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Comment

*355 PLANT PATENT LAW: THE FEDERAL CIRCUIT SOWS THE SEED TO ALLOW AGRICULTURE TO GROW

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INTRODUCTION

Biotechnology [FN1] has taken America by storm, leading to many developments in numerous industries, including: pharmaceuticals; industrial chemical production; environmental protection; and agriculture. [FN2] Undoubtedly, most people agree that the production of improved human health care products such as drugs, vaccines, diagnostics, and therapeutics benefits society. [FN3] The efficiency of microorganisms (bacteria) benefits industry via mass production of chemicals that serve the consumer. [FN4] Further, genetically engineered microorganisms help break down toxic wastes and wastewater, which, in turn, protects the environment. [FN5]

Although the use of biotechnology obviously benefits society, the specific use of biotechnology in agriculture is more controversial. Scholars worry that intellectual property laws allow large corporations to profit from agricultural biotechnology (agribiotech) at the expense of farmers and ranchers. [FN6] Farmers and ranchers fret because the companies that develop new crops and animals seek to protect their financial interests, including investments in research and development. [FN7] This desire for patent protection is illustrated by the use of production contracts with farmers and ranchers, which state that the company owns the farmers' products and limits how the farmers can use the crops. [FN8] An obvious example of the protection sought is ***356** manifested in the following license printed on a tag affixed to a hybrid seed corn bag by Pioneer: [FN9]

> [T]he purchase of these seeds includes a limited license under patent(s) ... to produce a single corn crop in the United States. This license does not extend to the use of seed from such crop or the progeny thereof for propagation or seed multiplication. Furthermore, the use of such seed or the progeny thereof for propagation or seed multiplication or for production or development of a hybrid or different variety of seed is strictly prohibited. [FN10]

This license contradicts farmers' traditional practice of saving seed from one year to re-plant the next year and increases their operating costs. [FN11] A farmer will often save a portion of a crop to use for seed the next year. This limited license prohibits this practice with the licensed seed and forces the farmer to purchase new seed each year.

A company's control over the farmer exists because the company patents the seed or animal used by the agriculturist. Based on current patent laws, an agribiotech company unquestionably has the right to patent an animal. [FN12] The issue of whether plants are patentable under the general patent statutes recently was decided by the U.S. Court of Appeals for the Federal Circuit. In *Pioneer Hi-Bred International v. J.E.M. Ag Supply, Inc.*,

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[FN13] the U.S. Court of Appeals for the Federal Circuit held that seeds and seed-grown plants are patentable subject matter under the general patent statutes. [FN14] This comment explores the positive implications that the *Pioneer* decision will have on agriculture and society.

First, this comment examines the history of patent law as it relates to living organisms. Next, it discusses the relevant federal statutes interpreting the protection available to plant breeders through the Plant Protection Act (PPA), the Plant Variety Protection Act (PVPA), and the general patent statutes. Finally, this comment discusses the Federal Circuit Court of Appeals decision and its effects on agriculture in the future.

***357** BACKGROUND

History of Patenting Living Organisms

The history of patent law began when the founding fathers provided Congress with the authority, "[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." [FN15] Congress responded by passing the first Patent Act, which was signed into law by President George Washington on April 10, 1790. [FN16] Patents involving "living things" have been issued ever since. [FN17]

Over two centuries later, in a landmark patent law decision [FN18] the United States Supreme Court held that the patent laws enacted by Congress were broad enough to allow a man-made microorganism to be patented. In *Diamond v. Chakrabarty*, [FN19] the inventor sought to patent a genetically engineered bacterium. [FN20] The Supreme Court stated "the patentee has produced a new bacterium with markedly different characteristics from any found in nature and one having the potential for significant utility. His discovery is not nature's handiwork, but his own ...." [FN21] In *Chakrabarty*, the bacteria in question was engineered to break down crude oil, a characteristic not inherently present in the bacteria. [FN22] The Court opined that the patent laws were intended to be construed broadly and that limitations on patents should be subject to the legislative process, not the judgment of the courts. [FN23]

Patents are issued to organisms besides bacteria. [FN24] In *Ex parte Allen*, the Patent and Trademark Office Board of Patent Appeals and Interferences (Board of Appeals) stated that "polyploid oysters are non-naturally occurring manufactures or compositions of matter within the confines of patentable subject matter under 35 U.S.C. 101." [FN25] The Board of Appeals in *Allen* used *Chakrabarty* as controlling authority "that Congress intended statutory subject matter to 'include anything under the sun that is made by man.'" [FN26] ***358** Although the oysters in *Allen* were not granted a patent because the process used was "obvious," [FN27] the Patent and Trademark Office later issued a notice in the Federal Register stating, "[t]he Patent and Trademark Office now considers nonnaturally occurring non-human multicellular living organisms, including animals, to be patentable subject matter within the scope of 35 U.S.C. 101." [FN28] This announcement came days after the decision in *Allen*, reaffirming the ability of inventors to obtain patents on living organisms. The Board of Appeals limited patents on animals with respect to human beings because an "exclusive property right in a human being is prohibited by the Constitution." [FN29]

The first patent issued for an animal occurred in 1988 when the Patent and Trademark Office issued a patent for the Harvard Mouse. [FN30] The Harvard Mouse was a transgenic [FN31] mouse genetically engineered to

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make it more susceptible to cancer and, thus, a useful tool in cancer research. [FN32] Since the Harvard Mouse, patents have been issued on many biotechnology inventions, including: engineered DNA; tissue cultures; cell lines; plants; animals; and numerous therapeutic agents. [FN33] Thus, patents are allowed for genetically engineered living matter as long as "the living matter is a result of human intervention." [FN34]

History of Plant Patents

As discussed, patents are issued on many different organisms through the general patent statutes. [FN35] However, plants were excluded from intellectual property protection until the 1930's because plants were not considered patentable; they were thought to be "products of nature," not inventions. [FN36] Another obstacle to plant patentability was the difficulty in meeting the "written description requirement" for all patents. [FN37] General patent laws state that an inventor who makes or discovers "any new and useful process, machine, manufacture, or composition of matter" may obtain a patent for that ***359** invention. [FN38] The invention also must be novel, [FN39] non-obvious, [FN40] useful, and adequately disclosed. [FN41] Novelty means that the invention cannot be readily ascertainable from common knowledge. [FN42] Non-obviousness requires that the invention not be "obvious to one of ordinary skill in light of prior art." [FN43] Usefulness dictates that the invention is not frivolous, but has some practical utility. [FN44] Lastly, adequate disclosure requires that the manner of making and using the invention be disclosed to increase the body of public knowledge and to assure the invention will be available to the public when the patent expires. [FN45] Adequate disclosure is accomplished by a written description of the invention that details the claimed features of the invention. [FN46] For plants, the written description was considered unattainable because new varieties [FN47] of plants differ from previous varieties in only one characteristic, such as color or perfume. [FN48] Thus, differentiation in the written description was considered impossible. [FN49]

