Essay: The Risks of Going Non-GMO

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ESSAY: THE RISKS OF GOING NON-GMO*

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Introduction

In response to the StarLink® controversy, where StarLink® corn was EPA-approved for animal feed but not for human consumption, many food companies may think of avoiding transgenic crops altogether in their food or feed supplies. By so doing, these food companies are attempting to protect the carefully nurtured and closely protected reputation of their food products for safety. Obviously, this motivation to protect a reputation for food safety is extremely important. No one should fault a company for having this concern nor for acting on this concern when appropriate.

Yet, the strategy of going non-Genetically Modified Organism (non-GMO) also carries risks that companies should not overlook in their hurried response to the StarLink® controversy. These risks must be carefully considered so that food companies make decisions with a full appreciation of relevant considerations.

At times in this article, the author will use the names of food companies. The author does so solely to make the examples concrete and to reflect the real world, as opposed to using hypothetical or speculative situations. The author does not use names with any intent to offend, to attack, to cast aspersions on the conduct of the companies, nor to evaluate negatively the decisions that companies may have made. The author uses company names solely to provide clarity — clear examples of the risks of going non-GMO.

The risk of having a crop approved for one use (such as for feed or for an industrial stock) while the same crop is not approved for human consumption is a risk that occurs with non-GMO crops too. Brassicae is the best example of a plant family that as rapeseed is approved as an industrial oil but, in slightly different varieties, as canola is approved as a widely used cooking oil. Through identity-preservation techniques, the industrial crop is kept segregated from the food crop. However, cross-pollination between nearby fields of the varieties of rapeseed/canola regularly occurs so that the industrial crop will be found in the food crop.[1]

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1. Rapeseed and canola are the same crop that differ by two genes. The two genes removed from

Moreover, accidentally or intentionally mixing the oil from the two crops may harm human health. In one incident in the early 1980s in Spain, newspaper reports state that more than 1000 people died and another 25,000 suffered serious crippling injuries from eating food cooked in industrial rapeseed oil.[2] Despite this risk of mixing food and non-food varieties of brassicae and their oil products, canola has become the top cash crop in Canada, surpassing wheat.[3]

The rapeseed/canola example illustrates that going non-GMO will not avoid risks similar to the StarLink® controversy. Indeed, food companies should be aware that as agricultural crops providing a variety of nutritional, medicinal, industrial, and environmental benefits become commercialized, the mixing of crops that are approved for some purposes but not for others will become common.

However, the remainder of this article focuses on three risks directly related to the decision to go non-GMO in food and feeds. Two risks entail legal accoun-

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the canola variety of the crop prevent the high production of erucic acid. With high erucic acid, rapeseed produces an industrial oil. With low erucic acid, canola is a very good, healthy cooking oil. Telephone Interview with Jack Brown, Ph.D., Canola Plant Breeder at the Plant, Soil & Entomological Sciences Div., Dep't of Agric., Univ. of Idaho at Moscow (Nov. 10, 2000).

The difference between rapeseed and canola is the level of erucic acid in the oil. At a high level, erucic acid is toxic to human beings, which explains why rapeseed, producing an industrial oil, is not approved for human consumption while canola is approved. *See id.*

Pollen movement between rapeseed and canola will occur between fields two miles apart. Under present regulations for the production of certified canola seed, canola fields must be at least 500 feet from a rapeseed field. But even if the cross-pollination were at a 10% level (a very high cross-pollination level), the cross-pollinated canola would be below the tolerance level set for erucic acid in canola — 2% of the oil. *See id.*

In the state of Idaho, different geographical districts grow rapeseed and canola but at the borders of these districts rapeseed and canola fields abut one another without any distance separation. No regulation requires distance separation between crop fields, as opposed to certified seed fields. *See id.*

Canadian plant breeders developed canola from rapeseed through conventional breeding techniques in the 1950s and forward. In recent years, canola has been genetically modified because it is from the Brassica family of plants, a relatively plastic plant species that lends itself to genetic modification. *See id.*

For newspaper articles on Dr. Brown's work, see Sandra Lee, *New Canola, Mustard Varieties Reach Farms*, LEWISTON MORNING TRIB., Feb. 18, 1999, at 10G; Larry Smith, *The New Oilseed Mustards Provide Best of Both Worlds*, LEWISTON MORNING TRIB., Sept. 15, 1997, at 9A; Melissa Jones, *Agricultural Research: Alternative Crops Fit into Rotation Cycle; University of Idaho Scientists Are Working on Varieties of Canola and Mustard that May Be More Suitable to the Region and Help Farmers Turn a Better Profit*, LEWISTON MORNING TRIB., Aug. 25, 1996, at 3.

2. For newspapers articles that chronicled this food safety tragedy, see *Angry Spanish Women Jeer Defendants in Tainted Oil Trial*, TORONTO STAR, Mar. 31, 1987, at A3; *Cooking Oil Deaths*, N.Y. TIMES, Nov. 29, 1981, at 10; *Court Opens Hearings on Oil Scandal*, INDEPENDENT (LONDON), Feb. 25, 1992, at 9; *Spain's Cooking Oil Scandal Cripples Its Seafood Canners*, N.Y. TIMES, Dec. 9, 1981, at D5; *Toxic Oil Victims Win Payout*, THE GUARDIAN (LONDON), May 25, 1996, at 12, *available in* 1996 WL 4026138.

From reading these articles, it is unclear whether the industrial rapeseed oil itself was the cause of the deaths and injuries or whether the dye added to industrial rapeseed oil caused the deaths and injuries. As an identity-preservation technique, dye is added to the industrial rapeseed oil to distinguish it visually from the for-human-consumption canola oil.

3. *See* Eric Beanchesne, *Canola Surpasses Wheat as Number One Cash Crop: Receipts for the Oil Seed Reach $ 2.8-Billion*, NAT'L POST, Feb. 25, 1999, at C09, *available in* 1999 WL 3910837.

tability; the third risk is a societal risk with legal implications. Those three risks are: the risk of legal liability for damages; the risk of environmental compliance; and the risk of scientific ignorance.

The Risk of Legal Liability for Damages

The Gerber Example — Products Liability Exposure

In September 1999, Gerber announced that its baby food products would no longer use any ingredients from genetically modified crops. Indeed, Gerber further stated that it would attempt to shift its products to organic crops that are grown without pesticides or chemical fertilizers. Gerber acted to protect the reputation of its products — from Greenpeace-instigated threats of consumer boycotts against genetically improved food — by adopting the widespread perception that organic products are safer for consumers.

Gerber is a subsidiary of Novartis.[4] Novartis is a leading manufacturer of agricultural pesticides and developer of genetically improved crops. Novartis has the scientific expertise to evaluate carefully and thoroughly the safety of foods produced by its subsidiary corporations. Novartis has the scientific expertise in agricultural biotechnology to design healthy and safe food products using biotechnology.

What if Gerber reacted to "fear-mongering" by Greenpeace and adopted an ingredient procurement strategy that, in fact, increases the health risk of its smallest consumers? Is that possible?

Various studies show that Gerber may have unintentionally increased the health risk for its baby consumers:

> According to the United Nations Food & Agriculture Organization (FAO), 25% of the world's food grain crops are 'infected' with mycotoxins each year. That echoed a similar finding by Mannon and Johnson in 1985. (ASA *Leader Letter*, June 5, 1997) Mycotoxins are a group of toxins (metabolites) naturally produced by certain fungi that can infect some crop plants (e.g. corn). Chief among those mycotoxins is aflatoxin B_1, the most potent cancer-causing agent know to mankind. (Ohio State University Bulletin, 1986, *Moldy Grains, Mycotoxins and Feeding Problems*). Aflatoxin swiftly appears in milk after a cow ingests it, so humans can consume aflatoxin in both milk and grains. According to a 1993 World Bank report entitled INVESTING IN HEALTH, approximately 40% of disability-adjusted life years (premature death) in developing countries are lost due to diseases linked to mycotoxin consumption (e.g. liver cancer). Because the primary vectors for . . . the *Aspergillus flavus* and *A. parasiticus* fungi that

4. *See Novartis Faces Perception Problem*, FARMER PROGRESSIVE, Sept. 2000, at 8.

Novartis is presently undergoing corporate organizational changes. Novartis and AstraZeneca are merging their agro-chemical divisions to form Syngenta. At the same time, Bayer AG is purchasing Novartis's crop protection business.

