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Intellectual Property Protection and Its Impact on the U.S. Seed Industry

by

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INTELLECTUAL PROPERTY PROTECTION AND ITS IMPACT ON THE U.S. SEED INDUSTRY

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I. INTRODUCTION

Plant breeding, the art of improving the genetics of plants, has been around as long as man has planted and saved the seeds of the best plants for the next year's crop.[1] This early form of man-made selection enabled the gradual evolution of cultivated crops.[2] As these early plant breeders learned more about their crops, their ability to make wise selections, as well as the performance of their crops, improved.[3] The saved seed could either be used as a source of food in the form of grain for humans or livestock or as a source of starting material for next year's crop.[4] In addition, this seed was also a commodity because it could be traded for other goods or sold for cash.[5]

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1. *See* JOHN MILTON POEHLMAN, BREEDING FIELD CROPS 4 (3d ed. 1987).
2. *See id.*
3. *See id.*
4. *See* JACK RALPH KLOPPENBURG, JR., FIRST THE SEED: THE POLITICAL ECONOMY OF

It was in these humble beginnings of plant breeding that the seed industry was born. The first introduction of hybrid corn varieties in 1926 began to change the face of the seed industry from the small company and farmer seedsmen to hybrid seed production companies that provided the farmers with superior hybrids in quantities.[6]

The plant breeders and early seedsmen had to protect their efforts to develop superior seeds as best they could because there was no intellectual property protection for sexually-produced plant material prior to 1970.[7] Since 1970, there has been a steady effort to improve the intellectual property protection of sexually-produced seeds to provide incentive for private plant breeding research, with the ultimate goal of better seed cultivars and varieties for the farmer.[8]

This Note discusses the development of the United States seed industry from its beginning to the present. It attempts to compare the development of intellectual protection for plants and the changes in the seed industry. Because the seed industry includes a plethora of crops too large to cover in a single paper, this Note will be primarily limited to the sexually reproducing crops of corn (maize) and soybeans. These crops have been chosen for the following reasons: they are important to the seed industry; they represent two different types of pollination and, therefore, they have different intellectual property protection issues; and they have a role in litigation concerning and gradually defining the limits of intellectual property available.

Part II of this Note discusses the development of the seed industry in the United States from a historical perspective.[9] In addition, it examines the important contributions of the Native American Indians that include: the efforts of the early settlers, the early plant collectors and plant breeders, and the early hybrid seed companies.[10] Part III of this Note discusses the different intellectual property mechanisms available for crop plants and the seed industry's role in the creation of these protective property rights mechanisms.[11] These intellectual property protective mechanisms include: trade secrets, plant patents, plant variety protection, and utility patents. Finally, Part IV discusses the impact of intellectual

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PLANT BIOTECHNOLOGY 1492-2000, at 37 (1988).

5. *See id.*

6. *See* POEHLMAN, *supra* note 1, at 13-14; CURTIS NORSKOG, HYBRID SEED CORN ENTERPRISES: A BRIEF HISTORY 69 (Maracom Corp. 1995).

7. *See* Robert J. Jondle, *Overview and Status of Plant Proprietary Rights*, *in* CROP SCIENCE SOC'Y OF AM., INC. ET AL., ASA SPEC. PUB. NO. 52, INTELLECTUAL PROPERTY RIGHTS ASSOCIATED WITH PLANTS 5, 5 (Billy E. Caldwell et al. eds., 1989).

8. *See id.* at 6.

9. *See* discussion *infra* Part II.

10. *See* discussion *infra* Part II.

11. *See* discussion *infra* Part III.

property protection on the seed industry from past predictions to present realities.[12] The Note concludes with a discussion of the role intellectual property protection may play in determining who will be the key players in the seed industry in the future, or, perhaps more importantly, how the key players will interact as a result of intellectual property protection.[13]

II. SEEDS OF COMMERCE: DEVELOPMENT OF THE SEED INDUSTRY

In this section, the author discusses the evolution of plant breeding from the early collecting of native plants and exotic cultivars to the development of plants suited to the different environments of the United States. This discussion traces the beginning of the seed industry from the early American settlers, communal farms, to the early propertied landowners, to the governmental organizations dedicated to the collection and dissemination of plants adapted to the United States, and to the early entrepreneurs of the seed industry.

A. *Early North American Plant Breeding and the Government's Involvement in the Collection and Dissemination of Seed*

The Native Americans developed a system of cultivated crops that included maize, beans, and squash.[14] When the early English settlers arrived in Jamestown, they brought with them the seeds they grew in England with the expectation that these seeds would serve them well in the New World.[15] Unfortunately, these early settlers nearly starved because of these faulty expectations.[16] The early settlers quickly learned that they had to select seed, including maize which was donated by the Native American Indians and better adapted to this new environment.[17] Different varieties were tested and the best plants of those that survived were saved as seed in order to plant the next year's crop.[18] This early form of "simple mass selection" formed the beginning of "an adapted base of germplasm for American agriculture."[19]

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12. *See* discussion *infra* Part IV.
13. *See* discussion *infra* Part V.
14. *See* KLOPPENBURG, *supra* note 4, at 50.
15. *See id.* at 51.
16. *See id.*
17. *See id.*
18. *See id.* at 51-52.
19. *Id.* at 52. Germplasm is a term used by plant breeders and geneticists to collectively describe the genetic stocks within a species of plants. *See id.* It is a term used to describe generally the sum total of the heritable basis of a species or variety of plants. *See* POEHLMAN, *supra* note 1, at 171-72, 705.

From the early days of the colonies to their declaration of independence, most seeds were grown on private or communal farms, and the seeds from the best plants were saved for the next year's crops. [20] However, many of the wealthier landowners, including George Washington, imported large quantities of a wide variety of seed species from British suppliers and other European suppliers.[21] Another wealthy landowner was Thomas Jefferson, who distributed some of this seed to friends in agricultural societies that were being formed at the time.[22] Membership to these societies, and therefore access to much of this seed, was not available to the common farmer.[23] The members of these societies were the propertied landowners interested not only in broadening the nation's germplasm base but also in developing successful plantation operations.[24]

In 1819, following the lead of these early entrepreneurs, the Secretary of the Treasury, William L. Crawford, requested that the foreign consuls and the naval officers supply seeds from all over the world to all Americans.[25] In 1839, the Commissioner of Patents, Henry Ellsworth, determined that the Patent Office, then under the Department of the Treasury, should undertake the collection and distribution of novel plant varieties.[26] Ellsworth succeeded "in obtaining congressional funding for the collection and distribution of seeds, plants, and agricultural statistics."[27] Under Ellsworth, the Patent Office sent plants and seeds to farmers "through the postal service some five years before parcel post arrangements were established for other items. By the time he left the commissionership in 1849, Ellsworth was sending out 60,000 packages of seed each year."[28] Following Ellsworth's retirement, the agricultural division of the Patent Office continued to increase their activities in seed collection and distribution.[29] "By 1855, over a million packages had been distributed."[30]

While the Patent Office collected and disseminated the seeds and plants, it was the farmers who took this germplasm and developed it into adapted and improved crop varieties.[31] The farmers continued a pattern of "simple mass selection to improve the land races of the crops they grew by screening out poorly

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20. *See* KLOPPENBURG, *supra* note 4, at 51-52.
21. *See id.* at 52.
22. *See id.*
23. *See id.* at 53.
24. *See id.*
25. *See id.* at 53-54.
26. *See id.* at 55-56.
27. *Id.* at 55.
28. *Id.* at 56 (citation omitted).
29. *See id.*
30. *Id.*
31. *See id.*

adapted types and saving superior individuals and populations for seed."[32] By 1860, the farmers created a firm basis of germplasm.[33] In 1862, Congress established the United States Department of Agriculture (USDA).[34] The USDA's "general designs and duties . . . [were] to acquire and to diffuse among the people of the United States useful information in subjects connected with agriculture in the most general and comprehensive sense of that word, and to procure, propagate, and distribute among the people new and valuable seeds and plants."[35]

The USDA continued to expand the germplasm base brought into the United States and "remained substantially identified with plant introduction and seed distribution late into the nineteenth century . . . . As late as 1878, fully a third of the department's annual budget was being spent on germplasm collection and distribution."[36] However, in 1893, the Secretary of Agriculture, J. Sterling Morton, called for the end, or at least a very significant reduction, of the government's gratuitous distribution of seed.[37] Morton considered this distribution an expensive service fraught with problems, and more importantly, a service the developing seed industry was now in a position to handle a great deal better than the government.[38] Congress did not heed Morton's initial admonitions that the "USDA's [s]eed division has outlived its usefulness, and that its further continuance is an infringement of the rights of citizens engaged in legitimate trade pursuits."[39] Morton felt the gratuitous dissemination of seed was "*antagonistic to the seed as a commodity-form and in direct competition with the private seed trade.*"[40] However correct Morton may have been, Congress was not going to support the removal of the free seed system from their farmer and other seed-utilizing constituents.[41] Therefore, the government continued to send out high quality and quantities of

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32. KLOPPENBURG, *supra* note 4, at 57 (footnote omitted). Crops are improved by framers or professional plant breeders through selection of those plants exhibiting the most desirable traits from the variety of traits observed in a particular planting of a crop.

> By saving seed only from these more desirable specimens and repeating the process over many generations a distinct 'breed' of the crop is brought into existence. Where this is accomplished by farmers themselves the 'breed' is known as a *land race* and is characteristic of the local area in which it has arisen. Where the new 'breed' is the outcome of a scientifically conducted breeding [program] it is known as a *cultivar* or more commonly in layman's terms a *variety*.

J.C. FORBES & R.D. WATSON, PLANTS IN AGRICULTURE 212 (1992).

