

Guiding the Hand That Feeds: Toward Socially Optimal Appropriability in Agricultural Biotechnology Innovation

Peter J. Goss[†]

Introduction.....	1397
I. Agricultural Biotechnology: Its Achievements, Its Promise.....	1400
A. Higher Yields, Disease Resistance, and Environmental Benefits.....	1400
B. Biotechnology as a Weapon Against Genetic Erosion and Genetic Uniformity.....	1402
II. Domestic Proprietary Protection for Plant Breeding Innovation	1403
A. Utility Patents.....	1403
B. The Plant-Specific Acts.....	1406
1. The Plant Patent Act of 1930.....	1406
2. The Plant Variety Protection Act.....	1407
a. The Research Exemption.....	1409
b. The Crop Exemption.....	1410
i. Judicial Efforts to Limit the Crop Exemption's Scope.....	1411
ii. Legislative Efforts to Limit the Exemption's Scope.....	1413

Copyright © 1996 California Law Review, Inc.

[†] Associate, Faegre & Benson, L.L.P., Minneapolis, Minnesota; B.A., M.A., University of California, Berkeley; J.D., Boalt Hall School of Law, University of California, Berkeley. I would like to thank everyone at CLR who put their time and energy into this Comment, especially Jennifer Berman, Daniel Johnson, Heather Skinazi, and Sean Anderson. Their excellent work proved an invaluable guide for improving the Comment throughout. All remaining errors are my own. I would also like to thank Professor Robert Merges for his oversight, and Bruce Morrissey for his input at both the beginning and the end of this project. This Comment is dedicated to my father, John R. Goss, who inspired me to write it, as he has inspired me in all my other endeavors.

C. Trade Secret Protection.....	1414
1. <i>Pioneer Hi-Bred Int'l, Inc. v. Holden Foundation</i> <i>Seeds</i> and the "Genetic Message from the Cornfields of Iowa".....	1415
2. Maintaining Trade Secrets: Reasonable Precautions.....	1416
D. Private Intellectual Property Protection Arrangements: Hybrids, Purchase Agreements, and Label Notices.....	1418
1. Hybrid Technology: Engineered Protection.....	1418
2. Purchase Agreements.....	1419
3. Label Notices.....	1420
III. Risks Associated with Granting Proprietary Rights in Plant Genetic Resources	1421
A. Genetic Uniformity and Genetic Erosion.....	1422
B. Impact on Germplasm Exchange	1423
C. Concentration Within the Seed Industry	1424
IV. How Current Appropriability Options Disappoint Proponents of Intellectual Property Rights in Plant Genetic Resources.....	1426
A. The Siren Song of Utility Patents	1427
B. The Amended PVPA: The More Things Change	1429
C. Trade Secrets: It's Midnight; Do You Know Where Your Parent Lines Are?.....	1431
D. Contracts and Label Notices: Not Worth the Trouble.....	1432
V. A Proposed Solution.....	1433
A. A Better Balance	1433
B. Proposed Amendments to the PVPA	1434
Conclusion.....	1435

Guiding The Hand That Feeds: Toward Socially Optimal Appropriability in Agricultural Biotechnology Innovation

Peter J. Goss

Recent innovations in biotechnology have produced many new, market-tailored agricultural products. Under current law, the developers of such new plant varieties have a number of options to protect their intellectual property rights. These options include utility patents, plant patents, state-law trade secret protection, and such private measures as product labels and contractual provisions. This Comment argues that none of the foregoing options is entirely satisfactory, and that the law must achieve a better balance among the property interests of the developers, the need to encourage further innovation in plant varieties, the preservation of competition in the seed industry, and the prevention of such environmental harms as genetic uniformity and genetic erosion. To this end, the author proposes amendments to the Plant Variety Protection Act that would strengthen the protection afforded to plant breeders, but shorten the period over which that protection extends. These amendments, the author contends, would insure profits for the developers of valuable plant varieties, thus providing an incentive for innovation, but would also promote competition in the seed industry by making new developments widely available for use in spurring further innovation, which in turn can help to reduce the threat of genetic erosion and genetic uniformity.

INTRODUCTION

American agriculture¹ is undergoing one of the most significant transformations in its history. Recent biotechnological innovations have introduced market-tailored products into an industry traditionally known for commodification and bland uniformity. For instance, Calgene, whose Flavr Savr[®] tomato is engineered to ripen more gradually than conventional tomatoes, now allows grocers to stock their

1. While "agriculture" encompasses both livestock animals and plants, this Comment will focus exclusively on biotechnological developments in plants, e.g., fruits, vegetables, and seed crops. Thus, any reference to "agriculture" or "agricultural biotechnology" should be taken in this limited sense.

shelves with ripe tomatoes in the winter. Similarly, many crop-seed companies are developing herbicide- and pesticide-resistant versions of major seed varieties.² These engineered varieties³ promise to benefit the environment by dramatically reducing the need for agricultural chemicals. Seed companies are also creating "identity-preserved"⁴ and "end-use tailored"⁵ varieties to serve specialized agricultural sub-markets. These varieties offer consumers environmentally safe, high quality, low-cost food and fiber products.

The recent technological innovations in agriculture have brought intense competition to the crop-seed industry. Companies have fought legal battles over the right to use germplasm⁶ with desirable traits in breeding projects.⁷ As litigation has escalated, seed companies have sought broader and stronger intellectual property rights in order to reap more of their inventions' value.

2. Monsanto Company has been developing varieties that are resistant to its herbicide, Roundup®. W. Wayne Withers, *Regulation/Commercialization of Genetically Engineered Plants*, in BIOTECHNOLOGY: NEW DEVELOPMENTS IN FEDERAL POLICIES AND REGULATIONS 97, 102 (PLI Patents, Copyrights, Trademarks, and Literary Property Course Handbook Series No. 256, 1988). Seed companies have also been developing varieties that produce the insect control protein found in the genes of *Bacillus thuringiensis* ("B.t."). Charles S. Gasser & Robert T. Fraley, *Genetically Engineering Plants for Crop Improvement*, 244 SCIENCE 1293, 1295 (1989). Herbicide and pesticide resistance are discussed further *infra* Part I.A.

3. The Plant Variety Protection Act defines "variety" as follows:

The term "variety" means a plant grouping within a single botanical taxon of the lowest known rank, that, without regard to whether the conditions for plant variety protection are fully met, can be defined by the expression of the characteristics resulting from a given genotype or combination of genotypes, distinguished from any other plant grouping by the expression of at least one characteristic and considered as a unit with regard to the suitability of the plant grouping for being propagated unchanged. A variety may be represented by seed, transplants, plants, tubers, tissue culture plantlets, and other matter.

7 U.S.C. § 2401(a)(9) (1994).

4. "Identity preserved grains" have been characterized as "prescription products" that must be produced outside the traditional commodity system. One example is Pioneer Hi-Bred International, Inc.'s Better-Life™ grains, which are certified as having been produced without the use of chemical pesticides. Thomas N. Urban, *Agricultural Industrialization: It's Inevitable*, CHOICES, Fourth Quarter 1991, at 4.

5. "End-use tailored" varieties are a subgroup of identity preserved grains. These grains are engineered to have special characteristics desired by a downstream end-user, often a processor or a livestock producer. One example is DuPont's Optimum Quality Grains division's Topcross™ high-oil corn, which is targeted for the livestock industry. *Dinner is Served: The Higher Energy Content of Optimum® High-Oil Corn Lowers Feed Costs for Livestock Producers*, DUPONT MAGAZINE, vol. 90, no. 4, July/August 1996, at 17-19 [hereinafter *Dinner is Served*].

6. Germplasm is the substance in plant germ cells by which hereditary characteristics are believed to be transmitted. WEBSTER'S NINTH NEW COLLEGIATE DICTIONARY 514 (1991).

7. See, e.g., *Pioneer Hi-Bred Int'l v. Holden Found. Seeds, Inc.*, 35 F.3d 1226, 1228 (8th Cir. 1994) (affirming Pioneer's award of over \$46 million in lost profits resulting from Holden's misappropriation of Pioneer's parent hybrid corn seeds, which were held to have been protected by Iowa trade secret law); *Suits Sprout Over Rights to Seeds*, WALL ST. J., March 5, 1990, at B1 (discussing suit by Dole Food Co. against Scattini Seed Co. for the rights to the "Napoleon" variety of celery, which is resistant to "bolting," a process wherein cold weather causes stalk elongation to the extent that the celery cannot be sold as food).

Many oppose strengthening appropriability⁸ options for plant breeders. Environmentalists fear that because enhanced intellectual property rights would restrict access to plant genetic resources, such enhancement would contribute to genetic erosion—the shrinking of the global gene pool. Others fear that intellectual property rights will increase economic concentration in the seed industry, leading to higher seed costs and threatening the viability of small farms. Finally, some worry that granting intellectual property rights to large, private breeders will squeeze smaller breeders out of the market and thereby impede the creation of innovative new products. Despite these concerns, in 1994 Congress attempted to strengthen seed companies' intellectual property rights by amending the Plant Variety Protection Act ("PVPA").⁹

In this Comment, I argue that Congress's amendments to the PVPA needlessly overextend the Act's protection period,¹⁰ ignore environmental and economic objections, and ultimately fail to provide a socially optimal incentive for plant breeding innovation. I also argue that the options currently available to plant breeders for protecting their inventions fail to meet the needs of both proponents and critics of strong property rights in plant genetic resources. First, I discuss the dangers associated with private ownership of plant genes. Then, I demonstrate that current intellectual property devices are inefficient for plant breeders because they fail to provide inexpensive and reliable protection. Finally, I argue that a socially optimal incentive for plant breeding innovation can be set by modifying the PVPA so that it provides plant breeders stronger protection for their inventions, but for a shorter period of time. This proposed solution would diminish the negative economic and environmental effects of granting intellectual property rights in plant genes, but would still provide breeders a clear incentive to continue developing the valuable innovations they have produced in recent years.

Part I of this Comment discusses the achievements of agricultural biotechnology, and what biotechnology promises to bring in the future. Part II discusses proprietary protection currently available for plant breeding innovation. This protection includes "utility" patents, plant patents, trade secret protection, and private intellectual property arrangements. Part III of this Comment presents the risks associated with

8. I use the term "appropriability" to mean any method, legal or non-legal, that an inventor can use to capture some of the value that her invention confers on society. A simple example of an effective legal appropriability device is copyright royalties, where (in theory) an author or composer receives compensation in proportion to how widely her work is enjoyed in society.

9. 7 U.S.C. §§ 2321-2582 (1994).

10. See *Congressional Passage of New PVP Law a Triumph for Seed Industry*, DIVERSITY, vol. 10, no. 3, 1994, at 34-35 [hereinafter *PVP Law a Triumph*].

granting proprietary rights in germplasm.¹¹ Part IV addresses the shortcomings of currently available protections from the seed industry's perspective. Finally, Part V proposes amendments to the PVPA that aim to establish a socially optimal incentive for plant breeding innovation.

I

AGRICULTURAL BIOTECHNOLOGY: ITS ACHIEVEMENTS, ITS PROMISE

A. *Higher Yields, Disease Resistance, and Environmental Benefits*

For centuries, plant breeders have sought to increase both the amount of produce that a type of seed yields and its resistance to disease and environmental stresses. Higher yields and disease resistance are attractive for geopolitical reasons, such as increasing the world food supply. Producers seek these traits for economic reasons as well. A farmer would choose a higher-yielding, more disease-resistant seed over a competing one, for the simple reason that it would allow her to bring more goods to market. Thus, the plant breeder who develops the most disease-resistant and high-yielding variety on the market stands to sell far more seed than her competitors.

Through modern biotechnology, plant breeders can now develop high-yielding, disease-resistant varieties in a shorter period of time than ever before. Historically, breeders have used "first-generation"¹² biotechnological methods to transfer attractive traits by selecting plants that exhibit them and cross-breeding them with other plants within the species over several generations.¹³ Modern biotechnology, however, enables breeders to insert a desired gene directly into the target plant's DNA. This process has increased the pace of varietal improvement dramatically.¹⁴ Where traditional plant breeding took six to ten years to breed genetic transformations into commercial varieties, genetic engineering is expected to cut that time in half.¹⁵

Many plant diseases are controlled by a single gene.¹⁶ Through modern biotechnology, breeders can isolate key genes and breed varieties where they are not expressed, or otherwise manipulate the plant's

11. Throughout this Comment, I use "germplasm" interchangeably with "plant genetic material," "plant genetic resources," and other similar terms. A plant's genes are located in its germplasm. See *supra* note 6.

12. Simply put, first-generation biotechnology involves repeated selecting and crossing at the "organismal" level; second generation involves cellular manipulation; and third generation involves the manipulation of recombinant DNA. See Suzanne Y. Bell, *USDA Regulation of Biotechnology: Incorporating Public Participation*, 7 STAN. ENVTL. L. J. 6, 8 n.7 (1987-88).

