

Genetic Engineering in the Garden of Eden

Basic information about agricultural biotechnology for Hawai‘i

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GMOs in the Garden of Eden¹:

A New, Silent, Invisible, Invasion of the Hawaiian Islands

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The natural and cultural history of the Hawaiian Islands can be read as a series of invasions, from the first birds landing on freshly cooled lava, to the arrival of Captain Cook and the missionaries, to the landing of the Marines at the end of the 19th Century.

By the end of the 20th Century, the takeover seems complete. Native Hawaiian culture is endangered, and invasive species have made Hawaii the world's epicenter of species extinction. The world's most expensive freeway, when it was being built, H3, now runs through the birthplace of Papa, the ancestral goddess of the Hawaiian people, in Halawa Valley, on Oahu. None of these assaults are accidental. This latest invasion is a silent and invisible one. And it may be the most devastating. Artificial life forms, known as genetically modified organisms, or GMOs, are being grown here by agro-chemical companies seeking to profit from biotechnology. Once again, corporations are putting the Hawaiian people and islands at risk. At the end of the 19th Century, Hawaii was told that what was good for Dole was good for Hawaii, and now, at the end of the 20th Century, it said that what's good for Dow, is supposed to be good for Hawaii. But it's the same sad story of economic and cultural exploitation.

The answer is to restore local agriculture and sustain natural resources through appropriate development and fair trade. Hawaii is home to many community activists and people who care about the environment and native rights. The seeds for this vision for a vibrant healthy Hawaii were planted by the indigenous Hawaiian movements in the 1970's. And now, combined with the work being done by others, including environmental and political activists, the time is right to take back control over Hawaii's agriculture and return it to local communities, to return land to native families, and to restore traditional farming and local food systems. Current events make it even more crucial that new collaborative efforts be made that maintain local economies, and sustain cultural, racial, and biological diversity and prosperity, providing the best means to resist the corporate predation that drains the economic and environmental base of the islands.

This series of talks is intended to give basic information about genetic engineering. It is an overview, not a complete review of this complex and fast changing field. But each talk will include question and answer time and will provide resource materials for further research. These introductory presentations will take the form of answering ten basic questions about agricultural genetic engineering and its impact on Hawaii. The attached materials are intended as basic background information. They were prepared for a farmer to farmer campaign conducted in 2001, sponsored by the National Coalition of Family Farmers and Farm Aid.

¹ The "Garden of Eden" idea comes from the Judeo-Christian tradition and may be the wrong metaphor for Hawaii – or at least one that is culturally insensitive. There is no doubt that every inch of the islands is sacred ground to the indigenous peoples of Hawaii and the problem with using the idea of Eden is that it appears to adopt foreign notions of what is sacred. The definition of sacred is, to some extent culturally relative. I am not endorsing anyone's idea of what is sacred, I am just using "The Garden of Eden" idea because so many tourists, activists, and recent arrivals do think of Hawaii in these terms and because I think the romanticization of Hawaii is part of the problem – it masks the reality of the impacts of tourism and development. The purpose of this series of talks, and this paper, is to reach all those who are living with the contradictions posed by tourism, government/military/corporation predation, environmental degradation, and cultural survival that are going on in this fragile nation and to discuss the dangers of genetic engineering in that context.

Questions People Should Ask About Agricultural Genetic Engineering

What are GMOs?

GMOs stands for “genetically modified organisms.” In agriculture, it usually refers to plants that are modified by inserting genes from other organisms that have been engineered into crops to change the plant in some way. For instance, GMO soybeans can be sprayed with herbicides that would kill a conventional soybean, and there is a GMO corn that produces its own insecticide. GMOs look, grow and taste like conventional crops but at the molecular level they are different. Isn’t Genetic engineering is just like conventional breeding?

Absolutely not. Traditional breeding observes the biological boundaries that nature placed between species. Genetic engineering transfers modified genes between totally unrelated species and adds in newly created genes that assist in the engineering process, such as “promoters” made from viruses which are used to overcome a plant’s natural defense mechanisms. GMOs are alive, able to reproduce and they effect the environment in unpredictable ways. GMOs are especially prone to out-crossing, for instance, so they can transfer their traits to other plants. A University of Chicago study, published in the prestigious journal *Nature*, found that transgenic plants were 20 times more likely to interbreed with related plants than traditionally produced plants.²

How is genetic engineering being used in agriculture?

About 100 million acres of GMO crops were planted in 1999, about 99 percent in just three countries: the United States, Argentina and Canada. The most common GMO crops are those used for weed control, called “herbicide tolerant” (HT) crops. They are engineered to withstand being sprayed “over the top” with lethal doses of broad based herbicides, which kill the weeds but not the crop. They make up 71% of all transgenic crops.³ HT soybeans made up 54% of the world’s soybean crop, grown on about 54 million acres worldwide, mainly in the U.S. and Argentina. In 1999, HT cotton was grown on about 4 million acres, HT corn was grown on 3.7 million acres, and HT canola, widely grown in Canada, covered 8.6 million acres.

The second most common GMO crops are used for insect control. They are called “Bt” crops because they produce a genetically engineered form of “Bt” (*Bacillus thuringiensis*) a pesticide that comes from a naturally occurring soil bacterium. Bt crops such as corn, cotton and potatoes account for about 22% of GMO crops and were planted on 21.9 million acres worldwide in 1999. Other GMO crops such as fruits and vegetables with virus resistance and combined “stacked gene trait” crops make up the rest of the products currently available. Genetically engineered

² Bergelson, Joy, et. al. “Promiscuity in Transgenic Plants.” *Nature*, Vol. 395: September 1998.

³ All crop acreage information from “Global Review of Commercialized Transgenic Crops” 1999 International Service for the Acquisition of Agribiotechnology Applications (ISAAA)
http://www.agbiotechnet.com/reports/isaaa_briefs/Brief12.pdf

insects, animals and plants that will be used for manufacturing and medicines - so called “biopharming” are now being tested, in open field tests all over the country, particularly in the Midwest and Hawaii. (See biopharming report at www.foe.org.)

Have genetically engineered crops had any field performance problems?

Studies of Roundup Ready (RR) soybeans – which make up over 54% of the world's GMO crops - show that they produce, on average, between 6.7 to 10 percent less than comparable conventional varieties.⁴ A University of Nebraska study released in May 2000 found consistent “yield drag” of RR soybeans of between 6 to 11%.⁵ Two agronomists at Iowa State University suggested that, while the cause of this problem is not yet known, genetic engineering could limit a plant's productivity and even affect its nutritional qualities.⁶

Although manufacturers test GMO crops carefully to avoid marketing defective products, a few HT crops have suffered serious deformities, from stem splitting in soybeans under heat stress⁷ to deformed plants and boll drop in HT cotton, leading to the withdrawal of 5 varieties.⁸ Bt crops can leave active Bt in plant residues that persist in the soil and affect soil health, and farmers are required to plant buffer zones and implement an insect resistance management plan for Bt crops to reduce both contamination from pollen flow and their environmental impacts.

Are U.S. regulatory agencies testing GMOs for human health and environmental safety?

Three federal agencies are responsible for regulating GMOs in the U.S.: the Food and Drug Administration (FDA), the US Department of Agriculture (USDA), and the Environmental Protection Agency (EPA). None of these agencies perform tests or apply any independent analysis because of a policy decision, made in the early 1990's, that determined GMOs to be “substantially equivalent” to conventional crops. The regulatory system is basically passive and the agencies rely solely on information that is voluntarily submitted to them by GMO manufacturers. Because GMOs have been essentially deregulated, the long term human health and environmental hazards have not been studied. Farmers and consumers are, therefore, involved in a massive proving experiment, the results of which will not be known for some time.

