Impacts of Genetically-Modified Crops and Seeds on Farmers

Prepared by David Kruft, Legal Research Assistant
November 2001

I. Introduction

The agriculture industry has traditionally been supportive of technological advancement, particularly in the field of genetic crop improvement.[1] For decades, the industry has been mixing naturally the genetic traits of seeds in the search for particularly robust varieties.

Genetically-modified (GM) seeds are a significant step forward in the production of agricultural crops. GM seeds are seeds that have been modified to contain specific characteristics such as resistance to herbicides (in the case of "Roundup Ready" products) or resistance to pests (in the case of Bt corn). But the method of modification used with GM seeds varies from the traditional method in an important respect: the genes have not been modified over generations of cross-fertilization, but rather inserted directly into the DNA of the seed.[2] Although this method is more efficient, critics fear that the result — a "novel gene combination" — may have health or environmental impacts that are not being adequately addressed.[3] As a result, the technology is surrounded by significant controversy.

The reaction of farmers to this new technology has been mixed. Some farmers have quickly adopted the technology.[4] Other farmers, mindful of the controversy surrounding GM products, have hesitated to use GM seeds as part of their agricultural operations.

Farmers should understand both the benefits and concerns that are raised by the use of GM seeds. Benefits of the technology include increased crop yields, diminished use of pesticides and herbicides, and increased profits. Concerns that farmers should address before adopting the technology include the private contractual relations between farmers and seed companies, the environmental impacts of the technology, and the potential impacts of consumer concerns (both domestic and international) on the market for GM products.

This paper describes the benefits that GM seeds can provide to farmers, as well as the concerns that farmers should address before utilizing these seeds. It is intended only as a general introduction to these benefits and concerns. The information contained in this paper should not be considered legal advice.

II. Benefits

A. Increased crop yields

There is an expectation widely held by those in agriculture that GM seeds will increase

the yields of farmers that adopt the technology. Although there is not yet a large volume of research regarding the impact of biotechnology on crop yields and returns, the research that is available supports this expectation.

In a study using 1997 data, the Economic Research Service (ERS) found a statistically significant relationship between increased crop yields and increased adoption of herbicide- and pesticide-tolerant crop seeds.[5] The ERS study found that crop yields "significantly increased" when farmers adopted herbicide-tolerant cotton and Bt cotton.[6] The use of herbicide-tolerant soybeans resulted in a "small increase" in crop yields.

Another study performed by Iowa State University found that Bt crops out-yielded non-Bt crops. The university studied 377 fields and estimated that crops grown from GM seeds yielded 160.4 bushels of Bt corn per field, while crops grown from non-GM seeds yielded 147.7 per field.

B. **Fewer applications of pesticides and herbicides**

Similarly, farmers expect that, as adoption of GM seeds increases, the use of chemical pesticides and herbicides (and the costs associated with their application) will decrease. Again, the research that is available generally supports this expectation.

The study by ERS found a decrease of pesticide and herbicide use when farmers adopted GM seeds. The decrease in pesticide use was significant.[9] This decrease in herbicide use was also significant (except for the herbicide glysophate, for which the research revealed a significant increase).[10]

Other studies have not found a clear connection between the use of GM seeds and decreased chemical use. For instance, the Iowa State University study discussed above found that farmers' use of pesticides on GM crops remained "surprisingly large." Farmers applied pesticides on 18% of non-GM crops and 12% of GM crops.[11]

C. **Increased profits**

In general, studies indicate that farmers' profits increase as they adopt GM seeds. The ERS study found that in most cases there is a statistically significant relationship between an increase in the use of GM seeds and an increase in net returns from farming operations.[12] For example, the service found that, on average, GM soybean crops produced a net value of $208.42 per planted acre, while other crops produced a value of $191.56 per planted acre.[13] The service also found a "significant increase" in net returns for herbicide-tolerant cotton crops and Bt cotton crops.

