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Utility Plant Patents: A Review of the U.S. Experience (1985 - July, 1995)

Issue: RAFI examines the 10 year history of industrial plant patents in the U.S. The utility plant patent is the most powerful intellectual property protection available for plants and plant-related inventions. Our database uncovers numerous patent claims extending far beyond a single cultivar to multiple varieties or an entire genus or species. Patent holders who identify new genes can claim 20 years of exclusive control over that gene in any plant including derived seeds and tissue. Utility plant patents permit a single corporation to extend proprietary control to *any* plant exhibiting a patented trait.

Impact: RAFI believes that current trends in utility plant patenting are a threat to world food security and demonstrate that the system is out-of-control. Exceedingly broad patents on biological materials and the processes used to manipulate them are "locking-up" new plant biotechnologies in the hands of a small number of corporations who can afford to acquire and license patented technologies. Utility patents threaten to constrain exchange of germplasm by preventing other breeders from using patented genes or traits. Broad patent claims make it increasingly difficult for researchers to avoid infringing patents, and drive up the cost of doing research. The implications for public-sector plant breeders/molecular biologists are particularly severe.

Implications for the South: Some 70 Third World nations who are signatories to the World Trade Agreement are obligated to adopt some form of *sui generis* intellectual property for plant varieties. Given the uncertainty and confusion surrounding the patenting of plants in the U.S. and Europe, it is unacceptable that the industrial IP model be promoted as an workable option.

Introduction

This issue of the *RAFI Communique* examines plant utility patents granted by the U.S. Patent and Trademark Office from 1985 through mid-1995. The U.S. government has granted industrial patent protection for plants since the mid-1980s. Our study looks at trends in utility plant patenting based on this 10 year history. The U.S. experience is important to examine because there is strong international pressure for other countries to adopt plant patent regimes based on the U.S. model.

Background on U.S. Plant Patent Statutes

There are three separate intellectual property systems covering plants in the United States. These are:

- The 1930 Plant Patent Act (PPA),
- The 1970 Plant Variety Protection Act (PVPA)
- Utility (industrial) plant patents.

The 1930 Plant Patent Act provides 17-year patent protection for new varieties of asexually reproduced plants (plants produced by budding, grafting and tissue culture). There are close to 9,000 issued plant patents under the PPA. The cost of applying is U.S. $490.

The Plant Variety Protection Act (PVPA) is the U.S. version of patent-like laws that are known internationally as "plant breeders' rights." The PVPA was established in 1970 to provide breeders

International Office: Suite 504 - 71 Bank St., Ottawa, Ontario K1P 5N2, CANADA, Tel: 613-567-6880 Fax: 613-567-6884 E-mail: rafican@web.apc.org
RAFI-USA: P.O. Box 655, Pittsboro, NC 27312, USA, Tel: 919-542-1396 Fax: 919-54-0069 E-mail: rafiusa@igc.apc.org

with rights over the production, marketing and sale of new, sexually reproduced (i.e. reproduced by seed) plant varieties for 18 years. To qualify for protection, the variety must be 1) new; 2) distinct; 3) uniform; 4) stable.

PVPA legislation was amended in 1994 and its scope broadened to include coverage for first generation hybrids and tuber-propagated plants. Whereas the older law protected only the cultivar described in the patent, protection has now been expanded to include all materials harvested from protected varieties. The long-standing farmer's and breeder's exemptions, once prominent features of the PVPA, have been significantly restricted and the term of protection increased from 18 to 20 years.[1] As a result of 1994 amendments to the PVPA, it is now illegal for farmers to sell proprietary, farm-saved seed to their neighbours, and they may save only enough seed for re-planting their own land. As of July, 1995, 3,453 certificates have been issued under the PVPA. The application fee is US $2,450, plus the costs associated with preparing the application.

Utility Plant Patents

In 1985, the U.S. Patent and Trademark Office (PTO) began issuing utility patents for all plants.[2] All industrial patents must meet the standard criteria of novelty, utility and non-obviousness.

The decision to grant industrial patents on plants stems from the Supreme Court's landmark ruling in 1980 (Diamond vs. Chakrabarty) that human-altered microorganisms are patentable subject matter, just like any other industrial invention (computer chip or sewing machine). Diamond vs. Chakrabarty gave the fledgling biotechnology industry legal means to gain exclusive monopoly control over living organisms, and opened the floodgates to the patenting of all life forms--microorganisms, plants, animals and human genetic material.