Why are labels not required in the U.S.?

Consumers worldwide are demanding labels for GMO foods, and labeling laws in Europe and Asia are now being implemented. Here in the U.S. polls taken by news organizations and industry show that as much as 93 percent of Americans want labels, but the FDA made a policy decision, not a scientific one, that GMOs were “substantially equivalent” to conventional food and therefore no labels are required. A lawsuit challenging that decision is pending.

⁴ Benbrook, Charles. Evidence of the Magnitude of the Roundup Ready Soybean Yield Drag from University-Based Varietal Trials in 1998, Technical Paper Number 1, July 13, 1999. <http://www.biotech-info.net>

A list of over 30 articles on yield drag is available at www.btinternet.com/~nlpwessex/Documents/yeildproblems.htm

⁵ Soybean Scorecard, *Nebraska Farmer*, August 2000.

⁶ Liebman, Matt and E. Charles Brummer. “Impacts of Herbicide Resistant Crops”, March 2000.

⁷ Coghlan, Andy. *New Scientist*, “Monsanto's modified soya beans are cracking up in the heat” November 20, 1999

⁸ Bloomberg Business News, February 21, 1998.

About how much of conventional food contains GMOs?

Conservative estimates would say at least 70% of the food in U.S. grocery stores contain GMOs.
What are some of the economic considerations?

There are, of course, the price/cost considerations, the level of infestation and other factors that farmers consider when choosing any particular crop variety. But GMO producers also need to consider that the markets for GMOs are unpredictable. Also, given the increasing restrictions and even rejection of GMOs in the export market, such as by Japan and Europe, the domestic market for GMOs is overburdened with GMOs and manufacturers are looking for new ways to use them.

The use of GMOs increases the control of corporations over farmers because GMO seeds and inputs are only available when farmers enroll in the manufacturer's highly restricted, and expensive, technology program. As corporate consolidation increases the control of agribusiness over the farm economy, farmers have less leverage over prices and market access. Farmers, who are facing the largest surpluses and lowest prices on record, have to consider the overall impact of achieving higher yields for commodity crops, since it will continue to depress prices. And consumers continue to reject GMOs. GMO potatoes are all but gone from the market, for instance. The major market for GMOs, livestock feed, is now being targeted by anti-GMO consumer activists who do not want to eat products from animals fed GMOs.

What about segregation and testing of GMOs?

GMOs are being segregated from non-GMO crops because domestic and foreign buyers are demanding them and because farmers can get premiums for segregated varieties. The testing and traceable handling methods used to prevent contamination, and produce an audit trail for GMO-free certification, is called Identity Preservation (IP). Neither an "official" system of certification and testing, nor the exact tolerance levels for "GMO-free" crops has yet been established. Tests vary in their accuracy and reliability. "PCR" or polymerase chain reaction testing detects the presence of any modified genes but is a more expensive and complex laboratory technique. There are a half dozen testing companies in the United States, some of which produce cheap "strip" tests that can detect GMOs at certain levels, but for any accuracy and low level detection, accurate sampling and the PCR method is preferable. IP is important to conventional and organic farmers but contamination rates continue to rise.

What legal issues should farmers be concerned about?

- Liability is an issue. Farmers who plant GMOs may inadvertently contaminate the conventional or organic crops of nearby farmers, or GMO contamination can occur during transportation or processing, resulting in possible financial responsibility for farmers. GMOs have a disruptive impact on the environment through pollen flow and because GMOs out-cross with weedy relatives and other plants.
- Insurance is not available that specifically covers risks of loss related to GMOs.

- Farmers may be exposed to fines and litigation costs, even if they unintentionally violate the seed company contracts. Farmers should read the “technology use agreements” (TUAs) very carefully before signing them. Seed companies can leave farmers “holding the bag” if something goes wrong, because TUAs make the farmer responsible for how the crops are grown. TUAs also reduce a farmers’ rights and flexibility in choosing what farming practices (chemicals, herbicides, etc.) to use and how to handle the seed. TUAs forbid farmers to save or test GMO seeds on their farms. GMO manufacturers are now routinely suing farmers for patent infringement, hundreds of lawsuits are pending.
- The patents large multinational corporations take out on GMOs takes the germplasm of staple crops out of the hands of farmers and public researchers and has a negative impact on agricultural genetic diversity.

Do farmers need to plant GMOs to feed the world’s hungry people?

Not at all. There is a major surplus of grain in the world that is expected to continue. The Food and Agriculture Organization (FAO) of the United Nations reports that world food production will stay ahead of world population growth through the year 2030. Besides, hunger is caused by poverty, and that can not be cured with technology. Current food supplies are not getting to the world’s hungry, because they can’t afford to buy food and lack access to land and resources needed to feed themselves. Farmer self-sufficiency is the answer to hunger.

What are the benefits of GMOs and who are they for?

GMO crops did not originate on the farm. Agricultural genetic engineering came from the private laboratories of commercial interests. There are no consumer benefits from the current products. This technology is an invention that is still in search of a necessity. While farmers may realize some convenience with easier weed and insect control in the short term, in the long term environmental damage and economic losses may be the real issue. But GMO companies aren’t taking any chances. They have launched a massive \$53 million advertising campaign aimed at getting farmers to plant GMOs and the public to believe their pitch - that what they call “biotechnology” - a very broad term - is a good idea.

The public relations efforts of the biotechnology industry make vague promises about its supposed benefits, but fail to provide the proof. Polls show that consumers at home and abroad aren’t buying these messages. The recent international Angus Reid poll found that 65% of American consumers would reject GMO foods if given a choice. The rejection rates in Europe and Asia are as high as 85-90% and the negative trend is growing. What farmers are concerned about, according to the August 2000 Iowa Farm and Rural Life Poll, is, according to 85 percent of the respondents, the increasing concentration of the food supply in a few large corporations. What consumers care about is safe, healthy food. Polls show they would pay a bit more if the money went to the farmer, so consumers want healthy farms, too. GMOs are the antithesis of healthy food from healthy farms. They are, and continue to be a commercial technology that is expensive to develop and expensive to use and that has limited application. They were designed to sell the patented herbicides (such as Monsanto’s Round-up) and patented seed technologies as a way of extending control and profits of the agro-chemical companies that make them.

A Farmer's Guide to Agricultural Genetic Engineering

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This guide provides farmers with background information on some of the most important agricultural, economic, legal and environmental implications of agricultural genetic engineering. The great success that farmers have had in feeding the world has long been founded on farm based innovation. But agricultural genetic engineering did not come from farmers. It came from companies who have very different interests, such as patenting their products and processes, controlling the technology, and profitably selling their seeds and chemicals. If American farmers want to continue their leadership in providing the world's growing population with high quality, healthy and marketable farm products, they must weight their own interests against the perils and the promises of genetic engineering⁹. This backgrounder, and the attached fact sheets, offer information and analysis that is useful in assessing the risks of this technology and in considering its impact on farmers.

The Impact of Agricultural Genetic Engineering on the Farmer

In evaluating agricultural genetic engineering, farmers should consider the following six factors: 1) Economics – whether or not transgenic crops are cost effective and marketable; 2) Agronomic performance – how transgenics perform in the field; 3) Legal issues such as grower contracts, liability and insurance; 4) Environmental impacts of GMOs on soil, plants, insects, wildlife and contamination from gene flow; 5) Farmer autonomy - how agricultural genetic engineering contributes to increasing corporate consolidation and control; and 6) Consumer concerns and human health risks.

