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Biotechnology, Property Rights and the Environment

In recent decades, scientists have developed promising new agricultural crops through the use of biotechnology. Both in the U.S. and in Europe, these crops are subject to regulation that requires evaluation of the crops and their environmental effects before they are tested in the field and sold commercially. Once the crops are commercialized, manufacturers and farmers may face other legal issues connected with land use and private property rights. These issues have been identified as the focus of the Agrarian Law (Agriculture and Science) topic. Particularly relevant issues are private law rules for bringing tort actions (e.g., nuisance) to redress damages that agricultural crops may cause and the availability of state and local land-use regulation (zoning) as a means to protect rural land and the environment.

After a brief introduction, this report discusses some benefits and risks of agricultural crops developed through biotechnology and summarizes the complex U.S. regulatory scheme for GM crops. The report then addresses nuisance and other possible tort law remedies for damages caused by these crops. Finally, it provides examples of some state-law regulatory approaches and considers zoning as a means of controlling the location of GM crops to protect the environment and neighboring landowners.

I. Introduction

Biotechnology is "any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for special use."[1] In recent years, biotechnology has played a highly visible and controversial role in agriculture. Agricultural biotechnology often uses recombinant DNA technology, and its products are called genetically modified (GM) or

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1. United Nations, Framework Convention on Biological Diversity, 5 June 1992, art. 2, 31 *I.L.M.* 818, 823 (1992).

genetically engineered.[2] As one scientist indicated, "genetic engineering of existing species is one way to increase the productivity and genetic diversity of the existing [narrow] food base on which the human population depends. Thus, biotechnology has the potential to improve profoundly the quality and abundance of the food supply."[3]

Worldwide plantings of crops produced by biotechnology increased from only 4.3 million acres in 1996 to approximately 100 million acres in 1999, with most production in the U.S.[4] The 71 million acres of GM crops planted in the U.S. in 1999 covered about one fourth of cropland planted with major crops.[5] U.S. production included 28.3 million acres of GM corn, 35 million acres of GM soybeans, and 7 million acres of GM cotton, plus other GM crops, including canola and potatoes.[6] Statistics for the years 2000 and 2001 indicate that biotechnology varieties made up significant percentages of total crops. In 2001, biotechnology varieties were 26 percent of corn (25 percent in 2000), 68 percent of soybeans (54 percent in 2000), and 69 percent of upland cotton (61 percent in 2000).[7] Moreover, "[w]ind-blown pollen, commingled seeds and black-market plantings" mean that GM products extend beyond the acres officially planted to GM crops. As a well-known agricultural lawyer-economist noted, "The [GM] genie is already out of the bottle."[8]

Biotechnology, in general, is vulnerable to litigation for a number of reasons, including its novelty and quick development, often without full knowledge of consequences; lack of a comprehensive specially-designed regulatory system; sensationalist media reporting; opposition from non-governmental organizations and other interest

2. Kupchella, Note, "Agricultural Biotechnology: Why It Can Save the Environment and Developing Nations, But May Never Get a Chance," 25 *Wm. & Mary Envtl. L. & Pol'y Rev.* 721, 723 (2001).

3. Yoshida, "The Safety of Genetically Modified Soybeans: Evidence and Regulation," 55 *Food & Drug L.J.* 193, 193 (2000). Yoshida notes that 90% of the world food supply depends on 15 plant species and 8 animal species.

4. Transgenic crops have been developed, introduced, and adopted quickly in the U.S., perhaps in part because approval is cheaper and faster than the approval process for a new chemical pesticide. David E. Ervin et al., *Transgenic Crops: An Environmental Assessment* 14 (Henry A. Wallace Center for Agricultural & Environmental Policy at Winrock International, Nov. 2000), available at http://www.winrock.org/Transgenic.pdf (visited 17 Jan. 2001). Regulatory requirements are discussed infra in part III.

5. Id. at 13.

6. Biotechnology Industry Organization, 1999 Acreage Data on Biotechnology Crops, http://www.bio.org/food&ag/1999Acreage.html (visited 6 Sept. 2001). BIO's website does not give data for 2000 or 2001.

7. Agricultural Statistics Board, NASS, USDA, *Acreage* 26-27 (June 2001).

8. David Barboza, "As Biotech Crops Multiply, Consumers Get Little Choice," *N.Y. Times*, 10 June 2001 (genie quote from Neil E. Harl). StarLink's appearance in the global food supply, though it was approved only for animal feed, indicates the extent of proliferation of GM crops.

groups; and perceptions of danger by consumers.[9] Litigation precipitated by biotechnology has included claims in product liability, and, with some as tort class actions.[10] Recent litigation focused on GM crops includes the widely-publicized claims involving StarLink corn and patent infringement actions involving Monsanto. Liability is the focus of part IV, below.

II. Some Benefits and Risks of GM Crops

Because the U.S. has planted so many GM crops, in comparison with other countries, the U.S. will be most able to evaluate environmental benefits and risks of these crops.[11] But a recent environmental assessment of transgenic crops concluded that "[t]he scientific knowledge base for understanding both the potential benefits and the risks is small and often yields inconsistent results."[12] For example, little is known about the environmental effects of genetically modified crops, because these crops are relatively new, few analytic or field studies exist, research results are sometimes inconsistent, and extensive ecosystem monitoring has not been done.[13] Moreover, development of biotechnology has been rapid, leaving little time to collect critical "baseline ecological data."[14]

A recent synthesis of empirical studies concluded that considerable uncertainty exists about environmental risks and benefits of GM crops. Both risks and benefits depend on location and crop, and not all potential risks and benefits have been evaluated. Moreover, predicting ecological impacts, particularly long-term effects, is difficult, and scientists have little experience evaluating environmental benefits.[15] Even with this uncertainty, one proponent of GM crops argued that "[t]he simple truth, given the scrutiny directed at GMO products prior to marketing, is that certain genetically improved crops may pose fewer *known* risks than their non-GMO counterparts. The companies producing genetically improved crops have undertaken a process of product "stewardship" that protects consumers from all known and "knowable" risks . . . ."[16]

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9. Deacon & Paterson, "Emerging Trends in Biotechnology Litigation," 20 *Rev. Litig.* 589, 594-602 (2001). The authors add that litigation may also increase as elderly patients who take multiple medications also take GM drug products.

10. Id. at 622.

11. Ervin et al., supra n. 4, at 14.

12. Id. at 30. On environmental risks, see also Redick & Bernstein, "Nuisance Law and the Prevention of 'Genetic Pollution': Declining a Dinner Date With Damocles," 30 *Envtl. L. Rep. (Envtl. L. Inst.)* 10328, 10330-10332 (May 2000).

13. Ervin et al., supra n. 4, at 11, 30.

14. Id. at 15.

15. Wolfenbarger & Phifer, "The Ecological Risks and Benefits of Genetically Engineered Plants," *Science* 2088, 2092 (15 Dec. 2000).

16. Thomas P. Redick, *Agricultural Biotechnology: Will Regulatory "Precaution" Expand Liability Risks?* 25 (Washington Legal Foundation, 2000) (citation omitted).

Despite the difficulty in determining the benefits and risks of GM crops with certainty, some of these benefits and risks are outlined here, as background for further discussion.

A. *Some Benefits*

Many GM crops already introduced commercially offer advantages that seem to benefit seed companies and farmers, rather than offering lower prices or higher quality to consumers.[17] Nonetheless, these first-generation crops, which offer insect tolerance or resistance to herbicides, have been called "a bounty of improved crops in commercial production."[18] Second-generation GM crops promise to offer nutritional benefits and increased yield. One example is a golden rice that produces [beta]-carotene, a precursor to the vitamin A needed to preserve vision in young Asian children whose food staple is rice.[19] GM crops now in development may offer solutions to food shortages and other agricultural problems in developing countries. Such crops can "boost nutritional value of crops, reduce the need for pesticides, reduce the need to till soil, improve yields, and increase drought resistance of plants."[20]

Beyond the merits of GM crops themselves, some would argue that biotechnology has helped to reduce ecological damage, albeit indirectly. Higher yields achieved through biotechnology, for example, may have reduced the need to convert lands to agricultural use to address food needs.[21] Increased yields engineered into crops like Bt corn and cotton could also diminish pressure to produce more intensively on land already farmed, thus resulting in conservation benefits.[22] Yield changes, however, depend on numerous conditions and may be difficult to predict; so far, no large yield increases have been documented.[23]

In addition, use of GM crops may lead to reductions in pesticide application, with related environmental benefits. Initial expectation was that crops modified to repel or resist pests would result in use of

17. Hodges, "The Genetically Modified Food Muddle," 62 *Livestock Prod. Sci.* 51, 52 (Dec. 1999). See also Peters, "Genetic Engineering in Agriculture: Who Stands to Benefit?," 13 *J. Agric. & Envtl. Ethics* 313 (2000)(arguing that agri-biotechnology companies are prime beneficiaries).

18. Goldman, "Labeling of Genetically Modified Foods: Legal and Scientific Issues," 12 *Geo. Int'l Envtl. L. Rev.* 717, 718 (2000).

19. Id. at 718-19.

20. Kupchella, supra n. 2, at 747.

21. Bergkamp, "Allocating unknown risk: Liability for Environmental Damages Caused by Deliberately Released Genetically Modified Organisms, " *Tijdschrift voor Milieuaansprakelijkheid* (Part I) 61 (June 2000), (Part II) 104, 110 (Aug. 2000).

22. Ervin et al., supra n. 4, at 20-21.

23. Id. at 30. Further, though GM crops may lead to reduced soil tillage and water use, no empirical evidence yet exists to support this effect. Id. at 21.

fewer insecticides and herbicides, but long-term effects are uncertain, and effects may differ among GM crops.[24]

B. Some Risks

1. Environmental Risks

Because genetic processes are not fully understood, deliberate release of GMOs into the environment involves some risks.[25] Among these are gene transfer, displacement of other species, and invasiveness or damage.[26] Not all these risks are equally serious. Crop displacement by "introduced non-indigenous crops" (foreign species) occurred with traditional crops, long before GMOs. Research suggests that traditional non-indigenous crops have caused severe ecological damage, but no evidence exists that GM crops have caused damage to the environment.[27]

Gene flow, that is, transfer of genes to wild relatives, is perceived as a significant risk of GM crops. Some studies indicate that genes move easily from crops to their wild relatives (e.g., radishes, canola, sunflowers, grain sorghum),[28] and scientists believe that GM genes will also move from crops into wild species. Thus, "[t]he relevant concern is not whether the genes will move, but whether they will thrive in the wild and how they might significantly increase the 'weediness' of particular wild plants, by conferring a fitness advantage that makes such plants more difficult (e.g., expensive) to control in areas where they are not desired."[29] Gene transfer may be more likely when GM crops are planted near related wild species, but further study is necessary.[30]

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24. Id. at 15-17.