In 1930, Congress passed the Townsend-Purnell Plant Patent Act (PPA) to "afford agriculture, so far as practicable, the same opportunity to participate in the benefits of the patent system as has been given to industry." [FN50] In the PPA, Congress eliminated the two obstacles that prevented plants from being patented. First, Congress explained "that the work of the plant breeder 'in aid of nature' was [a] patentable invention," thus alleviating the product of nature doctrine. [FN51] Second, Congress lessened the written description requirement for plants by requiring that the plant patent description be "as complete as is reasonably possible." [FN52] The PPA gives plant patent holders "the right to exclude others from asexually reproducing the plant or selling or using the plant so reproduced." [FN53] However, PPA patent protection applies only to *asexually* [FN54] reproduced plants, [FN55] where the cloned plant ***360** retains the unique characteristic desired by the plant breeder. The PPA allows the plant breeder to patent a plant with a unique characteristic that can be physiological or anatomical. [FN56] Therefore, the patentee protects one unique characteristic of a plant that can be cloned by grafts, buds, or cuttings, resulting in a new plant with the same characteristic. [FN57] Under the PPA, the patent protection on the plant continues on all asexually reproduced clones of the parent plant for twenty years from the date the patent application is filed, as long as the unique characteristic remains with the plant. [FN58]

Although the PPA provides patent protection for asexually reproduced plants, it fails to provide patent protection for the developers of new seeds for agriculture that are produced sexually. [FN59] The Federal Circuit used statutory language, legislative history, case law, and views of commentators to determine that the scope of a plant patent under the PPA is for a single plant and the asexual progeny thereof. [FN60] Congress passed the Plant Variety Protection Act (PVPA) of 1970 to help crop breeders get protection for seeds. [FN61] The PVPA

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provides patent-like protection, in the form of a certificate issued by the Department of Agriculture, to sexually reproduced plants that is similar to the protection afforded asexually produced plants under the PPA. [FN62] The protection provided by the PVPA differs from that afforded under the PPA because the PVPA is specific for plant varieties that are *sexually* reproduced or tuber propagated, [FN63] while the PPA is specific for asexually reproduced plants with a unique characteristic. [FN64] Congress recognized that only asexually reproducing plants were protectable under the PPA, so it passed the PVPA to protect agricultural crops that are grown by seed. [FN65] Thus, under the PPA a plant breeder can patent an ornamental plant that was reproduced asexually. However, agricultural crops grown by seed cannot be protected under the PPA because they are reproduced sexually and not within the scope of the PPA. Therefore, the agriculture industry needed the PVPA to protect seeds for sexually reproduced crops. The ***361** PVPA allows a plant breeder to protect seed crops with a certificate of plant variety protection from the Secretary of Agriculture, granting the breeder the right "to exclude others from selling the variety, or offering it for sale, or reproducing it" for twenty years from the date the certificate is issued [FN66] if the new variety is new, distinct, uniform, and stable. [FN67] Because patent protection was thought unattainable for seeds under the general patent laws, the requirements for protection under the PVPA are easier to meet than under the general patent statute. The PPA and the PVPA both afford plant breeders twenty years of protection, and the significant difference between the PPA and the PVPA is the type of plant protected.

The Controversy Over Plant Patents

The protection afforded by the general patent statutes creates incentives for inventors and companies to research and develop new products to benefit mankind by allowing them to make a profit in the twenty year period allowed for inventors to market their invention free from competition. [FN68] The patent system is used for inventions such as the cotton gin, telephone, electric lamp, modern medicines, and space machines. [FN69] Although patent laws undoubtedly are responsible for providing scientists and inventors with incentives to produce new products, the use of biotechnology in agriculture spawns debate because of the potential effects on farmers and ranchers. Farmers and ranchers fear that allowing agribiotech companies patent protection will force the agriculturalists to pay royalties for the purchase of genetically altered plants and animals. [FN70] This obligation to pay royalties and increased costs likely will reduce the annual net profits of farmers and ranchers. [FN71] Farmers fear that the increased costs of seed coupled with low crop prices will drive many of them out of business.

The agribiotech industry has grown large worldwide, producing revenues of six hundred seventy million dollars in 1997. [FN72] Projected revenue is more than five billion dollars by the year 2002. [FN73] Numerous moral and ethical challenges to the agribiotech industry exist, but the legal challenges stem from licensing agreements and intellectual property protection that accompany patented seeds. [FN74] Patents for modified plants rank second only to software***362** patents for the number of legal challenges filed. [FN75] These licensing agreements from agribiotech companies are feared to lead to the "industrialization" of farming by requiring farmers to use limited licenses with seed purchases and to encourage the use of contract production. [FN76] For example, Monsanto [FN77] does not simply sell seed to farmers, it also requires farmers to buy licenses to use the company's seed technology. [FN78] To use Monsanto's Roundup Ready soy beans, the farmer must agree to use the seed only once. [FN79] Further, Pioneer [FN80] places tags on its bags of corn that limit the farmer to planting the seed for only one year. [FN81] Such licenses often forbid the farmer from the traditional practice of saving seed to replant the following year. [FN82] Many farmers claim they cannot afford to purchase more expensive bioengineered seed each year. [FN83] On the contrary, agribiotech companies claim the licenses are necessary to protect their investments in research and development [FN84] and have instituted lawsuits against

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farmers who save seed for future planting. [FN85]

ANALYSIS

The Plant Patent Challenge

The patents issued under the general patent statutes for crops to agribiotech companies recently were challenged. Pioneer Hi-Bred (Pioneer), the world's largest seed corn producer, brought a patent infringement action against J.E.M. Ag Supply Inc., Farm Advantage Inc., and others (Defendants). [FN86] Pioneer holds seventeen plant patents under the general patent statutes for sexually reproducing corn and alleged that the Defendants infringed on its patents "by making, using, and selling, or offering for sale Pioneer seed corn, although none of the Defendants is a party to any dealer contract with Pioneer." [FN87] Pioneer sold these products "under a limited label license that did not allow for resale, but solely for use 'to produce grain ***363** and/or forage."' [FN88] The Defendants claimed that Pioneer's patents were invalid. [FN89] The Defendants maintained that sexually reproducing plants are not patentable under the general patent laws, but, rather, protection for sexually reproducing plants is exclusively covered by the PVPA. [FN90]

