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"Attack of the Killer Tomatoes?" Corporate Liability for the International Propagation of Genetically Altered Agricultural Products

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TABLE OF CONTENTS

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I. INTRODUCTION

We are now entering an age where humans have the ability to create life, and in essence play God. In 1973, the gene was first cloned.[1] Now, in 1997, chimpanzees[2] and sheep[3] are being cloned using biotechnology.[4] These scientific discoveries and genetic experiments are said to be in the best interest of mankind.[5] In fact, biotechnology is justified as a solution to many intractable environmental and societal problems. Currently, the world's population is depleting its natural resources faster than they can regenerate.[6] Similarly, the growing world population is producing more waste, thus contaminating the ecosystem.[7] Finally, the reality of hunger is prevalent in every nation.[8] The application of biotechnology is perhaps the solution to all of these critical international issues.

On the other hand, the potential deleterious impacts of biotechnology on the environment and mankind may outweigh the benefits. The introduction of a new species into the environment could cause the extinction of native species.[9] Similarly, a more productive species could be used extensively, thus reducing worldwide

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1. *See* MICHAEL W. FOX, SUPERPIGS AND WONDER CORN 7 (Lyons & Burford 1992) (describing the commercialization of biotechnology as growing at amazing speed since the first gene was cloned in 1973). A clone is an exact genetically identical organism. *Id.* at 193.

2. *See* Bob Baum, *Monkey Cloning Fuels Controversy*, ASSOCIATED PRESS (Mar. 2, 1997) <http://aol.com> (Apr. 28, 1997) (on file with *The Transnational Lawyer*) (reporting two monkeys have been cloned in Scotland as an experiment to help research AIDS, alcoholism, depression and other illnesses).

3. *See* Malcolm Ritter, *Researchers Clone Mammal*, ASSOCIATED PRESS (Feb. 23, 1997) <http://aol.com> (Apr. 28, 1997) (on file with *The Transnational Lawyer*) (discussing Dolly, the result of the first cloning of an adult mammal by using genes from a six year old ewe to create pregnancies in other sheep).

4. *See* OFFICE OF TECHNOLOGY ASSESSMENT, U.S. CONGRESS, NEW DEVELOPMENTS IN BIOTECHNOLOGY: PATENTING LIFE 5, 183 (1989) (defining biotechnology as any technique that uses living organisms or substances from those organisms to make or modify a product, to improve plants or animals, or to develop micro-organisms for specific uses). *Cf.* David R. Purnell, *International Implications of New Agricultural Biotechnology*, 25 U. MEM. L. REV. 1189, 1192 (1995) (describing health beneifts of biotechnology); Michael E. Sellers, Note, *Patenting Non-naturally Occurring, Man-Made Life: A Practical Look at the Economic, Environmental and Ethical Challenges Facing "Animal Patents"*, 47 ARK. L. REV. 269, 271 (1994); *see generally* Charles E. Lipsey et al., *Protecting Trade Secretes in Biotechnology*, 224 PLI/Pat 807, 811 (1986) (describing biotechnology as encompassing the venerable technologies of plant breeding and food fermentation to the emerging sciences based on recombinant DNA and monoclonal antibodies); Alek P. Szecsy, *From the Test Tube to the Dinner Table in Record Time: Liberalizing Effects on Domestic and International Regulatory Frameworks for Controlled Environmental Introduction of Genetically Engineered Agricultural Organisms*, 2 DICK. J. ENVTL. L. & POL'Y 177 (1993) (citing examples of genetic engineering and biology as including biocomputing, eugenics, biomedical forensics, human tissue transplantation, bioagriculture, bio-assisted environmental pollution remediation, and bio-assisted natural resource development).

5. *See infra* notes 38-61 and accompanying text (discussing the various beneficial impacts which transgenics are thought to bring to society).

6. *See infra* notes 42-46 and accompanying text.

7. *See infra* notes 47-48 and accompanying text.

8. *See infra* notes 49-54 and accompanying text (discussing the various goals of transgenics to include development of the world's natural resources and combating world hunger).

9. *See infra* notes 68-70 and accompanying text.

genetic diversity.[10] In addition, the ability of plants to pollinate and reproduce across national boundaries forces foreign nations to address biotechnology on an international level.[11] Additionally, countries will now be able to produce products through bioengineering which they had to import in the past.[12] Finally, and most importantly, no one knows if a bioengineered species has the capacity to destroy the world's food resources or create a new incurable disease.

Until these potential impacts of biotechnology are fully understood, the release of a bioengineered species into the environment may cause an injury to a private party. If an injury traceable to a bioengineered species were to occur, a remedy should be provided to the injured party.

This Comment discusses current international issues surrounding transgenics, a specific form of biotechnology, and possible liability of private biotechnology producing corporations for damages resulting from their products when released in a foreign nation. Part II provides an overview of the science involved in creating a transgenic species, the public policy issues which currently arise from experiments in transgenics, and the corporate domination of sales and research in the transgenic industry.[13] Part III explains how genetically engineered transgenic products can proliferate and destroy adjacent cropland regardless of human attempts at control, and uses a hypothetical scenario to demonstrate the implications of transgenics.[14] Part IV covers the international choice of forum and choice of law issues which a private party must face in seeking a remedy from a corporation for damages caused by a transgenic agricultural product.[15] Part V discusses how the current liability schemes in international law and of the United States, Japan and Germany, the world's three largest biotechnology producing countries, could apply to damages caused by transgenic products.[16] Finally, Part VI assesses the ability of a private party to successfully seek a remedy from a corporation for damages from transgenics.[17]

II. BACKGROUND OF TRANSGENICS

A transgenic species of plant is a species which includes traits which have been transferred to it from another unrelated plant, animal, virus or bacteria by genetic engineering techniques.[18]

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10. *See infra* notes 71-73 and accompanying text.
11. *See infra* notes 74-78 and accompanying text.
12. *See infra* notes 79-81 and accompanying text.
13. *See infra* notes 18-101 and accompanying text.
14. *See infra* notes 102-51 and accompanying text.
15. *See infra* notes 152-78 and accompanying text.
16. *See infra* notes 179-403 and accompanying text.
17. *See infra* notes 404-10 and accompanying text.
18. *See* Glenda D. Webber, *Regulation of Genetically Engineered Organisms and Products*, Office of Biotechnology, Webber, at 2 (Feb. 20, 1997) <http://biotech.uams.edu:80/edu/bio 11.html> (on file with *The Transnational Lawyer*) (defining a transgenic species as an organism which includes traits which have been transferred from another organism).

New species of crops are not a new phenomenon to the farming industry, however, as man-made cross-pollination[19] of corn began in the 1930s in the United States.[20] As a result, other countries followed suit and the Green Revolution[21] began the world's drive to increase the production of crops through the breeding of new strains of wheat, corn and rice.[22] Moreover, in the last twenty years, scientists have discovered that deoxyribonucleic acid (DNA)[23] is interchangeable among animals, plants, bacteria and other living organisms.[24] Now, genetic engineering is taking the place of cross-pollination and producing new species of plant life with characteristics of organisms other than plants.[25]

A. *The Scientific Process of Transgenics*

This section will detail a fair amount of basic scientific theory and terminology which needs to be understood for a grasp of the legal issues presented. All living organisms are made up of cells that contain DNA.[26] DNA molecules in turn are made up of genes which determine the characteristics of the organism.[27] Scientists have recently developed the ability to interchange the DNA of animals, plants, bacteria and other organisms.[28] The human manipulated process of transferring foreign DNA into a cell, through methods such as direct injection or allowing a bacteria to infect the cell is genetic engineering.[29] The cell injected with foreign DNA will exhibit the

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19. *See* HELENA CURTIS & SUE BARNS, BIOLOGY 988 (Worth Publishings 1989) (stating when two different strains of corn are crossed with one another, a new hybrid which displays traits of each is developed).

20. *See id.* (covering the revolutionary development of the hybridization of corn in the 1930s which produced corn of greater size and hardiness).

21. *See id.* at 1148 (describing the Green revolution as a major effort to increase the world's food supply through the development of new crops plants and grains). The major activity occurred in the 1950s, through the 1970s. *Id.*

22. *See* DANIEL B. BOTKIN & EDWARD A. KELLER, ENVIRONMENTAL STUDIES: EARTH AS A LIVING PLANET 263 (2d ed. 1987) (listing the Green Revolution and the various programs which drove the success of the revolution, such as the International Rice Research Institute in the Philippines, and the International Maize and Wheat Improvement Center in Mexico).

23. *See* CURTIS & BARNS, *supra* note 19, at G-7 (defining deoxyribonucleic acid (DNA) as the carrier of genetic information in cells which is composed of two complementary chains of nucleotides wound in a double helix and capable of self-replication as well as coding for RNA synthesis); *see also* Fox, *supra* note 1, at 1 (describing DNA as the molecule that carries the genetic blueprint of every living organism).

24. *See* Webber, *supra* note 18, at 2 (describing genetic engineering as interchanging genes from all living organisms).

25. *See id.* at 2 (discussing a method to improve plants beyond traditional methods of cross-pollination such that transgenic plants can resist insects and viruses).

26. *Id.* at 2.

27. *Id.* at 2; Fox, *supra* note 1, at 1.

28. *See* Webber, *supra* note 18, at 2 (claiming in the last twenty years scientists have been able to interchange DNA from one organism to another); Fox, *supra* note 1, at 1 (stating various techniques can now be used to inject DNA into plants and animals).

29. *See generally* Webber, *supra* note 18, at 2 (describing direct injection as shooting cells with DNA particles from a gun, thus injecting the cells).

traits of the genes which made up the injected DNA, thus a new species is created.[30] This new species, with the foreign DNA, is called a transgenic species.[31]

In all plants, including transgenic plants, pollination[32] is a necessary biological reproductive function. Pollination brings the sperm of one individual plant together with the egg of another to facilitate reproduction.[33] There would be no fertilization, fruit or seed production without pollination.[34] In addition, when one species of plant pollinates another, a cross-pollination has occurred.[35] As a result of the cross-pollination, the genes of the two plants will have outcrossed.[36] Finally, the issue of transgenic species would not exist unless they were placed into the environment. Thus, the deliberate release of transgenic crops occurs when they are planted in an environment outside of a controlled study area.[37]

B. Societal Benefits and Fears of Transgenic Crops

One of the goals of transgenic crop production is to alleviate many of the environmental stresses caused by the ever-growing world population.[38] Problems currently gripping many countries include: (1) scarce resources;[39] (2) environmental contamination;[40] and (3) world hunger.[41]

Scarcity of resources is evidenced by, the depletion of the world's fisheries. Transgenic fish, that reproduce faster, are thought to be a solution to this serious problem.[42] In aquaculture[43] and mariculture,[44] trout, catfish, shrimp and many other

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30. *Id.* at 2.

31. *Id.* at 2.

32. 14 McGRAW-HILL, ENCYCLOPEDIA OF SCIENCE & TECH. 116 (6th ed. 1987) [hereinafter ENCYCLOPEDIA OF SCIENCE & TECH.] (defining pollination as the transport of pollen from the plant parts that produce them to the ovule-bearing organs, or ovules).

33. CURTIS & BARNS, *supra* note 19, at 512-15 (describing the evolution of the flower).

34. ENCYCLOPEDIA OF SCIENCE & TECH., *supra* note 32, at 116.

35. *Id.*

36. *See* Correspondence with Roger Chetelat, Curator, Tomato Genetic Resources Center (Feb. 12, 1997) (on file with *The Transnational Lawyer*) (discussing the difference of cross-pollination and an outcross).

37. *See* Judy J. Kim, Note, *Out of the Lab and into the Field: Harmonization of Deliberate Release Regulations for Genetically Modified Organisms,* 16 FORDHAM INT'L L. J. 1160, 1160-61 (1993) (stating deliberate release is the introduction of genetically-modified organisms into the environment). *See generally* Foundation On Economic Trends v. Heckler, 587 F. Supp. 753 (D.D.C. 1984) (analyzing the plans of the University of California to release genetically altered bacteria into potato crops).

38. *See* Bette Hileman, *Views Differ Sharply Over Benefits, Risks Of Agricultural Biotechnology,* CHEMICAL & ENGINEERING NEWS, at 1 (Aug. 21, 1995) (finding the world population could increase by 100 million people each year for the next thirty years); Fox, *supra* note 1, at 64 (describing biotechnology as being applied to enhance growth, disease resistance and to produce protein and pharmaceuticals from fish).

39. *See infra* notes 42-46 and accompanying text.

40. *See infra* notes 47-48 and accompanying text.

41. *See infra* notes 49-54 and accompanying text.

42. *See Views Differ, supra* note 38, at 1 (hypothesizing biotechnology as having the ability to relieve food and water shortage problems throughout the world); *see also id.* at 17 (quoting Rita R. Colwell to say the world's demand on fisheries demand that we must raise transgenic fish). The world's oceans can produce 100 million metric tons of fish annually, the current harvests have dropped to 80, and the world's population will soon require 135

species are now transgenic products of biotechnology.[45] These transgenic fishes are now able to reproduce more readily and resist disease which had decimated populations in the past.[46]

Environmental contamination of irrigation water due to herbicide and insecticide run-off into local rivers is the cause of a scarce fresh water supply throughout much of the world.[47] Crops can now be engineered to genetically repel weeds and insects, thus less herbicide and insecticide will be applied to the crops and less will enter the rivers.[48]

Finally, experts predict the world population will expand by 100 million people a year for the next thirty years,[49] while farmland can only be increased slightly and erosion[50] threatens many existing farms.[51] It appears inevitable that world population will grow faster than food production.[52] Transgenics can allow food production to be increased by creating hardier agricultural species that ripen faster, have more offspring and mature more quickly.[53] Consequently, perhaps our diets will include only transgenic foods in the near future.[54]

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million metric tons. *Id.*

43. Aquaculture is the production of food from aquatic habitats-marine and freshwater. ENVIRONMENTAL STUDIES, *supra* note 22, at 265.

44. Mariculture is the production of food from marine habitats . . . it is part of aquaculture. *Id.* at 267.

45. *See* Fox, *supra* note 1, at 64 (describing the spectrum of biotechnology applications in the production of fish). Biotechnology is being applied to enhance growth, disease resistance and to produce protein and pharmaceuticals from fish. *Id.*

46. *Id.*

47. *See Views Differ*, *supra* note 38, at 1 (emphasizing bioengineered species which genetically resist pests could reduce the use of herbicides and promote no-till agriculture which in turn will reduce run-off into the local water supply).

48. *Id.* at 1. *But see* Fox, *supra* note 1, at 84 (hypothesizing it is possible that diseases arose due to unsound farming practices and the decrease in crop dependence on pesticides and herbicides by using transgenic species is not the solution; changing the farming practices is).

49. *See Views Differ*, *supra* note 38, at 1 (discussing the world's problems as we enter into the twenty-first century to include erosion, loss of fishery production and water contamination).

50. *See* BOTKIN & KELLER, *supra* note 22, at 281 (stating soil is always being lost from agriculture, but the rate of loss varies with the crop and methods of agriculture). In the United States, about 80 millions hecta acres (10,000 m^2) are either totally ruined or only marginally productive. *Id.* at 282.

51. *See Views Differ*, *supra* note 38, at 1 (stating farmland cannot be expanded to equal the population growth, as population increase is concurrent with soil erosion and thus, farm depletion).

52. *See* CURTIS & BARNS, *supra* note 19, at 1148-49 (claiming if the world population would remain at the 1950s level, there would be no problem with food supplies since the incredible increase in agricultural productivity of Mexico, China and India in the 60s and 70s, will not be able to keep pace forever).

53. *See* Fox, *supra* note 1, at 64 (describing the ability of biotechnology to enhance the biocompetitiveness and adaptability of crops, drought, salinity, disease and pest resistance, and growth, productivity, and nutrient value of crops); Purnell, *supra* note 4, at 1192 (stating crops could be made more resistant to pests which allows farmers to rely less on pesticides which in themselves are harmful to humans).