33. *See id.*
34. *See id.* at 58.
35. *Id.* at 59.
36. *Id.* at 60.
37. *See id.* at 60-61.
38. *See id.* at 62.
39. *Id.* (citation omitted).
40. *Id.* at 63.
41. *See id.*

common varieties.[42] In 1897, the USDA sent out over twenty-two million packages; each package consisted of five packets of seed, and each packet had a different variety.[43] These shipments represented over 1.1 billion packets of seed.[44] By the end of the nineteenth century, the government had established a firm presence in the plant sciences and put itself in the conflicting roles of supporting farmers while inhibiting the growth of the private seed industry.[45]

B. *The Development of the Seed Industry in the United States*

Because of the perceived lack of protection for the seed collectors' investment or the plant breeders' efforts and insight, there was little incentive to introduce and adapt new varieties.[46] In fact, the Patent Office's, and later the USDA's, seed distribution activities were ultimately a stumbling block in the path of the nascent seed industry. By the mid-nineteenth century, the seed industry had gained little market share for field crop seeds and "was still almost exclusively characterized by on-farm production and inter-farmer commerce."[47] The only seed industry able to establish itself to any degree at that time was the vegetable and flower seed industry because most of those crops are harvested before the plant reaches full maturity and the seed sets.[48] However, the Commissioners of Agriculture and Congress continued increasing quantities of free seed to be sent out.[49] After 1875, most of these increases were seen in vegetable and flower seed.[50] In an attempt to develop a sound basis of germplasm for the farmers of the United States, Congress and the Patent Office threatened to undermine the only seed trade market that managed to establish a presence in the market.[51]

"In 1883 the representatives of thirty-four seed companies met in New York City to found the American Seed Trade Association (ASTA) as a vehicle to promote their interests before the government."[52] In addition, although he was ultimately unsuccessful in convincing Congress, J. Sterling Morgan, "a conservative journal editor who became Grover Cleveland's Secretary of

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42. *See id.* at 63-64.
43. *See id.*
44. *See id.* at 64.
45. *See id.* at 65.
46. *See id.* at 54.
47. *Id.* at 61.
48. *See id.*
49. *See id.* at 62.
50. *See id.*
51. *See id.*
52. *Id.*

Agriculture in 1893," recognized the importance of the developing seed industry and championed it with great conviction.[53]

In 1900, the 1865 genetics work of Gregor Mendel was rediscovered and detailed in several papers.[54] This early work in heredity was embraced by the scientific community and ultimately resulted in some of the first hybrids.[55] These hybrids were not the hybrid crosses of today, which result from crossing highly inbred lines, but were the simple, single cross of two varieties.[56] The art of plant breeding was moving from the simple selection of combinations of germplasm found in nature to the selection of varieties with desired traits that have been molded by man through deliberate and planned mixing of more than one type of genetic material.[57]

Although the government's original intention of getting a large variety of high quality native and exotic seeds into the hands of farmers so that they could adapt it to the environments of the United States was an ultimate success, the success was at the expense of the developing seed industry.[58] Furthermore, while the farmers were equipped to carry out the simple mass selection plant breeding, they were unequipped to handle the more sophisticated plant breeding techniques that were developing as a result of the rediscovery of Mendel's work.[59] However, while this initial hybridization research was going on, from 1900 to 1930, the nation's agricultural productivity as a whole was stagnating.[60] The newly available "scientific" approach to plant breeding, coupled with a lack of growth in agricultural productivity, spurred the business community to pressure Congress to create "financial and institutional space for basic agricultural research."[61]

The early seed companies realized they needed to establish their markets; yet the government's distribution of free seeds initially hindered establishing such markets. Through constant pressure from the seed trade business and emerging seed organizations, such as the ASTA and the American Breeders Association (ABA), Congress finally eliminated the distribution of free seeds to the public in 1924.[62] Once the distribution was terminated, the seed industry could then turn its attention to overcoming its many other problems,[63] including the marketing

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53. *Id.* at 62-63.
54. *See id.* at 68-69.
55. *See id.* at 69, 78.
56. *See id.* at 68, 78.
57. *See id.* at 69.
58. *See id.* at 65.
59. *See id.* at 66.
60. *See id.*
61. *Id.*
62. *See id.* at 71.
63. *See id.* at 71-77. The developing seed industry suffered from poor regulation that often resulted in the sale of seed that was not clean, true to name, pure, or guaranteed to germinate. *See id.*

problems inherent in the natural reproducibility of seeds.[64] Because grain crops' ultimate product was also the very seeds that the industry was trying to market, the grain seed crop industry still had a difficult time establishing a market presence.[65] A further complication in the grain seed industry was found in the practice of utilizing independent farmers to grow the seed crops.[66] If the seed company did not buy all the seeds the farmer produced, as they frequently did not, the farmer would sell the remaining seeds himself.[67] This practice had the double negative effect of placing the seed companies' own new variety seeds in the market and at a lower price—in effect, they were creating their own competition.[68]

Turning to the genetics of plant breeding and applying the benefit of hindsight, it can be seen that the early hybridization experiments (conducted mainly on government and university experimental stations) resulted in improved varieties through the introduction of a single trait or selected traits from one variety, crossed into another variety through backcrossing.[69] Even though these experiments certainly created new varieties with traits of interest for the farmers, it did not overcome the inherent problem for the seed industry that the seed a farmer planted for this year's crop would create sufficiently similar seed for that farmer to save to grow next year's crop.[70] In addition, the same farmer was free to sell this seed to any of his friends and neighbors. In fact, there was nothing to stop him from growing enough to set up his own seed business. "[I]n the absence of any kind of legal protection for newly developed varieties there would be difficulty in obtaining adequate returns on research investment."[71]

Through the early 1900s, the grain seeds being sold were the open pollinated[72] varieties.[73] From 1915 to 1925, many U.S. agricultural experiment stations and the USDA developed and evaluated inbred lines and hybrids.[74] "In

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These problems were addressed through the efforts of organizations and legislation directed at remedying the problems in the seed industry and educating the farmer in the new scientific practices. *See id.*

64. *See id.* at 71.

65. *See id.* at 71-72.

66. *See id.* at 72.

67. *See id.*

68. *See id. See supra* text accompanying notes 149-51 (discussing the holding in *Asgrow v. Winterboer*, 513 U.S. 179 (1995)).

69. *See* KLOPPENBURG, *supra* note 4, at 78-81.

70. *See id.* at 71

71. *Id.* at 81.

72. *See* POEHLMAN, *supra* note 1, at 20. Open-pollination, also known as natural cross pollination, is the transfer of pollen by such means as the wind or insects from the anther on one plant to the stigma or silk of another plant. *See generally id.* (discussing different forms of pollination).

73. *See* NORSKOG, *supra* note 6, at 25, 66, 80-81.

74. *See* A.R. Hallauer et al., *Corning Breeding*, *in* AMERICAN SOC'Y OF AGRONOMY, INC. ET AL., AGRONOMY PUB. NO. 18, CORN AND CORN IMPROVEMENT 463, 464 (George F. Sprague &

1926, Henry Wallace set up the Hi-Bred Corn Co. (now Pioneer Hi-Bred International, Inc.) in Des Moines, Iowa, and marketed the first hybrid seed corn."[75] By the 1930s the farmers had accepted hybrid corn seed and by 1943, virtually one hundred percent of the corn planted in Iowa and ninety percent of the corn planted in the U.S. Corn Belt was hybrid seed corn.[76]

The emergence of hybrid seeds helped spur the seed industry because the creation of inbred lines and the sale of hybrid seeds afforded the industry some protection, therefore creating incentive for research through trade secret. Inbred lines are lines of germplasm so nearly homozygous, or genetically stable, that when the plant is allowed to self-fertilize, the resulting progeny seed will grow a plant that is the same as the parent plant.[77] These inbred lines could be kept secret by the hybrid seed companies because only the hybrid seeds resulting from the cross of two inbred lines would be sold.[78] It was discovered that by crossing these inbred lines to each other (a single cross) or by crossing the resulting single cross progeny to each other (double-cross), the resulting progeny plants had such a mix of new genetic material that they were much more vigorous plants and had much higher yielding than the parent plants.[79] This new hybrid vigor, or heterosis, was a boon to the farmer who wanted the increase yield, but it had an even greater advantage to the hybrid seed company.[80] Once the hybrid plant (F_1 plant) was grown and allowed to open pollinate, the genetic makeup of the next generation (F_2 plant) became even more scrambled, and the hybrid vigor began to decrease.[81] The farmer could better maximize his yield and return not by saving the seeds, but by purchasing new F_1 hybrids every year.[82]

John Wesley Dudley eds., 3d ed. 1988).

75. NORSKOG, *supra* note 6, at 69.

76. *See* Hallauer et al., *supra* note 74, at 464.

77. *See generally* FORBES & WATSON, *supra* note 32, at 224-27 (discussing patterns of inheritance in plants); POEHLMAN, *supra* note 1, at 239-41, 706 (discussing inbreeding and inbred lines).

78. *See generally* William A. Stiles, Jr., *A Congressional View on Proprietary Rights*, *in* CROP SCIENCE SOC'Y OF AM., INC. ET AL., ASA SPEC. PUB. NO. 52, INTELLECTUAL PROPERTY RIGHTS ASSOCIATED WITH PLANTS 35 (Billy E. Caldwell et al. eds, 1989) (discussing trade secret protection of inbred lines used to create commercial hybrids). However, commercial hybrid seeds can contain extremely small amounts of the inbred parent seed. *See* POEHLMAN, *supra* note 1, at 239-46. This can occur when there is an incomplete detasseling of a female parent or an inadequate removal of a male parent plant in a hybrid seed production field. *See id.* at 245-46.

79. *See generally* POEHLMAN, *supra* note 1, at 241-46, 706 (discussing hybrid vigor resulting from single-and double-crosses).

80. *See generally id.* at 241-43, 705 (discussing hybrid vigor producing increased yield).

81. *See generally* FORBES & WATSON, *supra* note 32 (discussing advantages and disadvantages of F_1 and F_2 hybrids).

82. *See id.* at 231.

The advent of the hybrid seed, while not eliminating the need for intellectual property protection, certainly tipped the balance in favor of research and development and the establishment of new hybrid seed companies. However, the need for intellectual property still was sorely needed for the protection of the inbred lines and for other open pollinated crops or self-pollinating crops that are not conducive to hybridization.

It should also be mentioned that the advent of biotechnology techniques that introduced improved genetic traits to plant material further increased the need for intellectual property protection for all types of plant breeding. Although the promise for return with these new technologies is great, the research costs are very high. Without the promise of some kind of protection for research investments, no organization would want to undertake such an expensive and time-consuming endeavor.

III. PLANT INTELLECTUAL PROPERTY PROTECTION

In this section the author discusses the involvement of the seed industry and other plant breeding organizations in the creation of a mechanism to protect the intellectual property rights of their research and investments. The intellectual property protection available for crop plants, either individually or in combination, includes: trade secrets, plant patents, plant variety protection, and utility patents. These different forms of intellectual property protection are discussed in this section.

A. *The Seed Industry's Influence on the Development of Plant Intellectual Property Protection in the United States*

The United States Constitution provides that Congress shall have the power "[t]o promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries."[83] Although the first Patent Act was enacted in 1790, no one at that time thought to apply for patent protection of the germplasm that was being imported or created.[84] Because of this apparent oversight, and the ease with which the early open-pollinated varieties could be propagated, there was little incentive of a profitable return for the entrepreneurial collector or farmer-plant breeder.[85] Even with the advent of hybrids, the only way to protect the inbred parent lines was through trade secret, a form of law developed from other areas of the law, such as

83. U.S. CONST. art. I, § 8, cl. 8.
84. *See* KLOPPENBURG, *supra* note 4, at 54.
85. *See id.*

contracts, torts, and property.[86] Although trade secrets helped the hybrid seed producers for crops such as corn, it did nothing for the producers of open pollinated varieties or self pollinated crops, such as soybeans. The ASTA continued strong lobbying efforts for the seed industry.[87] "In 1961, the Union for the Protection of New Varieties of Plants (UPOV) was created by six European nations to provide an international legal framework for [Plant Breeders Rights] legislation."[88] The ASTA quickly studied the UPOV system and ultimately developed and promoted an American system that provided patent-like protection while avoiding requirements as to superior quality.[89] "Novelty, uniformity, and stability (consistent phenotypic reproducibility) were to be the sole criteria for protection."[90] An ASTA drafted bill, called the Plant Variety Protection Act (PVPA), was ultimately enacted in the United States in 1970.[91] The passing of the PVPA in 1970 allowed the seed industry to protect its research investment by granting "[o]riginators of novel varieties of sexually reproducible crop plants . . . . exclusive rights to the production and sale of seed of the protected variety."[92]

As will be discussed below, the passage of the PVPA was only one step, albeit a critical one, in the development of plant intellectual property protection. There are five main types of plant intellectual property: trade secret, contracts, Plant Patent Act,[93] Plant Variety Protection Act,[94] and utility patents.[95] Although contracts that include confidentiality agreements and other restriction requirements are certainly important to the seed industry, the breadth of that topic is beyond the scope of this Note. In addition, this Note is primarily directed to the crops of corn and soybean. Therefore, the protection provided for asexually reproducing plants by the Plant Patent Act is not within the scope of this Note and will be discussed

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86. *See generally* Stiles, *supra* note 78 (discussing trade secret protection of inbred lines used to create commercial hybrids); WILLIAM H. FRANCIS & ROBERT C. COLLINS, CASES AND MATERIALS ON PATENT LAW: INCLUDING TRADE SECRETS, COPYRIGHTS, AND TRADEMARKS 7-8 (4th ed. 1995) (discussing trade secret law).