> produce aflatoxin in crops are the very insects (e.g. *Ostrinia nubialis*) best controlled by transgenic Bt crops, the Bt crops hold the potential to "reduce or even eliminate mycotoxins in the food supply." (P. F. Dowd, *A Comparison of Insect and Ear Mold Incidence & Damage in Commercial Bt and Non-Bt Corn Lines* (USDA Res. Paper, 1997); P. J. Cotty, *Update on Methods to Prevent Aflatoxin Formation* (USDA Res. Paper, 1997)). According to the head of the World Health Organization's (Codex) Food Safety Program, "Bt corn which reduces insect damage and in turn the amount of mycotoxins in food raw materials can have a direct impact on the reduction of liver cancer. (*Environmental Feed Technology*, April 2000 at p. 14).[5]

Gary Comstock in his book *Vexing Nature* makes a similar point that some genetically improved sweet corns are less likely to accumulate mycotoxins (fumonisins) than some non-GMO varieties. Fumonisins are a cause of cancer in rats, pulmonary edema in swine, equine leukoencephalomalacia, and are a suspected cause of esophageal cancer in humans.[6]

In light of the information just presented, let us now assume a worst case scenario: a mother discovers that her Gerber-fed baby has developed either liver or esophageal cancer. While the risk of this happening is assuredly very low, and while Gerber strictly monitors its baby products to prevent contamination by mycotoxins, if it does happen it is important to note the kind of lawsuit the child has against Gerber.

On the child's behalf, the products liability plaintiff's lawyer will allege strict products liability based on the contamination (mycotoxins) in the baby food as the causal agent of the cancer. This contamination claim is a manufacturing defect cause of action in products liability law.[7] This contamination claim is one in which

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5. KIM NILL, GENETICALLY IMPROVED PLANTS FOR FOOD — GLOBAL UTILIZATION AND DIRECTION (2000) (on file with author). Mr. Nill is the Technical Issues Director of the American Soybean Association.

For additional information on the research of P.F. Dowd, see <http://www.ars.usda.gov/is/pr/2000/000426.htm>. Mr. Dowd has recently published additional research that shows reduced mycotoxin level under certain conditions for Bt corn. *See* P.F. Dowd, *Indirect Reduction of Ear Molds and Associated Mycotoxins, in Bacillus Thuringiensis Corn Under Controlled and Open Field Conditions: Utility and Limitations*, 93 J. ECON. ENTOMOLOGY 1669-79 (2000).

6. *See* GARY L. COMSTOCK, VEXING NATURE: ON THE ETHICAL CASE AGAINST AGRICULTURAL BIOTECHNOLOGY 228-29 (2000). Professor Comstock cites G.P. Munkvold, *Comparison of Fumonisin Concentrations in Kernels of Transgenic Bt Maize Hybrids and Nontransgenic Hybrids*, 83 PLANT DISEASE 130-38 (1999).

Gary Comstock is the Director of the Iowa State University Bioethics Institute in Ames, Iowa.

7. *See* RESTATEMENT (THIRD) OF TORTS: PRODUCTS LIABILITY § 7 (1998). This section provides:

> One engaged in the business of selling or otherwise distributing food products who sells or distributes a food product that is defective under § 2, § 3, or § 4 is subject to liability for harm to persons or property caused by the defect. Under § 2(a), a harm-causing ingredient of the food product constitutes a defect if a reasonable consumer would not expect the food product to contain that ingredient.

Id.

the baby food has a manufacturing defect because the baby food departs from its intended product specifications.[8]

In addition to the manufacturing defect claim — and this is the under-appreciated, important point — the products liability plaintiff's lawyer also will allege a design defect in the baby food because Gerber (and its parent Novartis) knew of a baby food designed (made) with less risky ingredients and purposefully chose to use the riskier design — i.e., Gerber chose to use non-GMO ingredients knowing that these have a higher risk of mycotoxin contamination. Due to the knowledge and expertise available to Gerber through its parent Novartis, Gerber had a reasonable alternative design (safer genetically improved ingredients) that Gerber ignored. As a result, Gerber is likely facing a design-defect products liability claim.[9]

If Gerber attempts to respond to this design defect claim by saying that Gerber was only responding to consumer demand, Gerber encounters Comment g to the Restatement, which blocks this defense. Comment g subjects a design defect to a risk-utility balancing in which consumer expectations is only one factor in determining whether the product design (i.e., non-GMO ingredients) is not reasonably safe.[10]

Gerber may also attempt to respond to this design defect claim by arguing that if Gerber non-GMO baby food is found not reasonably safe, consumers are denied consumer choice. However, if Gerber makes this argument, the plaintiff's liability lawyer may add an additional claim to the lawsuit. The plaintiff adds that product liability attaches to the Gerber non-GMO baby food because Gerber failed to

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8. *See id.* § 2. Subsection (a) provides: "A product is defective when, at the time of sale or distribution, it contains a manufacturing defect . . . . A product: (a) contains a manufacturing defect when the product departs from its intended design even though all possible care was exercised in the preparation and marketing of the product." *Id.* For additional understanding of the manufacturing defect as related to food products see also *id.* cmts. c, h.

9. *See id.* § 2. Subsection (b) states:

> A product is defective when, at the time of sale or distribution, it . . . is defective in design . . . . A product:
>
> (b) is defective in design when the foreseeable risks of harm posed by the product could have been reduced or avoided by the adoption of a reasonable alternative design by the seller or other distributor, or a predecessor in the commercial chain of distribution, and the omission of the alternative design renders the product not reasonably safe.

Id.

10. *See id.* Comment g provides:

> Subsection (b) [of Section 2] likewise rejects conformance to consumer expectations as a defense. The mere fact that a risk presented by a product design is open and obvious, or generally known, and that the product thus satisfies expectations, does not prevent a finding that the design is defective. But the fact that a product design meets consumer expectations may substantially influence or even be ultimately determinative on risk-utility balancing in judging whether the omission of a proposed alternative design renders the product not reasonably safe. It follows that, while disappointment of consumer expectations may not serve as an independent basis for allowing recovery under Subsection (b), neither may conformance with consumer expectations serve as an independent basis for denying recovery. Such expectations may be relevant in both contexts, but in neither are they controlling.

Id. cmt. g.

provide adequate instructions or warnings. For example, Gerber could have labeled its non-GMO baby food as follows: "This product does not contain genetically modified ingredients. Consequently, this product has an additional risk of mycotoxin contamination. Mycotoxins can cause serious diseases such as liver or esophageal cancer."[11]

As the knowledge and science of genetic modification of crops increases, food manufacturers will increasingly face the same dilemma that Gerber faces. Does Gerber respond to threats of consumer boycotts by Greenpeace by going non-GMO in order to protect its reputation from consumer panic and fears about GMOs? Or, does Gerber use the scientific information available to it to design food products using GMO ingredients that are known to be safer in terms of health risks? As genetically improved foods denominated functional foods — with enhanced health and nutritional benefits — become commercialized, this dilemma will face food companies on a daily basis. Companies in the future will not only have to purchase food supplies that are safe; companies in the future will have to use the science of agricultural biotechnology to choose the design of their food products for health and nutrition. Choosing a design that causes harm when the company could have chosen a different, less risky design gives rise to products liability based on design defects.

Food companies face a tremendous dilemma when threatened with consumer boycotts about genetically improved foods. If the company ignores or mishandles the threats, it may well undermine its products' reputation for safety and nutrition.

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11. *See id.* § 2. Subsection (c) declares:

> A product is defective when, at the time of sale or distribution it . . . is defective because of inadequate instructions or warnings. A product:
>
> (c) is defective because of inadequate instructions or warnings when the foreseeable risks of harm posed by the product could have been reduced or avoided by the provision of reasonable instructions or warnings by the seller or other distributor, and the omission of the instructions or warnings renders the product not reasonably safe.

Id.

For additional understanding of the relationship between product liability based on design defect and product liability based on failure to instruct or warn, see *id.* cmt. f. *See also id.* cmt. l.

Moreover, if society deems consumer choice for non-GMO products, despite increased potential for mycotoxin contamination, to be an important value, the legal system could treat non-GMO products similarly to prescription drugs and medical devices. The *Restatement* further explains:

> Under Subsection (c) a drug is defectively designed only when it provides no net benefit to any class of patients. Courts have concluded that as long as a drug or medical device provides net benefits to some persons under some circumstances, the drug or device manufacturer should be required to instruct and warn health-care providers of the foreseeable risks and benefits. . . . In part, this deference reflects concerns over the possible negative effects of judicially imposed liability on the cost and availability of valuable medical technology. . . .