13. See Thomas O. McGarity, *Federal Regulation of Agricultural Biotechnologies*, 20 J. L. REFORM 1089, 1092-93 (1987).

14. See *id.* at 1093.

15. See Withers, *supra* note 2, at 99.

16. *Id.* at 100.

genetic makeup to resist disease. Similarly, breeders can engineer resistance to environmental stresses such as drought, heat, frost, and salinity.¹⁷ The potential benefits are striking. For example, if scientists were to genetically engineer frost-resistance into frost-susceptible crops, \$1.6 billion—the cost to society of frost damage in a typical year—could be saved annually.¹⁸

The environment also could benefit substantially from agricultural biotechnology. Run-off of agricultural chemicals such as fertilizers and pesticides has contaminated ground water and caused other environmental problems. With biotechnology, breeders can create plants with improved photosynthetic and nitrogen fixation capabilities,¹⁹ significantly reducing the need for fertilizer. Similarly, pesticide use could be cut dramatically by splicing into crop varieties a gene from a bacterium, *Bacillus thuringiensis* ("B.t."), which causes the plant to produce a protein harmless to humans but toxic to many insect pests.²⁰ Some varieties of corn with the B.t. gene have received EPA marketing approval.²¹

Plant breeders are also creating herbicide-resistant varieties to reduce the need for toxic herbicides. The most environmentally friendly herbicides—those with low toxicity, low soil mobility, and rapid biodegradation—are also the most likely to destroy one's crop along with the weeds.²² As a result, farmers seeking to control weeds must apply more particularized herbicides, which are also more toxic.²³ Genetically engineered resistance to environmentally friendly herbicides would significantly reduce the need for more toxic alternatives.

Biotechnology has also played a prominent role in the development of "end-use-tailored" varieties. Plant breeders now can more easily create products—whether cotton of a certain color, or soybeans with a specified oil content—that suit the needs of particular end-users. For example, DuPont's Optimum Quality Grains division, in partnership with Holden Foundation Seeds, has created Topcross™, a corn variety engineered to have a high energy content.²⁴ This trait is desirable to

17. See *id.*; see also Kevin Bastian, *Biotechnology and the United States Department of Agriculture: Problems of Regulation in a Promotional Agency*, 17 *ECOLOGY L.Q.* 413, 429 n.129 (1990).

18. Withers, *supra* note 2, at 100.

19. Bell, *supra* note 12, at 9.

20. See Withers, *supra* note 2, at 101; Bastian, *supra* note 17, at 429 n.127.

21. Bruce W. Morrissey, *Protecting an Interest in Quality Seed and Quality Seed Traits: Benefits to All*, in *PROCEEDINGS OF THE FIFTH ANNUAL CORN & SORGHUM INDUSTRY RESEARCH CONFERENCE 1995*, at 68.

22. See Withers, *supra* note 2, at 102. These herbicides are termed "non-selective" because they do not discriminate between weed and crop. *Id.*

23. See *id.*

24. *Dinner is Served*, *supra* note 5, at 17-19.

many livestock producers, who anticipate that Topcross™ grain will help them produce larger, healthier animals in less time than was previously possible using conventional grain.²⁵ Varieties can also be engineered to increase efficiency in grain processing, and to help processors develop specialized grain and oil products, such as vegetable oil low in saturated fat.²⁶ In sum, agricultural biotechnology allows plant breeders to develop plants that benefit the environment,²⁷ and that can lead to more nutritious²⁸ and less expensive²⁹ products for consumers.

*B. Biotechnology as a Weapon Against Genetic Erosion
and Genetic Uniformity*

Preserving the planet's biodiversity is one of today's most pressing issues. The animal and plant kingdoms are threatened by "genetic erosion," the reduction of genetic diversity within the global gene pool. A staggering number of species are lost from the planet every year,³⁰ reducing the potential adaptability of all remaining species to disease and environmental stresses.³¹ Plants and animals adapt to changing environmental conditions by acquiring the genes of similar species that are resistant to those conditions. But when a species becomes extinct, its genes are lost, along with the environmentally advantageous characteristics they might contain. Therefore, when a plant species disappears, remaining plants lose the ability to appropriate its beneficial traits. At the same time, plant breeders lose the chance to introduce those traits into other plants through biotechnology.

Biotechnology cannot directly address the problem of genetic erosion. Desirable genetic traits cannot be created from whole cloth; they can only be copied from other plants. But while biotechnology cannot bring lost species back from the dead, it can diminish potential losses. To prevent extinction, breeders can genetically engineer endangered

25. *Id.*

26. For example, while harder-textured grains are easier for farmers to harvest and store, processors find softer-textured grains more efficient for their purposes. Grains can be genetically engineered to meet the processors' needs. Urban, *supra* note 4, at 4. See also Gasser & Fraley, *supra* note 2, at 1298 (discussing applications of plant biotechnology to food engineering such as the production of specialized starches, the elimination of particular fatty acids in seed crops, and the production of proteins with nutritionally balanced amino acid composition); *Dinner is Served*, *supra* note 5, at 19 (quoting Bob Giaquinta of DuPont: "[W]e've been able, through genetics, to alter the fatty acid profile of the soybean so it yields an even more healthful oil").

27. See Bell, *supra* note 12, at 10.

28. See *id.* at 9.

29. McGarity, *supra* note 13, at 1093.

30. It is estimated that at least 20,000 species become extinct every year. Harold J. Bordwin, *The Legal and Political Implications of the International Undertaking on Plant Genetic Resources*, 12 *ECOLOGY* L.Q. 1053, 1056 n.17 (1985) (quoting Edith Brown-Weiss, *The Planetary Trust: Conservation and Intergenerational Equity*, 11 *ECOLOGY* L.Q. 495, 526 (1984)).

31. See *id.*

plant species to have greater environmental or disease resistance, simply by inserting those traits into the DNA of the endangered species.

The problem of "genetic uniformity" is related to genetic erosion. Genetic uniformity refers to the genetic similarity of varieties employed to produce a crop.³² When the varieties used to produce a region's crop of a certain plant—say corn or soybeans—are genetically similar, they will react similarly to drought, disease, insects, and other environmental factors.³³ Consequently, a far-reaching environmental factor could decimate an entire region's harvest of a crop. The Irish potato famine of the nineteenth century and the 1970 corn leaf blight in the United States provide examples of past catastrophes that were exacerbated by genetic uniformity.³⁴

Biotechnology promises to alleviate this problem. Because biotechnology has led seed companies to generate varieties for increasingly specialized markets of "end-users," genetic uniformity is simply no longer the threat it used to be. Where in the past the nation's corn crop came from a handful of varieties, future corn crops will come from a significantly broader genetic heritage because they will be specially tailored to serve a variety of distinct market niches.³⁵

In addition, scientists can use biotechnology to counter genetic uniformity directly when a threat arises.³⁶ Plant breeders can now generate more quickly new varieties that resist unexpected environmental factors.³⁷ Breeders can also take beneficial traits from one species and transfer them directly into another species, a process that could not be done with traditional plant breeding.³⁸ This capability allows rapid response to crises brought on by genetic uniformity.

II

DOMESTIC PROPRIETARY PROTECTION FOR PLANT BREEDING INNOVATION

A. *Utility Patents*

The "utility patent" statute, 35 U.S.C. § 101, provides that "[w]hoever invents or discovers any new and useful process, machine,

32. *Id.* at 1056.

33. *Id.* at 1056-57.

34. *Id.* at 1057; *see also* Bastian, *supra* note 17, at 429. The corn leaf blight caused losses to farmers of between \$500 million and \$2 billion. Bordwin, *supra* note 30, at 1057 n.23; *see also* Barbara A. Claffey, *Patenting Life Forms: Issues Surrounding the Plant Variety Protection Act*, S. J. AGRIC. ECON. (December, 1981) at 29, 35 (noting that as of 1981, 71% of the nation's corn acreage depended on just six varieties, and that the 1970 corn blight destroyed nearly one-fifth of the crop that year).

35. *See* Bell, *supra* note 12, at 10.

36. Whether biotechnology will be used for this purpose is addressed *infra* Part III.A.

37. *See* Bastian, *supra* note 17, at 429.

38. *See, e.g.,* Withers, *supra* note 2, at 100.

manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title."³⁹ Under this statute, which can apply to everything from windshield-wiper blades to dance steps, a plant breeder who creates an innovative variety can get a "utility patent."

Some have argued that plants, and all other living things, should not be "patentable subject matter."⁴⁰ In *Diamond v. Chakrabarty*, however, the United States Supreme Court rejected this argument and recognized the patentability of living inventions.⁴¹ Chakrabarty, a microbiologist, sought to patent a bacterium he invented which was useful for cleaning up oil spills because of its capacity to "eat" crude oil.⁴² The patent examiner rejected his application on the ground that micro-organisms are "products of nature" and therefore not patentable under the statute.⁴³

The Supreme Court, however, held that the examiner should have issued Chakrabarty a patent for his invention.⁴⁴ The Court noted that patents are only available for "a nonnaturally occurring manufacture or composition of matter—a product of human ingenuity 'having a distinctive name, character [and] use,'" and not for "hitherto unknown natural phenomen[a]."⁴⁵ Applying these principles, the Court held that Chakrabarty's bacterium was a product of human labor, contained characteristics "markedly different" from any found in nature, and had the potential for "significant utility."⁴⁶ These characteristics made Chakrabarty's bacterium eligible for a patent.⁴⁷

The *Chakrabarty* decision opened the door for plant breeders to seek patents for new plant varieties. *Chakrabarty* established that the relevant distinction in patent law is not between animate and inanimate objects, but rather between products of nature and products of human effort.⁴⁸ However, because *Chakrabarty* dealt with a bacterium, which is technically not a plant, it did not fully secure the availability of utility patents for plant breeding innovations.

39. 35 U.S.C. § 101 (1994).

40. See *Diamond v. Chakrabarty*, 447 U.S. 303, 314-15 (1980) (presenting petitioner's argument that micro-organisms cannot qualify as patentable subject matter because "genetic technology was unforeseen when Congress enacted § 101"); see also *New Coalition Attacks Human/Animal Patenting*, BIOTECH REPORTER, Jun. 1995, at 2 (describing the efforts of the Joint Appeal Against Human and Animal Patenting, led by advocate Jeremy Rifkin, in opposition to the patenting of living matter).

41. *Id.*

42. *Id.* at 305.

43. *Id.* at 306.

44. *Id.* at 318.

45. *Id.* at 309-10 (quoting *Hartranft v. Wiegmann*, 121 U.S. 609, 615 (1887)).

46. *Id.* at 310.

47. *Id.*

48. *Id.* at 313.

New plant varieties became eligible for utility patents under *Ex Parte Hibberd*.⁴⁹ The dispute in *Hibberd* concerned the applicability of § 101 to maize plants with increased levels of free tryptophan, an amino acid.⁵⁰ The patent examiner argued that because Congress enacted two “plant-specific” statutes—the Plant Patent Act (“PPA”) and the Plant Variety Protection Act (“PVPA”)—to provide intellectual property protection for plant breeders,⁵¹ Congress must have intended to exclude plants from eligibility for utility patents under § 101.⁵²

The Board of Appeals, however, found no express congressional intent indicating that the PPA and PVPA should supersede § 101 for plants.⁵³ The Board held that when Congress enacted the PVPA in 1970, it believed that “it [did] not alter protection currently available within the patent system.”⁵⁴ The Board also found that Congress originally enacted the PPA in 1930 to combat two obstacles that plant breeders faced in obtaining intellectual property protection: that plants were considered unpatentable “products of nature,” and that it was difficult for new plant varieties to satisfy the “enablement” requirement of patent law.⁵⁵ Thus, the Board of Appeals held that Congress enacted the plant-specific acts out of concern that plants would not qualify for patent protection, not because Congress thought plants were inherently unpatentable. As a result of the Board’s decision, new plant varieties became eligible for utility patents under § 101.

Plant breeders responded to the *Hibberd* decision by prosecuting numerous patents.⁵⁶ Utility patents are popular because they provide a breeder with strong protection, allowing her to exclude others from making, using, or selling the patented item (or practicing the patented process) without her permission.⁵⁷ The scope of utility patent protection

49. 227 U.S.P.Q. (BNA) 443 (Bd. Pat. App. & Interferences 1985).

50. *Id.*

51. The Plant Patent Act, 35 U.S.C. §§ 161-164 (1994), is discussed *infra* Section II.B.1, and the Plant Variety Protection Act, 7 U.S.C. §§ 2321-2582 (1994), is discussed *infra* Section II.B.2.

52. *Hibberd*, 227 U.S.P.Q. (BNA) at 444.