54. *See* Fox, *supra* note 1, at 92 (hypothesizing a dinner of transgenic foods to be in our near future) Appetizers: Spiced Potatoes with Waxmoth genes, Juice of Tomatoes with Flounder gene. *Id.* Entree: Blackened Catfish with Trout gene, Scalloped Potatoes with Chicken gene, Cornbread with Firefly gene. *Id.* Dessert: Rice Pudding with Pea gene. *Id.* Beverage: Milk from Bovine Growth Hormone (BGH)-Supplemented Cows. *Id.*

In an effort to stop the depletion of resources, environmental contamination, world hunger and meet other goals, the biotechnology industry is constantly innovating, developing and testing new organisms.[55] However, the world is beginning to recognize the inter-relation of mankind and the environment; and study global environmental problems.[56] In fact, issues of sustainable development and biodiversity are prevalent in many international agreements.[57] Consequently, environmental protection is a common concern of mankind drawing international action.[58]

By manipulating DNA, scientists can now create enhanced species of plant life.[59] The manipulated DNA, however, may be transferred between species causing immunological and other disabling or disastrous effects.[60] During the 1970s and 80s, the free flow of manipulated plant genetic resource materials created a new concern throughout the world.[61]

55. *See generally* Sean Adams & Dennis Senft, *The Busiest of Bees*, AGR. RES., available in Westlaw, 1994 WL 13044728, at 1 (Feb. 1, 1994) (discussing tomato pollination). *Cf. Agricultural Glycosystems Signs License Agreement with Government of Israel*, WORLDWIDE BIOTECH, available in Westlaw, 1996 WL 5809749 (Mar. 1, 1996) (exposing IGG International, Inc.'s licensing agreement with Israel to field trials of immune response compounds on crops); *Mycogen Receives Approval in Spain for MVP Bioinsecticide*, WORLDWIDE BIOTECH, available in Westlaw, 1992 WL 2331151 (Aug. 1, 1992) (stating a bioinsecticide that kills moths is now legal for sale in Spain); Maureen Byrne, *Genetic Engineering: Designer Genes for the 21st Century*, FOOD ENGINEERING INTERNATIONAL, available in Westlaw, 1994 WL 13277276 (Oct. 1, 1994) (describing various genetic engineered crops); *Delayed-Ripening Tomato Declared Safe to Grow Without Oversight*, WORLDWIDE BIOTECH, available in Westlaw, 1995 WL 8111423 (Mar. 1, 1995) (explaining the U.S. Department of Agriculture's decision to allow the release of delayed-ripening tomato line). *But cf.* David Barrager, *Japan: Food Imports Soar*, FOOD ENGINEERING INT'L, available in Westlaw, 1996 WL 11265077 (June 1, 1996) (describing the lack of Japanese production).

56. U.N. GAOR, U.N. CONFERENCE ON ENVIRONMENT AND DEVELOPMENT 7/9/1991 [hereinafter CONFERENCE ON ENVIRONMENT] (recognizing the ministers from 41 developing countries agreement that deep concerns exist about the degradation of the environment). Global elements essential to human life are threatened by air pollution, climate change, ozone layer depletion, loss of fresh water, water pollution, floods and droughts, soil loss, desertification, deforestation, loss of biodiversity and others. *Id.* at n.1.

57. *See infra* notes 190-212 and accompanying text.

58. *See* CONFERENCE ON ENVIRONMENT, *supra* note 56, at n.2 (claiming sustainable development and environmental protection is a concern which requires international actions and global cooperation).

59. *See* Fox, *supra* note 1, at 10 (discussing the advancement of DNA technology to manipulate plants).

60. Linda Maher, *The International Framework for Biotechnological Regulation*, 6 N.Y. INT'L L. REV. 98 (1993) (listing problems of transgenics such as mutation and chain toxins); *see* Hileman, *supra* note 38, at 1 (stating critics claim the advantages of bioengineered products have been exaggerated and potential dangers that have not been fully investigated). *But see* Fox, *supra* note 1, at 61 (stating agribusiness seeks to increase productivity of animals and crops and to stop diseases that other manipulations have caused).

61. *See* Michelle *Thom, International Policy on Plant Genetic Engineering, Institute for Agriculture and Trade Policy*, at 1 (Nov.11, 1996) <http://www.igc.apc.org/iatp/ipr-info11.html> (on file with *The Transnational Lawyer*) (claiming the free flow of plant genetic resources created concern in the developing nations and caused Third World leaders to start the seed wars of the 80s and voice there concerns in the United Nations Food and Agriculture Organization (FOA)); *see also* Fox, *supra* note 1, at 88 (implying cancer, sterility, developmental defects and inherited abnormalities all develop from food, water and air). Economic impacts are also recognized as the synthetic production of vanilla in the United States competes with third-world countries economies which were once the sole source for natural vanilla. *Id.* at 17.

Biotechnology, while promising tremendous benefits, also brings fears.[62] Potential world-wide problems include: (1) disruption to the ecosystem;[63] (2) reduction in genetic diversity;[64] (3) ability of transgenic species to proliferate across national borders;[65] and (4) the potential to wipe out the major exports of developing nations.[66] But, perhaps the greatest fear of all, is that the exact consequences of a released transgenic organism are unknown.[67]

The introduction of transgenic species into the environment could provide a devastating impact on wildlife and ecosystems.[68] By generating a species which is impervious to environmental defenses such as disease or harsh weather,[69] transgenic species will be able to enter and dominate new regions which will have no natural defenses to the new species.[70]

Furthermore, the reduction in genetic diversity is a major scientific concern of transgenics.[71] Once a transgenic crop enters the world market and is proven to ripen quicker or be less susceptible to disease, farmers will buy it.[72] Soon most of the fields will be planted with the most prolific species and all others will be forgotten. Similarly to the concerns threatening the ecosystem, if transgenic species are able to

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62. *See generally* Fox, *supra* note 1, at 17 (deducing risks to animals from transgenics to include direct suffering from genetic manipulation and habitat competition). Risks to humans can involve environmental, social and ethical issues. *Id.*; Diamond v. Chakrabarty, 447 U.S. 303, 316 (1980) (where former United States Supreme Court Chief Justice Burger called the possible harm of manmade living organisms, a "gruesome parade of horribles"); *see also* Purnell, *supra* note 4, at 1190 (claiming biotechnology represents an unknown and most frightening threat as man imposes his domination on the fundamental nature of life); Fox, *supra* note 1, at 172 (noting biotechnology when applied can create things we do not want to encounter, and be better off without).

63. *See infra* notes 68-70 and accompanying text.

64. *See infra* notes 71-73 and accompanying text.

65. *See infra* notes 74-78 and accompanying text.

66. *See infra* notes 79-81 and accompanying text.

67. *See generally* Purnell, *supra* note 4, at 1193 (claiming concerns about biotechnology exist because of the unknown consequences); *see also* Kim, *supra* note 37, at 1166 (noting the apprehension among ecologists is not due to the scientifically certain harms which will follow the introduction of a transgenic species, but the potential and uncertain problems of GMOs).

68. *See* Fox, *supra* note 1, at 3 (stating the complexity of the ecosystem causes uncertainty as to the exact impacts of our actions until they occur). *See generally* Kim, *supra* note 37, at 1169 (discussing the similar characteristics of the introduction of exotic species, which will often dominate and destroy a native species, and the possible impacts of an introduction of transgenics).

69. *See* Fox, *supra* note 1, at 146-47 (discussing the defenses of local wildlife and ecosystems such as local diseases and weather patterns which would keep the transgenic species out, without the genetically altered resistance). The fact that the transgenic species will be impervious to many of the local environmental limitations will enable it to out-compete and displace the native species causing extinction of the indigenous species. *Id.* at 147.

70. *See* Fox, *supra* note 1, at 147 (finding the introduction of transgenic species to possibly hasten the destruction of wildlife and habitat); *see also* Kim, *supra* note 37, at 1168 (comparing the introduction of transgenic species to the introduction of exotic species). Although transgenic species cannot be thought of as analogous to an exotic species, displacement and domination of native species by transgenic species could occur. *Id.*

71. *See* Maher, *supra* note 4, at 1194 (stating result is a dramatic decline in the number of varieties used in today's crops).

72. *See id.* at 1194 (noting farmers naturally choose the most productive varieties of crops).

out-compete native species, biodiversity will be threatened on farms and in the ecosystem.[73]

The environmental problems previously discussed[74] are further enhanced by the ability of transgenic species proliferate across national borders.[75] Transgenic plant species outcross through cross pollination.[76] The pollen of transgenic plants can be moved over great distances by wind, animals or other process.[77] Thus, outcrosses and impacts are out of human control.[78]

An often overlooked impact of transgenics is its potential to wipe out the major exports of developing nations.[79] Mankind now has the ability through transgenics to produce natural vanilla[80] and high-yielding cacao plants[81] in countries that previously could not grow such plants.

The simple fact is, the same technology which produces transgenic species does not indicate how the earth will receive them.[82] The effects hypothesized can be extreme and extend to all aspects of society.[83]

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73. *See* Maher, *supra* note 60, at 99 (hypothesizing if bio-engineered species out compete natural species, bio-diversity would be lost). *But see* Purnell, *supra* note 4, at 1194 (arguing genetic engineering is not the cause of a loss of biodiversity, but it is the desire of producers to use the most productive varieties).

74. *See supra* notes 62-73 and accompanying text.

75. *See* Thomas O. McGarity, *International Regulation of Deliberate Release Biotechnologies,* 26 TEX. INT'L L.J. 423, 424 (1991) (postulating genetically engineered plants can proliferate from the nation of introduction, across national borders, to cause impact in countries great distances from the country of initial release of the transgenic species). *See generally* Edith Brown Weiss, *Transboundary Air Pollution: International Legal Aspects of the Co-operation of States,* 82 AM. J. INT'L L. 197, 198 (1988) (noting pollution has no recognition of borders). Transfrontier pollution includes loss of biological diversity. *Id.* at 198.

76. *See supra* notes 26-37 and accompanying text (formulating the scientific processes of pollination). *See generally* CURTIS & BARNS, *supra* note 19, at 615-17 (discussing the fertilization of flowering plants).

77. *See infra* notes 102-32 and accompanying text (setting forth the many possibilities of pollination in nature). *See generally* ENCYCLOPEDIA SCIENCE & TECH., *supra* note 32, at 117 (discussing pollination by wind as possibly explosive, scattering pollen widely, and the pollination systems as measurable systems for measuring gene flow).

78. *See* EDWARD BRUGGEMANN, ENVIRONMENTAL RISKS OF TRANSGENIC TOMATOES, WORKSHOP ON SAFEGUARDS FOR PLANNED INTRODUCTION OF TRANSGENIC TOMATOES, CONFERENCE REPORT, pg. 15 (1992) (stating we cannot depend on farmers to stop all escape of transgenes and thus, we must accept that genetic escape will occur).

79. *See generally* Fox, *supra* note 1, at 99 (citing The Rural Advancement Fund International (RAFI) Communiques Sept. 1986) (summarizing Nigeria, Senegal, Sudan, and other states could possibly lose $60 million in annual export earnings from gum arabic).

80. *See id.* (stating Madagascar, Comoros Islands, Reunion and Indonesia may lose up to $67 million in export earnings of vanilla orchids, now that tissue cultures from vanilla orchids can be transferred to other species); *see also* Hileman, *supra* note 38, at 15 (a genetically modified bacterium is being developed to produce vanilla flavoring).

81. *See generally* Fox, *supra* note 1, at 99 (citing RAFI Communique May 1987) (stating cacao plants are used by the chocolate industry, and can now be produced on a large plantation-like scale, thus destroying demand in many cocao producing countries).

82. *See generally* Hileman, *supra* note 38, at 1 (stating the potential dangers of biotechnology have not been investigated).

83. *See supra* notes 62-83 and accompanying text.

C. The International Business of Transgenics

A billion dollar industry,[84] transgenics has the ability to revolutionize both developed and developing countries, through massive inflow of capital in countries which produce[85] and allow for the release of transgenics. [86]The moneys generated from sales and patents will transform the economies of developed nations.[87] Similarly, developing nations will embrace more transgenic products, with less strict release regulations, and will benefit from higher yielding and higher quality crops through the export market.[88] In the context of transgenics, technology is the engineering of life processes for commercial ends.[89] By the year 2000, annual sales of transgenic products may reach several billion dollars.[90]

The large impact of transgenics will be dominated by large corporations with the extensive capital to produce both the products and the continuous research needed to stay on the cutting edge.[91] Since most of the transgenic species are sought to resist pests, resist disease and grow faster and healthier,[92] companies with interests in the seed industry, crop chemicals and animal health will be advantaged.[93]

The first transgenic product's approval for sale in the United States followed many years of development.[94] Between 1987 and 1991, the United States government approved approximately fifty applications to release transgenic species into the en-

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84. *See* Fox, *supra* note 1, at 66 (stating billions of dollars are invested to increase farm production); *see generally* Maher, *supra* note 60, at 105 n.2 (1993).

85. *See* Purnell, *supra* note 4, at 1192 (maintaining although the countries which allow the transgenics into their farms will benefit, the fact that transgenics is patentable in the United States and other countries, producers of the transgenes will gain benefits).

86. *See id.* at 1192 (relating more efficient, higher yielding, higher quality crops will provide economic benefits to countries which facilitate the release of these superior products through the export markets).

87. *See generally id.* at 1192 (discussing the benefits of transgenics).

88. *See id.* at 1192 (listing the export benefits to countries allowing the use of transgenics to boost their agricultural products).

89. *See* Fox, *supra* note 1, at 60 (explaining how we are trying to use our power over genetics to improve on nature for our gains); *see also* McGarity, *supra* note 75, at 438 (claiming companies may sell transgenic plants to foreign countries to exploit a lack of resources or expertise in transgenics).

90. *See* Hileman, *supra* note 38, at 3 (hypothesizing the possible economic impact that the emerging transgenic industry will have).

91. *See* Fox, *supra* note 1, at 65 (quoting Dr. David Wheat, that large companies will have to acquire agricultural biotechnology in order to compete effectively with the smaller companies that currently produce transgenics). However, small firms may be forced to sell their technology or pursue specialty markets. *Id.* at 65. *See generally* McGarity, *supra* note 75, at 435 (stating the international development and marketing of biotechnologies will be dominated by multinational corporations).

92. *See supra* notes 38-61 and accompanying text (depicting the benefits of transgenic species to include heartier crops).

93. *See* Fox, *supra* note 1, at 65 (hypothesizing companies such as Pioneer, Sanoz, Imperial Chemical Industries, Dow, and Ciba-Giegy will have an advantage).

94. *See* Hileman, *supra* note 38, at 3 (stating the first major agricultural bioengineered product to enter the United States marketplace was Monsanto's recombinant bovine growth hormone; approved for sale in February 1994).

vironment for field testing.[95] For example, bovine growth hormone was approved in February of 1994;[96] transgenic tomatoes[97] soon followed. However, the United States is not the only country which is actively seeking to improve on life.[98]

The release of genetically modified organisms is an issue of concern throughout the world.[99] The transgenic species is now entering the marketplace on an international level.[100] Transgenic organisms have been released in Argentina, Australia, Belgium, Canada, Chile, Denmark, Finland, France, Germany, Great Britain, Italy, Japan, Mexico, the Netherlands, New Zealand, Spain, and Sweden.[101]

III. PROPAGATION: HOW TRANSGENICS CAN SPREAD

Pollination[102] brings the sperm of one individual plant together with the egg of another.[103] Thus, there would be no fertilization, fruit production or seed crops without pollination.[104] The pollination of plants can occur in many ways which are out of

95. *See* Fox, *supra* note 1, at 12 (citing THE GENE EXCHANGE, vol. 2, no. 3 (Washington, DC: Nat'l Wildlife Fed'n, 1991), pp. 11-14 (sp12) (naming the various companies which applied to release transgenic species including: Calgene, Amoco, Monsanto, Ciba-Geiy, Upjohn, Pioneer Hybrid, and Campbell Soups).

96. Hileman, *supra* note 38, at 3; *see* Fox, *supra* note 1, at 103 (summarizing Ohio State researcher J. Mintz' prediction of the future in transgenic agricultural products to include cattle weighing over 10,000 pounds and pigs exceeding 12 feet in length becoming possibilities in the near future).