Other studies have reached similar results. Studies in Tennessee and Mississippi found higher returns from herbicide-resistant soybeans than from conventional

soybeans. A North Carolina study indicated that GM soybeans yielded $6 more per acre than traditional varieties.[14]

III. Concerns

A. Contractual issues

The contracts that seed companies require that buyers of their GM seeds sign when obtaining those seeds may disadvantage farmers. Seed companies have invested significant funds in the research and development of GM seeds, and they protect this investment through their contracts with agricultural growers.[15] These contracts aggressively protect the biotechnology company's rights to the seeds, frame the context within which disputes may be settled, and limit the liability of the company.[16]

1. **Limited rights to retain and reuse seed**
   Under a private contract between a grower and a biotech company, the grower's rights to the purchased seed are significantly limited. Such contracts generally contain a "no saved seed" provision.[17] This provision prohibits growers from saving seed and/or reusing seed from GM crops.[18] In effect, the provision requires growers of GM crops to make an annual purchase of GM seeds.

   A patent infringement case stemming from unauthorized saving of GM seeds was recently tried in the Canadian courts.[19] In this case, Monsanto Company sued Percy Schmeiser, a local farmer, for saving and planting GM seeds produced from pollen that had blown onto his fields from a neighboring farm. Schmeiser himself had no contract with Monsanto. The court found that the defendant planted seed saved from a field onto which pollen from GM canola had blown. The court found further that Schmeiser had engaged in these activities knowingly. This violated the patent Monsanto held on the Roundup tolerant seed. Mr. Schmeiser was required to deliver to Monsanto any remaining saved seed and to pay to Monsanto the profits earned from the crops, plus interest.[20]

2. **Binding arbitration**
   Often contracts between seed companies and private growers contain a binding arbitration clause that requires all conflicts arising from performance of the seed (or technological traits within the seed) to be resolved through arbitration.[21] This binding arbitration clause precludes farmers from filing lawsuits.

   Additionally, the farmer is constrained in terms of the time frame within which he must raise a dispute. Under the contract, the grower is typically given as little as 15 days from the day that the problem is first observed to file a complaint with the seed company.[22]

3. **Acceptance of limited liability**
   Contracts between seed companies and farmers sometimes contain a clause that limits the "liability of [the seed company] to or any seller for any and all losses, injury or damages resulting from the use or handling of a product containing [the seed company's] gene technology shall be the price paid by the grower for the quantity of such product involved, or at the election of [the seed company] or any seller, the replacement of such quantity. In no event shall [the seed company] or any seller be liable for any incidental, consequential, special or punitive damages."[23] Under such a clause, if the use of GM seed has a negative impact on another aspect of the farmer's operations, this clause precludes the farmer from recovering any damages from the company in the event the use of the product causes harm.

B. **Environmental Concerns**

1. **Development of resistant weeds and insects**
   Farmers may worry that their use of GM seeds will create "superweeds" or "superbugs" that, over time, become resistant to GM seeds and crops and to other herbicides and pesticides. There is some research that suggests that weeds and bugs could possibly evolve into resistant organisms. Gene movement from crop to weed through pollen transfer has been demonstrated for GM crops when the crop is grown near a closely related weed species.[24] Similarly, insects have, in the past, developed a resistance to pesticides. A recent study documented a decreased susceptibility in pests to the use of Bt as a sprayed pesticide.[25]

   One particular strategy that has been developed to prevent the growth of pests resistant to GM seeds is "refuge areas." These areas are swaths of land, planted with non-GM crops, which act as refuges for the pests. Pests migrate to and remain in these areas, where they eat and breed. Since the refuge area offers the pest adequate food, the pest has no need to become resistant to GM crops, and thus the bulk of the crop is protected. The use of refuge areas is now mandated by the EPA.[26]

2. **Difficulty of preserving the identity of non-GM crops**

   Identity preservation in the field

   Potential cross-pollination of GM seeds onto non-GM crops is also a concern to farmers, particularly those farmers that certify their crops as non-GM crops or organic crops. There is evidence that such cross-pollination is already occurring.[27] Plants with GM characteristics have been found in conventional crops as well as in crops that have been grown using only organic farming practices.[28] Tests performed by Successful Farming magazine found evidence of cross-pollination in both corn and soybean crops.[29]

