ARE INTELLECTUAL PROPERTY RIGHTS STIFLING AGRICULTURAL BIOTECHNOLOGY IN DEVELOPING COUNTRIES?

by Philip G. Pardey, Brian D. Wright, and Carol Nottenburg

FOR MORE THAN a century, plant breeders in government-funded research centers have sought out crop varieties with characteristics that might help poor farmers in developing countries grow more food. They have painstakingly bred and cross-bred these varieties through generations to achieve a desirable mix of characteristics. At an accelerating pace in the 1960s and 1970s the work of these breeders changed the developing world—the higher-yielding varieties of wheat, rice, and other food staples they produced helped avert catastrophic famine in Asia—and their work continues to improve the lives and livelihoods of millions of people. Now, however, critics of the newest tool in the agricultural researchers' toolbox—genetic engineering—argue that the new environment for agricultural research may leave farmers in the developing countries out in the cold.

Whereas government or international public institutions once performed most agricultural research, now private firms are taking the lead in applying the tools of genetic engineering to agriculture. When corporations (and increasingly public agencies too) develop new agricultural biotechnology products or processes or new crop varieties, they often seek legal rights over the intellectual property these innovations represent. Many are concerned that corporations' efforts to protect their profits will isolate developing countries from the benefits of important innovations by blocking access to new developments by public and nonprofit researchers.

Corporations concentrate their research efforts on crops such as hybrid corn, soybean, canola, cotton, and some specialty horticultural products, which are grown for markets with high commercial value. The range of crops and production problems addressed by private research could well expand, but, as in the health area, private investment is mostly a complement, not a substitute, for continued public and other nonprofit research. Moreover, the development of a vast number of crops critical to food security throughout the developing world (such as cassava, yams, sweet potatoes, sorghum, millet), as well as crops that are globally grown (like rice, wheat, and maize), must continue to rely on public and nonprofit institutions as the principal source of genetic innovation. In developed economies, these types of institutions may increasingly find their access to essential new research inputs uncertain, unduly expensive, or even blocked altogether. This lack of access to intellectual property in the developed countries is a source of aggravation and inefficiency but is not currently a serious threat to the well-being of their citizens.

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For the poor in less-developed countries, access to new biotechnology might be much more crucial. They rely for sustenance on crops that are largely beyond the focus of the private research sector, and that have modest future commercial prospects. In addition, poor producers often face production problems different from those of commercial farmers in wealthier countries. Recent well-publicized "donations" of "intellectual property" by major multinational corporations to developing countries for certain noncommercial crops, while dramatizing the potential usefulness of biotechnology, have reinforced the impression that these countries lack access to modern technologies.

A closer look at the legal and economic realities facing agricultural researchers in developing countries reveals that these concerns are valid over the longer term but highly exaggerated as an immediate threat, thereby diverting attention away from more important problems.

THE RIGHTS TO RESEARCH

The principal public policy rationale for intellectual property rights (IPRs) is that they provide direct socially beneficial incentives to innovate as well as facilitate further innovation by mandating public disclosure of the patented technology. When individuals or organizations know that legal protection will enable them to recoup their research investments, they have a stronger incentive to pursue such innovations. Countries with strong traditions of innovation have long histories of IPRs—the United Kingdom awarded its first patent in 1449, and the authority for the U.S. patent system is enshrined in that country's Constitution ratified in 1788. In the absence of protection, disclosed new ideas and information are entirely in the public domain, and an innovator's attempts to recoup investment or to profit commercially from an innovation may fail because of imitation. Knowing this, prospective inventors may underinvest in R&D, or inventors may exploit their inventions in secret. In addition, by clarifying rights to new ideas, intellectual property rights help reduce the costs that would otherwise be required to determine ownership of rights.

An important, but perhaps under-appreciated aspect of most systems of intellectual property rights is their requirement that the inventors and researchers seeking these rights must disclose the new knowledge they have obtained. As new ideas are disseminated through publication, licensing, or other means, this information stimulates further rounds of innovation and technological advances.

Inherent in intellectual protection is a tension between the goal of providing incentives for innovation and the goal of allowing innovators to build upon one another's work. The broader the monopoly rights conferred, the larger the potential threat to the freedom to operate—the ability to practice or use an innovation. Owners of a technology may be unwilling to share or license it or willing only after costly negotiations, thus making it difficult for others to obtain essential tools for advancing their own research. Moreover, owners of technology may litigate against alleged infringers, so in practice, those who hope to use a protected technology must weigh the risk of litigation against the costs of obtaining licenses.