See id. § 6 cmt. b. In other words, prescription drugs and medical devices are so socially valuable that products liability is restricted to manufacturing defects and failure to instruct or warn.

If consumer choice is so important for non-GMO products, despite any increased health risks of these non-GMO products, society could limit products liability to a failure to instruct and warn and remove non-GMO products from the design defect category of § 2(b) of the *Restatement*. At present, however, food products, including raw farm produce, carry the same products liability as other products in commerce. *See id.* § 7; *see also id.* § 19 cmt. b.

However, if the company gives into the threats, it may retain consumer confidence in the short run while losing consumer confidence in the long run. The company can lose consumer confidence in the long run in two ways. First, the company faces the design-defect products liability risk already described, which, if it occurs, will destroy its products' reputation for safety. Second, the company has reinforced consumer fears that prevent the company from creating genetically improved functional foods through product development that are likely the source of new, nutritional foods for consumers in the years to come. Without new, improved foods in the future, the company may well place itself in an uncompetitive position.

The J. R. Simplot, McDonald's, Burger King, and Wendy's Example — Contribution and Indemnity Exposure

Potatoes are a booming crop primarily due to the consumption of french fries at fast-food restaurants like McDonald's, Burger King, and Wendy's. However, growing potatoes is not easy because potatoes are attractive to Colorado potato beetle, aphid-spread viruses, and potato blight. To combat these insects and infestations, potato growers use an assortment of fungicides (to control blight), insecticides (to kill aphids and the Colorado potato beetle), and fumigants (to control soil nematodes). As a specific example, growers used methamidophos, a toxic organophosphate nerve poison to control the aphids. While methamidophos is an EPA-approved pesticide, the EPA is presently reevaluating organophosphate use and, at the end of the reevaluation, may prohibit or greatly restrict the use of organophosphate pesticides.[12]

Monsanto developed a potato containing a Bt gene to control the Colorado potato beetle combined with another transplanted gene to control the virus spread by the aphids. In effect, Monsanto created a potato inoculated by a vaccine that protected its potato — called NewLeaf® — from these two scourges to potato growers.[13] Potato growers who planted NewLeaf® reduced their use of chemical controls, increased their yield, and became convinced from 1994 through 1999 that transgenic potatoes were the best (environmentally and economically) way to farm potatoes.

Five years of excellent experience with NewLeaf® potatoes has ended. Under pressure from anti-biotech groups, McDonald's, Burger King, Wendy's, and others informed their potato suppliers that they would no longer accept transgenic potatoes as the ingredient for their french fries. Thereafter, potato processors, such as J. R. Simplot, informed farmers that the processors would no longer buy transgenic

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12. *See, e.g.*, Brian Broderick, *Pesticides: ILSI Report Lists Six Organophosphates on Basis of Shared Mechanism of Toxicity*, 204 Daily Env't Rep. (BNA) A-6 (Oct. 22, 1997); *Pesticides: Some Uses on Food of Organophosphates Unacceptable, Preliminary Assessments Say*, 7 Daily Env't Rep. (BNA) A-7 (Jan. 12, 1999); Karen Werner, *Pesticides: Food Risk Posed by Organophosphate to Infants, Young Children, EPA Says*, 24 Daily Env't Rep. (BNA) A-13 (Feb. 4, 2000). Each of these cited stories specifically discusses methamidophos.

For a good, general discussion of the EPA pesticide-review process under the Food Quality Act of 1996, see *Special Focus: FQPA (Food Quality Protection Act)*, CHOICES, 3d Q. 2000, at 17.

13. The author has heard that Monsanto is also working to develop a potato that would have the third added trait of resistance to potato blight — the source of the Irish potato famine in the 1840s.

potatoes and inserted a non-GMO potato variety clause into their farmer-processor contracts. NewLeaf® potato with its environmental and economic benefits disappeared, as a practical matter, as an acceptable variety that potato growers could choose to plant.[14]

Now let us assume that a farmer, required to plant non-GMO potatoes by contractual arrangement, sprays his potato crop with methamidophos (the organophosphate nerve poison). Unfortunately, the pesticide drifts into a nearby stream and over nearby farm laborers. Thousands of fish die in the stream[15] while farm laborers[16] immediately check into hospital emergency rooms complaining of serious nerve injuries. The state environmental agency brings an administrative action for civil damages to recover for the cost of the fish kill. A plaintiff's personal injury lawyer files a class action on behalf of the farm laborers to recover the personal injury damages that the laborers have suffered from pesticide poisoning.

If the farmer being sued for damages had

> · for the previous several years planted genetically modified potatoes, and
>
> · was contractually bound to return to non-GMO technology[17] by the potato processor and its fast-food retail buyers (who knew that non-GMO potatoes require organophosphate pesticides for production),

the lawyer defending the farmer should join J. R. Simplot (the contracting processor) and McDonald's, Burger King, and Wendy's (the ultimate purchasers of the potatoes as the ingredient for french fries) as cross-defendants claiming either contribution in tort law or indemnification in contract law for any damages legally imposed upon the farmer client. The defense lawyer would argue that those companies should bear the ultimate responsibility for the damages because they caused the farmer to engage in riskier production practices than the farmer would otherwise have used. These companies chose to impose a non-GMO variety upon the farmer knowing that the farmer would have to use organophosphate pesticides to produce the potato. The defense lawyer would argue that the farmer should have a legal remedy to pass any damages (arising from contractually imposed potato

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14. *See* Hal Bernton, *Hostile Market Spells Blight for Biotech Potatoes*, SEATTLE TIMES, Apr. 30, 2000, at A1.

15. The scenario, as related to fish kill, is taken from an actual event. *See* Colin Nickerson, *Potatoes, Pesticides Divide Island*, BOSTON GLOBE, Aug. 30, 2000, at A1. In one of its paragraphs, the story says, "At the same time, however, they [the farmers] feel frustrated by environmental activists who blast pesticide use but have prevented farms from switching to genetically modified potato resistant to beetles and blight." *Id.*

16. With regard to farm laborers' exposure to methamidophos, a Food & Agriculture Organization (FAO) report in 1997 stated: "More than 7,500 of the [pesticide poisoning] cases [in China] were mostly attributed to normal agricultural use of parathion and methamidophos." *Pesticides: Five Organophosphates Added to U.N. International Trade Monitoring Program*, 186 Daily Env't Rep. (BNA) A-4 (Sept. 25, 1997).

17. Farmer Clen Atchley, of Ashton, Idaho, when describing his being required contractually to abandon genetically improved potatoes in favor of non-GMO potatoes referred to the non-GMO technology as being from the "Stone Age." *See* Bernton, *supra* note 14.

variety and its affiliated production practices) back to the processor and the fast-food chains. Those companies that insist that a farmer use production techniques involving foreseeable harms to the environment and humans should be legally accountable for that decision.[18]

The Risk of Environmental Compliance

The Tyson Foods, Inc. Example — Co-Permittee Exposure

Poultry operations have become a significant topic of legislative concern in various states, particularly the land application of poultry litter.[19] State legislatures have become concerned that poultry litter applied to land causes water pollution due to nutrient-runoff from the litter, especially nitrogen and phosphorous. As a consequence of these concerns, poultry operations are being required to develop an Animal Waste Management Plan (AWMP). A typical AWMP requires poultry operators to measure the nitrogen and phosphorous in poultry litter and to apply the poultry litter to land at a rate at which the land can utilize the nutrients without polluting waters of the United States.[20]

At the same time that states have become concerned about pollution from poultry operations, the United States Environmental Protection Agency (EPA) has been reviewing its environmental regulations relating to animal feeding operations.[21] In August 1999, the EPA issued a *Guidance Manual and Example NPDES Permit for Concentrated Animal Feeding Operations, Review Draft* (Guidance Manual).[22] The EPA has proposed that poultry processors (such as Tyson Foods, Inc.) be co-permitted with their contractual growers as a way of assuring greater environmental protection from and accountability for excessive nutrients found in poultry litter.[23]

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18. The author makes no prediction as to how successful the farmer's contribution or indemnification arguments are likely to be in the courts. The author does predict that farmers contractually required to return to a more dangerous production practice that causes environmental and personal injuries will present these contribution and indemnification arguments to the courts for a resolution concerning the allocation of damages.

