolving door between biotech companies and U.S. government regulatory agencies raises serious concerns that the industry's desire for a rapid approval process of GE foods dictates U.S. regulations.[26]

Tremendous consumer concerns in Europe and growing concerns in the U.S. have fueled a major controversy regarding labeling of foods produced using GE. An estimated 30,000 items in U.S. grocery stores have been produced using GE. U.S. consumers have only recently begun to join their European counterparts in asking for labeling to assure they know whether their food has been produced using GE. However, the U.S. government has taken a very different stance, having come out against mandatory labeling. This position seems to be moderating with the introduction of the "Genetically Engineered Food Right to Know Act" into the U.S. House of Representatives on November 16, 1999. At the state level, signatures are being gathered for a Genetically Engineered Food Labeling Ballot Initiative in California and legislation on labeling genetically engineered foods is being considered in New York, Vermont and Minnesota.

The European Union and Consumers International (a worldwide federation of 246 consumer groups) say any food produced with genetic engineering techniques should be labeled as such. As previously mentioned, there is overwhelming public support in Europe for labeling;. Indeed, 92% ninety-two percent of respondents to a survey by UK Consumers' Association wanted genetically manipulated food to be labeled, regardless of the presence of a GE ingredient in the final product. In the U.S. there is also support for labeling. A survey done by *Time* magazine (Jan. 11, 1999) showed that 81% percent of U.S. consumers think GE food should be labeled.

The U.S. government opposes mandatory labeling of all GE foods. However, the recently adopted Biosafety Protocol, which has the same international standing as the World Trade Organization, allows countries to restrict imports of GE products. Shipments of GE commodities must be labeled as "may contain" GE organisms. Within two years more specific labeling requirements will be negotiated.[27] Most concerns that consumers have can be summarized into public policy issues when building the case for labeling. The rationale for labeling is based on consumers' right to choose their food, whether for health or other reasons. It follows several key precedents and principles of good public policy:

- **Public Right to Know**. The statutory basis for the Toxics Release Inventory (TRI) that demands industry disclose its toxic emissions, is premised on the basic recognition that citizens have a right to know about their exposures to potentially hazardous toxic substances. The agricultural biotechnology industry should also be held to this reasonable expectation.
- **Consumer Right to Choose Food**. Like salt-free, fat-free, organic or other diet choices, consumers have the right to make informed choices about food for reasons of health and, as with Kosher foods, should be able to make informed choices based on environmental, religious and ethical grounds.
- **Free Market Economics**. The U.S. government passionately promotes the merits of free markets as a natural social regulator of the supply and demand of goods through consumer choices. A crucial premise of free market economic theory is that consumers are informed about their choices. In a free market economy, full consumer information about genetically engineered foods is crucial.
- **Precautionary Principle**. This principle states that in the presence of scientific uncertainty it is important to take precautions, in other words, to look before we leap. It recognizes that we don't know all that can harm us. In the realm of GE foods, although there are questions about the validity of claims of danger, much is unknown about long-term and complex effects of such foods. Thus, we should invoke the precautionary principle.
- **Scientific Inquiry**. Those concerned about agricultural genetic engineering argue for reliable scientific studies to ascertain long-term health effects of these technologies. Many scientists argue that labeling is necessary to actually conduct meaningful epidemiological studies about the relationships between genetically modified foods and human health.

GE's Link to Corporate Control and Reduced Decision-Making

In addition to the environmental issues and consumer concerns raised above, genetic engineering has greatly decreased farmers' latitude for on-farm decision-making. Historically, there has been a continual move from farmers making decisions locating decision-making about crops, livestock and inputs on the farm to putting power in the hands of corporations, locating decisions in distant markets or within large industrial organizations in distant markets. The movement toward industrialized agriculture with its heavy dependence upon scientific expertise can be traced back to the beginning of the century. Hybrid seeds, commercial fertilizer and, soon thereafter, chemicals became common inputs on farms while farm equipment also became much larger. These technologies led to consolidation of acreage into fewer and larger farms, while reducing the number of people living on farms and in rural communities. GE is only the latest round in furthering this consolidation.

