RESTRAINTS ON COMPETITION THROUGH THE ALTERATION OF THE ENVIRONMENT AT THE GENETIC LEVEL

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INTRODUCTION

Human beings have bred crops and livestock selectively to produce desired strains for over ten thousand years, but we have just recently gained the ability to alter the traits of species directly at a genetic level.[1] This new ability is a tremendous advancement over the process of selective breeding. Selective breeding contains a more limited set of options, since offspring can only exhibit traits that are possible products of the parents' genes and random mutations.[2] Genetic engineers can now insert genes that encode for the traits of one species into another species, a technology known as recombinant DNA.[3] This allows scientists to produce traits in a species that could not be obtained with a thousand years of breeding. Some commercial uses of this technology have included placing genes from fish that encode for a natural antifreeze into tomatoes to make them more resistant to frost, and placing genes that code for pesticides into potatoes

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[1] *See* SHELDON KRIMSKY & ROGER P. WRUBEL, AGRICULTURAL BIOTECHNOLOGY AND THE ENVIRONMENT: SCIENCE, POLICY AND SOCIAL ISSUES 9 (1996). *See generally* HRH the Prince of Wales, *Seeds of Disaster*, 28 THE ECOLOGIST 252 (1998) (likening genetic engineering to playing God).

[2] *See* Horace Freeland Judson, *A History of the Science and Technology Behind Gene Mapping and Sequencing*, *in* THE CODE OF CODES 37 (Daniel J. Kules & LeRoy Hood eds., 1992).

[3] *See id*.

to achieve greater resistance to insects than the periodic spraying of the same pesticides.[4]

The use of recombinant DNA technology creates new risks of harm that society has not been forced to encounter before.[5] The consumption of these crops may cause health problems for humans or livestock. The examination of these possible health risks is beyond the scope of this paper, but they are substantial and have received much attention in the media.[6] One such hazard is that because evolutionary processes are not static, the altered biological products that farmers introduce into the environment can further evolve and can cause other organisms in the environment to evolve in harmful ways. For example, pest species may become resistant to the adaptations of genetically modified organisms, such as the ability to produce pesticides, and become a greater nuisance as the techniques farmers use to combat them begin to fail.[7] Genetically altered organisms could also affect the evolution of other species through pollination. Individual members of a species can pollinate each other to produce offspring with the traits of the genetically enhanced parent, and members of related species may pollinate each other and exchange genetic information.[8] As beneficial traits are passed from crop species to weed species, farmers will incur greater costs in combating these "super weeds."

Recombinant DNA can produce drastic changes to the environment in a very short period of time. Once the technology escapes, we cannot take it back. The focus of this Article is to explore how competition law may provide recourse to farmers who do not use genetic modification, for injuries suffered from the evolution that stems from altering the environment through recombinant DNA technology. The type of harm focused upon primarily is the effect upon the farmers who reject growing genetically modified crops from having those crops placed into the environment. Society must adapt to create a framework for allo-

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[4] *See* Michael Pollan, *Playing God in the Garden*, N.Y. TIMES, Oct. 25, 1998, § 6 (Magazine), at 44.

[5] *See id.* (biological pollution is different from chemical pollution since, in many cases, chemical pollution can be reversed).

[6] *See id*.; Marie Woolf, *Revealed: Risks of Genetic Food*, INDEPENDENT, Dec. 13, 1998, at 1.

[7] *See* Pollan, *supra* note 4, at 44.

[8] *See* Stephen Kelly Lewis, "*Attack of the Killer Tomatoes?" Corporate Liability for the International Propagation of Genetically Altered Agricultural Products*, 10 TRANSNAT'L LAW. 153, 165 (1997).

cating the costs of these harms. The issue will be viewed as one of unfair competition practiced by biotechnology-producing firms, where they alter the environment in harmful ways with the result of squeezing out of their "organic" competitors (farmers who do not grow crops produced through genetic engineering).[9] To place this issue into the greater context of an antitrust debate over the manipulation of environments, the Article will compare the alteration of natural environments by biotech firms to the alleged predatory practices of Microsoft through its manipulation of an artificial environment. The similarities between the two situations will illustrate the propriety of using competition laws in the future as a means of preventing biotech firms from altering the environment to the detriment of their competitors.[10]

I
BACKGROUND

There is great debate as to whether there is any need for this technology, and whether the world population will be fed through more traditional agricultural techniques.[11] The proponents of using genetic engineering to alter agricultural products claim that this technology will enable farmers to feed the growing world population more efficiently.[12] Some claim that traditional farming techniques will fail to feed the world's population as it grows. To date, there are about eighteen billion dollars' worth of genetically engineered crops grown each year.[13] The United

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[9] For the sake of simplicity, this Article will refer to non-genetically altered crops as "organic." However, this does not assume that the farmers refrain from using chemicals on their crops. In some states farmers must refrain from using chemicals on their crops in order to label produce as "organic."

[10] In certain markets and industries, such as credit card networks and computer operating systems, each user gains value when other compatible users enter the market.

[11] *See* KRIMSKY & WRUBEL, *supra* note 1, at 22; Andrew Kimbrell, *Why Biotechnology and High-Tech Agriculture Cannot Feed the World*, 28 THE ECOLOGIST 294 (1998) (arguing that food production is great enough to feed the world population, and that starvation is most often caused by deficiencies in distribution, rather than production); Mae-Wan Ho, *The Inevitable Return to a Sane Agriculture*, 28 ECOLOGIST 318 (1998) (citing Cuban studies in which fully organic fields of crops produced equal yields to those grown with a reliance on agrochemicals).

[12] *See Biotech Basics* (visited Apr. 20, 2000) <http://www.biotechbasics.com>.

[13] *See* Charles Arthur, *It's Hard to Swallow*, INDEPENDENT, Dec. 13, 1998, at 21.

States government currently subsidizes the prices on many agricultural products by paying farmers not to grow crops on their land. This illustrates that farmers can meet current worldwide demand. Farm subsidies have created an unusual non-market system, where many of the efficiency gains made by farmers through the use of technology are not necessarily passed along to the consumers. Therefore, it is difficult to assess whether consumers have gained anything in exchange for accepting the risks associated with genetically modified agricultural products.[14] Thirteen genetically engineered crops were commercially cultivated in 1997.[15] There is great debate as to whether these crops have lived up to the hopes of genetic engineers, and whether they ever will.[16] What is certain is that the growing of genetically engineered agricultural products will increase.

II
Genetic Responses to Environmental Change

The theory of evolution proposes that species evolve to be better fit to their environments through differential rates of survival and reproduction.[17] Those species that have traits (or adaptations) that serve them well in their environment are less likely to die than others in the same environment that do not have that favorable adaptation. Those individuals who are better fit to the environment are more likely to survive and are therefore able to reproduce. Through this mechanism, traits that are beneficial to the individual are inherited by some of the offspring, who are then weeded out by these same natural selection processes.

Evolution should result in a strain of the species in which the members display the favorable adaptations. If a segment of the population of a species becomes isolated, it is possible for those members to evolve independently to become a unique, distinct species. A metaphor that has been used to illustrate this process

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[14] Under the precautionary principle, which has gained some support as an international legal principle, entities should not postpone taking precautions against risks that are not yet certain.