1) Economic Issues:

Cost effectiveness: The price tag for transgenic crops includes both direct and indirect costs. Direct costs include higher prices for seed, an additional technology fee, and any proprietary chemicals that may be required for GMO crops. In 1999, a full Roundup Ready soybean system cost \$68.77 per acre, about 50% more than the cost of conventional seed and weed management systems used in the Midwest just a few years ago.ⁱ Indirect costs include potential legal risks, environmental impacts both on and off the farm, and problems relating to the farm economy in general such as overproduction, which are discussed in other sections.

Some GMO crops have lower per acre yields than similar conventional varieties, especially those engineered for herbicide tolerance. A price/cost analysis should include an assessment of the relative cost/benefits of other weed and pest control measures as well as consideration for crop varieties that have a proven record of success on the farm. As farmers

⁹ This Guide uses the term genetic engineering, referring specifically to the agricultural applications of recombinant DNA technology, and it uses the term interchangeably with “GMOs” and transgenic crops. It does not use the term “biotechnology” which has much broader applications. The attached Fact Sheets provide additional information on genetic engineering, how it works, how it is used in agriculture, as well as on international markets, identity preservation, seeds, crops and animals.

know all too well, across the board, seed and chemical costs continue to rise, while prices paid to farmers are at rock bottom. Production costs, on a “per bushel” basis for grains, for instance, have almost doubled in the last two decadesⁱⁱ so just one extra application of an herbicide can push the costs of this technology beyond what is reasonable, especially given their poor performance and yield lag.

For Bt crops, productivity is offset by two considerations. One is that conventionally bred hybrids, which also offer some natural insect resistance, can perform as well as the more expensive genetically engineered varieties. Studies of European corn borer injury rates indicate no difference in yield between Bt and non-Bt lines, depending on the level of infestation. Also, Bt crops must include insect resistant management strategies, as flawed as they may be, and these strategies can mean that between 20-50% of the acreage will be planted in non-Bt varieties, further eroding the potential for productivity or even crop protection that would justify their higher cost.

Companies now offer “guarantees” with their technology programs, such as AgroEvo/Novartis’s corn guaranteed weed control program which requires the application of 4 different proprietary herbicides. Agricultural Economist Chuck Benbrook says, however, that “[O]ffering guarantees as a marketing ploy has been strongly criticized in the past for establishing unreasonable expectations among farmers, ratcheting up cash expenditures, and encouraging excessive herbicide use, which can trigger resistance and other problems.”ⁱⁱⁱ

“When I started farming 23 years ago we didn’t use the most powerful chemicals on the market, we didn’t flood the land with fertilizer, and we still made a good living. I felt that I was in control of my operation. Our gross revenue to expense ratio was 3 to 1. Today, we are on the cutting edge, using GMOs, changing crop varieties almost yearly, using chemicals as if we farmed in Europe, and our revenue to expense ratio has dropped to 1.25 to 1, on a good year, just enough to pay the grocery bill.”

- Lloyd Fear, Manitoba farmer, @g Worldwide Correspondent.^{iv}

Marketing GMOs: Because of growing consumer objections and import restrictions in Europe and Asia, the market for GMOs is shrinking. Labeling requirements are being imposed on GMO foods throughout Europe, and in Japan, South Korea, Australia and most recently, even in China. The International Biosafety Protocol and other international requirements such as the Codex Alimentarius are calling for increased safety testing and labels, despite efforts by the U.S. to oppose them. Consumers who have a choice are choosing not to buy GMOs and a recent Angus Reid survey shows consumer acceptance continuing to decline, world wide. As a result of US farmers not being able to provide conventional crops, corn and soybean exports to Europe dropped drastically in 1999, leaving farmers in other countries in a better position to supply these markets.

After several years of rapid adoption rates, 1999 was not the best year for GMOs. Deutsche Bank, Europe’s largest bank, issued a report in May 1999 provocatively titled: “GMOs are Dead” which recommended that investors sell their holdings in genetic engineering companies and predicted, correctly, that prices for transgenic crops would drop and that premium prices for conventional crops would be offered.^v The U.S. Agriculture Department then reported that, indeed, in 1999 grain buyers were paying a premium of 8 to 10 cents a bushel for non-

genetically modified corn grown in Illinois^{vi} and major traders discounted their GMO crop prices. (See Section Two: Performance Problems, below.)

There are signs that the golden days of GMOs are fading. Polls taken in late 1999 and early 2000 showed that farmers were expected to decrease their GMO plantings from 15 to 25 percent in 2000, primarily because of growing uncertainty in the market. A mid year survey by American Corn Growers Association showed that 76.3% of the nations corn farmers said they would plant fewer acres of GMO corn, if the grain industry requires segregation and that 81.8% support the right of foreign customers to choose GMO-free grain. Contamination of the human food supply with GMO corn intended for animal feed (See Lessons from Starlink™, attachment 4.) has created even greater uncertainty. As the international market for GMOs collapses, farmers are carefully considering whether or not “betting the farm” on GMOs is a wise investment.

Marketing GMO-free crops: The opportunities to realize a better price for GMO-free crops may vary. Although Archer Daniels Midland (ADM) offered a premium for GMO-free crops in 1999, the possibility of premiums in the 2000 crop year is still not known. Transportation and segregation costs enter in to the price/cost equation, especially since premiums for GMO-free crops are more likely to be found at river export terminals and processing plants. Not all elevators can handle segregated crops and realizing a premium for GMO-free crops now requires participation in some certification program that verifies a crop as GMO-free. (Please see Identity Preservation Fact Sheet.)

In July 2000, Canadian farmers asked the government to take a GMO variety off the market completely because it could cost farmers income by interfering with their export markets. Although available for years, the GMO flax had not been planted commercially and flax growers concluded that if export markets are forced by trade rules to accept the GMO flax, it will create difficult identity preservation issues and harm the market for GMO-free flax farmers. The producer association that called for the withdrawal said they were in complete agreement about this, the first time farmers have called for a variety to be struck from the national registry.

Internationally, some buyers are now offering contracts for GMO-free products at a premium, especially in Asia. Japan has paid premiums of 40-50 percent for segregated non-GMO soy and corn. Japan’s grain exchange has launched GMO-free futures contracts, signaling a strong market in identity-preserved commodities. Altogether, GMO-free crops would seem to have the best chance of avoiding market uncertainty, but buyers will require documentation of the source of seed, planting, harvesting, storing and shipping of GMO-free crops. (Please see Fact Sheets on Identity Preservation and Overview of International Markets.)

2) Performance Problems Demonstrated by Genetically Engineered Crops:

Herbicide tolerant (HT) crops have demonstrated some severe systemic problems as well as reduced yields. Roundup Ready™ (RR) varieties of HT crops, on average, produce about 10 percent less than comparable conventional varieties. A recent Nebraska study, according to an article in the August 2000 *Nebraska Farmer*, found that the RR soybean yield penalty is about 5.5 bushels or 11%. The cause of this “yield drag” is not yet known, but the Nebraska study concluded that genetic engineering, not the farming practice, was responsible.