The utility patent is the most powerful intellectual property protection available for plants and plant-related inventions. In contrast to the other plant patent statutes, utility patent protection generally requires a deposit of biological material, and the invention must be unobvious (involves an inventive step not known previously by someone skilled in the field). In general, utility plant patents offer stronger protection for the patent holder, they are more difficult to obtain, and the cost of applying is far greater. The cost of preparing a patent application in the U.S. ranges from about (US) $10,000 - $20,000.[3] The initial cost of applying, however, pales in comparison to the cost of defending/enforcing a patented invention. One industry observer estimates that the cost of enforcing an industrial patent over its lifetime is approximately (US) $250,000.[4]

Plant utility patents are not restricted to claims on a single cultivar. Far from it: Multiple varieties, or even an entire genus or species may be covered in a single application. Plant patents can cover all plant biological material as well as processes. They may include, genes, proteins, recombinant processes, culture techniques, plant parts, seed, etc.

Under industrial patent statutes there has never been a "farmer's exemption." "Whoever sells a component" of a patented item is guilty of infringing the patent. This means that all parts of a plant, including its seeds, tissue, and cells are protected, as is the use of a plant's seeds or pollen to create more plants. Put simply, farmers who re-plant or sell seed (for reproductive purposes) harvested from a proprietary variety are in violation of the patent and liable for "damages caused to the patent holder" in court.

There is no provision in the U.S. patent statutes exempting experimental users from patent infringement liability. This means that breeders or scientists who use patented biological materials in their research could be guilty of infringing a patent. (While a judicially created experimental use exception has been recognized that may allow the use of patented germplasm in research, it is legally tenuous. A recent U.S. Federal Circuit court decision implies that it may not apply to profit-oriented entities.) [5]

RAFI's Patent Database and Explanation of Methodology

RAFI's database on plant utility patents is based on patents issued at the U.S. Patent & Trademark Office (U.S. PTO) from 1985 through July, 1995. It includes a total of 358 plant utility patents. Of these patents, 197 are on transgenic plants (or processes that effectively convey patent protection to altered plants). A transgenic plant is a plant that has been genetically engineered by the insertion of DNA from a foreign, unrelated organism.

The process of identifying plant utility patents at the U.S. PTO is not straightforward.[6] RAFI's data

is based largely upon the U.S. patent classes for transgenic and non-transgenic plants (800#, and related "product" and "digest" classes). During the course of research, however, we found that these classes do not provide a comprehensive listing of plant utility patents, especially for patents involving transgenic techniques. Several non-800 PTO classifications in fact contain plant patents.

The PTO definition of a "transgenic plant patent" includes only claims on entire plants that have been altered with foreign DNA. A close look at recent biotech patents reveals that this definition gives a very incomplete picture. DNA sequences, and vectors (means of inserting foreign DNA) have been patented that are not necessarily considered "transgenic plant patents" by the PTO, even when the patent claims extend to plants that contain the patented gene or exhibit a patented trait.

A case in point is Calgene's patent on napin producing transformed *Brassica* (#5,420,034). Because the patent claims expression in transformed **seeds** that overproduce valuable oils, the PTO has *not* listed the patent as a "plant patent." This sort of logic defies a common sense understanding of nature that says that exclusive control over the seed inherently means control over the plant. Calgene claims that its patent 5,420,034 "covers three seed specific promoters, including napin, in DNA constructs **and *Brassica* host plants containing these constructs.**" (emphasis added)[7] There's no denying that this is a plant patent, yet it was not classified as such by the PTO.

Because plant utility patents are dispersed across a variety of large classes, a comprehensive analysis would necessitate the individual examination of thousands of patents. Such an intense and time-consuming analysis was beyond the scope of RAFI's study. However, RAFI has made an effort to include as many plant patents from related classes as possible. Ultimately, we believe our approach offers a more realistic accounting of plant utility patents and current trends.

The PTO's uneven classification of plant patents appears to stem from the rapidly evolving nature of modern biotechnologies, the "optional cross classification" system (in which patent examiners at times use their discretion to classify a patent), and the PTO's distinctions between "product," "process," and "use" claims. The U.S. PTO recognizes these irregularities and is currently restructuring the plant utility patent classes to more consistently reflect the nature of patents.

The Power of Patents: Staking Ever-Broader Claims on Entire Species and Important Traits

Over the past two years RAFI and partner NGOs have actively opposed broad, "species-wide" patent claims on food and industrial crops as a threat to world food security. The best known examples are W.R. Grace's controversial patents on *all* genetically engineered cotton and soybeans. These patents claim ownership over all transgenic varieties of cotton and soybean, regardless of the transformation technique or germplasm used to create them. (For background, please see *RAFI Communiqués*: "Control of Cotton," August, 1993 and "Species Patent on Transgenic Soybeans Granted to Transnational Chemical Giant--W.R. Grace," March/April 1994.) These patents have been challenged by NGOs, scientists, and governments on three continents. On December 1, 1994 RAFI was joined by 18 NGOs in opposing Grace's soybean patent at the European Patent Office. A few days later the U.S. PTO revoked the W.R. Grace patent on all transgenic cotton. The patent remains in effect until W.R. Grace exhausts all appeals.