87. *See generally* William T. Schapaugh, *The Seed Trade's View on Proprietary Rights*, *in* CROP SCIENCE SOC'Y OF AM., INC. ET AL., ASA SPEC. PUB. NO. 52, INTELLECTUAL PROPERTY RIGHTS ASSOCIATED WITH PLANTS 17 (Billy E. Caldwell et al. eds., 1989) (discussing ASTA's view on proprietary rights); KLOPPENBURG, *supra* note 4, at 132-33 (1988) (discussing ASTA's lobbying efforts for the seed industry).

88. KLOPPENBURG, *supra* note 4, at 136-37.

89. *See id.*

90. *Id.* at 139.

91. *See id.* at 139-40. *See generally* Plant Variety Protection Act, 7 U.S.C. §§ 2321-2582 (1994).

92. POEHLMAN, *supra* note 1, at 692.

93. Plant Patent Act, 35 U.S.C. §§ 161-164 (1994).

94. Plant Variety Protection Act, 7 U.S.C. §§ 2321-2582 (1994).

95. *See* 35 U.S.C. §§ 100-103 (1994).

only briefly. This Note will focus on trade secrets, the Plant Variety Protection Act, and utility patents for sexually reproducing plants.

B. *Trade Secret*

Trade secret law has developed mainly out of the law of torts and was defined in the original Restatement of Torts (1939) of the American Law Institute.[96] "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."[97] While a trade secret does not have to have an element of novelty as patent law requires, it does have to "possess at least that modicum of originality which will separate it from everyday knowledge."[98] Trade secret laws require that the information to be protected be held confidential and without disclosure to the public.[99] Because these laws are state laws, the level of trade secret protection may vary from state to state.[100]

One of the most important cases involving trade secrets in the seed industry is *Pioneer Hi-Bred International, Inc. v. Holden Foundation Seeds, Inc.*[101] Pioneer alleged that Holden misappropriated proprietary inbred maize lines—either H3H or H43SZ7 ("H3H/H43SZ7"), or both—that were Pioneer trade secrets.[102] Pioneer did not have plant variety protection or patent protection on H3H; [103] however, it had maintained this parental line as a trade secret.[104] The United States District Court for the Southern District of Iowa found for Pioneer and awarded it over $46.7 million in damages.[105] Holden appealed this decision.[106] Under Iowa law, Pioneer had to "show three elements to prevail in a trade secret action: (1) existence of a trade secret, (2) acquisition of the secret as a result of a confidential relationship, and (3) unauthorized use of a secret."[107]

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96. *See* FRANCIS & COLLINS, *supra* note 86, at 8-9.
97. RESTATEMENT OF TORTS § 757 cmt. b (1939).
98. Cataphote Corp. v. Hudson, 444 F.2d 1313, 1315 (5th Cir. 1971).
99. *See* Jondle, *supra* note 7, at 6.
100. *See id.*
101. *See* Keith D. Parr, *Developments in Agricultural Biotechnology*, 19 WM. MITCHELL L. REV. 457, 469-71 (1993) (citing Pioneer Hi-Bred Int'l, Inc. v. Holden Found. Seeds, Inc., 35 F.3d 1226 (8th Cir. 1994)).
102. *See* Pioneer Hi-Bred Int'l, Inc. v. Holden Found. Seeds, Inc., 35 F.3d 1226, 1229 (8th Cir. 1994).
103. *See* Parr, *supra* note 101, at 469-70.
104. *See Pioneer*, 35 F.3d at 1229.
105. *See id.* at 1228.
106. *See id.*
107. *Id.* at 1235 (quoting Basic Chemicals, Inc. v. Benson, 251 N.W.2d 220, 226 (Iowa

On appeal, Holden argued "that it should not be liable for misappropriating H3H/H43SZ7 because Pioneer failed: (1) to keep the genetic messages secret; (2) to prove that Holden actually possessed the protected genetic messages; and (3) to prove that Holden obtained the material by improper means."[108] The Eighth Circuit "assume[d] without deciding that genetic messages can qualify for trade secret status."[109] The court affirmed the district court's finding that Pioneer had taken every effort to keep H3H and H43SZ7 secret by such means as grower confidentiality contracts, unlabeled fields, secret codes on production seed bags, and the removal of male inbred lines to be mixed with other corn before sending to elevators or putting in bags.[110] Based on scientific evidence, the district court found, and the Eighth Circuit agreed, that the Holden's lines, LH38, LH39, and LH40, were more likely than not fathered by Pioneer's H3H/H43SZ7, rather than the Holden line, L120.[111] Finally, the appeals court also affirmed the district court's finding that Holden had obtained H3H/H43SZ7 by improper means because: (1) the evidence showed that Holden had admitted to attempting to obtain Pioneer lines by means such as walking through the fields of friendly farmers for stray inbred plants found in hybrid fields; (2) Holden was unable to produce records showing how LH38, LH39, and LH40 was derived from LH120; and (3) Holden was unable to show that H3H/H43SZ7 was lawfully acquired.[112] Holden also argued that "the Plant Variety Protection Act, 7 U.S.C. §§ 2321-2582 preempts state trade secret law as applied to sexually reproducing plants."[113] However, the court did not find merit in that argument because of the legislative history of the Act and the Supreme Court's holding that "trade secret and patent protection can 'peacefully coexist.'"[114] The appeals court "affirm[ed] the district court's judgment and order of damages."[115]

While *Pioneer* shows that inbred lines used to create hybrids can be protected as trade secrets, perhaps a less obvious message which can be taken from this case is that trade secret rights can be costly to defend and the burden to prove misappropriation can be difficult. This case "consumed the attention of the district court for over a decade, requiring ten weeks of actual trial time, and involved court-ordered complex scientific testing and growouts."[116] Had Holden been able

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1977)).

108. *Id.*
109. *Id.*
110. *See id.* at 1236.
111. *See id.* at 1235, 1237-38.
112. *See id.* at 1238-41.
113. *Id.* at 1242.
114. *Id.* at 1243 (quoting Kewanee Oil Co. v. Bicron Corp., 416 U.S. 470, 485-85 (1974)).
115. *Id.* at 1246.
116. *Id.* at 1242.

to show breeding records or produce seed of L120, Pioneer may have had an even more difficult time supporting the inference that Holden misappropriated H3H/H43SZ7.[117] Perhaps a better way to bolster the protection of a seed company's assets in research and development of sexually reproducing proprietary lines is to create a package of protection that includes a combination of elements such as contracts, trade secrets, plant variety protection, and/or patents.[118]

C. *Plant Patent Act of 1930*

> Until 1930, one could not patent a plant. Plants were excluded from patent law for two reasons. First, plants are products of nature. Second, plants were not thought to be amenable to the written description requirement of patent law.
> As a result of lobbying efforts by the seed industry, the United States first recognized plants as patentable in the Plant Patent Act of 1930. Patents were limited, however, to plants which were reproduced asexually. The rationale for restricting protection to asexually reproduced plants was the belief that new plant varieties could not be reproduced reliably by seed.[119]

Sexual reproduction in plants, like in mammals, involves the formation of male and female sex cells called gametes, which are then fused in the process of fertilization.[120] "Reproduction involving gametes . . . takes place in the flower and results in the formation of fruits containing seeds."[121] Asexual reproduction in plants, in particular crop plants, takes place through vegetative propagation, or the creation of seeds or new plants, without the fusion of gametes.[122]

> Vegetative propagation may be by roots, tubers, stolons, rhizomes, sprigs, stem or leaf cuttings, or by tissue culture. A group of plants that have been propagated vegetatively from a single plant constitutes a *clone*.

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117. *See id.* at 1239-40.

118. Although a combination of protective elements is possible, and perhaps preferable, trade secrets are still powerful tools in the protection of germplasm. On October 28, 1998, Pioneer Hi-Bred International, Inc. filed suit for alleged theft of seed-corn genetics and trade secrets against Cargill, Inc., Asgrow Seed Co., and DeKalb Genetics Corp. *See* Anne Fitzgerald, *Pioneer Sues 3 Corn Rivals*, DES MOINES REG., Oct. 30, 1998, at A1. *See also* Pioneer Hi-Bred Int'l, Inc. v. Asgrow Seed Co., No. 4-98-CV-70577 (S.D. Iowa filed Oct. 28, 1998); Pioneer Hi-Bred Int'l, Inc. v. Cargill, Inc., No. 4-98-CV-70576 (S.D. Iowa filed Oct. 28, 1998); Pioneer Hi-Bred Int'l, Inc. v. DeKalb Genetics Corp., No. 4-98-CV-70578 (S.D. Iowa filed Oct. 28, 1998).

119. Susan E. Gustad, Note, *Legal Ownership of Plant Genetic Resources—Fewer Options for Farmers*, 18 HAMLINE L. REV. 459, 464 (1995).

120. *See* FORBES & WATSON, *supra* note 32, at 159.

121. *Id.*

122. *See* POEHLMAN, *supra* note 1, at 34-35.