[15] *See generally* Joseph Mendelson, *Roundup: The World's Biggest-Selling Herbicide*, 28 Ecologist 270 (1998) (stating that 36 genetically engineered whole foods have been patented).

[16] *See id.* at 273 (noting that the first year's crop of Roundup-Ready cotton had many problems, sparking complaints, arbitration and settlements in several states).

[17] For an explanation of basic genetics, see Edward O. Wilson, Diversity of Life 51 (1992).

is that of the selfish gene. Each individual gene attempts to proliferate by reproducing (through the organism of which it is a part), resulting in larger numbers of offspring with the gene. These offspring compete, through differential rates of survival and reproduction, with organisms that do not contain the gene. The stronger strain survives at higher rates than the weaker strain, and all members of the species eventually display the favorable adaptation for which the gene encodes.

The vast majority of adaptations do not create organisms that are beneficial to the organism in surviving in the environment. Some are benign, but others are harmful to organisms that display the trait. It is possible that many of the adaptations, such as the production of specific chemicals by the organism, will harm the modified individuals. The production of extra chemicals by an organism requires energy and other scarce inputs, and may prove to be detrimental under conditions of extreme weather or disease.[18] Genetic engineers attempt to create adaptations that are favorable, but these crops have not undergone the thousands of years of evolutionary testing that more traditional strains have.

Environmental conditions are not static. Species are constantly evolving in response to the changes in environment. The evolution of the predators or prey of a species, or the evolution of another type of organism that competes for the same resources as the first species, can provide especially strong selective pressures. Since species evolve as a result of selective forces in nature, building a better mousetrap should result in the breeding of a better mouse, one that is able to defeat or avoid the new trap. If the species does not evolve in response to a strong selective pressure, the extinction of the species becomes more likely.[19] The producers of biotechnology have altered agricultural species to give them traits that create advantages over their competitors, and this will at least in theory cause the competitors in the environment to evolve. It is possible that pest species could be rendered extinct by aggressive pesticides, but as is illustrated by man's efforts to eliminate pests such as termites and rodents, it is unlikely that humans could defeat a hearty insect species such as the potato beetle. It is much more likely that the overuse of

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[18] *See* SHELDON KRIMSKY, BIOTECHNICS & SOCIETY 138-39 (1991).

[19] For example, when non-native species of fish are introduced to lakes and rivers, many native species are eliminated from the body of water.

chemical pesticides will make the species more resistant to the overused pesticides.

Many of the problems that the genetically altered strains attempt to solve stem from the fact that monocultural farming on large plantations defeats many of the protections that plants utilize in natural environments. Monofarming is the technique that attempts to grow the same single crop on the same land year after year. Pest species may gain a stronghold since their habitats are not disrupted by crop rotation. Growing the same crops year after year places a heavy demand on the same resources each year. This forces farmers to use artificial means of replacing the natural protections that they destroy through monofarming. Some of these artificial means have included the use of fertilizers, pesticides and herbicides, and more recently the alteration of crop species at a genetic level. Corporate farmers claim these large plantations are able to produce most efficiently due to economies of scale, but evidence has shown that medium-sized farms are the most efficient and produce fewer environmental externalities, such as erosion, than their larger counterparts.[20] Below, this Article provides examples of the different ways in which genetic engineers are altering species and environments. It then describes the potential for harm as a result of the evolution of other species in the environment.

A. *Pesticide-Producing Potatoes*

The Monsanto Corporation has developed and marketed an enhanced strain of potato called the NewLeaf by inserting a gene into potatoes that encodes *Bacillus thuringiensis (*Bt) in every part of the potato for the production of the pesticide.[21] The pesticide Bt is currently one of the most popular pesticides that farmers spray to prevent the destruction of their potatoes by the potato beetle. Bt is a natural product of a strain of bacteria, and biologists were able to place the genes that encode for the chemical into the genome of the potato.[22] Allowing the potatoes to produce their own pesticides is cheaper and more effective than spraying the crops since the potatoes will maintain consistently

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[20] *See* Kimbrell, *supra* note 11, at 295.

[21] *See* Pollan, *supra* note 4, at 44.

[22] *See* Michael G. Koziel et al., *Transgenic Plants for the Control of Insect Pests*, *in* AGRICULTURAL BIOTECHNOLOGY 283, 285 (Arie Altman ed., 1998).

high levels of Bt without the costs of purchasing or administering the chemicals.

One source of potential harm from these pesticide-producing potatoes is that the pest species that Bt now controls will likely become resistant to Bt.[23] This should (at least in theory) occur when selective pressures upon the pest species increase as a result of higher Bt levels in the environment.[24] In our current environment, Bt kills many of the individual beetles that attempt to feed on the potatoes, but many other members of the pest species survive. Some of the survivors have a heightened genetic resistance to Bt, while others just fortuitously feed upon leaves that do not contain high levels of Bt. Both types of survivors encounter each other in the natural environment and the two types of individuals interbreed. Selective pressures will tend to favor individuals with higher tolerance to Bt, but since they interbreed with individuals that have a low tolerance, it will take many generations and many years for the proliferation of a strain that is too highly resistant to Bt for the pesticide to be useful.

When farmers grow the genetically enhanced potato, there are much greater concentrations of the chemical in the environment and, therefore, a much lower chance that low-tolerance individuals will survive long enough to breed with highly resistant individuals. Highly resistant individuals will mate more often, producing a greater number of resistant individuals.[25] This will greatly hasten the process by which a strain that is immune to Bt will be produced.[26] Experts have estimated that the life span of Bt will be reduced from about 30 years to only a few years with the widespread farming of the Bt-producing potatoes.[27] Corn (maize) plants have also been given the ability to produce Bt,

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[23] *See* Pollan, *supra* note 4, at 48.

[24] *See id.*

[25] *See id.* at 6-50.

[26] *See* Brian Tokar, *Monsanto: A Checkered History*, 28 THE ECOLOGIST 254, 259 (1998). *See also* Koziel et al., *supra* note 22, at 291. Resistance to Bt has been produced in the laboratory and in controlled field experiments. It has also been predicted with computer models, but these models are sensitive to the assumptions relied upon.