While individual species patents have been challenged, the issue is far from being resolved. RAFI's database on industrial plant patents reveals that many other food and industrial crops are the subject of sweeping patent claims. See chart on page 9.

A biotech subsidiary of seed industry giant Goupe Limagrain (France) holds a patent on virtually all transgenic melons, muskmelons and cantaloupes. DNA Plant Technology (USA) has patented all transgenic pepper plants (genus *Capsicum*) and transgenic garden pea plants. Calgene Inc. (USA) claims ownership of all genetically engineered plants in the *Brassica* family!(Brassica includes: rapeseed, broccoli, cauliflower, cabbage and brussels sprouts.) Escagenetics holds a patent on all transgenic coffee plants (*C. arabica*).[8]

The trend is morally unacceptable and fundamentally inequitable. It means that a single corporation can set the terms and conditions for access to processes for manipulating plants as well as the plants themselves. Quite literally, the plants we grow in our gardens, the crops that feed and sustain humankind, are subject to exclusive

monopoly control of a handful of industrial corporations who are given the legal right to determine the future of high-tech research for entire segments of agriculture and plant genetics.

RAFI believes that the system is fundamentally inequitable because it fails to recognize or reward the contributions of informal innovators--generations of farming women and men, and indigenous peoples who have conserved, nurtured and developed plant germplasm for thousands of years. Informal innovators are effectively marginalized from the rewards and benefits of plant intellectual property systems.

No matter how stunning their technological achievements or costly their research, genetic engineers are literally building on the accumulated innovation and success of generations of anonymous farmers (as well as formal sector breeders). Sweeping patent claims extending to *any* plant engineered to express a specific gene or to exhibit a particular trait demonstrate dramatically that the intellectual property system is recklessly out-of-control. It is a system that works well for industrial corporations, who are increasingly calling the shots and "bending the rules" to accommodate their needs.

In order for patents to have economic value, corporations must defend their plant claims and enforce the requirement for licensing. But the uncertainty and confusion over the application of patent law to living materials has resulted in immense legal battles between corporations who are competing for ownership of strategic genes, traits, and biological processes. Instead of benefiting society, biotech corporations are spending millions of dollars in legal fees, diverting resources away from agricultural research and societal needs.[9] Ultimately, broad utility patents will increase the cost of doing research, limit the exchange of information and germplasm, and have a chilling effect on research--particularly in the public sector.

Dr. Neil Hamilton of the Drake University Agricultural Law Center (Iowa, USA) describes what happens when corporations stake hierarchical and competing claims over plant products and processes:

"One company may claim a variety tailored for a specific trait, while another company claims the technology used to develop the trait, while perhaps a third company lays a claim to the trait itself or even to the gene involved. This potential for serial patent claims may be standard in the industrial setting but it is certainly a new experience within agricultural production. It appears to have the potential to lead to extensive demands for the services of patent counsel but whether the confusion will be as profitable for the agricultural community or the seed industry is open to question." [10]

Who is Patenting?

The largest holders of plant patents are corporations in the North, who account for 79% of all utility plant patents in RAFI's database. Northern-based research institutions and universities follow with 14%. Bringing up the rear is the United States Government (1%). "Unassigned" patents whose ownership remains in the hands of the inventor(s) account for 6% of all patents in the database.

Country of Origin

Not surprisingly, the overwhelming majority of patent claims originate in the industrialized world. Seventy-six percent (271 patents) of the patents in RAFI's database come from the United States. As a whole, the industrialized countries (including Europe, U.S., Canada, Japan, Australia, New Zealand and Israel) account for nearly 100% of plant utility patents. **The South is virtually unrepresented, despite the fact that much of the patented germplasm originated there.** A few patent claims originate in Southern countries; but in all such cases, the assignee (or owner) of the invention is a Northern corporation.

The graph on page 9 lists 14 corporations and universities who are dominant players in transgenic plant patenting. The top 14 account for 56% of all transgenic plant patents and processes. The concentration of ownership and control of new plant technologies is far greater when partnering agreements (collaborations, agreements, equity participation) between companies is taken into account. For example, Monsanto Corporation (#1) recently acquired 49.9% of Calgene (#3).