To further complicate matters, the modern methods used to develop new crop varieties depend on a wide range of component innovations, the rights to which might be held by many competing parties—be they patent rights or assigned use rights via commercial contracts or licenses. And the number of separate rights needed to produce a new innovation will only escalate as biotechnology patents become more prevalent. If ownership of these rights is diffuse and uncertain, it can be difficult or impossible for potential users to successfully negotiate with all of the relevant parties.

Yet agricultural researchers in many developing countries are freer than one might think to make use of innovations protected in the developed countries. This is because there is no such thing as an "international patent right." A patent or other intellectual property right awarded in, for example, the United States does not *a priori* confer property rights in the rest of the world. Patents and other intellectual property rights are awarded by national governments, and the protection conferred extends only as far as the geographic boundaries of the country in which the right is awarded. Thus, to obtain patent protection in several countries, innovators must apply for and gain rights in each. Anyone is

free to make, use, or sell whatever technology or knowledge is available for crops in countries where that technology is not subject to intellectual property protection, irrespective of whether the crop is grown for subsistence or commercial use or whether the technology is protected elsewhere.

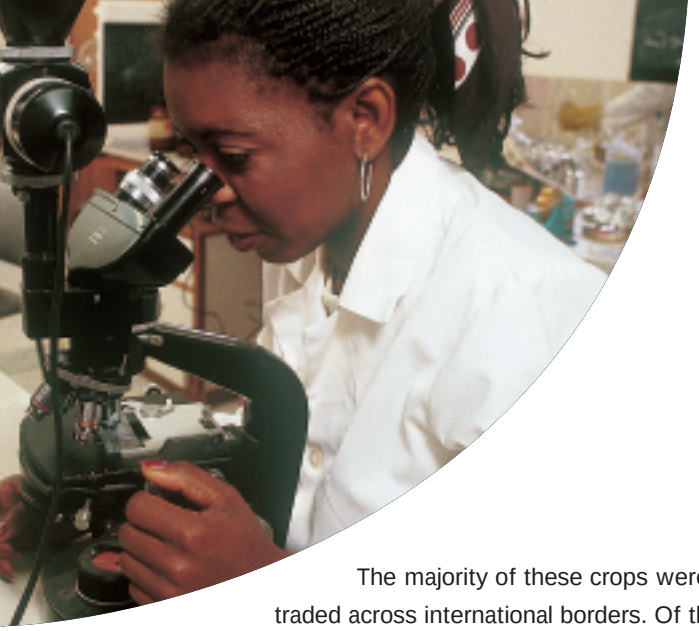
The extent of freedom to operate in less-developed countries is not well understood. For example, the recent vitamin A rice innovation ("golden rice") reportedly requires permission to practice over 70 patent rights. The well-publicized donations by major corporations of their intellectual property relevant to vitamin A rice left a strong impression that the exercise of large numbers of crucial patent rights was being relinquished in favor of the poor in developing countries. In fact, in some major rice-consuming countries, there are no valid relevant patents, and in most, there are very few. Similarly, the well-publicized donations of virus-resistant technology for some noncommercial potato varieties in Mexico and for sweet potato in Africa apparently do not involve any patents relevant in the target countries. Finally, a survey reported fairly widespread use of protected intellectual property by the centers of the Consultative Group on International Agricultural Research, in many cases without formal authorization from the patentees. But no distinction was drawn between patents valid in developed countries and those valid in the centers' host countries.

Though there is no international patent, international treaties and organizations do play an important role in intellectual property rights: they make it easier to extend protection to multiple countries and provide a uniform, minimal set of laws and standards that apply to all subscribing countries. Increasingly, innovators in developing countries are seeking intellectual property rights in developed countries, and vice versa. Currently, however, in the fields of agriculture and agricultural biotechnology, the type and scope of protection varies greatly from country to country, especially between developed and developing countries. This variation makes it more difficult to assess whether there is freedom to operate on an international level.

HOW PRODUCTION AND TRADE PATTERNS AFFECT INTELLECTUAL PROPERTY RIGHTS

Crop breeders in the developing world are free to produce crops as long as the inputs and processes used and the crop varieties grown are not protected under local intellectual property laws. But those crops cannot be legally exported to countries where they fall under intellectual property protection. In such cases the importer, not the breeder, may be infringing on intellectual property rights.