53. *Id.* at 445.

54. *Id.* (quoting S. REP. NO. 1246 at 3 (1970)).

55. *Id.* The “enablement” requirement is codified at 35 U.S.C. § 112 (1994). It requires the inventor to provide a written description of her invention that is sufficiently specific to “enable” others “reasonably skilled in the art” to recreate it based upon that description.

56. See Neil D. Hamilton, *Who Owns Dinner: Evolving Legal Mechanisms for Ownership of Plant Genetic Resources*, 28 TULSA L.J. 587, 596 (1993) (“In the years since [*Hibberd*], hundreds of patents have been issued for plant varieties.”); see also Robert J. Jondle, *Overview and Status of Plant Proprietary Rights in INTELLECTUAL PROPERTY RIGHTS ASSOCIATED WITH PLANTS* 5, 8 tbl. 1-1 (Am. Soc’y of Agronomy, Inc. 1989) (listing plant patents issued for, inter alia, “Hybrid corn line,” “Tryptophan overproducer mutants,” and “Process producing odorless soybean”) [hereinafter INTELLECTUAL PROPERTY RIGHTS].

57. 35 U.S.C. § 271(a) (1994).

can be wide. Under the "doctrine of equivalents,"⁵⁸ patentees are protected from imitations of their inventions. Further, patentees are protected from inventors who independently come up with the same invention; independent discovery is not a defense in an infringement suit.⁵⁹

However, patent protection is expensive to obtain. An inventor first must prove several elements: (1) that her invention is novel and useful, (2) that it is "enabled,"⁶⁰ and (3) that it is not merely an obvious improvement upon prior inventions.⁶¹ Because of the difficulty of proving these threshold requirements, § 101 patents frequently are more expensive and take longer to obtain than other forms of intellectual property protection.⁶²

B. The Plant-Specific Acts

1. The Plant Patent Act of 1930

In 1930, Congress enacted the PPA to enable plant breeders to obtain patent-like protection for their inventions.⁶³ The PPA allowed breeders to overcome the objection that plants are "products of nature" and to surmount the difficulties surrounding the patent law's enablement requirement.⁶⁴

However, the PPA's application is limited to asexually reproducing plants, which are produced from cuttings or grafts and not grown from seed.⁶⁵ The PPA does not cover tuber-propagated plants like potatoes, nor does it protect sexually reproducing plants (those grown from

58. See Jondle, *supra* note 56, at 9. The test provided by the doctrine of equivalents is that if the product accomplishes the same things as the patent claims and in substantially the same way, it infringes on the patent. *Id.*

59. WILLIAM LESSER, *PATENTING SEEDS: WHAT TO EXPECT* 8 (Cornell Univ. Agric. Experiment Station 1986).

60. See *supra* note 55 and accompanying text.

61. The "nonobviousness" requirement, codified at 35 U.S.C. § 103 (1994), has not been expressly formulated in the area of plant breeding, but in general a new variety must be separated from prior varieties by at least one distinguishing trait. LESSER, *supra* note 59, at 8-9. The distinguishing trait need not be commercially significant. *Id.*

62. The expense of obtaining utility patents is explored further *infra* Part IV.A.

63. *Chakrabarty*, 447 U.S. at 311-13.

64. Whereas § 112 requires full enablement, the PPA provides that plant patentees are exempt from § 112 so long as their description is as "complete as is reasonably possible." 35 U.S.C. § 162 (1994). However, current Patent and Trademark Office practice requires only a deposit of the variety to meet § 112, the same requirement imposed by the PPA. See Nicholas J. Seay, *Protecting the Seeds of Innovation: Patenting Plants*, 16 AIPPLA Q.J. 418, 422 (1988-89). Thus, it appears that enablement no longer presents a significant obstacle to the patentability of plants.

65. The PPA provides that "Whoever invents or discovers and asexually reproduces any distinct and new variety of plant, including cultivated sports, mutants, hybrids, and newly found seedlings, other than a tuber propagated plant or a plant found in an uncultivated state, may obtain a patent therefor . . ." 35 U.S.C. § 161 (1994).

seed).⁶⁶ Hence, as more research capital was invested in sexually reproducing varieties, and as the market for seed crops became more profitable, plant breeders pressured Congress to extend intellectual property protection to sexually reproducing plants.⁶⁷

2. *The Plant Variety Protection Act*

In 1970, Congress enacted the PVPA to address the need for protecting breeding innovations in sexually reproducing plants.⁶⁸ The PVPA's requirements are more restrictive than the PPA's: whereas the PPA requires only that a variety be new and distinct, the PVPA also requires that the variety be uniform and stable.⁶⁹ Consequently, plants that do not breed true—that is, plants failing to exhibit the same traits when grown out over several generations—are not eligible for protection.⁷⁰

PVPA protection runs for twenty years,⁷¹ providing a PVP certificate holder ample opportunity to reap the economic gains of her innovation. Anyone violating the rights provided by the certificate can be

66. *Id.*

67. See S. REP. NO. 1246 at 3 (1970) (indicating that "No protection is available to those varieties of plants which reproduce sexually, that is, generally by seeds. Thus, patent protection is not available with respect to new varieties of most of the economically important agricultural crops, such as cotton or soybeans").

68. The requirements of PVPA protection are as follows:

The breeder of any sexually reproduced or tuber propagated plant variety (other than fungi or bacteria) who has so reproduced the variety, or the successor in interest of the breeder, shall be entitled to plant variety protection for the variety, subject to the conditions and requirements of this Act, if the variety is—

(1) new, in the sense that, on the date of filing of the application for plant variety protection, propagating or harvested material of the variety has not been sold or otherwise disposed of to other persons, by or with the consent of the breeder, or the successor in interest of the breeder, for purposes of exploitation of the variety—

(A) in the United States, more than one year prior to the date of filing; or

(B) in any area outside of the United States—

(i) more than 4 years prior to the date of filing; or

(ii) in the case of a tree or vine, more than 6 years prior to the date of filing;

(2) distinct, in the sense that the variety is clearly distinguishable from any other variety the existence of which is publicly known or a matter of common knowledge at the time of the filing of the application;

(3) uniform, in the sense that any variations are describable, predictable, and commercially acceptable

7 U.S.C. § 2402(a) (1994).

69. Following the 1994 amendments, the PVPA requires "uniformity" in the sense that "any variations are describable, predictable, and commercially acceptable." 7 U.S.C. § 2402(a)(3) (1994). It defines "stable" to mean that "the variety, when reproduced, will remain unchanged with regard to the essential and distinctive characteristics of the variety with a reasonable degree of reliability commensurate with that of varieties of the same category in which the same breeding method is employed." *Id.* at § 2402(a)(4).

70. Varieties ineligible for protection include, especially, any hybrid varieties, because such varieties do not breed true after even one generation. Hybrid technology is discussed *infra* Part II.D.1.

71. 7 U.S.C. § 2483(b) (1994).

sued for infringement.⁷² But the strength of PVPA protection is diminished by two significant exemptions, the "research exemption" and the "crop exemption." And unlike the utility patent statute, which allows the patentee to exclude anyone from making, using, or selling her invention, the PVPA allows a breeder's competitors to use her protected variety to create new varieties without her permission.⁷³ Furthermore, the PVPA allows farmers to save seed from crops grown from a breeder's protected variety and use the seed for certain purposes without compensating her.⁷⁴

The 1994 PVPA amendments attempted to narrow the scope of the two exemptions.⁷⁵ The amendments partially achieve that goal, but they

72. The PVPA provides the following grounds for infringement:

(a) Acts constituting infringement

Except as otherwise provided in this subchapter [7 U.S.C. §§ 2531-2582], it shall be an infringement of the rights of the owner of a protected variety to perform without authority, any of the following acts in the United States, or in commerce which can be regulated by Congress or affecting such commerce, prior to expiration of the right to plant variety protection but after either the issue of the certificate or the distribution of a protected plant variety with the notice under section 2567 of this title:

(1) sell or market the protected variety, or offer it or expose it for sale, deliver it, ship it, consign it, exchange it, or solicit an offer to buy it, or any other transfer of title or possession of it;

(2) import the variety into, or export it from, the United States;

(3) sexually multiply, or propagate by a tuber or a part of a tuber, the variety as a step in marketing (for growing purposes) the variety;

(4) use the variety in producing (as distinguished from developing) a hybrid or different variety therefrom;

(5) use seed which had been marked "Unauthorized Propagation Prohibited" or "Unauthorized Seed Multiplication Prohibited" or progeny thereof to propagate the variety;

(6) dispense the variety to another, in a form which can be propagated, without notice as to being a protected variety under which it was received;

(7) condition the variety for the purpose of propagation, except to the extent that the conditioning is related to the activities permitted under 2543 of this title;

(8) stock the variety for any of the purposes referred to in paragraphs (1) through (7);

(9) perform any of the foregoing acts even in instances in which the variety is multiplied other than sexually, except in pursuance of a valid United States plant patent; or

(10) instigate or actively induce performance of any of the foregoing acts.

(b) Uses authorized by owner

(1) . . . the owner of a protected variety may authorize the use of the variety under this section subject to conditions and limitations specified by the owner.

7 U.S.C. § 2541 (1994).

73. 7 U.S.C. § 2544 (1994).

74. 7 U.S.C. § 2543 (1994).

75. The 1994 PVPA amendments allowed the United States to become the first country to comply with the 1991 amendments to the International Convention for the Protection of New Varieties of Plants ("UPOV"). *PVP Law A Triumph*, *supra* note 10, at 34. The United States has been a signatory of the UPOV since 1981. *New PVPA Amendments Proposed by Senator Bob Kerrey Would Bring United States into Compliance with UPOV*, DIVERSITY, vol. 9, no. 4, 1993/vol. 10, no. 1, 1994, at 57 [hereinafter *Compliance with UPOV*]. The UPOV, created in 1960, provides uniform plant variety protection for its signatory nations; sixteen nations had signed the UPOV by 1991. *Id.* The PVPA changes required by the UPOV Amendments (and accomplished by the 1994 Amendments) include:

(1) extending protection to first generation hybrids

(2) lengthening the term of protection to 20 years

(3) extending protection to harvested plant parts

fail to fill completely the gaps in PVPA protection. Moreover, by lengthening the PVPA protection period to twenty years, Congress increased the risks associated with long-term private ownership of plant genetic resources. The discussion of the two exemptions that follows focuses on the problems they engender and the need for further amendments to the PVPA.

a. The Research Exemption

The research exemption provides that "[t]he use and reproduction of a protected variety for plant breeding or other bona fide research shall not constitute an infringement of the protection provided under this chapter."⁷⁶ Thus, even if a plant breeder obtains a PVPA certificate, she will not be able to prevent other breeders from using her variety to develop their own lines with the same unique and valuable traits.

This does not mean that plant breeders are free to steal each others' inventions. Certain uses of protected varieties are prohibited. For example, a breeder cannot use another's protected variety "in producing (as distinguished from developing) a hybrid or different variety therefrom."⁷⁷

The difference between "producing" and "developing" a hybrid variety has not been litigated, so no authoritative interpretation of those terms is available. The vagueness of the two terms raises the concern that some breeders might try to justify their infringement of a protected variety by calling their attempt to copy the variety "development" rather than "production." It seems clear, however, that Congress did not intend to allow plant breeders to free-ride on each other's research investments by means of this semantic argument. Rather, it appears that Congress intended scientists to use each others' discoveries as stepping-stones to advance further developments in agricultural biotechnology.⁷⁸ Nevertheless, the research exemption exposes a PVPA certificate holder's proprietary information to her competitors in a manner that would be impermissible under the utility patent statute. This gap in the PVPA's armor significantly diminishes the appeal of PVPA protection.

(4) limiting the farmer's exemption to saving seed for use only on their own holdings;

(5) defining "essentially derived"; and

(6) modifying other definitions, including "breeder" and "variety"

Id. These changes are discussed further *infra* Parts II.B.2.a, II.B.2.b, and IV.B.

76. 7 U.S.C. § 2544 (1994).

77. 7 U.S.C. § 2541(a)(4) (1994).

78. This assertion follows from Congress' indication of the purpose of the PVPA, "to encourage the development of novel varieties of sexually reproduced plants." S. REP. NO. 1246 at 3 (1970). If appropriation of a variety's traits could be legally accomplished by mere production of the variety (*i.e.*, merely by growing it yourself), the encouragement provided by the PVPA to develop valuable new varieties would be practically nil.