What is being patented?

Because broad patent claims often cover multiple target species, or fail to specify claims on a single species, it is not possible to provide a concise analysis of which plant species are being patented. Patented plant materials include those that are classically-bred, as well as plants and processes that are products of new biotechnologies. Utility plant patents are not confined to crop

species; they also include patents on flowers, trees, fungi and algae.

Among classically-bred plants, the number of claims on in-bred maize lines (the parents of hybrids maintained by corporate breeders as part of their working stocks) is especially notable. There are 70 utility patents on in-bred maize lines in RAFI's database. The U.S. hybrid maize seed market is valued at $1.95 billion annually. Pioneer Hi-bred and Holden's Foundation Seed, two of the largest hybrid maize seed companies in the world, together hold 55 patents on their in-bred lines. A representative of Pioneer, which controls nearly 45% of the U.S. hybrid maize market, told RAFI that his company seeks the strongest possible proprietary protection for their in-bred lines, and routinely patents them under both PVPA and utility patents. (It is interesting to note that a 10-year legal battle between Pioneer and Holden's Foundation was decided in July 1994 when a federal court ruled that Holden had misappropriated Pioneer's in-bred maize line protected under trade secrecy laws. Pioneer was awarded over $46 million in damages.)

Plant Patenting in Europe: More Confusion and Uncertainty

In March, 1995 the Appeals Board of the European Patent Office (EPO) ruled that a patent granted to Plant Genetic Systems (PGS) in 1990 for a genetically engineered herbicide-tolerant rapeseed is too broad, and cannot cover the plants and seeds resulting from the process. The ruling is important because it means that patent claims on genetically modified plants do not extend to plant varieties, seeds and future generations of plants.

The EPO ruling stems from Greenpeace's challenge that the PGS claim constituted a patent on a variety, and was therefore inadmissible under Article 53b of the European Patent Convention (EPC).

Although plant varieties are excluded from patentability under the terms of the EPC, this is the first time the EPO has restricted a patent from covering a specified plant. Indeed, despite Article 53b, more than 200 plant patent applications were considered by the EPO between 1982 and 1991, and 56 patents were granted during this period according to a study conducted by Gabriel Nemoga-Soto of the National University of Colombia. The table on page 11 is drawn directly from Dr. Nemoga-Soto's study.[11]

The EPO's decision is expected to have an impact on past and future patent claims in Europe for both plants and animals. While the biotech industry may continue to claim patents on the process for manipulating plant cells and the inserted genes, they cannot now assume that their claim extends to seeds or further generations of plants. It remains to be seen how the EPO will resolve the question of plant patent claims. In the meantime, it should be noted that there is considerable difference between the US and European plant patenting regimes. The question of what is patentable is both unsettled and extremely controversial.

Implications for the South

As a result of GATT TRIPs (Trade Related Aspects of Intellectual Property), signatories to the World Trade Agreement are now obligated to adopt "effective" intellectual property standards for plants and microorganisms over the next 5-15 years. The GATT TRIPs agreement permits governments (including some 70 countries in the South) to: 1) Adopt standard industrial patent laws for plant varieties; or 2) Adopt some other form of *sui generis* (that is, of its own kind, a unique form of IP) legislation for plant varieties. *Sui generis* options include the adoption of Plant Breeder's Rights laws compatible with the 1978 or 1991 Convention of the Union for the Protection of New Plant Varieties (UPOV), or a *sui generis* system outside of the UPOV model. (Note: the 1978 UPOV Convention remains an option only until the end of 1995.)

The spectre of industrial plant patenting looms large in the South. Countries are being asked to buy into the industrial model.

Unfortunately, the far-reaching implications of plant patenting are not understood, and the subject is little known and debated outside of law offices and corporate board rooms in the North. It is obvious that industrial patents are an important marketing tool for multinational enterprises in global markets. But RAFI concludes that the system is out-of-control, with very negative and far-reaching implications for farmers, diversity and society.

Although proponents of patenting argue to the contrary, there is no evidence that intellectual property protection, including Plant Breeders' Rights, actually stimulates innovation in and technology transfer to the South.[12] All intellectual property is designed to promote innovation--but no one really knows if this is the case.