25. Other risks apply at other levels of the distribution chain. For example, workers in biotechnological development may risk exposure to genetically modified microorganisms. Bergkamp I, supra n. 21, at 61.

26. Id. at 61-62.

27. Id. at 69; Bergkamp II, supra n. 21, at 110. Bergkamp explains, "The relative harmlessness of GMO's can be explained scientifically. Genetic alterations . . . lead to genome changes in the order of magnitude of fractions of a percentage, while a non-indigenous species' degree of novelty in a foreign habitat can be up to 100%; the high degree of novelty is what renders foreign species a potential environmental risk." Id. at 110.

28. Davies & Levine, "Biotechnology's Challenge to the Law of Torts," 32 *McGeorge L. Rev.* 221, 227 n.28, citing Carol Kaesuk Yoon, "When Biotechnology Crops and Their Wild Cousins Mingle," *N.Y. Times*, 3 Nov. 1999, at A18.

29. Ervin et al., supra n. 4, at 22. One commentator notes that "[e]vidence that a released GMO might alter the natural ecosystem comes from years of experience with the successful establishment of many wild species released from their natural habitat; exotic wild species that have been released accidentally or on purpose have had enormous effects on natural biodiversity." Harte, "Land Use, Biodiversity, and Ecosystem Integrity: The Challenge of Preserving Earth's Life Support System," 27 *Ecology L.Q.* 929, 958 (2001). Harte worries about the prospects of genetic homogeneity.

30. Ervin et al., supra n. 4, at 31. Crop-to-crop gene flow may also pose risks, as the StarLink and other situations have indicated. Ellstrand, "When Transgenes

Gene transfer from GM to traditional crops is not just a theoretical possibility. Researchers in Mexico recently discovered DNA from GM corn in native corn varieties. Corn is an important cultural symbol in Mexico, and contaminated seeds were discovered in an area prized as a center for corn diversity. Scientists had believed that these native varieties, often grown in remote regions, were not contaminated, in part because commercial planting of GM corn is not approved in Mexico.[31]

Particular types of GM crops may involve specific environmental impacts. For example, crops bred for increased resistance to herbicides and pest damage may result in less frequent use of less-toxic herbicides, but interbreeding of herbicide tolerant crops and wild relatives may make weeds more herbicide resistant.[32] In addition, some scientists argue that herbicide resistance may encourage farmers to use more chemicals, with accompanying risks to the environment and pesticide applicators.[33]

Insect-resistant crops can lead to decreased use of insecticides, as well as reduced insect damage. But insect pests can adapt, become resistant to pesticides, and eventually require use of other, perhaps more toxic, pesticides.[34] The EPA has required refuge areas for corn and cotton acreage to help maintain pest populations, but resistance-management plans for GM crops may be desirable.[35] Some seed companies require growers to plant a percentage of their land with conventional crops, instead of GM varieties, to prevent resistance.[36] Toxins produced by resistant crops may also affect non-target organisms (animals, plants, microorganisms, including soil biota), but research results are inconsistent and controversial (e.g., the monarch butterfly studies). Should effects occur, they may be extensive if predators of non-target organisms are affected, too.[37]

Wander, Should We Worry?," 125 *Plant Physiol.* 1543, 1545 (Apr. 2001), available at http://www.plantphysiol.org/cgi/content/full/124/4/1543.

31. Carol Kaesuk Yoon, "Genetic Modification Taints Corn in Mexico," *N.Y. Times*, 2 Oct. 2001, at D7. In April 2002, however, the editors of *Nature*, which published the original research (*Nature* 414, 541-43 (2001), concluded that "the evidence available is not sufficient to justify the publication of the original paper." *Nature* 416, 601-02 (2002).

32. Ervin et al., supra n. 4, at 23-24.

33. Stone, Note, "Restraints on Competition Through the Alteration of the Environment at the Genetic Level," 8 *N.Y.U. Envtl. L.J.* 704, 713-714 (2000).

34. Ervin et al., supra n. 4, at 23-24, 31-32. GM crops with Bt pose an additional problem for organic farmers, who can use Bt insecticide as an emergency pest-control measure. If insects become resistant to Bt, through cultivation of Bt plants, organic farmers will lose their only important pest-control option. Greenpeace, Press Release, "Center for Food Safety and Organic Farmers Sue E.P.A. over Gene-Altered Crops," http://www.icta.org/ctanews/bt2press.htm (18 Feb. 1999) (visited 19 Sept. 2001).

35. See EPA and USDA, Position Paper on Insect Resistance Management in Bt Crops (1999), available at www.epa.gov/pesticides/biopesticides/otherdocs/bt_position_paper_618.htm (visited 10 Sept. 2001).

36. Stone, supra n. 33, at 712.

37. Ervin et al., supra n. 4, at 26-29, 32.

Crop genetic diversity may also be an issue, but scientists disagree about the effects of biotechnology. Some argue that large-scale cultivation of GM crops will result in simplified cropping systems with less genetic diversity; others assert that molecular techniques enhance diversity by improving tracking and conservation of plant genetic resources in seed banks. Both assertions may be correct.[38]

2. Economic Risks

Legal commentators recently noted that most environmental risks from GM crops now seem to be "largely hypothetical or easily managed. . . . In stark contrast," they add, "*economic* risks posed by the sale of an unapproved variety in the commercial marketplace presents [sic] a potentially cataclysmic economic impact on the commodity exports of the United States."[39]

The commingling of GMOs that cannot be exported with non-GMOs and other crops approved for export poses significant economic risk.[40] Such commingling can lead a trading partner that has not approved the commingled GM crop to reject an entire shipment of grain. Further, "farmers who grow non-GM, specialty GM, or organic crops may find that their neighbor's crop of unapproved GMOs presents a threat to their livelihood, an inconvenience, or an offense—in legal terms, a nuisance."[41] StarLink corn, approved for animal feed but not for food, provides a dramatic example of the risk of commingling, even with only limited planting. When the corn was detected in food, Aventis CropScience recalled StarLink and has faced serious economic losses, as well as litigation. Individual farmers, too, may be sued, and the disaster has had significant trade consequences.[42]

Commingling threatens organic farmers, especially under new federal standards prescribing that certified organic foods be produced without use of genetic engineering. Organic farming is "one of the fastest growing segments of U.S. agriculture."[43] In 1997, over 1.3 million acres of farmland were operated under organic production systems, and state estimates for 1999 showed significant increases. Despite a doubling of organic cropland during the 1990s, consumer demand for organic products has not been met, suggesting that or-

38. Id. at 29-30, 32-33.
39. Redick & Bernstein, supra n. 12, at 10330.
40. Id.
41. Id. at 10329. The authors were not aware of specific nuisance suits.
42. See Redick, "Lessons from StarLink™: Preventing Liability for Genetically Engineered Crops" (manuscript from author), published in *StarLink: Lessons Learned* (Stephen Clapp ed., 2001).
43. Greene, "U.S. Organic Agriculture Gaining Ground," *Agric. Outlook* 9, 9 (Apr. 2000). Despite the growth, in 1997 only 0.2% of U.S. cropland had organic certification (0.1% of corn and soybean acreage; 2% of apple, grape, lettuce, and carrot acreage). Id. at 9, 13.

ganic production will increase in the coming years as national certification standards are implemented.

The Organic Food Production Act,[44] enacted in 1990, created the National Organics Standard Board, which recommended in 1996 that organic products be free from GMOs.[45] In December 2000, the Board enacted final national standards for organic food.[46] Under those standards, certain substances, methods and ingredients are prohibited in organic crop production and handling. Among the "excluded methods" is genetic engineering.[47] Products labeled "100 percent organic" or "organic" (at least 95% organically produced ingredients) or "made with organic ingredients" (at least 70%) may not use excluded methods, including genetic modification.[48] State and private organic certification programs must be at least as strict as the new federal standards. Some state statutes already require organic producers to avoid use of GM organisms.[49]

Thus for organic farmers, cross-pollination or commingling may cause serious marketing problems, especially for corn or canola, which are "wide pollinating" crops.[50] Organic farmers may have their tainted products rejected from the organic market, lose their organic certification, and face income loss during the years needed to be recertified as organic producers.[51] Even farmers who plant traditional crops may face additional expenses to segregate non-GM from cross-pollinated crops. For example, a farmer may harvest 100 rows from the sides of non-GMO fields to avoid cross-pollination and have additional costs for travel to an elevator that handles non-GMO crops.[52]

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44. 7 U.S.C §§ 6501-6520.

45. National Organic Standards Board, Biotechnology Policy (Sept. 1996), available at http://www.ams.usda.gov/nop/nop2000/nosb%20recommendations/biotecpolicy.htm (visited 1 Oct. 2001).

46. 7 CFR Part 205, 65 Fed. Reg. 80637 (21 Dec. 2000).

47. 7 CFR § 205.105(e) lists these prohibitions. "Excluded methods" are defined in § 205.02: "A variety of methods used to genetically modify organisms or influence their growth and development by means that are not possible under natural conditions or processes and are not considered compatible with organic production. Such methods include cell fusion, microencapsulation and macroencapsulation, and recombinant DNA technology (including gene deletion, gene doubling, introducing a foreign gene, and changing the positions of genes when achieved by recombinant DNA technology). Such methods do not include the use of traditional breeding, conjugation, fermentation, hybridization, in vitro fertilization, or tissue culture."

48. 7 CFR § 205.105.

49. E.g., Michigan Organic Products Act, 2000 Mich. Pub. Acts 315, effective 1 Oct. 2001.

50. Redick, supra n. 16, at 32.

51. Repp, Comment, "Biotech Pollution: Assessing Liability for Genetically Modified Crop Production and Genetic Drift," 36 *Idaho L. Rev.* 585, 594 (2000).

52. Knight, "Who's Liable for Damages from GM Crops," 25 Feb. 2000, http://www.twnside.org.sg/title/liable.htm. Seed companies believe that 400 rows may be required.

Law can help to manage risk through *ex ante* regulation or *ex post* liability. Regulation reduces risk by setting standard for regulated activities, while liability rules shift the burden of damage from the victim to the person who caused the damage.[53] In the U.S., federal regulation of GM crops ensures that known risks are avoided or minimized. As a supplement to federal laws, state or local land-use regulations can offer another regulatory approach to minimize incompatible land uses. In addition, tort claims, usually based in state common law, are available to assign liability for damages. The materials that follow review federal regulation, potential tort liability, and state and local regulation, including land-use measures.