> Plants of the same clone, barring genetic mutation, are identical in heredity and bear the characteristics of the parent plant.[123]

Most crop plants are reproduced sexually and multiplied by seed, including corn and soybeans.[124] Because the Plant Patent Act of 1930 only conferred protection on asexually reproducing plants, the Act did not benefit most breeders of the new varieties of crop plants.[125] The ASTA attempted to obtain patent protection for sexually reproduced plants through a bill to amend the 1930 Plant Patent Act.[126] Although ASTA was unsuccessful, their effort helped bring about meetings and negotiations between the ASTA, the USDA, and others which ultimately resulted in the Plant Variety Protection Act.[127]

D. *Plant Variety Protection Act*

When a crop plant is sold, such as a commercial variety of soybean, in which the genetics are mostly fixed, or homozygous for the traits of interest, the parent plant being sold will yield seed that will grow a plant essentially identical to the parent plant.[128] This means that the seed the breeder or seed company sells to the farmer, if planted and allowed to self-pollinate or pollinate in an area isolated from other pollen producers, will yield plants bearing seeds capable of growing plants with essentially identical traits as the seeds sold.[129] In effect, the breeder or seed company is no longer needed to propagate more of the same seed. This practice also had the effect of allowing farmers to plant the seeds obtained from the breeder or seed company, harvest the seeds from the resulting plants, bag the seeds, and sell it in a non-descriptive bag—without any of the research and development cost borne by the original breeder or seed company.[130] The practice is often referred to as "brown-bagging."[131]

As farmers were becoming more sophisticated in their planting practices, they demanded different and specific characteristics in the plants grown. At the same time, and as discussed above, the plant breeders, seedsmen, and seed

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123. *Id.* at 35.

124. *See id.* at 30-32.

125. *See* KLOPPENBURG, *supra* note 4, at 132.

126. *See id.* at 139.

127. *See id.*

128. *See generally* POEHLMAN, *supra* note 1, at 189-90 (discussing the genetic significance of pollination methods, in particular, self-pollination).

129. *See id.*

130. *See* Gustad, *supra* note 119, at 467. *See generally* KLOPPENBURG, *supra* note 4, at 136-40 (discussing the struggle of plant breeders and the seed industry for a law to protect their new plant varieties).

131. *See* Gustad, *supra* note 119, at 469.

companies lobbied for a way to protect their investments.[132] On December 2, 1961, the 1961 Act of the International Convention for the Protection of New Varieties of Plants (UPOV) was adopted.[133] This 1961 UPOV Act was enacted to promote the protection of the "rights of plant breeders [in new plant varieties] . . . on an international basis."[134] Although the United States did not become a member state of UPOV until 1981,[135] the 1961 UPOV Act was certainly a catalyst in the creation of a plant variety protection mechanism in the United States.[136] The result was the enactment of the Plant Variety Protection Act of 1970 (PVPA).[137] "The purpose of the PVPA is 'to encourage the development of novel varieties of sexually reproduced plants and to make them available to the public, providing protection available to those who breed, develop, or discover them, and thereby promoting progress in agriculture in the public interest.'"[138]

To receive the twenty-year protection provided under the PVPA, a breeder must apply for a PVPA certificate for a specific plant with a specific genotype or genetic makeup.[139] To be eligible for protection under the PVPA, certain requirements must be met: the plant must be new; the plant must be a distinct or novel variety, although "any trait difference(s) between two cultivars will allow both cultivars to receive PVPA protection";[140] the plant must be uniform and stable; the plant must reproduce sexually; a complete description of the plant, including breeding history, must be provided; and a deposit of the seed must be made for viability testing.[141] Once a PVPA certificate is granted, the holder is protected from anyone else selling, reproducing, importing, or exporting his

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132. *See generally* POEHLMAN, *supra* note 1, at 421-24 (discussing the introduction and evolution of soybean breeding); Gustad, *supra* note 119, at 464-65 (discussing the introduction of the Plant Variety Protection Act of 1970).

133. *See New Plant Varieties and the Protection of the Rights of Their Breeders: A Historical Note* (visited Feb. 19, 1999) <http://www.upov.int/eng/newplant/histnote.htm> (discussing the 1961 International Convention for the Protection of New Varieties of Plants).

134. *Id.*

135. *See States Party to the International Convention for the Protection of New Varieties of Plants* (visited Feb. 19, 1999) <http://www.upov.int/eng/members>.

136. *See* discussion *infra* Part III.A. *See also* Neil D. Hamilton, *Who Owns Dinner: Evolving Mechanisms for Ownership of Plant Genetics Resources*, 28 TULSA L.J. 587, 594-619 (1993) (discussing plant intellectual property protection both nationally and internationally).

137. *See* Plant Variety Protection Act of 1970, Pub. L. No. 91-577, 84 Stat. 1542.

138. Gustad, *supra* note 119, at 464-65 (quoting H.R. REP. NO. 1605, 91st. Cong., 2d Sess., 84 Stat. 1542 (1970), *reprinted in* 1970 U.S.C.C.A.N. 1793).

139. *See* AGRICULTURAL MARKETING SERVICE, USDA, PLANT VARIETY PROTECTION ACT AND REGULATIONS AND RULES OF PRACTICE §§ 42, 83 (1997); 7 U.S.C. §§ 2402, 2483 (1994). *See also* Jondle, *supra* note 7, at 7.

140. *Id.*

141. *See* Gustad, *supra* note 119, at 464-65; 7 U.S.C. §§ 2402, 2422 (1994); AGRUCULTURAL MARKETING SERVICE, *supra* note 139, §§ 42, 52.

variety for the next twenty years.[142] Under the PVPA, sexually reproducing varieties, inbreds and hybrids are eligible for protection.[143] However, there are two major exemptions from this protection: (1) a crop or "farmer's exemption"[144] and (2) a research or "breeders exemption."[145]

Under the PVPA, a farmer is allowed to plant a protected variety on his land and sell the harvested seed as long as his "primary farming occupation is the growing of crops for sale other than reproductive purposes."[146] This was often interpreted to mean that as long as a farmer sold only forty-nine percent of what he planted of a specific variety, he was within the farmer's exemption.[147] However, the Supreme Court holding in *Asgrow Seed Co. v. Winterboer*[148] interpreted the farmer's exemption much more narrowly.[149] The Court held that "a farmer who meets the requirements set forth in the proviso to § 2543 may sell for reproductive purposes only such seed as he has saved for the purposes of replanting his own acreage."[150] The Court also determined an exempted farmer's "primary farming occupation" to be one where "[s]elling crops for other than reproductive purposes must constitute the preponderance of the farmer's business, not just the preponderance of his business in the protected seed."[151] This holding will dramatically curtail the "brown-bagging" industry and help to ensure that the PVPA provides the protection promised to plant breeders.[152]

The second exemption, the research or breeder's exemption, allows anyone to use the PVPA protected lines in the laboratory or field breeding research program to develop new lines.[153] For example, this exemption allows a plant breeder to purchase a commercially available, PVPA protected, soybean variety and use it to develop a new line. This new line can be sold or applied for protection of its own, as long as it is new, distinct, uniform, and stable.[154] To be

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142. *See* 7 U.S.C. § 2483; Plant Variety Protection Act Amendments of 1994, Pub. L. No. 103-349, § 7(2), 108 Stat. at 3140; Jondle, *supra* note 7, at 7.

143. *See* 7 U.S.C. §§ 2401, 2402.

144. *See id.* § 2543. *See also* Plant Variety Protection Act Amendments of 1994, Pub. L. No. 103-349, § 10, 108 Stat. 3136, 3142 (striking the provision that allowed the sale of "saved seed" to other persons).

145. *See* 7 U.S.C. § 2544.

146. Jondle, *supra* note 7, at 7.

147. *See id.* at 7-8.

148. Asgrow Seed Co. v. Winterboer, 513 U.S. 179 (1995).

149. *See id.* at 192.

150. *Id.* (referring to 7 U.S.C. § 2543 (1994)).

151. *Id.* (referring to 7 U.S.C. §§ 2541(a)(3)-(4), 2543 (1994)).

152. The PVPA was amended in 1994 to delete the provision that allowed the sale of "saved seed" to other persons. *See* Plant Variety Protection Act Amendments of 1994, Pub. L. No. 103-349, § 10, 108 Stat. 3136, 3142.

153. *See* Jondle, *supra* note 7, at 8.

154. *See* Plant Variety Protection Act Amendments of 1994, Pub. L. No. 103-349, § 3, 108

distinct, the variety need only have "one or more identifiable morphological, physiological, or other characteristic" different than the originally purchased, protected line.[155] This has the ultimate effect of allowing company *A* to purchase seed from company *B*[156] to utilize in company *A*'s breeding program. This allows company *A* to enhance the genetic resources of its product lines without the research and development costs incurred by company *B* in the development of the line.[157] All this can take place lawfully under the PVPA's research or breeder's exemption.[158] Although *Asgrow v. Winterboer* reduced the impact on the seed industry from brown-bagging, it has not provided complete protection from others using a company's PVPA protected varieties, inbred lines, or hybrids in a breeding program.[159]

Stat. at 3138-39 (codified as amended at 7 U.S.C. § 2402(a) (1994)).

155. 7 U.S.C. § 2401 (1994); Plant Variety Protection Act Amendments of 1994, Pub. L. No.103-349, § 41(b)(5), 108 Stat. at 3138. *See also* Jondle, *supra* note 7, at 7.

156. "One major restriction to the research exemption results from the Plant Variety Protection Office's policy of not allowing access to its seed deposits"; therefore, the only way to legally obtain the protected seed is to purchase it or to obtain a sample directly from the breeder. Jondle, *supra* note 7, at 8.

157. *See* Carla R.D. Bourne, Comment, *Will §101 Patents Have Utility for Plants?*, 3 SAN JOAQUIN AGRIC. L. REV. 155, 160 (1993).

158. *See* 7 U.S.C. § 2544. The United States has ratified the 1991 Act of the UPOV Convention which enters force in the United States on February 22, 1999. *See* International Union for the Protection of New Varieties of Plants, Ratification by the United States of America of the 1991 Act of the International Convention for the Protection of New Varieties of Plants, UPOV Press Release No. 35 (Jan. 22, 1999). The 1991 Act ensures that a plant breeder's rights extend to "essentially derived" lines which are defined to include varieties that are: "predominantly derived from the [protected] initial variety, . . . while retaining the expression of the essential characteristics that result from the genotype or combination of genotypes of the initial variety"; "clearly distinguishable from the initial variety"; and "except for the differences which result from the act of derivation, it 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." International Convention for the Protection of New Varieties of Plants art. 14, § 5(b) (opened for signature Mar. 19, 1991) <http://www.upov.int/eng/convntns/1991/w_up911_.htm>. The "essentially derived" lines are also defined to include those varieties 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, or transformation by genetic engineering." *Id.* art. 14, § 5(c). In 1994, the PVPA was amended to include this same language. *See* Plant Variety Protection Act Amendments of 1994 § 2, 108 Stat. at 3137 (codified at 7 U.S.C. § 41(a)(3) (1994)).

159. *See* Asgrow Seed Co. v. Winterboer, 513 U.S. 179, 192 (1995). However, while the PVPA does allow for certain limited breeding exemptions, there are additional ways to limit the availability of proprietary or protected lines for breeding through such means as: careful and selective application for PVPA; utility patents; trade secrets; and through contract and licensing agreements at time of sale. *See* Jondle, *supra* note 7, at 6-9.