South Germplasm "Held Ransom" by Industrial IP: Ethiopia and Coffee

Plant patenting is already locking up strategic germplasm in the hands of industrial corporations and undercutting the potential for agricultural research and development in the South. Ethiopia, for example, has invaluable coffee germplasm; but its option to use this germplasm to commercially develop and export high-tech coffee varieties could be severely restricted by a patent such as Escagenetics' claim on *C. arabica*. Theoretically, all transgenic *C. arabica* varieties engineered using the Agrobacterium method will have to be licensed through the company before they can be commercialized in the US. The cost of licensing may well prove prohibitive for Ethiopian researchers. While not obligated to recognize a U.S. patent, Ethiopia could be prohibited from exporting transgenic coffee beans to the U.S. or other countries where the patent is recognized.[13]

Despite the controversy and confusion that exists over plant intellectual property in the U.S. and Europe, the biotechnology industry has aggressively promoted the U.S. plant patenting model in international trade agreements. Agricultural law expert Dr. Neil Hamilton points out the tremendous irony of extending the industrial plant intellectual property model to the South:

"...the uncertainty present in the U.S. system may only be magnified when these same issues are presented for resolution in international trade agreements, which have inherent difficulty in resolving disputes, or in the courts of developing countries neither receptive to resolving claims of ownership to plant genetic resources or equipped to resolve such claims."[14]

Policy Recommendations:

- In the US and Europe, plant patenting is recklessly out-of-control. There is confusion and uncertainty regarding the application of patent law to living materials. For governments of the South, the first real choice is to do nothing, taking full advantage of the time that is available to consider all options.

- South governments should be fully aware that it is not necessary to establish utility patent legislation for plant varieties to meet GATT requirements, nor is it necessary to adopt legislation that is compatible with UPOV.

- Countries that are in the process of debating plant breeders rights should be aware of the fact that joining UPOV places them on a very "slippery slope." The rules of the game are constantly changing. We would advise policymakers that once you have joined UPOV, it may be difficult to resist international political pressures for a continuous strengthening of the rights of commercial breeders. The pattern is a familiar one. Every time plant intellectual property laws are amended, it expands the scope of protection and the rights of industrial breeders at the expense of farmers, diversity and society.

- Incentives for innovation in plant breeding and new biotechnologies do not necessarily have to take exclusive monopoly control as the starting point. The South should consider all options available to them, giving special consideration to the development of *sui generis* alternatives outside of the UPOV frame work.

- The fundamental inequities of intellectual property systems require that all nations consider alternatives to the industrial models of intellectual property and that the role of innovation in society undergo a careful and thorough re-examination in a multilateral forum.

- Under any intellectual property system, farmers must retain the absolute right to save seed, to experiment with exotic germplasm, and to exchange seeds. Denial of these rights is to cut the heart out of global conservation and enhancement of biodiversity.

RAFI on the Internet

RAFI is happy to announce that many of its materials are now available on the internet. Internet users may access RAFI information using the world wide web (WWW). RAFI aims to create an unusually rich WWW site that goes beyond a simple "online brochure."

RAFI on line information includes the full text of past issues of the RAFI *Communiqué*, a copy of our 1992-94 biennial report, a listing and description of RAFI's works in progress, information on our publications, staff, and more.

To access RAFI's internet information, simply point your WWW browser (e.g. Netscape) to the following address:

http://www.charm.net/~rafi/rafihome.html

In the two weeks after the August 10th internet announcement of the new site, RAFI's pages were requested over 1,000 times by internet users in twenty six countries.

Finding Plant Utility Patent Information on the Internet

While the full text and claims of most patents are only accessible via fee services or directly from patent offices, some free patent information can be found on the internet. Several patent offices maintain World Wide Web pages. Some public WWW services have searchable indices of the numbers, titles, and abstracts of patents worldwide. Here are some good starting points:

Europe:
http://www.epo.co.at/epo/
USA:
http://www.uspto.gov/
http://sunsite.unc.edu/patents/intropat.html
http://www.spo.eds.com/patent.html
http://www.inform.umd.edu:8080/EdRes/Topic/AgrEnv/Biotech/Biotechnology_Patents-full_text
Brazil:
http://bdt.org.br/inpi
Canada:
http://eln.bc.ca/DB.eng.0.patent/sel
Hong Kong:
http://www.houston.com.hk/hkgipd