III. Federal Regulation of Biotechnology

Congress has not enacted regulatory measures specifically designed to address the risks and concerns connected with biotechnology.[54] Instead, to delineate a regulatory structure that would protect the public, the Office of Science and Technology, an executive agency, issued the Coordinated Framework for Regulation of Biotechnology.[55] The 1986 Coordinated Framework assigned regulation of GM organisms to three primary agencies: the United States Department of Agriculture (USDA), the Environmental Protection Agency (EPA), and the Food and Drug Administration (FDA). The Framework relied on then-existing laws and agency guidelines, rather than on new laws tailored to the challenges of biotechnology, to coordinate regulation of GM organisms.[56] The Coordinated Framework focuses on regulation of the products of biotechnology, rather than the process by which the products are created.[57] Since 1986, these agencies have enacted additional regulations.

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53. Bergkamp II, supra n. 21, at 108. These liability regimes can be combined, but then the operators may have to "pay the price of both systems and obtain the advantage of neither." Id.

54. Adler, "More Sorry Than Safe: Assessing the Precautionary Principle and the Proposed International Biosafety Protocol," 35 *Tex. Int'l L.J.* 173, 182 (2000).

55. Executive Office of the President, Office of Science and Technology, Coordinated Framework for Regulation of Biotechnology, 51 Fed. Reg. 23302 (1986). For the argument that the Coordinated Framework fit within a White House strategy of executive de-regulation, see Vito, "State Biotechnology Oversight: The Juncture of Technology, Law, and Public Policy," 45 *Me. L. Rev.* 329, 342-47 (1993).

56. Bessette, Note, "Genetic Engineering: The Alternative of Self-Regulation for Local Governments," 22 *Suffolk U. L. Rev.* 1121, 1124 (1988).

57. Kunich, "Mother Frankenstein, Doctor Nature, and the Environmental Law of Genetic Engineering," 74 *S. Cal. L. Rev.* 807, 823-24 (2001). One commentator stated in 1993 that "regulation by the Coordinated Framework is suboptimal because of concurrent jurisdiction, lack of regulation by any agency in some areas, and the fact that the existing regulatory authority of each agency does not derive from statutes which contemplate the specific applications and possible risks associated with the environmental release of genetically engineered organisms. Furthermore, it does not adequately protect the public or the environment because it does not incorporate proper risk assessment or risk management methodologies." Vito, supra n. 55, at 354.

Under the Coordinated Framework, the USDA determines whether GMOs are "safe to grow"; the EPA ensures that GMOs are "safe for the environment"; and the FDA determines whether they are "safe to eat."[58] Other agencies assume some responsibilities: National Institutes of Health, National Science Foundation, and Occupational Safety and Health Administration.[59]

USDA, acting through the Animal and Plant Health Inspection Service (APHIS), regulated genetically modified products under authority of the Plant Pest Act[60] and the Plant Quarantine Act.[61] Though neither law had specific provisions for GM crops, USDA enacted regulations to govern GM crops. In particular, APHIS regulates the field testing of GM crops, by requiring permits or (with an exemption) pre-release notification and review.[62] Before field testing occurs, APHIS evaluates environmental impacts, considering the possible effect on endangered species and non-target species; an environmental impact statement may be required.[63] If field trials indicate an absence of adverse effects, APHIS may make a determination of "nonregulated status," which allows the GM variety to move freely in commerce.[64] Both the Pest and Quarantine Acts were repealed in 2000, but USDA authority over GM crops continues under the new Plant Protection Act, enacted as Title IV of Agricultural Risk Protection Act of 2000.[65] The new law continues USDA's authority to prohibit or restrict movement of plants, plant products, biological control organisms, and other products.[66] Existing regulations govern until they are superseded.[67]

EPA regulates genetically engineered organisms under the Toxic Substances Control Act (TSCA)[68] and the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).[69] Under TSCA, the EPA evaluates chemical substances, defined to include micro-organisms, to

58. USDA, APHIS, United States Regulatory Oversight in Biotechnology, http://www.aphis.usda.gov/biotech/OECD/usregs.htm#usdalaw (visited 11 Sept. 2001).

59. Kunich, supra n. 57, at 824.

60. 7 U.S.C §§ 150aa-150jj, repealed by Pub. L. 106-244 (2000).

61. 7 U.S.C §§ 151-164a, 166-67, repealed by Pub. L. 106-244 (2000).

62. Kunich, supra n. 57, at 837-842.

63. Under the National Environmental Policy Act (NEPA), field testing may be a major federal action significantly affecting the quality of the human environment, for which an environmental assessment or an environment impact statement may be required. 42 U.S.C § 4332. See Foundation on Econ. Trends v. Heckler, 756 F.2d 143 (D.C. Cir. 1985) (EIS required for first deliberate release of GMO, the ice-minus bacteria, into an open environment).

64. Pasco, "Spotlight on Genetically Engineered Foods," 15 *Agric. L. Letter* 1, 4 (Nov.-Dec. 2000)

65. Agricultural Risk Protection Act of 2000, Title IV—Plant Protection Act, Pub. L. No. 106-224, 114 Stat. 358, 438 (2000), codified at 7 U.S.C §§ 7701-7758. Section 438 repeals 10 existing laws.

66. 7 U.S.C § 7712.

67. 7 U.S.C §§ 7754, 7758(c).

68. 15 U.S.C §§ 2601-2692.

69. 7 U.S.C §§ 136-136y.

determine whether those substances present an unreasonable risk to health and environment.[70] Under FIFRA, the EPA evaluates GM organisms with pesticidal properties, using the registration system of FIFRA to collect data on efficacy and environmental effects and to require labeling of registered pesticides.[71] The pesticide must be registered under FIFRA, a process that ensures, among other things, that the product will not cause "unreasonable adverse effects on the environment."[72]

GM plants that contain pesticide chemicals (e.g., Bt) are also governed by provisions of the federal Food Drug and Cosmetic Act (FFDCA), which requires that the EPA establish tolerances for pesticide residues in fresh and processed foods or that an exemption from the tolerance requirement be established. The tolerance, if required, must reflect a level of safety — that is, a reasonable certainty that no harm will result from all anticipated dietary and other exposures.[73] After extensive evaluation of data and tests, most GM foods have "been exempted from the requirement of a tolerance," after the EPA concluded that the foods did not endanger the public health or that there was a reasonable certainty that "aggregate dietary exposure to these modifications" would not cause harm.[74]

The FFDCA gives FDA the authority to regulate the safety and effectiveness of GM foods and additives through provisions that prohibit adulteration of food and govern food additives.[75] In general, FDA has decided that genetically engineered foods are not inherently dangerous and regulates them as ordinary foods. Only pre-market notification (rather than approval) has been required, if foods contain no unusual substances or attributes subject to regulation as additives. The FDA established a voluntary consultation process to help companies and the agency determine whether food made from GM organisms contained additives that would require pre-market approval.[76] In January 2001, the FDA proposed regulations that would require submission of data and information about plant-derived bioengineered foods or animal feeds at least 120 days prior to com-

70. Kunich, supra n. 57, at 826. Kunich demonstrates the "limited utility" of TSCA in regulating GM organisms. Id. at 824-31.

71. See Kunich, supra n. 57, at 831-37 for detail on regulation under FIFRA, which is limited to pesticides, not other GM products. Further, FIFRA "cannot govern the carriers of genetically engineered pesticides that transmogrify into new life forms. . . by mutation or by cross-breeding . . . " Id. at 835. EPA pesticide regulations are at 40 CFR Parts 152-180.

72. 7 U.S.C § 136a.

73. 21 U.S.C § 346a.

74. Goldman, supra n. 18, at 755. See id. at 745-57 for details of the regulatory requirements.

75. 21 U.S.C §§ 342, 348.

76. See FDA, Statement of Policy: Foods Derived from New Plant Varieties, 57 Fed. Reg. 22984 (29 May 1992). For more detail, see also Kunich, supra n. 57, at 842-844.

mercial distribution.[77] Notification will allow FDA to ensure that industry decisions and plant-derived bioengineered foods comply with the FFDCA. The mandatory process will replace the voluntary consultation process between FDA and biotechnology developers that has applied since 1994.[78]

The FDA requires labeling of GM food products only when changes in the food composition (e.g., different nutritional property, addition of an allergen) warrant labeling. Most food products produced from genetically modified ingredients do not differ materially from other foods and need not be labeled.[79] Nonetheless, in January 2001, FDA also published draft guidelines to assist manufacturers who wish to use labels voluntarily to indicate whether foods have been made with bioengineered ingredients.[80]

Federal regulation of biotechnology, governed by several agencies under laws enacted for other purposes, has been criticized as a "patchwork" and "a confusing and ineffective regulatory scheme,"[81] by a commentator who noted that

> There is no single federal statute that governs the subject matter. The regulatory regime . . . confronts a few aspects of the issue, and then only in a piecemeal, haphazard fashion. And there is no federal agency with overarching responsibility for the topic; rather multiple agencies are charged with monitoring disparate portions of it, with no effective means for ensuring comprehensive and consistent coverage. Consequently, there are sizable gaps in coverage, with the concomitant risk of significant harms slipping through the cracks and into the environment. Additionally, proponents of new and potentially important genetically engineered "products" are forced to navigate a confusing maze of agencies and statutes, with resulting inefficiency and needlessly steep economic and opportunity costs and delays for industry and the general public.[82]

77. 66 Fed. Reg. 4706-38 (18 Jan. 2001). Rules would be codified at 21 CFR Parts 192 & 592.

78. U.S. HHS, FDA Announces Proposal and Draft Guidance for Food Developed Through Biotechnology. HHS News P01-01 (17 Jan. 2001), available at http://www.cfsan.fda.gov/~lrd/hhbioen3.html.

79. Goldman, supra n. 18, at 725-26. See FDA, supra n. 76.

80. U.S. FDA, Draft Guidance for Industry: Voluntary Labeling Indicating Whether Foods Have or Have Not Been Developed Using Bioengineering, 66 Fed. Reg. 4839 (18 Jan. 2001).

81. Kunich, supra n. 57, at 823, 862.

82. Id. at 823. Kunich recommends a comprehensive federal Transgenic Release Act, which would include a register of transgenic organisms (without prior screening), an information-flow system to inform communities and others, a high-level and flexible center for transgenic research and testing, and (for the unlikely event of environmental damage) a system for remediation carried out by EPA and funded by administrative penalties paid by the GM manufacturer. Id. at 864-69.

The U.S. regulatory framework does not assign liability for damage to persons, property, and the environment caused by the use of GMOs.[83] But existing common-law tort principles (often state law) continue to apply, absent preemptive provisions in federal law. These principles of civil liability help to ensure that companies producing GM products live up to their responsibility to provide wholesome and safe food and feed.