E. *Utility Patent Protection*

In spite of the fact that trade secrets, contracts, the Plant Patent Act, and the PVPA provided much needed protection to the plant breeder and the seed industry, there was still a hole in protection as far as the other breeders, researchers, or seed companies were concerned.[160] This protection is particularly important for the producers of hybrid seed, where a self-pollinating inbred may be missed in the production fields and mistakenly included in the bag of hybrid seed.[161] These self-pollinated inbreds lack the hybrid vigor of their hybrid counterparts and are relatively easy for a trained plant breeder to pick out in the field.[162] With the advent of genetic engineering techniques, these seeds or plants, or both, may also be identified in a research laboratory.[163] Once identified, they can be analyzed for genetic composition or used in a breeding program.

The seed industry needed a form of protection for these inbred lines, or the hybrids created using two or more inbred lines, that did not allow an independent plant breeder or seed company to gain the benefit of another person's research and development efforts, and expense. The first breakthrough did not come in the area of plant breeding, but in the field of genetic engineering with the U.S. Supreme Court decision in *Diamond v. Chakrabarty*.[164] Respondent Chakrabarty invented a genetically-engineered or modified bacterium capable of breaking down crude oil in a way no naturally-occurring bacterium is capable.[165] Although the United States Patent Office examiner allowed Chakrabarty's claims to a method for producing the bacteria and to an innoculum containing the bacteria, Chakrabarty was denied claims to the bacterium itself.[166] The patent examiner asserted that "(1) micro-organisms are 'products of nature' and (2) that as living things they are not patentable subject matter under 35 U.S.C. § 101."[167] The Patent Office Board of Appeals affirmed the examiner on the grounds "that section 101 was not intended to cover living things such as these laboratory created micro-organisms."[168] The

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160. *See* KLOPPENBURG, *supra* note 4, at 139.

161. *See generally id.* at 245-55 (discussing production of commercial corn hybrid seed, and single and double cross hybrids).

162. *See generally id.* at 240-43 (discussing inbreeding depression and hybrid vigor).

163. *See* Virginia Walbot & Joachim Messing, *Molecular Genetics of Corn*, *in* AMERICAN SOC'Y OF AGRONOMY, INC. ET AL., AGRONOMY PUB. NO. 18, CORN AND CORN IMPROVEMENT 389, 389-429 (George F. Sprague & John Wesley Dudley, eds., 3d ed. 1988) (discussing methods and application of molecular genetics of corn).

164. Diamond v. Chakrabarty, 447 U.S. 303 (1980).

165. *See id.* at 305.

166. *See id.* at 305-06.

167. *Id.* at 306.

168. *Id.*

Court of Customs and Patent Appeals reversed this decision, and the Acting Commissioner of Patents and Trademarks sought certiorari, which was granted.[169]

In determining whether Chakrabarty's micro-organism was patentable subject matter under 35 U.S.C. § 101, the Court looked to the legislative history. It held that "Congress intended statutory subject matter to 'include anything under the sun that is made by man.'"[170] The Court determined "that whether the invention in question is animate or inanimate has no bearing on its patentability as long as it meets the criteria of novelty, utility, and non-obviousness, and as long as it is a product not of nature but of human manufacture."[171]

Even though the Supreme Court in *Chakrabarty* held that living matter could be patentable subject matter, a major issue remained unclear in regard to plant materials, that is: are sexually reproduced, "man-made" plants patentable subject matter under 35 U.S.C. § 101? Although the Court asserted that congressional enactment of the Plant Patent Act supported its opinion "that the work of the plant breeder 'in aid of nature' was [a] patentable invention,"[172] the Plant Patent Act applies only to *asexually* reproducing plants.[173] Furthermore, the Court determined that the PVPA extended protection to sexually-reproduced plants.[174] However, this protection did not confer the full level of protection from use by others, such as researchers and plant breeders, as the protection supplied to 35 U.S.C. § 101 patentable subject matter by a utility patent.[175] After *Chakrabarty,* there continued to be uncertainty as to how the protections afforded by the Plant Patent Act and the PVPA, and now utility patents would merge or overlap.[176] This uncertainty was "exacerbated by initial indecision within the [Patent and Trademark Office (PTO)] as to the application of *Chakrabarty* to plants."[177] While the PTO did allow patents to hybrid plants, "breeders soon found their patent applications for anything but hybrids rejected on the grounds that Congress had expressly articulated separate property-right policies for non-hybrid plants."[178] The PTO held that without further judicial guidance "any subject matter protectable under either the plant

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169. *See id.* at 306-07. The *Chakrabarty* case was originally consolidated with *In re Bergy*, 563 F.2d 1031 (1977), *cert. granted*, 444 U.S. 924 (1979). However, "*Bergy* was dismissed as moot, 444 U.S. 1028 (1980), leaving only *Chakrabarty* for decision." *Id.* at 307.

170. *Id.* at 309 (quoting the Committee Reports accompanying the Patent Act of 1952; S. Rep. No. 1979, 82d Cong., 2d Sess., 5 (1952); H.R. Rep. No. 1923, 82d Cong., 2d Sess., 6 (1952)).

171. KLOPPENBURG, *supra* note 4, at 262.

172. *Chakrabarty*, 447 U.S. at 312.

173. *See id.* at 313.

174. *See id.*

175. *See id.*

176. *See* KLOPPENBURG, *supra* note 4, at 262-63.

177. *Id.* at 263.

178. *Id. See also* Stephen A. Bent, *Protection of Plant Material Under the General Patent Statute: A Sensible Policy at the PTO?*, 4 BIOTECHNOLOGY L. REP. 105, 105-107 (1985).

patent law or the [PVPA was] preempted by that law and [could not] be protected under the general [utility] patent law."[179]

The issue of sexually reproducible plant patentability under 35 U.S.C. § 101 was squarely addressed in *Ex parte Hibberd*.[180] The subject matter on appeal to the United States Board of Patent Appeals and Interferences (BPAI) was maize plant technologies, including seeds, plants, and tissue cultures "which have increased free tryptophan levels, . . . or which are capable of producing plants or seeds having increased tryptophan content."[181] The issue before the BPAI was whether subject matter such as plants and seeds that are protectable under the PVPA or subject matter such as tissue culture that are protectable under the Plant Patent Act of 1930 are also protectable under 35 U.S.C. § 101.[182] The BPAI upheld the patentability of the claimed subject matter and based its decision on the Supreme Court's interpretation of 35 U.S.C. § 101 subject matter in *Chakrabarty*.[183] In granting the patent, the BPAI rejected the patent examiner's assertion that the Plant Patent Act and the PVPA "are the exclusive forms of protection for plant life covered by those acts."[184] The effect of the 1985 BPAI decision opened the door for seed companies by allowing them to file plant utility patent applications on their inbred lines, such as maize inbreds, and the self-pollinating varieties, such as soybeans.[185]

It should be noted that although the BPAI held in *Ex parte Hibberd* that sexually reproduced plants are patentable under 35 U.S.C. § 101, the Board's decision is not a court decision.[186] However, the issue of patent validity for sexually reproducing plants may again be considered, this time by the United States Court of Appeals, Federal Circuit.[187] In 1998,

> Pioneer [Hi-Bred International, Inc.] filed a patent infringement action against J.E.M. AG Supply [et al.] involving various patents for sexually reproducing corn seed products. J.E.M. AG counterclaimed that the patents in question were invalid because sexually reproducing plants are exclusively protectable under the Plant Variety Protection Act, 7 U.S.C. § 2321 et seq. rather than patentable under the general patent statute, 35

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179. KLOPPENBURG, *supra* note 4, at 263.

180. *See generally Ex parte* Hibberd, 227 U.S.P.Q. 443 (Bd. Pat. App. & Int. 1985) (discussing sexually reproducible plant patentability).

181. *Id.* at 443.

182. *See id.* at 443-44.

183. *See id.* at 444-45.

184. *Id.* at 444.

185. *See infra* Table 2.

186. *See Hibberd*, 225 U.S.P.Q. at 444-45.

187. *See* Pioneer Hi-Bred Int'l, Inc. v. J.E.M. Ag Supply, Inc., No. 563, 1998 WL 780948 (Fed. Cir. Oct. 27, 1998).

> U.S.C. § 101. On August 19, 1998, the [United States District Court for the Northern District of Iowa] denied J.E.M. AG Supply's summary judgment motion on the issue of patent validity. On August 31, 1998, the district court certified that issue for interlocutory appeal.
> . . . . Upon consideration of the district court's orders and the parties submissions, [the Federal Circuit Court of Appeals] determined in [its] discretion that granting the petition [to appeal] [was] warranted.[188]

Plant utility patents offer the greatest protection when compared to plant patents or PVPA certificates. Plant utility patents allow the inventor-breeder to claim not just one claim on the plant as a whole, as is the case with Plant Patents and PVPA, but the inventor-breeder can also claim the individual components of the variety.[189] In addition to the components of a variety such as the DNA sequence, gene, tissue culture, seed, or specific plant part, the inventor-breeder can claim methods to use the variety to make other varieties or hybrids and those resulting varieties or hybrids.[190] Patenting multiple components or uses of an inventive plant allows for the licensing of those individual components, which is an important factor in genetic engineering research.[191]

The elements that must be met to obtain a utility patent are somewhat more stringent than the PVPA or PPA in that the inventive variety must be useful, novel, non-obvious, and supported by a detailed-written description.[192] The requirement of non-obviousness may require more than a single trait modification from an otherwise patented or publicly known plant variety.[193] How much difference, or what is the "minimum distance" between varieties must be decided by the courts.[194]

In *Hibberd*, the inventors were required to deposit a sample of seed in an approved repository (such as the American Tissue Culture Collection or ATCC) to complete the description and enable a plant breeder to make and use the invention.[195] These deposits differ from those made in conjunction with a PVPA

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188. *Id.* at *1. *See also* Pioneer Hi-Bred Int'l, Inc. v. J.E.M. Ag Supply, No. C-98-4016-DEO (N.D. Iowa Aug. 19, 1998) (order denying summary judgment); Pioneer Hi-Bred Int'l Inc. v. J.E.M. Ag Supply, 33 F. Supp. 2d 794 (N.D. Iowa 1999) (order granting motion to stay proceeding pending appeal to the Federal Circuit of Appeals).

189. *See* KLOPPENBURG, *supra* note 4, at 263.

190. *See id.*

191. *See id.* at 264.

192. *See* 35 U.S.C. §§ 101-103, 112 (1994).

193. *See* KLOPPENBURG, *supra* note 4, at 265.

194. *See id.*

195. *See Ex parte* Hibberd, 227 U.S.P.Q. 443,447 (Bd. Pat. App. & Int. 1985); 35 U.S.C. § 112.

application as they are not restricted, but rather are publicly available.[196] However, the patent owner has the right to *exclude* others from making or using the claimed invention during the patent term, so any use of the patented line in a breeding program could potentially be an infringement of the patent.[197] In addition, there is no farmer's exemption to the utility patent on a plant.[198] "Farmers are no more exempt from the legal obligation to respect the property rights of developers of patented seed than are their corporate competitors."[199] "In enforcing their patent rights, seed companies will have to avoid unnecessarily antagonizing the farmer, who is, paradoxically, both the competitor and customer."[200]

IV. IMPACT OF INTELLECTUAL PROPERTY PROTECTION ON THE SEED INDUSTRY

The impact of the available intellectual property protection for crop plants, particularly utility patents, on the seed industry will now be discussed. This discussion will include past predictions of journalists and analysts and the present realities of who controls the largest market shares in the United States.