97. *See* JOHN PAYNE, CONFERENCE REPORT, UNIVERSITY OF CALIFORNIA, DAVIS, WORKSHOP ON SAFEGUARDS FOR PLANNED INTRODUCTION OF TRANSGENIC TOMATOES, (8/19-20/1992), Intro. (considering on July 14, 1992, The Animal and Plant Health Inspection Service (APHIS) of the United States Department of Agriculture (USDA) received a petition from Calgene Inc., requesting that its FLAVR SAVR™ tomatoes not be regulated). The petition was granted on Oct. 19, 1992. *Id.*

98. *See generally supra* notes 84-101 and accompanying text (discussing the international business of biotechnology and the accompanying notes).

99. *See generally supra* notes 62-83 and *infra* notes 33-41 and accompanying text (discussing current fears and historical problems which effect view s of biotechnology). *See also Bundestay Drucksache*, 11/6788, (27 Mar. 1990) (translated as The German Genetic Technology Act) [hereinafter *The German Genetic Technology Act*] (establishing a strict liability scheme in Germany for injury caused by transgenic species) (on file with *The Transnational Lawyer*) (interpreted in Caluse-Joerg Ruetsch and Terry R. Broderick, *New Biotechnology Legislation in the European Community and Federal Republic of Germany*, 18 INT'L BUS. LAW. 408, 410 (1990).

100. *See Views Differ, supra* note 38, at 3 (relating the current and future influx of transgenic foods into the world's markets).

101. *See* Fox, *supra* note 1, at 12 (noting the listed countries as active in field-testing transgenic organisms); *see also* Isabelle Meister & Sue Mayer, *Release of Genetically Engineered Plants and Their Impacts on Less Developed Countries*, Greenpeace International, Information about Intellectual Property Rights No. 9 (Apr. 1995) <http://www.igc.apc.org/iatp/ipr-info9.html> (on file with *The Transnational Lawyer*) (stating field trials with transgenic species have occurred in at least 18 developed countries and 35 developing countries).

102. ENCYCLOPEDIA OF SCI. & TECH., *supra* note 32, at 116 (defining pollination as the transport of pollen grain to the ovules or ovule-bearing organs).

103. *See* CURTIS & BARNS, *supra* note 19, at 512-15 (setting out the evolution of the flower).

104. *See* ENCYCLOPEDIA OF SCI. & TECH., *supra* note 32, at 116 (discussing the importance of pollination).

human control.[105] Indeed, the lack of the human ability to control natural pollination is the crux of this issue.[106]

A. Gene Transfer Through Natural Processes

Many plants release pollen into the air[107] to be carried by the wind. Also, insects are major pollinators for many species of plants.[108] Still, other plants depend on animals for pollination.[109] The animals in turn, consume the fruit of the plant and excrete the seeds in feces great distances away.[110]

In studies conducted in the United States and various other countries which produce the tomato plant, natural cross-pollination has occurred.[111] In field-testing in the United States, outcrossing in a typical field varies from zero to five percent.[112] In regions in the tropics, the numbers could be ten to thirty times higher.[113] These numbers indicate the scientific communities recognition of potential problems that are out of mankind's control once transgenic plants are released into nature.[114]

Transgenes in genetically-altered tomatoes can escape through either pollen or seeds;[115] however, the cultivated tomato is generally a self-pollinating crop.[116] In the

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105. *See infra* notes 107-32 and accompanying text.

106. Bioagriculture could spread across national borders in many ways, such as through trade agreements that bring a new species into the participating country, smuggling the technology into a country, and other means which are limited only by the imagination and future technology. Although the issues these forms of transfer can and will create are immense, they are beyond the scope of this comment. *See generally* ENCYCLOPEDIA OF SCI. & TECH., *supra* note 32, at 116 (describing how wind, bugs and animals can all act to carry pollen great distances).

107. ENCYCLOPEDIA OF SCI. & TECH., *supra* note 32, at 116. To facilitate exposure to the wind, anthers burst open to scatter the pollen widely. *Id.*

108. *See id.* at 116-17 (discussing Hawkmoth, butterfly, fly, beetle, and bee pollination). *See generally* Adams & Senft, *supra* note 55 (describing the pollination of tomatoes by bees).

109. CURTIS & BARNS, *supra* note 19, at 515.

110. *Id.* at 515. Many fruits evolved essentially as a payment to an animal visitor for transportation services, once eaten the seeds within the fruit pass through the digestive tract to be deposited some distance away for germination. *Id.*

111. CONFERENCE REPORT, UNIVERSITY OF CALIFORNIA, DAVIS, WORKSHOP ON SAFEGUARDS FOR PLANNED INTRODUCTION OF TRANSGENIC TOMATOES, (8/19-20/1992), exec. summ. pg 5 [hereinafter UCD EXEC. SUM.] (discussing some airborne pollination experiments in greenhouses, in which male-sterile tomato plants were grown among wild relatives within the genus that are prolific producers of pollen, indicated that low rates of hybridization were possible).

112. *See id.* at 6 (examining tests which indicate gene transfer of tomato plants does occur).

113. *See id.* at 6 (considering gene transfer rates of transgenic tomato plants in tropic and subtropic regions where outcross is more significant).

114. *See id.* at 6 (stating transfer of genetic material could occur despite restrictions which could possibly be placed on field trials or on production).

115. *See id.* at 5 (presenting the various stages of gene transfer of tomato plants, including pollen released from the plant and seed transfer from field to field).

116. *See id.* at 5 (discussing gene transfer of tomato plants). The structure of the flower practically guarantees self-fertilization. *Id.* The anthers are arranged in a tube surrounding the stigma. *Id.* Pollen drifts down the tube until it reaches the stigma, whose hard to reach "depressed" position generally shields it from pollen from other flowers. *Id.*

United States, tomatoes are pollinated largely by bumblebees.[117] In the tropics, they are pollinated by carpenter bees.[118] The ability of these bees to travel from plant to plant gathering and releasing pollen influences the frequency of genetic escape.[119]

Transgenes could "escape"[120] through natural cross-pollination during the growing season, during harvesting[121] or after the harvest. For instance, transgenes may escape when tomato fruits are left in the field[122] or during transportation to the processing plant.[123] It is even possible for transgenes to escape after processing when seeds are left in the fields or used in feeds.[124] Similarly, transgenes consumed in seeds, can pass intact through human or animal waste.[125]

The possible consequences of transgene escape depend upon which transformed genes are actually transferred to another species.[126] Of all of the possible dangers to the ecosystem, biodiversity and world economy,[127] are not believed to be a current and serious threat, at least not from tomatoes.[128] However, any escaped transgenic

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117. *See id.* at 5 (analyzing insect pollination of tomato plants in the United States).

118. *See id.* at 5 (discussing insect pollination of tomato plants in the tropics).

119. *See id.* at 5 (relating the presence of insect pollinators and their influences on the rate of outcross and gene transfer).

120. *See generally id.* at 5 (describing escape or outcrossing, as the cross-pollination from transgenic tomatoes from an experimental or commercial plot to other tomatoes).

121. *See* KENT J. BRANDFORD, GERMINATION AND DORMANCY OF TOMATO SEEDS, CONFERENCE REPORT, UNIVERSITY OF CALIFORNIA, DAVIS, WORKSHOP ON SAFEGUARDS FOR PLANNED INTRODUCTION OF TRANSGENIC TOMATOES, (8/19-20/1992), at 13 (suggesting to prevent contamination of current seed stocks, tomatoes should not be planted on the same fields which grew a transgenic crop for a minimum of two years); *see also* UCD EXC SUM, *supra* note 106, at 8 (stating cultivated tomatoes turn up in fields were they were previously planted as "volunteers").

122. *See* J.W. SCOTT, TRANSGENIC TOMATO FIELD TESTING CONSIDERATIONS, WORKSHOP ON SAFEGUARDS FOR PLANNED INTRODUCTION OF TRANSGENIC TOMATOES, CONFERENCE REPORT, at 34 (1992) (stating seeds from fruit left in the field would result in volunteers in the field).

123. *See* UCD EXEC. SUM., *supra* note 111, at 5 (conveying gene transfer possibilities when the tomatoes fall from the trucks in route to the processing plants). Any person who has driven the Interstate 5 or Highway 99 highways in central California, USA, will be familiar with the extent of fruit spill-over.

124. *See* BEN GEORGE, COMMERCIAL TESTING OF TRANSGENIC TOMATOES, WORKSHOP ON SAFEGUARDS FOR PLANNED INTRODUCTION OF TRANSGENIC TOMATOES, CONFERENCE REPORT 20 (1992) (formulating how waste from factories is processed into feed for cattle and chicken). The waste also is used in soil conditioners. *Id.*

125. *See* Bruggemann, *supra* note 78, at 16 (1992) (discussing the gene transfer of tomato plants through human agents). A local sewage treatment facility would deposit sludge derived from human wastes in open beds to dry. *Id.* Tomato seedlings covered the beds, as the seeds passed intact through both humans and the facility. *Id. See also* L. MARK LAGRIMINI, TRANSGENIC TOMATOES: SAFETY AND ENVIRONMENTAL CONCERNS, WORKSHOP ON SAFEGUARDS FOR PLANNED INTRODUCTION OF TRANSGENIC TOMATOES, CONFERENCE REPORT (1992) [hereinafter *Transgenic Tomatoes*] (reporting homeowners who have used composted sewage on their lawns as fertilizer, soon discover a field of tomatoes).

126. *See* SCOTT *supra* note 122, at 34 (disclosing the environmental consequences of escape).

127. *See infra* notes 79-81 and accompanying text (covering possible transgenic impacts on the environment and the economy of the world).

128. *See* UCD EXEC. SUM., *supra* note 111, at 5 (concluding the natural barriers to pollination, such as limitations on species that can actually cross-pollinate naturally, will keep transgenic escape minimal). *But see* Hileman, *supra* note 38, at 13 (quoting Jane Rissler, a Union of Concerned Scientists (UCS) senior scientist, to say the United States Department of Agriculture's (USDA) field tests of transgenic plants are conducted in a way that could not properly assess environmental risks, in fact the USDA showed very little attention to the experimental

plant genes that could harbor disease or insect pests would be of great concern.[129] Such a plant would in effect be bring an insect or disease into a new field where the crops are not protected against such an invasion.[130] Additionally, species of transgenic crops which pollinate more readily, will prove more susceptible to outcross.[131] Moreover, as transgenic species begin to dominate the world's farms, more transgenes will be prevalent, and thus greater occurrences of outcross will develop.[132] The potential impacts of transgenic crops can be taken in context with various agricultural disasters in the past.

B. *Historical Transfers and Problems*

Scientists argue transgenics will cause farmers to monocrop[133] with the most productive varieties possible.[134] Monocropping results in a single strain of one crop that all have the same genetic make up.[135] Thus, all grow at similar rates, but are susceptible to similar pests and diseases.[136] Consequently, such monocropping resulted in the Potato Famine of 1845-47 which devastated the population of Ireland.[137] An oomycete[138] which wiped out the entire Irish potato crop in a single week caused the

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analysis of risks). The USDA relies on intellectual arguments and does not give enough weight to field data. *Id.*

129. *See* SCOTT, *supra* note 122, at 34 (communicating the environmental consequences of escape). An escaped plant with increased survivability due to insect or disease resistance could bring with it diseases or harbor insects that may affect the new field. *Id.* In a real world lay example, think of the diseases you are innoculated for when traveling abroad.

130. *See id.* at 34 (discussing the environmental consequences of escape). An escaped plant with increased survivability due to insect or disease resistance could bring with it diseases or harbor insects that do not effect it but, may effect the new field. *Id.*

131. *See generally* James Lackey, Corn, <http//www.aphis.usda/gov/BBEP/BP/corn.html.> (on file with *The Transnational Lawyer*) (covering how genes of corn may escape either by pollen transfer or by grain movement). Genetic material could escape to another plant at a distance of 660 feet. *Id. See* James Lackey, *Canteloupe* <http//www.aphis.usda.gov/BBEP/BP/cucurbit.html.> (on file with *The Transnational Lawyer*) [hereinafter Cantaloupe] (disclosing how cantaloupe genes can escape as pollen, seeds or vegetative parts). Pollen could outcross with other plants up to a distance of two miles. *Id.*

132. *See* Hileman, *supra* note 38, at 12 (describing a study by Jack Brown on gene transfer of crops). The spread of herbicide resistance geners from transgenic canola has moved into its relatives in the mustard family. *Id.* It was then passed to another species. *Id.* The study concluded that even though the fractions affected was low, the mere masses of transgenic crops to be planted will induce more frequent problems. *Id.*

133. *See* BOTKIN & KELLER, *supra* note 22, at 267 (describing monoculture as large areas planted by a single species or single strain of crop). Monocropping contrasts with most natural ecosystems, which contain many species of plants in the same region. *Id.*

134. *See* Purnell, *supra* note 4, at 1194 (claiming the practice of planting a uniform species of crop to yield the most productive harvests is widespread).

135. *See* BUTKIN & KELLER, *supra* note 22, at 267 (describing monocropping to contain one strain of species).

136. *See* Purnell, *supra* note 4, at 1194 (claiming the use of monocropping places the crops at risk to decimation at the hands of new disease).

137. *See* CURTIS & BARNS, *supra* note 19, at 1149 (describing the process which a bacteria entered the Irish potato crop and decimated it within a week).

138. *See id.* at 467 (describing oomycetes to resemble fungi structurally, yet their cell walls contain cellulose, which is unlike fungi). Some forms of oomycetes are parasitic and pathogenic, such as the *Phytophthora infestans* or "plant destroyer" which produced the potato famine. *Id.* The oomycete releases airborne spores which alight on

famine.[139] The world's reliance on a limited number of corn, wheat and rice species could cause a similar tragedy of total crop failure, only on a much larger scale.[140] The selective monocropping which allowed for almost total crop destruction in the past, is but one worry in the gamut of hypothetical problems scientists have pondered.[141] To illustrate, posing a real world situation may be the best way to understand the reality of transgenic problems which we will soon face.

C. *Hypothetical Situation*[142]

In an effort to both feed the world's growing population and to make a profit, Ag-Sci, an agricultural biotechnology company, in country X[143] sells its newly patented "Super Tomato" to Farmer A, who lives in country Y.[144] Farmer A has saved the profits from his midsize tomato fields for ten years to be able to afford a genetically superior product to enhance his harvest quantity and quality. Ag-Sci informs Farmer A of a setback requirement between the transgenic crops and any non-transgenic crops. If the setback is followed, Ag-Sci's scientists claim little chance of cross pollination.[145] Farmer A thinks little of problems; after all, it is just a plant. Thus, he now dreams of entering the "big time" in crop production.

Super Tomato has been manufactured with transgenes that make the tomato grow faster and bigger. In addition, these genes allow the entire crop to resist disease.[146] Farmer A's farm is one mile from Farmer C, yet both are within country Y. However, one mile provides enough distance between crops according to Ag-Sci.

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a leaf and release spores that thrive on the film of water on the leaf's surface. *Id.* at 468. The spores germinate and penetrate the epidermis of the leaf to attack the photosynthetic cells of the leaf. *Id.* Without the photosynthetic cells the plant is unable to gather energy from the sun and gradually dies. *Id.*

139. CURTIS & BARNS, *supra* note 19, at 1149.

140. *See generally* Meister & Mayer, *supra* note 101, at 1 (stating corn, wheat and rice have all been genetically engineered and together form 50% of the world's food intake); *cf.* CURTIS & BARNS, *supra* note 19, at 468 (describing a species of oomyccota *Plasmopara viticola* which threatened the entire French wine industry in the nineteenth century with mildew).

141. *See infra* notes 133-40 and accompanying text (describing monocropping as one factor which will increase the problems transgenics will place on the environment).

142. This hypothetical fact situation will be used throughout the Comment as a basis for comparison and explanation. The facts will also be used in the questions of jurisdiction, choice of laws, and liability to enable a thorough understanding of the issues presented in international corporate liability.

143. Since the United States, Japan and Germany are the three largest producers of transgenics, Country X will be either one of these countries.

144. Country Y will represent either the United States, Japan or Germany. However, neither Country Y or X can be the same country.