The patenting of genetic material has intensified oligopolistic control in the seed, chemical and pharmaceutical industries. Mergers and acquisitions in the agricultural sector seek to link genetic material with agricultural inputs and markets for food and agriculture products in the hands of a few firms who prioritize profit margins over other concerns. The overlapping oligopolies created by these alliances disguise the anti-competitive practices taking place and reduce the likelihood that the anti-trust provisions of corporate law will be invoked. In the last three years there have been well over $15 billion worth of mergers and acquisitions between seed, chemical and pharmaceutical companies.[28]

Investments in GE extend agribusiness control of the food industry from genetic material to production and distribution. As control of the market becomes consolidated by a few transnational corporations, the increased marketing of GE products provides a means to regain research investments in the technology.

This vertical integration, where genomics, seeds and chemicals are linked, means agriculture is becoming supply, not market, driven. The development of Roundup Ready seeds is an example of this. The patent on Monsanto's herbicide Roundup will expire in the year 2000. In order to maintain significant profits from their herbicide, Monsanto developed a soybean that is resistant to Roundup. Subsequently, they developed Roundup Ready corn, cotton, and canola.

Through extensive advertising and public relations campaigns, Monsanto has encouraged farmers to purchase the seed-herbicide package. Since the seeds are genetically linked to the herbicide and farmers must sign a contract guaranteeing that the farmer will use Roundup with Roundup Ready seeds, Monsanto can better assure themselves of profit and control even after their Roundup patent expires.

The numerous corporate "alliances" in agriculture lead to what is often called a "seamless system" from the gene to the supermarket shelf. In such a system, markets cease to exist and "price discovery" happens only at the supermarket checkout. Thus, the food and agriculture system becomes centrally organized, where inputs and outputs are usually not purchased or sold until processed into their final food product.

In these food system clusters, the food product is passed along from stage to stage, but ownership and decision-making remain with the dominant firms that make up the cluster – not the farmer or consumer. The farmer becomes a grower, providing the labor and often some of the capital, but never having clear title to the product as it moves through the food system -- and never making the major decisions.

Because GE is such a capital intensive research enterprise, most small firms in the industry soon become marginalized because they cannot generate needed capital. Larger and more powerful firms receive patents on their technologies, further eliminating competition. Monsanto has acquired a number of established seed firms in the past few years. Starting with the seed to which all other inputs are linked, these mergers and acquisitions result in a handful of companies dominating the biotechnology industry. Even a firm as large as Cargill decided to sell their global seed business to Monsanto and form a joint venture with them rather than try to enter the biotechnology field on its own.

It is clear that GE is embedded in an industrialized system where the goal is profit without concern for sustainability. Corporations make the major decisions about our food production and basically control how GE will be used in the food system.

Unlike farmers, dominant food firms expect to achieve a 20 percent return on stockholder equity. Corporation's travel around the world "sourcing" their products wherever they can get them produced the cheapest while selling them in the most profitable consumer markets. In the globalized system, both capital and technology -- i.e. GE -- are very mobile and can be moved anywhere in the world very rapidly.

Similarly to small and moderate size farmers in this country, developing world farmers are having to choose to either purchase expensive GE crops and livestock and their associated input packages or face not having access to technologically improved varieties. These farmers in both developing and developed countries are left with fewer choices because neither are the scales of these technological improvements appropriate to their needs nor are they affordable.

Sustainable agriculture is about ecologically sound, economically viable, and socially just food and farming systems. Genetic engineering as it is currently practiced is about privately held, industrialized inputs in a capital intensive global food system. If biotech continues the way it has started, most of its benefits will not accrue to farmers or consumers, but to firms that hold the technology and cooperate with other large firms in seamless systems. Decision-making will be further displaced away from the farmer and consumer. From that vantage point, genetic engineering as it currently stands is certainly incompatible with the philosophy of sustainable agriculture.

GE: in the Public Interest?

Public dollars are designated annually to public research institutions to seek solutions to agricultural problems that improve small and large farms alike. Private biotechnology corporations are increasingly capitalizing on the expertise, graduate student labor, building space, and equipment public universities and research institutions like the U.S. Department of Agriculture have to offer. By establishing partnerships with universities, or being treated as a "customer" by USDA, corporations can leverage public investments and receive inexpensive basic research from which they then develop products, seek proprietary rights and increase profits.