With the 1994 amendments, Congress attempted to limit the potential for abuse of the research exemption by declaring that varieties "essentially derived" from protected varieties are infringing under the PVPA.⁷⁹ However, the term "essentially derived" is not self-defining, and Congress' definition leaves ample room for litigation.⁸⁰

The gist of Congress' definition is that an infringement occurs whenever a new variety incorporates a significant trait from a protected variety and is the same as the protected variety but for a few cosmetic changes. Of course, the courts will need to determine the precise boundaries of such terms as "clearly distinguishable" and "essential characteristics." Because the "essentially derived" basis for an infringement suit is so vaguely defined, and therefore so susceptible to litigation, it is questionable whether the amendments will actually deter abuse of the research exemption.

b. The Crop Exemption

The crop exemption⁸¹ has been a flashpoint between farmers and the seed industry. It was a primary target of the 1994 PVPA amendments, which limited its scope. As with the research exemption, though, Congress failed to close the gap in protection that the crop exemption represents.

Prior to the amendments, the crop exemption allowed a farmer who grew crops for sale as food or feed, but not as seed for planting, to save seed grown with a protected variety and use it to plant her crops the following year.⁸² She also could sell it to another farmer.⁸³ Such saved-

79. 7 U.S.C. § 2541(c)(1) (1994).

80. Congress defined an "essentially derived" variety as one that is "predominantly derived from another variety (. . . the "initial variety") . . . while retaining the expression of the essential characteristics that result from the genotype or combination of genotypes of the initial variety;" is "clearly distinguishable from the initial variety;" and "except for differences that result from the act of derivation, conforms to the initial variety in the expression of the essential characteristics that result from the genotype or combination of genotypes of the initial variety. . . ." 7 U.S.C. § 2401(3)(A) (1994).

81. The crop exemption, following the 1994 Amendments, reads as follows:

Except to the extent that such action may constitute an infringement under subsections (3) and (4) of section 2541 of this title, it shall not infringe any right hereunder for a person to save seed produced by the person from seed obtained, or descended from seed obtained, by authority of the owner of the variety for seeding purposes and use such saved seed in the production of a crop for use on the farm of the person, or for sale as provided in this section. A bona fide sale for other than reproductive purposes, made in channels usual for such other purposes, of seed produced on a farm either from seed obtained by authority of the owner for seeding purposes or from seed produced by descent on such farm from seed obtained by authority of the owner for seeding purposes shall not constitute an infringement. A purchaser who diverts seed from such channels to seeding purposes shall be deemed to have notice under section 2567 of this title that the actions of the purchaser constitute an infringement.

7 U.S.C. § 2543 (1994).

82. With most crops, the seed purchased from the seed company, when planted, begets more seed. In other words, seed goes in, and much more seed comes out at harvest than was initially

seed sales to other farmers became known as "brown-bag" sales because of the nondescript bags in which the seeds were sold.⁸⁴

While brown-bag sales may seem innocuous, their aggregate effects can cut severely into seed companies' profits. In 1990, Pioneer Hi-Bred International, one of the world's largest seed companies, decided to cease production of a variety of winter wheat in Kansas when it discovered that only eight percent of the variety grown in Kansas had been raised from seed actually purchased from Pioneer.⁸⁵ The secondary brown-bag market had swallowed 92% of Pioneer's market share. Thus, to the seed industry at that time, the crop exemption amounted to a gaping hole in the PVPA's protection.

i. Judicial Efforts to Limit the Crop Exemption's Scope

Prior to the 1994 amendments, courts attempted to limit the profiteering opportunities that the crop exemption created. While these efforts were somewhat successful, they failed to adequately protect seed companies' proprietary rights. By not providing optimal protection, courts failed to create an efficient incentive for seed companies to continue to invest in research and development of new varieties.

The Fifth Circuit was among the first courts to limit the crop exemption's scope. Its decision in *Delta & Pine Land Co. v. Peoples Gin Co.*⁸⁶ held that if farmers wished to sell saved seed to each other, they must do so directly, and not through intermediaries such as farm cooperatives and grain elevators.⁸⁷ Eliminating these brokered sales significantly reduces the volume of saved-seed transactions.⁸⁸ The Fifth Circuit noted that Congress' express intent in passing the PVPA was "to provide . . . protection for new varieties . . . so as to afford adequate encouragement for research, and for marketing when appropriate, to yield for the public the benefits of new varieties."⁸⁹ The court then held that the crop exemption should not thwart this basic purpose. While the crop exemption was included in the Act to allay concerns that the PVPA would impose higher costs on farmers (and ultimately consumers),⁹⁰ it

planted. The harvested seed can be sold as food (for people), feed (for animals), or as seed, which the purchaser can plant in her field to start the process all over again.

83. See 7 U.S.C. § 2543 (1970).

84. *Asgrow Seed Co. v. Winterboer*, 115 S.Ct. 788, 791 (1995).

85. *Hamilton*, *supra* note 56, at 632 n.142 (citing Brief for Pioneer Hi-Bred International, Inc., as amicus curiae, *Asgrow Seed Co. v. Winterboer*, 982 F.2d 486 (Fed. Cir. 1992)).

86. 694 F.2d 1012 (5th Cir. 1983).

87. *Id.* at 1016.

88. *Id.*

89. *Id.* at 1015 (quoting 7 U.S.C. § 2581 (1994)).

90. *Id.* at 1015.

was not intended to give farmers free rein to save and sell protected varieties.⁹¹

Even without brokered sales, however, a substantial number of farmer-to-farmer sales of protected varieties can still occur. No case better exemplifies this than *Asgrow v. Winterboer*,⁹² which reached the Supreme Court soon after Congress' 1994 amendment of the crop exemption, but before that amendment became effective.

Dennis and Becky Winterboer ran a farm in Clay County, Iowa.⁹³ The couple raised two of Asgrow's PVPA protected soybean varieties, and sold their brown-bagged "versions" of those varieties to other farmers.⁹⁴ The Winterboers' sales were extensive: they sold approximately 10,000 bushels of saved seed⁹⁵—enough to plant 400,000 acres of soybeans. The Winterboers never compensated Asgrow in any fashion for those sales.

Asgrow sued for an injunction to keep the Winterboers from selling saved seed.⁹⁶ The Winterboers answered that their sales were allowed by the crop exemption because their primary occupation was farming, and because they were selling directly to other farmers in compliance with the *Delta & Pine* decision.⁹⁷

The district court for the Northern District of Iowa held that Congress, by employing the restrictive modifier "saved" when discussing "saved seed," intended the crop exemption to be limited in some way.⁹⁸ The district court held that "[r]eading the statute as a whole, and giving effect to the intent of Congress, this court concludes that the intent of Congress in enacting this section was to allow a farmer to save seed for his planned seeding purposes."⁹⁹ Hence, this holding imposed an "ensuing crop limitation": a farmer could sell to other farmers only the amount of seed that she would otherwise need to plant her crop for the next year.¹⁰⁰ Because the Winterboers had sold

91. *Id.* at 1016.

92. 115 S.Ct. 788 (1995).

93. *Asgrow Seed Co. v. Winterboer*, 795 F. Supp. 915, 916 (N.D. Iowa 1991), *rev'd*, 982 F.2d 486 (1992), *rev'd*, 115 S.Ct. 788 (1995).

94. *Id.*

95. *Id.* at 920 n. 5.

96. *Id.* at 916.

97. *Id.* at 917-18.

98. *Id.* at 918.

99. *Id.* at 918.

100. *Id.* at 919. For example, assume a farm with 1,000 acres of soybean production. Recall that the seed planted is the same as the seed harvested, and that harvested seed can be sold as food or feed, or as seed for further planting (thereby repeating the process). The farmer here would only be able to save 1,000 bushels of soybeans (assuming the standard ratio of one bushel per acre) for the following year's planting purposes. Thus, the farmer, even though her farm would produce approximately 40,000 bushels of soybeans (assuming the standard yield of 40 bushels per acre), could only sell 1,000 of those bushels for seed. By contrast, without an ensuing crop limitation, the farmer

considerably more seed than they needed to plant their crops, they were liable to Asgrow for the difference.

The Court of Appeals for the Federal Circuit reversed,¹⁰¹ finding no indication that Congress wanted an ensuing crop limitation.¹⁰² Although the Federal Circuit recognized that “without meaningful limitations, the crop exemption could undercut much of the PVPA’s incentives,”¹⁰³ it decided against reading an ensuing crop limitation into the statute and vacated the permanent injunction against the Winterboers.¹⁰⁴

The Supreme Court, however, agreed with the district court that the crop exemption impliedly contained an ensuing crop limitation. Justice Scalia, writing for the majority, noted that under the research exemption, reproducing a protected variety with no intention of developing a new variety constituted infringement under the PVPA.¹⁰⁵ Given that the Winterboers were growing Asgrow’s protected varieties exclusively to sell them, and not to develop their own lines, the Court held that they had infringed Asgrow’s PVPA certificate.¹⁰⁶

Prior to the 1994 PVPA amendments, then, farmers could only sell seed they had grown for the purpose of replanting their own acreage.¹⁰⁷ Sales of seed exceeding the amount needed for replanting would violate the terms of the research exemption, because the seed would result from “producing (as distinguished from developing)” the protected variety. Such sales could therefore be prohibited under the PVPA.

ii. *Legislative Efforts to Limit the Exemption’s Scope*

Recognizing the impact of brown-bag sales on the seed industry, Congress removed the sale provision from the crop exemption altogether in 1994.¹⁰⁸ Farmers now may only sell seed “for other than reproductive purposes”¹⁰⁹—for food or feed, and not for planting. Thus, arrangements like the Winterboers’ would now infringe the rights of PVP certificate holders, no matter how little seed they sold.

could save and sell any amount less than 20,000 bushels (because in order for her primary occupation to be growing crops for non-reproductive purposes—a requirement for brown-bag sales—she would have to sell more than half of her crop for consumption as food or feed). The ensuing crop limitation thereby dramatically reduces a farmer’s opportunity to profit from brown-bagging (1,000 as opposed to 19,999 bushels available for sale).

101. *Asgrow Seed Co. v. Winterboer*, 982 F.2d 486 (Fed. Cir. 1992), *rev’d*, 115 S.Ct. 788 (1995).

102. *Id.* at 491.

103. *Id.*

104. *Id.* at 492.

105. *Asgrow Seed Co. v. Winterboer*, 115 S.Ct. 788, 795 (1995).

106. *Id.* at 796.

107. *Id.* Apparently, the rationale was to allow farmers to sell seed they decided not to plant.

108. *See* 7 U.S.C. § 2543 (1994).

109. *Id.*

While Congress may have rendered *Winterboer* moot by taking the sale provision out of the PVPA, the crop exemption remains a live issue. Farmers can no longer sell saved seed, but they can still use it for replanting. Every time a farmer replants with saved seed, the seed companies lose a potential sale. With certain varieties, a farmer may have to purchase the seed only once to be able to plant, harvest, save, and replant the seed indefinitely.¹¹⁰ Under these circumstances seed companies may only recapture a small part of their total research and development investment.

In sum, while the crop exemption represents the codification of the "historical and traditional right of small farmers" to save seed,¹¹¹ it nevertheless subverts the express purpose of the PVPA—to encourage research and the development of new plant varieties.¹¹²

Protection under the PVPA also fails to provide plant breeders with adequate incentive to market their innovations. The PVPA allows a plant breeder's competitors to appropriate her invention in slightly altered form, and it allows farmers to enjoy her product year after year, having paid for it only once. Because utility patents can be expensive and difficult to obtain, and because plant patents are not available for sexually reproducing plants, PVPA protection is frequently the only option available. As I will argue below, Congress should improve the PVPA option by providing stronger—albeit shorter—protection under its terms. This would benefit plant breeders and society as a whole by spurring optimal investment in breeding innovation.

C. Trade Secret Protection

Trade secret protection is derived from state tort law, outside the province of the federal statutes that have been discussed thus far. The goal of trade secret law is to uphold basic commercial morality by holding those who steal someone's commercially valuable "trade secret" liable for "misappropriation."¹¹³ Trade secret protection can be very valuable to plant breeders. Unlike the federal statutes, which pro-

110. Returning to the example discussed *supra* note 100, if a farmer produced 1,000 acres of soybeans, the farmer would have approximately 40,000 bushels of seed. Given the planting ratio of one bushel per acre, the farmer would have substantially more than enough seed to plant the following year's crop (and very likely the crops for years after that). Due to natural heterozygosity (i.e., fertilization from weeds and other plants instead of soybeans), yields and other characteristics (e.g., disease and environmental resistance) will decline over the years. Therefore, the farmer will eventually need to purchase new seed from the seed company. The farmer will still benefit substantially from saved seed for the years that the variety remains productive.

111. *Asgrow Seed Co. v. Winterboer*, 795 F. Supp. 915, 918 (N.D. Iowa 1991), *rev'd*, 982 F.2d 486 (1992), *rev'd*, 115 S.Ct. 788 (1995).