Cross-pollination raises the question of whether farmers planting GM crops are liable to their non-GM neighbors for pollen drift. Traditionally, farmers have not been liable for pollen drift onto neighboring properties. However, farmers have been held liable under a theory of negligence for pesticide use (including use of the pesticide Bt) if the drift from that pesticide encroaches on neighboring lands.[30] It remains to be seen whether pollen drift from Bt corn and other GM crops will be found by the courts to be actionable. Observers of the GM industry have suggested that a cause of action may be pled under the theory of trespass or negligence, or by analogizing the GM pollen drift to pesticide drift.[31]

Identity preservation from field to market

Another concern for farmers who are not currently planting GM crops is preserving the identity of their non-GM crops as those crops move from farm to market. Currently, bulk agricultural trading facilities are not able to separate GM crops from traditional crops.[32] Shipments of corn and soybeans originating at these facilities cannot be guaranteed as "GM-free."

The importance of preserving the integrity of agricultural crops was highlighted recently when Starlink corn was found in taco shells distributed through a national company and in a corn product used by the brewing industry.[33] Starlink corn has not been approved for human consumption. Although a recent study found no allergic reactions that could be traced to consumption of the Starlink products,[34] the larger question — how the agricultural industry can accurately segregate GM from non-GM produces — remains unanswered. The inability to segregate crops may lead to a situation where all products are de-valued (particularly in the international market, as discussed below) because they cannot be certified GM-free.

3. **Harm to other organisms**

Another concern centering on impacts of biotechnology is possible harm of GM seeds and crops to other, beneficial organisms. Very little research exists to support this concern. A study performed at Cornell University received significant publicity. This study indicated that a gene contained within Bt corn can be harmful to the larvae of a monarch butterfly when windblown onto milkweed leaves. But subsequent research has indicated that the actual level of Bt on milkweed plants in a real-life scenario do not reach the levels that produce a toxic results in the larvae.[35]

In fact, this later research suggests that the impact of Bt corn when genetically placed in the corn is far less damaging to non-target insect populations than spraying pesticides.[36]

C. Concerns in marketing GM and non-GM products

1. Potential loss of domestic markets due to uncertainties

Although the domestic market has generally responded positively to GM products, farmers fear that the uncertain effects of the products may "spook" domestic consumers.[37] This uncertainty is grounded in the lingering public perception that GM crops pose a hidden health risk to humans and that these crops are not being adequately regulated at the federal level.

Uncertainties concerning human health risks

Critics say that the effects of GM products on human health are not yet fully known. The largest threat to health is the presence of unknown allergens in the GM food supply. There is some evidence that humans who respond to allergens will respond similarly to that allergen when it is transferred to another organism. For example, a recent study found that people allergic to nuts reacted to GM soybeans into which a protein from a Brazil nut had been inserted.[38]

Overall, however, there is little evidence that GM crops pose a significant health hazard to consumers. The Centers for Disease Control recently concluded a study in which it found no connection between a processed food that contained a GM product and claimed allergic reactions.[39]

In addition, most observers of the GM industry recognize that the domestic market has consumed GM products for years and, thus far, there have been no accompanying health impacts.[40] Nor can Americans stop consuming these products. The large-scale adoption of GM crops, combined with the accidental "drift" of GM seeds into supposedly non-GM fields has left the domestic user with little choice but to consume GM crops.[41]

Uncertainties concerning the adequacy of regulatory safeguards

Critics of the GM industry claim that the domestic regulatory framework is fragmented and uncoordinated. The regulatory safeguards currently in place in the United States are enforced through three federal agencies: the Environmental Protection Agency (which regulates pesticides, particularly in their application to crops), the Food and Drug Administration (which sets standards for food), and the Department of Agriculture (which also sets standards and continuously inspects meat and poultry products). Proponents of this system suggest that this three-tiered approach provides accountability at several levels. Opponents of the current system state that

this fragmented approach weakens the efficacy of the regulatory scheme and allows some products to fall through the cracks.