19. *See, e.g.*, Oklahoma Registered Poultry Feeding Operations Act, 2 OKLA. STAT. §§ 10-9.1 to 10-9.25 (Supp. 2000). Oklahoma was the first state to pass an environmental statute that specifically focused on the poultry industry as a source of pollution.

20. In Oklahoma, 2 OKLA. STAT. § 10-9.7 (Supp. 2000) sets forth the statutory requirements for an AWMP for poultry operators.

21. The lead document in this EPA review is US-EPA, Unified National Strategy for Animal Feeding Operations (Mar. 9, 1999).

22. *See* US-EPA, GUIDANCE MANUAL AND SAMPLE NPDES PERMIT FOR CONCENTRATED ANIMAL FEEDING OPERATIONS (Final Internal Review Draft, Sept. 21, 2000), *available at* <http://www.epa.gov/OW-OWM.html/afos/dman_afo.pdf> [hereinafter GUIDANCE MANUAL]. NPDES stands for National Pollutant Discharge Elimination System.

23. *See id.* § 2.4.2. The section titled *The Relationship Between Growers and Producers and the Duty to Apply* states:

> Corporate entities that exercise such operational control over a CAFO are considered "operators" of the CAFO and should be held jointly responsible under the CWA [Clean Water Act] for complying with NPDES permits. . . .

Following the lead of the EPA, Maryland and Kentucky have recently initiated procedures to require co-permitting between the poultry grower and the poultry processor for poultry operations in their states. In a recent presentation, Mr. John D. Copeland, Executive Vice President for Ethics and Environmental Compliance, representing Tyson Foods, Inc. discussed the EPA concept of co-permitting.[24] While co-permitting raises many important legal issues relating to statutory and constitutional interpretation, Mr. Copeland argued that the core legal issue is whether poultry processors exercise substantial operational control over the poultry grower regarding poultry litter.[25]

In his paper, Mr. Copeland argues clearly and strongly that poultry processors do not exercise substantial operational control over poultry growers because

> · the processor's permit (relating to its processing plant) has no causal connection or rational relationship to the source of the pollution (i.e. the poultry litter);
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> · the processor is not involved in the day-to-day operational decisions of the poultry grower related to the source of the pollution — such as litter collection, application, or sale — because the litter is a valuable economic resource owned by the poultry grower; and
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> · the actions of the growers are beyond the control of the poultry processor and to require co-permitting would impose contractual terms upon the parties against their wishes in impairment of contracts.

> The decision of whether a corporate entity exercises substantial operational control of the facility should be made on a case-by-case basis by the NPDES permitting authority. . . .
>
> The following are examples of factors that should be considered relevant when determining whether a corporate entity exercises substantial operational control over a CAFO: (1) whether the corporate entity directs the activity of persons working at the CAFO either through a contract or direct supervision of, or on-site participation in, activities at the facility; (2) whether the corporate entity owns the animals; or (3) whether the corporate entity specifies how the animals are grown, fed, or medicated. The permitting authority may identify other factors that may also be used to determine substantial control over the operations of a specific CAFO. The greater the degree to which one or more of these factors is present, the more likely it is that the corporate entity is exercising substantial operational control, and, thus, the more important that it is that the corporate entity is permitted. . . .
>
> Regardless of whether corporate entities are permitted, the NPDES permitting authority should encourage them to establish a corporate environmental program for their contract growers. Such a program could assist the contract growers by developing CNMPs [Comprehensive Nutrient Management Plans] (see Section 3.1), providing environmental audits, and encouraging sound environmental practices, and it could be established as a condition of the contract with the growers.

Id. at 15-16.

24. *See* John D. Copeland, Co-Permitting: Are the States Opening a Pandora's Box?, Am. Agric. Law Assoc., 21st Annual Meeting and Educational Symposium, Conference Handbook (2000) (on file with author). To learn more about co-permitting, see *id.*

25. For the precise guidance language about a processor's substantial operational control over poultry growers, see *supra* note 23.

On Friday, October 20, 2000, Tyson Foods, Inc. announced that it would no longer feed its chickens StarLink® corn.[26] StarLink® had been specifically approved for animal feed; Tyson Foods ceased using an approved animal feed due to concerns about public perception.[27] By contrast, the Federation of Animal Science Societies (FASS) has reviewed all published peer-reviewed data and determined that the research conclusively indicates that "there is no effect of feeding biotech crops to livestock and poultry on the nutritional value or safety of meat, milk, and eggs."[28] Tyson Foods' decision to prohibit StarLink® corn for its poultry has profound implications for Mr. Copeland's argument about co-permitting.

Let us assume that the Tyson Foods decision about StarLink® becomes company policy — i.e., Tyson Foods decides that it will not allow poultry growers to use feed that has been genetically improved. By so doing, Tyson Foods will soon be requiring their poultry growers to *not* use animal feeds that reduce the amount of phosphorous in poultry litter. Plant bio-technologists are well along in creating genetically improved corn and soybeans that "contain reduced concentrations of phytic acid and increased concentrations of free phosphorous. This combination provides nutritional value in animal feed and environmental value because of reduced bound phosphorous released in animal waste."[29] However, Tyson Foods can ignore these genetically improved corn and soybeans with reduced phosphorous in the poultry litter by inserting a non-GMO feed obligation into its contracts with poultry growers. Or, Tyson Foods can directly supply non-GMO feed supplies to the poultry growers. Under either method, Tyson Foods has caused the farmer to use feed that has greater phosphorous in the poultry litter than would exist if the feed were reduced-phosphorous, genetically improved feed.

If Tyson Foods causes farmers to use non-GMO feeds, what are the implications of this action upon the issue of co-permitting? The implications appear to be quite profound for the meaning of substantial operational control. Rethink the bullet points that Mr. Copeland made in his presentation on co-permitting. First, if Tyson Foods prohibits its growers from reducing phosphorous in poultry litter by prohibiting genetically improved corn and soybean rations with reduced

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26. *See Tyson Stops Buying StarLink Gene-Altered Corn*, REUTERS, Oct. 20, 2000.

27. In the Reuters story, Tyson spokesman Ed Nicholson was quoted as saying, "This is basically a precautionary move to avoid confusion among consumers, although to my understanding, there has been no links to the protein in StarLink transferring to products." *Id.*

McDonald's Corp. has also announced that it will stop serving products in Europe made with chickens that are fed genetically engineered grains. *See McDonald's to Ban Chickens Fed Bio-Engineered Feed in Germany*, BLOOMBERG NEWS WIRE, Nov. 14, 2000.

28. Barbara Glenn, Fed'n of Animal Science Studies, *Meat, Milk and Eggs Are Safe From Livestock and Poultry Fed Biotech Crops, U.S. Scientists Say* (visited Jan. 30, 2001) <http://www.fass.org/pressrelease.htm>.

29. Barbara Mazur et al., *Gene Discovery and Product Development for Grain Quality Traits*, 285 SCIENCE 372, 375 (1999); *see also* Drew Kershen & Patricia E. Dougherty, Law and Policy for Feedlots: A Report on the ABA Special Committee on Agricultural Management Roundtable on Environmental Issues in Animal Feedlots (Nov. 18, 1997) (reporting discussion led by Professor Scott Carter, Oklahoma State University, on pig nutrition and phosphorous balance in the feed supply), *available at* <http://www.cast-science.org/9711aba2.htm>.

phosphorous, Tyson Foods is directly causing the source of the pollution (i.e. excessive phosphorous in the litter). Second, Tyson Foods has directly inserted itself into the grower's day-to-day operational decisions about how to control pollution by prohibiting its growers from choosing to use feed-stocks that reduce pollution. Third, Tyson Foods can no longer claim that the actions of the poultry grower are beyond its control because Tyson Foods controls the pollution-causing act (the choice of feed). Finally, Tyson Foods cannot defend against a state requiring co-permitting on the basis that the state is attempting to rewrite the contract related to pollution because Tyson Foods has voluntarily required its growers, by contract or direct supply, to create poultry litter with excessive phosphorous. In other words, the decision by Tyson Foods to go non-GMO may well be simultaneously, even if inadvertently, a decision to accept co-permitting for pollution events from poultry litter. Tyson Foods should carefully consider which is the greater risk: responding to consumer fears about GMO-feeds or accountability for environmental compliance as a co-permitted operator by prohibiting genetically improved corn and soybeans.