112. See 7 U.S.C. § 2581 (1994).

113. The elements of the tort of misappropriation of a trade secret are laid out in the UNIFORM TRADE SECRETS ACT §§ 1-12, 14 U.L.A. 437 (1990), and in RESTATEMENT OF TORTS § 757 (1939).

vide a fixed period of protection after which the innovation belongs to the public, trade secret protection can last indefinitely, so long as the innovation remains secret.

However, keeping an innovation secret involves continuous and costly expenditures on precautions to keep it "secret."¹¹⁴ Furthermore, unlike the protection offered by the federal patent statutes, trade secret protection ends as soon as one's innovation is no longer secret. This can result either from accidental disclosure or a competitor's successful reverse engineering¹¹⁵ of the invention. As a result, trade secret protection involves a large amount of uncertainty and risk.

1. *Pioneer Hi-Bred Int'l, Inc. v. Holden Foundation Seeds and the "Genetic Message from the Cornfields of Iowa"*

The Eighth Circuit extended trade secret protection to plant genes in the recent case of *Pioneer Hi-Bred Int'l, Inc. v. Holden Foundation Seeds*.¹¹⁶ Pioneer, one of the world's largest seed companies, sued Holden, one of its competitors, for misappropriating the genetic material in two of its hybrid parent corn seed lines.¹¹⁷ Pioneer claimed that Holden had taken Pioneer's highly successful parent lines and used them to develop copies that were only slightly different.¹¹⁸

In considering this case, the district court adopted the Restatement's definition of "trade secret":

A trade secret may consist of any formula, pattern, device or compilation of information which is used in one's business and which gives him an opportunity to obtain an advantage over competitors who do not know or use it. It may be a formula or a chemical compound, a process of manufacturing, treating or preserving materials, a pattern for a machine or other device, or a list of customers.¹¹⁹

114. Precautions required are those "reasonable under the circumstances." UNIFORM TRADE SECRETS ACT §1(4)(c), 14 U.L.A. 437, 438 (1990) (the comment to §1 notes that "The courts do not require that extreme and unduly expensive procedures be taken to protect trade secrets against flagrant industrial espionage").

115. The UTSA defines reverse engineering as "starting with the known product and working backward to find the method by which it was developed." *Id.*

116. 35 F.3d 1226, 1245 (8th Cir. 1994).

117. *Pioneer Hi-Bred Int'l, Inc. v. Holden Found. Seeds, Inc.*, No. 81060-E, 1987 U.S. Dist. LEXIS 18286 (S.D. Iowa, Oct. 29, 1987). Parent seeds are the in-bred lines that are crossed with each other to produce a hybrid. For a thorough discussion of the district court opinion, see Note, *The "Genetic Message" from the Cornfields of Iowa: Expanding the Law of Trade Secrets*, 38 DRAKE L. REV. 631 (1988-89) 21 [hereinafter *Genetic Message*].

118. *Pioneer Hi-Bred Int'l*, 35 F.3d at 1228-29. Note that if Pioneer had held PVPA certificates for these two lines, Holden's alleged activity would have been perfectly legitimate. However, trade secret protection, unlike the PVPA, contains no research exemption.

119. *Pioneer Hi-Bred Int'l, Inc.*, 1987 U.S. Dist. LEXIS 18286 at *99 (quoting RESTATEMENT OF TORTS § 757 cmt. b (1939)).

Although the Restatement's list of subject matter eligible for trade secret protection does not include "genetic material," the district court nevertheless held that the genetic messages of Pioneer's hybrid parent seeds were "trade secrets" because they were "akin to a secret formula [which] . . . did not exist outside of Pioneer's fields . . . and could only be duplicated with a great deal of effort and some luck."¹²⁰

On appeal, the Eighth Circuit affirmed the district court's holding that Holden had misappropriated Pioneer's trade secrets.¹²¹ Thus, it appears that plant breeders can sue others for misappropriation of the "secret" genetic messages of varieties they create. The Eighth Circuit noted, however, "that the owner of a trade secret [does not enjoy] an absolute property right in the trade secret which may be used to exclude the world from using the secret,"¹²² because the federal patent laws, which arguably place a ceiling on the strength of intellectual property protection states can offer,¹²³ would preempt such an interpretation of state trade secret law.

To grant someone patent-like protection (or more) without her undergoing the vigorous process of obtaining a patent would be socially inefficient: the value of patents would be denigrated, and inventors would be encouraged to keep their inventions secret, rather than place them in the public domain for everyone's benefit. While patent protection grants the patentee the right to exclude others from making, using, or selling her invention, trade secret law merely aims to protect against misappropriation of a reasonably protected commercial secret.¹²⁴ Thus, as mentioned, trade secret law does not protect against reverse engineering or other proper methods of acquiring trade secrets. Because the purposes of trade secret protection are limited to maintaining commercial morality and encouraging innovation, trade secret protection should not provide greater protection than is necessary to effectuate those aims.¹²⁵

2. *Maintaining Trade Secrets: Reasonable Precautions*

To preserve their right to sue competitors for misappropriation of trade-secret germplasm, seed companies must take reasonable precau-

120. *Id.* at 101.

121. *Pioneer Hi-Bred Int'l*, 35 F.3d at 1246. Holden specifically contended that it could not be liable for misappropriating Pioneer's seed because Pioneer failed to keep its genetic messages secret, to prove that Holden actually possessed the protected genetic messages, and to prove that Holden obtained the material by improper means. *Id.* at 1228-29.

122. *Id.* at 1238 n.42.

123. *Id.*

124. *Id.*

125. *Id.* (citing *Kewanee Oil v. Bicron Corp.*, 416 U.S. 470 (1974)).

tions to ensure that their innovations are kept secret.¹²⁶ This is very difficult, because crops are grown in open fields and sold to a broad market with no requirement of confidentiality. However, some measure of secrecy can nevertheless be achieved in this area.

Hybrid seed varieties are the easiest to keep secret. Often with hybrids, the seed company, rather than pursuing PVPA or utility patent protection, will instead keep its parental lines under lock and key, selling only the seed that results from crossing the two lines.¹²⁷ It is very difficult to determine the exact characteristics of the two parents from the resulting seed,¹²⁸ so this method presumably would constitute a "reasonable precaution" as required by trade secret law.

"Confidentiality" provisions in purchase agreements provide a further buffer against trade secret misappropriation. Pioneer Hi-Bred has the following "important information" printed on the labels of its hybrid corn seed bags:

The following provisions are part of the terms of sale of this product: One or more of the parental lines used in this hybrid are the exclusive property of Pioneer Hi-Bred International, Inc. Buyer intends to purchase and seller intends to sell only hybrid seed. Buyer agrees that purchase of this bag of seed does not give any rights to use any such parental line seed which may be found herein, or any plant, pollen or seed produced from such parental line seed for breeding, research or seed production purposes, or for any purpose other than production of forage or grain for feeding or processing.¹²⁹

This language puts the purchaser on notice that Pioneer's hybrid parent lines are trade secrets.¹³⁰ Thus, if the purchaser came across any parental seed in the bag, she could not make use of it (other than as specified) without incurring liability for misappropriation.¹³¹

126. UNIFORM TRADE SECRETS ACT §1(4)(c), 14 U.L.A. 437, 438 (1990). A seminal case defining the reasonable precautions requirement is *E. I. DuPont de Nemours & Co. v. Christopher*, 431 F.2d 1012 (5th Cir. 1970), *cert. denied*, 400 U.S. 1024 (1971).

127. See Seay, *supra* note 64, at 425-26. The process of hybridization is discussed in greater depth *infra* Part II.D.1.

128. However, it is not impossible. The potential gaps in trade secret protection are discussed further *infra* Part IV.C.

129. Pioneer Hi-Bred International, Inc. hybrid seed corn purchase agreement, *quoted in* Jeffrey L. Ihnen & Robert J. Jondle, *Protecting Plant Germplasm: Alternatives to Patent and Plant Variety Protection in INTELLECTUAL PROPERTY RIGHTS*, *supra* note 56, at 123, 135-36.

130. Note that the language could also be construed as a use restriction.

131. Effectively, Pioneer has given her "reason to know" that such acquisition of its parental lines could only be accomplished through misappropriation. See UNIFORM TRADE SECRETS ACT § (1)(2)(I), 14 U.L.A. 438 (1990). The enforceability of agreements such as this one is discussed *infra* Part IV.D.

*D. Private Intellectual Property Protection Arrangements:
Hybrids, Purchase Agreements, and Label Notices*

Because of the shortcomings of federal statutory protection and state trade secret law, seed companies have privately pursued their own appropriability options. For example, plant breeders have protected their innovations through hybridization, which renders reverse engineering almost impossible. Plant breeders are also increasingly using contractual restrictions and label notices to secure innovative varieties from theft. These private intellectual property options are discussed below.

1. Hybrid Technology: Engineered Protection

As described above, one way of protecting an invention is to engineer it so that others are unable to discover how it was put together. Hybrid seed varieties, of which corn is probably the most prominent, have this advantage over non-hybrid varieties. Hybrids work as follows: two "parent lines" or "inbreds" are developed by self-pollination and selection until each breeds relatively uniformly.¹³² The two parents are then "crossed" or inter-bred, which results in larger, more productive plants than either of the inbreds could have produced alone.¹³³ As noted above, hybrid seed companies typically protect their inbreds under state trade-secret law and sell only the crossed seed to producers.¹³⁴

Hybridization also increases the value of PVPA protection. The crossed seed, while extremely "vigorous" in the first generation, breaks down rapidly in the succeeding generations—so rapidly that farmers must purchase new seed every year.¹³⁵ Thus, the crop exemption to the PVPA cannot help farmers who plant hybrid varieties: because the yield of the hybrid variety diminishes significantly with each succeeding year, it would be pointless for a farmer to save seed for replanting. This means that a seed company can recoup more of its research investment after developing a new hybrid variety. Because of hybrids' capacity for "internalizing appropriability," seed companies have experimented for

132. *Genetic Message*, *supra* note 117, at 634 n.21.

133. Seay, *supra* note 64, at 425. This phenomenon is known as "heterosis vigor." *Id.*

134. See *supra* text accompanying note 127. Seed companies require "seedsmen" farmers to cross the inbreds, harvest the produce, and return it to the seed company, which in turn markets it to production farmers. Of course, seed companies, in order to maintain their proprietary interest in their inbreds, must make sure that their "seedsmen" do not disclose or otherwise appropriate them. For this reason, such "seedsmen contracts" have historically taken the form of a bailment. Neil D. Hamilton, *Why Own the Farm If You Can Own the Farmer (and the Crop)?: Contract Production and Intellectual Property Protection of Grain Crops*, 73 NEB. L. REV. 48, 70 (1994).

135. *Genetic Message*, *supra* note 117, at 634 n.21.

years with ways to hybridize crops other than corn, albeit with limited success.¹³⁶

2. Purchase Agreements

Another means of achieving intellectual property protection is through contract. One example discussed earlier is Pioneer's hybrid corn purchase agreement, which maintains the trade secret status of Pioneer's inbreds.¹³⁷ Seed companies have also used language in purchase contracts to gain better protection than the PVPA can offer.¹³⁸ Stine Seed Company of Dallas County, Iowa employs this technique through its sales agreements:

Supplier represents and Purchaser hereby acknowledges that Supplier is engaged in the business of developing and supplying for sale various varieties of seeds. Supplier has a substantial investment in the development and production of Stine Brand Seeds and in the use of the subsequent production of the Stine Brand Seeds herein sold. Supplier has expended substantial effort in developing a market for Stine Brand Seeds In consideration of the foregoing and in consideration of the Stine Brand Seeds herein sold, *Purchaser hereby acknowledges and agrees that the production from the Stine Brand Seeds herein sold will be used only for feed or processing and will not be used or sold for seed, breeding or any variety improvement purposes.* Purchaser acknowledges Supplier's proprietary interest in the use of subsequent production from the seeds herein sold, and agrees it would be a violation of this agreement to allow the subsequent production of the seed herein sold to be used to create a seed variety or seed product from said production, which may be used for seed purposes by individuals or entities other than Stine Seed Company.¹³⁹

Under this agreement, Stine could pursue breach of contract remedies if the farmer/purchaser used the harvested seed for replanting her own field, sold it to another farmer, or allowed it to fall into the hands of a plant breeder who used it to develop a new variety. This contract offers stronger protection than the PVPA can confer with its crop and research exemptions, and it arguably affords even stronger protection than utility patents do.¹⁴⁰

136. Hamilton, *supra* note 134, at 92. Although efforts to hybridize canola have been successful, efforts to hybridize cotton, wheat, and soybeans have not. *Id.*

137. See *supra* notes 129-131 and accompanying text.

138. See Hamilton, *supra* note 134, at 92-94.

139. *Id.* at 93 (quoting Stine Seed Company Purchase Agreement).