[1]Up to 25 years in the case of fruits and vines.
[2]Prior to this time, the PTO issued utility patents only for first generation plant hybrids because these plants were initially excluded from proprietary coverage by both of the "specialty" plant statutes described above.
[3]Personal conversation with Sidney B. Williams, patent attorney and plant intellectual property expert. Also, Lesser, William. Institutional Mechanisms Supporting Trade in Genetic Materials: Issues Under the Biodiversity Convention and GATT/TRIPs, UNEP, 1994, p. 37.
[4]Stewart, Thomas A. "Your Company's Most Valuable Asset: Intellectual Capital" Fortune Magazine, October 3, 1994, p. 70.
[5]Williams, Sidney B. and Kenneth Weber, 1989. "Intellectual Property Protection and Plants," in *Intellectual Property Rights Associated with Plants*, ASA Special Publication no. 52, p. 103.
[6]A plant utility patent examiner at the PTO, Dr. Gary Benzion, expressed surprise at the large number of transgenic plant patents that RAFI had uncovered. There is "no way," he claimed that nearly 200 transgenic plants have been patented in the U.S A recent article in Science magazine also presents a very different picture. It states that "since the early 1980s, the U.S. PTO has awarded 112 patents for genetically engineered plants and recombinant DNA approaches to manipulating plants." (Science, Vol. 268, 5 May 1995, p. 656).
[7]Calgene News Release, 30 May 1995.
[8]Please refer to the chart on page 9 for more detailed information. These claims are theoretically restricted to one or two transformation methods; but because the technologies are potentially pervasive in commercial seed production, we consider them "species" patents.
[9]Hamilton, Neil D., "Who Owns Dinner: Evolving Legal Mechanisms for Ownership of Plant Genetic Resources," Drake University Law School, White Paper 93-1, March, 1993, p. 47. Hamilton asks, "Could these resources be better used for plant breeding, genetic conservation and technological developments?".
[10]Hamilton, Neil D., 1993, p. 43.
[11]"Plant Technology at the EPO: Appropriation of Plants," by Gabriel Ricardo Nemoga-Soto, Brunel University, 1994.
[12]Jaffe, Walter and Jeroen van Wijk, 1995, *The Impact of Plant Breeders' Rights in Developing Countries: Debate and Experience in Argentina, Chile, Colombia, Mexico and Uruguay*," DGIS/IDRC, in press.
[13]RAFI recognizes that a financially-strapped company like Escagenetics may not be in a position to enforce its patent. This example illustrates how countries of the South could be "held ransom" to IP in the North. Kraft Foods Inc. (R.J. Reynolds Corporation) recently received US patent # 5,436,395 covering new methods for variety development, breeding and scale-up of superior genotypes of coffee plants for commercial production.
[14]Hamilton, Neil D., p. 45.

CORRECTION

We apologize for errors that appeared on pages 5 and 7 of the May/June RAFI *Communiqué*. In our report on work by indigenous peoples to defend their intellectual integrity, we incorrectly identified the Maori Congress as convenor of the First International Conference on the Intellectual and Cultural Property Rights of Indigenous Peoples. Though supported by the Maori Congress (a national body), the gathering was a community initiative, hosted and convened by the nine peoples of the Mataatua region in Aotearoa/NZ, headed by Ngati Awa. The resulting "Mataatua Declaration" is named after the Conference hosts. We also incorrectly identified the contact for further information. Inquiries should be addressed to:

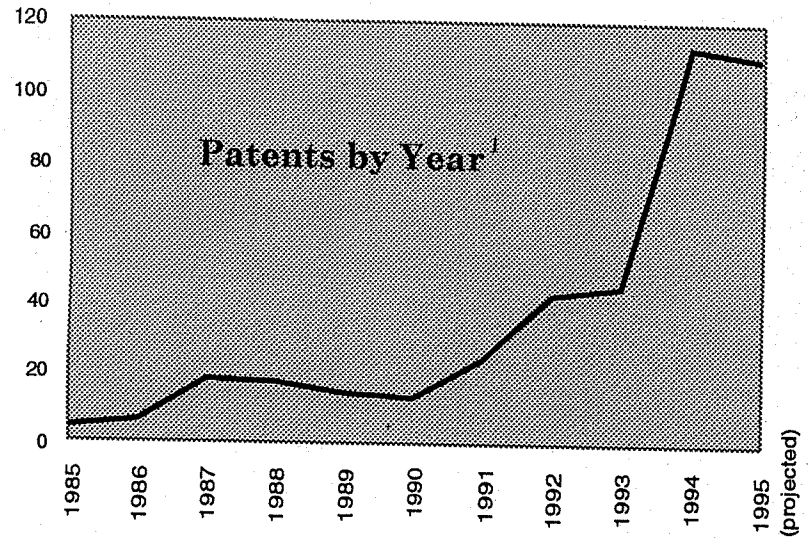
Ms. Aroha Te Pareake Mead,
P.O. Box 13177,
Johnsonville, Wellington
Aotearoa/New Zealand