145. *Cf.* BENITO ALVARADO-RODRIGUEZ, WORKSHOP ON SAFEGUARDS FOR PLANNED INTRODUCTION OF TRANSGENIC TOMATOES, CONFERENCE REPORT at 11 (1992) (discussing use of a net or wall, deflowering, and bagging of inflorescence to avoid escape); BRUGGEMANN, *supra* note 125, at 21 (suggesting the use of a border crop to curb outcross).

146. *Cf.* BRUGGEMANN, *supra* note 125, at. 21 (acknowledging transgenic tomatoes to have improvements in flavor, color, fiber content, insect and disease resistance).

While Super Tomato grows to maturity in Farmer A's field, Farmer C is growing a non-transgenic tomato crop. In addition, Farmer C has monocropped with one species of tomato throughout his entire field.

Once the Super Tomato reaches maturity, the tomatoes flowers' hollow anthers extend to release pollen. Along come hundreds of "Fuzzyfoot" bees, which buzz over the plants and causes them to release pollen.[147] As a result, some of the pollen sticks to the hairs on the bees, while the rest pollinates the tomato plants.

Farmer C's tomato crop is also reaching maturity. Similarly, the fuzzyfoots enter his field, buzz to pollinate, and some pollen from Farmer A's crop falls off their bodies and pollinates his crop. Consequently, cross pollination occurs in many plants to create a new hybrid of tomato.

At harvest, Farmer A collects his first crop of Super Tomatoes and experiences big, red and ripe tomatoes. On the other hand, Farmer C harvests, only to find much of his crop was destroyed by disease. Somewhere in the cross pollination process the new tomato became susceptible to a disease.

This hypothetical illustrates a scenario of natural cross pollination of a transgenic species with an non-transgenic species. We can presume that the transgene harbored a disease that it was engineered to resist. However the non-resistant species which was monocropped by Farmer C was not resistant to the disease.

Having been devastated financially by this disaster, Farmer C brings suit against Ag-Sci[148] for negligently creating and selling a potentially harmful product. However, since Ag-Sci is a foreign corporation many legal issues face Farmer C in seeking a remedy: (1) which country's court should the case be brought;[149] (2) are there any international theories which could provide liability;[150] and (3) what theories of national law could provide recovery?[151]

IV. CHOICE OF FORUM AND CHOICE OF LAW ISSUES

If a private party is injured by the actions of a foreign citizen or entity, the party has two hurdles to overcome in bringing a suit for relief: (1) choice of forum or jurisdiction;[152] and (2) choice of law.[153]

147. *Cf.* Adams & Senft, *supra* note 55, at 4 (discussing how the vibrations of the bees wings are strong enough to cause pollen to dislodge from the tomato and spread into the air, thus allowing them to attach to the bee).

148. Although Farmer C could also have a direct claim against Farmer A, such a claim is beyond the scope of this comment.

149. *See infra* notes 154-78 and accompanying text.

150. *See infra* notes 185-212 and accompanying text.

151. *See infra* notes 234-403 and accompanying text.

152. *See infra* notes 154-67 and accompanying text.

153. *See infra* notes 168-78 and accompanying text.

A. *Choice of Forum*[154]

A private party injured by a foreign party must seek relief either in the country where the injury has occurred or in the country were the offending activity originated.[155] To determine which country's courts have the power to adjudicate the specific issue, three main principles[156] of jurisdiction are applied in various countries: (1) the territorial principle;[157] (2) the nationality principle;[158] and (3) the effects principle.[159]

To find jurisdiction in a country which applies the territorial principle, the act causing the harm must have taken place completely within or in a great part of the country.[160] Additionally, the act must also affect a person or interest in the country.[161] Applying the Ag-Sci hypothetical, the harm took place in country Y and Farmer C is a resident of country Y. Thus, under the territorial principle, Farmer C would have jurisdiction in country Y to bring a suit against Ag-Sci.

If the country applies the nationality principle, a different analysis is needed. Jurisdiction under this principle is based on the actor's nationality.[162] Thus, a country's laws will apply to its own citizens or entities whether or not they are currently within the country.[163] Using this principle in the Ag-Sci hypothetical, we find

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154. A complete analysis of the individual state jurisdictional requirements is not within the scope of this comment. Therefore, a brief outline for context is all that is included.

155. STEPHEN C. MCCAFFREY, INTERNATIONAL UNION FOR CONSERVATION OF NATURE AND NATURAL RESOURCES, PRIVATE REMEDIES FOR TRANSFRONTIER ENVIRONMENTAL DISTURBANCES 17 (1975). A suit brought in a plaintiff's home country would give him the advantage of being familiar with the laws, language and location that will affect his case. *Id. See generally* International Court of Justice Statute, art. 34(1) (stating that the court lack contentious jurisdiction to deal with disputes involving individuals or entities that are not states).

156. Two other principles of international jurisdiction one recognized less frequently. *See generally* RESTATEMENT (THIRD) OF THE FOREIGN RELATIONS LAW OF THE UNITED STATES, § 402(3) (listing the protective principle to allow jurisdiction for conduct directed against important state interests); BARRY E. CARTER & PHILLIP R. TRIMBLE, INTERNATIONAL LAW 782 (2d ed. 1995) (stating the passive personality principle grants jurisdiction over foreigners whose acts directly effect subjects of the state asserting jurisdiction).

157. *See infra* notes 160-61 and accompanying text.

158. *See infra* notes 162-63 and accompanying text.

159. *See infra* notes 164-65 and accompanying text.

160. *See* RESTATEMENT (THIRD) FOREIGN RELATIONS, *supra* note 156, at § 402. Bases of Jurisdiction to Prescribe:

> Subject to § 403, a state has jurisdiction to prescribe law with respect to:
> (1) (a) conduct that, wholly or in substantial part, takes place within its territory;
> (b) the statue of persons, or interests in things, present within its territory;
> (c) conduct outside its territory that has or is intended to have substantial effect within its territory;
> (2) the activities, interests, status, or relations of its nationals outside as well as within its territory; and
> (3) certain conduct outside its territory by persons not its nationals that is directed against the security of the state or against a limited class of other state interests.

Id.

161. *Id.* § 402(1).

162. *Id.* § 402(2).

163. *Id.*

that Ag-Sci is a entity within country X. Thus, country X would have jurisdiction over Ag-Sci due to the companies domicile there.

Under the effects principle of jurisdiction, jurisdiction is based on the location of the harm.[164] Conduct, therefore, can actually occur outside of the country asserting jurisdiction if the harmful effects occur within the country.[165] Consequently, in the Ag-Sci hypothetical, the transgenic species was made in country X and then sold into country Y were the damage occurred. Thus, under the effects principle, country Y would be able to assert jurisdiction over Ag-Sci.

One final consideration in determining jurisdiction is forum non conveniens. Forum non conveniens is the doctrine that prohibits jurisdiction in a forum where it would be extremely burdensome for the defendant to defend.[166] For example, if evidence or witnesses are more readily available, or travel would be costly for the defendant, the case may be removed to the country where the defendant is domiciled.[167] In the Ag-Sci hypothetical, all of the evidence and witnesses needed to establish a case for Farmer C would be in country Y. However, corporate defendant Ag-Sci, being domiciled in country X, could file a motion to remove under forum non conveniens claiming the cost of travel to country Y to defend the suit would be unduly burdensome. However, Ag-Sci is a corporation, which most likely will have the means to afford traveling and litigation expenses. Thus, an appeal to the court's sympathies to remove may be unsuccessful. Additionally, the bulk of evidence needed in the case is in country Y; Ag-Sci's motion would likely be denied.

Once jurisdiction is determined, the court must determine which country's law to apply to provide a cause of action.

B. Choice of Law

Once jurisdiction is proper, the court must decide which country's substantive laws to apply to the case.[168] In the absence of a treaty between the countries, most civil-law and common-law countries in tort cases apply the law of the place of

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164. *Id.* § 402(1)(c).

165. *Id.*

166. *See* ALEXANDRE KISS & DINAH SHELTON, INTERNATIONAL ENVIRONMENTAL LAW 365 (Graham & Trotman 1991) (claiming there is a presumption in favor of plaintiff's choice of forum in United States federal courts and most state courts). The defendant can overcome the presumption by showing the forum would be unnecessarily burdensome. *Id.*; *see also* In re Union Carbide Corp. Gas Plant Disaster at Bhopal, India in December 1984, 809 F.2d 195 (2d Cir. 1987) (upholding dismissal on forum non conveniens grounds).

167. *See* KISS & SHELTON, *supra* note 166, at 365 (discussing forum non conveniens issues which effect the defendant's ability to remove a case to his home country).

168. *See generally* JOSEPH W. DELLAPENNA, SUING FOREIGN GOVERNMENTS AND THEIR CORPORATIONS 214 (1988) (covering the various choice of law theories which a court can utilize to determine which substantive legal system to apply to the case at bar); KISS & SHELTON, *supra* note 166, at 367 (addressing choice of law issues when a demand for compensation is made in an international context). Courts often apply local laws to the case at hand, however, public policy and nondiscrimination concerns weigh into the court's determination. *Id.*

wrong.[169] However, three approaches are generally used to determine the applicable law: (1) the Restatement (First) of the Conflict in Laws approach;[170] (2) the interest analysis approach;[171] and (3) the Restatement (Second) of the Conflict in Laws approach.[172]

Under a Restatement First analysis, the applicable law is that of the place where the last act necessary to create the cause of action occurred.[173] In the Ag-Sci hypothetical, the act of planting the Super Tomato by Farmer A which destroyed Farmer C's crops, was the last act necessary to allow the transgenes to escape, cause damage to Farmer C's crops and create the cause of action. This act occurred in country Y, thus country Y's laws should apply.

If the court applies the interest analysis approach, the policy of each country's laws becomes an issue.[174] Thus, the court will determine under the facts of the case at issue, which country's policy will be benefited to a greater extent by a judicial decision.[175]

In the Ag-Sci hypothetical under this analysis, policies underlying each country's regulations and liability schemes could provide a basis to weigh the current transgenic policies of each country.[176]

The final analysis of choice of law is the Restatement Second approach. Under the Restatement Second, the laws of the country most closely related to the transaction will control.[177] The Ag-Sci hypothetical pits country X's policies concerning the production and sale of transgenics, against country Y's current issues involving the release of transgenics within its borders. Thus, the court must balance economic concerns against societal concerns to determine which laws will govern.

Once the procedural issues of jurisdiction and choice of law are determined, the application of substantive law becomes the determining factor in the outcome of the suit. In order to determine whether liability will attach to a corporation for damage caused by the propagation of transgenic crops, a basic understanding of current select regulatory and liability systems, both international and national, which may govern transgenics is necessary.[178]

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169. *See* Richards v. United States, 369 U.S. 1, 8-10 (1962) (holding the two provisions of the Federal Tort Claims Act together require the decision to dictate the law used is that of where the wrongful act or omission occurred). The law chosen is to govern both liability and substantive issues of the case. *Id.*

170. *See infra* note 173 and accompanying text.

171. *See infra* notes 174-76 and accompanying text.

172. *See infra* note 177 and accompanying text.

173. *See generally* RESTATEMENT (SECOND) OF CONFLICT OF LAW (1971).

174. *See* CARTER & TRIMBLE, *supra* note 156, at 836 (describing the policy analysis needed in an interest analysis).

175. *Id.* at 836.

176. *See id.* at 836 (applying the interest analysis to a hypothetical set of facts and comparing one country's policies, which protect victims, to another country's wishes to protect producers).

177. RESTATEMENT (SECOND) OF CONFLICT OF LAWS, *supra* note 173, at §122 (1971).

178. *See infra* notes 185-403 and accompanying text.

V. FINDING CORPORATE LIABILITY

The creation and introduction of transgenic crop species will be, and is currently fueled by the interests of the corporate world.[179] Indeed, corporations provide the funding and direction to scientists to further develop and experiment with transgenic technology so that these corporations will profit from selling bigger, better, stronger, and disease resistant food crops.[180] As such, liability for damages caused by transgenics should attach to these corporations.[181] To the winner, the spoils. The applicable multinational regulations[182] and the current laws of the United States, Germany and Japan, the three largest producers of biotechnology,[183] will be discussed as possible theories of corporate liability.[184]

A. *The International Regulatory Process*

Usually, when determining private liability under international law, a court will look to the substantive provisions in international conventions or treaties governing the particular subject matter of the case at issue.[185] For example, private international liability schemes have been established in the context of outer space liabilities,[186] air

179. *See supra* notes 84-101 and accompanying text (discussing The International Business of Biotechnology).

180. *See* Fox, *supra* note 1, at 67 (emphasizing the promise of biotechnology to increase productivity and efficiency, thus reducing costs to the U.S. industry, therefore allowing for a competitive edge in world markets).

181. *Cf.* Fox, *supra* note 1, at 169 (concluding the issue of corporate responsibility must include a balancing of benefits to society and to corporations).

182. *See infra* notes 190-210 and accompanying text.

183. *See* Fox, *supra* note 1, at 10 (stating the United State leads the commercialization of biotechnology followed by Japan and Germany).

184. *See infra* notes 234-403 and accompanying text.

185. *See* KISS & SHELTON, *supra* note 166, at 95-113 (revealing the various sources of environmental international law: international conventions, customary international law, general principles of law recognized by civilized nations, judicial decisions and teachings of the most highly qualified publicists of the various nations, and resolutions).

186. *Cf.* Christopher D. Williams, *Space: The Cluttered Frontier*, 60 J. AIR L. & COM. 1151 (1995) (stating the first international treaty to deal with the law and liabilities of outer space was the Treaty on Principles Governing the Activities of States in the Exploration and use of Outer Space). The imposition of private responsibility can be found in Article VI and state liability in Article VII of the Outer Space Treaty. *Id.* at 1151. Article VI requires party states shall bear international responsibility for national activities in outer space, regardless of whether or not those activities are conducted by government or private entities. *Id.*

travel[187] and in oil pollution.[188]

Likewise, in the context of transgenics, there are many bilateral and multilateral treaties that recognize transgenics. However, they all fail to provide for a comprehensive liability scheme.

Additionally, case law and arbitration decisions establishing liability for environmental damages may apply and provide a basis for liability in the transgenics context. For example, the Trail Smelter Arbitration[189] could provide a basis for liability in transgenics cases absent explicit international treaties.

1. International Conventions: Regulations Which Recognize Transgenics

Various international treaties and agreements exist on the topic of transgenics such as: (1) the United Nations Food and Agriculture Organization (FAO) guidelines, the "International Undertaking on Plant Genetic Resources" (Undertaking) of 1983;[190] (2) the Organization of Economic Co-operation and Development's (OECD), Recombinant DNA Safety Considerations-Safety Considerations for Industrial, Agricultural and Environmental Applications of Organisms Derived by Recombinant DNA Techniques (rDNA Report) of 1986;[191] (3) the European Economic Community's, Deliberate Release Directive of 1990;[192] and (4) the U.N. Convention on Biological Diversity (Biodiversity Convention), Earth Summit in Rio de

187. *Cf.* Robert A. Brazener, *When is Passenger on Aircraft in International Transportation Embarking or Disembarking within Meaning of Article 17 of Warsaw Convention*, 39 A.L.R. FED. 452 (1978) (discussing the enactment of the Warsaw Convention to create an international strict liability regime for air carriers who's passengers are injured or killed). Article 17 provides the carrier shall be liable for damage suffered by a passenger, if the accident took place on board the aircraft. *Id.* This absolute liability scheme does however contain a cap for recovery of 125,000 francs. *Id.*

188. *Cf.* Eli Louka, *Bringing Polluters Before Transnational Courts: Why Industry Should Demand Strict and Unlimited Liability for the Transnational Movements of Hazardous and Radioactive Wastes*, 22 DENV. J. INT'L L. & POL'Y 63, 64 (1993) (stating oil pollution liability is the only established private liability regime in international law).

189. *See* Trail Smelter Arbitral Tribunal Decision 3 R.I.A.A. 1905 at 1960 (1941) [hereinafter *Trail Smelter*] (holding no state has the right to use or permit the use of its territory in such a manner as to cause in jury by fumes in or to the territory of another).

190. *See* Report of the Conference of FAO, U.N. Doc. c/89/REP, 1989 (available in WL 449888) [hereinafter the Undertaking] (forming the International Undertaking on Plant Genetic Resources).