IV. Tort Liability, Especially Nuisance

The issue of liability for use of GMOs is difficult, both in the U.S. and internationally. Some would argue that no special liability regime for GMOs is justified because regulation has reduced risk to "acceptable levels," and both "scientific knowledge and practical experience" indicate that no significant, unreasonable risk remains.[84] Negotiations prior to enactment of the Cartagena Biosafety Protocol considered numerous alternative liability regimes for biotechnology, but no agreement could be reached. Instead, the Protocol calls for further study.[85] In the European Union, no liability provisions were included in the 2001 directive governing deliberate release of GMOs;[86] instead a more general liability scheme is expected to apply to GMOs and other "dangerous" activities.[87] Nor do other liability regimes (e.g., the Council of Europe's Lugano Convention or the EC Products Liability Directive) impose liability on agricultural producers.[88] Some national liability regimes provide remedies through laws

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For a scientific evaluation of the regulatory framework, see National Research Council, Board on Agriculture, *Genetically Modified Pest-Protected Plants: Science and Regulation*, ch. 4 (2000), available at http://www.nap.edu/books/0309069300/html/. A more recent report examines APHIS regulatory oversight and makes recommendations for improvement (including environmental monitoring). National Research Council, *Board on Agriculture and Natural Resources, Environmental Effects of Transgenic Plants: The Scope and Adequacy of Regulation* (2002).

83. See Endres, ""GMO": Genetically Modified Organism or Gigantic Monetary Obligation? The Liability Schemes for GMO Damage in the United States and the European Union," 22 *Loy. L.A. Int'l & Comp. L. Rev.* 453, 481-82 (2000). For a proposal for a Transgenic Release Act, to be implemented by the EPA, with recommended major provisions, see Kunich, supra n. 57, at 859-69. See also Buckingham, "Issues and Options for the Multilateral Regulation of GM Foods," 2 *Estey Centre J. Int'l L. & Trade Pol.* 178 (2001), available at http://esteyjournal.com.

84. Bergkamp II, supra n. 21, at 110.

85. Bergkamp I, supra n. 21 at 66-67; Cartagena Biosafety Protocol, art. 27 (29 Jan. 2000), available at http://www.biodiv.org/biosafety/ (visited 29 Oct. 2001).

86. Directive 2001/18, 2001 O.J. (L 106) 1 (12 Mar. 2001).

87. See Commission of the EC, *White Paper on Environmental Liability* 26-27, COM(2000)66 final (9 Feb. 2000). In January 2002, the Commission of the EC published the proposal for a new directive on environmental liability, COM (2002) 17 final, which includes GMOs.

88. Bergkamp, I, supra n. 21, at 68-70; id. II, supra n. 21, at 104-105. See Council of Europe, Convention on Civil Liability for Damage Resulting from Activities Dangerous to the Environment, 32 I.L.M. 1228 (21 June 1993); Council Directive 85/374, 1985 O.J. (L 210) 29 (1985), as amended. The Council of Europe Convention is not directly binding, but must be transposed into national law.

imposing strict liability for defective goods or substances or through fault-based principles of negligence or nuisance.[89]

In the U.S., the production and use of GMOs engenders several types of legal obligations.[90] The federal regulatory system described above imposes duties on manufacturers, and other regulatory rights and duties arise from intellectual property laws. Farmers who grow GM crops will normally have contractual obligations under technology agreements that protect the seed company by requiring compliance with various management and inspection requirements. Other farmers whose crops are found to contain GM germ plasm may face claims of patent infringement.[91] Farmers may enter agreements, e.g., marketing or crop-sales contracts, that require production of specific (perhaps non-GMO) crops.[92] If their crops include GM germ plasm, they may be subject to damage claims under UCC implied warranties of merchantability and fitness for a particular purpose.[93] Tort liability may follow from "escape" of GM pollen or seeds from a farmer's property, when neighbors or others suffer damage. The discussion that follows focuses on common law tort liability, especially on nuisance claims against individual farmers.[94]

A number of GM "pollination events" could lead to liability: pollination of traditional seed (or a different GM seed) by GMOs during

89. Bergkamp II, supra n. 21, at 105-107.

90. See Moeller, "GMO Liability Threats for Farmers," manuscript (Oct. 2001), for a discussion of regulatory, contract, and tort liability.

91. See Monsanto Canada Inc. v. Schmeiser, 2001 FCT 256 (Fed. Ct. Canada, 2001), available at http://decisions.fct-cf.gc.ca/fct/2001/2001fct256.html. Monsanto has similar cases pending in the U.S. Schmeiser also sued Monsanto for damages from pollen drift from canola planted in his vicinity, evidently in response to Monsanto's suit. Mandler & Eads, "Liability Exposure to Seed Companies from Adventitious GMO Pollination due to Pollen Drift Resulting in Cross Pollination or Outcrossing," at 8 (26 Jan. 2000), available at www.faegre.com/downloads/gmo.doc. In January 2002, organic grain farmers filed a class action suit against Monsanto and Aventis. Q.B. No. 67, 2002 (Saskatoon); see http://www.saskorganic.com/Sod_Claim.pdf.

92. Farmers who grow grain, even non-GM crops, may face liability if GM germ plasm has contaminated their crop through pollen drift or commingling in farm equipment. Moreover, some seed sold as non-GM may have low levels of GMO germ plasm. See Harl, Genetically Modified Crops: Guidelines for Producers, available at http://www.exnet.iastate.edu/Pages/grain/gmo/gmo.html (visited 25 Sept. 2001).

93. Id. See, e.g., 810 ILCS 5/2-314 & -315 (2000) (UCC implied warranties of merchantability and fitness). Farmers who grow traditional crops may be asked to certify that their crop is non-GMO, but uncertainties about various contamination possibilities should make farmers cautious about statements that may be perceived as an express warranty. Harl, supra n. 92, suggested that farmers: "State that no seed represented by the seed company as GMO seed was planted. State that seed represented by the seed company as non-GMO seed *was* planted. State that care was take in avoiding contamination in bins, augers, and in the combine."

94. The discussion of liability here focuses primarily on individual farmers, with some references to manufacturers. For a discussion of manufacturer liability, see Lewis, Comment, "'Attack of the Killer Tomatoes?' Corporate Liability for the International Propagation of Genetically Altered Agricultural Products," 10 *Transnat'l Law.* 153 (1997).

seed production, pollination of traditional crops by GM crops planted in nearby fields, or a combination of these events. Claims arising from cross-pollination may be made by a variety of potential plaintiffs, including customers or users of other crops — traditional (non-GM) varieties, GM varieties not approved in the EU or by other trading partners, competitor GM or non-GM varieties. Other claimants could include producers of organic or identity-preserved crops, environmental groups, and foreign governments.[95]

For example, one incident of cross-pollination involved Bt corn, cultivated in Texas, that contaminated the fields of a certified organic farmer. Terra Prima, a Wisconsin food processing company, had used the organic farmer's corn to make organic tortilla chips, which were shipped to Europe. DNA testing revealed traces of Bt corn, and the food company had to destroy 187,000 bags of chips, worth over $100,000.[96] Anecdotal evidence points to other organic farmers whose crops have been contaminated with GM pollen from neighboring fields, with consequent loss of sales and loss of organic certification.

Assigning liability for damage from escaped GMOs may pose difficulties in proving the source of the GM cross-pollination. Indeed, "causation often is multi-factorial and uncertain. It is conceivable that there is not one identifiable cause for the damage but there are numerous causes that together caused one single indivisible harm. In the case of gene transfer, for instance, the cause of the damage is not only the modified gene, but also a multiplicity of other causes that together cause environmental damage."[97] Moreover, some damage may not be foreseeable. These difficulties are relevant in tort actions brought to recover for damage caused by GM crops.

95. Mandler & Eads, supra n. 91, at 1. This article discusses various cross pollination scenarios, involving different types of crops and victims, along with the claims that might arise.

96. Terra Prima, along with other plaintiffs, sued EPA, rather than the organic farmer, alleging that the EPA registration process did not consider the environmental and health impacts of Bt corn. Repp, supra n. 51, at 591; Bett, "Mounting Evidence of Genetic Pollution from GE Crops," *Envtl. Sci. & Tech.*, 1 Dec. 1999, available at http://www.purefood.org/ge/gepollution.cfm (visited 19 Sept. 2001); Greenpeace, supra n. 34.

97. Bergkamp I, supra n. 21, at 70. Bergkamp continues: "If a herbicide-resistance gene transfers from genetically modified maïze to a certain type of wheat, which spontaneously mutates as a result of which it is able to cross fertilize with stinging nettles, and the gene indeed transfers from the wheat to the nettles, which then becomes [sic] difficult to control with herbicides and displaces [sic] weaker plants and bushes ('super-weed'), the following causes can be identified: (1) the ability of maïze to cross-fertilize wheat, which may well be a normal property; (2) the mutation of the wheat causing the wheat to be able to transfer the gene to nettles; (3) the ability of the nettles to spread at a fast pace; and (4) the relative weakness of the plants and bushes replaced by the nettles." Id.

A. *Nuisance from GMOs*

Nuisance has long been an important common-law remedy when a defendant's activities interfere unreasonably with plaintiff's use and enjoyment of land, injure life or health, or interfere with public rights. Indeed, in the years before enactment of zoning, "the common law doctrine of nuisance served as an all-purpose tool of landuse regulation."[98] Nuisance raises issues of reasonable use of land in light of the circumstances. Both plaintiff and defendant have the right to reasonable use and enjoyment of their property; therefore the defendant cannot cause unreasonable harm to plaintiff, and plaintiff may have to endure some inconvenience to accommodate the defendant's legitimate land uses. In part because of the required balance of competing interests, the doctrine of nuisance has suffered from "confusions, contingencies and lack of principle."[99] Moreover, the distinction between nuisance and trespass is not always clear, and the same activities may give rise to both trespass and nuisance claims. Trespass, discussed below, requires an invasion of land that interferes with possession, while nuisance focuses on interference with use and enjoyment.

Private nuisance involves interference with an individual plaintiff's use and enjoyment of land. Public nuisance arises from activities that interfere with land use of a large number of plaintiffs or with public rights. Nuisance can be brought as an intentional tort, which requires the defendant to have knowledge that the activities were substantially certain to injure plaintiffs. Intentional nuisance also requires that defendant's use of land caused plaintiff to suffer substantial and unreasonable interference with use of property. Negligent nuisance as a cause of action requires proof that defendant's activities on its land (instead of the interference with plaintiff) were unreasonable.[100] Intentional nuisance is often easier to prove, because it does not require proof that the defendant's behavior (e.g., in planting GM crops) was unreasonable. Remedies for successful nuisance claims include injunction against specific activities and damage awards.