[27] *See* Union of Concerned Scientists, *EPA Requires Large Refuges*, THE GENE EXCHANGE, Summer 1998, at 1, *cited in* Tokar, *supra* note 26, at 259 (citing the U.S. Environmental Protection Agency).

illustrating the widespread use and reliance upon this pesticide in the agricultural industry.[28]

Pests may not simply become immune to Bt, but may also become highly resistant to all similar chemicals, a phenomenon known as cross-tolerance. When resistance occurs, the biotech companies that license the enhanced potato can simply insert a gene that encodes for another pesticide into the potato.[29] According to Jerry Hjelle, Monsanto's Vice President for Regulatory Affairs, pest resistance is not a great concern since "there are a thousand other Bt's out there. . . . We can handle this problem with new products. . . . The critics don't know what we have in the pipeline. . . . Trust us."[30]

Organic farmers will not be so lucky. The elimination of Bt as a viable pesticide will cause great economic harm to farmers who spray Bt on their crops to control pests. They will have to change their pesticide choices. Bt is a naturally produced product of certain bacteria and it degrades rapidly. It has the advantage of being nontoxic to mammals and many beneficial insect species.[31] Logic would dictate that those who currently rely on Bt do not use other pesticide options because they are in some way inferior to Bt. The other options available to these farmers are not as safe, effective or as cheap as Bt.[32] The profit margin on potatoes is extremely small, and an increase in pesticide costs may prohibit these non-modified crops from competing with the genetically altered varieties.[33] Farmers will then either have to purchase a license to grow the genetically altered varieties from the biotech company (or companies) with the patents to the economically viable potato, or leave potato farming.

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[28] *See* Jim Thomas, *Boycott—Brands and Products to Avoid*, 28 THE ECOLOGIST 309, 310 (1998) (noting that this is a product of Novartis).

[29] *See* Pollan, *supra* note 4, at 51.

[30] *See id*. *See also* Tokar, *supra* note 26, at 254-59 (giving a historical account of Monsanto's environmental safety record, including its involvement with the production of dioxin, agent orange, and PCBs, and noting that in 1997, Monsanto had to recall 60,000 bags of Roundup Ready seed in Canada since the gene inserted into the seeds was not the gene approved for safe consumption).

[31] *See generally* David Barboza, *Biotech Companies Take on Critics of Gene-Altered Food,* N.Y. TIMES, Nov. 12, 1999, at A1.

[32] *See* Pollan, *supra* note 4, at 44 (concluding that Bt is naturally created by bacteria, is safe to mammals, and degrades rapidly).

[33] *See id.*

There are steps that may be taken to slow the development of a genetic resistance to pesticides in pest species.[34] It is essential, however, that all farmers cooperate on an international scale to preserve hope that a resistance prevention plan will work. There is no proven method for delaying the onset of resistance, although many schemes have been proposed. These techniques involve growing organic crops in close proximity to the genetically enhanced ones. It will be more effective if no pesticides are administered to the organic crops. This allows individuals of the pest species with an adaptation for high resistance to breed with individuals who have a low resistance.

The biotech companies have a financial interest in preserving their patents by forcing farmers to grow organic crops alongside the enhanced varieties. Monsanto requires growers to set aside a portion of their land on which they may not grow the NewLeaf Potato.[35] The use of these "set asides" will nullify a substantial portion of the productivity gains made by genetic engineering, and farmers will be resistant to the implementation. Therefore, it is in each farmer's financial interest to avoid complying with the requirements. While the biotech firms wish to preserve their patents, the companies can change their chemical choices, decreasing their financial incentives to spend large sums on enforcement.[36] Although the United States government requires the biotech firms to implement resistance-slowing techniques, there is currently little government enforcement of these resistance programs.[37]

In the United Kingdom, it was found that more than ten percent of Monsanto's test facilities in the nation violated government regulations.[38] It is expected that Monsanto will be prosecuted for these criminal offenses, strengthening the assertion that biotech companies should not be left to self-regulate their resistance programs.

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[34] *See id.*

[35] *See id.*

[36] *See id.*

[37] *See* Thomas P. Redick et al., *Private Legal Mechanisms for Regulating the Risks of Genetically Modified Organisms: An Alternative Path Within the Biosafety Protocol*, 4 ENVTL. LAW. 1, 53-54 (1997) (noting that EPA, under Project XL, allows companies to implement their own schemes if they will produce results superior to the EPA plan).

[38] *See* Woolf, *supra* note 6, at 1.

B. *Chemical-Resistant Crops*

Another genetic feature that biotech companies have given to agricultural products is the ability to resist high levels of herbicides and pesticides.[39] This allows farmers to spray greater amounts of chemicals on their plants without damaging the crop.[40] One example of this is the Roundup-Ready soybean. Monsanto owns both the genetically modified soy species and the patent to the popular herbicide Roundup.[41] The growing of Roundup-Ready produce may advance Monsanto's market share for the herbicide. There is a risk that weed species can secure resistance to herbicides through cross-pollination or natural selection.[42] Herbicide-resistant weed species can increase the crop loss of all farmers, and drive up food prices due to a need for the use of costlier, less effective herbicides or the need for greater quantities of currently used chemicals.[43]

Greater amounts of these harsh chemicals in the environment pose risks to other species in the environment and to farmers who have to administer the chemicals.[44] Chemicals that are applied to fields often run off into aquatic environments, harming marine life. This poses a threat to the majority of the world's population which gets most of its protein supply from seafood.[45] The presence of crops that are resistant to chemicals such as herbicides and pesticides may encourage farmers to apply greater quantities of chemicals to the plants, and they may store chemical residues in the foods that people consume.[46] The Environmental Protection Agency (EPA) estimated that three to six thousand cases of cancer can be attributed to pesticide residues each year,

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39 *See* KRIMSKY & WRUBEL, *supra* note 1, at 34.

40 *See* Mendelson, *supra* note 15, at 270; Arthur, *supra* note 13, at 21.

41 *See* Mendelson, *supra* note 15, at 270; Arthur, *supra* note 13, at 21.

42 *See* KRIMSKY & WRUBEL, *supra* note 1, at 46 (stating that more than 100 weed species are already resistant to one or more herbicides); Jonathan Gressel, *Biotechnology of Weed Control*, *in* AGRICULTURAL BIOTECHNOLOGY, *supra* note 22, at 295, 315.

43 This may result in higher profits for the producers of herbicides.

44 *See generally* Mendelson, *supra* note 15, at 270 (concluding that herbicides such as Roundup have been found to harm mammal species).

45 *See* Kimbrell, *supra* note 11, at 297.

46 *See* KRIMSKY & WRUBEL, *supra* note 1, at 48. However, it is possible that these resistant crops will, at least in the short term, allow farmers to administer smaller yearly amounts of these chemicals by killing weeds through a single harsh shock treatment. *See generally* Thomas P. Redick et al., *supra* note 37, at 51 (stating that EPA decided not to regulate plants that are engineered for a resistance to nucleic acids).

and another 50 to 100 to agro-chemical application.[47] As illustrated above, the overuse of agro-chemicals has the potential to be extremely harmful and should be avoided.