Part A: Pioneer's Arguments

Pioneer argued that its patents are valid under the general patent laws, as over one thousand utility patents relating to plants have been issued since the Board of Appeals decision in *Ex Parte Hibberd*. [FN91] Pioneer contended that, since the *Hibberd* decision, patents for sexually reproducing plants are valid because "technological advances have been made to allow plant inventors to satisfy the legal requirement for statutory subject matter," not because of any change to the patent laws. [FN92] Hence, Pioneer argued that new developments in biotechnology and plant breeding bypassed the outdated notion that plants were not patentable because they were "products of nature." In *Ex parte Hibberd*, the Board of Appeals construed the *Chakrabarty* [FN93] court's "analysis of the legislative history of the plant specific Acts ... [to mean] that the legislative intent of these acts was to extend patent protection to plant breeders who were stymied by the two noted obstacles." [FN94] The Board of Appeals used statutory construction to find that the PPA, PVPA, and general patent statutes all must be given full effect. [FN95] The Board of Appeals said that the PPA and PVPA were enacted by Congress to enable plant breeders to obtain patent protection because of the two obstacles (the product of nature doctrine and the written description requirement) [FN96] of plant patentability. Thus, the Board of Appeals opined that plants are patentable under the general patent laws and the plant specific acts, the PPA, and PVPA. [FN97]

Pioneer also contended "that because Congress has not clearly and expressly excluded sexually reproduced plants from Section 101, there is no reason to read into Congress's past actions an intent to modify the plain meaning of the [[general patent] statute." [FN98] Pioneer's argument against an implied repeal was supported by the United States Supreme Court's ruling that "[a] cardinal principle of construction [is] that repeals by implication ***364** are not favored. When there are two acts upon the same subject, the rule is to give effect to both if possible." [FN99]

Part B: Defendants' Arguments

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The Defendants argued that "sexually reproducing plants ... are not patentable under 35 U.S.C. § 101 of the Patent and Trademark Act, but are instead covered exclusively by the Plant Variety Protection Act ...." [FN100] The Defendants relied on a House Report issued prior to passage of the PVPA that said, "[n]o protection is available to those varieties of plants which reproduce sexually, that is, generally by seeds. Thus, patent protection is not available with respect to new varieties of most of the economically important agricultural crops, such as cotton or soybeans." [FN101] The Defendants argued "that prior to 1970 sexually reproducing plants were not patentable subject matter and that Congress found it inadvisable to extend Section 101 to include sexually reproducing plants; instead, Congress sought to provide protection under the PVPA." [FN102]

The Defendants' argument has merit because Congress engrafted the PPA (providing protection to asexually reproduced plants) into the general patent laws in 1952. [FN103] The PPA provides: "[w]hoever invents or discovers and asexually reproduces any distinct and new variety of plant ... may obtain a patent therefor, subject to the conditions and requirements of this title [the general patent laws]." [FN104] As interpreted by the United States Court of Appeals for the Federal Circuit, section 161 of the PPA was integrated into the basic patent laws requiring all provisions of the general patent statute in Title 35 U.S.C. to apply to asexually reproducing plants. [FN105] However, the PVPA was *not* integrated into the general patent statute and lacks language allowing the breeders to obtain patents. [FN106] Thus, the Defendants claimed that patent protection is available to asexually reproducing plants under the PPA and that no patent protection existed for sexually reproducing plants until passage of the PVPA. The Defendants claimed that because the PVPA specifically says: "The breeder ... shall be entitled to variety protection for the variety," [FN107] and the application for variety protection shall be made to the Secretary of Agriculture, [FN108] the PVPA is not integrated into the general patent statutes. Thus, the Defendants argued that two different types of protection exist: One for asexually reproducing plants where a breeder can ***365** apply for a plant patent under the PPA and one for sexually reproducing plants where the breeder can apply for a certificate of protection under the PVPA.

Part C: The Federal Circuit's Decision

The Federal Circuit Court of Appeals affirmed the district court's ruling that seeds and seed-grown plants are patentable subject matter under the general patent statutes. [FN109] The *Pioneer* case came to the Federal Circuit on the Defendants' interlocutory appeal. [FN110] An interlocutory appeal on a controlling issue of law under patent law or plant variety protection law can be heard by the Federal Circuit, if the court agrees to hear the case. [FN111] If the Federal Circuit decides to hear such an appeal, the court has exclusive jurisdiction. [FN112] In *Pioneer*, the Defendants appealed the U.S. District Court for Northern District of Iowa's denial of summary judgment for Defendants, arguing that the PVPA is the exclusive mechanism for patent-like protection for sexually reproducing plants. [FN113]

The Federal Circuit first articulated that the Patent and Trademark Office has been granting patents on plants for at least fifteen years. [FN114] The Federal Circuit affirmed the district court in reaching the same conclusion as the Board of Patent Appeals in *Ex parte Hibberd*, where the Board of Patent Appeals rejected the argument that the PPA and the PVPA are the exclusive forms of plant protection. [FN115] In *Hibberd*, the Board of Patent Appeals said the general patent laws "include ... man-made life forms, including plant life." [FN116] The Board's reasoning was that both the plant-specific Acts and the general patent statutes are to be given effect unless there is a repugnancy or conflict where the statutes cannot co-exist. [FN117] The Board articulated that Congress enacted the plant-specific acts to enable plant breeders to obtain "patent" protection, but also said that protection for plants could exist under the general patent laws. [FN118] The dual protection that exists for plants

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resulted from pragmatic legislation. The plant-specific acts were passed by Congress because it believed "patent" protection was not available for plants when the acts were passed. However, improved plant breeding techniques and the *Chakrabarty* decision expanded the scope of general patent law protection to plants.