One example of such a public/private partnerships rose to the surface early in 1999, when it was revealed that more than $200,000 in public tax dollars for agriculture research were spent to develop the terminator technology. This research partnership formed between the U.S. Department of Agriculture (USDA) and Delta and Pine Land Co. helped to fund the terminator technology, the process of genetically engineering seed so that it is sterile in the second generation. Terminator was financed with an investment of $720,000 over four years. Individually, USDA spent $190,000 and jointly, with Delta and Pine Land Co, spent another $255,000 to finance this technology meant to guard the companies' investment in seed genetic engineering. Is it in the public interest when public dollars are used to protect corporate interests?

This research and resulting technology raised the ire of U.S. taxpayers. Farmers and consumers believe that the "terminator technology" will lead to fewer choices for small and moderate size family farmers around the globe. Their major concerns surround the ability to save seed, the technology's effects on biodiversity, and the fact that public research dollars were spent on technologies to increase profit for corporations and not to benefit the public. Increasingly, farmers and other citizens in the U.S. are raising their concerns about where our agricultural research agenda and, subsequently, the future of our food system is headed.

More and more of the public are asking to have a say in how their research dollars are spent. There are avenues for public input, but are these avenues being taken seriously? As illustrated by the terminator example, when USDA and private industry, and likely representatives from large commodity boards, brokered a research deal farmers, consumers or environmental representatives were not invited to the research decision-making table.

Small and moderate size farms (those grossing under $250,000 annually) account for 93% of farms in the U.S. and 40% of the production. Because the current push in agricultural research is toward biotechnologies applicable to large corporate farms (7% of U.S. farms; 60% of production) we see corporate farms on the rise (1998, Economic Research Service).

Instead of throwing money at GE, investing public dollars in research aimed at improving cover crops or developing crop varieties more amenable to cultural weed control would be of greater benefit to sustainable, small and mid-size farmers. These farmers are looking for improved management practices, affordable and appropriate scale technologies, ways to lower their costs and reliance on purchased inputs, and ways to capture more value for what they produce.

A case in point of the research push towards the more concentrated agricultural model is seen in the example of the "New Leaf" potato that has Bt as part of its genetic makeup. While widespread introduction of the new GE potatoes, soybeans, and corn are of benefit to large scale agriculture, organic growers are concerned about insect resistance to Bt. The impact of this technology on organic growers has not been researched by a public institution. Public research looking at how to combat Bt resistance has focused on developing refuge management plans, rather than finding alternatives to pesticides or safeguarding Bt as only one of few naturally occurring pesticides available to organic growers.

Another example of the corporate take over of our public research agenda, is the increasing private funding provided to public research institutions, many that are part of the public land grant (agricultural college) system. GE corporate giant Novartis recently gave $50 million to the University of California-Berkeley School of Natural Resources to build a new research facility and to fund several research appointments, graduate students and equipment. Subsequently, the UC system is now saying it is a "publicly assisted" university rather than a "public" one. In an environment where funding for public agricultural research is declining, private/public partnerships of this nature are on the rise.

While it is evident that increasing private/public partnerships and GE have arrived, there are serious economic, ethical, and environmental implications associated with these types of alliances. Also in question are the types of "public goods" created: the pure (non-rival, non-exclusive, available to all users) and impure (non-divisible, partially exclusive by geography or organisms, available to selective users).

As public institutions move towards creation of more impure and commercial types of public goods, concerns are raised over definitions of public interest research and who are the beneficiaries are. Public interest research aims at developing knowledge and/or technology that increases the commonwealth. Such research requires complex problem solving and will involve at least the economic, social, and environmental dimensions of people and natural resources. It will require that insights from these different ways of knowing be synthesized, and that an active citizenry be involved.

We find the following key benchmarks helpful in identifying public interest research:

- When the primary, direct beneficiaries of the research are society as a whole or specific populations or entities that are unable to carry out research on their own behalf;
- When information and technologies resulting from public interest research are made freely available (not proprietary or patented), and:
- When such information and technologies are developed with collaboration or advice from an active citizenry.

"Public" means "not private." Most research done in the private interest is done for the financial gain of a limited, circumscribed group. Research done in the public interest will seldom involve such direct financial gain to the developers and will benefit a community or the commons.