C. *Sterile Seeds*

The patents on genetically altered varieties of agricultural products are very valuable since farmers will have to pay a licensing fee for the genetically altered crops they grow. The right to collect these licensing fees is difficult to enforce since life reproduces itself. The biotech companies have found a potential solution to this problem by inserting a "terminator" gene into these enhanced plant strains.[48] The terminator gene will allow the seeds bought by farmers to germinate, but the seeds these plants produce will either be sterile or will produce offspring with certain "Achilles heels," which can be triggered by the biotech companies to destroy the crops of farmers who violate the patents.[49] For thousands of years, farmers have saved seeds of one season to plant their fields the next season.[50] The selling of seeds that are sterile or produce vulnerable offspring would halt this practice. One can imagine the crises that would arise in the third world when fluctuations in currency markets make it impossible for farmers, who can no longer save seeds of one generation to plant the next, to buy seeds from the biotech companies of the richest nations.[51] Terminator genes may also be used for military purposes, where seeds that contain genes that make them vulnerable could be sold abroad and triggered to intentionally destroy crop generations later.[52]

Another disaster that could occur is the passing of terminator genes from the genetically enhanced plants of one farmer's fields to the organically grown crops of a neighbor's fields through pollination.[53] Through pollination, genes may be exchanged between species as well as among members of the same

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[47] *See* Alfredo Herrera Estrella & Ilan Chet, *Biocontrol of Bacteria and Phytopathogenic Fungi*, *in* AGRICULTURAL BIOTECHNOLOGY, *supra* note 22, at 263.

[48] *See* Ricarda A. Steinbrecher & Pat Roy Mooney, *Terminator Technology the Threat to World Food Security*, 28 ECOLOGIST 276 (1998).

[49] *See* Pollan, *supra* note 4, at 92.

[50] *See* Steinbrecher & Mooney, *supra* note 48, at 276.

[51] This may be alleviated in the future through public initiatives to create GMOs.

[52] *See* Steinbrecher & Mooney, *supra* note 48, at 279.

[53] *See id*.

species. The neighbor may find that many of his or her seeds are sterile the next year. The biotech companies could also destroy the fields of organic farmers, either intentionally or unintentionally, by releasing certain chemicals into the environment to trigger the Achilles heel created by the terminator gene inherited from a neighbor's crops.

D. *Frost-Fighting Fruit*

Another manifestation of the ability to plant specific genes into the genetic code of agricultural products has been the production of a tomato that produces its own antifreeze to protect it from frost.[54] This genetic antifreeze is naturally found in some species of fish that live in cold water. It was isolated and placed into the tomato, illustrating that the genetic code knows not the boundaries of the different kingdoms by which scientists classify living things.[55] Scientists can insert the genes of humans into bacteria as readily as they insert the genes of bacteria into humans.

One potential cause for alarm is the possibility that these beneficial traits, such as resistance to frost, could be transferred between plant species through pollination.[56] This may result in heartier strains of pest species that destroy crops and require costlier measures to control. The risk of cross-species pollination increases greatly with the genetic relatedness of the two species. The phenomenon is found more frequently in the tropics than it is when one moves toward the poles. These weed species do not respect the boundaries of a farmer's field or political borders, and will, at first, impose costs on organic and genetically enhanced farms alike. The biotech companies can breed resistance to harsh chemicals into their crops, allowing their customers to defeat the enhanced weeds through stronger herbicides. This could result in higher levels of harm to organic farmers and the use of more dangerous chemicals in the environment.

E. *Mutations of Mutations*

Another danger that results from the genetic manipulation of crops is that once genetically altered organisms are placed into

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54 *See* Thomas, *supra* note 28, at 310 (discussing the Flav'r Sav'r Tomato, a product of Zeneca, which was designed to slow the process of rotting).

55 *See id*.

56 *See* Pollan, *supra* note 4, at 6-44, 49.

the environment, they are then free to mutate further,[57] and these mutations may be far more destructive to the environment than their first generation ancestors. The interaction of genes is not yet predictable, and it is impossible to foresee the myriad of possibilities that nature may produce.[58] For example, a potato strain that produces a pesticide may mutate to produce a far deadlier chemical that could harm humans, benevolent insect species or domesticated animals. The organic potato may not have developed these dangerous chemicals through thousands of years of evolution or selective breeding, but the possibility becomes far more likely when the potato is given a head start by genetic engineers. It will take some extension of our current tort laws to assign liability to the biotech firms if this occurs. It would be difficult to prove that the biotech companies, rather than "acts of God," are both the but-for and proximate causes of the harmful mutated strain. This analysis is beyond the scope of this Article, but the risks of further mutations are another set of potential harms that must be considered.

III
Legal Remedies for Organic Farmers

The main focus of this Article is to show why organic farmers may rightfully use existing laws that prohibit unfair restrictions on competition to obtain a remedy from the biotech firms that alter the environment by introducing genetically altered life. As iterated above, each time the mousetrap is improved, the mouse population should theoretically become stronger due to the different rates of survival and reproduction between those mice that are able and those that are unable to defeat the improved trap. One could say that the biotech companies have done nothing but improve the mousetrap. One may wish to resist assigning the consequential effects upon the environment to any single entity; however, the patenting and widespread distribution of a genetic adaptation that creates such a large jump has made it easy to spot the party that caused the evolutionary leap. Society is now able to hold these parties accountable for their environmental destruction.

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[57] *See* Wilson, *supra* note 17, at 156.

[58] *See* Krimsky, *supra* note 18, at 141.

The courts often assign liability to large entities that create environmental harms while individuals who commit the same acts on a smaller scale are not charged. An example of this can be seen in the following comparison. A factory that creates a drainage problem may be forced to pay for the environmental cleanup. However, homeowners, each of whom do little to contribute to the problem but contribute greatly in the aggregate, may not individually have to pay for the drainage problems they cause. Due to high transaction costs and the difficulty in proving both causation and harm, it is often more efficient to allocate costs in this manner. Scientists have proposed that the spraying of Bt on crops by the unrelated aggregate of organic farmers will slowly result in the development of resistance to Bt, and much of the agricultural community will share the benefits and eventual loss of the pesticide. The release of plants that produce the chemical by large biotech firms, however, has been predicted to result in a much quicker tolerance, with many of the benefits accruing to the biotech companies and many of the losses being felt by farmers.

Unlike the improvement of the mousetrap, the environmental conflicts created by these organisms are not just a simple case of one product being replaced by another superior product, but rather a case of one brand of product altering the environment so that it may become the only choice to the market. A large segment of the population would prefer organic vegetables to their genetically enhanced counterparts and would be willing to pay higher prices for them.[59] In the United States alone, the organic food market is a four billion dollar a year industry.[60] Many other consumers worldwide prefer organic produce. In Britain, where the labeling of genetically modified crops is required, the majority of the public is opposed to the genetic modification of food species.[61] This illustrates that genetically engineered varieties are not necessarily viewed as superior products. The consumers who prefer crops that have not been genetically modified will incur greater costs if farmers who grow these crops lose the ability to use certain pesticides and herbicides and therefore cannot raise crops in a cost-effective manner. Consumers currently may

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[59] *See* Barboza, *supra* note 31, at A1.

[60] *See* Kimbrell, *supra* note 11, at 296 (stating that the public outcry against genetically altered crops is even greater in developing nations).

[61] *See* Arthur, *supra* note 13, at 21.

not have the ability to choose, since the labeling of genetically modified organisms is not required in the United States, which eliminates the ability of markets to encourage the growing of the preferred crop varieties.[62] The health risks of consuming genetically engineered crops are largely unknown, but many of the environmental risks are known.[63] Therefore, this Article rejects the assertion that organic crops are being replaced by superior varieties.