Certainly, the largest controversy surrounding the regulation of GM foods has been labeling. Currently, the FDA requires labeling only when the food product has been changed in its composition, safety, or nutritional quality. FDA regulates the product, not the process by which that product is created. Biotechnology companies argue that, because GM foods are ultimately comprised of the same nutritional contents, the majority of these foods need not be labeled.[42] Whether domestic consumers will demand that GM foods be labeled — or refuse to consume these foods until they are labeled — remains to be seen.

2. **Current problems with international markets**

GM crops are not universally accepted throughout the international market. Trading blocs such as the European Union (EU) have banned the import of crops with inserted genes, citing concerns about human health and the environment.[43] The EU has thus far not been forced to accept GM crops because it has other sources of supply rather than the United States. Brazil, for example, does not allow the use of GM crops, and remains a viable source of supply for those countries that will not import GM crops.[44]

The hesitancy of the United States' international trading partners to accept GM crops impacts the marketability of these crops. With good reason, farmers fear losing the ability to sell commodities to these partners. The financial impacts have been significant. In 1996, American exports of corn and soybeans to the EU totaled $3 billion. In 2000, these exports had dropped to $1 billion.[45] Further actions on the part of the EU to regulate American imports may have a further impact on farmers.[46]

IV. Conclusions

Perhaps the only conclusion to be drawn from a consideration of the benefits and concerns raised by GM seeds is that neither full-scale adoption nor full-scale rejection is a viable option. The technology may be more appropriate for farmers that have difficulty spraying pesticides and herbicides. GM seeds may work well for farm areas that are inaccessible to tractors or close to water bodies, or in places where winds are high.

Conversely, GM seeds may be least appropriate for farmers who are particularly reliant on a stable market. The uncertainty surrounding consumer acceptance of GM products, particularly in foreign markets, is a risk that may simply be unacceptable to some farmers.

Certainly, GM seeds are a revolutionary technology in the agricultural industry. Certainly, too, the potential benefits of these seeds promise to be considerable. But an uneducated acceptance of this technology by farmers is not the proper response. The technology of GM seeds and the attendant legal issues raise concerns that may work against an individual farmer. The best response of every farmer is to educate himself about this technology and to carefully read all legal documents before deciding to plant GM seeds. It is hoped that this paper might be a tool in that education process.

---

[1]U.S. Department of State, *Frequently Asked Questions About Biotechnology* (March 21, 2000).

[2]See U.S. Department of State, footnote 1 above.

[3]Union of Concerned Scientists, *Fact Sheet: Risks of Genetic Engineering* (2000).

[4]*Talk of the Nation: Science Friday*, National Public Radio broadcast (May 21, 1999).

[5]Economic Research Service, United States Department of Agriculture, *Genetically Engineered Crops for Pest Management* (2000).

[6]See Economic Research Service, footnote 5 above. The service defined a "significant increase" as a one to five per cent increase in crop yield for each 10 per cent increase in a farmer's use of GM seeds.

[7]See Economic Research Service, footnote 5 above. A "small increase" was defined as a less than one per cent increase in crop yield for each 10 per cent increase in a farmer's use of GM seeds.

[8]Dan Miller, *Do GMOs Pay?*, Progressive Farmer (August 2000). However, the study determined that, after increased costs of using GM seeds were accounted for, the profits derived from this increased yield was less significant than the increase in the yield itself.

[9]See Economic Research Service, footnote 5 above. A "significant increase" was defined as a one to five per cent decrease for each 10 per cent increase in a farmer's use of GM seeds.

[10]See Economic Research Service, footnote 5 above.

[11]See Dan Miller, footnote 8 above. The study also found that the cost of applying pesticides on GM crops cost farmers more than applying pesticides on non-GM crops by more than $2.50 per acre. Similarly, applying herbicides to GM crops cost farmers $3.00 per acre more than applying herbicides to non-GM crops.

[12]See Economic Research Service, footnote 5 above.