140. This raises the question of federal preemption, discussed further *infra* Part IV.D. The agreement outstrips utility patent protection in that it, unlike the latter, does not require disclosure of the variety to the public.

Of course, in order to provide this ironclad protection, the contract must be enforceable. Enforceability is by no means guaranteed. A court might vitiate the agreement under an adhesion contract or even an unconscionability analysis, especially if the "agreement" is a label printed on a bag and does not require the purchaser's signature.¹⁴¹ Thus, seed companies pursuing such contractual protection will have to make significant expenditures at all phases of the marketing of their products, in order to put potential and actual purchasers on notice of their intellectual property rights.¹⁴²

Another drawback of contractual protection is that seed companies are limited to contract remedies when a breach occurs. Consequently, if a farmer sells a seed company's proprietary seed to a rival company, the seed company can only sue the farmer for contract damages, and will not be able to sue in tort or enjoin the rival seed company from using the variety. Thus, contract remedies might cover only a fraction of the overall losses suffered by the vendor seed company.

3. Label Notices

Label notices provide another means by which patentees can protect their intellectual property. In *Mallinckrodt, Inc. v. Medipart, Inc.*,¹⁴³ the Court of Appeals for the Federal Circuit held that a patentee may restrict a purchaser's use of her patented item by affixing a "label notice" of the restriction to the item. The case involved a suit by Mallinckrodt, manufacturer of a medical device, against Medipart, which serviced the device for hospitals.¹⁴⁴ Mallinckrodt marked the device, which was an apparatus for the delivery of radioactive or therapeutic material to a patient's lungs, with the inscription "Single Use Only."¹⁴⁵ Despite the notice prohibiting reuse, hospitals sent used devices to Medipart, which cleaned and returned them.¹⁴⁶

The Federal Circuit held that while some use restrictions, namely those amounting to antitrust violations or patent misuse, are per se violations of the patent law, others are permissible as long as they are "in accordance with the rule of reason."¹⁴⁷ Thus, so long as Mallinckrodt's restriction on reuse was within the scope of its patent, and did not have

141. See Jondle, *supra* note 56, at 7.

142. See Morrissey, *supra* note 21, at 79 (discussing the elaborate steps that DuPont has taken to provide notice of its intellectual property rights to purchasers of its high-oil corn products).

143. 976 F.2d 700, 708-09 (Fed. Cir. 1992).

144. *Id.* at 701.

145. *Id.* at 701-02.

146. *Id.* at 702.

147. *Id.* at 708.

anticompetitive effects, *Mallinckrodt* could enforce it against infringers.¹⁴⁸

The Federal Circuit's endorsement of "label notices" could be a boon to seed companies. As noted, purchase agreements potentially provide excellent protection, but are worthless if held unenforceable. Enforceability often requires at least a signature, and sometimes requires more extensive negotiations between buyer and seller. However, under *Mallinckrodt*, a seed company could simply affix a label notice containing all its protective provisions to the seed bag, and the purchaser would be bound.¹⁴⁹ Of course, to take advantage of *Mallinckrodt*, a seed company would first have to obtain a patent for its seed, which represents a significant obstacle.¹⁵⁰ Nevertheless, for plant breeders with utility patents, *Mallinckrodt* represents an extremely effective means of further protecting their intellectual property.

III

RISKS ASSOCIATED WITH GRANTING PROPRIETARY RIGHTS IN PLANT GENETIC RESOURCES

While there are very good reasons to enhance existing intellectual property protection for agricultural biotechnology innovation, critics are concerned about the negative effects of strengthening plant breeders' intellectual property rights. The risks associated with intellectual property rights in plant genetic resources are manifold. They include environmental dangers such as genetic uniformity and erosion, and economic hardships for smaller seed companies and farming operations. These risks increase in direct proportion to the duration of the intellectual property protection: the longer seed companies can protect their innovations, the more likely there will be increased genetic uniformity, higher market concentration in the seed industry, and rising food prices. Thus, by lengthening the PVPA protection period to twenty years, the 1994 PVPA amendments increased the cost to society of intellectual property rights in plant genetic resources, without adding significant benefits.

Having discussed the benefits of agricultural biotechnology and the means of protecting plant breeding innovations, I turn now to the concerns of critics of enhanced intellectual property rights in plant genetic resources.

148. *Id.* at 708-09.

149. It may not be this simple. See the discussion of *Mallinckrodt* *infra* Part IV.D.

150. See *supra* Part II.A and *infra* Part IV.A.

A. Genetic Uniformity and Genetic Erosion

A chief concern of many critics is that strengthening breeder's rights will result in increased genetic uniformity of major food crops. As discussed, genetic uniformity presents the danger that a single environmental factor could wreak widespread crop damage. The fear is that biotechnology will enable a few varieties, bioengineered to contain profitable features, to dominate agricultural production. If these varieties acquire intellectual property protection for seventeen years under § 101, or for twenty years under the PVPA, it may not be possible to introduce competing varieties in time to counteract disasters engendered by genetic uniformity.

In addition, the Rural Advancement Foundation International ("RAFI"), a group long active in the genetic diversity debate, claims that strengthening plant breeders' rights will accelerate genetic erosion.¹⁵¹ However, proponents of breeders' rights claim that developing an incentive system designed to value genetic resources properly could prevent runaway genetic erosion.¹⁵² They argue that if true market value is assigned to genetic material, better collection and preservation of it will follow.

With regard to genetic uniformity, proponents of breeders' rights assert that modern biotechnology will enable them to develop new varieties quickly enough to limit the effects of any crisis.¹⁵³ It also seems clear that if a variety cannot tolerate an environmental condition, it would be in a seed company's best economic interests to make changes immediately in order to reduce its losses.

Still, breeders' ability to create new varieties and quickly change existing varieties may not eliminate the problem of genetic uniformity. After conducting an extensive study of the impact of intellectual property rights on the United States seed industry, L.J. Butler and B.W. Marion stated that "[arguing] that genetic diversity necessarily follows from breeding more varieties is not only naive, but may lead to complacency in breeding."¹⁵⁴ One problem is that in the current crop-seed market, genetic diversity does not pay: efficient agricultural production requires consistent, uniform performance in all aspects from yield to harvestability.¹⁵⁵ Thus, because only a few varieties can effectively and

151. See *Compliance with UPOV*, *supra* note 75, at 58-59.

152. LESSER, *supra* note 59, at 16.

153. See *supra* notes 36-38 and accompanying text.

154. L.J. BUTLER & B.W. MARION, *THE IMPACTS OF PATENT PROTECTION ON THE U.S. SEED INDUSTRY AND PUBLIC PLANT BREEDING* 72 (U.S. Dep't of Agric. Monograph 1985).

155. See Claffey, *supra* note 34, at 35. Claffey notes that:

Demands for efficiency are really demands for uniformity in a different guise. . . .

....

uniformly meet society's demands for quality, inexpensive food and fiber products, market forces converge to limit the genetic variability of major crops.¹⁵⁶

It is unclear whether intellectual property rights ameliorate or worsen the problem of genetic uniformity.¹⁵⁷ However, monopoly rights, which intellectual property rights essentially are, unquestionably reduce competition. The newly increased protection offered by the PVPA and plant breeders' increasing use of utility patents could gradually reduce competition in the seed industry and thereby contribute to genetic uniformity and erosion.

B. Impact on Germplasm Exchange

Critics also express concern over the potential impact of stronger intellectual property rights on plant breeders' access to germplasm. Ready access to germplasm is crucial to the development of new varieties. Historically, the government has provided breeders and farmers with germplasm through agricultural experiment stations and land grant universities.¹⁵⁸ However, recent trends indicate that private breeding has superseded public research for most commercially significant crops.¹⁵⁹ As a result, more germplasm than ever is subject to private proprietary rights. This is problematic because private breeders are less generous than the government in granting other breeders access to their germplasm.¹⁶⁰ Most seed companies either block access entirely or charge significant licensing fees.¹⁶¹

An extreme view, expressed by Becky Winterboer after the Supreme Court's *Winterboer* decision, is that "[t]he largest companies

Crops must be uniform for harvesting. Tomatoes, peas, and potatoes must ripen at the same time if they are to be machine harvested because the machine cannot distinguish between a green tomato and a ripe one. . . . And so it goes, uniformity—always uniformity.

Id. (quoting DIVISION OF BIOLOGY AND RESEARCH COUNCIL, NATIONAL ACADEMY OF SCIENCES, GENETIC VULNERABILITY OF MAJOR CROPS 289 (1972)).

156. *Id.*

157. See BUTLER & MARION, *supra* note 154, at 73 (reporting that while 63% of private industry plant breeders thought the PVPA increased genetic diversity, the majority of public plant breeders felt the Act has had little effect).

158. For an extensive discussion of the government's role in plant breeding, see JACK R. KLOPPENBURG, JR., *FIRST THE SEED: THE POLITICAL ECONOMY OF PLANT BIOTECHNOLOGY*, 1492-2000 (1988).

159. See Robert E. Evenson, *Intellectual Property Rights and Agribusiness Research and Development: Implications for the Public Agricultural Research System*, AM. J. AGRIC. ECON., 967, 971 (Dec. 1983).

160. Telephone Interview with Bruce W. Morrissey, Corporate Counsel, E.I. DuPont de Nemours & Co., (August 27, 1996).

161. *Id.* Controlling access to germplasm in this manner makes perfect sense when one considers the investment a company must make in order first to develop the germplasm, and then to obtain intellectual property protection for it.

have tied up the gene pool.”¹⁶² However, while large seed companies probably have the highest incentive to gain exclusive control over germplasm, they are not likely to be able to “tie up” the entire industry; smaller seed companies have also developed and obtained protection for their varieties, and will continue to do so.¹⁶³ Furthermore, public breeders at experiment stations and universities can keep private industry from monopolizing germplasm access by engaging in “defensive patenting,” where they secure protection for innovative varieties and make them available to the public, rather than selling them to seed companies.

Nevertheless, the cost of germplasm access may increase significantly because of the restrictions the 1994 PVPA amendments place on the research exemption¹⁶⁴ and the increasing number of utility patents issued for new varieties. Where a breeder has obtained protection for a variety with valuable traits, she will be able to charge her competitors high fees to use it, which will ultimately be passed on to consumers. The longer the protection period, the longer the owner of the variety will seek high fees from those desiring access to it, and the longer the public will be denied new agricultural products derived from the variety.

C. Concentration Within the Seed Industry

Some critics argue that strengthening intellectual property rights in germplasm will accelerate the entry of multinational conglomerates into the seed industry. Since 1970, large corporations have purchased a number of formerly independent seed companies.¹⁶⁵ These newcomers include petro-chemical and/or pharmaceutical conglomerates, grain or food processing companies, and genetic engineering firms.¹⁶⁶ They have entered the seed business to diversify their holdings, to pursue the profitable returns promised by strengthened intellectual property rights, to escape the public and regulatory scrutiny that has plagued the pharmaceutical and chemical industries, and in some cases, to integrate their businesses horizontally.¹⁶⁷ Because of these incentives, conglomerates like Celanese, Ciba-Geigy, Occidental Petroleum, Royal Dutch Shell, Sandoz, and Upjohn have become players in the seed market.¹⁶⁸ Their

162. *Milford Family Feuds with Supreme Court, Says Ruling Will Bring Seed Gouging*, PILOT TRIB. (Storm Lake, IA), Jan. 19, 1995, at 3 [hereinafter *Milford Family Feuds*].

163. See Jondle, *supra* note 56, at 13.

164. See *supra* Part II.B.2.a.

165. Claffey, *supra* note 34, at 32.

166. BUTLER & MARION, *supra* note 154, at 50.

167. See *id.* at 50-51.

168. See *id.* at 50, 85 app. tbl. A2.

impact on the industry has been unmistakable; by 1982, nearly half of all PVPA certificates were held by just fourteen conglomerates.¹⁶⁹

It is not clear, however, that intellectual property rights have been the only force fueling consolidation of the seed industry. As indicated, many conglomerates acquired seed companies for reasons other than the promise of intellectual property protection. Companies may view solid intellectual property protection as an added benefit of a decision they were going to make anyway. Therefore, the recent enhancement of breeders' rights may not have a significant impact on concentration in the seed industry, since the industry was already trending towards greater concentration.

To say that the conglomerates' acquisition of seed companies is inevitable, however, is not to say that it will be harmless. While some seed companies have fared well after merging with a conglomerate, others have struggled.¹⁷⁰ On balance, conglomerates have decreased competition within the seed industry by acquiring previously independent companies and by out-spending the remaining independents in research and development.¹⁷¹ Where the prize at the end of the race is a seventeen- or twenty-year monopoly, companies with large research and development budgets are the most likely to win.