Some scientists suggest that directing a plant's resources towards resisting toxic sprays effects the plant in unpredictable ways. A study by the USDA showed, in one result, HT cotton with a 12% yield drag and another study of GMO canola in Canada reported a yield drag of over 20%. The most extensive resource for farmers on the agronomic performance of transgenic crops, or for any information about the impacts and applications of agricultural genetic engineering is the "BioTech Info" web page at <http://www.biotech-info.net>.^{vii}

HT crops, under some conditions, had serious deformities such as soybeans stem splitting in hot climates, when conventional varieties did fine. In 1997, it was widely reported that thousands of acres of RR cotton in the Mississippi Delta produced deformed plants and suffered boll drop. Monsanto reportedly paid several million in compensation to the Mississippi Delta cotton growers and then withdrew five types of cotton seed involved in those problems. In Texas other farmers reported deformed roots in RR cotton. And about 190 cotton farmers in Georgia, Florida and North Carolina announced in early 1999 that they were bringing a lawsuit against Monsanto, contending that the GMO cotton they were sold was rushed to market without adequate testing and that Monsanto mislead farmers and agricultural officials about field performance problems with the cotton seed. One Georgia farmer lost almost a quarter of his cotton crop, costing him about \$250,000. A cotton specialist at the University of Georgia said their tests indicated serious performance problems with the GMO cotton and warned growers not to plant it.

Transgenic crops did not make their way through the system of agricultural extension and farm advisors and GMO crops were introduced without the regional field testing and unbiased assessment of Extension crop specialists. Instead, GMOs were promoted and sold to farmers by commercial companies who controlled the information farmers obtained, often limited to singing its praises in advertisements. Farmers, like the general public, often assume that the regulatory process has evaluated these products for their safety and efficacy, when in fact government regulatory agencies are entirely passive and only review the information that companies submit to them and most GMO crops are deregulated. As a result, farmer are often the testing ground for new GMO varieties and companies have shifted the expense and risk of crop failures to farmers. Professor Charles Hagedorn of Virginia State University and an Extension Specialist says farmers want GMOs based on commercial promotions "whether they need them or not" and that farmers are adopting them without objective husbandry and economic justifications.

3) Legal Issues for Farmers - Liability, Insurance, Contracts and Litigation:

Liability: Farmers are concerned that they may be liable for damages that may be caused by their crops or farming practices. In 1998, a German farmer discovered that his conventional corn crop was contaminated with pollen from a nearby farmer's field of Novartis transgenic corn. Novartis Corporation denied any responsibility for the contamination, pointing to its contract with the grower, which called for the planting of a 200-meter buffer zone. This case illustrates two problems for farmers: one, seed companies are likely to use their technology use agreements to deflect liability or pass it on to the farmer; and two, that since there are no notice or registration requirements in place that allow farmers to know what is being planted so that precautions can be taken to prevent cross-pollination or where to look if contamination does occur.

Farmers who plant GMOs should be concerned about contamination issues, and where necessary, plant buffer zones as neighboring farmers whose crops are contaminated could sue under trespass or nuisance laws. While most corn pollen doesn't travel more than 60 feet, it can be carried by wind or insects much farther. A recent study in Europe found GMOs in the guts of bees miles away from the test site.

One of the first contamination cases involved organic corn tortilla chips that were found to contain GMOs when tested by a Netherlands importer in 1998. The company, Terra Prima Inc., a small Wisconsin organic food company, destroyed 87,000 bags of the product, losing \$147,000. Press reports said the source of the contamination was unknown but the company did not blame the farmer. But now that certification programs are available, all farmers growing GMO-free crops, conventional and organic, should consider test sampling that begins on their farms, in order to protect themselves. Some farm groups are raising questions about why GMO-free farmers should be forced to assume the burdens of testing and segregation costs, and risk of liability, when they are not the cause of the contamination or a producer of GMOs. (See Fact Sheet on Testing, Segregation and Identity Preservation.)

Contaminated conventional seed was sold by Advanta Corporation to farmers in Europe, causing them to inadvertently plant transgenic crops. Six hundred farmers in Britain, and smaller numbers of farmers in France, Germany and Sweden suffered serious losses. Several countries ordered the farmers to destroy crops as they have in other seed contamination cases. Seed companies have agreed to pay damages, and have avoided lawsuits and legislation, so far. But payments for seed contamination are often limited to the cost of seed, and do not cover crop losses and other damages and the question of assigning responsibility has not been settled.

When contamination or other damages occur, if there is no legislation that clarifies who is responsible, it will be up to the courts to decide who pays, and for what, and how much. Currently there is no legislation before the U.S. Congress on the issue of liability, but several farmer advocate groups have asked that seed companies be required to accept liability for their products and ensure that farmers are not left holding the bag.

Other liability questions include: Who should be liable for damages that might result from a consumer who has an allergic reaction to a GMO food? Can an organic farmer whose crop, and organic certification, is lost due to contamination recover losses and from whom? And now that farmers are forced to use ever stronger herbicides to kill the new herbicide tolerant weeds and stronger pesticides to eradicate newly resistant crop pests, who should cover those costs, the farmer or the manufacturers that created the problem? The larger social questions of who will pay for environmental clean up costs or the loss of beneficial insect controls such as Bt have not been addressed at all.

Insurance: A recent review shows that there are no known companies offering insurance that specifically covers risks from the hazards of GMOs. The 130 year old Swiss reinsurance company Rueck, concluded in their 1998 report, "Genetechnology and Liability Insurance," that there is no way for insurance companies to evaluate the risks and thus offer appropriate coverage. That is the general sense of why coverage is unavailable, the risks can not be ascertained.

Bloomberg Newswire reported that American Agrisure, the third largest crop insurer in the US, does not offer a policy to cover damages relating to genetically engineered seeds.^{viii} NFU Mutual, the largest farm insurance company in the UK, said in a letter to farmers that they would not offer insurance against the loss of “GMO-free” status, or the potential loss of crops or loss of farmland through cross pollination and GM pollution.^{ix} Some insurance companies, such as Cigna International, reportedly said that they would “think twice” before providing coverage to companies for GMO products, given their experience with asbestos, PCBs and other products that promised miracles and produced dangerous problems.^x

Regular crop and liability insurance may apply to claims from certain acts of negligence or even some crop damage, but there are standard exclusions for pollution and GMO contamination may fall under that exclusion. What private insurance there is available for small businesses, including farms, would not cover catastrophic environmental losses. Large companies may insure some risks for genetic engineering under existing liability policies or product liability coverage. The lack of insurance points to the need for legislation that assigns liability to the manufacturers and protects farmers.

Restrictive Contracts - Technology Use Agreements: Farmers who grow transgenic crops sign “technology use agreements” when they buy transgenic seeds. Monsanto Corporation’s “Technology Value Package” for the year 2000 is actually an “enrollment” in an ongoing program and is self-renewing until the grower or Monsanto terminates it. Once enrolled, a farmer is given new technology and new terms every year.

These contracts favor the companies that write them. The Monsanto contract, which is fairly typical in the industry, begins by telling the “grower” that a violation of the contract means losing whatever rights the grower had, as well as any right to purchase seed in the future, and may also result in liability for patent infringement. However, even though the grower’s *rights* are terminated, the grower’s *obligations* still continue. The contract gives Monsanto the right to recover all their costs and legal fees for enforcing it but gives no reciprocal right to the farmer if the farmer suffers damages from the use of the technology. Under the Monsanto contract that was reviewed, a grower does not have a choice in how disputes are resolved but agrees to go to federal district court or a state court for “all disputes” over the seeds or the technology. This may be prohibitively expensive and thus effectively leave the farmer without legal recourse.

Many farmers object to the provisions that give Monsanto the right to review their private financial records, such as reports to the Farm Service Agency, and retailer invoices. Depending on the crop, Monsanto insists on the right to inspect fields or demand invoices to verify that seeds were purchased under the contract, on the presumption that the farmer can not be trusted. To enforce these contracts, Monsanto has hired Pinkerton detectives to look into the affairs of seed dealers and farmers and has hundreds of cases against farmers under investigation and in court and Monsanto seeks hefty fines against violators. The farmer agrees that any violation of those terms would result in damages that include – in addition to all the usual remedies for breach of contract that the law allows – paying Monsanto Corporation’s costs and legal fees AND paying Monsanto 120 times the technology fee.