191. *See* Organization of Economic Co-operation and Development, Recombinant DNA Safety Considerations-Safety Considerations for Industrial, Agricultural and Environmental Applications of Organisms Derived by Recombinant DNA Techniques (OECD 1986) [hereinafter rDNA Safety].

192. *See* Council Directive 90/219/EEC of 23 April 1990 on the Contained Use of Genetically-Modified Micro-Organisms, OJ No L117/1 (8 May 1990) [hereinafter Directive 90/219/EEC] (developed to promote the safe use and development of genetically modified organisms (GMOs)). A genetically-modified organism, as defined by the directive, is an organism or micro-organism in which genetic material has been altered in a manner that does not occur naturally by mating or natural recombination. *Id.* art.2. Council Directive 90/220/EEC of 23 April 1990 on the Deliberate Release into the Environment of Genetically-Modified Organisms, OJ No L117/15 (8 May 1990); Council Directive 90/220/EEC of 23 April 1990 on the Deliberate Release into the Environment of Genetically-Modified Organisms, OJ No L117/15 (8 May 1990) [hereinafter Directive 90/220/EEC].

Janeiro of 1992.[193] Even though the treaties all recognize and regulate transgenic species, none propose a comprehensive liability scheme.[194]

The FAO began the multi-national concerns of biotechnology in 1983.[195] The FAO's International Undertaking on Plant Genetic Resources (the Undertaking) established a legally non-binding set of guidelines for transgenics.[196] The purpose of the Undertaking is to ensure that plant genetic resources for agriculture, will be explored, preserved, evaluated and made available for plant breeding and for scientific purposes.[197] The Undertaking is a legally non-binding set of guidelines, yet still eight countries, including the United States refused to adhere to it.[198]

The OECD is made up of twenty-four industrialized countries.[199] In 1986 it published the rDNA Report which recommended the development of rDNA techniques among the OECD member states.[200] In brief, the rDNA Report required national review of any deliberate release of transgenic species.[201] Furthermore, the OECD in 1992, created Safety Considerations for Biotechnology; a report containing general principles of safety assessment for field-testing of transgenics.[202] These general principles are supported by all twenty-four members.[203]

The EEC, has mandated its Member States to enact laws which encompass corporate liabilities.[204] The EEC, enacted the Deliberate Release Directive in 1990.[205] This directive was the first multilateral agreement with binding authority to deal with

193. *See* Convention on Biological Diversity, June 4, 1993, S. Treaty Doc. No. 103-20 (available in 1993 WL 796847 (Treaty) [hereinafter Convention on Biological Diversity].

194. *See infra* notes 195-212 and accompanying text.

195. Undertaking, *supra* note 190.

196. *Id.* The basic notion of the undertaking is that "plant genetic resources are a heritage of mankind and consequently should be available without restriction." *Id.* In 1991, an annex was adopted to the Undertaking which recognized that countries of origin have legal ownership and right of control of their native plant genetic resources. *Id.*; *Thom, supra* note 61, at 2 (promoting that the annex reaffirmed the open access of biotechnology, but made it subject to the sovereign rights of the individual nations which innovated the genetic plant resource).

197. *See* the Undertaking, *supra* note 190.

198. *See* Thom, *supra* note 61, at 1 (arguing the guarantee of access without restriction was the basis for the withdraw of the eight countries; including the United States).

199. *See* Alan T. Bull, *Biotechnology: International Trends and Perspectives* 2 (OECD 1982) (listing the OECD countries as: Australia, Austria, Belgium, Canada, Denmark, Finland, France, the former Federal Republic of Germany, Greece, Iceland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweeden, Switzerland, Turkey, the United Kingdom, and the United States).

200. rDNA Safety, *supra* note 191, at 24-31.

201. *Id.* at 42.

202. Organization of Economic Co-operation and Development, Safety Considerations for Biotechnology (OECD 1992) at 25.

203. United States Congress, Office of Technology Assessment, A New Technological Era For American Agriculture 183 (1992) at 205.

204. *See* Directive 90/219/EEC, *supra* note 192.

205. *See* Directive 90/220/EEC, *supra* note 192.

the deliberate release[206] of genetically-modified organisms (GMOs).[207] The Directive requires the user to notify the Member State authorities of the State of the release.[208]

The Earth Summit in Rio de Janeiro, Brazil, yielded the Biodiversity Treaty.[209] The Biodiversity Treaty, signed by 153 nations, provides for safety regulations to guard against the potential adverse affects of specific genetically modified organisms.[210]

Nevertheless, even with this global recognition,[211] corporate liability for damages caused by transnational propagation remains illusory.[212] Thus, Farmer C in the Ag-Sci hypothetical has no international conventions to look at for a remedy. However, perhaps international judicial decisions of a comparable nature can provide a remedy.

2. *A Judicial Decision: Finding A Comparable Scheme of International Liability*

As mentioned above, there is no international legal regime to establish liability for the release of and damage by from transgenic organisms through conventions.[213] However, domestic courts may use a judicial decision of international law as a guideline for decisions.[214] For example, the international legal system could assess liability for transboundary[215] bioagriculural damages in accord with the legal principles of transboundary disturbances. The *Trail Smelter Arbitration*[216] provides that no state may allow its territory to be used for acts causing pollution which in turn damage the territory of other states.[217]

In *Trail Smelter*, sulfur dioxide emitted by a lead and zinc smelter near Trail, a city in British Columbia, Canada, harmed agricultural activities and other business

206. *See id.* art 2 (defining deliberate release, as the intentional introduction of GMOs into the environment without provision for containment).

207. *See id.* art 2 (defining a genetically-modified organism).

208. Directive 90/219/EEC, *supra* note 192, at art. 5(1). The notification requirement includes a human health or environmental risk evaluation, technical dossier containing information on personnel and training, the GMO, conditions of release, receiving environment, interaction between the GMO and environment, and plans for monitoring control, waste treatment, and emergencies. *Id.* art. 5(2).

209. *See* Convention on Biological Diversity, *supra* note 193.

210. *See Kim, supra* note 37, at 1185 (citing Article 19 of the Biodiversity Treaty).

211. *See supra* notes 190-212 and accompanying text (indicating the current international treaties and agreements which recognize the growing issue in transgenics).

212. *See id.* (making note of the fact that no liability scheme is implemented in any of the international agreements which concern transgenics).

213. *Id.*

214. *See* KISS & SHELTON, *supra* note 166, at 107 (describing the ability of courts to use judicial decisions as a guideline for ruling on international issues).

215. *See generally id.* Transboundary can be defined for the purpose of our discussion as an environmental disturbance which originates in activities within the jurisdiction or control of a state and causes harm outside the jurisdiction of that state. *Id.*

216. *Trail Smelter, supra* note 189, at 1960 (Canada was held liable to the United States for environmental damages caused by a release of sulfur fumes from a commercial smelting plant).

217. *Id.*

in the State of Washington, United States.[218] The emissions of sulfur dioxide from the smelter were a normal by-product of the operation of the plant.[219] In fact, the disbursement of the sulfur dioxide into the atmosphere and the interaction of the pollutants with the State of Washington was only controlled by the daily meteorological conditions in the two countries.[220] Canada was held liable for damages caused to the private farmers in Washington.

Similar to the emissions of a natural byproduct in *Trail Smelter*, in the Ag-Sci hypothetical case, the pollen emanating from Farmer A's fields were a normal by-product of farming.[221] Additionally, the transfer of genetic material between species can be referred to as genetic pollution.[222] The fuzzyfoot bee was the natural force that instigated the harm to Farmer C's crops in a similar process as the meteorological conditions determined the effects in *Trail Smelter*.

A comparison of the facts between *Trail Smelter* and the Ag-Sci hypothetical cases can provide international legal guidelines to be applied to future transgenic cases by analogy.[223] However, the transfrontier principle, is a specific legal theory designed to deal with pollution and interference, not pollination. Yet, the harm caused by transgenic crops could also be included within the definitions of environmental interference as posed by the World Commission of Environment and Development (WCED)[224] and within the OECD's definition of pollution.[225]

The WCED defines environmental interference to mean any impairment of human health, living resources, ecosystems, material property, amenities or other legitimate uses of a natural resource of the environment caused, directly or indirectly, by man through polluting substances, ionizing radiation, noise, explosions, vibrations or other forms of energy, plants, animals, diseases, flooding, sand-drift or other

218. *See also* KISS & SHELTON, *supra* note 166, at 122 (claiming American farmers suffered extensive damages due to the emissions of two 409 foot stacks which released chemicals into the air from Trail, British Columbia, Canada); *see generally Trail Smelter*, *supra* note 189.

219. *See generally Trail Smelter*, *supra* note 189; *see also* KISS & SHELTON, *supra* note 166, at 122 (discussing as a result of the operation of the smelter in Canada, 300 to 350 tons of sulfur and other chemicals entered the air).

220. *See Trail Smelter*, *supra* note 189.

221. *See supra* notes 142-51 and accompanying text (covering the hypothetical situation whereby natural pollination processes occurred by bees pollinating a tomato crop).

222. *See* Meister & Mayer, *supra* note 101, at 2 (stating since genetically altered organisms are living they can and will reproduce, they will not be able to be controlled by scientists once out of the laboratory).

223. *Compare supra* notes 142-51 (displaying a hypothetical fact scenario of transgenics) *with Trail Smelter*, *supra* note 189.

224. *See generally* 24 RENE LEFEBER, DEVELOPMENTS IN INTERNATIONAL LAW, TRANSBOUNDARY ENVIRONMENTAL INTERFERENCE AND THE ORIGIN OF STATE LIABILITY 9 (Kluwer Law International 1992) (*citing* WCED Exports Group on Environmental Law defining environmental interference).

225. *See generally* LEFEBER, *supra* note 224, at 9 (applying the elements of the OECD's definition to not include the taking of a substance from the environment, but must include an introduction of a substance into the environment); KISS & SHELTON, *supra* note 166, at 116 (defining each element of pollution with explanation).

similar means.[226] The elements of WCED's environmental interference could be satisfied by applying the facts of our Ag-Sci hypothetical situation.[227]

First, the destruction of Farmer C's crop could be characterized as an impairment of living resources, ecosystems, material property and/or a legitimate use of natural resources, namely a country's crop production.[228] Second, the transboundary pollination which is the cause of the destruction was directly introduced by Farmer C's bioengineered plant which was included into his crop rotation.[229] Finally, the pollen originated from a plant, a bioengineered plant.[230] Thus, Ag-Sci's creates an environmental interference according to WCED's definition, strengthening the analogy to the judicial decision in *Trail Smelter*.

The OECD defines pollution to be the introduction by man directly, of substances or energy into the environment resulting in deleterious effects of such nature as to endanger human health, harm living resources and ecosystems, and impair or interfere with amenities and other legitimate uses of the environment.[231] Similarly, the elements of the OECD's definition of pollution could be satisfied by applying the facts of our Ag-Sci hypothetical.

First, the bioengineered plant was introduced by Farmer A into his own crop rotation, thus there was human introduction of a transgenic species which released pollen into the air and caused injury.[232] Second, the destruction of Farmer C's crop rotation, which both harmed living resources and depleted a country's food supply, could be considered a deleterious effect.[233] Again, transgenics could be considered an analogous situation to the harm protected against in environmental interference cases.

A court first confronted with a transgenics issue, currently will not have a express international treaty or precedent to attach liability. However, perhaps the international treaties recognizing transgenics and analogous theories will allow a court to define a cause of action. If the court does not apply international principles, it could look to the current national laws in the United States, Japan or Germany, the three largest producers of transgenics.

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226. *See generally* LEFEBER, *supra* note 224, at 9 (discussing the WCED Exports Group elements of environmental interference).

227. *See supra* notes 142-51 and accompanying text.

228. *See id.* (describing the effects of the transgenic pollen in the hypothetical to cause susceptibility to disease).

229. *See generally* LEFEBER, *supra* note 224, at 9 (listing the elements of environmental interference).

230. *Id.*

231. *See generally* LEFEBER, *supra* note 224, at 9 (applying the OECD Principles Concerning Transfrontier Pollution elements of the OECD's definition to not include the taking of a substance from the environment, but must include an introduction of a substance into the environment); KISS & SHELTON, *supra* note 166, at 116 (defining each element of pollution with explanation).

232. *See id.*

233. *See* LEFEBER, *supra* note 224, at 9 (discussing the elements of pollution); *see also supra* notes 133-39 and accompanying text (utilizing the potato famine for description of catastrophic consequences that are possible in the agricultural industry).

B. Liability in the United States[234]

The United States is the world leader in transgenics.[235] Nevertheless, the United States has failed to keep pace with its biotechnology industry by not establishing a new regulatory or liability scheme to govern transgenics.[236] Rather, the United States has chosen to adapt existing administrative regulations to cover biotechnology as a whole, but do not provide for liability.[237] The current applicable U.S. administrative regulations and legislation adopted to govern transgenics are administered by: (1) the Office of Science and Technology Policy (OSTP);[238] (2) the National Institutes for Health (NIH);[239] (3) the Food and Drug Administration (FDA);[240] and (4) the Department of Agriculture (USDA).[241] These agencies oversee and implement a regulatory system of permits,[242] testing[243] and tolerance setting[244] for pre-release of transgenic species. Once a transgenic species has passed the permitting, testing and tolerance requirements, the United States provides no specific cause of action for a private plaintiff injuries caused by the approved transgenics.[245]

The first administrative agency regulating transgenics is the OSTP. In an effort to coordinate the extensive regulatory scheme, the OSTP formally announced a regulatory framework in 1986.[246] This framework was enacted to encourage development of the biotechnology industry and reduce inter-agency conflicts in the application of

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234. Liability in the United States includes a discussion of the application of Negligence and Strict Liability. An analysis under Strict Products Liability (SPL) may also be warranted for bioengineering. Issues in SPL are not within the scope of this comment.

235. OFFICE OF INTERNATIONAL AFFAIRS, NATIONAL RESEARCH COUNCIL, COMMITTEE ON JAPAN, OFFICE OF JAPAN AFFAIRS, U.S.-JAPAN TECHNOLOGY LINKAGES IN BIOTECHNOLOGY: CHALLENGES FOR THE 1990S, 1 (National Academy Press 1992) (discussing the United States a leading the world in biotechnology through commercializing technology).

236. *See generally* Szecsy, *supra* note 4, at 179 (describing the United States' regulatory process as a conglomeration of agencies acting to cover transgenics without any new law to guide them).

237. *See id.*

238. *See infra* notes 246-48 and accompanying text.

239. *See infra* notes 249-51 and accompanying text.

240. *See infra* notes 252-56 and accompanying text.

241. *See infra* notes 257-61 and accompanying text.

242. *See* GLENDA D. WEBBER, REGULATION OF GENETICALLY ENGINEERED ORGANISMS AND PRODUCTS, BIOTECHNOLOGY INFORMATION SERIES (BIO-11), NORTH CENTRAL REGIONAL EXTENSION PUBLICATION, IOWA STATE UNIVERSITY, (Feb. 20, 1997) <http> at 3 (Apr. 28, 1997) (on file with *The Transnational Lawyer*) (explaining the USDA to include the Animal and Plant Health Inspection Service (APHIS) which administers the Federal Plant Pest Act (FPPA) to regulate interstate and importation of transgenics through permitting system which includes: permits for movement and importation, release into the environment and courtesy permits).

243. *See id.* at 6 (discussing the FDA testing system to regulate foods other than meat and poultry which are regulated by the USDA).

244. *See id.* at 8 (discussing the EPA tolerance setting system to determine if specific foods are deemed safe for consumption).

245. *Id.*

246. *See* Office of Science & Technology, Coordinated Framework for Regulation of Biotechnology, 51 Fed. Reg. 23,302, 23,303 (1986). *See generally* Maher, *supra* note 60, 137.

or administration of U.S. regulations.[247] The framework is merely to provide guidance to agency policy making, not to provide substantive law that will enable a plaintiff to establish corporate liability.[248]

Second, and the main regulator of research involving recombinant DNA (rDNA) within the OSTP frame work, is the NIH.[249] In October of 1988, the NIH created a country notification requirement to all release tests in a foreign host county.[250] As a result, the Ag-Sci corporation in the hypothetical,[251] would be required to notify country Y of the impending release upon sale of its transgenic Super Tomato.