A. *Past Predictions*

Following the announcement of the BPAI decision in *Ex parte Hibberd*, the press and trade journalists alike began analyzing the effect this would have on the seed industry. In an October 4, 1985 article, the *Wall Street Journal* referred to Molecular Genetics Inc. company officials, the owner of the patent in question in *Hibberd*, as saying "the board's ruling will give companies the ability to patent seed and plant-tissue cultures that could shake up the $3 billion dollar U.S. seed industry."[201] On January 1, 1986, *Inc.* magazine published an article stating that the large companies were going to move in and acquire the financially stricken farm-based research operations and small start-up research operations.[202] This article stated that analysts predicted "[f]ewer than 40 of the 400 seed companies in the Midwest [would] survive the heightened competition brought on by consolidation . . . ."[203] Following *Asgrow v. Winterboer*, numerous papers and

196. *See* KLOPPENBURG, *supra* note 4, at 265.
197. *See* 35 U.S.C. § 101.
198. *See* KLOPPENBURG, *supra* note 4, at 265.
199. *Id.*
200. *Id.* at 266.
201. Bill Richards, *Ruling on Gene Structures Produced in a Laboratory May Shake Seed Industry*, WALL ST. J., Oct. 4, 1985, *available in* 1985 WL 238387.
202. *See* Greg Critser, *Big Companies Taking over Agriculture*, INC., Jan. 1986, at 17, 17.
203. *Id.*

trade journals predicted the decline of farmer-to-farmer seed sales.[204] Analysts predicted in 1993 that Pioneer Hi-Bred International, Inc. would continue to "grab market share and build earnings", perhaps even "snare more than half of the North American corn hybrid seed market by 1995."[205] It was also noted that DeKalb Genetics Inc. was "at a crossroads and must decide whether it wants to continue spending the big bucks on research required to support the seed-corn business."[206]

All of these predictions pointed to a large reduction in the number of small research companies and small family seed businesses, a resulting increase in market share for the larger seed companies, and an increasing involvement in large chemical companies looking for a way to distribute their agricultural related products such as herbicides and herbicide resistant plants—predictions that proved to be quite accurate.[207] By 1996, seed companies and chemical companies "were trading shares and technology rights in mind-numbing, multimillion dollar deals. Most of the high-dollar deals revolved around access to Bt [and other crop plant related] technology and patent claims."[208]

B. *Present Realities*

When the past predictions are looked at in conjunction with the market share data of Table 1, it can be seen that many, if not all, of the predictions mentioned came to pass. Table 1 is a compilation of the major companies selling corn and/or soybean seeds over the last two decades. It appears that the many small family-run seed companies and foundation seed companies that make up "Others" are losing market share. In addition, the large seed companies such as Pioneer, DeKalb (now owned by Monsanto), and Funk/Ciba (now part of Novartis) are vying for even larger percentages of the market.

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204. *See generally* Ann Toner, *Supreme Court Limits Sale of Farmers' Seeds*, OMAHA WORLD-HERALD, Jan. 19, 1995, at 19-M.

205. Dirck Steimel, *Time Is Ripe for Pioneer, Firm Poised to Increase Its Share of the Market*, DES MOINES REG., July 4, 1993, at 3S. While Pioneer remained the leader in market share, it can be seen by Table 1 that the predicted "more than half" market share was not quite reached.

206. *Id.* This prediction proved accurate; DeKalb went up for sale in 1998 and observers speculated the sale was in part due to the fact that the seed industry had become an expensive "research game." *See* Marcia Berss, *Gone to Seed*, FORBES, Dec. 19, 1994, at 166.

207. *See generally* Mike Holmberg, *Ag's New Alliances: The Cost of Developing New Technology Is Pushing Companies to Find Common Ground with Competitors*, SUCCESSFUL FARMING, Nov. 1, 1996, at 30 (comparing the total payment for buyout of Bt technology and patent claims to NBA negotiations).

208. *Id.* at 30. *See also* Jeff Swiatek, *Business of Seeds Changing in Big Ways; Biotech Developments and a Wave of Mergers Are Reshaping Industry*, INDIANAPOLIS STAR, Jan. 12, 1997, at E01 (setting forth current Monsanto buyout and general trends in chemical company purchases of 1997).

TABLE 1
PERCENT MARKET SHARE BASED ON TOTAL UNITS OF CORN PLANTED IN THE U.S.[209]

Company Name	1977	1987	1997	1998
Pioneer Hi-Bred	28.5	38	42	42
DeKalb (bought by Monsanto)	16.2	9	10	11
Funk (Ciba) (became Novartis)	7.9			
Golden Harvest	3.2	3	4	3
NK (Sandoz) (became Novartis)	4.3			
PAG (bought by Cargill)	3.5			
Trojan (bought by DeKalb)	4.6			
Novartis		8	8	8
Mycogen (bought by Dow)		3	4	3
Cargill		2	4	3
Advanta		4	3	3
Asgrow (bought by Monsanto)		2	3	
Limagrain		1	2	2
NC+		1	1	1
Helena		2	1	1
Fiedler's Choice			1	1
Cenex		<1	1	1
Crows		1	1	1
Others*	31.6	25-26	15	17

*Includes Holden Foundation Seeds which was purchased by Monsanto in 1997.

It is also interesting to note that the larger companies are those that are aggressively patenting their technologies as can be seen in Table 2.

209. Data from Tom Dougherty, Director of Marketing Research and Analysis, Pioneer Hi-Bred International, Inc. This table represents the U.S. market shares for corn.

TABLE 2
NUMBER OF UTILITY PATENTS BY COMPANY[210]

Company Name	Corn Patents	Soybean Patents
Pioneer Hi-Bred	263	23
DeKalb	36	8
Novartis	87	16
Golden Harvest	0	0
Mycogen	103	11
Cargill	40	11
Advanta	0	0
Limagrain	0	0
NC+	2	0
Helena	3	1
Fielder's Choice	0	0
Cenex	0	0
Crows	0	0
Funk	0	0
Northrup King	1	0
PAG	0	0
Trojan	0	0
Holden Foundation Seeds	47	0
Sandoz	381	12
Garst/ICI	11/69	0/18
Asgrow	12	61
Stine	2	13
Zeneca	67	9
Monsanto	258	77

210. Manual Search of United States Patent Office Web page, Full Text Patent Database (Feb. 15, 1999) <http://www.uspto.gov/patft/index.html> (search for records for "All years" containing "maize or corn" in ACLM field and each company's name in AN field); Manual Search of United States Patent Office Web page, Full Text Patent Database (Feb. 15, 1999) <http://www.uspto.gov/patft/index.html> (search for records for "All years" containing "aclm/soybean or 'glycine max'" in ACLM field and each company's name in AN field). Holden is a foundation seed company that sells inbred seed to many seed companies, therefore its impact on market share is significant in the group identified as "Others" in Table 1. Table 2 is merely an indication of any particular company's patent portfolio. There may be specific patents that are represented in both the "corn" and "soybean" columns or patents that were missed by the search query. Further, and more importantly, this does not indicate the possibility of licensing or cross-licensing among the different companies for the right to use the patented inventions.

The market share changes are due at least in part to the maturing of biotechnology programs. "After years of hype and over promising, biotechnology is becoming part of the day-to-day business of industrial America, and the potential profits are huge."[211]

Large chemical companies, such as Monsanto and DuPont, are either purchasing seed companies or building alliances with seed companies in an effort to better market their chemical and biotechnology products. [212] For example, Monsanto purchased Holden Foundations Seeds for just over $1 billion,[213] the remaining sixty percent share of DeKalb that it did not already own it purchased for $2.3 billion,[214] and now Monsanto has joined with Cargill in "a marketing and research joint venture worth perhaps $200 million over five years."[215] Monsanto now owns DeKalb Genetics, Holden's Foundation Seeds, Asgrow, and Delta & Pine Land Co. (bought for $1.9 billion in 1998).[216] In addition, Monsanto had approximately a fifty-five percent equity investment with Calgene,[217] then went on to purchase the rest in April 1997.[218] Monsanto also purchased the "crop biotech assets of W.R. Grace & Co.'s Agracetus unit" in April 1996.[219]

All of Monsanto's spending has not occurred without its problems. In June 1998, at the height of Monsanto's spending spree, Monsanto "[agreed] to combine with American Home Products Corp. in a $35 billion stock swap."[220] However, the two mega-forces mutually terminated their merger pact in October 1998 over rumored disagreements about who would have run the combined giant

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211. Shannon Brownlee, *Dollars for DNA*, U.S. NEWS & WORLD REP., May 25, 1998, at 48, 48.

212. *See* Matthew Lerner, *Monsanto Grows Biotech Presence with Seed Deal*, Chem. Mkt. Rep., Jan. 13, 1997, at 1, 1.

213. *See id.*

214. *See* Scott Kilman & Susan Warren, *Old Rivals Fight for New Turf—Biotech Crops*, WALL ST. J., May 27, 1998, at B1. The first forty to forty-five percent of DeKalb sold to Monsanto went for approximately $150 million in 1996 following DeKalb's announcement of being granted a product patent on Bacillus thuringiensis corn. *See* Scott Kilman & Peter Frisch, *Monsanto Agrees to Buy Stake in DeKalb for Up to $158 Million*, WALL ST. J., Feb. 2, 1996, at B4.

215. Dan Miller, *Monsanto's Buying Binge*, PROGRESSIVE FARMER, July 1998, at 22, 22. *See also Monsanto to Buy Cargill Operation*, DES MOINES REG., June 30, 1998, at 8S (announcing Cargill's sale of "it's international seed operations in Central and Latin America, Europe, Asia and Africa to Monsanto Co. for $1.4 billion. . . . [Cargill still maintains its] U.S. and Canadian seed operations . . . [and its] Agricultural Merchants in the United Kingdom."); Scott Kilman, *Monsanto to Pay Cargill $1.4 Billion for Foreign Seed Business*, WALL ST. J., June 30, 1998, at A4.

216. *See* Miller, *supra* note 215, at 22.

217. *See id.*

218. *See* Kilman, *supra* note 215, at A4.

219. *Id.*

220. *Id.*

pharmaceutical biotech company.[221] This left Monsanto with an $8 billion bill for its ag-biotech purchases and no merger to help pay.[222] While Monsanto "intends to go through with its planned acquisitions,"[223] it must turn its immediate attention to survival in an aggressive marketplace with a strained balance sheet.[224] Monsanto is trying to maintain financial independence through several actions aimed at cutting costs and raising money, such as: selling select side businesses, cutting 1700 jobs and raising "more than $4.2 billion in stock, debt, and other securities."[225] The next year or two should prove to be important and exciting for Monsanto.[226]

While perhaps not as prolific a purchaser as Monsanto, DuPont has had its share of market positioning in the area of seed and ag-biotech related industries. DuPont announced in May 1998 "that it would sell up to 20% of its $22 billion Conoco subsidiary and plow the proceeds into its life-sciences businesses, which use biotechnology to develop genetically engineered crops, new drugs, and innovative methods for manufacturing chemicals."[227] DuPont spent $1.7 billion to form a joint venture with Pioneer Hi-Bred International, Inc., giving DuPont a twenty percent stake in Pioneer Hi-Bred.[228] DuPont's joint venture with Pioneer Hi-Bred, Optimum Quality Grains, was finalized less than one year after Pioneer Hi-Bred disclosed in a lawsuit against Monsanto that Pioneer had "rebuffed an

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221. *See American Home, Monsanto Scrap Merger: Disagreement Among Executives on Who Would Run Combined Giant Killed $33.66 Deal*, BOSTON GLOBE, Oct. 14, 1998, at C2.