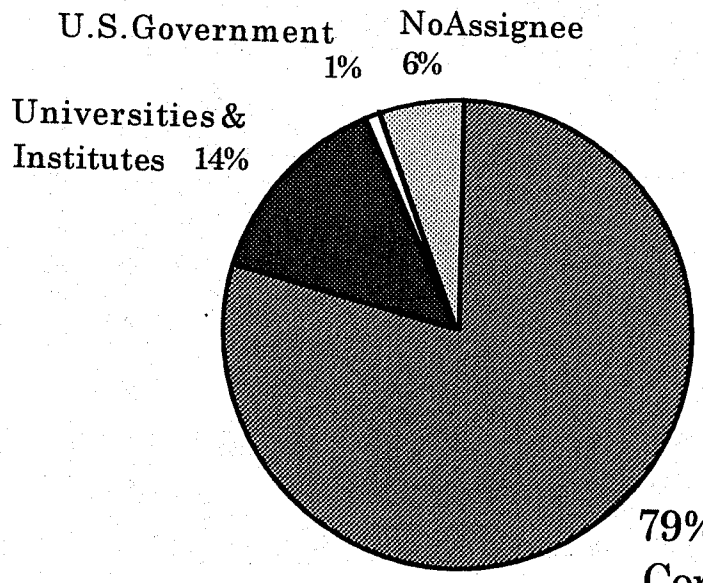
Mead was Conference coordinator, and is Foreign Policy Convenor for the Maori Congress.

MORE TO COME ON PLANT PATENTING

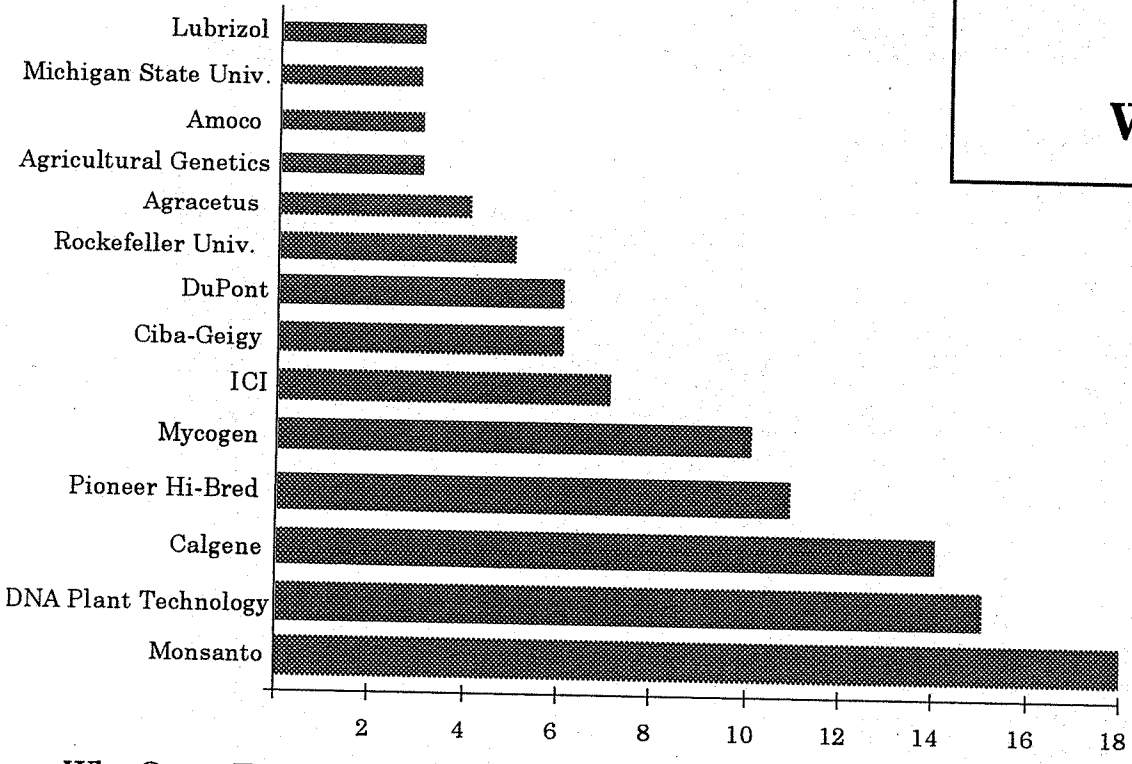
This is the first in a series of analytical reports on plant patenting regimes. Look for RAFI to release additional studies on the U.S. Plant Patent Act (PPA) and Plant Variety Protection Act (PVPA).

At a Glance: RAFI's US Plant Utility Patent Database





Who Owns Plant Utility Patents?