One may ask whether negligence or product liability law already provide an effective remedy to organic farmers who are hurt by the environmental effects of genetic alteration. The requirements to sustain a negligence claim usually include: a duty, a breach of the duty, causation, proximate cause, and an actual injury.[64] Negligence law does not provide a sufficient remedy. Courts often require that physical harm be proven by plaintiffs who claim economic losses due to the defendant's negligence.[65] However, raising the costs of another business is a purely economic harm. Furthermore, the environmental harms associated with genetic alteration may be viewed as a result of chemicals used by the aggregate of farmers in the industry, rather than any single entity, making it difficult to attribute resistance to any single producer. Causation will also be hard to prove by each individual farmer, since crops fail for a variety of reasons and pest species naturally evolve without human intervention.

One may also have difficulty in showing that the biotech firms had a duty to protect organic farmers who use the same chemicals without quantity restrictions, thus making a negligence claim very difficult to maintain. The government has not yet required that the biotech firms take conclusively effective measures to slow the rate at which pest species become resistant to pesti-

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[62] There is a growing movement worldwide to require the labeling of genetically modified crops. This movement may preserve the ability of farmers who reject genetic modification to resist the genetic engineering paradigm. *See* Barboza, *supra* note 31, at A1.

[63] *See* Paul Kingsnorth, *Bovine Growth Hormones*, 28 ECOLOGIST 266 (1998) (noting that bovine growth hormone, a biotech product of Monsanto, was declared safe by the FDA in 1993, but the alleged health risks are now greatly debated).

[64] *See* Lewis, *supra* note 8, at 180.

[65] *But see* People Express Airlines, Inc. v. Consolidated Rail Corp., 495 A.2d 107 (N.J. 1985) (allowing claim that defendants negligently caused an environmental harm that caused plaintiff's business to suffer, even though no physical harm came to the property of the plaintiff).

cides. Therefore, these companies have had to base their levels of precautions upon their own investigations. Juries will have a difficult task in deciding what level of resistance-halting measures is sufficient. It is possible that juries will find that the minimum level of care required by the government is sufficient. Many farmers would purchase seeds from the biotech firms if the growing of organic strains became less profitable. It is possible that juries will not find that the organic farmers have suffered any harm as a result of being forced to purchase seeds from the biotech firms, especially if farming through biotechnology turns out to be as profitable to the average farmer.

Strict liability will also be difficult to apply to the producers of genetically altered crops. Strict liability involves a great risk of harm, a high magnitude of harm, an inability to eliminate risks through reasonable precautions, an unusual activity, an inappropriateness of location where the activity is conducted, and an outweighing of benefits to society by potential harm.[66] Strict liability may fail since increasing agricultural productivity is a potential benefit. Therefore, courts may not place such heavy restrictions upon the release of genetically modified crops. In addition, such activity may not be seen as different from traditional hybridization. It may also be determined that resistance-slowing techniques constitute the ability to reduce risk, favoring the handling of the matter under negligence law rather than through strict liability.

International issues, jurisdiction, and choice of law complicate many of the problems involved in assigning liability for these injuries. It may be hard to determine the site of injury. Where does resistance occur? No international treaties yet establish a framework for private liability for these types of harms.[67] However, the issues created by the production of genetically modified agricultural products are global ones, and any problems that arise must be solved on a global scale.

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[66] *See* Lewis, *supra* note 8, at 186.
[67] *See* Lewis, *supra* note 8, at 173.

A. *Regulatory Schemes for Controlling Genetically Altered Crops*

1. *United States Regulation*

Genetically engineered crops are regulated through a splintered scheme, with separate responsibilities delegated to the Food and Drug Administration (FDA), United States Department of Agriculture (USDA), National Institutes of Health (NIH) and the Environmental Protection Agency (EPA).[68] The FDA is charged with ensuring that the final products are safe. Genetically engineered crops are given limited scrutiny since the process of genetic engineering is analogous to that of natural evolution and hybridizing. Under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), the EPA is charged with regulating pesticides.[69] The EPA has largely left the decisions concerning the implementation of resistance-slowing plans to the design of the biotech companies by instituting minimal standards and allowing companies to apply to the FDA for approval of their own plans.[70] Resistance-slowing plans are still untested, and there is no generally accepted plan that is believed to be sufficient. In the United States there are relatively few impediments to the creation, testing and release of genetically modified crops.

2. *International Regulation*

The alteration of agricultural environments and the elimination of valuable inputs that farmers depend upon is a global problem. Pest species can be transferred from one country to another during the growth cycle as individuals spread into new territories, or during transport. The regulation of genetically modified organisms has been a main focus of the work stemming from the Convention on Biological Diversity.[71] The United States, along with many other industrialized nations, has been reluctant to pass legislation prohibiting the use of this technology since the biotechnology industry could be affected adversely.[72] For example, the United States and five other industrialized na-

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[68] *See* KRIMSKY, *supra* note 18, at 99-111.

[69] *See* Lewis, *supra* note 8, at 179-80.

[70] *See id. See also* Redick et al., *supra* note 37, at 51.

[71] *See* Redick et al., *supra* note 37, at 5.

[72] *See* Andrew Pollack, *U.S. Sidetracks Pact to Control Gene Splicing*, N.Y. TIMES, Feb. 25, 1999, at A1 (noting that approximately 130 other nations favor the measure).

tions originally refused to sign international legislation stemming from the Convention on Biological Diversity designed to regulate the importation of genetically engineered crops.[73] An international biosafety protocol was recently passed which does allow for labeling of non-genetically engineered crops and restrictions on the importation of crops that are a product of genetic engineering.[74] However, it may not go far enough to protect the global environment from the results of the creation of these enhanced pests.

The creation of resistant pests may force all farmers to shift to a paradigm of genetic modification, and the peoples of less industrialized nations have little opportunity to participate in this decision.[75] Individuals worldwide are consuming these genetically modified crops both knowingly and unknowingly through the consumption of processed foods. Farmers around the world may lose the ability to grow many of the crops they currently grow without paying expensive licensing fees each year. They may also lose the ability to use many of the farming techniques they have relied upon for thousands of years, such as the saving of seeds. These losses will be incurred without the gains in the biotechnology sector that will be realized by developed nations.

Less developed nations actively oppose terminator seed technology because it takes from them the autonomy to provide for their own needs in the future.[76] The growing of terminator seeds gives both biotech firms and governments with the power to control the technology the ability to starve citizens of less powerful nations. Companies such as Monsanto are currently involved in disputes with farmers who have saved seeds from the company's patented products, illustrating the company's desire to enforce their patents strictly.[77] Even if an agreement could be

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[73] *See id*.

[74] *See* Helene Cooper & Scott Kilman, *Trade Rules on Biocrops Benign to U.S.*, WALL ST. J., Jan. 31, 2000, at A3 (concluding that the bill allows nations to regulate the importation of genetically altered organisms; however, it will not provide a remedy to those farmers who stand to lose the use of traditional pesticides due to the development of enhanced pests).

[75] Many nations have attempted to prohibit the importation of genetically modified crops, but nations such as the United States have resisted these prohibitions on the ground that they violate the General Agreement on Tariffs and Trade (GATT).