The EPA is likely already thinking along the lines outlined in the preceding paragraph. The EPA assuredly realizes that a decision by a company, like Tyson Foods to go non-GMO weakens, and possibly undermines, a company's claim that it is not in substantial operational control of its poultry growers' operations with respect to the specific pollution event arising from poultry litter.[30] Moreover, recall that in the Guidance Manual, the EPA stated that regardless of whether corporate entities are co-permitted, corporate entities should encourage sound environmental practices.[31] By negative implication, the EPA is hinting broadly that if a corporate entity does not encourage sound environmental practices the EPA intends to hold the corporate entity accountable for the unsound environmental practices. Prohibiting pollution-reducing feeds is an unsound environmental practice unless there is a significant offsetting environmental harm from genetically improved reduced-phosphorous feeds.

In addition, the EPA would probably be delighted politically at the decision of a company, like Tyson Foods, to go non-GMO and thereby cause increased pollution in poultry litter. Through the years, the EPA has been very reluctant to enforce environmental regulations against farmers because farmers have politically powerful allies in Congress. Further, farmers benefit from the public's substantial sympathy regarding the potential costs to farmers and the loss of independence to farmers if the EPA targeted agriculture for strict environmental compliance.[32] If

30. Environmental groups opposed to agricultural biotechnology and to corporate agriculture win twice with Tyson Foods' decision to prohibit the use of genetically improved feeds. First, growers cease using agricultural biotechnology thereby causing a serious economic blow to life-sciences companies; second, corporate agriculture becomes accountable for environmental compliance for the additional pollution created when growers abandon agricultural biotechnology. Environmental groups can hardly imagine a better win-win scenario.

31. *See* GUIDANCE MANUAL, *supra* note 22, § 2.4.2.

32. *See* J.B. Ruhl, *Farms, Their Environmental Harms, and Environmental Law*, 27 ECOLOGY L.Q. 263, 328-33 (2000) (noting that farmers may benefit in the portion titled *Farms as a Special Case in Environmental Law — Separating Fact from Fiction*).

the EPA can show Congress and the American public that the costs can justly and sensibly be transferred to large food companies that have forced farmers to engage in polluting practices, the EPA has solved many of its political problems regarding agricultural pollution.

Finally, the EPA very likely realizes that if a company forces a poultry grower to use non-GMO feed that increases pollution in the poultry litter, the EPA has a wedge to drive between the grower and the company. At present, growers want to have the litter as an economic resource. However, if the grower is forced to create an economic liability (i.e. poultry litter with excessive phosphorous) when the grower has the option to create an even more valuable economic resource than presently exists (i.e. poultry litter with reduced phosphorous that more closely matches the fertilizer needs of surrounding farmers), growers may become antagonistic to the company. Growers may join the EPA in demanding that their poultry processors be co-permitted for environmental compliance relating to poultry litter.[33]

The J. R. Simplot Example — Total Maximum Daily Load Exposure

In light of the analysis about Tyson Foods and co-permitting, J.R. Simplot and potato processing companies that impose non-GMO variety requirements upon potato growers are also putting themselves at significant legal risk of being held accountable for their growers' environmental compliance. This legal risk of environmental compliance is in addition to the legal risk of contribution and indemnification described earlier in this article for these contractual terms.

Potato growers are presently facing increased environmental compliance for runoff from fields. The EPA has recently invigorated the Total Maximum Daily Load (TMDL) approach to water quality under section 303(d) of the Clean Water Act.[34] If the EPA is successful in applying the TMDL approach to non-point source pollution[35] (e.g., agricultural runoff), potato growers who want to manage

33. In a recent magazine article, Dermott Hayes, Pioneer Chair of Agribusiness, and Noah Wendt, a student, of Iowa State University, reported on the willingness of livestock producers to pay a premium for genetically improved feedgrains. *See* Dermott Hayes & Noah Wendt, *ISU Analysis Suggests Livestock Producers Unlikely to Pay More for Value-Added Corn*, SEED & CROPS DIG., Dec. 2000, at 20, 27. They reported that the producers' major motivation was economics, meaning that producers were reluctant to pay any premium. *See id.* However, Professor Hayes and Wendt remarked, "If regulations on total phosphorus application were put in place, the animal feeding industries would be forced to use the modified variety or close down. The relatively low costs associated with adding these modified varieties to animal diets suggest that the industry would adopt the modified varieties quite readily." *Id.*

34. *See* GUIDANCE MANUAL, *supra* note 22, § 5.1.

35. The application of TMDLs to non-point source pollution is presently being contested in litigation. For two papers that provide a good introduction to TMDLs in agriculture, see Terence J. Centner, Animal Agriculture: TMDLs, AFOs, and Co-Permitting, Am. Agric. Law Assoc. 21st Annual Meeting and Educational Symposium, Conference Handbook C-1-1 (2000) (on file with author); *see also* Carolyn S. Richardson, The 21st Century Trojan Horse, Am. Agric. Law Assoc. 21st Annual Meeting and Educational Symposium, Conference Handbook C-1-1 (2000) (on file with author). Mr. Centner is a Professor with the University of Georgia College of Agricultural and Environmental Sciences; Ms. Richardson is an environmental attorney for the California Farm Bureau Federation.

their TMDL obligations by growing potatoes that require fewer pesticide applications will assuredly urge the EPA to require their contractors to share the TMDL burdens. The growers will argue to the EPA that their potato processors have contractually forced them to use more pesticides than necessary by requiring non-GMO varieties of potatoes.

Note that for the risk of environmental compliance with TMDLs, the author does not make an argument that McDonald's, Burger King, or Wendy's, as examples of fast-food companies, would be accountable for growers' TMDL compliance. McDonald's, Burger King, or Wendy's do not directly contract with the potato growers and thus are much less likely to exercise substantial operational control over the grower. The key to the risk of environmental compliance is substantial operational control founded upon contractual relationships, unlike tort liability where liability can be imposed so long as a causal connection exits between the harm creating damages and the act alleged to be the source of the harm. In other words, tort liability reaches up the chain from the injury to a source of the injury and to a source of compensation for an injury much further than does environmental compliance. Similarly, Tyson Foods would not be responsible for environmental compliance with TMDLs of farmers growing corn and soybeans, unless Tyson Foods, Inc. creates substantial operational control over these farmers through contracts for an assured source of non-GMO grain as poultry feed.

The Risk of Scientific Ignorance

By the risk of scientific ignorance, the author means the refusal to pay attention to an overwhelming scientific consensus that "such-and-such" is factually true. Overwhelming scientific consensus exists that the earth is not flat.[36] Thus, for example, express mail companies that refuse to send packages to the Orient — out of fear that somewhere beyond Hawaii the planes fall off the edge of the earth — have adopted scientific ignorance as the basis for their business decision.

Seven academies of science issued a report this past summer expressing the overwhelming scientific consensus that, in order to feed the people of the world, scientific discoveries and new technologies (including transgenic plants) must be used.[37] Specifically, these seven scientific academies stated: "Foods can be

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For two concise and clear explanations of TMDLs in agriculture, see Anne Hazlett & Barclay R. Rogers, *District Court Rules Non-point Sources are Included in Listing of Impaired Waterways, Calculation of Total Maximum Daily Loads*, AGRIC. L. UPDATE, Oct. 2000, at 4-7; Anne Hazlett & Barclay Rogers, *New Water Quality Regulations Raise Questions About EPA Influence over Agricultural Practices*, AGRIC. L. UPDATE, Nov. 2000, at 4-7.

36. The fact that a scientific consensus exists does not mean that everyone agrees with the scientific consensus. *See e.g.*, Robert J. Schadewald, *The Flat-Out Truth: Earth Orbits? Moon Landings? A Fraud! Says this Prophet*, SCIENCE DIG., July 1980, *available at* <http://www.lhup.edu/~dsimanek/fe-scidi.htm>. Mr. Schadewald wrote about the International Flat Earth Research Society and its president. *See id.*

37. *See* Report of the Royal Society of London, the U.S. National Academy of Sciences, the Brazilian Academy of Sciences, the Chinese Academy of Sciences, the Indian National Academy of Sciences, the Mexican Academy of Sciences, and the Third World Academy of Sciences, *Transgenic Plants and World Agriculture* (National Academy Press, July 2000) *available at*

produced through the use of GM technology that are more nutritious, stable in storage, and in principle health promoting — bringing benefits to consumers in both industrialized and developing nations."[38]

In a report released in October 2000 by the Irish government, the reporting committee set forth conclusions about the consensus concerning modern biotechnology.[39] Two paragraphs from the conclusion are particularly appropriate to understanding the consensus about agricultural biotechnology.