In a very broad, and bold, assertion of ownership over life, Monsanto also says that they retain ownership of the genes and the gene technologies used in their products. Under the contract, the grower agrees not to save, sell, acquire, or supply seeds for planting outside the terms of the contract, giving up some of the most fundamental of farmer's rights to control how crops are grown and the time honored tradition of saving seed and on farm experimentation. The grower agrees to use seed for a single commercial crop, not to sell, save or replant seed, not to use the seed for any research, crop breeding, seed production or other specified uses. As the head of BASF's crop protection business, Friedrich Vogel, said in *Farmers Weekly*, these "strict contracts will dictate production methods and severely limit the farmer's share of any added value the new crops offer to food processors and retailers."

The grower also agrees to "understand" a long list of warnings including several that set forth the uncertainty of grain export markets and that the grower "must" be ready to use the grain on farm or for animal feed or other domestic uses. Growers are asked to refer to the company's guidebook on the potential for pollen movement to neighboring crops. The grower agrees to use only Monsanto's proprietary herbicide for "over the top" application, or the warranty will be void. The contract also spells out limits on Monsanto's liability and limits on their warranty that the seed will perform as promised in the sales pitch. One effect of all these provisions, and the fine print, may have, is that if a problem occurs, Monsanto can say they disclaimed responsibility in the contract the grower could be left liable.

Litigation: For the last several years, public interest groups have been bringing lawsuits against the government agencies that regulate GMOs, demanding labels, pre-market testing and other consumer and environmental rights. The courts have yet to be heard from on these issues but in private litigation the courts have upheld the right to patent life forms and seeds and even public interest litigation can result in companies avoiding . In perhaps the most important test of corporate power over the food supply has been brought by an international coalition of farmers, against Monsanto and other "life science" companies for failure to test GM seeds and crops for environmental and human health safety, for price fixing and other anti-trust activities.

4) The Environmental Effects of Transgenic Crops:

All three major transgenic crops: herbicide tolerant, insect resistant, and virus resistant plants, as well as those that combine these traits, are now known to have serious environmental impacts. Some environmental effects result from the crops themselves, some are related to the genetic engineering process itself and some are attributed to the farming practices associated with transgenic crops.

According to a group of scientists who gathered at the University of California, Berkeley, to assess the risks of genetically engineered crops, the scientific information that is currently available indicates that while there are no known reports of ecological catastrophes associated with genetically engineered crops, there are substantial ecological risks. GMOs are living organisms can reproduce, migrate, recombine and mutate and they are becoming a persistent form of pollution that is hard to detect and difficult to eradicate. As a July 5, 1999 article in *Scientific American* entitled "Poison Plants?" points out, fields of transgenic crops look lush and

green, but “appearances can be deceiving” because the problems with genetically engineered crops are not visible. UC Berkeley scientist Dr. Ignacio Chapela explains that bio-contamination is not like toxic pollution from chemicals, which can create visible dead zones and death. Bio-contamination from gene-flow, says Professor Chapela, creates numerous forms of persistent, but unseen, pollution. Aside from its economic effect, the rising rates of GMO contamination, in crops, the food supply and the environment is a cause of concern.

“Biological pollution will be the environmental nightmare of the 21st century.”
Andrew Kimbrell, Center for Technology Assessment.

The environmental effects associated with HT crops include the overuse of toxic herbicides, particularly Roundup®, also known as glyphosate. While Monsanto says that Roundup is safe, a growing body of evidence indicates that Roundup is poisonous. The U.S. Environmental Protection Agency (EPA) reported 109 incidents of health effects associated with glyphosate between 1966 and 1980 and glyphosate is the third most commonly reported cause of pesticide poisoning for farm workers in California.

A Canadian study found that herbicide use increased by more than 50 percent due to the introduction of transgenic crops. As herbicide use increases, weeds develop resistance to them. Eventually, the herbicide is no longer effective as the weeds become herbicide tolerant. Or genetically engineered HT crops can cross with weedy relatives and other related plants and pass on the tolerance trait. HT crops can create thereby “superweeds” or plants that are impervious to one or more herbicides. A farmer in Canada who grows transgenic canola reports having “triple resistant” weeds that are resistant to three herbicides and require ever more potent weed killers to control.

Another indication that HT crops are using more herbicides is that regulatory agencies in the U.S. and elsewhere have been asked by chemical companies to modify their residue tolerances for transgenic crops. Higher residue limits are allowed, especially for crops used in animal feed, as long as they are be used for forage. However, from an environmental standpoint, allowing higher tolerances of herbicides does nothing to decrease agriculture’s dependence on chemicals.

Recently, a problem with HT cotton was reported in South Carolina, where farmers found that they were inadvertently providing a refuge for the dreaded boll weevil, when Roundup Ready (RR) cotton was rotated with RR soybeans. Volunteer RR cotton plants that are resistant to herbicide, essentially HT weeds, emerged the next year and provided a boll weevil refuge that threatened nearby cotton fields but since they are herbicide resistant, they were difficult to control with available herbicides. The last time there was a weevil re-infestation, it cost farmers \$1.3 million to eradicate, so this new HT weed problem is considered serious.

The environmental effects associated with Bt crops include the development of resistance in the insect pests that they are intended to control. Eight species of insects have developed some level of resistance to Bt. Transgenic pesticide producing plants may be creating “superbugs” faster than expected, reports *The Wall Street Journal*. As a result of rapidly developing resistance, both Bt sprays and Bt crops are rapidly becoming ineffective. Bt crops

contribute to this loss of a valuable, and safe farming tool because they express their Bt gene in all parts of the plant, throughout its life cycle, even continuing in the soil, and this Bt is genetically engineered to be always “active” unlike the foliar spray Bt, which requires an insect to ingest it to be activated.

Bt crops do not just kill the pests they are designed to control. They harm and kill non-target insects, such as butterfly larva that feed on Bt laced pollen, as well. Bt crops harm beneficial insects, including pollinators, and extensive studies in Switzerland show that they harm pest predators like the lace-wing larva, which play a beneficial role in balancing insect populations.

Bt crops also affect the soil and the essential nutrients and microorganisms that live in the soil’s micro-ecosystem. Genetically engineered Bt binds with soil microbes and has been shown to remain active there for a year. Newer Bt crops exude the pesticide through the roots and high dose versions of these root exudate Bt crops will have an even greater impact on the soil. Bt crop residues also affect soil chemistry and the life of the micro-organisms.

Virus resistant crops expose the environment to new transgenic viruses. Recent research shows that GMOs are not stable, but instead have the potential to create new viruses, to transfer genes both through reproduction and through horizontal transfer such as through cell walls and that transgenic viruses can combine with other viruses and form new viruses or new infectious diseases. The USDA has been considering setting new restrictions intended to reduce the risk of harmful new plant viruses from GMO crops.

There are environmental threats associated with the process used to manufacture GMOs. (Please see attached Fact Sheet on What is genetic engineering and How Does it Work?) At the early stages of the development of genetic engineering, it was believed that transgenic plants were stable and more likely sterile and would only very rarely breed with other plants. Then ground breaking research at the University of Chicago on herbicide tolerant plants showed that genetically engineered plants were actually 20 times *more* likely to outcross than the nontransgenic form of the same plant. The implications of this, and subsequent studies that have expanded the supporting data, is that GMOs proliferate once they are released into the environment. Some genetically engineered crops have a competitive advantage that contributes to their survival, making it possible that they will eliminate other species that can not compete.