222. *See* Scott Kilman & Thomas M. Burton, *A Big Gamble on Seeds, Drugs Get Riskier*, WALL ST. J., Oct. 14, 1998, at B1.

223. *Id.*

224. *See Merger Halted, Monsanto Refocuses on Survival*, J. COM., Oct. 20, 1998, at 11A.

225. Robert Steyer, *Monsanto Will Trim Work Force by 1,700—More Fallout from Failed Merger*, ST. LOUIS POST-DISPATCH, Jan. 22, 1999, at C8.

226. In early March 1999, it was disclosed that Monsanto and DuPont were discussing a possible merger. *See* Anne Fitzgerald, *DuPont, Monsanto Talk Merger*, DES MOINES REG., Mar. 4, 1999, at 10S. This disclosure led to speculation that DuPont would have to divest its 20% interest in Pioneer Hi-Bred International, Inc., leaving Pioneer vulnerable to a takeover. *See id.* Although DuPont and Pioneer announced an agreement to merge on Monday, March 15, 1999, a merger between Monsanto and DuPont may still be possible. *See* Anne Fitzgerald & Jennifer Dukes Lee, *Pioneer Deal: 'Powerhouse'*, DES MOINES REG., Mar. 16, 1999, at 1A; *DuPont's Big Deal*, PROGRESSIVE FARMER, Apr. 1999, at 6, 7.

227. Brownlee, *supra* note 211, at 48.

228. *See* Anne Fitzgerald, *Pioneer's Pursuit: Teamwork, Profits—Partnership Deal with DuPont Opens Research Avenues*, DES MOINES REG., Feb. 1, 1998, at B1; Kilman & Warren, *supra* note 214, at B1. On March 15, 1999, DuPont and Pioneer signed a merger agreement. *See* Fitzgerald & Dukes Lee, *supra* note 226, at 1A. "DuPont expects to pay about $7.7 billion in cash and stock to acquire the 80 percent of Pioneer that it does not own." *Id.* While the merger is an apparent change of thinking for Pioneer which has long protected its independence, "[t]he Pioneer-DuPont merger also signals a continuation of the consolidation in the seed industry in the United States." *Id.* It is hoped the deal will gain the approval of the shareholders and federal regulators sometime in the summer of 1999. *See id.*

overture that could have led to a multi-billion dollar acquisition offer from the chemical giant."[229] DuPont also agreed to buy the Ralston Purina Company's soy business for $1.5 billion in stock.[230] DuPont announced it intends to use the soy unit to "process higher-value soybeans from its joint venture with Pioneer."[231] DuPont appears to be focusing their growth strategy on "out-put traits, which are characteristics that make crops healthier, more productive, or tastier."[232]

Although the acquisitions of chemical giants such as Monsanto and DuPont are more visible than other companies, there is certainly plenty of activity going on in all sectors of the seed industry. For instance, "Pioneer entered a $16 million dollar deal with a genomics company called Human Genome Sciences, in Rockville, Maryland, in an effort to sequence all 80,000 genes that serve as the blueprint for corn."[233] Pioneer plans to use this blueprint to ultimately increase productivity in its crops whereby the farmers will make more money as well.[234] In addition, Garst Seed Co. announced in October 1998 that it would join forces with AgriBioTech Inc. to jointly purchase AgriPro Seeds Inc. "to speed their development of genetically enhanced crops."[235] The advancements in disease and insect resistance technologies have also spurred a great deal of mergers and acquisitions.[236]

Another interested party in the U.S. genetically modified seed industry is Novartis AG, a Swiss based pharmaceutical giant with a large plant biotechnology effort who is also a major seed producer.[237] However, Novartis AG has just 8.5% of the "U.S. corn-seed market and has been unwilling to buy U.S. seed companies at prices as high as 100 times earnings."[238] In fact, it is this unwillingness that caused Novartis to lose out in a bidding war with Monsanto over DeKalb.[239]

The seed industry is obviously in a position of flux at this time due to the flurry of acquisitions and mergers. A great deal of this activity is because of the research investment in plant breeding and biotechnology, and more importantly, the protection for the rights to those research efforts through intellectual property

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229. Scott Kilman, *Pioneer Hi-Bred Discloses It Rebuffed a Takeover Overture from Monsanto*, WALL ST. J., Apr. 17, 1997, at B5. *See also* George Anthan, *'Super' Seeds Promise Profits*, DES MOINES REG., Sept. 28, 1997, at 3FC.

230. *See* Kilman & Warren, *supra* note 214, at B1; *DuPont to Buy Ralston's Soy Business*, DES MOINES REG., Aug. 23, 1997, at 12B.

231. *Id.*; *DuPont To Buy Ralston's Soy Business*, DES MOINES REG., Aug. 23, 1997, at 12B.

232. Brownlee, *supra* note 211, at 48, 50.

233. *Id.*

234. *See id.* at 50.

235. *Garst Acquiring Corn, Soybean Business*, DES MOINES REG., Oct. 30, 1998, at 10S.

236. *See, e.g.*, Holmberg, *supra* note 207, at 30; Swiatek, *supra* note 208, at E01.

237. *See* Killman & Warren, *supra* note 214, at B1

238. *Id.*

239. *See id. See also* Brownlee, *supra* note 211, at 48.

protection. As seen in Table 2, it is the largest patent holders that are the most active in purchasing and collaborating with each other to position themselves for the future.[240] Even more important than the granting of a patent or a PVP certificate, however, may be the aggressive enforcement of these patents and PVP rights.

One method of enforcing patents is by ensuring that other parties wishing to use the patented technology agree to license the technology.[241] This method can both secure a royalty payment as well as avoid the expense of litigation over patent infringement.[242] For example, DuPont licensed certain Biolistic gene delivery technology to Agracetus.[243] Both companies had "patent positions that would block each other, and without the agreement [they] would have been constantly filing claims against each other's business."[244] DuPont also licensed this technology, along with others, to DeKalb in return for the "rights to utilize certain [ideas] of DeKalb's intellectual property relating to corn transformation and enhanced amino acid traits."[245]

Another method of enforcing intellectual property rights can be demonstrated by Monsanto's efforts to protect its rights in Roundup Ready® seeds.[246] While Monsanto is protecting its rights in Roundup Ready® technology through licensing agreements with other companies, such as Dow Chemical Co. and Pioneer Hi-Bred,[247] it is also investigating reports of seed piracy or abuses of "brown-bagging."[248] For example, Monsanto is protecting its research investments by first obtaining intellectual property rights to its technologies and then "leasing," rather than selling, them to customers.[249] This lease agreement obligates the purchasing farmer to a one time use and gives Monsanto the right to inspect the farmers fields for the next three years—in other words, the farmer cannot save the seeds to plant

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240. *See infra* Table 1.

241. *See* Ann Fitzgerald, *Seed Corn Companies Hurry to Patent Biotech Processes*, DES MOINES REG., Dec. 31, 1996, at 12S.

242. *See id.*

243. *See* Mary Powers, *Agracetus, DuPont Reach Agreement to End 'Gene Gun' Patent War*, BIOTECHNOLOGY NEWSWATCH, June 1, 1992, at 12.

244. *Id.*

245. *DuPont Licenses "Gene Gun" Technology to DeKalb Genetics*, BIOTECH PATENT NEWS, Jan. 1, 1996, at 1.

246. *See* Anne Fitzgerald, *Under Deal, Pioneer to Use Monsanto's Technology*, DES MOINES REG., June 29, 1998, at 10B.

247. *See, e.g., id.*; Steyer, *supra* note 225, at C8.

248. *See* Jim Webster, *Bio Engineers Cracking Down On Seed Piracy*, THE SCOTSMAN, Nov. 14, 1998, at 30; Bob Williams, *Seed-saving Farmers Forced to Alter Their Ways*, NEWS & OBSERVER, Nov. 8, 1998, at B1.

249. *See* Rick Weiss, *Monsanto's Gene Police Raise Alarm on Farmers' Rights and Rural Traditions*, WASH. POST, Feb. 3, 1999, at A01.

the next year's crop.[250] Monsanto enforces this agreement by hiring investigators to obtain samples from the farmers fields who bought Monsanto's genetically altered seeds one year, but who did not purchase it in the following year, and then testing that plant material for evidence that it contains the altered genetic makeup indicative of the Roundup Ready® genetics.[251] If the DNA analysis reveals the following year's crop contains the unique genes of the genetically engineered crop that was leased for only a one time use, Monsanto may then sue the farmer for "seed piracy."[252]

The attempt to enforce intellectual property rights among the major players in the seed industry—both property rights pertaining to traditional plant breeding products and those pertaining biotechnology related advancements in plant material—has also taken place in the courtroom.[253] For example, Pioneer is suing Monsanto, Cargill, DeKalb, and Asgrow in separate suits for allegedly wrongfully obtaining and using genetic material that belongs to Pioneer.[254]

Perhaps one of the most litigated technologies to date in the seed industry has been the right to use and market the plants or seeds altered to contain *Bacillus thuringiensis*, (Bt) genes.[255] The Bt genes produce proteins in plants that enable them to resist certain insects, most specifically the European Corn Borer.[256] In May 1995, Mycogen started the Bt patent wars when it filed suit against Monsanto "claiming Monsanto had infringed on Mycogen's rights to certain Bt technologies

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250. *See id.*

251. *See id.*

252. *See id.*

253. *See generally* Anne Fitzgerald, *Seed Corn Companies Hurry to Patent Biotech Processes*, DES MOINES REG., Dec. 31, 1996, at 12S (discussing early industry efforts to patent and enforce biotechnology rights); Anne Scott, *Bio Wars*, BUS. REC. (Des Moines), May 12, 1997, at 25 (detailing the explosion in patent infringement suits). *See also* Neil D. Hamilton, *Who Owns Dinner: Evolving Legal Mechanism for Ownership of Plant Genetic Resources*, 28 TULSA L.J. 587, 646-652 (1993) (analyzing the role of the legal system in industry disputes).