[13]See Economic Research Service, footnote 5 above. These returns are net costs of chemical applications. Gross value of GM crops was $258.12 per planted acre; gross value of non-GM crops was $239.78 per planted acre.

[14]See Dan Miller, footnote 8 above.

[15]Of course, the seed companies also protect their investment by applying for and litigating patent rights. Patenting plant genes is an area of the law currently in flux. See John R. Thomas, *May Investors Obtain Utility Patents on Plants?, Preview of United States Supreme Court Cases.* Seed companies protect these patents in the context of relations with individual growers by relying on their contractual relations with each grower.

[16]Eva Ann Dorris, *Monsanto Contracts: To Sign or Not To Sign*, Mississippi Farmer (December 1, 2000).

[17]Neil Hamilton, *Legal Issues in Biotechnology*, proceedings from annual meeting of the American Agricultural Law Association (2000).

[18]See Neil Hamilton, footnote 17 above.

[19]Monsanto Company v. Schmeiser Enterprises, Ltd.

[20]Monsanto Company v. Schmeiser Enterprises, Ltd. If the parties could not agree on the "quantum of profits," the court stated, Schmeiser would have to pay $15,450 to Monsanto.

[21]See Eva Ann Dorris, footnote 16 above.

[22]See Eva Ann Dorris, footnote 16 above.

[23]See Eva Ann Dorris, footnote 16 above. Dorris was quoting from a contract from Monsanto Company.

[24]Colorado State University, *Transgenic Crops: An Introduction and Resource Guide* (http://www.colostate.edu/programs/lifesciences/TransgenicCrops/risks.html).

[25]See Colorado State University, footnote 24 above.

[26]Steve Cocheo, *GMO Issue Rolls On*, ABA Banking Journal (February 2000).

[27]David Barboza, *As Biotech Crops Multiply, Consumers Get Little Choice*, New York Times (June 2001).

[28]Mike Holmberg, *I-P Crops: Mission Impossible; Problems in Producing Non-genetically Modified Identity-Preserved Crops*, Successful Farming (February 15, 2001).

[29]See Mike Holmberg, footnote 28 above. The presence of GM characteristics in soybean plants was within limits of most production contracts (approximately 1%). But the presence of these characteristics in soybeans were also more surprising to the researchers, since soybeans are self-pollinating and thus considered less susceptible to pollen drift.

[30]Robert Blomquist, *Toward Reconceptualizing Liability to Neighbors for Crop, Livestock, and Personal Damages from Agricultural Chemical Drift*, Oklahoma Law Review (Summer 1995).

[31]Neil Hamilton, *Legal Issues Shaping Society's Acceptance of Biotechnology and Genetically Modified Organisms*, Drake Journal of Agricultural Law (Spring 2001).

[32]See U.S. Department of State, footnote 1 above.

[33]Associated Press, *Biotech Corn Discovered in Beer Product*, Washington Post (January 13, 2001).

[34]Andrew Pollack, *U.S. Finds No Allergies to Altered Corn*, New York Times (June 14, 2001).

[35]See Colorado State, footnote 24 above.

[36]Colorado State, U.S. Department of State

[37]David Barboza, *Redesigning America*, New York Times (March 17, 2000).

[38]See Colorado State University, footnote 24 above.

[39]See Andrew Pollack, footnote 34 above.

[40]See Colorado State University, footnote 24 above. Almost half of the U.S. soybean crop and twenty five percent of the U.S. corn crop is of a GM variety.

[41]See David Barboza, footnote 27 above.

[42]See Neil Hamilton, footnote 17 above.

[43]Alan Sipress and Marc Kauffman, *U.S. Challenges EU's Biotech Food Standards*. Washington Post, (August 26, 2001).

[44]See Neil Hamilton, footnote 17 above.

[45]See David Barboza, footnote 35 above.

[46]See Alan Sipress and Marc Kauffman, footnote 41 above.

The Agricultural Law Resource and Reference Center
The Dickinson School of Law of the Pennsylvania State University
150 S. College Street
Carlisle, PA 17013
717-241-3517
E-mail: aglaw@psu.edu