Early in the development of biotechnology, nuisance law was recognized as a remedy for actual damage (or even fear of future harm) resulting from technological developments like recombinant DNA re-

98. Halper, "Untangling the Nuisance Knot," 26 *B.C. Envtl. Aff. L. Rev.* 89, 101 (1998)

99. Id. at 91. Halper, at 90, quotes a U.S. Supreme Court justice, who noted that "one searches in vain . . . for anything resembling a principle in the common law of nuisance." Lucas v. South Carolina Coastal Council, 505 U.S. 1003, 1055 (1992) (Blackmun, J., dissenting).

100. Zygmunt J.B. Plater et al., *Environmental Law and Policy: Nature, Law, and Society* 166-69 (2d ed. 1998).

search.[101] The tort suit served as "a vehicle for asserting a sense of dread in the face of uncertainty and in the absence of existing public administrative regulation. It provides an existing mechanism for asserting a risk-averse approach to new scientific and technological activities."[102]

Farmers who plant GM crops may be subject to nuisance claims if pollen moves across their boundary onto neighbors' fields and has an adverse impact — e.g., cross-pollination. Further, transport of seed by birds or insects could also constitute a nuisance, if that transport is considered foreseeable. In addition, growers who fail to segregate their GM crops can be subject to nuisance claims. Growers of an unapproved GMO variety, in particular, must segregate their crop to avoid commingling and the resultant unmarketability of commingled crops. Seed companies may also be subject to nuisance claims, particularly public nuisance. Joint and several liability may apply, if both producer and seed company are held liable.[103]

1. Public Nuisance

"A public nuisance is an unreasonable interference with a right common to the general public."[104] Public nuisance claims are normally brought by a government official or, less often, by a private plaintiff with an injury different in kind (a so-called "special injury") from members of the general public. In adjudicating a public nuisance claim, the court may be asked to balance the value of the defendant's conduct against the seriousness of the harm to the public right. Public nuisance is versatile and has been suggested as a useful remedy for various environmental threats, including threats to biodiversity from the intentional or unintentional introduction of exotic species that threaten biodiversity.[105] But a public nuisance action does not normally provide monetary damages to private plaintiffs, so it would not provide a sufficient remedy for individual farmers whose crops have been damaged by pollen from GM crops. Further, a seed company, rather than an individual farmer, seems more likely to be defendant in a public nuisance action.

GM crops could constitute a public nuisance in situations involving "pollen drift or outcrossing, to wild relatives, and . . . commingling of unapproved GMOs and approved GMOs or non-GMOs in the ex-

101. See Furrow, "Governing Science: Public Risks and Private Remedies," 131 *U. Pa. L. Rev.* 1403 (1983).

102. Id. at 1466. But Furrow would redefine common-law nuisance entitlements and rely on the judiciary to fashion complex injunctions.

103. Redick & Bernstein, supra n. 12, at 10329, 10333-34. The authors focus on GM varieties not approved in the EU.

104. Restatement (Second) of Torts § 821B (1979).

105. See Larsen, "Combatting the Exotic Species Invasion: The Role of Tort Liability," 5 *Duke Envtl. L. & Pol'y F.* 21 (1995). Exotic species, however, are often prohibited under state or federal law, whereas GM crops are subject to regulatory oversight.

port stream of commerce."[106] Marketing practices that threaten exports could be a public nuisance. A lawsuit might therefore seek an injunction against sale of an unapproved GM variety or even against sale of a variety not approved in importing nations, if such sales would seriously interfere with public interest in grain trade or if the seed company does not warn growers about commingling and its economic risks.[107]

Plaintiffs have already alleged public nuisance involving GM crops in U.S. lawsuits. For example, the complaint in a class action against Monsanto Company, an important player in the biotechnology industry, alleged that "Monsanto has created a public nuisance by causing the widespread use of genetically modified crops in the United States, which constitutes an unreasonable and significant interference with public rights, public health, public comfort and public convenience, in that such crops are not adequately tested for human health and environmental safety."[108] The alleged nuisance affected the community at large, as well as numerous individuals, because of Monsanto's alleged failure to test and the inability of consumers to know the GMO status of their food crops.

As commentators noted, seed companies could minimize nuisance claims "by developing voluntary industry standards for 'identity preservation' of GMOs requiring segregation from other crops, thereby neutralizing the threat to neighbors and the corresponding threat of nuisance liability."[109] Perhaps in response to nuisance exposure, companies and trade associations have begun to specify standards of care, including buffer zones and other protections against commingling. Information about location of vulnerable wild relatives of GM crops would help farmers to minimize outcrossing. "There is still time to maintain a voluntary approach to managing nuisance risks before the cyclones of litigation or state legislation blow away contracts and the freedom of growers to plant the crop of their choice."[110]

2. Private Nuisance

A private nuisance is "a nontrespassory invasion of another's interest in the private use and enjoyment of land."[111] A private nuisance claim often results from an activity on defendant's land that unreasonably interferes with the use of plaintiff's neighboring land.

106. Redick & Bernstein, supra n. 12, at 10335.
107. Id. at 10334-35. The latter claim may be akin to fraud.
108. Higgenbotham v. Monsanto Co., amended complaint, count V, Case No. 1:99cv03337 (D.D.C.), ¶ 199, available at http://www.cmht.com/casewatch/cases/seedcomplaint.htm.
109. Redick & Bernstein, supra n. 12, at 10329.
110. Id. at 10330, 10340-10341.
111. Restatement (Second) of Torts, supra n. 104, § 821D.

The individual farmer who suffers damage from GM crops planted in the immediate area may use private nuisance to claim damages and perhaps to seek an injunction against future planting of GM crops. Private nuisance, if successful, can provide a financial remedy to individual farmers, but courts are generally reluctant to enjoin otherwise legal behavior without proof that harm will result. Therefore, relief from a nuisance claim may be limited to damages for harm caused to neighboring land and crops.[112] If several nearby farmers planted GM crops that could have damaged plaintiff, damages could be apportioned between defendants.[113]

The movement of airborne contaminants has been held to constitute a nuisance, when those contaminants (e.g., pesticides applied by air) cause actual harm to property or impair use of the property. Several states have used nuisance in cases involving farm chemicals.[114] Airborne pollen from GM crops is arguably analogous, and private nuisance may offer a remedy for a plaintiff whose land is contaminated, with resulting loss of an organic crop and organic certification or decreased marketability of a traditional crop. The plaintiff who pleads intentional nuisance must prove that the defendant knowingly planted a GM crop without taking proper precautions to prevent pollen drift to a neighboring field. A damage award may issue if losses are severe enough to constitute an unreasonable interference with plaintiff's use and enjoyment of land.

The plaintiff who pleads negligent nuisance faces the additional burden of proving that defendant's activities were unreasonable. If the defendant has followed industry standards to avoid pollen drift and commingling, an argument that defendant's behavior is unreasonable may not be convincing, in light of the wide usage of GM crops and their perceived economic importance. But the behavior of a defendant who planted GM crops without observing recommended separation distances may be considered unreasonable.

Nuisance suits involving farmers raise the issue of applicability of right to farm laws. These laws, now effective in every state, discourage conversion of farmland to other uses by protecting farmers and farming operations from public or private nuisance liability.[115] Many right to farm laws codify the "coming to the nuisance" defense; these laws protect existing agricultural operations when a nuisance

112. See Endres, supra n. 83, at 493.

113. See Repp, supra n. 51, at 607, citing California Orange Co. v. Riverside Portland Cement Co., 195 P. 694, 695 (Cal. Dist. Ct. App. 1920).

114. E.g., Arizona, Arkansas, California, and Texas. 2 Julian Conrad Juergensmeyer & James Bryce Wadley, *Agricultural Law* § 27.4.1 (1982 & Supp. 1985).

115. For an early overview of right to farm laws, see Grossman & Fischer, "Protecting the Right to Farm: Statutory Limits on Nuisance Actions Against the Farmer," 1983 *Wis. L. Rev.* 95. For a criticism of right to farm laws for their "misallocation of land use benefits and burdens," see Reinert, Note, "The Right to Farm: Hog-Tied and Nuisance-Bound," 73 *N.Y.U. L. Rev.* 1694, 1736 (1998).

arises from changed circumstances in the surrounding area.[116] The laws often protect only farmers whose practices are not negligent or improper, and some require compliance with environmental standards. In addition, some laws limit the application of local government nuisance ordinances to farmland. Recently, an Iowa right to farm law was held to cause an unconstitutional taking of property rights of landowners adjacent to the protected farmland.[117] Nonetheless, the majority of right to farm laws continue to apply, and these laws "remain a significant obstacle to the use of common law environmental remedies against farms."[118]

State right to farm laws vary considerably, so their applicability to protect growers of GM crops will depend on the language of the statute in the grower's jurisdiction. In many instances, the plaintiff in a nuisance suit against a farmer growing GM crops will be a neighboring farmer who grows traditional crops. In that situation, it is unlikely that changed circumstances on neighboring land will have led to the allegation of nuisance, and a right to farm law that codifies the coming to the nuisance defense will not protect the defendant farmer. In many states, the defendant farmer will not be protected if farming practices were negligent. If the defendant planted GM crops without observing the buffer zone or reserve requirements, or without taking measures to avoid commingling of GM and traditional crops, that farmer's practices are likely to be considered negligent. Though right to farm laws may not be effective in preventing nuisance suits, their existence may encourage opponents of GM crops to press for legislative restrictions on GM planting.[119]

A GM seed company may also be target of a private nuisance suit. For example, a company that does not disclose known risks of commingling of unapproved GM seeds to producers who plan to export crops may have engaged in an unreasonable marketing practice. Companies that fail to prescribe proper use, including separation distances and reserves, may also face liability. Under these circumstances, the neighbor whose crop is contaminated by GM seed may

116. Modern nuisance law has adopted "a multifactored analysis of land use conflict that attempts to balance the harm caused by the activity complained of against the value of that activity." This modern approach has rejected the "coming to the nuisance defense," which is central to many right to farm statutes. Thus, in a sense, right to farm laws enacted a "dogmatic return to the fault-based origins of nuisance law." Under right to farm laws, plaintiffs who come to the nuisance "are to blame for their own troubles." Reinert, supra n. 115, at 1700-1701, 1703.