Transgenic crops also affect the world’s genetic diversity, the common heritage of germplasm that is essential to agriculture and biodiversity. Because of patents and restrictive uses of GMO crops, fewer varieties are being planted, and seed bank collections are shrinking. Furthermore, since GMO crops can cross with other plants, all the wild relatives of GMO crops such as corn, squash, carrots, strawberries, beans and sunflowers – to name those crops with origins in the Americas – may eventually become transgenic, losing their original genetic integrity. This possibility is a serious problem worldwide, at various centers of origin for the world’s crops, such as with GMO grasses like Sorghum in Africa, or with soy and rice in Asia, and corn in Mexico.

The environmental effects associated with GMO farming practices include the recent documentation that GMOs do not necessarily, across the board, reduce pesticide use, as claimed

by the GMO industry, and pesticides are associated with a wide variety of environmental problems. Studies also show that the use of herbicides has actually increased due to transgenic crops. The controversy may involve the fact that GMOs are currently designed to control one insect pest, and they can have the effect of reducing the need for the chemical pesticide previously used against that pest. However, other toxic chemicals may still be needed to control a variety of other insects, and the pesticide producing transgenic plant, Bt, is also a pesticide. So the use of broad terminology may not be helpful in assessing the impact of GMO crops on chemical use, but the need for accurate data would be. Pesticide use by farmers is not tracked nationally and information is spotty or limited to sales information. An article in the *New Scientist* reported that patent applications by industry scientists list a wide variety of insects that attack Bt crops and identify several combinations of pesticides that are commonly used on them and growers report the need to continue using other pesticides on Bt crops.^{xi}

5) How GMOs Contribute to Corporate Consolidation & the Ongoing Farm Crisis:

Agriculture has changed dramatically in the last twenty years, and no more so than in agribusiness, where the consolidation of corporate interests have resulted in a handful of companies now wielding unheard of power to control markets, prices, farming practices and almost every aspect of the food system from seed to stomach. Rural sociologist William Heffernan points out that when just four firms dominate 50-80% of the market, such as in the beef, pork and soybean processing industry, they exert enormous control and even without any making agreements to fix prices, the very small numbers of players can result in them acting in concert to control markets. These companies are also vertically integrated and have recently developed relationships with the large food retailers – and about five retailers now sell 50 percent of the groceries – and these links will exert further control and domination over the food supply.

"We could be coming back to a situation like the Middle Ages where producers have to depend on a single, powerful company for their livelihood." Quebec Agriculture Minister, Remy Trudel, July 7, 2000

This power also translates into political prowess and resulted in the passage of the last farm bill, which was a disaster for family farmers. Government payments have reached record amounts, following the Freedom to Farm bill which was supposed to phase them out and the larger corporate producers are able to get massive subsidies, which were intended to help the smaller farmer. Congress just approved \$7.1 billion in farm aid, the largest level of support since the farm crisis of the mid-1980's. The U.S. is choking on its own productivity and GMOs contribute to this imbalance because the more you produce, the more money you can get from government. That, in turn, contributes to the massive over production problem that is keeping prices down. American farm policy is biased toward industrialized production and exports, subsidies direct and for irrigation, fossil fuels and chemicals.

As farmers face continued loss of their livelihoods and rock bottom prices, making an average of less than zero to 2 or 3% return, the agribusiness corporations are making enormous profits in the range of 18-20% return. Meanwhile, the average American consumer continues to expect to pay less than 9% of annual household income on food, just half of what households

paid about two decades ago. This does not result in farm income, the welfare of rural economies, or in a healthy farm economy overall. One agricultural economist, Stephen Blank, has predicted in his book entitled "The End of Agriculture," that America will soon no longer be able to afford to farm. Certainly, agricultural genetic engineering, by continuing to depress prices, raise the environmental stakes, and alienate customers while providing short term expensive technological "fixes" for farmers, does not ensure that American farmers will have a prosperous future.

Globalization and liberalized trade policies are acting to the advantage of large multinational agribusiness operations. The harvest off one of every three acres farmed in the U.S. is exported and the U.S. is leading the assault on foreign markets. Although American farmers are told that exports are good for them, the profits from these exports are not returning to rural communities, and the U.S. is increasingly importing its food. Most of the grain grown in the Midwest goes into animal feed, for instance. Heffernan points out that it cost the big grain cartels about the same amount to ship grain to other countries as it does to ship it across America and that exports are used to feed livestock in other countries, and then imported back into the U.S. America is a net importer of beef, and is increasingly importing other farm products, leaving farmers to fend for themselves in the global economy.

Mergers in the Seed and Chemical Industry:

Throughout the early 1990's international agribusiness companies were enthusiastically merging with one another and with pharmaceutical companies to form what were called "life science" conglomerates. But by the end of 1999, these gene giants were selling off their agricultural holdings and the "life science" strategy had hit hard times. European life science giants Novartis and AstraZeneca merged, combined their agbiotech divisions, then sold them off. This move "effectively washed their hands of crop biotechnology," in favor of their pharmaceutical divisions, according to the Wall Street Journal.

Here is how the big fish consumed the smaller fish. Novartis Corporation, which was the result of the 1997 merger between Ciba Geigy and Sandoz, merged with AstraZeneca. AstraZeneca was the product of a 1998 merger between Astra and Zeneca. Syngenta Corporation is a new company made up of Novartis, AstraZeneca, and Advanta Seeds. It will be "the world's first global, dedicated agribusiness company" with sales based on 1998 figures, of \$6,900 million in agrochemicals alone. Along with two other top agrochemical companies, Dow and Aventis, there are now just five "Gene Giants" who control virtually 100% of the GMO seed business. Five years ago three of these companies: Syngenta, AstraZeneca and Aventis did not even exist.

Monsanto, the world leader in GMOs, was bought by a pharmaceutical company named "Pharmacia" a recent merger with pharmaceutical giant UpJohn. Sales for Monsanto's leading Roundup Ready crops, may have topped out in 1999. Monsanto hoped to reap \$881 million in licensing fees for its transgenic seeds by 2003, but now admits that target is unreachable.^{xii} Monsanto's stock suffered throughout 1999 as it also struggled to recoup its 8 billion dollar investment in seed acquisitions. After its sale, an autonomous agricultural subsidiary which will continue to use the name Monsanto.

The seed score card looks like this: the current top three seed companies are DuPont, (which now owns Pioneer Hi-Bred) Monsanto/ Pharmacia Corporation, and Syngenta. The top ten consolidated seed companies now control 33% of the \$23 billion world seed trade and the top ten agrochemical companies control 91% of the \$31 billion agrochemical market. These combined seed, pharmaceutical and chemical companies either have holdings in other parts of the food supply chain or work with other conglomerates in joint ventures. Large grain and trading companies are also vertically integrated, meaning that they have some form of control over all aspects of a commodity, through holding patents on the technology, owning the seed production and sales process, enforcing provisions in farmer contracts, and even manufacturing and distributing the processed foods sold to the consumer.

Patents are the lifeblood of agricultural biotechnology, but they are exerting a stranglehold on farmers. But by privatizing the seed germplasm and connecting it to proprietary chemical and genetic technologies, and by controlling how the farmer plants and markets GMOs these consolidated agribusiness corporations are able to control what farmers plant and what prices they will be paid. Given the lack of competitive markets, and the need to recoup huge investments in R&D, these companies are squeezing the farmer by charging high prices for seed and inputs. The expense of GMO research is such that only the big corporations can afford it, which also has the effect of eroding the role of public research and democratic participation in developing new products and assessing the risks and benefits of this technology.