> Some interpretations of that precautionary principle appear to suggest that, where there is *any* risk or *any* harm to health or the environment, a new product or process should be not approved. This is not a tenable position in our view. There should instead be grounds to believe, on the basis of scientific risk assessment, that there is a real risk of significant harm. Precaution should not be equated with prevention, though application of the precautionary principle is particularly relevant to the management of risk. There are few risk-free activities. As we have seen, conventional agriculture and food production methods — even, some would contend, organic farming — also pose risks to food safety and the environment. Unless we are to have a world marked by stagnation, new innovations and techniques must be pioneered, developed, and tested.
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> Some of the difficulty evident in the public debate over genetic modification stems from the fact that, in this as in other areas, scientists have been unable to offer absolute guarantees that there are no risks of adverse effects. Though science does not deal in certainties, it remains the most reliable and rigorous form of knowledge we have and offers the only possible basis for assessing the safety of new products and processes. While the available scientific evidence suggests that the current applications of biotechnology do not pose a hazard to human health or the environment, this provides no grounds for complacency. There is no guarantee that some future applications of biotechnology will not present more serious risks. However, the likelihood of, and potential exposure to risk can be assessed scientifically. That is why it is essential that all such applications are thoroughly evaluated on the basis of the case-by-case, step-by-step principles which underlie the present regulatory code.[40]

In light of these conclusions by scientific academies and governmental committees, the author posits that the overwhelming scientific consensus about agricultural biotechnology for food and feed is that genetically improved crops can

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<http://www.nap.edu/html/transgenic>.

38. *Id.* at 1.

39. *See Inter-Departmental Group on Modern Biotechnology Report* (Stationery Office, Ireland, 2000) (visited Jan. 26, 2001) <http://www.entemp.ie/biotec.pdf>.

40. *Id.* at 162.

be developed that are safe, nutritious, health-promoting, and environmentally friendly. Food companies that turn their backs on the approved products of agricultural biotechnology adopt scientific ignorance as the basis for their decisions.

The risk of scientific ignorance is ultimately a societal risk, but the risk of scientific ignorance has a facet that clearly implicates legal liability for both damages and environmental compliance.

The Legal Liability Facet

For years, the Food and Drug Administration (FDA) refused to allow irradiation of food products due to consumer resistance based on fears related to radiation. The FDA now allows food companies to use ionizing radiation to kill pathogens such as salmonella.[41]

If food companies ignore the overwhelming scientific consensus that food irradiation creates no toxicological, microbiological, or nutritional problems but does reduce food-borne pathogens,[42] food companies adopt scientific ignorance as the basis for their decisions. Food companies that do so will be held legally liable for illnesses and deaths caused by food-borne pathogens that the company could have prevented through the use of irradiation.[43]

In many ways, the risk of scientific ignorance related to irradiation is similar to the risk of scientific ignorance as applied to agricultural biotechnology. Indeed, one could argue that the risks of going non-GMO discussed earlier in the article — damages and environmental compliance — are simply examples of the legal liability facet of the risk of scientific ignorance. In other words, scientific ignorance is the cause of legal liability for product liability and environmental compliance because courts will impose liability where companies have no defense based on safety considerations. Rather, companies will have to try to defend their imposing product and environmental risks upon society on the basis that they are responding to consumer preferences to avoid genetically modified foods. The problem with this consumer preference defense is that the defense, at least in the United States, is likely to be false. Consumers in the United States are not significantly concerned about genetically improved foods.[44]

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41. *See, e.g.*, Final Rule, Irradiation in the Production, Processing and Handling of Food, 65 Fed. Reg. 45,280-01 (July 21, 2000) (approving ionizing radiation for the control of salmonella in fresh shell eggs).

42. *See* U.S. Gen. Accounting Office, *Food Irradiation: Available Research Indicates that Benefits Outweigh Risks*, GAO REPORTS, THE MONTH IN REVIEW, RCED-00-217 (Aug. 24, 2000) *available via link from* <http://www.gao.gov>, *or directly at* <http://frwebgate.access.gpo.gov/cgi-bin/ useftp.cgi? IPaddress=162.140.64.21&filename=rc00217.pdf&directory=/diskb/wais/data/gao>.

43. The author purposefully does not pursue the labeling issues that immediately come to mind regarding products subjected to irradiation and products not protected by irradiation. Similar labeling issues about agricultural biotechnology products, conventional agricultural products, and organic products are also beyond the scope of this paper.

44. *See* Julianne Johnston, *Survey: U.S. Food Consumption Unaffected by StarLink Fiasco*, AGWEB.COM, Nov. 28, 2000 (on file with author). The news item discusses the survey work on consumer attitudes about genetically improved foods undertaken by Dr. Thomas J. Hoban, Professor of Sociology, North Carolina State University. Professor Hoban presented his research, referenced in the

There is a second legal liability facet of the risk of scientific ignorance that deserves discussion. The EPA has often purposefully set high regulatory standards on the theory that companies striving to meet these standards (and thereby avoid legal sanctions) will invest in research, development, and new technologies that will produce cost-effective ways to reach the regulatory standard. To use terminology common to environmental lawyers, the EPA has used its regulatory authority to adopt regulations that are technology-forcing.[45]

The EPA has approved crop-expressed-protectant plants, such as Bt cotton and Bt corn, for commercialization because these have no significant adverse effect on the environment. The EPA is obviously aware that the United States Department of Agriculture and the FDA have similarly approved the commercialization of many other agricultural biotechnological crops after a finding of no significant adverse impact. Indeed, genetically improved crops very likely contribute positive environmental benefits, among others, by reducing herbicide and pesticide applications on crop lands.[46]

In light of these regulatory approvals for genetically improved crops, the EPA may very well adopt environmental standards that are technology-forcing towards environmentally friendly products of agricultural biotechnology. In the past, the EPA has been very reluctant to heed industry complaints that these technology-forcing standards created huge expenses. There are no obvious reasons why the EPA should pay any greater attention to industry cries that they will suffer huge expenses (flowing from consumer fears of a small, though vociferous, minority of

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news item, in a talk entitled "Consumer Perceptions of Food Biotechnology" to *From Farm to Table: A Food Biotechnology Conference*, sponsored by the American Soybean Association. A copy of Professor Hoban's presentation materials are in the possession of the author.

Even in Europe where agricultural biotechnology has faced greater resistance than in the United States, a European Commission study published in January 2001 concludes that Europeans are neither for nor against GMOs. *See* Sabine Louet, *EC Study Reveals an Informed Public*, NATURE BIOTECHNOLOGY, Jan. 2001, at 15-16.

45. For a brief but informative discussion of technology-forcing regulations, see CELIA CAMPBELL-MOHN ET AL., ENVIRONMENTAL LAW FROM RESOURCES TO RECOVERY §§ 4.1(I),4.2(B) (1993).

46. *See Inter-Departmental Group on Modern Biotechnology Report, supra* note 39, at 74-76, 82-86; *see also* LEONARD P. GIANESSI & JANET E. CARPENTER, AGRICULTURAL BIOTECHNOLOGY: BENEFITS OF TRANSGENIC SOYBEANS (Nat'l Ctr. for Food and Agricultural Policy, Apr. 2000); Fred S. Betz et al., *Safety and Advantages of Bacillus Thurigiensis-Protected Plants to Control Insect Pests*, 32 REG. TOXICOLOY & PHARMACOLOGY 156-73 (2000). For a very cautious view about the environmental impact of transgenic plants, see David E. Ervin et. al., Transgenic Crops: An Environmental Assessment (Winrock International, Nov. 2000), *available at* <http://www.winrock.org/what/wallace_center.asp>.

The author addresses briefly one other environmental concern about Bt crops' — rapid or increased insect-resistance to Bt. In a recent report, scientists reported that pink bollworm resistance against Bt in Arizona cotton fields did not increase between 1997 and 1999. *See* Daily University Science News, *Pest Resistance To Genetically Modified Cotton Not Seen* (visited Jan. 26, 2001) <http://unisci.com/stories/20004/1121005.htm>.