***366** The Federal Circuit affirmed the district court and came to the same conclusion as the *Hibberd* Board that plant patents under the general patent statutes are valid. [FN119] The district court first looked to the language of the statutes to determine whether plants are excluded under the general patent laws. The district court reviewed the provisions of the PPA and PVPA and concluded "that neither the PPA [n]or the PVPA expressly excludes any plant subject matter from protection under 35 U.S.C. Section 101 of the general patent law." [FN120]

The district court next examined the legislative histories of the PPA and PVPA, which the Defendants relied upon in their argument. [FN121] The Defendants' argument against patent protection for sexually reproducing plants was persuasive because the PVPA legislative history says, "[n]o protection is available to those varieties of plants which reproduce sexually." [FN122] Though the Defendants' argument that no protection for sexually reproducing plants was persuasive, the Defendants failed to point out that the PVPA legislative history did not say why no protection existed. [FN123] The "written description" and "product of nature" obstacles to patenting plants existed prior to 1930. [FN124] Thus, the PPA and PVPA were enacted to bypass these noted obstacles. The Defendants also relied on the purpose of the PVPA, which stated "[u]nder patent law, protection is presently limited to those varieties of plants which reproduce asexually ...." [FN125] In reviewing the legislative histories, the district court concluded that "there is nothing in those legislative histories from which one could conclude that Congress intended to remove from the already in place protection of Section 101 any subject matter already within the scope of that section." [FN126] Rather, the district court relied on the U.S. Supreme Court's analysis of the legislative histories of the PPA and the PVPA in *Chakrabarty*. [FN127] The Supreme Court said "[i]n enacting the Plant Patent Act, Congress addressed both of the concerns," when referring to the "written description" and "product of nature" obstacles. [FN128] The district court articulated that "[t]he Supreme Court's analysis makes it clear that the legislative intent of these [[plant specific] acts was to ***367** extend patent protection to plant breeders ..." instead of limiting the scope of protection available under the general patent laws. [FN129]

The Defendants next argued for an implicit narrowing of the general patent statutes because the PVPA and the general patent laws conflict. [FN130] In essence, the Defendants argued that the patentability of plants under the general patent laws was repealed by Congress when it enacted the PVPA. [FN131] The Defendants asserted that the following conflicts prevented plants from patentability: the PVPA research and farmer exemptions conflict with the general patent law because no exemptions exist in the general patent law; the PVPA spells out infringement in great detail and has a compulsory licensing provision while no such provisions exist under the general patent statutes; and the PVPA does not allow limited label licenses while the general patent laws allow such labels. [FN132] The district court said that the differences in protection between the general patent laws and the PVPA "fall far short of what could be required to find an irreconcilable conflict that would mandate a partial repeal of Section 101 by implication." [FN133] The district court relied on the "cardinal rule" that repeals by implication are not favored. [FN134] This principle was enunciated by the Supreme Court: "When there are two acts upon the same subject, the rule is to give effect to both if possible." [FN135] Therefore, the Federal Circuit affirmed the district court's reasoning that "[n]either Congress nor the courts excluded new plant varieties from the patent statute; the enactment of the PVPA did not effect such an exclusion." [FN136] As the Defendants pointed out in their argument that the PVPA and general patent statutes conflict, the two types of protection are different, not conflicting.

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On appeal, the Defendants also objected because Pioneer obtained patents under the general patent laws *and* certificates under the PVPA for the same plants. [FN137] The Federal Circuit agreed with the district court opining "that the asserted conflict is simply the difference in the rights and obligations imposed by the two statutes." [FN138] The Federal Circuit also confirmed that more than one statute can apply to a legal or property interest, such as an ornamental design being protected under both design patent law and copyright. [FN139] The Federal Circuit affirmed the district court's reasoning "that the availability of one form of statutory protection does not preclude ***368** the availability of protection under another form." [FN140] Thus, the presence of more than one statute that exists to protect a plant invention is "simply the difference in the rights and obligations imposed by the two statutes." [FN141]

In discussing the policy underlying the patent system, the Federal Circuit discussed the two noted obstacles to patent protection for plants under *Chakrabarty*; [FN142] the "product of nature" and "written description" requirements that prevented plants from being patented. [FN143] The Federal Circuit concluded that "mankind is learning how to modify plants in ways unknown to nature," so the "product of nature" doctrine is no longer an obstacle. [FN144] The "written description" obstacle for plants is not an obstacle because of the "rules authorizing the deposit of new species in publicly available depositories, and advances in botanical understanding and analysis." [FN145] Thus, in affirming the ability of plant breeders to patent seeds and seed-grown plants, the Federal Circuit articulated how advancements in science fall under the patent system and how "its application to all areas of technology-based commerce" will continue to promote progress in science. [FN146]

The Federal Circuit concluded that patentable subject matter under the general patent statutes includes seeds and seed-grown plants. [FN147] However, the Federal Circuit's holding does not answer all the Defendants' allegations in the complaint. The Defendants also contended that the specifications of the Plaintiff's patents are not enabling; that the written description was not satisfied by the deposit of the seed; and that the validity of the patents was in issue. [FN148] The Federal Circuit did not discuss these issues as they were not before the court, and these issues will be decided by the Northern District of Iowa, which granted a stay on the proceedings pending disposition of the interlocutory appeal. [FN149]

Effects on Farmers

Now that plant patentability is confirmed, seed users must be aware of the protection on seed they plant. The farmer should be aware of whether the seed he is planting is patented, protected by a certificate under the ***369** PVPA, or not protected at all. Patent infringement occurs when someone without authority makes, uses, offers to sell, or sells any patented invention, here seed, during the term of the patent. [FN150] A violation of the license could occur if a farmer were to resell the patented seed or if the farmer violated the license attached to the seed. For example, the patented seed in *Pioneer* has a limited label license that allows use to produce grain and/or forage, but does not allow for resale. [FN151] Other licenses on patented seed require the farmer to sign a contract in which the farmer agrees to use the seeds for only one season. [FN152]

Patent infringement is a statutory wrong governed by federal law. [FN153] Infringement is established by the following elements: 1) the patent exists; 2) the plaintiff has title to such patent; and 3) the defendant violated 35 U.S.C. § 271. [FN154] Defenses to patent infringement include: 1) the patent is invalid, or 2) any other defenses listed in 35 U.S.C. § 282. [FN155] An infringer can be liable to the patent holder for damages adequate to compensate for infringement. [FN156] Infringement damages for the patent holder against the infringer "in no event will be less than a reasonable royalty" and includes interest and costs. [FN157] Treble damages also can

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be imposed if willful infringement or bad faith is found. [FN158]

A certificate of protection issued under the PVPA from the Department of Agriculture is another form of protection for seed producers. [FN159] A PVPA certificate gives the plant breeder rights similar to patent rights, including the right to exclude others from selling the variety. [FN160] Protection under the PVPA is less desirable for plant breeders because two exemptions exist under the PVPA. Most plant breeders seek patent protection because the exemptions are not present under patent law. The farmer exemption allows a farmer to save seed and replant the crop the next year with the same seed. [FN161] In the past, the exemption also allowed a farmer to sell the seed that he saved, but the amount the farmer sold could not exceed the amount he saved to replant his own acreage. [FN162] However, Congress amended the PVPA in 1994 to eliminate the exemption from infringement liability for seed sold from one farmer to another if the seed is sold for reproductive purposes. [FN163] ***370** The second exemption is the research, or breeder's, exemption, which allows anyone to use the protected seed in a laboratory or field breeding research to develop new lines. [FN164] Plant breeders dislike this exemption because it allows others to use the protected seed in their research. The exemption permits other researchers to develop new breeds using the protected seed and exploit the investments made by the certificate holder. Thus, a company can take advantage of investments in money and research by the original inventor and reap financial rewards without the inventor's consent.