The third U.S. agency, the FDA, has authority over all foods derived from biotechnology.[252] Although the FDA has the authority to test any bioengineered product before sale or inclusion in food products, it guidelines are only voluntary.[253] In addition, in the FDA's view, transgenics should receive little regulation since the process of genetic engineering merely speeds up natural evolutionary processes.[254] In the Ag-Sci hypothetical,[255] the Super Tomato would have to pass through FDA regulations, normally a pre-market independent test, before entered into the commerce.[256]

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247. *See generally* Maher, *supra* note 60, at 138 (listing the multi-purpose of the framework).

248. *See* Foundation on Economic Trends v. Johnson, 661 F. Supp. 107 (D.D.C. 1986) (holding the Framework was merely a guide for policy making and not meant for substantive decision making).

249. *See* Proposed NIH Guidelines, 41 Fed. Reg 27,907. (The NIH issued guidelines for research involving recombinant DNA (rDNA) molecules). Initially deliberate release of rDNA containing organisms was prohibited and subject to the National Environmental Policy Act (NEPA). *Id.* Under NEPA, a two-part test is required to determine if the release is to be subject to the preparation of a Environmental Impact Statement. *Id.* at 42 U.S.C.§4332(2)(C). First, there must be a "major federal action" and, second the action must "significantly effect" the environment. *Id. See generally* Maher, *supra* note 60, 143 (illustrating a law suit to enjoin the U.S. experimental field test of a biogenetic rabies vaccine in Argentine as a basis for expansion to private funded projects and testing done in foreign soils); CURTIS & BARNS, *supra* note 19, at G-18 ("rDNA" is DNA formed either naturally or in the laboratory by the joining of segments of DNA from different sources). "DNA" is the carrier of genetic information in cells. *Id.* at G-7.

250. *See generally* Bureau of National Affairs, United States Biotechnology: A Legislative and Regulatory Roadmap, BNA Special Report on Biotechnology #27 (Aug. 1989).

251. *See supra* notes 143-44 and accompanying text (indicating in the hypothetical scenario that the transgenic tomato was sold from country X to country Y).

252. *See* STATEMENT OF POLICY: FOODS DERIVED FROM NEW PLANT VARIETIES, 57 Fed. Reg. 22,984 & 22,985-88 (1992) (The FDA has authority over foods derived from biotechnology); *see also* 21 U.S.C.A. §§ 301-394 (West 1972 & Supp. 1993); FOX, *supra* note 1, at 42 (portraying the weight of federal authority divided among the individual agencies). The main purpose of the FDA regulations is to promote the responsible production of genetically engineered organisms in food and drugs. *Id.*

253. *See* 21 C.F.R. § 10.90(b)(1)(i) (1997) (allowing a person to follow the FDA guidelines or different procedures or standards)..

254. *See generally* Maher, *supra* note 60, 149 (covering the FDA's relaxed regulations).

255. *See supra* notes 142-51 and accompanying text (since a tomato is a food product, Ag-Sci would have to pass a pre-market test before it was certified to sell the tomato to the public, however, the FDA does not require Ag-Sci to follow guidelines during the construction of the Super Tomato).

256. *See* Maher, *supra* note 60, at 150 (discussing the pre-market independent testing of about thirty transgenic species before release into commerce).

Finally, the USDA is a main regulator of the biotechnology industry's activities in agriculture.[257] For instance, the USDA, has set a licensing policy to establish a permit system to ensure the safe release of biotechnological organisms.[258] Additionally, the USDA has established a National Biological Impact Assessment Program to collect, store and retrieve data on field tests and to develop risk assessments.[259] Thus, Ag-Sci in the hypothetical, Ag-Sci would be required to get a permit and establish the Super Tomato was safe. Additionally, Ag-Sci would have received data from the USDA concerning any risk that is perceived to occur, from the risk assessments.[260] This data could be used by Ag-Sci to warn its buyers about transgenic dangers and also enable Ag-Sci to foresee the possible harm the Super Tomato may create.[261]

Even with the extensive regulatory scheme which a producer of any transgenic product must adhere to, no regulation includes liability for injuries caused by transgenics.[262] However, there are two possible theories which an injured party may recover damages for injury caused by a transgenic species in the United States: (1) traditional United States negligence law;[263] and (2) strict liability for abnormally dangerous activities.[264] They will be discussed in turn.

1. Negligence Law in the United States

The required elements to establish a cause of action for negligence in the United States include: (1) duty;[265] (2) breach;[266] (3) causation;[267] (4) proximate cause;[268] and (5) actual injury.[269] All five must be present before a court will find liability. This issue will be addressed within the context of the previously mentioned hypothetical.[270]

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257. FOX, *supra* note 1, at 42 (The USDA is responsible for engineered organisms used with crop plants and animals); *see also* 58 Fed. Reg. 17,044 (1991).

258. FOX, *supra* note 1, at 42.

259. *See* U.S. Department of Agriculture, Guidelines For Research Involving Planned Introduction Into The Environment Of Genetically Modified Organisms <http://www.nbiap.vt.edu:80/usdasra/abrac.gui.txt> (copy on file with *The Transnational Lawyer*). *Cf.* FOX, *supra* note 1, at 42.

260. *See* Szecsy, *supra* note 4, at 183 (analyzing risk assessment).

261. *Compare supra* note 145 and accompanying text (describing the set-back warnings given to Farmer A) *with infra* notes 304-13 and accompanying text (discussing proximate cause and foreseeability).

262. *See supra* notes 236-61 and accompanying text (describing the United States regulatory system, and indicating a lack of liability).

263. *See infra* notes 265-315 and accompanying text.

264. *See infra* notes 316-46 and accompanying text.

265. *See infra* notes 271-85 and accompanying text.

266. *See infra* notes 286-90 and accompanying text.

267. *See infra* notes 291-303 and accompanying text.

268. *See infra* notes 304-13 and accomanying text.

269. *See generally supra* notes 142-51 and accompanying text (describing the injury to farmer C.).

270. *See supra* notes 142-51 and accompanying text.

First, under the duty element, does a corporation which created a transgenic species, have a duty to farms adjacent to those farms to which it sold its products? Applying the hypothetical, Ag-Sci holds a patent for its Super Tomato, thus Ag-Sci is the legal owner of the genetic material which makes up the tomato.[271] Furthermore, it was the genetic material from Ag-Sci's patented tomato which is thought to be the cause of the Farmer C's crop destruction.

Under a misfeasance duty theory, it must be shown that (1) the defendant's conduct created a risk and (2) the plaintiff was foreseeable. First, a release of transgenic species can lead to outcross which in turn can allow for increased susceptibility to disease or insects.[272] Thus, a new risk of harm to Farmer C's fields was created by Ag-Sci when it sold the Super Tomato into country Y. Second, transgenes are scientifically proven to escape and cross-pollinate up to two miles away.[273] This provable fact means that any farm within a two mile radius of release would foreseeably be subject to outcross.[274] Farmer C's farm was within a two mile radius of Farmer A's transgenic crop, thus it was foreseeable that outcross could have occurred on Farmer C's farm. Therefore, under a misfeasance theory, Ag-Sci would owe a duty to Farmer C.

Public policy issues are also important in a U.S. duty discussion.[275] Another alternative duty test applied in the United States includes policy factors used in *Rowland v. Christian*:[276] (1) are the defendant's actions morally blameworthy;[277] (2) will a duty here, define policy to prevent future harm;[278] (3) who could insure better against such harm;[279] (4) would a duty here cause future deterrence;[280] (5) was the plaintiff's harm foreseeable; (6) was the injury certain to occur; and (7) was there a connection between the injury and the defendant's conduct.

A duty analysis under Rowland factors (5)-(7) discuss issues which will be covered in both the cause in fact and proximate cause analysis to follow. Thus only factors (1)-(4), which are the major policy issues, will be discussed below.

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271. *See* Diamond v. Chakrabarty, 447 U.S. 303, 316 (1980) (holding genetically engineered microorganisms can be patented).

272. *See* SCOTT, *supra* note 122, at 34 (claiming escaped plants which harbor disease or insect pests are a serious threat).

273. Lackey, Cantaloupe, *supra* note 131, at 3 (claiming two miles should be a reasonably effective precautions against pollen escape in cantaloupe and squash).

274. *See id.*

275. *See supra* notes 62-83 and accompanying text (listing the various fears associated with the introduction of transgenics).

276. *See* Rowland v. Christian, 443 P.2d 561 (Cal. 1968) (holding a person is liable for injuries caused by his failure to exercise reasonable care by balancing foreseeability of harm, certainty of injury, connection of the act and injury, moral blame of the conduct, policy to prevent future harm, consequence to community of a duty and insurance availability).

277. *See Rowland*, 443 P.2d at 564; *see also infra* notes 280-83 and accompanying text.

278. *See Rowland*, 442 P.2d at 564; *see also infra* notes 284-85 and accompanying text.

279. *See Rowland*, 442 P.2d at 564; *see also infra* note 286 and accompanying text.

280. *See Rowland*, 442 P.2d at 564; *see also infra* note 286 and accompanying text.

Under the first factor, currently, the sale and release of transgenics is a morally heated battle.[281] Drawing condemnation from both the President of the United States[282] and the Pope.[283] The Ag-Sci hypothetical begs the question of the possible immorality of science.

The second Rowland factor in a U.S. duty analysis, finding Ag-Sci to have a duty to Farmer C must aid policy to prevent future harm. First, finding a duty will allow Farmer C the opportunity to seek compensation for his injuries. Thus, establishing a precedent of liability in transgenic cases. Second, finding a duty may bring transgenic issues to the attention of the populous, causing concern and legislative action.

Third, for insurance purposes, Ag-Sci alone holds the patent information[284] about the tomatoes, and it alone produces the tomato. Similarly, industry is in the position to offset the costs of the insurance by dispersing them to consumers. As a consequence, Ag-Sci is in a far better position than a farm to both purchase and provide insurance companies with the information necessary for proper coverage.

Finally, finding a duty here should cause future deterrence. A duty imposed could force Ag-Sci to create products which do not cause such harm; if they are found liable. Thus, the liability that could attach to transgenic production could force the corporations to produce a safer product.

To conclude, from a policy standpoint in the United States, the gains of transgenics are immense, yet the risks are equally immense.[285] If industry is to pursue testing and creation of transgenics, they should have a duty to protect society from outcross of transgenic species.

The second element of U.S. negligence law is breach. *United States v. Carrol Towing Co.*[286] provides an analysis for breach. The court will balance the: (1) magnitude of risk; (2) gravity of harm; and (3) utility of conduct to determine whether a duty exists.[287] Applying the Carrol Towing analysis in the Ag-Sci hypothetical, the magnitude of risks associated with transgenic crops range from causing a single

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281. *Cf.* Bram Pols, *The "Frankenstein Food" Flap,"* NRC HANDELSBLAD" (INDEPENDENT), ROTTERDAM, Nov. 30, 1996, *reprinted in* WORLD PRESS REV., Mar. 1997, at 32 (discussing the public protests in Britain and Germany concerning biotechnology); Nico Ladenis, *Why Soybeans Go Bananas*, "THE GUARDIAN" (LIBERAL), LONDON, Dec. 5, 1996, *reprinted in* WORLD PRESS REV., Mar. 1997, at 32 (conveying the advance of science as invading food).

282. *Cf.* Sonya Ross, *Clinton Nixes Cloning*, ASSOCIATED PRESS Mar. 2, 1997 (writing the United States' president Clinton urged a halt in research on cloning and barred all spending of federal money on human cloning).

283. *Cf. Pope Attacks Experiments*, ASSOCIATED PRESS Mar. 2, 1997 (mentioning the Pope denounced experiments that are a threat to human dignity; just days before the Vatican proposed a ban on cloning humans).

284. *See generally* Diamond v. Chakrabarty, 447 U.S. 303 (holding genetically engineered micro-organisms can be patented, thus allowing for the patenting of transgenics); *see supra* notes 136-45 and accompanying text (listing the Super Tomato as patented by Ag-Sci).

285. *See supra* notes 38-83 and accompanying text (discussing both the goals and fears of biotechnology).

286. *See* United States v. Carrol Towing Co., 159 F.2d 169 (2d Cir. 1947) (describing a duty analysis to include a balancing of burden to avoid the risk verses magnitude and propensity of risk).

287. *Id.*

cross-pollinated plant to become susceptible to disease, to destroying the entire world supply of rice.[288] The gravity of harm created by these risks extends to total destruction of the world's biodiversity and food supply.[289] Conversely, the utility of the conduct of transgenics includes such bold impacts as curing world hunger and preventing disease.[290] The question becomes can we risk everything, loss of biodiversity and destruction of major food sources, to gain the ability to produce hardier crops? It seems reasonable that under a *Carrol Towing* analysis a breach would be found in the Ag-Sci hypothetical.

The third element of negligence law in the United States is cause in fact.[291] In order to establish liability, a chain of causation must be determined between the culpable act and the damages suffered.[292] The but-for test of cause in fact is applied to determine whether the defendant's conduct is more likely than not the cause of the injury to the plaintiff.[293]

Applying the but-for test to the Ag-Sci hypothetical,[294] facts must show that but for the outcross of transgenes from the Super Tomato, Farmer C's crop would not have been susceptible to the disease which infected it.[295] The same technology that has created transgenics problems, has however, created a scientific and conclusive determination of cause.[296] Methods can be used to detect whether a certain gene has outcrossed.[297] Current genetics allow a reporter gene[298] to be physically linked to a transgene of interest[299] which will indicate escape.[300] In situations where multiple fields of transgenic crops are in the vicinity, similar methods can be used to deter-

288. *See supra* notes 69-70 and accompanying text.

289. *See supra* notes 71-73 and accompanying text.

290. *See supra* notes 38-61 and accompanying text (discussing the various goals scientists feel can be achieved with transgenics).

291. *See generally* Mt. Healthy City School District Board of Education v. Doyle, 429 U.S. 274 (1977) (covering legal cause in terms of cause in fact and proximate cause).

292. *Cf.* Malone, *Ruminations of Cause-in-fact*, 9 STAN. L. REV. 60 (1956); Green, *the Causal Relation Issue in Negligence Law*, 60 MICH. L. REV. 543 (1962); KISS & SHELTON, *supra* note 166, at 352 (discussing the link of causality).

293. *See* RESTATEMENT (SECOND) OF TORTS § 432(1) (1976).

294. *See supra* notes 142-51 and accompanying text (describing the pollination of Farmer C's crops by the bees which transported pollen form Farmer A's transgenic crops).

295. *See* RESTATEMENT (SECOND) OF TORTS, *supra* note 292, at §432(1).

296. *See* GEORGE, *supra* note 124, at 21 (claiming there are highly sensitive methods for the detection of outcrosses for the possibility of escape).

297. *See id.* at 21 (stating current technology would permit the detection of outcrosses, even at low frequency).

298. *See* LAGRIMINI, *supra* note 125, at 21 (describing reporter genes as individual genes that can be physically linked to the transgenes that may escape). The reporter genes used are not present in higher plant life, thus they would be easy to detect if an outcross occurred. *Id.*

299. *See id.* (defining a gene of interest as the transgenic gene which escape is possible).

300. *See* GEORGE, *supra* note 124, at 21 (listing examples of reporter genes to include firefly luciferance and E.coli B-glucuronidase). Sub-nanogram levels can be detected through large samplings of effected plants. *Id.*

mine the exact transgene as the source.[301] Assuming the transgenes present in the Super Tomato can be proven to detect an ability to harbor disease, this element of cause in fact can be met.

In the Ag-Sci hypothetical, Farmer C would be able to have his ruined tomato crops tested for their genetic makeup.[302] The patented transgenes of the Super Tomato allow for a genetic structure which is distinct from every other variety of tomato.[303] The Ag-Sci transgenes will be picked up in Farmer C's crops and causation conclusively and reliably established.