[76] *See* Steinbrecher & Mooney, *supra* note 48, at 277.

[77] *See* Jennifer Kahn, *The Green Machine*, HARPER'S MAG., Apr. 1, 1999, at 71.

arranged between the biotech firms and less developed nations so that crops are not terminated during emergencies such as wars and famines, there may be no way to enforce this on an international level. The distribution of seeds that contain an Achilles heel may itself be construed as an act of war since it purposefully introduces vulnerability into a country for future exploitation.[78]

B. *Unfair Competition and Antitrust Law: Microsoft, Monsanto and the Control of Integrated Environments*

Common law tort claims, including unfair competition and interference with prospective advantage, have been used to prevent and compensate one for the disturbance of elements of the natural environment that a competitor relies upon in her business. For example, in the early case of *Keeble v. Hickeringill*, the plaintiff employed decoy ducks in his business in order to attract wild fowl, which the defendant scared away by discharging a gun.[79] The court allowed the defendant to set up his own decoys, but prohibited the use of an offensive act, such as scaring away the fowl, that would interfere with a competitor's business.[80] In *People Express Airlines, Inc. v. Consolidated Rail Corp.*,[81] the New Jersey Supreme Court held that a defendant could be liable under a tort theory for another's loss of business caused by environmental harm resulting from the defendant's negligent conduct.

Unfair competition is a long-recognized claim in tort law, but it has been preempted greatly by antitrust legislation. Antitrust laws were designed during the age of industrialization to protect markets from operating inefficiently. The purpose behind antitrust law is to protect consumers from having to pay more for the products they need than they would without restraints on competition, rather than the protection of the competitors from each other. Antitrust law does not prohibit the domination of a market, unless it is accomplished through undesirable methods.[82] A producer should not be penalized for designing a product that is superior to all others on the market and

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78 *See* Steinbrecher & Mooney, *supra* note 48, at 277.

79 *See* 103 Eng. Rep. 1127, 1128 (Q.B. 1706).

80 *See id.* at 1128.

81 495 A.2d 107 (N.J. 1985).

82 *See* Olympia Equip. Leasing Co. v. Western Union Tel. Co., 797 F.2d 370, 373 (7th Cir. 1986).

selling the quantity that the market demands. However, a large enough producer should be prevented from using its size to exclude competitors from the market when it hurts consumers.

One of the areas that antitrust legislation regulates is that of monopolization, under Section 2 of the Sherman Act.[83] Under the Act, a plaintiff must show "(1) the possession of monopoly power in a relevant market; and (2) the willful acquisition, maintenance, or use of that power by anticompetitive or exclusionary means or for anticompetitive or exclusionary purposes."[84] These laws must be reevaluated in light of the metamorphosis that world economies have recently endured. One way this law has recently been tested is in the protection of producers in networked environments from being excluded by dominant competitors. An example of this is the exclusion of certain software manufacturers by those who produce computer operating systems.[85] Below, this Article suggests that biotech companies that alter the environment by introducing genetically altered strains in the future may be found in violation of the Sherman Act. It is also possible that tort law concerning unfair competition and interference with prospective advantage may deal with the harms that could occur to organic farmers.

1. *Raising a Competitor's Costs*

Antitrust law and tort law relating to unfair competition are not static, and scholars and courts have recognized new causes of action as needed. One of these developments has been the recognition of antitrust violations for raising competitors' costs.[86] One way in which this can occur is through the collusion of producers and suppliers to drive up a competitor's prices. Cost raising may occur when a large competitor colludes with the lowest-cost suppliers to deal only with the one producer. This raises the

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[83] 15 U.S.C. §§ 1-11 (1994).

[84] Aspen Skiing Co. v. Aspen Highlands Skiing Corp., 472 U.S. 585, 596 n. 19 (1985), *citing* United States v. Grinnel, 384 U.S. 563, 570-571 (1966).

[85] *See* United States v. Microsoft Corp., 87 F.Supp.2d 30 (D.D.C. 2000) (holding that Microsoft violated the Sherman Antitrust Act by maintaining monopoly power through anticompetitive means, including attempting to monopolize the Internet browser market by integrating and bundling its browser to its operating system).

[86] *See* Thomas G. Krattenmaker & Steven C. Salop, *Anticompetitive Exclusion: Raising Rivals' Costs to Achieve Power over Price*, 96 YALE L.J. 209, 230-42 (1986) (this influential and often-cited article illustrates how large producers can use a variety of techniques to raise their rivals' costs).

costs of smaller producers, and the firm with access to the low-cost supplier can then raise prices. This is referred to as a bottleneck.[87] However, collusion may not be necessary to drive up the costs of one's competitors. A large producer can accumulate scarce inputs with the effect of driving up prices on the input to levels that prohibit new producers from entering the market.[88] This is referred to as a supply squeeze. This phenomenon is especially powerful if new suppliers depend upon the scarce resources more than the established monopolist does.[89] Consumers may suffer due to a lack of producers in the market, which allows the established producers to raise costs.

Although this theory is fairly new, courts have found companies to be in violation of the Sherman Act when they take actions to raise their rivals' costs.[90] The unnecessary raising of a competitor's costs should be considered an offensive act for the purposes of the tort of unfair competition. For example, in a Fourth Circuit case in which two unions colluded with one another to raise labor costs, the plaintiff prevailed in an antitrust claim based on the theory that the collusion harmed consumers by raising their power costs.[91] A similar result was found in the Seventh Circuit in *Premier Electrical Construction Co. v. National Electrical Contractors Ass'n*.[92] In the Tenth Circuit, a defendant was found in violation of the Sherman Act when it scheduled its bar review courses to conflict with a competing course, thus raising the costs incurred by the competitor.[93]

This Article takes the position that the prohibition on raising rivals' costs may be applied to the conflict between organic farmers and the biotech firms that release genetically altered strains of agricultural products into the environment, if these products alter the environment to prevent organic varieties from competing. First, organic farmers and biotech companies must be viewed as competitors. Although farmers do not often try to market their seeds, they compete for scarce environmental re-

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87 *See id*. at 234.

88 *See id*. at 236.

89 *See id*. at 238.

90 *See* National Elec. Contractors Ass'n, Inc., v. National Contractors Ass'n, 678 F.2d 492 (4th Cir. 1982).

91 *See id* at 501.

92 *See* 814 F.2d 358, 371 (7th Cir. 1987).

93 *See* Multistate Legal Studies, Inc. v. Harcourt Brace Jovanovich Legal and Prof'l Publications, Inc., 63 F.3d 1540, 1553 (10th Cir. 1995).

sources with the biotech firms. They both supply inputs used in the same industry and must rely upon the viability of their products in the same environment. Part I of this Article illustrated that the survival of the two paradigms on a global scale may be incompatible. Organic farming involves both the production of seeds and the growing of these seeds. This paradigm is in competition with a paradigm in which the biotech companies bifurcate the farming and seed production industries. This compelled extra step in the production process shifts the costs of production and allocation of profits. Therefore, organic farmers are direct competitors with the biotech firms and farmers who use genetic modification.