D. Impact on Farmers

Following the Supreme Court's decision in *Winterboer*, Dennis Winterboer expressed his fear that seed companies would proceed to "gouge the heck out of everybody."¹⁷² His concern is not entirely unfounded. Seed prices increased more than 175% between 1970 and 1980.¹⁷³ While market forces¹⁷⁴ and higher energy prices¹⁷⁵ may have played a role, it is probably no coincidence that the main price increases in the seed industry began in 1970, the year Congress enacted the PVPA. Market concentration, and the decrease in competition it brought, probably also played a role in the price increases. Further, seed companies enjoyed greater freedom to raise prices as the availability of public varieties, once a significant control on pricing, diminished.¹⁷⁶

169. *Id.* at 51.

170. *See id.*

171. *See id.*

172. *Milford Family Feuds*, *supra* note 162, at 3. Winterboer claimed further that the practice of farmer-to-farmer sales "was one of the few checks and balances that farmers had." *Id.*

173. BUTLER & MARION, *supra* note 154, at 55.

174. *See id.*

175. *See Claffey*, *supra* note 34, at 34-35.

176. KLOPPENBURG, *supra* note 158, at 151 ("The evident demise of public varietal release removes the disciplinary effect that public breeders had exerted on the seed market and eliminates constraints on existing trends to concentration, rising prices, and genetic uniformity.").

Just as farmers are concerned about rising seed costs, they worry that an increase in intellectual property rights will fundamentally change the structure of farming practice and their relationship with seed suppliers.¹⁷⁷ Although farmers have not participated extensively in the debate over control of plant genetic resources, they are directly affected by the issues that breeders' rights raise.¹⁷⁸

For example, the development of "identity-preserved" and "end-use-tailored" varieties promises to "industrialize" agricultural production.¹⁷⁹ This means that seed companies will play a more intensive role in farming to integrate and control all stages of production,¹⁸⁰ which promises to radically restructure the traditional relationship between farmers and seed suppliers. Agricultural observers are concerned that farmers will bear the risks and costs of this restructuring, because lucrative contracts to grow "end-use-tailored" and "identity preserved" varieties will probably be extended only to the largest, most efficient farming operations.¹⁸¹ Smaller farms with less capital may miss out on this new "agricultural revolution" simply because they are not well-equipped to operate an "industrial" farming operation.¹⁸²

IV

HOW CURRENT APPROPRIABILITY OPTIONS DISAPPOINT PROponents OF INTELLECTUAL PROPERTY RIGHTS IN PLANT GENETIC RESOURCES

Not only did the 1994 PVPA amendments add to the social costs of intellectual property rights in plant genes, they also failed to confer significant benefits on plant breeders. This Part will show how the amended PVPA and all other currently available protective options fail to provide socially optimal protection for plant breeders' innovations. At this point, all available options provide protection that is either too flimsy, too expensive for breeders, or too costly with respect to other interests involved in the debate over control of plant genetic resources.

177. See Hamilton, *supra* note 134, at 50.

178. Neil D. Hamilton, *Feeding Our Future: Six Philosophical Issues Shaping Agricultural Law*, 72 NEB. L. REV. 210, 252-53 (1993).

179. See generally Urban, *supra* note 4 (invoking the term "industrialization" to describe the new changes in production agriculture).

180. See *id.* at 4-5 (explaining that while farmers remain the best managers of the land, seed companies are rapidly becoming key players in the integration of the food production system).

181. See Hamilton, *supra* note 178, at 255.

182. However, farmers may have a means of ensuring that contracts are fairly distributed. Farmers may organize, as labor did at the turn of the century. Urban, *supra* note 4, at 5; Hamilton, *supra* note 56, at 645-46. Congress has endorsed organized farm labor through passage of the Agricultural Fair Practices Act of 1967, which prohibits suppliers and distributors from discriminating against farmers who participate in an association of producers. 7 U.S.C. § 2303 (1994). By organizing, farmers would be able to negotiate more effectively with seed companies.

A. *The Siren Song of Utility Patents*

Utility patents offer unparalleled protection to plant breeders. For varieties that meet the threshold requirements, they confer a seventeen-year right to exclude others from making, using, or selling that variety without the patentee's consent.¹⁸³ Further, utility patents, unlike PVPA protection, are not subject to research and crop exemptions. Nevertheless, the benefits of utility patents tend to blind seed companies to their potential dangers, which are no less real for being overlooked.

Utility patents are highly susceptible to litigation for two reasons: (1) the stakes are high because the winner gets to exclude the loser for seventeen years, and (2) the law (at least in the United States) leaves significant room for argument over who ultimately should receive the patent. American law awards the patent to the first to create the invention, not the first to file a patent application for it.¹⁸⁴ As a result, a patentee may find her patent invalidated down the road by a previously unknown inventor who convinces a judge that she came up with the invention first.

Furthermore, the scope of patent protection is also prone to litigation. The "doctrine of equivalents"¹⁸⁵ in some cases extends a patent's protection beyond its literal scope to eliminate imitators. However, applicability of the doctrine must be determined on a case-by-case basis. Where a patented device or process is particularly valuable, many will attempt to invent around it, and test the borders of the patent's protection. Effective protection may require patentees to fight every imitator in court. Before long, the patentee will have committed substantial resources to such challenges.

Calgene's experience with the Flavr Savr[®] tomato provides an apt illustration. Calgene successfully piloted its tomato through the Food and Drug Administration's ("FDA") approval process, making it the first genetically altered plant to obtain FDA approval.¹⁸⁶ Calgene developed the tomato by employing "anti-sense" technology to manipulate the genes that control the ripening process in order to lengthen the ripening period.¹⁸⁷ However, a rival company, Enzo Biochem, has claimed that it holds the first, "pioneering" patent on anti-sense technology. Consequently, Enzo has challenged Calgene in court, arguing that the Flavr Savr[®] infringes upon its patent.¹⁸⁸ If Enzo wins in court, it could obtain a permanent injunction blocking Calgene from producing the

183. See the discussion of utility patent requirements and protection *supra* Part II.A.

184. 102-03 ROBERT A. CHOATE, WILLIAM H. FRANCIS, ROBERT C. COLLINS, CASES AND MATERIALS ON PATENT LAW, 3d ed.

185. See *supra* note 58 and accompanying text.

186. Mike McKee, *A Ripening Patent Controversy*, THE RECORDER, May 20, 1994, at 1.

187. See *id.* at 10.

188. *Id.* at 1.

Flavr Savr[®] for seventeen years. It could then force Calgene to pay a heavy licensing fee to market the tomato.

If a victorious Enzo denies Calgene a license to market the tomato, Calgene would lose an estimated \$500 million in annual profits.¹⁸⁹ Due to the high stakes, Calgene has aggressively litigated its case.¹⁹⁰ By 1994, however, the company had already lost \$114 million since its founding in 1980, and it was anticipating further losses due to the Flavr Savr[®]'s legal woes.¹⁹¹ Calgene's utility patent thus appears to be a mixed blessing for the company.

Regardless of who wins the Calgene-Enzo battle, one of the two companies will end up controlling the rights to all anti-sense technology, whether applied to tomatoes or turnips.¹⁹² Any breeder seeking to develop any variety containing the technology during the next seventeen years will have to obtain a license from Enzo or Calgene. Such broad rights, however, are not unique in the field of utility patents for plants. For example, Agracetus, a Wisconsin-based company, recently obtained a patent for all genetically engineered cotton.¹⁹³ The patent arguably covers all existing methods of producing transgenic cotton,¹⁹⁴ so that any plant breeder seeking to improve a cotton variety through biotechnology will have to negotiate with Agracetus to obtain a license.

Both small and large seed companies are concerned about the potential impact of utility patents on their industry. While such patents can be a cash cow for patentees, others suffer impeded access to valuable germplasm for the entire seventeen-year patent period. For this reason, the American Seed Trade Association ("ASTA") has issued a statement in favor of limiting patentees' rights.¹⁹⁵ The ASTA statement acknowledges that "[u]ndue restrictions on flow and utilization of plant germplasm would undermine incentives for, and negatively impact competitive research programs to continue genetic improvements of

189. *Id.*

190. *See id.* at 10.

191. *Id.*

192. *Id.* at 1.

193. Karol Wrage, *Agracetus Claims Patent on "All" Genetically Engineered Cotton: The Beginning of First Big "Legal Monopolies" in Crop Development?* *AGBIOTECHNOLOGY NEWS*, Dec. 1992, at 1. The patent's terms are as follows:

Cotton seed capable of germination into a cotton plant comprising in its genome a chimeric recombinant gene construction including a foreign gene and promoter and control sequences operable in cotton cells, the chimeric gene construction being effective in the cells of the cotton plant to express a cellular product coded by the foreign gene, the cellular product imbuing the plant with a detectable trait, the cellular product selected from the group consisting of a foreign protein and a negative strand RNA.

U.S. Patent 5,159,135, cl. 1, *quoted in* Hamilton, *supra* note 134, at 91.

194. Wrage, *supra* note 193.

195. William T. Schapaugh, *The Seed Trade's View on Proprietary Rights*, in *INTELLECTUAL PROPERTY RIGHTS*, *supra* note 56, at 18 (quoting Statement of the American Seed Trade Association).

crops.”¹⁹⁶ It also recognizes that “[u]nrestricted rights under patent laws and application of patent law doctrines could result in ‘locking up’ plant germplasm or block [*sic*] alternative genetic approaches to solve crop performance problems/needs.”¹⁹⁷

To remedy this problem, ASTA proposes the establishment of a compulsory licensing scheme, whereby breeders could gain access to patented germplasm for a reasonable fee.¹⁹⁸ While such a scheme would benefit the industry as a whole, patentees are unlikely to relinquish voluntarily the economic advantage they have spent substantial resources to obtain. As long as even one patentee holds out, the system becomes inefficient: the hold-out “free-rides” on the willingness of other patentees to license their inventions, without reciprocating. Thus, the ASTA proposal is unlikely to garner enough support to address effectively the concentration of control over plant genetic resources.

In sum, utility patents are a gamble for plant breeders, and are detrimental to the health of the seed industry as a whole. The benefits of holding a patent can be wiped out by litigation costs. And for every patent a plant breeder obtains, her competitors may obtain many more, blocking her access to valuable genetic material. Where the market for licenses operates efficiently, access to germplasm will be only minimally impeded. However, where the protection periods are long, and where the value of the germplasm is high, the licensing market may break down. As demonstrated, the licensing market is sufficiently flawed to prompt the seed industry’s trade organization to propose a compulsory licensing scheme. And as more breeders obtain utility patents, the situation will only deteriorate.

B. The Amended PVPA: The More Things Change . . .

With the 1994 amendments, Congress strengthened PVPA protection by eliminating the sale provision from the crop exemption, extending the protection period from eighteen to twenty years, and providing for infringement suits against makers of “essentially derived” varieties.¹⁹⁹ Congress included “essentially derived” varieties in the Act’s definition of infringement²⁰⁰ to deter breeders from copying protected varieties by incorporating them into their own lines with only a few cosmetic changes. Whether the “essentially derived” language will actually limit abuse of the research exemption remains to be seen. Since the 1994 amendments took effect on April 1, 1995, no court has

196. *Id.*

197. *Id.*

198. *Id.* at 19.

199. See *PVP Law A Triumph*, *supra* note 10, at 34-35.

200. 7 U.S.C. § 2541(c)(1) (1994).

interpreted the meaning of "essentially derived."²⁰¹ But the language is highly susceptible to litigation. To determine whether a variety is "essentially derived," a court must first decide what the variety was derived from. This is called the "initial variety." Then the court must decide whether the variety is "predominantly derived" from the initial variety. Then the court must determine the "essential characteristics" of the initial variety that the essentially derived variety allegedly appropriated. At each step of this analysis, the definitions are ambiguous and susceptible to litigation. This ambiguity provides a seed company wanting to copy a valuable variety with strong incentive to do so and take its chances in court.

Because the "essentially derived" language is ambiguous, it is questionable whether it will have any impact on research exemption abuses. It appears likely that on balance, plant breeders will spend more time in court enforcing the protection they thought they had secured through the 1994 amendments. Resources that could have gone to breeding projects will go to legal fees. And even when a breeder succeeds against an infringer, her victory means that valuable germplasm will be more difficult for other breeders to access for the next twenty years. In sum, it is an open question whether the 1994 PVPA amendments truly will benefit the seed industry.