When private corporations leverage public dollars, research has the potential to become potentially can become privately "owned," and academic freedom and the interest of the public good may come into question. In this arrangement, will questions be asked about the effects of a new "genetic engineering" on the social, environmental, health and economic well being of the recipients? Public research institutions must remain true to their missions to serve the public good and to conduct research inquiry regardless of the potential for financial gain.

The U.S. Department of Agriculture and the agricultural colleges are moving towards greater public involvement in agriculture research decision-making. are in the works. This is largely due to the long efforts by members of the larger public including the environment, family farming and sustainable agriculture communities as well as the public in general. These efforts have long questioned the role of science in society, insisting that social ethics are a crucial part of scientific discovery and resulting technologies. In addition, "stakeholders" should mean more than token involvement by those people who will be beneficiaries of, and directly affected by, the research and resulting technologies. For example, the Agriculture Research Service, the research arm of USDA, is now conducting customer input workshops at which diverse stakeholders share their research needs and help to set the future research agenda.

U.S. Secretary of Agriculture Dan Glickman has named a diverse Advisory Committee on Biotechnology and in a recent speech to the National Press Club warned, "The potential is enormous, but so, too, are the questions…"As we encourage the development of these production systems, we cannot blindly embrace their benefits." He also shared his concern that in our rush to embrace new technologies and bring them into the marketplace we must take care to ensure that, "small and medium sized family farmers are not simply plowed under."

Recommendations

The Midwest Sustainable Agriculture Working Group (MSAWG) advocates for national policies that foster healthy and prosperous family farms and rural communities and a healthy environment. Given the concerns and issues raised about agricultural biotechnology -- and in particular, genetic engineering -- MSAWG groups, and other signatories of this document, support the following key policies and principles to foster this vision and support agriculture's sustainable development.

Many of our recommendations listed below center on the Precautionary Principle. The Precautionary Principle states that when an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause-and-effect relationships are not fully established scientifically. Core elements of the Precautionary Principle can be summarized as:

- Having as its primary goal the protection of the environment and public health;

- Using proactive measures toward this goal even in the face of scientific uncertainty;
- Shifting the responsibility to developers of potentially harmful technologies to show that technologies are reasonably safe, or that there are no safer alternatives; and
- Having open, informed, and democratic processes to make decisions about the acceptability of technology, research and policy goals as well as the processes to achieve these goals.

The Precautionary Principle is triggered in specific circumstances.:

- When there is recognized potential for serious harm. "Serious" refers to long-term, broad-scale, persistent, accumulative and/or irreversible harm. In other words, the Precautionary Principle should be applied when the stakes are high.
- When &190; despite recognition of potentially serious harm¾ there remains significant uncertainty about the nature, extent and severity of the hazard so that precise measurements and effective control mechanisms are not feasible.
- When the situation entails highly complex interactions among many dynamic systems (including ecological, social and value systems) so that precise safety evaluation does not require simply more research and more regulation, but research and regulation *of a significantly different kind*.

Although large-scale release of GE crops fulfills all of these criteria, current regulations and research programs are not sufficiently precautionary.

Recommendation #1:

Encourage public dialogue around genetic engineering.
GE technologies are evolving without broad public input or discussion. Especially if government institutions are involved, the process must be as transparent as possible. We recommend a series of 6 public dialogues to be organized by USDA in cooperation with a diversity of stakeholders, especially the supporters of this paper.

We suggest a dialogue in each of the following regions: Northeast, Southeast, Midwest, Southwest, Rocky Mountain West and the West Coast. These dialogues should be inclusive, fair, balanced, transparent, comprehensive and accountable.

Public input should not only be collected, but also considered. Summaries of all dialogues should be sent to all participants for feedback. This feedback must be considered before any final decisions are made on how to proceed with future regulation and legislation of GE technologies. Again, the Secretary's of Agriculture’s biotechnology advisory board would be an appropriate partner in conducting these dialogues and evaluating and considering the public input.