The fourth element in a U.S. negligence cause of action is proximate cause. Proximate cause determines if the defendant should be liable even though his actions were the cause-in-fact of the injury.[304] To illustrate, under *Babbitt v. Sweet Home Chapter of Communities for a Great Oregon*,[305] proximate cause is determined by the foreseeablility of the injury.[306] In *Babbitt*, the U.S. Supreme Court held the Secretary of the Interior's definition of "harm" within the Federal Endangered Species Act[307] to include significant habitat modification that actually kills or injures a listed species.[308] An injury is foreseeable when an actor knows that an activity, such as draining a pond, would result in harm to a species by destroying its habitat.[309] However, U.S. Supreme Court Justice O'Connor in concurrence limits the notion of

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301. *See* Chetelat, *supra* note 36 (describing the use of reporter genes in the context of a field of transgenic tomatoes (expressing the reporter) surrounded by normal tomatoes (not containing the transgenes). If transgenics are widely grown, there is the possibility that several fields could have the same reporter gene, however, gene constructs tend to be very well described for patents, so if an outcross is detected, it would be relatively easy to determine the exact sequence of the transgene construct, which would point to a particular variety as the source. *Id.*

302. *See generally id.*

303. *See generally id.*

304. *See* RESTATEMENT (SECOND) OF TORTS § 431.

305. *See* Babbitt v. Sweet Home Chapter of Communities for a Great Oregon, 115 S. Ct. 2407 (1995) (discussing a foreseeability requirement in the proximate cause element). In a hyphothetical, the majority finds an injury foreseeable when a developer drains a pond knowing hat the act of draining the pond will kill a species. *Id.* at 2415 n.15.

306. *See generally id.*

307. 16 U.S.C. §1531 (1988).

308. *See Babbitt*, 115 S. Ct. at 2418 (holding the Secretary reasonably interpreted harm to include significant habitat modification or degradation that actually kills or injures wildlife).

309. *See id.* at 2414 (concluding harm that knowingly will have a certain series of effects, which directly lead to the extinction of a species is foreseeable).

foreseeability[310] and the dissent requires a cause which directly produces an effect without any intermediate effects.[311]

Applying the Ag-Sci hypothetical to Sweet Home's proximate cause analysis, harm to Farmer C may be considered foreseeable since Ag-Sci knows that the spread of transgenes can occur through outcross and within the distance to Farmer C's crop.[312] Additionally, intermediate factors such as wind or bees will be considered, if Ag-Sci knows that wind and bees can cross-pollinate over great distances. However, the distance and exact process of the cross pollination will cause problems for Farmer C under the concurrence or dissent. Under these theories, if the court concludes the pollen transfer was remote, even one step removed, no foreseeability exists.[313]

The final element of a U.S. negligence cause of action is proof of the injury. The Ag-Sci hypothetical has Farmer C's crops destroyed, and such an event would satisfy the injury requirement.

The application of U.S. negligence liability to the Ag-Sci hypothetical, could provide a remedy for Farmer C. However, a court's ability to impose a duty upon Ag-Sci should be based largely on public policy.[314] Additionally, with the new ruling covering proximate cause in *Babbitt*, lower courts may be able to determine the threshold of foreseeability in each case.[315] Under the U.S. system of negligence, non-scientifically trained judges may fail to realize the certainty of harm once the transgene is placed in the environment.

2. *The Strict Liability Approach to Deliberate Release Liability*

A second theory of liability in the United States which may apply to transgenics is strict liability for abnormally dangerous activities. Strict liability may be imposed

310. *See id.* at 2420 (J. O'Connor, concurring) (using a hypothetical of a farmer who tills his field, finding it may not be foreseeable that causing erosion and silt run-off into a river, which in turn depletes the river waters oxygen will injure the fish) *Cf.* NIGEL BUNCE, ENVIRONMENTAL CHEMISTRY, 221 (Wuerz Publishing Ltd. 1991) (describing the process from the hypothetical; stating eutrophication is created by excessive levels of nutrients entering the water from the farmed soils causing drastically increased populations of algae during the summer). When the algae die, there decomposition places a greatly increased Biological Oxygen Demand (BOD) on the lake). Increased BOD can use up the available oxygen in the water so that organisms literally suffocate. *Id.* at 122.

311. *See Babbitt*, 115 S. Ct. at 2429-31 (J. Scalia, dissenting) (discussing proximate cause as an immediate or direct cause of the injury, thus in the eutrophication issue, it would not be foreseeable that the fish would be injured from the farmers tilling of the soil).

312. *See id.* at 2414 n.13 (interpreting a federal statute as being subject to the ordinary requirements of proximate causation and foreseeability).

313. *Id.* at 2420, 2429-31.

314. *See supra* notes 275-85 and accompanying text (discussing the public policy issues present in a negligence analysis under United States law).

315. *See generally Babbitt*, 115 S. Ct. at 2418 (creating a foreseeability threshold which must be interpreted by lower courts in a case-by-case basis as questions of degree must be addressed through the usual course of law).

upon an abnormally dangerous activity that causes injury.[316] The elements to determine whether an action is an abnormally dangerous activity are: (1) existence of a high degree of risk of some harm to the person, land or chattels of others;[317] (2) likelihood that the harm that results from it will be great;[318] (3) inability to eliminate the risk by the exercise of reasonable care;[319] (4) extent to which the activity is not a matter of common usage;[320] (5) inappropriateness of the activity to the place where it is carried on;[321] and (6) extent to which its value to the community is outweighed by its dangerous attributes.[322] If these elements are met strict liability attaches, irrespective of fault.

The first element of strict liability in the United States is the existence of a high degree of risk of harm.[323] To illustrate, outcrossing is an inevitable occurrence if transgenic species are released into the environment.[324] Once the transgenic species are released into the field, natural cross pollination will occur due to wind, insect and animal pollinators.[325] The risk of harm is great, in fact it is almost guaranteed

The second element is the likelihood that the harm that results from it will be great.[326] One authority, describes transgenics as potentially one of the most serious threats to the biodiversity and ecological integrity of our planet.[327] The impacts to the food supply and biodiversity, are threats which can alter the natural processes on earth or destroy massive amounts of the world's food production.[328] As an activity which threatens the entire earth,[329] transgenics, should meet the threshold of possible great harm.

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316. *See* RESTATEMENT (SECOND) OF TORTS § 520 (defining abnormally dangerous activities). In determining whether an activity is abnormally dangerous, the following factors are to be considered:

(a) existence of a high degree of risk of some harm to the person, land or chattels of others;
(b) likelihood that the harm that results from it will be great;
(c) inability to eliminate the risk by the exercise of reasonable care;
(d) extent to which the activity is not a matter of common usage;
(e) inappropriateness of the activity to the place where it is carried on; and
(f) extent to which its value to the community is outweighed by its dangerous attributes.

Id., *see generally* MCCAFFREY, *supra* note 155, at 47 (describing North American Law).

317. *See infra* notes 323-25 and accompanying text.

318. *See infra* notes 326-29 and accompanying text.

319. *See infra* notes 330-33 and accompanying text.

320. *See infra* notes 334-37 and accompanying text.

321. *See infra* notes 338-40 and accompanying text.

322. *See infra* notes 341-43 and accompanying text.

323. *See* RESTATEMENT (SECOND) OF TORTS § 520(a).

324. *See* GEORGE, *supra* note 124, at 20 (discussing the prevention of gene transfer).

325. *See id.*

326. *See* RESTATEMENT (SECOND) OF TORTS § 520(b).

327. FOX, *supra* note 1, at 156.

328. *See* FOX, *supra* note 1, at 156 (comparing transgenics to the sanction and promotion of the wholesale application of pesticides and the development of capital-intensive monoculture farming and forestry); *see also supra* notes 62-83 and accompanying text (hypotesizing the possible negative impacts of transgenics on society and the environment).

329. FOX, *supra* note 1, at 156.

Strict liability in the United States also requires an inability to eliminate the risk with reasonable care.[330] If transgenic species are released into the environment, outcrossing will occur.[331] In brief, once in the field, there are no practical methods to prevent the low frequency of natural cross pollination and genetic escape through pollination by wind or insects.[332] Many precautions such as set-backs and planting a boarding species can limit outcross,[333] however, outcross cannot be completely eliminated.

The fourth element of strict liability is the extent to which the activity is not a matter of common usage.[334] Currently, the release of transgenics is experimental and limited in number.[335] However, most of the world's wheat, rice and corn have been genetically altered.[336] Although cross-pollinating different species of plants to form hybrids is common,[337] adding transgenes such as spider venom to tomatoes is not.

Next, U.S. strict liability law requires the inappropriateness of the activity to the place of occurrence.[338] The spread of transgenics will be occurring largely on farmland. Growing crops that are superior in quantity and quality is not inappropriate on farmland.[339] However, growing a product that has the ability to destroy plant-life, within the same farmland which already must produce efficiently to feed the world, is inappropriate.[340] Until transgenes can be developed, understood and controlled, they belong in the lab, not threatening the world's food supply.

Finally, the extent to which its value to the community is outweighed by its dangerous attributes is considered.[341] Many industrial activities that cause pollution are often socially desirable.[342] Public policy driven by economics, therefore, often renders courts reluctant to hold polluters absolutely liable.[343] As the world's popu-

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330. *See* RESTATEMENT (SECOND) OF TORTS § 520(c).

331. *See* GEORGE, *supra* note 124, at 20 (1992) (discussing the prevention of gene transfer).

332. *See id.*

333. *See* LAGRIMINI, *supra* note 125, at 21 (stating a boarder crop of at least 150 feet should prevent outcross of transgenic tomato genes); UCD EXEC. SUM, *supra* note 111, at 9 (concluding that a thirty foot isolation zone between transgenic tomatoes and non-transgenic species should be enough to prevent outcross).

334. *See* RESTATEMENT (SECOND) OF TORTS § 520(d).

335. *See* Meister & Mayer, *supra* note 101, at 1 (stating release of transgenics have occurred in eighteen developed countries and soon in thirty-five developing countries).

336. *See id.* (claiming all of the world's major food crops, including rice, wheat and corn, have been genetically altered).

337. *See* CURTIS & BARNS, *supra* note 19, at 988-89 (depicting cross pollination of hybrids in crops).

338. *See* RESTATEMENT (SECOND) OF TORTS § 520(e).

339. *See supra* notes 49-54 and accompanying text (describing increased crop production as a goal of transgenics)

340. *See supra* notes 62-83 and accompanying text (covering the fears of transgenics).

341. *See* RESTATEMENT (SECOND) OF TORTS § 520(f).

342. As an example: production plants for steel, chemicals or coal all emit waste into the environment. These activities, however, provide jobs and income for many communities.

343. *See* MCCAFFREY, *supra* note 155, at 47 (hypothesizing that fear of discouraging socially desirable conduct, public policy, has made courts reluctant to hold polluters strictly liable); *see also* Fritz v. E.I du Pont de Nemours & Co., 45 Del. 427 (1950) (depicting the immense weight courts give even in cases involving hazardous substances such as chlorine gas).

lation continues to grow and the Earth's resources are stretched to their limits, policy may favor unencumbered transgenics. We may soon have no choice, however, we are not currently in such a dire situation.

In conclusion, under U.S. law, a plaintiff seeking the application of negligence liability for damages caused by a release of transgenics will find no judicial precedent, nor a framework to establish consistency.[344] Both, public policy and foreseeability will be interpreted by the court on a case-by-case basis.[345] Similarly, the U.S.'s strict liability for abnormally dangerous activities approach also includes a public policy element.[346]

However, the United States could create a transgenic strict liability scheme, but set a cap on the amount of recovery. Such a scheme could both satisfy the advance of science, economics of industry and allow for protection of the public at the same time.

C. Liability in Japan

Assuming the law of the United States is not applicable to a transgenic issue, perhaps the court has chosen the laws of Japan, the world's second largest producer of transgenics.[347] In the formation of its regulatory scheme for propagation, Japan established a diffused regulatory structure similar to the United States.[348] However, the regulatory process in Japan is more stringent than that of the United States.[349] Where the U.S. regulatory system is product-oriented, that is based on the product of the technology by testing completed organisms,[350] Japan's system is process-

344. *See supra* notes 234-43 and accompanying text (discussing the United State's regulatory and tort liability framework).

345. *See supra* notes 275-85 and accompanying text (covering public policy concerns present in a United States duty analysis); *supra* notes 304-13 and accompanying text (emphasizing the Sweet Home case and the issue of foreseeability).

346. *See supra* notes 341-43 and accompanying text (conveying the public policy issues in U.S. strict liability claims).

347. *See* OFFICE OF TECHNOLOGY ASSESSMENT, U.S. CONGRESS, BIOTECHNOLOGY IN A GLOBAL ECONOMY 29, at 19 (1991) (stating that Japan would most likely be the leading competitor of the United States in Biotechnology); *see also* FOX, *supra* note 1, at 16, tab. 1.4 (depicting the United States as supporting 388 biotechnology companies, Japan supporting 105).

348. *See* ROBERT T. YUAN & MARK D. DIBNER, JAPANESE BIOTECHNOLOGY, 4 at 60-61 (1990) (initating the Japanese Ministry of Education, Science and Culture regulates basic research at universities). The Science and Technology Agency regulates basic research in national laboratories and private industry. *Id.* The Ministry of Agriculture, Forestry, and Fist regulates large-scale production of plants and animals. *Id.* The Ministry for Industrial Trade and Industry [hereinafter MITI] regulates large-scale manufacture of specialty chemicals. *Id.* MITI and the Environmental Protection Agency regulate waste treatment together. *Id.* The Ministry of Welfare and Health regulates the large-scale production of drugs. *Id.*; *see also* Karen Graziano, Comment, *Biosaftey Protocol: Recommendations to Ensure the Safety of the Environment*, 7 COLO. J. INT'L ENVTL. L. POL'Y 179, 181 (1996) (discussing the Japanese regulatory system).

349. *See* Graziano, *supra* note 348, at 181 (describing the Japanese regulatory system).

350. *See supra* notes 234-64 and accompanying text (discussing the United States regulatory system as product based).

oriented, it regulates the process of production.[351] In fact, Japan's regulatory system was so stringent, it was not until 1991 that a transgenic tomato was released in Japan.[352] Where a release occurred in the United States over twelve years ago, in 1985.[353] These regulations reflect the Japanese society's concern over deliberate release of a transgenics and its potentially devastating effects.[354]

Similar to the United States, the Japanese regulations do not include a liability scheme to deal with transgenic species. Thus, any recovery in Japan must utilize the country's tort system.

Tort liability in Japan is based on intentional and negligent violations of another's rights.[355] Four elements must exist to find a tort under Japanese law: (1) the tortfeasor must have acted with intent or negligence;[356] (2) the act was unlawful;[357] (3) causality must exist between the tortious act and the loss;[358] and (4) the loss must have occurred.[359]

Under the first element of tort liability, if the act was committed intentionally the element is satisfied, however, negligence in Japanese law can be defined in terms of either: (1) a state of mind; or (2) a breach of duty.[360]

Defined in terms of a state of mind, a defendant is negligent for failure to foresee that a loss is likely to occur from his actions.[361] Under this the first theory of negligence, the foreseeability analysis will be similar to that of the United States.[362] The foreseeability analysis will center on the fact that science can reliably trace the spread of transgenes.[363] Similarly, cross-pollination is common knowledge in the scientific community.[364] Using the Ag-Sci hypothetical, a general foreseeability analysis provides Farmer C the most likely recovery scheme against Ag-Sci.

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351. *See* Graziano, *supra* note 348, at 180 (analyzing the Japanese regulatory system).

352. *See* OFFICE OF TECHNOLOGY ASSESSMENT, U.S. CONGRESS, A NEW TECHNOLOGICAL ERA 207 (1992) (noting the first field testing of tomatoes by the National Institute of Agro-Environmental Science).

353. *See* FOX, *supra* note 1, at 9 (citing OFFICE OF TECHNOLOGY ASSESSMENT, 1991, MAJOR EVENTS IN THE COMMERCIALIZATION OF BIOTECHNOLOGY) (listing Advanced Genetic Sciences, Inc., as receiving the first experimental use permit issued by the EPA for release of GMOs (strains P. syringae and P. flourescens, absent the gene for ice-nucleation protein).