If it is accepted that seeds producers are competitors of one another, it is then possible to examine whether the biotech firms are creating a supply squeeze by improperly raising the costs of organic competitors for exclusionary purposes. Certain pesticide and herbicide compounds are necessary inputs for organic farmers.[94] Some of these are also necessary to the biotech firms that place genes that encode for these chemicals into the genomes of their altered strains. By promoting resistance to these chemicals in pest species, both organic farmers and the biotech giants may have to alter their chemical choices. Organic farmers may have to increase the quantities of pesticides and herbicides they use as pest species develop a resistance to them. Crops suffer when large quantities of harsh chemicals are administered to them. The biotech firms have created a resistance to these chemicals in their altered strains, but organic farmers cannot.

The biotech firms can create continually high levels of these chemicals in their crops, while traditional farmers will have to purchase and administer these additional chemicals. This disparity makes the organic farmers more vulnerable to chemical resistance than those who rely upon genetic engineering. If the biotech companies hasten the resistance of pests to these chemicals, they will raise the input costs to organic farmers to a greater extent than they raise costs to those who rely upon biotechnology. Given these incentives, it may not be in the best interests of the biotech companies to preserve the value of their patents through the strict development and enforcement of resistance-slowing techniques. It may be in their best interest to trade the

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[94] For the purpose of this Article, the term "organic" describes those crops that are not the product of genetic engineering. *See supra* note 9.

value of their first generation patents for increased sales of complementary chemicals and dependency of farmers upon the next generation of pesticide-producing crops.[95]

Biological restraints on organic farmers may some day create monopolies within the seed industries. Due to tremendous startup, testing, and regulatory costs, there are only a few biotech companies that have the capacity to alter organisms at the genetic level.[96] Patents on these crops prohibit companies from introducing the same pesticides, herbicides and resistance into their products as their competitors. Large biotech firms already own the patents to the most popular agricultural chemicals, allowing them to develop integrated chemical systems in which pesticides and the resistance to herbicides are both given to one organism. New competitors in the market may not be able to offer strains that are compatible with the chemicals farmers already use and know. The use of agricultural chemicals is often complex, and farmers may be resistant to change their choices since they will incur experimentation costs. If there are substantial barriers to entry into the industry, the companies that own patents to the crops that produce familiar chemicals, and the resistance to them, could raise prices to the detriment of the public.

It may be argued that new competitors will enter the market for genetically altered seeds as the technology becomes cheaper and more widespread. Even if the technology becomes more widespread, it is not certain that new competitors will be able to keep up with those companies that have a head start in the market. As the leading companies develop and patent new traits, they will add these traits to those they have already patented and distributed. As the time limits on patents run down, pest resistance may render the adaptations obsolete. These companies will have replaced them with new patented adaptations before this occurs. The plant species that these companies distribute will contain a variety of adaptations, designed to address a variety of needs. If new competitors were to develop and patent additional adaptations, they would be prohibited from

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[95] For facts that may be analogous to those present in the biotech industry, *see generally* United States v. Microsoft Corp., 84 F.Supp.2d 9 (D.D.C. 1999) (issuing findings of fact concluding that Microsoft had monopoly power in the operating systems licensing market).

[96] *See* Jennifer Ferrara, *Revolving Doors: Monsanto and the Regulators*, 28 ECOLOGIST 280, 282 (1998) (reasoning that the costs of obtaining regulatory approval for these products is a barrier to entry into the market).

piggybacking these traits upon those that are already patented. It is unlikely that farmers will change their choices to take advantage of a new innovation if these seeds do not contain the adaptations they already rely upon.

Faced with these prospects, it may not be financially sound to attempt to compete with those who have a head start. If new competitors do produce innovative adaptations, it is likely that the patents will be sold to the market leaders, who can take advantage of bundling the trait with others for which they hold patents.[97] It will be extremely expensive for new competitors to develop enough traits to offer comparable products, entrenching those who are first to enter the market. In the future, it is very possible that biotech companies may have a monopolist's share of the market for certain agricultural products.

2. *Proving Harm to Consumers*

An antitrust claim will not be successful without proof of an economic harm incurred by the public. Therefore, if a single strain of an agricultural species dominates the market, it is necessary to determine whether consumers would benefit from farmers' lack of seed choice. In deciding this, it is necessary to consider that some products, such as telephones, ATM machines and credit card networks, dictate that the entire network gains value and utility when every participant adopts the same format. Compatibility often adds value, and therefore it is difficult to persuade consumers to be the first to change to a new format.[98] This phenomenon is called a network effect, with network positive externalities. To illustrate the phenomenon, a telephone network is most useful when all telephones are built to enable users to talk to each other. Computer users gain utility if they are able to share data. Economies of scale dictate that computer hardware prices should be lower when the producers can market to all computer users, rather than to small niches.

However, in the agricultural world the situation is reversed, and society will incur negative externalities through the development of a single network with all farmers dependant upon ge-

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[97] *See generally* Microsoft, 84 F.Supp.2d 9 (considering Microsoft's continued dominance in the software industry by examining factors such as Microsoft's ability to set standards and the costs that users incur in changing formats).

[98] *See* Thomas A. Piraino, Jr., *An Antitrust Remedy or Monopoly Leveraging by Electronic Networks*, 93 Nw. U. L. Rev. 1 (1998).

netic engineering and complementary chemicals. This creates environmental risks when society overuses chemicals and loses genetic diversity. Once the agriculture industry adopts the genetic engineering paradigm, it will be difficult, if not impossible, to switch back. Scientists some day may discover health risks in the genetically altered varieties. Even if health risks are not found, consumers may still have a subjective preference for non-genetically enhanced strains over the altered varieties.[99] Consumers may even be willing to pay more for them, but since law in the United States does not provide for labeling of genetically enhanced products, it may be impossible for consumers to make the choice.[100] Consumers could be worse off with an influx of the growth of genetically altered crops, even if prices do not rise. Another possible hazard is that a single strain may be particularly vulnerable to a specific disease, and a large part of an entire year's worth of a crop could be lost due to one type of blight.[101]

As a society, we must decide whether to allow one producer to harm competitors who rely upon the same networked inputs, or whether to consider this an offensive act for purposes of antitrust law and the tort of unfair competition. Technology has increasingly caused this issue to be raised.[102] The integration of producers is especially important to the high technology industries.[103] A prime example of this has been the ongoing prosecution of Microsoft for antitrust violations, which has resulted in a proposed breakup of the company.[104] Microsoft produces the Windows operating system, which runs the majority of the world's personal computers, and also produces much of the software that runs on personal computers. Microsoft has been accused of using its dominance over the operating system industry to exclude competitors that produce other operating systems

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[99] *See generally* Mendelson, *supra* note 15, at 275 (estimating that United States producers could lose $250 million in maize exports if the European Union decides not to approve genetically engineered varieties).

[100] *See* Barboza, *supra* note 31, at A26 (noting that current legislation in Congress would require the labeling of GMOs).

[101] *See* Lewis, *supra* note 8, at 166-67.