*C. Trade Secrets: It's Midnight; Do You Know
Where Your Parent Lines Are?*

Breeders of hybrid varieties often find trade secret protection attractive, because it allows them to sell hybrid seed without having to disclose the makeup of their parental lines.²⁰² Further, whereas utility patent and PVPA protection expire after a defined period, trade secret protection theoretically can last forever, as long as the breeder takes rea-

201. The definition of an "essentially derived variety" is as follows:

(A) In General

The term "essentially derived variety" means a variety that—

(i) is predominantly derived from another variety (referred to in this paragraph as the 'initial variety') or from a variety that is predominantly derived from the initial variety, while retaining the expression of the essential characteristics that result from the genotype or combination of genotypes of the initial variety;

(ii) is clearly distinguishable from the initial variety; and

(iii) except for differences that result from the act of derivation, conforms to the initial variety in the expression of the essential characteristics that result from the genotype or combination of genotypes of the initial variety.

(B) Methods

An essentially derived variety may be obtained by the selection of a natural or induced mutant or of a somaclonal variant, the selection of a variant individual from plants of the initial variety, backcrossing, transformation by genetic engineering, or other method.

7 U.S.C. § 2401(c)(3) (1994).

202. For a basic discussion of hybrid technology, see *supra* Part II.D.1.

sonable precautions to keep the parental lines "secret."²⁰³ However, these days "forever" can be a very short time.

Pioneer Hi-Bred Int'l, Inc. v. Holden Foundation Seeds,²⁰⁴ which extended trade secret protection to plant genes, did not address a practice known as "chasing the selfs"²⁰⁵ that is potentially fatal to trade secret protection of hybrid parental lines. Occasionally, because of imperfections in the cross-pollination process, a few parent seeds show up in bags of hybrid seed.²⁰⁶ Consequently, if the purchaser of a bag takes the time to sift through enough hybrid seed to locate a parent seed—which is difficult but not impossible—that seed is no longer "secret." Because the seed company has disclosed its parental line to the public, albeit accidentally, the seed company can no longer claim protection under trade secret law.²⁰⁷ This represents a dangerous gap in trade secret protection for seed companies.

Companies can also acquire a trade-secret parental line legitimately through reverse engineering. It is now possible to "fingerprint" plant genes using restriction fragment-length polymorphisms (RFLP).²⁰⁸ It may soon be possible to use RFLP to reverse-engineer hybrids and other breeding innovations.²⁰⁹ Whether the trade secret is discovered in this manner, or by another legitimate method such as "chasing the selfs," it appears that trade secret law's promise of everlasting protection may be a mirage.²¹⁰

D. Contracts and Label Notices: Not Worth the Trouble

Purchase agreements potentially offer seed companies ironclad protection,²¹¹ so long as they are held to be enforceable. Enforcement is difficult, however, where the seller does not require the purchaser to sign the agreement, or where the parties otherwise fail to negotiate the agreement's terms.²¹² Further, courts will determine enforceability largely on a case-by-case basis, which could lead to high expenditures on legal fees.

203. See *supra* Part II.C.2.

204. 35 F.3d 1226 (8th Cir. 1994).

205. Seay, *supra* note 64, at 426.

206. *Id.*

207. As discussed *supra* in text accompanying notes 137-142, seed companies have attempted to protect themselves against disclosure through "chasing the selfs" by means of purchase agreements that put the buyer on notice of the seller's proprietary interest in the inbred seed. However, as noted, enforcement of these agreements is hit-or-miss at best.

208. Ihnen & Jondle, *supra* note 129, at 123. RFLP is also often used to test blood samples in criminal trials.

209. *Id.*

210. The breakdown of trade secret protection may, however, benefit the seed industry as a whole by providing access to previously unavailable germplasm.

211. For examples, see *supra* text accompanying notes 129, 139.

212. See *supra* note 141 and accompanying text.

Even if an agreement is enforceable as a matter of contract law, federal intellectual property law could preempt state contract law. Federal preemption of contract-based intellectual property arrangements is an issue that has not been litigated extensively. However, the Fifth Circuit has held that the federal Copyright Act, which allows limited copying, preempts computer software licenses designed to prevent purchasers from making copies of purchased programs.²¹³ This precedent could lead to further preemption of contractual intellectual property arrangements. If the contract grants the seed company better protection than could be achieved through the PVPA or § 101, a court might conclude that Congress enacted the PVPA and § 101 for the express purpose of placing a ceiling on intellectual property rights for plant breeders.

Mallinckrodt "label notice" protection is not subject to preemption because it extends from federal patent protection. Under the *Mallinckrodt* rule, as long as the notice falls within the scope of the patent, and does not give the patentee an anticompetitive advantage, purchasers of the patented item will be bound to the notice's use restrictions—even if a court would not find an enforceable contract under state law.²¹⁴

While "label notices" offer attractive protection to patentees, their effectiveness may be fleeting.²¹⁵ In *Mallinckrodt*, the Federal Circuit departed somewhat from precedent in allowing companies to restrict use via label notices.²¹⁶ Another circuit (or the Supreme Court) could decide to hold that such notices are unenforceable. Presumably, many in the agriculture industry and elsewhere would be willing to test the validity of label notice restrictions. This could lead seed companies employing such notices to spend more time in court, and less time developing new products.

213. *Vault Corp. v. Quaid Software Ltd.*, 847 F.2d 255, 270 (5th Cir. 1988).

214. See *supra* notes 147-148 and accompanying text.

215. In addition, their availability is limited to patented items. PPA- or PVPA-protected varieties would presumably fall outside *Mallinckrodt*'s scope.

216. The Federal Circuit reached its holding by narrowly reading the "doctrine of exhaustion," which generally holds that a patentee exhausts her rights to restrict the use of her invention upon selling it to another. See *Mallinckrodt, Inc. v. Medipart, Inc.*, 976 F.2d 700, 706-08 (Fed. Cir. 1992). For a broader reading of the doctrine, see, e.g., *Adams v. Burke*, 84 U.S. (17 Wall.) 453 (1873). That case held that,

[W]hen the patentee, or the person having his rights, sells a machine or instrument whose sole value is in its use, he receives the consideration for its use and he parts with the right to restrict that use. . . . That is to say, the patentee or his assignee having in the act of sale received all the royalty or consideration which he claims for the use of his invention in that particular machine or instrument, it is open to the use of the purchaser without further restriction on account of the monopoly of the patentees.

Id. at 456.

In sum, all currently available devices for protecting plant breeding innovations leave something to be desired. Utility patents are costly to obtain, susceptible to litigation, and threaten the overall health of the seed industry. The PVPA's 1994 amendments extended its protective period, but their ambiguity takes away the protection they would confer. Trade secret protection requires significant investment in "reasonable precautions," which may be worthless if a competitor reverse-engineers or otherwise legitimately obtains one's "secret" variety. Finally, enforcement of contracts and label notices will often require a costly campaign of litigation.

V

A PROPOSED SOLUTION

A. *A Better Balance*

This Comment has presented a web of intersecting and opposing interests surrounding intellectual property rights in plant genetic resources. On the one hand, there is significant evidence that current appropriability options fail to protect the interests of plant breeders adequately. Thus, the current laws have not provided breeders with sufficient incentive to continue to bring forth valuable biotechnology innovations.

On the other side are those who link breeders' intellectual property rights to genetic erosion and uniformity, economic concentration, barriers to germplasm access, higher costs for consumers, and the extinction of the small farm. Similarly, within the seed business, some believe that granting broad intellectual property rights for extended periods will eventually diminish the health of the industry.

The future of American agriculture thus depends on finding a better balance among all interests concerned. Both proponents and critics of strong intellectual property rights in plant genes have valid concerns. The goal, therefore, is to set a socially optimal incentive for plant breeding innovation: one that will be large enough to spur continuing investment in varietal improvement, but not so large that it will trigger the negative effects of overextended property rights.

B. *Proposed Amendments to the PVPA*

Amending the PVPA is the most effective means of setting a socially optimal incentive for agricultural biotechnology innovation. While utility patents should always be available for varieties that meet the patent statute's higher threshold, ordinary varietal improvement should be channeled through the PVPA. Because Congress wrote the PVPA for plant breeders, Congress can tailor it to meet more effectively breeders' present needs.

Congress must give breeders an incentive to pursue PVPA protection over trade secret protection, so that valuable germplasm will remain within the public domain. Therefore, Congress must amend the PVPA to make breeders' rights as clear as possible and provide an unmistakable incentive for them to pursue protection on its terms.²¹⁷ Because the introduction of the term "essentially derived" will only increase the ambiguity of those rights, this Comment proposes that it be eliminated from the Act. This amendment alone will shift seed industry resources away from the courts and back into breeding projects.

Congress must still address abuses of the PVPA's research exemption. Therefore, this Comment suggests amending the PVPA's definition of infringement to include *development* (in addition to production) of a new variety from a protected variety.²¹⁸ This would completely disallow a breeder's competitors from using her variety to make their own, slightly-altered versions without her permission. Such an amendment truly broadens, in the clearest possible terms, PVPA certificate holders' rights against those who copy their inventions.

Of course, the broadening of PVPA rights cuts against the interests of increasing competition in the seed industry, increasing genetic diversity, improving germplasm access, and lowering seed costs for farmers. Therefore, Congress must *shorten* the PVPA protection period. I propose that Congress scale back the protection period from its present twenty-year span to seven years.²¹⁹ Breeders earn most of the profit from a new variety in its first five years.²²⁰ Consequently, by the time the proposed seven-year period expires, the seed company will have

217. This Comment recognizes that any proposed amendments to the PVPA would jeopardize the United States' standing as a signatory of the 1991 amendments to the UPOV. The United States was the first country to ratify the amended UPOV. *PVP Law A Triumph*, *supra* note 10, at 34. The United States also could be the first to lead the world towards a better system of breeders' rights.

218. My amendment to 7 U.S.C. §2541 reads as follows:

(a) Except as otherwise provided in this subchapter, it shall be an infringement of the rights of the owner of a protected variety to perform without authority, any of the following acts in the United States, or in commerce which can be regulated by Congress or affecting such commerce, prior to expiration of the right to plant variety protection but after either the issue of the certificate or the distribution of a protected plant variety with the notice under section 2567 of this title:

....
(4) use the variety in producing...or *developing* a hybrid or different variety therefrom;

....
219. My amendment to 7 U.S.C. § 2483(b) is as follows:

The term of plant variety protection shall expire *seven (7) years* from the date of issue of the certificate in the United States, except that, in the case of a tree or vine, the term of the plant variety protection shall expire 25 years from the date of issue of the certificate. If the certificate is not issued within three years from the effective filing date, the Secretary may shorten the term by the amount of delay in the prosecution of the application attributed by the Secretary to the applicant.

220. R. Dean Plowman, *Intellectual Property Rights in Plants—An ARS Perspective*, DIVERSITY, vol. 9, nos. 1 & 2, 1993, at 74, 76.

captured the lion's share of its potential returns. Having been protected against *any* (and not just "essentially derived") imitations of its variety for seven years, the seed company will reap substantial profits for that period, after which the variety and its germplasm will be available for other breeders to use in their breeding projects.

Reducing the protection period to seven years serves multiple interests by promoting greater competition. Seed companies holding a PVPA certificate will no longer be able to sit complacently on a twenty-year monopoly;²²¹ a company will have to develop new varieties at least every seven years to take advantage of PVPA protection. This would give smaller seed companies a fighting chance, and would lead to an overall decrease in genetic uniformity. More germplasm will be available for both private and government breeders to pursue breeding projects and further varietal innovations. Finally, increased competition will reduce seed costs for farmers, thereby lowering food prices for consumers.

In sum, the proposed PVPA amendments set an optimal incentive for agricultural biotechnology innovation for all parties concerned. Because the amendments would provide strong, patent-like protection, plant breeders would no longer feel compelled to pursue costly utility patents, uncertain trade secret protection, and litigation-intensive contractual arrangements. Plant breeders and seed companies would have ample incentive to invest heavily in varietal research and development, knowing that they could obtain effective protection at low cost for their inventions. Society would reap the rewards of a dramatic increase in the development of high-quality, inexpensive food and fiber products.

CONCLUSION

The advent of biotechnology has revolutionized agriculture. Plant breeders have made advances that benefit everyone, and more are certain to come. Breeders have continuously pushed the limits of intellectual property protections, and the law has struggled to meet their demands, as well as the demands of critics who resist the expansion of property rights in plant genetic resources. This Comment has endeavored to present the full array of appropriability options for plant breeders, to discuss the concerns of both proponents and opponents of breeders' intellectual property rights, and to propose a scheme that more effectively balances all parties' interests.

A socially optimal incentive for plant breeding innovation must balance the need to spur varietal improvement with the countervailing need to limit the dangers of genetic uniformity and erosion, market

221. Of course, a 17-year monopoly would still be available for those varieties so innovative as to qualify for a utility patent.

concentration, limited germplasm access, and high food costs. Amending the PVPA to provide protection that is broader, yet shorter in duration, reconciles these competing needs. This opportunity to reconcile the concerns of all voices in the debate over intellectual property rights in plant genetic resources should not be missed; the future of agriculture in America and world-wide is at stake.