354. *See* OFFICE OF TECHNOLOGY ASSESSMENT, U.S. CONGRESS, BIOTECHNOLOGY IN A GLOBAL ECONOMY 29 (1988)

355. Japan's Civil Code Art. 709: "A person who intentionally or negligently violates the rights of others shall be liable for the loss caused by the act." (as cited in HIROSHI ODA, JAPANESE LAW, at 207 (Butterworths 1992) [hereinafter JAPANESE LAW].

356. *See infra* notes 360-68 and accompanying text.

357. *See infra* notes 369-74 and accompanying text.

358. *See infra* notes 375-88 and accompanying text.

359. *See supra* notes 142-51 and accompanying text (discussing the injury to farmer C).

360. *See* JAPANESE LAW, *supra* note 355, at 209 (stating the prevailing view of negligence is that of a breach of duty).

361. *See id.* at 210 (describing state of mind school of thought on the application of negligence definitions).

362. *See supra* notes 302-08 and accompanying text (analyzing foreseeability in the United States).

363. *See generally* Chetelat, *supra* note 36 (discussing the ability of science to recognize reporter genes, thus determining exactly which transgenic crop has outcrossed).

364. *See id.*

In the alternative, under the breach of duty theory in Japan, a defendant would only be considered negligent if he fails to take measures needed to avoid and prevent the loss.[365] Japanese courts seem to prefer this approach, focusing on the ability to avoid the loss.[366] However, applying the avoidability approach to the Ag-Sci hypothetical, Ag-Sci can take adequate measures[367] to avoid the foreseeable consequences of cross pollination.[368] Since Ag-Sci required Farmer A to have set backs in planting the crops, it is likely that a Japanese court would find proper avoidance. Yet, a court could hold that Ag-Sci is liable, knowing there are no measures to prevent damage.

Proving the second element in Japanese tort liability involves a balancing test to determine the unlawfulness of the act in question.[369] The courts balance the nature of the interest[370] which was violated against the extent of the breach. Cases of slight breach when the interest affected is serious can yield liability.[371] Alternatively, if the interest violated is not serious, the violation must be.[372] Under the facts of the Ag-Sci hypothetical, assuming that the court will find Ag-Sci's breach to be minimal due to its avoidance requirements,[373] the right violated must be serious. Farmer C's crops

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365. *See* JAPANESE LAW, *supra* note 355, at 210 (describing the breach of duty school of thought on the application of negligence definitions).

366. *See* JAPANESE LAW, *supra* note 355, at 210 (concluding a majority of courts hold that even if the defendant had foreseen or should have foreseen the result of his act, he is not held liable if he fulfilled his duty to prevent and avoid the loss); *see also* Judgment of the Supreme Tribunal, 22 Dec., 1916 (*Minroku* 22-2474: Osaka Alkali case) (finding a polluting corporation not liable due to prevention taken by the corporation to prevent the pollution) (as interpreted in JAPANESE LAW, *supra* note 355, at 210); Judgment of the Supreme Court, 24 Sept., 1968 (*Hanji* 539-40) (holding a driver has no duty to take action to prevent an accident) (as interpreted in JAPANESE LAW, *supra* note 355, at 210). *But see* Judgment of Nitigata District Court, 29 Sept., 1971 (*Hanju* 642-96: Niigata Minamata case) (holding if damage to human health is likely with even the most advanced technology, it is the duty of the company to stop operation of the plant) (as interpreted in JAPANESE LAW, *supra* note 355, at 211).

367. *See* JAPANESE LAW, *supra* note 355, at 211 (stating higher standards of care have been placed on industries such as food producers and chemical companies); Judgment of Fukuoka District Court, Kokura Division, 29 March, 1982 (*Hanji* 1037-14: *Kanemi Yusho* case) (holding a food processing plant to a high duty of care where a toxic substance was mixed into rice oil) (as interpreted in JAPANESE LAW, *supra* note 355, at 211). *But see id.* at 212 (stating if the defendant has taken care in abiding by current scientific research he will not be held liable under higher standard); Judgment of the Supreme Court, 13 Nov., 1979 (*Hanji* 952-49) (ruling a doctor was not liable when his treatment caused retinal disease in a premature baby, since his treatment was within the standard of surgical knowledge) (as interpreted in JAPANESE LAW, *supra* note 355, at 212.

368. *See supra* notes 107-32 and accompanying text (recognizing outcrosses from transgenic species will occur once released into the environment).

369. *See* JAPANESE LAW, *supra* note 355, at 213 (naming the second requirement for tort liability).

370. *See id.* at 214 (stating initially in order to have a violation, a right under Article 709 had to be violated). *But see* Judgment of the Supreme Tribunal, 28 Nov., 1925 (*Minshu* 4-670: Daigaku-yu case) (holding it is sufficient that an interest be considered as appropriately deserving protection under the law) (as interpreted in JAPANESE LAW, *supra* note 355, at 214).

371. *See* JAPANESE LAW, *supra* note 355, at 213 (balancing the severity of the breach against the importance of the interest effects).

372. *See id.*

373. *See supra* notes 142-51 and accompanying text (detailing the set-back requirements discussed between Ag-Sci and Farmer A).

being destroyed could be considered a serious violation of his rights to conduct a business and make a living.[374]

Once the defendant is shown to have acted intentionally or negligently[375] and the act was unlawful,[376] a plaintiff must prove causation.[377] The causation requirements in Japanese law are similar to the requirements of U.S. law[378] where the plaintiff bears the burden of showing the causal relationship between the act and injury.[379] However, Japanese law has relaxed the burden of proof on the plaintiff in some cases.[380]

In cases where the plaintiff may lack the technical knowledge to prove causality,[381] a mere probability of causality may suffice.[382] In our Ag-Sci hypothetical, under such a requirement, Farmer C would need only to show circumstantial evidence of cross pollination from Farmer A's field,[383] but could specify the transgene present in his field.[384] Ag-Sci would have to disprove the evidence.[385]

In a second rationale of lessening the burden of the plaintiff, the doctrine of indirect counter proof exists in Japan to help plaintiffs prove their cases.[386] This doctrine allows the plaintiff to prove causation to the extent of the ordinary man, unless the defendant can produce facts to the contrary.[387] Under this theory in the Ag-Sci

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374. *See* JAPANESE LAW, *supra* note 355, at 214 (stating the courts have interpreted the depravation of rights requirement broadly to include loss of sunlight and defamation).

375. *See supra* notes 360-68 and accompanying text (reviewing the analysis of negligent actions under Japanese tort law).

376. *See supra* notes 369-74 and accompanying text (covering the unlawfulness element under Japanese tort law).

377. *See* JAPANESE LAW, *supra* note 355, at 214 (describing causation as the link between the tortious act and the injury suffered).

378. *See supra* notes 291-92 and accompanying text (discussing the United States negligence element of cause in fact).

379. JAPANESE LAW, *supra* note 355, at 214 (stating the plaintiff has the burden to establish a causal like between the defendants unlawful act and the injury suffered).

380. *See id.* at 215 (stating Japanese courts have lessened the burden on plaintiffs to prove causality in pollution, medical or product liability cases).

381. *Id.*

382. *See* Judgment of Toyama District Court, 30 June, 1971 (*Kaminshu* 22-5/6-1) (holding the causal link need not be proven beyond any possible doubt) (as interpreted in JAPANESE LAW, *supra* note 355, at 215).

383. *See* JAPANESE LAW, *supra* note 355, at 215 (stating there are cases in which the court has alleviated the burden of proof, ruling that if a disease causing substance can be proven and traced with circumstantial evidence, liability can be found).

384. *See generally* Chetelat, *supra* note 36 (describing the scientific possibilities of determining the outcross of transgenes).

385. *See* Judgment of Niigata District Court, 29 Sept., 1971 (*Kaminshu* 22-9/10-1: Niigata Minamatabyo case) (discussing the switching of the burden on the defendant in a case involving chemical releases which were circumstantially traced to the defendant's factory) (as interpreted in JAPANESE LAW, *supra* note 355, at 215).

386. *See* JAPANESE LAW, *supra* note 355, at 215 (stating another theory which can alleviate the burden of proof). If the victim proves the existence of indirect facts which tends to show the causal link between the act and the loss, causation is presumed unless disproved. *Id.* at 215-16.

387. *See* Judgment of the Supreme Court, 24 Oct., 1975 (*Minshu* 29-9-1417) (acknowledging causality when there is not any other circumstances that can explain the occurrence of a child reacting to a penicillin shot) (as interpreted in JAPANESE LAW, *supra* note 355, at 216).

hypothetical, Farmer C has even a lessor burden. Farmer C would have to prove the presence of a new transgenic crop in Farmer A's field and the destruction of his crop. The link between could be provided by scientific evidence to show with a high probability that Farmer A's transgenes had caused Farmer C's loss.[388]

The final element of Japanese tort law is proof of the injury. The Ag-Sci hypothetical has Farmer C's crops destroyed, such an event would satisfy the injury requirement.

The Japanese legal system does not provide specifically for liability for transgenics, thus like the U.S. system a plaintiff will have to use traditional tort laws. However, the Japanese system does provide a causation requirement which is plaintiff friendly in cases of a technical nature.[389] The mere probability of causality theory and the doctrine of indirect counter proof are both designed for issues such as transgenics, where causation can become a critical issue. The Japanese law is changing to keep pace with technology.

D. Liability in Germany

Finally, the laws of Germany, the third largest producer of transgenics, shall be analyzed. In 1990, the German National Parliament passed the process-oriented Genetic Technology Act (the GTA).[390] Consequently, Germany has the only specific liability scheme enacted for transgenics of the three countries. The GTA was brought to fruition in response to the EC Directives[391] for deliberate release and contained use, and a German Court of Appeals decision in late 1989.[392]

The GTA permits the release of genetically engineered organisms after regulatory approval by the Federal Health Authority.[393] The GTA also entails civil

388. *See* JAPANESE LAW, *supra* note 355, at 216 (analyzing the theory of indirect counter proof to provide the plaintiff with a smaller burden of proof). Under this theory, if the plaintiff can plead logical facts of the injury, the court can presume the causal link between the unlawful act and the injury).

389. *See id.*

390. *See* Ruestch & Broderick, *supra* note 99, at 410 (citing *The German Genetic Technology Act* 11/6778 (27 March 1990); *see also* Graziano, *supra* note 348, at 181 (discussing Germany's Genetic Technology Law which imposes civil and criminal liability to meet with public pressure to regulate transgenics); Kim, *supra* note 37, at 1170-73 (addressing Germany's strict transgenics laws to pose perhaps the most stringent deliberate release regulations in the world).

391. *See* Council Directive 90/219/EEC, *supra* note 192, Council Directive 90/220/EEC, *supra* note 192; *see id.* at Articles 11(7), 17 of the Contained Use Directive, and Articles 4(2)-(3) of the Deliberate Release Directive (stating member states are required to designate competent authorities to perform their responsibilities under the Directives, including organizing inspections and other control measure to ensure compliance).

392. *See* Ruestch & Broderick, *supra* note 99, at 410 (citing *Hessischer Verwaltungsgerichtshof,* Decision of 6 November 1989, which held that an express statutory basis for approval of genetic-technology facilities is required). The reasons for the rapid enactment of the German Genetic Technology Act are in part due to the EC Directives and in part due to the Administrative Court of Appeals in Hessen's ruling. *Id.*

393. *See The German Genetic Technology Act, supra* note 99, at § 8(1), 14(1) (requiring express approval for construction and operation of facilities for contained use and for all deliberate releases) (as interpreted in *New Biotechnology Legislation in Germany* at 410).

liability without fault[394] and criminal penalties.[395] The rationale behind the liability scheme is, technology when released into the environment will entail some risk regardless of testing and precautions.[396] The acceptance of risk by the German legal community parallels the strict liability requirements in the United States for abnormally dangerous activities.[397]

In response to the understanding that injuries from transgenics will occur, Germany imposes liability without fault on those who create the risks.[398] Additionally, the operators who create these risks must also obtain insurance to protect against liability.[399] However, a cap has been placed on the recovery amount.[400]

The Ag-Sci hypothetical, under German law, would hold Ag-Sci liable to Farmer C for damages up to the cap amount. Farmer C would have to show the transgene from Ag-Sci's tomato was now in his crops to establish a claim. However, the GTA imposes a duty on Ag-Sci to disclose the relevant genetic information to allow Farmer C to make his claim.[401]

Germany is the only country to recognize the importance of transgenics,[402] while at the same time providing adequate protection for both the environment and society. The GTA allows the transgenic producers the ability to invent and test new species, knowing that a fixed fine will be imposed if injuries occur.[403] Society is able to receive the benefits of better quality crops, while at the same time not fearing catastrophe.

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394. *See The German Genetic Technology Act, supra* note 99, at § 32 (discussing no-fault liability with a capped recovery limit), *id.* § 35 (imposing a duty of information on the operator to make it easier for the injured party to assert a claim for compensatory damages); *id.* § 36 (requiring the operator to obtain insurance to protect against liability) (as interpreted in Ruestch & Broderick, *supra* note 99, at 411). *See generally* Graziano, *supra* note 348, at 180 (discussing Germany's Genetic Technology Law); Kim, supra note 37, at 1173.

395. *The German Genetic Technology Act, supra* note 99, at § 38-39 (outlining the criminal and penalty provisions of the act) (as interpreted in Ruestch & Broderick, *supra* note 99, at 411).

396. *See supra* note 131 and accompaning text.

397. *See supra* note 316-43 and accompaning text (covering U.S. strict liability).

398. *See The German Genetic Technology Act, supra* note 99, at § 32 (as interpreted in Ruestch & Broderick, *supra* note 99, at 411).

399. *See The German Genetic Technology Act, supra* note 99, at § 36 (as interpreted in Ruestch & Broderick, *supra* note 99, at 411).

400. *The German Genetic Technology Act, supra* note 99, at § 32 (which sets the cap at DM 160 million) (as interpreted in Ruestch & Broderick, *supra* note 99, at 411).

401. *The German Genetic Technology Act, supra* note 99, at § 35 (as interpreted in Ruestch & Broderick, *supra* note 99, at 411).

402. *See* part V.B *supra* discussing liability under U.S. law, *see also* part V.C covering liability under Japanese law.

403. *See* Ruestch & Broderick, *supra* note 99, at 411 (discussing the German Genetic Technology Act to impose preventive responsibility on the operator of a genetic technology facility; requiring risk assessment and precautions against potential dangers to be taken).

VI. CONCLUSION

Biotechnology is here to stay.[404] Consequently, releases of new transgenic species will occur with greater frequency.[405] We can all understand the goals of ending world hunger, stopping disease and sustaining our environment. However, the fears of the unknown are extreme. How will a certain transgene react in the natural environment? Will it out-compete native species, destroy the entire world's supply of rice or mutate into who knows what years from now?

Transgenics can and will be a part of society, yet society needs the ability to feel safe amongst the unknown. The world is recognizing and beginning to understand this issue more every day.[406] However, transgenics is not a country-by-country issue, it is a global issue.

The economics of development and propagation of transgenic species will be dominated by national and multi-national corporations.[407] Currently, in most countries, national regulations provide a structure to oversee and regulate creation and testing of transgenics.[408] However, Germany is the only major producer of transgenics to have a specific transgenic liability law.[409] Most countries courts will have to apply current tort liability to find a remedy.[410]

The significance of transgenics demands countries to enact laws which deal specifically with biotechnology issues. The breadth of transgenic applications and world-wide interest, demands an international standard to cover liability. As we approach and enter the twenty-first century in a complex blur of technology, let us not forget to simply protect ourselves.

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404. *See generally* FOX, *supra* note 1, at 181-82 (concluding biotechnology is not a utopian dream, but a will create benefits or injuries depending on if it is used prudently and with respect).

405. *See* Meister & Mayer, *supra* note 101, at 1 (claiming releases of transgenic species have occurred in at least 18 developed countries and may occur in 35 developing countries soon).

406. *See supra* notes 185-212 and accompanying text (discussing the international regulatory process).

407. *See supra* notes 84-101 and accompanying text (discussing the international business of biotechnology).

408. *See supra* notes 234-403 and accompanying text (discussing U.S., Japan and German laws and regulations).

409. *See supra* notes 390-403 and accompanying text (discussing The German Genetic Technology Act).

410. *See supra* notes 265-389 and accompanying text (discussing U.S. and Japanese Tort law).