Although the general patent laws provide plant breeders with more protection than PVPA certificates, PVPA protection still will have benefits for plant breeders. Under patent law, once a technology matures or becomes better known, novelty may be lost because the invention would be readily ascertainable from common knowledge. [FN165] Therefore, once a biotechnological technique used in plant breeding loses novelty, the seed no longer will be patentable. PVPA protection would still be available on seeds that lack the novelty requirement because PVPA protection is available for new varieties that are new, distinct, uniform, and stable. [FN166] Therefore, plant breeders will be able to obtain PVPA protection on seeds that are not patentable.

Pros and Cons of Plant Patents

The Federal Circuit's decision in *Pioneer* affirms the ability of plant breeders to patent their inventions. Allowing plant patents will continue to allow plant breeders to develop newer and better varieties of crops to support the earth's growing population. The development of crops began around 9500 B.C. and has changed continually. [FN167] Today, gene-splicing techniques are combined with traditional methods of crop breeding, such as hybridization and selective breeding and are used to develop new crops. [FN168] These new genetic techniques expedite the process of producing better crops.

Supporters of genetically engineered crops claim the new crops increase crop yields, reduce the need for pesticide use, and promote no-till farming, all of which benefit the farmer economically. [FN169] For example, in a 1997 survey of the corn belt, Bt [FN170] corn users produced an average of 13.5 ***371** more bushels of corn more per acre than non-Bt corn users. [FN171] Also, Roundup Ready soybeans [FN172] cost twelve dollars less per acre for weed control and lead to 4.5 more bushels of soybeans per acre. [FN173] Therefore, when the patented crops perform as advertised, the farmer spends more on seed, but saves money in pesticide use and gains revenue from increased yield.

In addition to higher yields, nutritionally enhanced crops may help people obtain more nutritious foods. This could be especially beneficial for use in the Third World. For example, researchers currently are working to genetically modify rice to add vitamin A. [FN174] The genetically modified rice potentially could help the two

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hundred and fifty million children in South-east Asia at risk for eye disease due to lack of vitamin A. [FN175]

However, transgenic crops also have their skeptics. Ed Oplinger, Ph.D. at the University of Wisconsin, conducted performance trials on Roundup Ready soybeans and concluded that, on average, the transgenic soybeans yielded an average of four percent lower than conventional soybeans. [FN176] Other critics argue that the use of transgenic crops, such as Bt crops, will lead to insects that become resistant to insecticides, similar to the development of antibiotic resistant bacteria. [FN177]

The loss of biodiversity [FN178] also is a source of debate regarding transgenic crops. Since 1900, approximately seventy-five percent of the genetic diversity of agricultural crops has been lost because farmers plant several fields with one variety of seed instead of using numerous varieties. [FN179] Rather than food supply stabilization through transgenic crops, opponents fear the loss of crop biodiversity will subject the food supply to mass failure due to pests or diseases that could devastate the engineered crops not designed for such challenges. [FN180]

***372** Environmental and consumer groups also question whether potential risks to the environment and human health have been adequately studied. [FN181] Environmentalists fear that genetically engineered crops could lead to an accidental release of genes into the environment that could destroy the delicate balance in an ecosystem. [FN182] Some consumers worry that unforeseen dangers, such as unknown food allergies, [FN183] lurk in genetically engineered crops.

While these concerns are well-founded, many are unsubstantiated. Today, an estimated sixty percent of all processed foods contain at least one genetically engineered component. [FN184] Also, genetically engineered foods are subjected to the same regulatory reviews that are applied to all new food products. [FN185] To date, no one has detected a health problem caused by a genetically engineered food; potential dangers are eliminated in the review process. [FN186]

The controversies surrounding genetically engineered foods are issues that must be addressed by Congress, not the courts. As the U.S. Supreme Court noted in *Chakrabarty*, "[t]he legislative process, ... is best equipped to weigh the competing economic, social, and scientific considerations involved, and to determine whether living organisms produced by genetic engineering should receive patent protection." [FN187] Congress already is dealing with these issues. A currently pending amendment to the Federal Food, Drug, and Cosmetic Act would require that genetically engineered material be labeled accordingly for consumer benefit and knowledge. [FN188] Therefore, the Federal Circuit was correct in affirming the district court in allowing plants to be patented under the general patent statutes.

CONCLUSION

The Federal Circuit followed past precedent in affirming the district court in the *Pioneer* case and allowing the general patent laws to include seeds and seed-grown plants. [FN189] Plant patents under the general patent laws have been allowed since 1980 [FN190] when the U.S. Supreme Court decided the landmark case patent law of *Chakrabarty*. The *Chakrabarty* Court held that "[a] live, human-made micro-organism is patentable subject matter" and ***373** said the patent laws should "include anything under the sun that is made by man." [FN191] The Board of Patent Appeals has used the *Chakrabarty* decision's broad language to conclude that animals, engineered DNA, tissue cultures, cell lines, and numerous therapeutic agents are all patentable. [FN192]

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The Federal Circuit's decision in *Pioneer* will give plant breeders the patent protection needed to foster growth of the agricultural industry. The patent protection will allow plant breeders to develop new plants capable of revolutionizing agriculture by inventing more efficient and healthier crops. Today's genetically engineered foods are safe for consumers, and through continued regulation by the EPA, USDA, and FDA, tomorrow's genetically engineered foods will be healthy and safe for consumption. [FN193]

[FN1]. Biotechnology is defined as “direct manipulation of genetic material in animals, plants, and microorganisms to produce new types of organisms or improve existing life forms.” MODERN DICTIONARY FOR THE LEGAL PROFESSION (2nd ed. 1996).

[FN2]. *See* MICHAEL A. EPSTEIN, MODERN INTELLECTUAL PROPERTY, Ch.11, I (2nd ed. 1992).

[FN3]. *Id.* Some examples include the production of human insulin by bacteria for people suffering from diabetes and the production of drugs for the treatment of heart attacks. *See also* Carrie F. Walter, Note, *Beyond the Harvard Mouse: Current Patent Practice and the Necessity of Clear Guidelines in Biotechnology Patent Law*, 73 IND. L.J. 1025, 1032 (1998).

[FN4]. EPSTEIN, *supra* note 2. Biotechnology also is used in the production of foodstuffs including beer, wine, bread, and yogurt. *Id.*

[FN5]. *Id. See also infra*, notes 18-23 and accompanying text. The first patented man-made organism was a bacteria capable of breaking down crude oil. Diamond v. Chakrabarty, 447 U.S. 303 (1980).