Recommendation #2:

A mandatory labeling system should be implemented whereby foods containing GE ingredients would be labeled as such at the expense of the GE developers.
Consumers have a right—and are demanding—to know if their food is a result of genetic engineering, so they can choose whether they want to purchase it. Consumers may have allergic or other health concerns, environmental concerns, religious, ethnic or ethical constraints, or would just rather not consume this type of product. Whatever the reason, consumers have the right to choose, which is best ensured through product labeling. The developers of GE should be responsible for the costs of segregating and mandatory labeling.

Recommendation #3:

Place the burden of labeling genetically engineered seeds with their developers.
Organic farmers buy much of their seed from smaller seed companies. Seed that is genetically engineered should be labeled to assist organic and other farmers in their ability to easily distinguish GE from non-GE seed. However, small seed companies that do not produce genetically engineered seeds, and so cannot collect the associated royalties, are presented with an undue burden if required to label their products as non-GE. The burden of labeling, therefore, should rest with the seed companies developing GE seeds and gene protections systems.

Recommendation #4

Establish a system that assigns full liability to companies developing GE technologies for economic and other loss caused by genetic drift and other environmental effects created through genetic engineering.
Certified organic and conventional farmers who want to produce for the expanding GE-free market face losing those markets due to genetic pollution from open pollinated GE crops. The companies that have introduced products into the environment that can potentially have negative impacts must assume financial liability (in the form of a performance bond) for what goes wrong. This is particularly appropriate in that the corporation receives money for a licensing fee and thus should be held liable for the safety of their technology. Corporations should be held responsible for damages from currently released GE products.

Recommendation #5:

Invest public dollars in researching alternative production systems and guarantee the capacity for research in the public good.
We oppose the overemphasis on GE at the expense of agro-ecological research. To do so is shortsighted, and undesired by the public. Instead, more research emphasis should be aimed at developing the basic understanding of interactions between living organisms in agricultural ecosystems, in particular those interactions that are affected by management decisions and systems choices.

The large scale production bias inherent in the existing research system, which favors large-scale production, needs to be redirected and refocused. Researching production methods that address pest problems, improve cover crops, develop crop varieties more amenable to cultural weed control, conserve and enhance soil, and produce a profitable economic return to small and moderate size family farmers is an imperative investment for public monies.

More public investment in research needs to focus on providing farmers with knowledge and research on production and marketing systems that enable them to reduce capital and input costs and to increase their share of the profit in the food system. The precautionary principle calls not only for examination of all possible solutions for a problem, but to find one solutions that will minimize its damage to people and the environment.

It is crucial that our public institutions take a leading role to develop and promote production systems that do not pollute nor generate other problems. Programs such as Sustainable Agriculture Research and Education (SARE) can fill this information void, but with funding representing less than 1% of total federal agricultural research dollars, it is clear that we are not putting enough resources in this area.

Recommendation #6:

Implement regulations on agricultural genetic engineering research using the Precautionary Principle and public interest science definition as guides.
The Precautionary Principle argues that it's the regulator's responsibility to take preventative action to avoid harm before scientific certainty has been established. Precautionary steps include identifying the impact of potential problems or threats of a new technology, pinpointing where scientific uncertainty exists,; deciding when and how to proceed, and if proceeding, how impacts could be minimized. These are the types of vital considerations policy makers and regulators should operate under as they make decisions about agricultural GE research. Further, we should ensure that research benefits the public's interest.— Research in the publics' interest which is to develop knowledge and/or technology that increase the commonwealth. We need a functioning policy and regulatory structure in which the greater public can hold trust.

Recommendation #7:

Involve more under-served stakeholders in research planning by strengthening the stakeholder input rules and plans of work guidelines at land-grant universities.
USDA and the /Cooperative State Research, Education, and Extension Service (CCSREES) should revise the Proposed Rule for Stakeholder Input Requirements so that the Final Rule issues strong standards and clear guidance to land-grant universities and colleges suggesting how they collect and utilize stakeholder input for the future. Guidelines for the State Plans of Work required by land grant and other recipients of federal formula funding should reflect these revisions.

The Agricultural Research, Extension and Education Act of 1998 requires land-grant colleges and universities to establish and implement a process for obtaining stakeholder input as a condition of receiving federal funds. The Rule should require a minimum level of standards and criteria incorporating fairness, transparency, accessibility, inclusion, accountability and comprehensiveness into how land-grant universities and colleges collect and utilize stakeholder input. Strong rules and plans of work that incorporate stakeholder input and review will meet Congress' mandate.