[102] One example of this is the disdain felt for Microsoft by a small but vocal segment of consumers. *See generally* Robert S. Greenberger*, Microsoft's Fate May Depend on the Computer, Which Picks Panel From Diverse Appeals Court*, WALL ST. J., May 24, 2000, at A28.

[103] *See Lessons from Microsoft: Dominant High-Tech Firms May Not Look Like Traditional Monopolies*, ECONOMIST, Mar. 6, 1999, at 21.

[104] *See* Greenberger, *supra* note 102, at A28.

and software.[105] One example of this is Microsoft's packaging of its Internet browser with the Windows operating system and its attempt to tie its Internet browser into the operating system itself. This has caused a loss of market share for Microsoft's competitor Netscape, which sells its own Internet browser. Microsoft has also been accused of withholding important information concerning the specifications of Windows from competitors such as Netscape, Apple, and Intel.[106] Microsoft's greatest concern over the browser market is that Internet browsers may be used to run other applications and eventually replace the need for the Windows operating system.

By dominating the operating system market, Microsoft has the power to set industry standards, which is often accomplished by working with hardware manufacturers such as Intel, a company that has recently provoked its own antitrust investigations. Standardization is very important in the computer industry since it allows hardware and software to work together and allows users to share data. Independent producers must ensure that their products are compatible with the latest Windows operating system and Intel hardware for their designs to be of value to the computing public.

The Microsoft antitrust allegations share many parallels to the competition between organic farmers and biotech firms. In fact, Monsanto has used the analogy to describe itself.[107] By manipulating the environment, both software and biotech producers are able to drive competing formats out of the market when they gain enough market share. The biotech firms may be able to influence seed choice through their paradigm that uses great quantities of the chemicals farmers depend upon. It may eventually lead to higher prices for consumers as other strains become obsolete due to changes in the environment.

Like Microsoft, the actions of the biotech firms represent a choice of paradigms to the exclusion of other paradigms. The D.C. Circuit found Microsoft in violation of antitrust law for attempting to drive its competitors out of the market by integrating

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105 *See* Rachel V. Leiterman, *Smart Companies, Foolish Choices? Product Designs that Harm Competitors*, 15 SANTA CLARA COMPUTER & HIGH TECH. L.J. 159, 185 (1999).

106 *See Lessons from Microsoft: Dominant High-Tech Firms May Not Look Like Traditional Monopolies*, *supra* note 103, at 21.

107 *See generally* Pollan, *supra* note 4, at 44.

and bundling its own web browser into Windows.[108] This was allegedly done out of fear that Netscape's browser would eventually become a competitor of Windows. Microsoft has created a computing paradigm in which the Windows operating system is an essential input. It has attempted to perpetuate this paradigm by prohibiting the proliferation of alternative paradigms through the manipulation of the integrated computing environment. Netscape represents the possibility of an alternative paradigm for the future, one in which a Microsoft operating system is not an essential element. Like the Microsoft-Netscape situation, it will be difficult for genetic modification to permanently coexist with organic farming without labeling and other protective measures.

Although there is no general duty to protect smaller competitors, the courts have created a duty in a very limited number of cases where a dominant competitor's actions are unnecessarily restrictive.[109] In a very limited set of circumstances, courts have required dominant competitors to take affirmative actions to protect their smaller competitors' access to essential inputs. For example, in *MCI Communications Corp. v. American Telegraph & Telephone, Co.*, the Seventh Circuit required that AT&T, which owned local telephone lines, make available their lines to competitors such as MCI.[110] In the computer industry, due to the power of network effects to secure monopoly power over markets, Intel Corporation was forced to provide competitor Intergraph with advance access to Intel's microprocessors.[111] Another relevant example is the Thompson Corporation, purchaser of West Publishing Corporation, which was forced to license its pagination system to competitors.[112] Before granting a remedy, courts have required that plaintiffs show that the defendant's overuse of an essential input is unnecessarily restrictive.

Under a similar analysis, antitrust law should be extended to force competitors that dominate the natural environment to consider the results of their actions when they harm competitors through environmental changes. Due to insect resistance as a re-

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108 *See* Microsoft, 87 F.Supp.2d at 35.

109 *See* Aspen Skiing Co. v. Aspen Highlands Skiing Corp., 472 U.S. 585 (1985).

110 *See* 708 F.2d 1081 (7th Cir. 1983).

111 *See* Intergraph Corp. v. Intel Corp., 3 F.Supp.2d 1255 (N.D. Ala. 1998).

112 *See* United States v. Thompson Corp., 949 F.Supp. 907 (D.D.C. 1996), *cited in* Mark A. Lemley & David McGowan, *Legal Implications of Network Economic Effects*, 86 CALIF. L. REV. 497, 537 n. 249 (1998).

sult of insufficient resistance-slowing techniques, biotech firms may face a short-term loss of their patents, but could squeeze organic competitors out of the market in the long term. The act of creating environmental harms itself should be offensive enough to create this duty. Biotech firms should be forced to conduct greater testing and provide strong evidence that their altered strains will not unnecessarily hinder the ability of farmers to grow organic crops.

The conflict in the agricultural world may some day be a more compelling opportunity than the current conflict in the computer world for the application of competition law. Paradigms in the computer world are temporary. Networks are fungible and replicable, and the personal computer market may not exist as we know it in a relatively short period of time. However, the market for agricultural products will continue well into the foreseeable future, the environmental harms created are permanent, and the world's agricultural network cannot be recreated independent of environmental hazards created by others.

Conclusion

The proliferation of genetically altered species creates risks of harm that have not been encountered before. Corporations have been given the power to patent and distribute strains of agricultural products that could squeeze organic competitors out of the market, giving the biotech giants patents to what may some day become the only viable strains of certain crops. The externalities associated with genetically modified organisms are best dealt with through legislation on a worldwide level, but since governments have in the past been unwilling or unable to remedy these potential harms, the law must allocate the costs associated with the activity in other ways.

The use of antitrust and unfair competition law may some day provide a remedy to organic farmers, as it has increasingly provided to other competitors in networked commercial environments. The *Microsoft* case illustrates how antitrust laws that were designed in the era of industrialization can be resurrected to meet a new technological challenge. These laws are currently being tested and may some day evolve to prohibit the monopolization of commercial agricultural species through genetic engineering when it raises the costs of inputs needed to grow other strains of crops. It is unlikely that organic farmers will be able to

put an end to the release of genetically altered strains, but it is possible that the threat of legal penalties could force the biotech firms to take more aggressive measures to protect the environment. This could lead to more research in the area of resistance control and increased spending to enforce these plans.

The creation of genetically enhanced organisms may very well feed the growing world population. Genetic modification may also be used to solve and prevent environmental harms by replacing the use of harsher chemicals and more destructive processes. It is also likely that more traditional farming techniques, such as crop rotation, would be just as effective at this task. As a society, we should not allow genetic experimentation to destroy the viability of those agricultural techniques and crops that have fed the world for countless generations. If these harms do occur, the courts should allocate the costs to those who made the choice to experiment. Anti-competition and antitrust law may be one method of allocating these costs, or it may serve to prevent such costs by forcing the biotech companies to protect their competitors and the environment.