[FN6]. Neil D. Hamilton, *Reaping What We Have Sown: Public Policy Consequences of Agricultural Industrialization And The Legal Implications Of A Changing Production System*, 45 DRAKE L. REV. 289, 296 (1997).

[FN7]. *Id.* at 295.

[FN8]. *Id.* at 296.

[FN9]. Pioneer is one of the largest seed companies in the United States. Pioneer Hi-Bred Int'l Inc., v. J.E.M. Ag Supply, Inc., 33 F. Supp.2d 794, 795 (N.D. Iowa, 1999).

[FN10]. *CAFC to Decide if Biotech Plant Patents are Legal*, BIOTECH PATENT NEWS, March 1, 1999, *available in* 1999 WL 12979097.

[FN11]. Peter Downs, *Bad Seed*, The Progressive, February 1, 1999, Prgsve 3638, *available in* Westlaw 1999 WL 3680377.

[FN12]. STEVEN Z. SZCZEPANSKI, UPDATED BY MICHAEL A. EPSTEIN, ECKSTROM'S LICENSING IN FOREIGN AND DOMESTIC OPERATIONS, Ch.13, § 13.06 (1999).

[FN13]. Pioneer Hi-Bred Int'l, Inc., v. J.E.M. Ag Supply Inc., 200 F.3d 1374 (Fed. Cir. 2000).

[FN14]. *Id.* at 1378.

[FN15]. U.S. CONST. art. 1, § 8, cl. 8.

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[FN16]. Proclamation No. 6013, 54 Fed. Reg. 34,125 (1989), *available in* 1989 WL 330690.

[FN17]. SZCZEPANSKI, *supra* note 12. For example, Louis Pasteur obtained a patent for beer fermentation in 1873. *Id.*

[FN18]. Diamond v. Chakrabarty, 447 U.S. 303 (1980).

[FN19]. *Id.*

[FN20]. *Id.*

[FN21]. *Id.* at 310.

[FN22]. *Id.*

[FN23]. *Id.* at 314. The Supreme Court also noted that when the Patent Laws were recodified in 1952, Committee Reports indicated that the statutory subject matter was "to include anything under the sun that is made by man." *Id.* at 309.

[FN24]. SZCZEPANSKI, *supra* note 12.

[FN25]. *Ex parte* Allen, 2 U.S.P.Q.2d 1425, 1427 (Bd. Pat. App. & Interf. 1987). In *Allen*, the induction of polyploid oysters (oysters with more than the usual number of chromosomes) was a way to increase growth of cultured oysters. *Id.* at 1428.

[FN26]. *Id.* at 1427.

[FN27]. *Id.* The Board of Appeals held that because experts in the art of inducing polyploidy in oysters already recommended that cultured oysters could be made polyploid, the process claimed in *Allen* was "too obvious" and not patentable. *Id.* at 1428. *See infra* note 43 and accompanying text.

[FN28]. Animal Legal Defense Fund v. Quiqq, 932 F.2d 920, 923 (Fed. Cir. 1991), *citing* 1077 Off. Gaz. Pat. Office 24 (April 21, 1987).

[FN29]. *Id.*

[FN30]. Carrie F. Walter, Note, *Beyond the Harvard Mouse: Current Patent Practice and the Necessity of Clear Guidelines in Biotechnology Patent Law*, 73 Ind. L.J. 1025 (1998).

[FN31]. A transgenic organism is an organism that has received DNA, or a gene from a different organism. *Id.* at 1050.

[FN32]. MICHAEL A. EPSTEIN, MODERN INTELLECTUAL PROPERTY, SECOND EDITION, Ch.11, II, A (1998).

[FN33]. *Id.*

[FN34]. SZCZEPANSKI, *supra* note 12. *See also* 60 AM. JUR. 2D Patents § 76 (1997).

[FN35]. 35 U.S.C. §§ 101-112 (1994).

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[FN36]. Diamond v. Chakrabarty, 447 U.S. 303, 311 (1980).

[FN37]. *Id.*

[FN38]. 35 U.S.C. § 101 (1994).

[FN39]. 35 U.S.C. § 102 (1994).

[FN40]. 35 U.S.C. § 103 (1994).

[FN41]. 35 U.S.C. § 112 (1994).

[FN42]. EPSTEIN, *supra* note 32.

[FN43]. *Id.*

[FN44]. *Id.*

[FN45]. *Id.*

[FN46]. *Id.*

[FN47]. Variety means a plant grouping that can be "distinguished from any other plant grouping by the expression of at least one characteristic and considered as a unit with regard to the suitability of the plant grouping for being propagated unchanged." 7 U.S.C. § 2401(a)(9) (1994).

[FN48]. Diamond v. Chakrabarty, 447 U.S. 303, 312 (1980).

[FN49]. *Id.*

[FN50]. Imazio Nursery, Inc. v. Dania Greenhouses, 69 F. 3d 1560, 1563 (Fed. Cir. 1995), *quoting* S. REP. NO. 315, at 3 (1930).

[FN51]. *Chakrabarty*, 447 U.S. at 312, *quoting* S. REP. NO. 315, at 6-8 (1930) and H.R. REP. NO. 1129, at 7-9 (1930). The product of nature doctrine stands for the proposition that patents only can be issued for inventions stemming from man's ingenuity, not for something existing naturally occurring in nature. *Id.* at 311.

[FN52]. 35 U.S.C. § 162 (1994).

[FN53]. 35 U.S.C. § 163 (1994).

[FN54]. Asexually reproduced plants are "clones" of the parent plant and genetically identical to the parent. The clones are produced without seeds. *See Imazio Nursery, Inc.*, 69 F.3d at 1568.

[FN55]. *Imazio Nursery, Inc.*, 69 F.3d at 1566.

[FN56]. PETER D. ROSENBERG, PATENT LAW FUNDAMENTALS § 6.01 (2d ed. 1999). Physiological characteristics include ease of reproduction, immunity to disease, or resistance to cold while anatomical characteristics include size, shape, color, or absence of seed. *Id.*

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[FN57]. A graft, bud, or cutting comes from the unique plant and is able to regenerate the unique plant, thus creating a genetically identical clone retaining the unique characteristic. *See* 35 U.S.C. § 161 (1994).

[FN58]. 35 U.S.C. § 271 (1994).

[FN59]. In *Imazio Nursery*, the Court of Appeals for the Federal Circuit said that the PPA only affords protection to asexually reproduced plants and not seeds. *Imazio Nursery, Inc.*, 69 F. 3d at 1569.