The report from Arizona is identical to the reports from Mississippi and Australia where bollworm resistance to Bt has not increased after several years of widespread, extensive planting of Bt cotton. *See* E-mail from Michael Caprio, Entomologist, Mississippi State University (Nov. 1, 2000) (on file with author); E-mail from Richard Roush, Entomologist, Adelaide University (July 18, 2000) (on file with author).

United States citizens) if the EPA adopts technology-forcing regulations in agricultural biotechnology. Rather, the EPA will more likely adopt genetically improved crops as the best technology available to resolve environmental problems arising from agricultural production. The EPA will promote sound science to solve environmental problems rather than allow food companies to adopt scientific ignorance.

The Societal Risk

The societal risk of scientific ignorance is that society will make, or be forced to make, decisions based on factually unfounded fears or fact-ignoring ideologies rather than upon knowledge gained through the scientific method.[47] If a society is driven by fears or ideologies, it can quickly degenerate into quackery or worse.[48]

Italy is a society in which the Agricultural Minister from the Green Party is attacking agricultural research because Italian agricultural researchers use modern biotechnology. In a petition circulated worldwide requesting public support against the actions of the Agricultural Minister, Italian scientists state:

> Both basic and applied plant research in Italy are being seriously compromised by the current Agriculture Minister, Alfonso Pecoraro Scanio. After having waged a long campaign against the use of modern day genetics in agriculture, he is now attempting to close down any research involving genetically modified organisms (GMOs). . . .
>
> The Italian scientific community should not accept the intimidation tactics of the Minister of Agriculture, which are based on purely ideological prejudices. This message is aimed at scientists and members of the public with the hope of reestablishing conditions in which the freedom of scientific thought is championed. Should this not be a cardinal right of all modern societies?[49]

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47. Our society is not the first society to face the choice between scientific ignorance or fears and the scientific approach to knowledge. For two wonderful books thoughtfully sensitive to these issues, see DAVA SOBEL, GALILEO'S DAUGHTER: A HISTORICAL MEMOIR OF SCIENCE, FAITH, AND LOVE (2000) and MARK POPOVSKY, THE VAVILOV AFFAIR (1984).

For an excellent discussion of the Risk of Scientific Ignorance, said better and said earlier than this article, see Susanne L. Huttner, *Chapter 16: Government, Researchers, and Activists: The Critical Public Policy Interface*, *in* 12 LEGAL, ECONOMIC AND ETHICAL DIMENSIONS BIOTECHNOLOGY: A MULTI-VOLUME COMPREHENSIVE TREATISE 460 (H.J. Rehm et al. eds., 2d ed. 1995). Dr. Huttner is the Director, Industry-University Cooperative Research Program, Life Sciences Infomatics Program, University of California, Berkeley.

48. Two examples of 20th century societies driven by fears and ideology are Nazi Germany with its racial purity laws and the Stalinist Soviet Union with its Lysenkoism (a modernized, ideologically driven version of Lamark's theory of evolution that predated Darwin and Mendel).

49. Petition in Support of Agricultural Biotechnology in Italy (AgBioView listserve, Nov. 9, 2000) (on file with author).

For additional information about the political situation in Italy, see Lone Frank, *Plant Biotechnology: Italian Scientists Blast GMO Restrictions*, 290 SCIENCE 2046 (2000).

Due to the ideology of the Green Party, Italy is at risk not only of falling behind in the rapidly advancing science of biotechnology but also of abandoning the freedom of scientific inquiry. If twenty-first century societies adopt scientific ignorance as a basis for decisions, then scientific method and scientific research are the early victims.

In attending conferences or debates about agricultural biotechnology, one often hears speakers opposed to agricultural biotechnology argue that agricultural biotechnology should learn to respect the species barrier in nature. These ecocentric speakers assert that nature respects species barriers and that nature is speaking profound truths about species barriers to humans, a truth that agricultural scientists refuse to hear because of their arrogance. These speakers assert that nature has an intrinsic value that agricultural biotechnology disrespects.[50]

Nature does not respect species barriers if the word "respect" means that nature does not cross species barriers. Nature does cross species barriers. Crossing species barriers is embraced by what we know as evolution. If twenty-first century societies adopt the risk of scientific ignorance about agricultural biotechnology, evolution as a scientific approach to understanding the living world is another early victim.

Moreover, the empirical claim by ecocentrists that agricultural biotechnology disrespects nature because biotechnology — by crossing species barriers — is different in kind from previous plant breeding techniques is false. Plant breeders have crossed species barriers, even genera barriers, in agricultural crops regularly since the early 1930s, seventy years ago. In an article published in Science magazine in 1987, the magazine authors identified thirty different present-day crops from thirteen different species that involved human manipulation to cross species or genera barriers. These crops are true-breeding crops, meaning that these crops sexually reproduce, just like most other plant and animal species. To name just three of the modern crops created by crossing species or genera barriers, the magazine authors discuss present-day bread wheats, present-day commercial tomatoes, and the post-1950s cereal crop triticale.[51] In other words, to adopt the

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50. For an excellent discussion of this ecocentrism, see COMSTOCK, *supra* note 6, at 199-218. Professor Comstock ends the cited portion of his book with this paragraph:

> We have spent much time investigating the scientific and philosophical foundations of ecocentrism because it is the strongest theory available for justifying the attribution of intrinsic value to nature. We have seen that there are reasons to doubt the scientific foundations of ecocentrism and to be skeptical about its philosophical structure. Therefore, ecocentrism does not provide us with the theory we need to justify belief in [the argument that agricultural biotechnology vexes nature]. In the absence of another theory justifying belief in the thesis that nature is an internally-directed individual with goals of its own, the idea that we could vex nature no longer seems compelling.

Id. at 218.

51. *See* Robert M. Goodman et al., *Gene Transfer in Crop Improvement*, 236 SCIENCE 48-54 (1987). The 13 species that have been crossed beyond species or genera barriers to create crop improvements are oat, sugar beet, swede turnip, pumpkin, cotton, tomato, tobacco, rice, black currant, potato, bread wheat, durum wheat, and maize. *See id.* at 49 tbl.1; *see also* GIDEON LADIZINSKY, PLANT EVOLUTION UNDER DOMESTICATION § 4.4, at 146-54, § 4.5, at 155 (1998).

ecocentrist position that agricultural crops must not be allowed to cross species barriers rules out both modern agricultural biotechnology and many agricultural crop improvements of the past seventy years.

If food companies were to adopt scientific ignorance (as exemplified by the Italian agricultural minister and the ecocentrist position on crossing species barriers), food companies would have simultaneously made two decisions. First, food companies would have decided to abandon food science research and development for new and improved foods. Second, food companies would have to purge a significant number of their products presently sold to consumers.

Food companies again starkly face a dilemma. Companies can bow to consumer fears that are scientifically untenable to gain short-term relief from activist-generated threats of consumer boycott. However, if companies reinforce scientific ignorance and scientific ignorance gains the upper-hand in American society, companies may lose much more in the long term. Bowing to pressures now may preclude the benefits of agricultural biotechnology and related food technologies in the years to come.

It can be persuasively argued that consumer fears are not irrational because consumers do not know the level of risk involved in genetically improved foods. Hence, it could also be argued that companies should honor these consumer fears because, regardless of the scientific correctness of these fears, consumers are always right. By contrast, food companies could decide that the correct response to consumer fears is better, more pervasive consumer education. Moreover, if food companies fail to provide education to consumers, consumer fears may easily become consumer prejudices that unfairly and unjustly place an undeserved onus on agricultural biotechnology. Food companies should strive to avoid becoming guilty of complicity in these consumer prejudices.[52]

See generally DISTANT HYBRIDIZATION OF CROP PLANTS (G. Kalloo & J.B. Chowdhury eds., 1992) (providing an overview of basic and applied as well as classical and molecular aspects of distant hybridization). *Id.*

For a very recent example of plant breeding that crosses species barriers through non-GMO techniques, refer to the work of Joseph Kirkbride and Chen Jin-Feng in creating a cucumber-melon cross. These two plant breeders created this cross-species plant in order to gain disease resistance. *See For the First Time, Scientists Have Crossed A Cubumber with a Melon*, DIVERSITY, No. 3, 2000, at 40.