Farmers are losing control over farming for many reasons. There are fewer farmers than ever before, their reduced income means they make less of a contribution to the rural economy, they have very little choice about what and how to farm and they have almost no clout when it comes to prices. But, cynically, farmers still have an important function, in addition to the land and labor they provide: they absorb most of the risk of producing the nation's food. Genetic engineering is a good example of how this works. The agribusiness corporation gets its money up front when the seed is purchased and because its technology that it controls it protects itself with the technology use agreement. The farmer has to bear the brunt of any performance problems, has to take the risk of poor prices and wait until harvest to realize any gain or take the loss in uncertain markets.

Agricultural genetic engineering is an invention in search of a necessity. It was not created by farmers to solve their critical problems, in fact it may be making them worse. Certainly American agriculture has suffered some of its worst years since genetic engineering was introduced. While it may offer some convenience, it has not proven to be beneficial, except to its manufacturers. Since transgenic crops were introduced in 1996, net farm income, including emergency government payments is down, drastically.

The promises of environmental benefits are proving to be untrue while the environmental hazards are proving to be real. The world, especially America, is awash in agricultural productivity, which is a major factor in keeping prices so low. Genetic engineering is not needed to feed the world, since there is already more than enough food being produced and hunger is caused by poverty, not lack of productivity. Third world subsistence farmers can not afford these expensive technologies, they need access to land and basic tools and resources, not high tech patented seeds and proprietary inputs. The world also needs its collective heritage in germplasm,

not more private ownership and control over agricultural genomics. Agricultural genetic engineering has accelerated the worst trends in agriculture rather than contributing to the welfare of the family farmer or the public, who, by all measures, still values its farmers and farmland.

6) Consumer and Human Health Concerns about GMOs:

Farmers who plant transgenic crops may be frustrated by the controversy over GMOs. However, from the consumer standpoint, there are no advantages to these foods. Because they were put on the market without labels, people resent having them “shoved down their throats” so to speak. As they become aware that they are eating products with organisms in them that have never been consumed before and that have not been subjected to pre-market testing, consumers are offended. The manufacturers of GMOs grossly underestimated the emotional connections that people have with food.

Few farmers are aware of the fact that the GMO industry developed two very different sales pitches for their products, one for farmers which touts their economic benefits and another for the public which touts its environmental and social benefits. Given the lack of justification for these claims, the public is just not buying it and worldwide, consumer rejection of GMO products is gaining momentum. Cattle farmer and seedstock producer Rob Whitbeck, echoed consumer frustration in an opinion piece in a July 2000 issue of *Capital Press*, a farming publication in the West, said that people are going to be angry when they find out the “deception” of the “biotech industry” and “...in truth, nobody knows what the long-term consequences will be, nor does anyone know what retribution nature will end up taking for this. We’re clueless. It’s a massive corporate experiment with farms, farmers, livestock and consumers, including children, as the guinea pigs.”^{xiii}

Consumer right to know laws are popular, for good reason, and the public is beginning to see the hypocrisy of the FDA that requires labels for far less unusual substances than GMOs but has sided with the genetic engineering industry in its opposition to labels. Despite polls that show well over 90% of the public supports labeling of GMOs, the FDA has said that just because the public wants them, that is no reason to require them. Instead, the Clinton administration has proposed rules that would “allow” producers who want to make a claim that a product is “GMO-free” to do so, effectively shifting the burden of testing, segregation and labeling on to everyone but the GMO industry. “Though it seems highly unlikely that the continued development and use of these products will be banned, labeling and perhaps additional regulation may increase costs in the food system and, ultimately, affect retail food prices” says Mike Singer, agricultural economist at the U.S. Federal Reserve Bank^{xiv}

Because of the consumer backlash, a growing number of food companies and retailers in the United States, and abroad, have rejected GMOs and the trend, especially in food retailing, from late 1998 through 2000, has been to turn away from them. Supermarkets in Europe label and test for GMOs and as it becomes more difficult to provide GMO-free products, are calling for stricter controls.

- U.S. baby food manufacturers Gerber and H. J. Heinz announced they would go GMO-free. Gerber is owned by Novartis, a leading producer of GMO products.

- McDonald's has asked its suppliers not to use GMO potatoes. The two largest potato suppliers, McCain Foods of Canada, the world's largest french-fry maker^{xv} and J.R. Simplot of Idaho, have asked their growers not to plant Bt potatoes
- PepsiCo's Frito-Lay, reported to own 57.5 percent of the snack food market, who uses 22 million bushels of corn annually, said that it would phase out genetically engineered corn in it's chips.
- U.S. food retailers Wild Oats and Whole Foods^{xvi}, with combined sales of almost two billion dollars annually, announced that they will reject GMOs for their house brands.
- Shoppers outside the U.S. will have a growing array of GMO-free products and brands to choose from. Loblaws, a Canadian supermarket announced they will stock and promote foods that are not genetically modified.^{xvii} According to Greenpeace International,^{xviii} European chains that have announced they will not sell any genetically engineered products include Sainsbury's and Marks & Spencer in the UK, Carrefour (France), Superquinn (Ireland), Migros (Switzerland), Delhaiz (Belgium) and Efferlunga (Italy) as well as Unilever (Germany), and 90% of supermarkets in Austria.
- Japanese breweries Kirin, which is a leading biotechnology company in Japan, and Sapporo, other Japanese soy companies, and divisions of Nestle in Hong Kong are also on record as phasing out GMOs. Many of these foreign food companies, at a minimum, are complying with labeling laws in Europe and Asia.
- After U.S. based *Consumer Reports* published a list of brands containing GMO's, companies making veggie burgers and other soy foods began to remove GMOs from their products, especially those selling to the popular natural foods customers like Ben & Jerry's, Morningstar Farms and Hain Food Group.^{xix}
- Chefs from famous restaurants have called for labels, testing and GMO free menu items.

In another and potentially far reaching development for American farmers, consumers are now also demanding GMO-free animal feed and promising to boycott products made with GMOs or animals fed GMOs. This may cut off the only recourse GMO growers have for selling their crops.

Lessons from Star-Link™

In the fall of 2000, three popular brand consumer products containing genetically engineered Bt corn called "Starlink", which was not approved for human consumption, were recalled. The effects reverberated throughout the food system. It began with taco shells manufactured by Kraft and distributed through the Taco Bell chain, then spread to products at thousands of Safeway, Food Lion and Shaw's food stores, forced a withdrawal of all food products containing yellow corn tortillas by a Mexican corn miller, Gruma SA, and the large U.S. tortilla makers, Mission Foods. Then restaurants from Applebee's to Wendy's and more grocers including IGA, Albertsons's, Kroger and Wal-Mart pulled yellow corn tortilla chips and taco shells. It eventually affected Archer-Daniels-Midland whose partner, Azteca Milling of Texas, was a major source of the contaminated corn flour; Cargill Corporation, who had to institute new testing methods at their mills, and Tysons Foods who reportedly stopped feeding Starlink corn to chickens. It forced ConAgra to stop milling corn in Kansas and the shut down of Kellogg's supply mills and a breakfast cereal plant in Memphis. It even reached the shores of Japan when it found the banned corn in imports that were then rejected.

That a single GMO corn variety, intended for animal feed only, sold by one company: Aventis Crop Science, grown on only a few million acres in the US and making up less than half of one percent of U.S. corn production, could end up in so many food products and affect so many consumers and companies is a lesson in how integrated the food system has become and how weaknesses in the regulatory system fail to protect the food supply. These products slipped through that safety net and were detected by citizen's groups, and only later verified by government investigators.