254. *See* James P. Miller, *Pioneer Hi-Bred Sues 3 Rivals over Seed Corn*, WALL ST. J., Oct. 30, 1998, at A4; Anne Fitzgerald, *Pioneer Files New Lawsuit Against Monsanto: The Company Accuses Monsanto of Misappropriating Germplasm*, DES MOINES REG., Feb. 6, 1999, at 12S. *See also* Pioneer Hi-Bred Int'l, Inc. v. Asgrow Seed Co., No. 4-98-CV-70577 (S.D. Iowa filed Oct. 28, 1998); Pioneer Hi-Bred Int'l, Inc. v. Cargill, Inc., No. 4-98-CV-70576 (S.D. Iowa filed Oct. 28, 1998); Pioneer Hi-Bred Int'l, Inc. v. DeKalb Genetics Corp., No. 4-98-CV-70578 (S.D. Iowa filed Oct. 28, 1998); Pioneer Hi-Bred Int'l, Inc. v. Monsanto Co., No. 4-99-CV-90063 (S.D. Iowa filed Feb 4. 1999).

255. *See* Russ Hoyle, *Another Salvo in the Plant Patent Wars*, NATURE BIOTECHNOLOGY, June 1996, at 680; *Corn Borer Protection Yields Bountiful Harvest of Patents*, WEST'S LEGAL NEWS, INTELLECTUAL PROPERTY: AGRICULTURAL PATENTS, Dec. 19, 1996, *available in* 1996 WL 725908.

256. *See* Hoyle, *supra* note 255, at 680; *Corn Borer Prevention Yields Bountiful Harvest of Patents*, *supra* note 252.

for pesticide-resistance and herbicide-resistance in cotton, corn, and potatoes."[257] While Mycogen lost the first battle to the process claims,[258] the war raged on.[259] In January 1996, DeKalb announced it had a patent for Bt in corn.[260] This announcement was followed by a March 1996 announcement that Monsanto was granted a patent for a Bt gene in corn[261] and that Monsanto was suing Mycogen and Ciba-Geigy for patent infringement.[262] The decision against Mycogen was reversed on appeal in early April 1996.[263] In late April 1996, "DeKalb filed suit against Mycogen, Pioneer-Hi Bred, which has a research agreement with Mycogen [and which has licensed Bt technology from Monsanto], and Ciba-Geigy."[264] In 1997, Pioneer and Monsanto filed suits against each other for breach of contract over issues involved in the licensing agreement between the two companies in regard to Bt technology.[265] On November 9, 1998, a Bt related patent owned by Novartis Seeds was held to be invalid—this was a patent Monsanto and DeKalb had been charged of infringing.[266] However, Novartis asserts they will appeal the verdict.[267] As certain Bt patents are resolved, others remain to be settled and yet others seem to appear. What does seem to be clear is that of critical importance to the seed companies is the ownership of, or the access to, the patent rights for those emerging biotechnology inventions and their applications to plant material.

Although a seed company may obtain a strong patent portfolio, it is not a guarantee of successful independence in the seed industry, however, it is good "insurance" for obtaining a high price for research efforts even in the event of a

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257. Hoyle, *supra* note 255, at 680. *See also* Mycogen v. Monsanto, No. 95-0653-J, 1995 U.S. Dist. LEXIS 20383, at *1 (S.D. Cal. 1995).

258. *See Mycogen*, 1995 U.S. Dist. LEXIS 20383, at *4.

259. *See, e.g., Corn Borer Protection Yields Bountiful Harvest of Patents*, *supra* note 251, at 680.

260. *See Corn Borer Prevention Yields Bountiful Harvest of Patents*, *supra* note 251; U.S. Patent No. 5,489,520 (granted Feb. 6, 1996).

261. *See* U.S. Patent No. 5,500,365 (granted Mar. 19, 1996).

262. *See* Hoyle, *supra* note 255, at 680. *See also* Monsanto Co. v. Agrigenetics, No. CV96-133 (D. Del. filed Mar 19, 1996).

263. *See id.*

264. *Id. See also* Anne Fitzgerald, *Pioneer to Utilize Monsanto Genetics*, DES MOINES REG., Nov. 23, 1995, at 12S; DeKalb Genetics Corp. v. Pioneer Hi-Bred Int'l, Inc., Nos. 96C50112 & 96C50113 (N.D. Ill. filed Apr. 30, 1996); DeKalb Genetics Corp. v. Ciba-Geigy Corp., No. 96C500114 (N.D. Ill. filed Apr. 30, 1996).

265. *See* Pioneer Hi-Bred Int'l, Inc. v. Monsanto Co., No. 97C199 (W.D. Wis. filed Mar. 27, 1997).

266. *See* Novartis v. DeKalb Genetics Corp., No. 97CV39 (D. Del. filed Jan. 21, 1997) (consolidated with Novartis v. Monsanto Co., No. 97CV40 (D. Del. filed Jan. 21, 1997)).

267. *See Patent Suits Dropped, Pending, and Won*, FOOD INGREDIENT NEWS, Dec. 1, 1998, *available in* 1998 WL 9867836; Shera Dalin, *Monsanto Wins Patent Suit Filed by Rival Novartis*, ST. LOUIS POST-DISPATCH, Nov. 10, 1998, at C6.

whole-company sale. For example, DeKalb Genetics has thirty-eight patents relating to corn and eleven relating to soybeans as seen in Table 2, and aggressively asserts their patent rights for Bt Corn by suing several competitors for patent infringement.[268] Yet, as discussed previously, on February 11, 1998, DeKalb Genetics announced it was putting itself up for sale and analysts correctly predicted Monsanto was the most likely buyer.[269] The situation that DeKalb was facing was that the seed industry had become a "research game" and although large, it was not large enough to keep up on its own.[270] DeKalb sold forty percent of its stock to Monsanto to keep its head above water, supporting the prediction that Monsanto would "buy the rest of the company to head off rivals."[271] For whatever reason DeKalb decided to sell, it is fairly safe to postulate that its large market share, its supply of seed genetics, and its large portfolio of patents played a critical role in the ultimate $2.3 billion selling price of the remaining sixty percent of its stock to Monsanto.[272]

Even when a multimillion dollar deal seems certain, a lawsuit over intellectual property rights can change things in a hurry. In September of 1998, Hoechst Schering AgrEvo GmbH (AgrEvo) agreed to purchase Cargill Hybrid Seeds North America for $650 million, and by February 1999, the deal was off.[273] In October 1998, Pioneer Hi-Bred International, Inc. filed a lawsuit against Cargill for misappropriation of its corn germplasm.[274] AgrEvo responded to this announcement by lowering its offer for Cargill to $350 million.[275] Cargill later conceded that "genetic material belonging to Pioneer was introduced into its hybrids without its knowledge by a former Pioneer employee [hired by Cargill]."[276] Pioneer Hi-Bred has also filed a lawsuit against this former employee.[277] The next day, Cargill announced the sale with AgrEvo was to be set aside until the lawsuit

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268. *See* Scott Kilman, *Pioneer Hi-Bred Sees Decision Soon on Corn Genetics Patent*, 14:41 DOW JONES NEWS SERVICE, Oct. 30, 1996, *available in* WESTLAW, WIRESPLUS Database.

269. *See* Toni Clarke, *DeKalb Up for Sale; Monsanto May Buy*, CHI. SUN-TIMES, Feb. 12, 1998, at 57.

270. *See* Marcia Berss, *Gone to Seed*, FORBES, Dec. 19, 1994, at 166, 166.

271. Clarke, *supra* note 269, at 57.

272. *See* Anne Fitzgerald, *Iowan Is Among Monsanto Leaders*, DES MOINES REG., Dec. 6, 1998, at 2S.

273. *See* Bloomberg.com: Quotes, *AgrEvo Drops Plan to Buy Cargill Unit, Citing Lawsuit (Update 1)* (visited Feb. 5, 1999) <http://quote.bloomberg.com>.

274. *See id. See also AgrEvo Reportedly Seeking Lower Price on Cargill Seed Unit: Patent Lawsuit Prompts German Venture to Reconsider Its $650 Million Purchase*, STAR-TRIB. (Minneapolis-St. Paul), Nov. 12, 1998, at 02D.

275. *See* Bloomberg.com: Quotes, *supra* note 273.

276. *Id.*

277. *See* Pioneer Hi-Bred Int'l, Inc. v. Ishler, No. 99CV-557 (E.D. Penn filed Feb. 3, 1999).

with Pioneer is resolved.[278] While Cargill has at least forty issued patents[279] and sales of over $100 million,[280] it was unable to sell its seed business as planned because of the impact of intellectual property within the seed industry.

V. CONCLUSION: IMPACT ON THE FUTURE

What will ensure growth in the market share for the future, or at the very least, the ability to maintain the share a company has carved out for itself? While it is always dangerous looking backward while running forward, perhaps a quick glance can help. When looking at the companies that survive and thrive, they seem to have some key elements in common: (1) a well developed and focused research program; (2) the ability to get the resulting products to market; (3) good intellectual property protection for the products they intend to market, such as the owning of patents or agreements with those that do; and (4) the willingness to see that this intellectual property protection is enforced.

As the climate becomes even more competitive and a few large companies continue to compete for market share, it seems clear that these companies will have to pay close attention to their intellectual property strategies. This approach can be analogized to the old "work smart" philosophy. Obtaining patent protection is not an inexpensive proposition for a company. Each United States utility patent can cost a company, with more than fifty employees, at least $8200 in fees to the U.S. Patent Office, from initial application through the end of the patent life.[281] Due to the expense of obtaining and maintaining patent protection, companies can make the best use of their research investment by targeting which of their key technologies or germplasms to patent, focus on getting as broad coverage as possible for each of these technologies and/or germplasms, and supplement with PVPA and trade secret protection where applicable. In addition, although the cost of litigation is high, the enforcement of these intellectual property rights is critical.

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278. *See* Bloomberg.com: Quotes, *supra* note 273.

279. *See infra* Table 2.

280. *See AgrEvo Agreement to Acquire Cargill Hybrid Set Aside*, ASSOCIATED PRESS NEWSWIRE, Feb. 4, 1999 <http://nasweb/mkintel/news/articles/0299/h020500435>.

281. *See* 37 C.F.R. §§ 1.9, 1.16-.22 (1998). This figure is based on a large entity status with the patent office and current patent application fee, issue fee, and all maintenance fees. This figure does not include any of the potential additional fees for additional claims, extension of time petitions, notice of appeals, other petitions, or any patent attorney or patent agent fees. The figure of "at least $8,200" will be much greater, perhaps double, upon addition of these additional costs. To obtain equivalent patent protection in at least ten other countries in addition to the United States patent can cost near $250,000. *See, e.g.*, John E. Dull, *Getting the Most Out of Intellectual Property Management Requires a New Alliance Between IP Counsel and Business Managers*, AM. LAW. CORP. COUNSEL MAG., Dec 1998, at 42, 42-43.

As the competition gets tighter, the patent and PVPA holder will have to send a strong message through enforcement of their intellectual property rights.

While having a strong intellectual property protection portfolio will not necessarily ensure an ever increasing market share, or even guarantee against sale or takeover, it can ensure that the successful research efforts of the seed company will be protected from others using the newly developed germplasm in their sales or research without compensating the developing company for those successful efforts. It will also likely ensure that if a seed company does find itself on the sale block, it can command a much higher price because of its intellectual property portfolio.