Research done in the name of the public's interest is best served when those directly impacted by this research are involved in the process. Their concerns, issues and perspectives can strengthen research conducted, and help to identify potential negative impacts of agricultural GE research.

Recommendation #8:

Because of a lack of caution during the rapid introduction of GE agriculture to date, there is now an urgent need to assess the impacts of already introduced GE products on the environment, human health, social and economic well- being of rural communities and small and moderate size farmers/ranchers. Developers and marketers of GE products should shoulder the costs of this impact research. Likewise, a sufficient research and regulatory system that honors the precautionary principle should be instituted before any new GE products are released.
GE technologies, like so many technologies, are assumed by the product developers to benefit farmers, the environment, rural communities, and consumers. This assumption is unacceptable and detrimental. Technologies must address the problems, not symptoms, of farming today and must consider the social and environmental costs -with a full accounting of the external costs.

Following the Precautionary Principle, proponents of GE technology are responsible to prove that harm to the environment, people, or the economy does not come from the proposed technology, and must shoulder the costs of establishing this information. If a corporation is the ultimate benefactor of this technology, it should bear the costs.

According to the Precautionary Principle, monitoring should be conducted by an independent party. Preferably this party is a public body that holds the interest of the public, rather than the company in question in order to preserve objectivity.

Recommendation #9:

Protect the right of public domain over seeds and germplasm.
We must strengthen our national seed banks, and work together with a broad range of farmers, researchers and others to preserve genetic biodiversity. Research and development conducted at our public universities must remain in the public domain. Much public concern has been expressed over the use of public funds to develop the "terminator technology."

We recommend that the biotechnology advisory board being appointed by the Secretary of Agriculture reviews the right of public domain and whether the public's right to public domain seed and germplasm materials is being infringed upon by patenting and proprietary rights laws. Genetic resources should not be patented and owned by private corporations with the aid of public tax dollars. The public should have the same rights of access to seeds and other genetic resources as the private sector.

Recommendation #10:

Return production control to farmers by enforcing anti-trust laws.
Monopolization of the food system by a few vertically integrated corporations is illegal, and is leaving farmers with little decision- making power. removing farmers' decision-making powers. GE technologies further the control of farming inputs by a few corporations, thereby reducing farm level decision-making. Moreover, GE technologies have the potential to allow corporations to increase vertical integration by making market access dependent upon particular genetic material, a situation that already exists in the poultry and hog industries.

GE is an inherently consolidatory technology (see pages 11-12 above) and thus falls under anti-trust legislation. The United States Department of Agriculture and Justice Department must enforce existing anti-trust laws. Adequate funding must be provided to support enforcement efforts.

Recommendation #11:

Seek ways for farmers, consumers and communities to again be directly connected in the production and consumption of food.
Despite proponents' claims, GE will not solve all of our environmental, hunger, and economic problems, and in fact may significantly contribute to these problems. Much effort and thought must be put into dealing with these serious challenges. There is no magic bullet.

We must continue and provide adequate funding for innovative programs, such as the Community Food Security Project, which ties together farming and the community to address hunger issues and establish food security. Supporting rural development and cooperative programs, such as the Rural Cooperative Development Grant Program, is key to assisting farmers with linking back to consumers.

While direct marketing, selling at farmers markets or other local markets are viable options for some, other farmers need other forms of market access. Connecting people and communities back to their food is a necessary step in a sustainable and responsible food system.

Footnotes

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[2] See "Biotech Goes Wild" by Charles Mann, July/August 1999 issue of Technology Review for a current discussion of the problem.

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[18] Nordlee, J.A., et al. 1996. "Identification of a Brizil-nut allergen in transgenic soybeans." *The New England Journal of Medicine*. No. 334:688-92.

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[25] Center for Food Safety. 1998. The Litigation Against Unregulated, Unlabeled Genetically Engineered Foods: Alliance for Bio-Integrity et al. vs. Shalala et al. Docket No. 98-CV-1300 (CKK). Filed D.D.C. May 27, 1998. Plaintiffs' Briefs and supporting Documents. The lawsuit alleges that under current law the FDA should be requiring the labeling of foods obtained through genetic engineering.

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