A recent IFPRI study looked at production and trade data for 15 of the crops most important to research agencies operating in developing economies: rice, wheat, maize, soybeans, cassava, coconut, groundnuts, bananas, beans, potatoes, sorghum, lentils, millet, barley, and chickpeas. As a group, the developing countries accounted for an average of more than 65 percent of the world's production of sorghum, beans, and lentils during 1994–98. For the rest of the 15 crops, they accounted for more than 90 percent of world production (and for quite a few of these crops, more than 98 percent).



The majority of these crops were never traded across international borders. Of the 15 crops, soybeans, coconuts, bananas, lentils, and beans are the only ones for which more than 10 percent of developing-country production is exported. Just two crops (soybeans and bananas) account for 64 percent by value of developing-country crop exports to the developed countries, and just four countries (Argentina, Brazil, Costa Rica, and Ecuador) account for 42 percent of such trade in these two crops. When exports of rice to developed countries (mostly from Thailand) and coconuts (mostly from the Philippines) are added into the soybean and banana exports, these four crops account for 80 percent of the total exports from developing to developed countries. Of these four crops, only rice and coconuts are staples in the exporting countries. (The traded bananas are dessert bananas; the staple cooking bananas are almost entirely consumed domestically.)

Freedom to operate depends upon specific circumstances. An investigation of the intellectual property rights assigned to the key enabling technologies used to transform crops revealed that these rights are mainly held in, and are therefore primarily relevant to, rich-country jurisdictions. Thus, for most of the crops that matter for food security in poor countries, researchers' freedom to operate is not impeded—much of the needed technology is unencumbered by intellectual property rights in developing countries and little of the developing-country production gets shipped into developed-country jurisdictions where intellectual property rights may prevail. This does not mean, however, that freedom to operate is not a problem for developing-country research on export-oriented cash crops such as horticultural products, tropical beverages like coffee or cocoa, or dessert bananas.

FOCUSING ON THE REAL PROBLEMS

The largely misplaced concerns that patents and other forms of intellectual property are currently severely constraining the freedom to operate in developing countries is diverting attention from more crucial issues for agricultural researchers working on staple food crops.

During the 1990s, growth in investment in agricultural research in and for developing countries stalled. For some regions like Africa it even began to shrink. Furthermore, many developing countries lack the scientific skills to effectively access the rapidly advancing stock of complex modern biotechnologies, whether they are protected by patents or not. As a matter of fact, most are not protected in these developing countries. Failure to invest in developing the domestic expertise needed to evaluate, access, and regulate the new technologies is currently a far greater constraint than freedom to operate.

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Moving forward in the 21st Century, the intellectual property landscape will be altered by the Trade-Related Aspects of Intellectual Property (TRIPs) agreement, which introduced minimum standards for intellectual property rights for new technologies by which all members of the World Trade Organization must abide. As developing countries come into compliance with the intellectual property rights provisions of the TRIPs agreement, the implementations of those provisions—both domestically and in export markets—will affect researchers' freedom to operate in future technologies of research and development. TRIPs requires that member states allow patents for inventions but with certain exceptions. The precise nature of these exceptions has yet to be resolved. Members are not required to allow plants to be patented, but they are required to protect plant varieties, either through patents or through a *sui generis* system (such as plant-breeder rights), or through a combination of both systems.

The misconception that intellectual property rights currently impair freedom to operate of developing-country breeders of food staple plants also threatens these countries' effectiveness in bargaining for access to the scientific outputs of private corporations. By the mid-1990s, just over one-half of the estimated US$21 billion (1993 prices) of agricultural R&D in rich countries was done by private firms. Much of the know-how and many of the constructs used to improve crop varieties now reside in these corporations. Institutional arrangements to facilitate effective partnerships between the public and private sectors in agricultural R&D are just beginning to emerge. These arrangements could help enable the sharing of expertise along with the products and processes to do the breeding and, perhaps, help direct some private research toward poor peoples' crops. Many of these public-private arrangements involve institutions in rich countries and are still largely unresolved regarding research directed toward the poorer parts of agriculture in developing countries. Bridging this private-public divide can have profound long-term development consequences, but it behooves all parties to have a proper perception of their present degrees of freedom in order to effectively tap intellectual property on behalf of the world's poor.