117. Bormann v. Board of Supervisors, 584 N.W.2d 309 (Iowa 1998), cert. denied sub nom. Girres v. Bormann, 525 U.S. 1172 (1999)

118. Ruhl, "Farms, Their Environmental Harms, and Environmental Law," 27 *Ecology L.Q.* 263, 316 (2000).

119. See generally, Hamilton, "Right-to-Farm Laws Reconsidered: Ten Reasons Why Legislative Efforts to Resolve Agricultural Nuisances May Be Ineffective," 3 *Drake J. Agric. L.* 103 (1998).

have the right to recover lost profits in nuisance against the seed company.[120]

Nuisance claims can sometimes be avoided by simple cooperation between neighboring farmers. For example, a traditional farmer could request that the neighbor planting GM crops observe set-back distances sufficient to avoid cross-pollination.[121] Moreover, the seed industry has launched programs intended to avoid commingling and resultant legal claims. For example, the American Soybean Association, motivated by the threat of nuisance liability to farmers it represents, asked seed companies not to sell unapproved varieties commercially. This step has helped to avoid commingling of approved varieties with GM varieties not acceptable to trading partners, particularly in the EU.[122]

B. Other Tort Claims for Damage from GMOs

1. Trespass

Farmers whose GMOs escape and enter onto the land of others risk liability for trespass to land. Trespass is an intentional tort. It involves invasion of property that interferes with the plaintiff's exclusive possession of real property and causes damage to that property.[123] The tort of trespass arises when "a defendant intentionally enters the land of another or intentionally causes something to enter the land of another. Although intent is required, it is the intent to enter the land, not the intent to trespass, that is key."[124] Intent for trespass, as for intentional nuisance, is a form of knowledge.

Courts have awarded damages in trespass for invasion of and damage to plaintiff's property by airborne pollutants.[125] Even invisible particulates can cause trespass, as long as their invasion causes damage to the plaintiff.[126] Drift from aerial application of pesticides has been held to constitute trespass, when the pesticides entered the plaintiff's property.[127]

Thus, crops that cross-pollinate or contaminate land of neighbors may make the farmer vulnerable to a trespass claim. Trespassing crops or pollen may interfere with a neighbor's right to exclusive possession of land. If the farmer "knows that it is substantially certain

120. Redick & Bernstein, supra n. 12, at 10329, 10338. Seed contracts for "identity preserved" crops often shift the risk of nuisance liability to the farmer. Such disclaimers, however, should be accompanied by detailed descriptions of risks, so that the farmer's consent is truly informed. Id. at 10339.

121. Id. at 10337.

122. Id. at 10341; Redick, Lessons, supra n. 42, at 9.

123. See Repp, supra n. 51, at 600.

124. Davies & Levine, supra n. 28, at 223.

125. E.g., Borland v. Sanders Lead Co., 369 So. 2d 523 (Ala. 1979).

126. E.g., Martin v. Reynolds Metals Co., 342 P.2d 790 (Or. 1959), cited in Repp. supra n. 51, at 601

127. Mandler & Eads, supra n. 91, at 10.

that seeds from her pesticide-resistant plants will find their way on to the plaintiff's property, she can be liable for trespass to land," and for all harm that results from that trespass.[128] Pollen from crops may also constitute trespass, in jurisdictions that have recognized trespass by particulates.[129]

One of the difficulties in proving a trespass case involving GMOs is causation. Courts are likely to require proof that the plaintiff did not cause the contamination (for example, by planting commingled seed), that the defendant neighbor's crop could have caused the trespass, and that it actually did cause the trespass (instead of crops from other, non-defendant neighbors). Damages from trespassing GMO seed or pollen may include contamination that makes the land unfit for use (for example for organic crops) or loss of market for crops commingled with GMOs.[130]

2. Negligence

A claim of negligence usually requires the plaintiff to prove that the defendant had a duty to conform to a specific standard of conduct (normally, to exercise reasonable care under the circumstances), that the defendant breached that duty, that the plaintiff suffered harm, and that the defendant's breach of duty was the proximate cause of plaintiff's injury.[131]

A plaintiff injured by GM crops — for example, through cross-pollination of GM crops to organic crops — may find it difficult to recover in a negligence action, in light of uncertainty about the scope of the defendant farmer's duty to control cross-pollination from approved GM crops. It can be argued, however, that the seed manufacturers' imposition of buffer zones, or the requirement that a reserve area be planted with conventional crops, may make injury to neighbors foreseeable and give rise to a duty of care for farmers who plant GM crops. If the duty of care exists, the plaintiff must then prove that the defendant breached that duty by acting unreasonably in connection with the GM crops. A farmer who fails to follow appropriate practices (e.g., by failing to maintain required buffer zones, like the 600-foot setback required for StarLink corn) may have acted unreasonably. In contrast, a farmer who follows the requirements imposed

128. Davies & Levine, supra n. 28, at 223-24. Can the (foreseeable) actions of insects carrying pollen from GM crops to neighboring fields make the GM farmer liable in trespass? States have enacted toxic trespass laws for legal recourse against environmental polluters who release toxins. Bett, supra n. 96. It is unclear whether these would apply for GM pollution (e.g., in class action by organic farmers).

129. Redick & Bernstein, supra n. 12, at 10336.

130. See Repp, supra n. 51, at 602-05.

131. See Endres, supra n. 83, at 482-87 for a discussion of negligence.

in connection with purchase of GM seed is less likely to have breached the duty of care.[132]

Of course, that defendant's unreasonable conduct must have damaged plaintiff's crops or real property. As in trespass actions, causation may raise problems of proof. Though cross-pollination is a foreseeable injury (satisfying the proximate cause requirement), the plaintiff may have difficulty proving cause-in-fact, especially if several producers in the plaintiff's vicinity planted GM crops.[133] Moreover, negligence does not always provide an adequate remedy. In some states, mere economic loss from defendant's negligence will not be compensated; plaintiff must also prove physical harm to property.[134]

It should be noted briefly that negligence cases against seed companies that are based on failure to warn or another labeling claim may be preempted by FIFRA, when the GM crop has pesticidal properties and has been registered under FIFRA. That law preempts state "requirements for labeling or packaging in addition to or different from" those required for pesticides by federal law.[135] Numerous federal court decisions have applied FIFRA preemption to state tort cases based on claims of inadequate labeling.[136]

3. Strict Liability

Strict liability applies in situations when the defendant causes injury in the course of an activity characterized as abnormally dangerous or ultrahazardous. When strict liability applies, the plaintiff need not prove that the defendant's conduct was unreasonable. But determining whether an activity like planting GM crops is abnormally dangerous may be difficult. Factors that can help to identify an abnormally dangerous activity include the degree of risk, likelihood of serious harm, inability to eliminate risk, commonness of usage, appropriateness of activity to area, and its value to the community.[137] In the analysis, "[t]he essential question is whether the risk created is so unusual, either because of its magnitude or because of the circumstances surrounding it, as to justify the imposition of strict liability for the harm that results from it, even though it is carried on with all reasonable care."[138]

Recent commentators note that "the modern development of strict liability arose in the context of competing land uses, situations

132. Repp, supra n. 51, at 615-16.
133. Endres, supra n. 83, at 486-87.
134. Stone, supra n. 33, at 718.
135. 7 U.S.C § 136v(b).
136. E.g., Papas v. Upjohn Co., 985 F.2d 516 (11th Cir.), cert. denied, 510 U.S. 913 (1993). See Mandler & Eads, supra n. 91, at 18-20.
137. Restatement (Second) of Torts, supra n. 104, § 520.
138. Id. cmt. f.

where a plaintiff's land was injured due to activity by the defendant on the defendant's neighboring property."[139] It may seem logical to assert a strict liability claim if, for example, a farmer planted a GM pesticide-resistant crop, which spread to a neighbor's land and harmed crops there. It seems unlikely, however, that planting GM crops will normally be considered an ultrahazardous activity. The benefits that GM crops offer to society enhance their value to the community, and these crops have been planted widely in the U.S., making their use common. In some areas, particularly where organic crops predominate, GM crops may not be appropriate because of their propensity for cross-pollination and the potential for serious harm. Perhaps in those areas GMOs might be considered an "alien substance," and it can be argued that the producer who introduces the alien substance should be responsible for damage caused by its escape.[140]

Instances of cross-pollination from GM crops are analogous to cases involving pesticide drift, because of "[t]he size of GM pollen and/or seeds and their susceptibility to the impact of natural atmospheric forces."[141] A few states have allowed recovery under strict liability for damage from aerial spraying of pesticides. The leading strict liability case affirmed a jury judgment that awarded damages to an organic farmer whose farm was contaminated by pesticide drift, destroying his crops and eliminating him from the organic food market.[142] Most other decisions, however, refused to impose strict liability for pesticide drift and instead required proof of negligence to support liability.[143] Similarly, courts may be reluctant to impose strict liability for GMOs.

A thoughtful European commentator indicated that it is unlikely that approved GMOs, used appropriately, would pose enough risks to be considered ultrahazardous. It is possible, however, that use of unapproved GMOs or practices that do not comply with regulations and guidelines could pose significant, foreseeable risk and thus be subject to strict liability,[144] as well as to assertions of negligence.

Another type of claim, strict products liability, might be asserted against a GM seed company. Strict products liability requires the plaintiff to establish that a defect, which made the product unreason-

139. Davies & Levine, supra n. 28, at 226-27.

140. See Rylands v. Fletcher, [1863-1873] All E.R. Rep. 1 (1866)(Ex. Ch.) (involving water). This suggestion comes from Endres, supra n. 83, at 489.

141. Repp, supra n. 51, at 618 n.237.

142. Langan v. Valicopters, Inc., 567 P. 2d 218 (Wash. 1977). See Blomquist, "Applying Pesticides: Toward Reconceptualizing Liability to Neighbors for Crop, Livestock and Personal Damages from Agricultural Chemical Drift," 48 *Okla. L. Rev.* 393, 403-408 (1995).

143. E.g., Bennet v. Larsen Co., 348 N.W.2d 540, 553 (Wis. 1984) ("pesticide application is not an ultrahazardous activity").

144. Bergkamp II, supra n. 21, at 111.

ably dangerous, existed when the product was released into the stream of commerce. Defects may involve design, manufacturing, or marketing.[145] For example a GM crop with a new allergen could lead to a strict products liability claim.[146] Proof that the GM product is defective in design or manufacture may be difficult for the plaintiff, however, and some products of biotechnology are exempt from strict products liability for defects in design.[147]

Though nuisance and other tort claims are available in case of damage to the environment and to individual producers and buyers of GM crops, the efficacy of these remedies remains theoretical until courts have had the opportunity to decide cases involving damages from GMOs. The difficulties of proving the causation of cross-pollination and other types of damage, likely with the aid of experts, may make GM damage cases expensive to litigate.