For farmers, who were not adequately warned that Starlink was restricted, it has been a difficult and expensive exercise. Some, but not all farmers, were given information about restrictions on the use of Starlink, mainly regarding the separation distances for fields to prevent cross-pollination with non-GMO crops and insect refugia requirements. But the limitations on use and marketing were not highlighted or adequately explained.

Aventis has offered to purchase the 1999 and 2000 Starlink crop, including paying a premium for any corn used for feed on the farm and has offered an apology to farmers for their inconvenience, but it also is reported to have attempted to get farmers who planted Starlink to sign retroactive contracts. However not all costs were reimbursed, and the issues of legal liability remain unanswered. The National Family Farm Coalition's Farmer to Farmer campaign has warned farmers to get legal advice before signing contracts with Aventis. They also called for Aventis to ensure that farmers would not be left the hook for the costs of contamination or other liability.

An analysis by faculty at Iowa State University, "The Starlink Situation" suggested that the program instituted by Aventis's in October 2000 was too little too late, given that Starlink corn had already been commingled on farms and at elevators and other corn crops were contaminated by cross-pollination with Starlink. The report said that restrictions on planting were not adequately explained to farmers and concluded that, at least in Iowa, the buffer zones and restrictions were "not done in a significant number of fields."

Another recent report on the economics of Starlink suggested that the question of the costs of identity preservation and segregation are still too ambiguous to account for but that they will depend, ultimately, on the tolerance levels set by governments and not necessarily from the costs of completely restructuring the current grain handling system or reshuffling the current system to handle the separation, cleaning, identity preservation, testing, tracking and labeling of GMO products.^{xx}

While it continues to cope with financial and regulatory problems, the legal issues may ultimately cause the most distress for Aventis. The Attorney General in Missouri is suing Aventis for the costs borne by farmers, grain elevators and other businesses, including farmers who did not raise Starlink corn but whose crops were contaminated. Later in December 2000, a nation wide class action suit was announced that would not only seek such compensation but also require Aventis to decontaminate equipment and soils, stop selling any Starlink product until it is proven safe and take responsibility for what it alleges was Aventis' reckless, negligent and

intentional conduct that caused damages to farmers, consumers and the grain handling and storage system.

Other Health Concerns:

The public, environmental, health and consumer groups are concerned with the human health risks posed by transgenic crops. They include potential allergens, such as posed by the Starlink fiasco, and the very serious risk of antibiotic resistance attributed to the antibiotic resistant markers used in the manufacturing process. Doctors have noted the differential impact GMOs could have on babies, children, the sick and elderly, through changes to the immune system, which have been associated with GMOs. There is also an increased risk of cancer associated with milk from cows treated with rGBH. GMOs may contribute to the creation of new toxins and viruses, and the lack of studies on these and the impact of GMOs on human and animal digestion are other serious concerns. The British Medical Association, which represents 80% of physicians in the UK, issued a report in May 1999 that warned of many of these health hazards and called for a ban, pending further studies.

An important study published in *The Journal of Medicinal Food*, in July 1999, found significant nutritional differences between transgenic and conventional soybeans, a reduction of between 12-14 percent of plant phytoestrogens in transgenic soybeans, when compared to conventional soybeans grown under similar conditions. Other impacts on the nutritional qualities of transgenic crops are coming to light.

The public is also concerned about the environmental hazards and ethical and religious issues. These are not emotional and unfounded fears, in fact, most of the health problems that were mere predictions a few years ago now have evidence to show that the concerns were appropriate. Even the prestigious scientific journal *Lancet* said that the controversy has been mishandled by everyone involved, but governments should never have allowed these products into the food chain without rigorous testing.

And where is all this headed? Once again, Europe is leading the way. The largest supermarket chain in Europe, Iceland, just announced that will switch to selling organic food, and do so at no extra cost to the consumer. It will buy 40% of the world's organic vegetable crops and spur the growth of organic farming in Europe and elsewhere. Organic food is the most customer-friendly option health conscious consumers have, if they want to avoid GMOs and support nature friendly farming. Organic industry is booming, with growth in sales of over 20% per year. Organic farmer organizations have been outspoken critics of agricultural genetic engineering and customers are showing their support for that position.

New models of farming that include diversified and organic or reduced chemical input production are being developed and publicly supported in Europe. Research is beginning to show that organic crops can outperform conventional and transgenic crops, under some conditions. A recent study also showed that smaller "multi-functional" farms were more productive and efficient than larger industrialized farms and another study found that organic farms were capable of feeding large populations.

Meanwhile, in the U.S., farmers can take advantage of the growing market for GMO-free products. Finding the answers to the farm crisis and to the devastating effects of corporate concentration will take a much greater, concerted political effort.

“Some day,” old Jamie had said, “there will come a reckoning and the country will discover that farmers are more necessary than traveling salesmen, that no nation can exist or have any solidity which ignores the land. But it will cost the country dear. There’ll be hell to pay before they find out.” ~ Louis Bromfield *The Farm* (1933)

ⁱ Benbrook, Charles. “*World Food System Challenges and Opportunities: GMOs, Biodiversity, and Lessons from America’s Heartland.*” January, 1999.

ⁱⁱ *Id.*, page 15.

ⁱⁱⁱ *Id.*

^{iv} *Id.* Page 5.

^v “World GM crop plantings to decrease.” Planet Ark, February 18, 2000.

^{vi} *Id.*

^{vii} This extensive site offers full papers on every possible topic as well as extensive links and is the primary source for the papers written for farmers by the insightful independent agricultural economist, Charles Benbrook, the former director of the Board on Agriculture at the National Academy of Sciences.

^{viii} Chase, Brett. “Gene-Altered Crops are Trouble in the Wind for Organic Foods” *Bloomberg Newswire* 8/11/99

^{ix} No Cover for GM Pollution, Farmers Told, PA News, February 17, 2000

^x Taken from the insurance industry magazine *Post* quoting Maunce Pullen, manager at Cigna International and cited in Biotech Briefing, *Terrain*, Winter 1999.

^{xi} www.biotech-info.net/bt-transgenics.html

^{xii} *Business Week*, October 18, 1999.

^{xiii} “Biotech’s deception awaits discovery” *Capital Press*, July 21, 2000.

^{xiv} “GMO Crop Use May Boost Food Costs” Reuters, December 27, 1999.

^{xv} McCains has 55 operations in 11 countries, had \$ 5.6 billion in sales in 1999. McCain’s processes over 1 million pounds of potatoes/hour.

^{xvi} Fulmer, Melinda. “Two Big natural Food Stores To Ban Gene-Altered Products” *Los Angeles Times*, December 31, 1999 and *Bloomberg News* 12/30/99.

^{xvii} Laidlaw, Stuart. “Loblaws targets consumer fears of modified food, grocer first chain to stock, promote ‘natural products’” *Toronto Star Business Reporter* February, 2000

http://www.thestar.com/editorial/news/20000219NEW01c_CI-LOBLAW.html

^{xviii} Greenpeace International Press release, March 17, 1999. For a thorough discussion of the UK and EU reaction to GMO products see Margaronis, Maria. “As Biotech Frankenfoods are Stuffed Down Their Throats, Consumers Rebel” *The Nation*. December, 1999.

^{xix} “Food Fright: Biotech Scare Sweeps Europe, and Companies Wonder if U. S. Is Next.” *Wall Street Journal* 7 Oct 1999.

^{xx} Bullock, David and Nitsi, Elisavet (University of Illinois) and Desquilbet Marion (Institut National de la Recherche Agronomique, France) “The Economics of Non-GMO Segregation and Identity Preservation. October 21, 2000.