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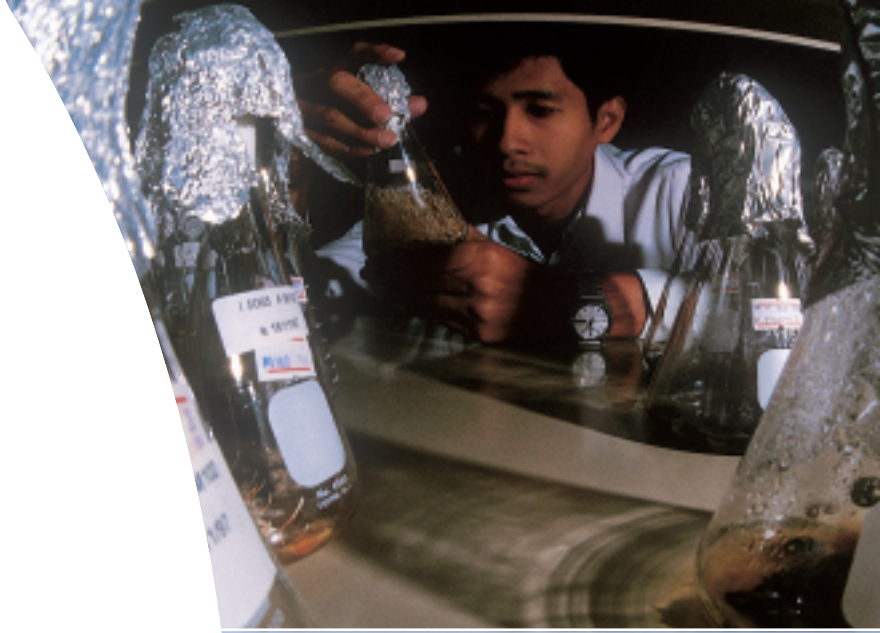
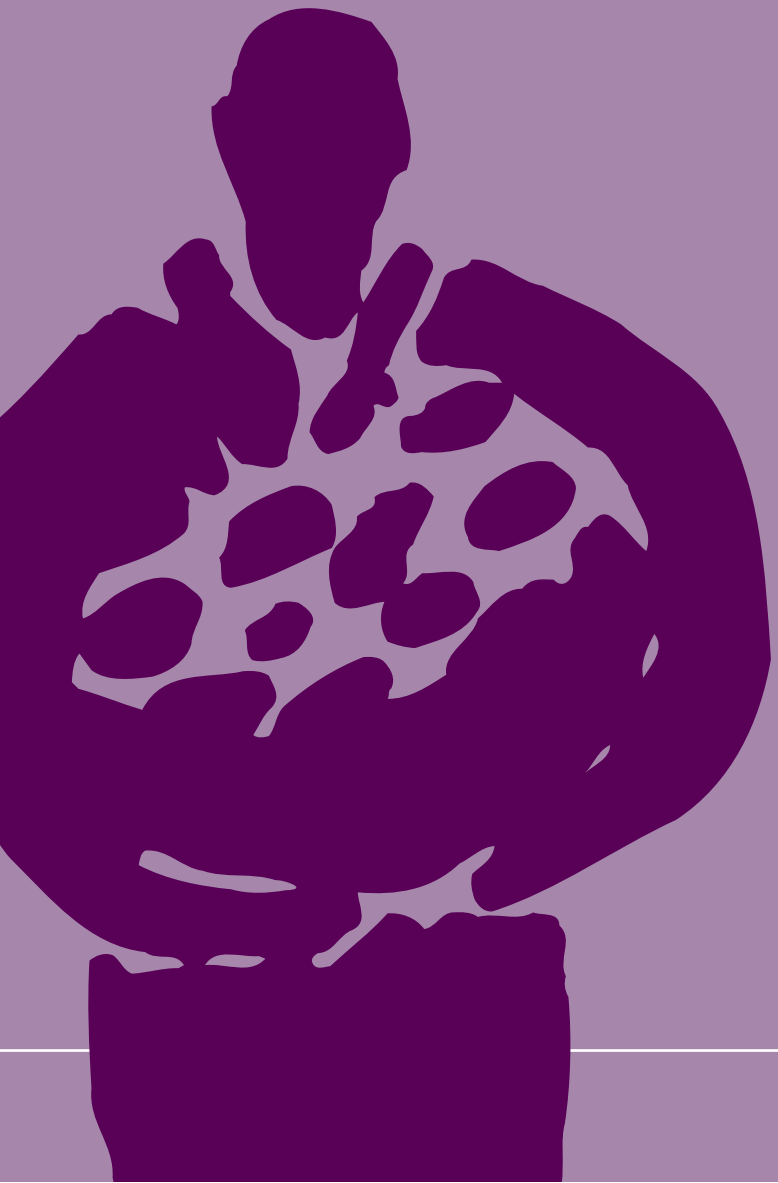