[FN60]. *Id.* at 1568.

[FN61]. 7 U.S.C. § 2321 et seq. (1994).

[FN62]. Asgrow Seed Company v. Winterboer, 513 U.S. 179, 181 (1995).

[FN63]. 7 U.S.C. § 2402 (1994).

[FN64]. 35 U.S.C. § 161 (1994).

[FN65]. H.R. REP. NO. 91-1605 (1970), *reprinted in* 1970 U.S.C.C.A.N. 5082, *available in* 1970 WL 5934.

[FN66]. 7 U.S.C. § 2483 (1994).

[FN67]. 7 U.S.C. § 2402 (1994).

[FN68]. 35 U.S.C. § 101 (1994).

[FN69]. Proclamation No. 4814, 46 Fed. Reg. 3801 (1981), *available in* 1981 WL 165113.

[FN70]. Animal Legal Defense Fund v. Quigg, 932 F.2d 920, 932 (Fed. Cir. 1991).

[FN71]. *Id.*

[FN72]. Bruce Rubenstein, *Growing Agro-Biotech Business Fuels Patent Battles, Dominance of a New Industry at Stake*, CORP. LEGAL TIMES, February, 1999, at 29 (1999). This booming industry is fueled by genetically engineered seed technology by companies including Monsanto, Novartis, Mycogen Corp., Cargill Inc., and Pioneer Hi-Bred International Inc. *Id.*

[FN73]. *Id.*

[FN74]. SZCZEPANSKI, *supra* note 12.

[FN75]. Sylvia Carter, *One Potato, New Potato/ Farmers and Biotech Companies are Battling for Control*, NEWSDAY, Mar. 28, 1999, at A51, *available in* 1999 WL 8164254.

[FN76]. Hamilton, *supra* note 6 at 295.

[FN77]. Monsanto is an agribiotech company engaged in the manufacturing and selling agricultural products including herbicides. It also is engaged in biotech research and development of crops. Rhone-Poulenc Agro S.A., v. Monsanto Company, 1999 WL 1124705 F.Supp 2d, (M.D.N.C. 1999).

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[FN78]. Downs, *supra* note 11.

[FN79]. Carter, *supra* note 75 at A51.

[FN80]. Pioneer is an agribiotech company that produces genetically engineered crops and is the world's largest seed corn producer. Pioneer Hi-Bred Int'l Inc., v. J.E.M. Ag Supply Inc., 49 U.S.P.Q. 2d 1813, 1814 (N.D. Iowa 1998).

[FN81]. *See CAFC to Decide if Biotech Plant Patents are Legal, supra* note 10.

[FN82]. *Id.*

[FN83]. Carter, *supra* note 75 at A51.

[FN84]. Hamilton, *supra* note 6 at 295-296.

[FN85]. Carter, *supra* note 75 at A51.

[FN86]. Pioneer Hi-Bred Int'l v. J.E.M Ag Supply, Inc., 33 F. Supp.2d 794, 795 (N.D. Iowa 1999).

[FN87]. *Id.*

[FN88]. *Id.*

[FN89]. *Id.*

[FN90]. *Id.*

[FN91]. Pioneer Hi-Bred Int'l Inc. v. J.E.M. Ag Supply Inc., 49 U.S.P.Q.2d 1813, 1815 (N.D. Iowa 1998).

[FN92]. *Id.*

[FN93]. *See supra* notes 18-23 and accompanying text.

[FN94]. *Ex parte* Hibberd, 227 U.S.P.Q. 443, 445 (Bd. Pat. App. & Interf. 1985).

[FN95]. *Id.* at 446.

[FN96]. *See supra* notes 36-37 and accompanying text.

[FN97]. *Hibberd*, 227 U.S.P.Q. at 446.

[FN98]. Pioneer Hi-Bred Int'l Inc. v. J.E.M. Ag Supply Inc., 49 U.S.P.Q.2d 1813, 1815 (N.D. Iowa 1998).

[FN99]. *Id.* at 1820, *quoting* United States v. Borden Co., 308 U.S. 189, 198-199 (1939).

[FN100]. Pioneer Hi-Bred Int'l Inc., v. J.E.M. Ag Supply, Inc., 33. F. Supp.2d 794, 795 (N.D. Iowa 1999).

[FN101]. *Pioneer*, 49 U.S.P.Q.2d at 1818, *quoting* S. REP. NO. 91-1246 (1970).

[FN102]. *Id.* at 1819-1820.

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[FN103]. Imazio Nursery, Inc. v. Dania Greenhouses, 69 F.3d 1560, 1564 (Fed. Cir. 1995).

[FN104]. 35 U.S.C. § 161 (1994).

[FN105]. *Imazio Nursery*, 69 F.3d at 1564.

[FN106]. 7 U.S.C. § 2321 (1994).

[FN107]. 7 U.S.C. § 2402(a) (1994).

[FN108]. 7 U.S.C. § 2421(a) (1994).

[FN109]. Pioneer Hi-Bred Int'l Inc., v. J.E.M. Ag Supply, Inc., 200 F.3d 1374 (Fed. Cir. 2000).

[FN110]. Pioneer Hi-Bred Int'l, Inc., v. J.E.M. Ag Supply, Inc., No. 563, 1998 WL 780948 (Fed. Cir. 1998) (unpublished opinion).

[FN111]. *Id. See also* 28 U.S.C. § 1292 (b), (c)(1) (1994).

[FN112]. 28 U.S.C. § 1295 (1994), 28 U.S.C. § 1338 (1994).

[FN113]. Pioneer Hi-Bred Int'l Inc., v. J.E.M. Ag Supply Inc., 49 U.S.P.Q.2d 1813 (N.D. Iowa 1998).

[FN114]. *Pioneer*, 200 F.3d at 1376.

[FN115]. *Id.* at 1374, *citing Ex parte* Hibberd, 227 U.S.P.Q. 443 (Bd. Pat. App. & Interf. 1985).

[FN116]. *Ex parte* Hibberd, 227 U.S.P.Q. 443, 444 (Bd. Pat. App. & Interf. 1985).

[FN117]. *Id.* at 445-46.

[FN118]. *Id.*

[FN119]. *Pioneer*, 200 F.3d at 1376.

[FN120]. Pioneer Hi-Bred Int'l, Inc., v. J.E.M. Ag Supply, Inc., 49 U.S.P.Q. 2d 1813, 1818 (N.D. Iowa 1998).

[FN121]. *Id.*

[FN122]. *Id., quoting* SEN. REP. NO. 91-1246 (1970).

[FN123]. *See* H.R. REP. NO. 91-1246 (1970).