Who Owns Transgenic Plant Patents and Processes to Create Them?[2]

NOTES:

[1] Neither RAFI nor the PTO have a complete explanation of the enormous jump in patents issued starting in 1994. Factors that may have contributed to the leap included increased experience dealing with plant utility patents at the PTO as well as a maturation of transgenic techniques. Additionally, because of the length of the patenting process, many applications filed several years ago have only recently recieved a final determination.

[2] Together, these patents represent 56% of the total number of transgenic plant utility patents. Notes on companies:

- Patents assigned to subsidiaries have been counted toward the parent companies' total.
- Patents assigned to another corporation after issue have been counted toward the new owner's total
- As of July, 1995, Monsanto(#1) has acquired 49.9% of Calgene(#3).

Examples of "Species-wide" and Broad Plant Patents

Patent Holder	Patent #	Claim
W.R. Grace & Co.	5,159,135	Species-wide patent on all transgenic cotton (revoked by PTO 12/94 but still in effect until appeals are exhausted)
W.R. Grace & Co.	EPO 0301749 (and US Patent filing disclosed)	Species-wide patent on all transgenic soybean (opposition filed at EPO by RAFI and other NGOs and 5 seed corporations)
Calgene, Inc.	5,188,958	Brassica transformation patent--covering any transgenic plant in the Brassica family (rapeseed, broccoli, cauliflower, cabbage and brussels sprouts) engineered using the Agrobaceterium method.
Escagenetics Corp.	5,334,529	Species-wide patent on all genetically modified plants and seeds of *c. arabica*, the most important commercial coffee species.
Biosem (France) subsidiary of Limagrain	5,422,259	Species-wide patent on *Cucumis melo* (melons, muskmelons, and cantaloupes), the patent covers all transgenic plants using Agrobacterium tumefaciens as the transformation technique.
DNA Plant Technology	5,262,316	Species-wide patent on all transgenic pepper plants (genus Capsicum) using several transformation methods.
FreshWorld (wholly-owned subsidiary of DNA Plant Technology)	5,286,635	All genetically transformed garden pea plants (Pisum sativum L.) using several methods for their production.

Source: RAFI

Examples of Broad Traits Patented

Patent Holder	Patent #	Claim
Dekalb Genetic Corporation	5,258,300	All transgenic plants with increased lysine content.
DNA Plant Technology	5,290,687	All plants genetically engineered to express higher levels of chitinase. Chitinase is a natural enzyme in plants that wards off fungal diseases.
Enzo Biochem	?	"Antisense" technology allowing the plant to block protein production
Lubrizol Corporation	4,627,192	All sunflower seeds and plants exceeding 80% oleic fatty acid content and identified secondary traits, no matter how achieved.
Lucky Biotech Corp. and Univ. of Californa	5,234,834	Edible fruit, seed and vegetables of transgenic plants engineered to express super sweet thaumatin or monellin genes derived from African plants.
Mycogen Corp.	5,380,831	Process used to synthesize B.t. genes in plants--Mycogen claims that this patent covers all transgenic crops that are being commercially developed to express the B.t. toxin.
Pioneer Hi-Bred	5,276,264	Sunflower products with low levels of saturated fatty acids.
Plant Genetic Systems	5,254,799	All plants genetically engineered to contain *Bacillus thuringiensis* (Bt) genes using Agrobacterium transformation method to control lepidopteran insects. Bt is the most widely-used source of natural insect resistance in transgenic crop R&D.
Upjohn Co. (merged with Pharmacia)	5,349,128	Any transgenic plant from cucubitaceae and solonaceae families containing cucumber mosaic virus coat protein gene (WL strain); used to engineer virus resistance in plants.

Source: RAFI

Who is Patenting Plants in Europe? (1982-91)

	Applicant:	Percent of Applications	Number of Applications	Patents Granted
Companies	Lubrizol	8.1	23	9
	Ciba-Geigy	8.1	23	5
	ICI	7.8	22	1
	Calgene	6.4	18	1
	Monsanto	6.0	16	6
	Plant Genetic Sys.	5.7	16	3
	Pioneer	3.5	10	-
	Mogen	2.8	8	-
	W.R. Grace	2.4	7	-
	Other Companies	32.7	93	17
	TOTAL COMPANIES	83.6	237	42
Institutions	Max Planck	2.4	7	2
	Rijksuniv. Leiden	2.1	6	6
	The General Hosp.	1.8	5	1
	INRA	1.4	4	1
	Other Institutions	7.4	21	4
	TOTAL INSTITUTIONS	15.1	43	14
	TOTAL	100	283	56

Adapted from Nemoga-Soto, Gabriel R. Plant Technology at the EPO: Appropriation of Plants, Brunel University, 1994. Change in patent ownership since study date not reflected.