Other examples of interspecies breeding by non-recombinant DNA techniques include: The King Ranch Santa Gertudis breed of cattle obtained by a cross of Indian cattle (Bos indicus) with European cattle (Bos taurus); beefalo obtained by a cross between European cattle (Bos taurus) and American bison (Bos bison); the Paradox walnut (a walnut timber crop) that Luther Burbank introduced in 1893 after he crossed two distantly related tree species in the walnut family (Juglans californica and Juglans regia); the Shasta daisy that Luther Burbank introduced in 1901 after crossing several different species of daisies; perennial wheat (also called agrotricum) obtained by crossing wheat (Triticum aestivum) with quackgrass (Thinopyrum intermedium); and the oat-maize crosses created by Ronald Phillips, Ph.D. at the University of Minnesota. The author does not cite the numerous works that support these other examples of interspecific crosses but will provide the citations to anyone who requests them.

52. Prior to the Civil Rights Act of 1964, restaurants faced the dilemma of honoring white consumer preferences not to eat with African-Americans due to white fears, long since become prejudices, about their fellow citizens. Civil rights laws eventually disallowed restaurants from honoring these consumer fears/prejudices.

Furthermore, a decision by the food companies to adopt scientific ignorance as the appropriate stance towards agricultural biotechnology raises significant questions as to whether such a decision is morally defensible. "Malnutrition is a disease; the medicine is food."[53] While agricultural biotechnology cannot solve all the problems of hunger and poverty in the world, agricultural biotechnology is very likely a needed and necessary technology to assist in the alleviation of hunger and poverty.[54]

Consumer fears about agricultural biotechnology in Europe, North America, and among wealthy classes in other nations are the fears of those who very likely will never go hungry. However, these same consumers know that they will be ill at times during their lives. When faced with their illnesses, these same European, North American, and wealthy consumers have warmly and openly embraced pharmaceutical biotechnology.[55] As of 1999, the FDA had approved 103 phar-

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USDA, FDA, and EPA regulations adopting genetically improved crops as safe and environmentally friendly may similarly disallow food companies from honoring consumer fears/prejudices, if honoring those consumer fears/prejudices means a categorical rejection of agricultural biotechnology. The last sentence is especially powerful if the EPA adopts genetically improved crops in technology-forcing regulations to address pollution in agricultural production.

53. The author has read the quoted saying several times but does not know the proper attribution.

54. *See, e.g.*, Maarten J. Chrispeels, *Biotechnology and the Poor*, PLANT PHYSIOLOGY, Sept. 2000, at 3-6, *available at* <http://bwg-berlin.de/akb/if_2_1.html>; Anatole F. Krattiger, *Food Biotechnology: Promising Havoc or Hope for the Poor?*, 17 PROTEUS 38 (2000); Martina McGloughlin, Why Safe and Effective Food Biotechnology is in the Public Interest, Critical Legal Issues Working Paper No. 99 (Washington Legal Foundation, Nov. 2000); Nigel J. Taylor & Claude M. Fauquet, *Can the Great Potentials of Biotechnology be Directed Towards Ensuring Food Security and Economic Development in the Developing World?*, 15 FORUM FOR APPLIED RES. AND PUB. POL'Y 3 (2000), *available at* <http://www.agbioworld.org/articles/challenge.html>; Per Pinstrup-Andersen, *A Matter of Life or Starvation: To Ignore Modern Biotechnology as a Possible Solution to Pressing Food Security Challenges Would Be Most Unwise*, BANGKOK POST, Nov. 26, 2000.

See generally G.J. PERSLEY & M.M. LANTIN, AGRICULTURAL BIOTECHNOLOGY AND THE POOR (G. J. Persley & M. M. Lantin eds., 2000) (publishing the proceedings of an International Conference on Biotechnology convened by the Consultative Group on International Agricultural Research (CGIAR) and the U.S. National Academy of Science); *see also* The Nuffield Foundation, *Genetically Modified Crops: the Ethical and Social Issues* (visited Jan. 26, 2001) <http://www.nuffield.org/bioethics/publication/modifiedcrops> (chapter 4, titled "Impact on Developing Countries: Implications for UK Policy"). In Chapter 4, paragraph 4.34, the Council writes:

> So far, proponents of GM crops have made too much of the first issue (claiming that they will lead to big gains for the world's poor, even with the present structure of GM research). Opponents have overplayed the second issue (emphasizing possible dangers, mainly in developed countries). The ensuing debate has neglected the third and most serious issue: the risk that the gains from GM crops will pass the poor by.

Id. ch. 4, ¶ 4.34.

55. A good example of the wealthy preference for pharmaceutical biotechnology while seeking a mandatory moratorium on agricultural biotechnology comes from the German B.U.N.D. (Association for Environment and Protection of Nature). In 1988, the German B.U.N.D. demanded a "prohibition of any genetic manipulation of life forms and viruses. This prohibition includes any research, production and use in this area." In 1990, the B.U.N.D. declared, "The necessary medical-pharmaceutical research and applications without reasonable alternatives can — case by case and including a risk assessment — be excluded from this [the 1988] prohibition." For the B.U.N.D. positions quoted see Dieter Brauer et al., *Chapter 3: Biosafety in rDNA Research and Production*, 12 LEGAL, ECONOMIC AND ETHICAL

maceutical-medical biotechnological products for American consumers. A total of 295 additional pharmaceutical-medical biotechnological products were undergoing human clinical trails in the United States. Hundreds more such products were in the developmental stage. Pharmaceutical companies had developed and deployed hundreds of medical diagnostic tests to detect viruses, pregnancy, and other health conditions.[56]

If food fears of wealthy consumers retard or destroy agricultural biotechnology — which has the potential to provide the poor with their most needed medicine (food) — while these same wealthy consumers embrace the benefits of pharmaceutical biotechnology for their medicines, we will have chosen the risk of selective scientific ignorance with global consequences. Hence, the decision to adopt scientific ignorance about agricultural biotechnology may be unsustainable, politically and morally, on our globe.

Conclusion

Food companies should not respond to food scares about genetically improved crops by hurriedly banning GMOs from their food ingredients. Food companies that do so are placing themselves at significant risk legally and socially. Food companies should respond to food scares with consumer education and consumer reassurance. Anything other than information and calm leadership does a disservice to the consuming public, the company, and to the society in which they exist.

DIMENSIONS BIOTECHNOLOGY: A MULTI-VOLUME COMPREHENSIVE TREATISE 63, 103 (H.J. Rehm et al., eds., 2d 1995).

56. *See* Biotechnology Indus. Org., Bio: Editors' and Reporters' Guide to Biotechnology 1, 18-27 (1998-99), *available at* <http://www.bio.org/aboutbio/guide2000/guide00_toc.html>. Eli Lilly Company used recombinant DNA techniques to create recombinant insulin, Humulin® and Humalog®, that gained FDA approval in October 1982 and June 1996, respectively. These recombinant insulin products have almost completely replaced animal-origin insulin for diabetes.

Recombinant DNA-derived vaccines are in various stages of development; the first, against Hepatits B, was approved by the FDA in 1986. A novel delivery system for recombinant vaccines that has been tested successfully is gene-spliced vegetables or fruits modified to synthesize an antigen that confers immunity to a certain target disease(s). These offer the advantage of oral administration of vaccines, which is especially attractive in parts of the world where transportation. refrigeration of pharmaceuticals and availability of disposable syringes are difficult. These vaccines might, for example, be administered orally as a reconstituted, extremely stable potato or tomato powder. *See DNA Techniques May Improve Immunization*, NORMAN TRANSCRIPT, Nov. 26, 2000, at D9; *see also Common Potato Packs Vaccine Punch, Study Finds*, NORMAN TRANSCRIPT, Dec. 10, 2000, at B8. These edible vaccines are but one example of a broad array of genetically modified medicines that are beginning to emerge from what is commonly called "pharming," the use of plants and animals to produce pharmaceuticals. *See generally* Rima Menassa et al., *Green Drug Factory Not Far Afield*, ISB NEWS REP., Dec. 2000, at 4-5, *available at* <http://www.isb.vt.edu/articles/dec0002.htm>.

In February 2001, the Biotechnology Information Institute, <www.biopharma.com>, will publish *Biopharma: Reference Book Concerning Bio-pharmaceutical Products*. The December 1, 2000, press release about the impending publication stated that the book would present approximately 300 entries concerning marketed bio-pharmaceutical products for medical, research, and industrial uses.