[FN124]. Diamond v. Chakrabarty, 447 U.S. 303, 311 (1980). The *Chakrabarty* court said these obstacles appeared to have derived from a decision in the patent office. *Id.* citing *Ex parte* Latimer, 1889 Dec. Com. Pat. 123.

[FN125]. *Pioneer*, 49 U.S.P.Q. 2d at 1818, *quoting* 1970 United States Code Congressional and Administrative News 5082, 1970 WL 5934.

[FN126]. *Id.*

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[FN127]. *Id.*

[FN128]. *Chakrabarty*, 447 U.S. at 312.

[FN129]. *Pioneer*, 49 U.S.P.Q. 2d at 1819.

[FN130]. *Id.*

[FN131]. *Id.* at 1820.

[FN132]. *Id.*

[FN133]. *Id.*

[FN134]. *Id.*

[FN135]. *Id., quoting* United States v. Borden Co., 308 U.S. 189, 198-199 (1939).

[FN136]. Pioneer Hi-Bred Int'l, Inc., v. J.E.M. Ag Supply, Inc., 200 F. 3d 1374, 1378 (Fed. Cir. 2000).

[FN137]. *Id.*

[FN138]. *Id.*

[FN139]. *Id.*

[FN140]. Pioneer Hi-Bred Int'l Inc. v. J.E.M. Ag Supply Inc., 49 U.S.P.Q.2d 1813, 1821 (N.D. Iowa 1998), citing Kewanee Oil Co. v. Bicron Corp., 416 U.S. 470, 485-87 (1974).

[FN141]. *Pioneer*, 200 F.3d at 1378.

[FN142]. *Id.* at 1376.

[FN143]. Diamond v. Chakrabarty, 447 U.S. 303, 311-312 (1980). The "product of nature" doctrine says that a patent is not available because the invention exists nature and is not a product of human ingenuity. *Id.*

[FN144]. Pioneer, 200 F.3d at 1376.

[FN145]. *Id. See also* 37 C.F.R. § 1.801 (1999). *See also Ex parte* C, 27 U.S.P.Q.2d 1492 (Bd. Pat. App. & Interf. 1993).

[FN146]. *Pioneer*, 200 F.3d at 1376.

[FN147]. *Id.* at 1378.

[FN148]. *Id.*

[FN149]. Pioneer Hi-Bred Int'l Inc. v. J.E.M. Ag Supply, Inc., 33 F.Supp. 2d 794, 799 (N.D. Iowa 1999).

[FN150]. 35 U.S.C. § 271 (1994).

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[FN151]. *See supra* notes 81-82 and accompanying text.

[FN152]. Andrea Foster, *Seeds Planted for Biotech Suits*, October 18, 1999, NAT'L L.J. at B5.

[FN153]. PETER D. ROSENBERG, PATENT LAW FUNDAMENTALS § 17.02 (2d ed. 1999).

[FN154]. *Id.*

[FN155]. *Id.*

[FN156]. 35 U.S.C. § 284 (1994).

[FN157]. *Id.*

[FN158]. *Id.*

[FN159]. 7 U.S.C. § 2301 et. seq. (1994).

[FN160]. 7 U.S.C. § 2483 (1994).

[FN161]. 7 U.S.C. § 2543 (1994).

[FN162]. *Id. See also* Asgrow Seed Company v. Winterboer, 513 U.S. 179 (1995).

[FN163]. ROSENBERG, *supra* note 56.

[FN164]. 7 U.S.C. § 2544 (1994).

[FN165]. *See supra* note 42 and accompanying text.

[FN166]. *See supra* note 66 and accompanying text.

[FN167]. Sara B. Blanchard, *The Muddled Law of Biotechnology: Frustrating Agricultural and Biomedical Progress*, 6 SAN JOAQUIN AGRIC. L. REV. 179 (1995).

[FN168]. *The Campaign Against Genetically Modified Food*, 21 No. 3 Jud./ Legis. Watch Rep. 1 (2000).

[FN169]. David Holzman, *Agricultural Biotechnology: Report Leads to Debate on Benefits Of Transgenic Corn and Soybean Crops*, Genetic Engineering News, April 15, 1999, at 1, 12.

[FN170]. Bt technology is transgenic technology that transfers a gene from the bacterium *Bacillus thuringiensis* to a crop, in this case corn. The Bt toxin is a toxin produced by the bacterial gene that acts as a natural insecticide which is excreted by the plant. *Id.* at 1.

[FN171]. *Id.*

[FN172]. Transgenic soybeans can be exposed to the herbicide Roundup. *Id.* at 12.

[FN173]. According to Monsanto, the maker of Roundup Ready soybeans. *Id.* at 12. The Roundup Resis tant soybeans allow farmers to spray their soybeans with Roundup, killing all plants except the soybeans which are

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resistant to the Roundup. *Id.*

[FN174]. *The Campaign Against Genetically Modified Food*, 21 No. 3 Jud./ Legis. Watch Rep. 1 (2000).

[FN175]. *Id.*

[FN176]. Holzman, *supra* note 169 at 29.

[FN177]. Rubenstein, *supra* note 72 at 29.

[FN178]. Biodiversity is the diversity or number of biological organisms. The more the varieties of particular species, the higher it's biodiversity or genetic pool. Jean Christie, et. al., *Of Monopolies an Meltdown (Intellectual Property Rights Over Living Things)*, CANADIAN DIMENSION, Jan. 1, 1998 *available in* 1998 WL 17502723.

[FN179]. *Id.*

[FN180]. Downs, *supra* note 11.

[FN181]. Doug McInnis and Gunjan Sinha, *Genes: They're What's for Dinner*, Popular Science, April 2000.

[FN182]. *Id.*

[FN183]. *Id.*

[FN184]. *Id.*

[FN185]. *The Campaign Against Genetically Modified Food*, 21 No. 3 Jud./ Legis. Watch Rep. 1 (2000).

[FN186]. *Id.*

[FN187]. Diamond v. Chakrabarty, 447 U.S. 303, 314 (1980).

[FN188]. 1999 Cong. US S 2080, 106th Congress, 2d Session, (Feb. 22, 2000).

[FN189]. Pioneer Hi-Bred Int'l, Inc. v. J.E.M. Ag Supply, Inc., 200 F.3d 1374 (Fed. Cir. 2000).

[FN190]. Carter *supra* note 75 at A51.

[FN191]. *Chakrabarty*, 447 U.S. at 303.

[FN192]. *See supra* notes 25-34 and accompanying text.

[FN193]. *See* Scott Kilman, *Government Is Advised to Tighten Regulation of Bioengineered Crops*, WALL ST. J., April 6, 2000, at B2.
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