A Primer on Intellectual Property Rights and Agricultural Biotechnology

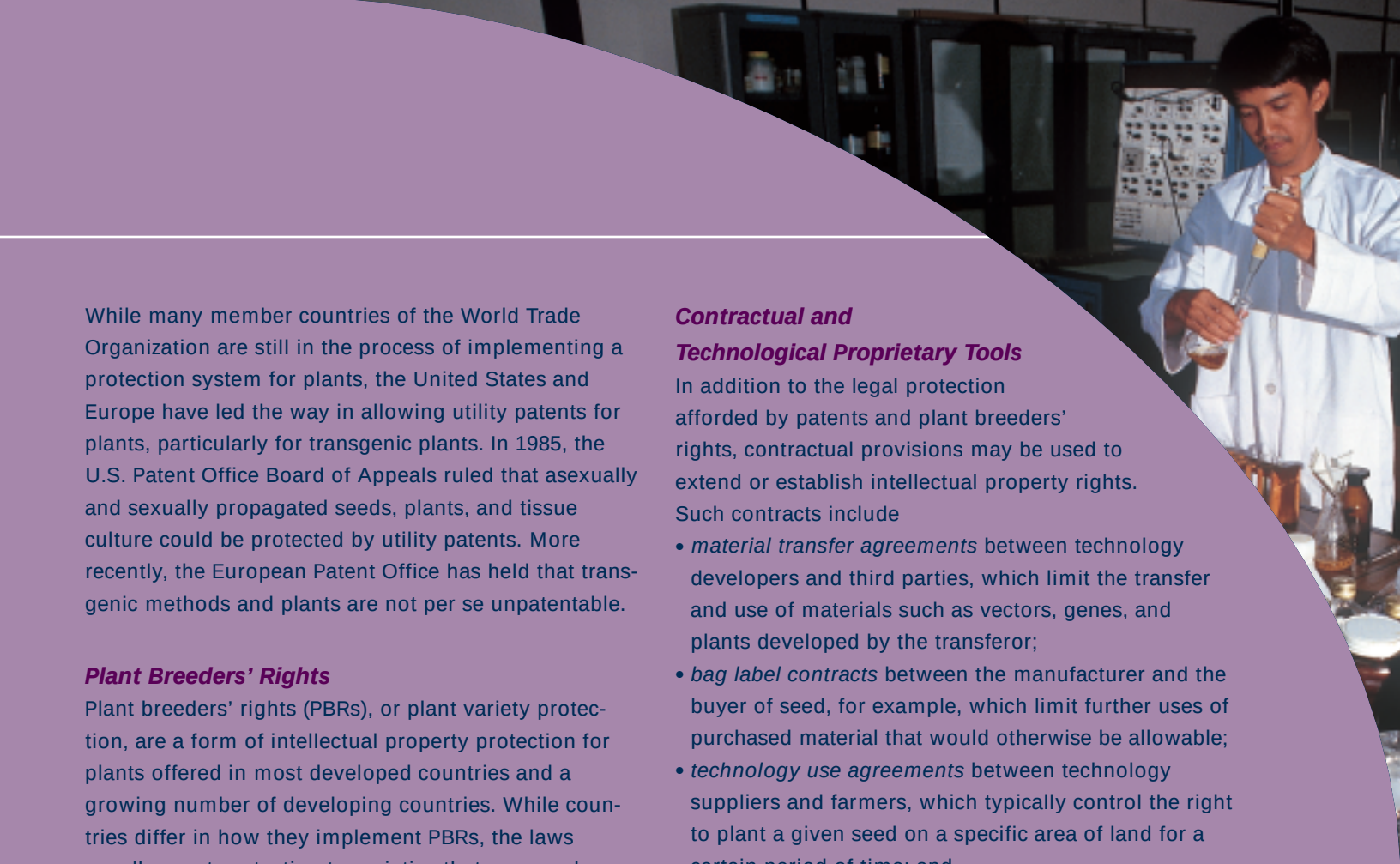
Intellectual property refers to products of the mind. Inventions, computer programs, publications, videotapes, and music are all examples of intellectual property. Intellectual property rights afford a time-limited legal protection to artistic, scientific, technological, or economic products. Copyrights, trademarks, design patents, utility patents, plant patents, plant breeders' rights, and trade secret laws are some of the ways of protecting intellectual property rights. The type of intellecual property to be protected and the legal and administrative system of the country where the right is being sought affect the extent of rights, such as the scope of the protection and the geographical limits to and duration of the rights.