V. State and Local Regulation of GMOs

A. *State Regulation*

State regulation of the use of GM crops and other GM products varies significantly, and not all states have enacted laws to address biotechnology. A study published in 1993 indicated that 25 states had taken no initiatives to regulate in this area, seven decided regulation was unnecessary, and two failed to pass legislation. Twelve states had enacted programs, and four were then considering regulation. Laws effective in 1993 were of four general types: amendments of existing laws governing agriculture, public health, or the environment to include genetic engineering; integration of state laws with a special interagency task force; new laws directed toward biotechnology; and new laws that created an administrative organization to regulate biotechnology.[148]

In recent months, a few states have enacted laws to address pressing concerns (e.g., cross-pollination); in other states, bills have stalled in the legislative process. The brief discussion of state legislation here does not attempt to be comprehensive, but only to provide a few examples of state laws and proposals. It must be noted that not all state laws governing GM crops are permissible. Federal provisions may preempt state (and local) laws and regulations that are

145. Deacon & Paterson, supra n. 9, at 602-03; Restatement (Third) of Torts: Prod. Liab. §§ 1-2 (Proposed Final Draft, 1997).

146. Weiswasser et al., "Genetically modified foods raise new legal issues," *Nat. L. J.*, 25 June 2001, at C4.

147. Davies and Levine, supra n. 28, at 230-31.

148. Vito, supra n. 55, at 361-64. Some of the laws Vito describes have expired or been repealed, e.g., N.C. Gen. Stat. §§ 106-765 to -780 (Genetically Engineered Organisms Act, which regulated sale, use, and outdoor release of GMOs until its expiration in 1995).

inconsistent with federal measures. For example, federal regulations that govern field testing of GM organisms are preemptive.[149]

1. Permits and Notification

Some state laws require a permit for certain releases of GMOs; others require only notification. For example, to protect both humans and the environment, Minnesota law requires a permit from the Commissioner of Agriculture for release of certain genetically engineered organisms used in agricultural production or processing.[150] A permit will issue only if the release is not likely to cause unreasonable adverse effects on the environment. Exemptions from the permit requirement are authorized when release of the organism can occur without adverse effects.[151] The Minnesota Environmental Quality Board coordinates regulatory activities connected with genetically engineered organisms, but its rules do not affect liability under other laws and regulations for adverse effects of the organisms.[152]

In contrast, only notification is required under the Illinois Release of Genetically Engineered Organisms Act,[153] effective in 1990. That law, directed toward public safety, requires notification of releases of genetically engineered organisms when those releases require federal notification, license, or permit under the Coordinated Framework. Designated state officials (Illinois Department of Agriculture or EPA) receive full notification, and local officials receive summary notification. The law does not address liability for release.

2. Manufacturer Responsibility

Like federal laws, most state statutes do not include provisions that govern liability to those damaged by GM crops.[154] But a law enacted in May 2001 in Maine assigns responsibility to manufacturers of genetically engineered plants, planting stock, or seeds that pose

149. See 62 Fed. Reg. 19903, 19915 (1997) (amending 7 CFR Part 340 and stating that preemption applies). In January 2002, the Pew Initiative on Food and Biotechnology released a fact sheet, "State Legislative Activity in 2001 Related to Agricultural Biotechnology," http://pewagbiotech.org/resources/factsheets/bills/factsheet.php3.

150. Minn. Stat. 2000, ch. 18F. See also Oklahoma Agriculture Biotechnology Act, 2 Okla. St. §§ 11-35 to -42, recodified from §§ 2012-2018, in H.B. 1378 (Ok. 2001), §§ 116-123, 261; R.R.S. Neb. § 2-10, 113 (2001), requiring a permit for some releases; Rev. Code. Wash § 17.24.051 (2001), requiring notification, plus a permit for releases not approved under federal law.

151. Minn. Stat. 2000, § 18F.13. A bill introduced in 2001 would have repealed this section and associated rules so that no exemptions were allowed. H.R. No. 807, 82nd Leg. Sess. (Minn. 2000-2001).

152. Minn. Stat. 2000, § 116C.91, § 116C.95.

153. 430 ILCS 95/1-11.

154. Endres, supra n. 83, at 482.

risk of cross-contamination.[155] The manufacturer must give written instructions to growers about how to grow and harvest crops to minimize cross-contamination. Instructions must be at least as comprehensive as USDA guidelines for buffer zones between GM and traditional or wild crops. In addition, the manufacturer or seed dealer must keep records, available to Maine officials, of the names and addresses of purchasers of GM crops. The law imposes a civil penalty for failure to comply. Maine also enacted legislation to govern voluntary labeling of GM foods with less than 1% GM ingredient to indicate that the products are GMO free. Rules to implement the law will be based on the FDA Draft Guidance for voluntary labeling.[156]

Recent proposals in several states have attempted to impose liability for harm, especially cross-pollination, from GM seeds. For example, a bill proposed in Minnesota would have required manufacturers of GM crop seeds to provide written instructions, approved by state officials, for planting and harvesting to avoid cross-pollination; manufacturers would also have had to notify neighbors of growers of GM seed. Those who failed to comply would be strictly liable to agricultural growers who suffer damage from cross-pollination from that manufacturer's seeds or crops. Any grower liability would be secondary to manufacturer's liability, and no waiver of the liability provisions was permitted.[157] Similarly, a bill introduced in Nebraska would have amended the seed law to impose liability on the licensing party for cross-pollination or other damage to a non-GM growing crop. Damage would have included loss of price premium and additional costs, plus any judgment or penalty to an injured grower of non-GM crops.[158] A Massachusetts bill would impose strict liability for damages from using GM products on the person who genetically engineers organisms for use as food. Damages include harm to human health, environmental harm, and crop contamination.[159]

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155. 2001 Me. Laws 330, codified at 7 MRSA §§ 1051-1052. In 1988, Maine enacted a law to establish a Commission on Biotechnology and Genetic Engineering, Me. Rev. Stat. Ann. tit. 7, §§ 231-236 (described in Vito, supra n. 55, at 376-377), but that law has been repealed.

156. 2001 Me. Laws 334, codified at 7 MRSA § 530-A. The Draft Guidance is cited supra n. 80. See S.B. 01-146, 63rd Gen. Assem. (Colo. 2001), which would have required labeling of genetically engineered foods, but was postponed indefinitely.

157. H.F. 2614, 81st Reg. Sess. (Minn. 1999). The bill was introduced in 2000, failed to pass, and was not carried over.

158. B. 959, 69th Legislature, 2d session (Neb. 2000). The bill failed to pass, and was not carried over.

159. S.B. 1789 (Mass. 2001). The bill was referred to committee. See also H. Con. Res. 1010, 76th Legislative Assembly (S.D. 2001), which asked that Congress pass legislation imposing liability for damages caused by GMO seeds on their developers. The resolution did not pass.

3. GM Moratorium?

In a few states, legislators have introduced bills to impose a moratorium on sale or planting of genetically modified wheat or other genetically modified crops within their territory. For example, a North Dakota bill would have prohibited sale of genetically modified wheat seed,[160] and a Montana bill would have prohibited production or planting of genetically modified wheat.[161] Bills introduced in New York,[162] Massachusetts,[163] and Vermont[164] would have imposed a moratorium on all GM crops. Opponents of such state restrictions argue that they may violate the dormant commerce clause of the U.S. Constitution by acting discriminatorily or extraterritorially or by imposing excessive burdens on interstate commerce. Recent commentary argues that legitimate local interests (e.g., protection against genetic drift and economic harm) may justify such restrictions, provided that they are drafted artfully to avoid extraterritorial effect.[165]

4. Liability for Damage to GMOs

Liability for damage to GM crops themselves — a form of eco-terrorism — is subject of new laws in a number of states. For example, a law enacted in Louisiana in June 2001 creates the crime of criminal damage to genetically engineered crops, and imposes fines and jail terms on those who damage GM crops, crop facilities, or crop information belonging to another person.[166] A number of other states have enacted laws designed to discourage destruction of GM crops or research facilities.[167]

In North Dakota, a recent law requires GM patent holders to obtain written permission from the farmer (or a court order) before entering farmland to obtain crop samples to investigate patent infringement, and enacts other safeguards.[168]

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160. H.B. 1338, 57th Leg. Assem. (N.D. 2001). The bill passed, after amendment, as a directive that the Legislative Council study issues related to GM products and report back to the legislature.

161. H.B. 211 (Mont. 2001).

162. A.B. 5741 & S.B. 3016, 224th Ann. Leg. Sess. (N.Y. 2001).

163. H.B. 2007, 182nd Gen. Ct. (Mass. 2001).

164. H.B. 247 & S.B. 79, 66th Bien. Sess. (Vt. 2001).

165. Moeller, "State GMO restrictions and the dormant commerce clause," *Agric. L. Update* 1 (Aug. 2001). Moeller found no reported GM cases that claimed violation of the dormant commerce clause.

166. 2001 La. ALS 1081, codified at La. Rev. Stat. Ann. § 14:56.3. See the fact sheet cited supra n. 149 for information on other state laws dealing with destruction of agricultural products.

167. Feirick, "Nighttime Gardening with Elves: The Rise of Eco-Terrorism," ch. K-3, at K-3-12, American Agricultural Law Association, 22nd Annual Meeting, Colorado Springs (12-13 Oct. 2001).

168. H.B. 1442, 57th Leg. Assem. (N.D. 2001), codified at N.D. Cent. Code § 4-24-13. A North Dakota soybean farmer, Rodney Nelson, has faced a legal battle with Monsanto for alleged patent infringement, http://www.nelsonfarm.net.

5. Restriction on local ordinances

States that intend to encourage the development and use of GM crops and other products can prohibit local restrictions on those crops. For example, Virginia law includes the following provision, effective 1 October 2001:

> No locality shall enact any regulation or ordinance regulating or prohibiting (i) the planned introduction of genetically engineered organisms into the environment or (ii) biotechnology research activities; however, the siting of biotechnology research activities shall be subject to the zoning and land use laws and regulations of the localities in which such activities are conducted . . . .[169]

This law negates local government authority to regulate GMOs, except in limited land-use and public safety contexts.

B. Local Regulation Including Zoning

Under the police power, state governments have the authority to protect the health, safety, and welfare of their citizens. Municipalities, counties and other units of local government enjoy regulatory power that has been delegated by state law.[170] Home rule units (counties and municipalities) enjoy broad power to protect the public health, safety, and welfare, though the state legislature can preempt most home rule powers.[171]

1. Early Regulation

As the Virginia law cited above suggests, local governments may have an interest in regulating or prohibiting activities that involve GM organisms. Research suggests that before 1986, regulatory efforts directed toward GMOs were local, often in areas with active research communities.[172] Local regulation was based on NIH Guidelines enacted in 1976 to govern recombinant DNA researchers funded by NIH.[173] Early local regulation supplemented the NIH Guidelines by adding lay participation in risk determination and widening their applicability.