In plant breeding, patents and plant breeders' rights have generally been the most important forms of intellectual property protection. As the biotechnological revolution unfolds, however, copyrights are becoming more important because the databases that hold information about plant genes can often be copyrighted. Such copyrights do not, however, affect trade in products developed using the protected information. U.S. state trade secret laws have been used to protect in-house breeding materials such as the inbred lines of maize used as parents of hybrids, but these laws do not protect against independent discovery or reverse engineering of products by their purchasers. Hence, patents afford stronger protection than trade secret law for innovation embodied in products. Trademarks are used for the protection of brand names of biotechnologies, such as Monsanto's Roundup Ready™ technology or Aventis's Liberty® and LibertyLink® technologies. Trademarks only protect the names and other symbols denoting products or technologies, not the technologies themselves.

Patents

The patent right is generally considered the most powerful tool in the intellectual property system, enabling the patent holder to exclude all others from making, using, selling, or offering to sell the invention in the country that granted the patent right or importing it into that country, if it is made elsewhere, for as long as the patent remains valid. To be patentable, an invention must satisfy the criteria of novelty, nonobviousness, and utility or industrial application. In addition, an inventor is required to describe the invention to the public in a manner sufficiently clear and complete for the invention to be reproduced by another person skilled in the art.



While many member countries of the World Trade Organization are still in the process of implementing a protection system for plants, the United States and Europe have led the way in allowing utility patents for plants, particularly for transgenic plants. In 1985, the U.S. Patent Office Board of Appeals ruled that asexually and sexually propagated seeds, plants, and tissue culture could be protected by utility patents. More recently, the European Patent Office has held that transgenic methods and plants are not per se unpatentable.

Plant Breeders' Rights

Plant breeders' rights (PBRs), or plant variety protection, are a form of intellectual property protection for plants offered in most developed countries and a growing number of developing countries. While countries differ in how they implement PBRs, the laws usually grant protection to varieties that are novel, distinct, uniform, and stable. Thus, the variety must not have been previously sold, be clearly distinguishable from previous varieties, be uniform, and breed true to type. The holder of a plant breeder's right has a legal monopoly over commercialization of that variety for a prescribed length of time, allowing the recovery of the cost of breeding commercially valuable new plant varieties. Although the details of protection vary from country to country, in general, the sale, reproduction, import, and export of new varieties of plants are encompassed. Exceptions may be made, however, for research, breeding of new varieties, and use of seed saved by a farmer for replanting. Moreover, in some countries, if a protected variety is used as the basis for a transgenic plant, the latter is covered by the plant breeder's right if it constitutes a variety "essentially derived" from the protected variety.

Contractual and Technological Proprietary Tools

In addition to the legal protection afforded by patents and plant breeders' rights, contractual provisions may be used to extend or establish intellectual property rights. Such contracts include

- *material transfer agreements* between technology developers and third parties, which limit the transfer and use of materials such as vectors, genes, and plants developed by the transferor;
- *bag label contracts* between the manufacturer and the buyer of seed, for example, which limit further uses of purchased material that would otherwise be allowable;
- *technology use agreements* between technology suppliers and farmers, which typically control the right to plant a given seed on a specific area of land for a certain period of time; and
- *licenses* between patent or property holder and licensee, which are negotiated grants of some or all of the holder's rights, such as allowing the use and sale of the technology.

There are also a number of genetic technologies that impose technical limits on farmers' use of seeds from their harvest to replant or to sell for replanting. The most common is production of hybrid crops that generally have a lower yield through loss of "hybrid vigor" if replanted. Modern alternatives include genetic use restriction technologies that confer sterility on replanted seeds—popularly dubbed terminator technologies—and others that allow reproduction but prevent expression of proprietary traits until the plant is treated with a specific chemical activator.