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169. Va. Code Ann. § 2.2-5509 (2001). Activities are subject to public safety and tax ordinances. This provision is part of the Virginia Biotechnology Research Act, id. §§ 2.2-5501 to -5509. The limitation on local regulation replaced a similar section (Va. Code Ann. § 2.1-778, repealed effective 1 Oct. 2001).

170. E.g., Ill. Const. art. VII, § 7.

171. E.g., Ill. Const. art. VII, § 6.

172. Vito, supra n. 55, at 356.

173. On the NIH Guidelines, see Bessette, supra n. 56, at 1127-1130; Rosenblatt, Note, "The Regulation of Recombinant DNA Research: The Alternative of Local Control," 10 *B.C. Envtl. Aff. L. Rev.* 37, 55-66 (1982). The NIH guidelines were relaxed in 1978 and 1980.

Cambridge, Massachusetts was the first municipality to regulate genetic engineering. After a short moratorium on biotechnology research, accompanied by an investigation of risks, the city council enacted an ordinance in 1977 to govern research. The ordinance incorporated the NIH Guidelines, but extended their applicability to all laboratories and imposed additional precautions, including safety provisions, a permit requirement, and measures for enforcement.[174] In 1982, Massachusetts officials developed a model local recombinant DNA ordinance intended "to ensure that research facilities are properly designed and equipped."[175] Other municipalities, especially in the Northeast and in California, enacted ordinances to govern biotechnology research.[176]

2. Zoning

States normally delegate to municipalities and counties the authority to govern land use through zoning.[177] Thus, zoning is an important form of local land-use control that can protect the public health and safety by restricting the location, or even the legality, of specified businesses or business activities. Local regulation, including zoning, can be preempted by federal or state provisions in some circumstances. Because zoning ordinances apply to a limited geographic area, they have rather narrow impact and are less easily accessible to researchers.

In a sense, zoning is the "flip side of nuisance law."[178] Nuisance law can be viewed as "a device for striking land-use bargains, a town-planning device prior to the emergence of zoning laws."[179] Though nuisance cases still arise frequently, the prevalence of zoning has made nuisance law less critical in resolving land-use conflicts. Indeed, zoning " was in some measure a reaction to the inability of nuisance law to provide fully for a resolution of the landuse conflicts which arose in a developed economy."[180] Zoning gives local governments the opportunity to avoid land-use conflicts, thus preventing incompatible land uses from giving rise to nuisance situations.

The first attempt to release a genetically altered pesticide in the United States led to enactment of a zoning ordinance. In 1985, the U.S. EPA issued the first GM field-test permit to Advanced Genetic

174. See Bessette, supra n. 56, at 1142-43; Rosenblatt, supra n. 173, at 68-77.
175. Bessette, supra n. 56, at 1143.
176. Hoffmann, "The Biotechnology Revolution and its Regulatory Evolution," 38 *Drake L. Rev.* 471, 537-38 (1988-1989).
177. E.g., 65 ILCS 5/11-13-1 to -20 (municipalities); 55 ILCS 5/12001-12019 (counties). A few states have more control of land-use decisions in programs that include state-wide zoning (only Hawaii) or state standards for zoning regulation (e.g., Oregon).
178. Reinert, supra n. 115, at 1703.
179. Furrow, supra n. 101, at 1437.
180. Halper, supra n. 98, at 128

Sciences, who planned to test their pesticide in Monterey County. After demonstrations by residents, the County responded with an ordinance that prevented the release.[181] The 1986 Monterey County ordinance subjected GM organisms to land-use regulation, allowing local governments to prohibit experiments with GM organisms on designated land areas.[182]

The Monterey County Zoning Ordinance continues to regulate genetic engineering experiments.[183] The ordinance declares that it does not intend to enter the "regulatory sphere occupied by the federal and state government," but instead to use land-use planning and zoning to determine the proper location for GM experiments, to facilitate local government response to adverse effects. Experiments involving the release of GM micro-organisms in the open environment require a use permit. Permits may be granted only on land designated for farming, grazing, and agricultural conservation or preservation, and experiments must normally be more than a mile from any permanent residence. Permits require environmental review, as well as submission of extensive information about the planned property, types of GMO, and various control measures. The ordinance regulates only experimental releases, not releases of approved varieties.

Local zoning intended to restrict GM crops, especially approved varieties, may face significant legal obstacles. Some important agricultural states have zoning delegation laws that limit local government power to regulate agricultural activities. For example, delegation of zoning to counties in Illinois gives county boards the authority to regulate the "location and use of buildings, structures and land for trade, industry, residence and other uses. . . ; [and] to regulate and restrict the intensity of such uses." But these zoning powers may *not* be used "to impose regulations, *eliminate uses*, buildings, or structures, or require permits with respect to land used for agricultural purposes, which includes the growing of farm crops, truck garden crops, animal and poultry husbandry . . . when such agricultural purposes constitute the principal activity on the land."[184] Counties may impose building or set-back lines and establish minimum lot sizes for residences on agricultural land.

181. The release occurred in 1987 at another California location. See 50 Fed. Reg. 49760 (1985) and Monterey County, Cal., Ordinance 3124 (1986), cited in Bessette supra n. 56, at 1135-36.

182. Bessette, supra n. 56, at 1144.

183. Monterey County Zoning Ordinance, title 21, § 21.64.140. The Coastal Implementation Plan, title 20, § 20.64.140, includes similar requirements. Both are available at http://ww.co.monterey.ca.us/pbi/Ordinances/ (updated Sept. 2001). Several other ordinances are cited at Bessette, supra n. 56, at 1147 n.188.

184. 55 ILCS 5/12001 (emphasis added). Counties may regulate certain parcels smaller than 5 acres. See also Mass. Ann. Laws ch. 40A, § 3 (1999) (restricting zoning on agricultural land). Similar limits apply in special agricultural districts, e.g., Minn. Stat. Ann. § 40A.12 (1998) (restricting local government regulation of "normal agri-

Depending on the language of the state enabling act, limitations on agricultural zoning powers may prevent local governments from zoning to restrict location of GM crops. Under the Illinois law, for example, "agricultural purposes" are defined broadly to include "growing of farm crops," which would surely include GM varieties. This statute defeated a recent county attempt to deny a permit to an industrial-scale hog facility; the court found hog farming to be an agricultural purpose which could not be prohibited under the zoning provision.[185] Counties would face similar obstacles in restricting GM crops, though set-back distances would seem to be acceptable.

C. *Possible State Approaches*

Zoning is not the only regulatory tool that could help to segregate GM crops from other varieties. Another way to minimize problems caused by pollen drift and commingling of GM and other varieties is through state-mandated geographic segregation.[186] Using police power, state governments could create districts where GM crops are permitted or prohibited. A model might found in the California law that forms the San Joaquin Valley Quality Cotton District.[187] That law restricts use of cotton lands, permitting only Acala and Pima cotton to be ginned in the district; "otherwise the gin will mix the different types of seed, crossing will take place in the field, the varieties will be mongrelized and cease to be uniform . . . ."[188] A Cotton Board implements the law, funded by assessments, and regulations govern cotton growing and related activities. Cotton that does not comply with the law is a public nuisance and subject to seizure; those who violate the law are guilty of a misdemeanor and are civilly liable for resulting damages. Building on this California model, state-created districts designed to segregate GM crops might help to avoid cross-pollination and commingling.

If mandatory state restrictions are not feasible, farmers may work together voluntarily. A number of states have authorized formation of special agricultural districts, designed primarily to prevent conversion of farmland. In exchange for agreements to keep land in agricultural use, district statutes offer protection from certain types of local government regulation and impose limits on nonfarm development; some programs include protection from nuisance lawsuits

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cultural practices" within an agricultural preserve, unless related to public health and safety).

185. County of Knox v. The Highlands, 723 N.E.2d 256 (Ill. 1999).

186. For the suggestion that growers' districts might offer protection, see Redick & Bernstein, supra n. 12, at 10339-40.

187. Cal. Food & Agric. Code §§ 52851-52982. See also the provisions that regulate identity preservation in rice varieties. Id. §§ 55000-55108.

188. Id. § 52852. Unapproved varieties can be grown only in compliance with regulations. Id. § 52981.

and reduced property tax assessments.[189] Agricultural districts are flexible devices, formed according to statutory procedures and approved by a governmental authority. Terms are normally fixed (e.g., 10 years), but renewable, and participation is voluntary.

Agricultural districts may also offer an opportunity for farmers to avoid some of the contamination and commingling problems that accompany production of GM crops. Owners of contiguous land could agree to form a special-purpose agricultural district and to limit production in that district to GM, traditional, or organic crops, with shared responsibility for measures (e.g., set-backs) required to protect the crops of district farmers and farmers adjacent to the district. In some states, existing agricultural district statutes may provide the necessary authority; in others, amendments may be necessary if acceptable practices in a district will be defined more restrictively than "agricultural production."[190] Nothing would seem to prevent owners of land in a district from acting voluntarily.

CONCLUSION

Crops developed through biotechnology offer significant agricultural benefits, and continued research promises new crops with nutritional and other improvements. Despite regulatory oversight and extensive testing, GM crops are perceived to pose environmental risks, especially for wildlife and biodiversity. Cross-pollution and commingling can lead to economic losses, especially when growers plant GM crops not approved for all uses and by important trading partners. If risk becomes reality, GM crops can affect the property rights of neighboring landowners, as well as the rights of the general public and those in the stream of grain commerce.

In the absence of laws specifically designed to address liability for damage from GMOs, common-law tort actions offer a remedy to the general public and to property owners who have suffered compensable damages. On the regulatory side, states have done little to restrict the growing of approved GM crops, even in areas with important wildlife or vulnerable organic crops. Moreover, agricultural activities are often protected from local zoning regulations that might otherwise delineate appropriate locations for GM crops. Special-use districts, imposed by state law or organized voluntarily, could be used to segregate GM crops from other vulnerable land uses.

GM crops are new, and continued experience with these products will eventually determine what risks are truly significant and what

189. For a summary of relevant provisions, see American Farmland Trust, Fact Sheet, Agricultural District Programs (1998), http://www.farmlandinfo.org/fic/tas/tasf-adp.html.

190. See, e.g., 505 ILCS 5/2-5/20.3, the Illinois statute, which defines agricultural production broadly.

problems can be avoided through appropriate management practices. Law will play a role in the process, both in *ex ante* regulation and *ex post* assignment of liability. But the promise of GM technology suggests that the law should not thwart its careful development. Indeed, as one commentator noted, in this area of "cutting-edge technology, where it is most important not to stifle creativity . . . , " regulators should not let "misplaced public concern . . . spawn hastily drafted, unnecessary, and shortsighted quick fixes."[191]

191. Kunich, supra n. 57, at 868, 870.

[Footnotes]

[15] **The Ecological Risks and Benefits of Genetically Engineered Plants**

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