The future of seeds and food

under the growing threat of patents and market concentration

Christoph Then & Ruth Tippe, April 2009

Written for the international coalition of "no patents on seeds", www.no-patents-on-seeds.org

In collaboration with: Tina Goethe, Francois Meienberg, Teshome Hunduma, Mute Schimpf, Bell Batta Thorheim

Editing: Alejandra Gochez, Layout: Berne Declaration

This report was published by:

Contents

Summary

This report was written against the backdrop of a pending decision at the European Patent Office (EPO) that will have a major impact on the international market for seeds and food, and, consequently, on global food security. The pending decision will encompass two patents: one patent claiming plants, seeds and the edible parts of broccoli (**EP 1069819**, named *'the patent on broccoli'* in this report); and the other involving tomatoes with reduced water content (**EP 1211926**, named *'the patent on wrinkled tomatoes'* in this report). The most important issue in these two cases is that both plants are derived from conventional breeding and, until now, conventional breeding has been exempted from patentability by the wording of the European Patent Convention (EPC). It is expected that the EPO's Enlarged Board of Appeal, the highest tribunal at the EPO, will take a decision on these cases (registered as G2/07 and G1/08, respectively) in 2009. The decision will set precedent on whether patents can be granted on conventional breeding processes involving plants and animals in Europe or not.

Under European patent law (EPC) there is an exemption for "essentially biological processes for the production of plants or animals" (Art. 53b, EPC). The pending decision will likely interpret this prohibition, thereby having far-reaching impacts on the patentability of processes in conventional breeding. It will be the first time that a patent office will deal with this specific question in detail.

To illustrate the severe consequences created by excessive seed patenting this report will describe the situation of farmers in the United States, where patents on seeds have been allowed for several decades. One can observe that in the United States a single company, Monsanto, has gained a dominant market position in genetically engineered (GE) seeds. In turn, the freedom to patent seeds combined with the high concentration of seed patents in one company has led to harmful results, such as the increase of seed prices and decrease of seed choices for farmers.

This report will also present the results of new, detailed research on patents in the field of conventional breeding. The patents researched for this report are either pending as applications or have been granted at the EPO. The number of patent application in the field of conventional breeding has been steadily increasing for years. Currently, about 500 patent applications involving conventional breeding methods—nearly 25% of all patent applications on plants and seeds filed in 2008—are pending at the EPO. In the years 2000 to 2002 this figure was below 5%. It is expected that the recent growth of these kinds of patents represents a trend that will continue to gain importance in the next few years.

These figures reflect an actual shift in plant breeding trends driven by recent successes in conventional breeding with traits such as yield and resistance against environmental stress and pests. These successes have shown that traditional breeding is generally superior to genetic engineering for improving more complex genetic characteristics in plants. This development is highly relevant for companies such as Monsanto, Dupont and Syngenta, the main drivers in genetically engineered seeds. These companies have access to a broad range of high quality genetic material that was owned by the seed companies that they acquired within the last few years. Considering the successes in conventional breeding and a trend shift toward traditional breeding these companies are highly interested in extending their patent monopolies into this area. So they have started "inventing inventions" in the area of traditional breeding by claiming that the use of trivial technical tools in breeding should be sufficient to turn the whole process of plant breeding into a patent monopoly.

The supposed technical and "inventive" parts of the abovementioned patents involve a broad range of methods used in conventional breeding, such as marker assisted breeding, genetic fingerprinting, description of compounds (such as oil or protein), or assessment of plant qualities such as yield or pest resistance. In most cases the technical input required in these cases is relatively minor or even trivial and can hardly be seen as inventive. Nevertheless, more than 70 patents on conventional breeding have already been granted in Europe.

The scope of the patents analysed for this report was not restricted to the use of specific technical processes, but also covered plant genetic resources, seeds, plants and even harvests and their use in food and biomass production. Further, because of the way many of these patents have been phrased, they can cover the use of the patented plants in later generations and after further crossings. And the patents also have the potential to accumulate within seeds after further crossings.

The strategy behind these patents is evident in several respects. For one, competitors are hampered by legal uncertainty for the time during which a patent is pending. Then, as soon as the patent is granted, access to technology and resources can be denied. Thus, a patent application may thwart competitors while it is in process and then, if granted, can deny competitors access to technology.

In addition, in some cases companies have been known to combine seeds derived from conventional breeding with patented GE traits (like herbicide resistance) to assure that they can raise an additional technology fee and hamper the choice between GE and traditional seeds.

Many of the patents analyzed for this report are of specially high relevance to developing countries and centres of biological diversity. Methods like marker assisted breeding, genetic fingerprinting, or the description of specific compounds can be applied to systematically screen for the most interesting regional and local varieties and can then be used as a tool for large-scale biopiracy.

In sum, the report shows a threatening scenario. It describes the potential takeover of plants' genetic resources by international companies, which would then be able to control access to the most important resources for conventional breeding and the whole food chain. Seeds, plants and food patents granted on a grand scale could significantly impact food prices and availability, and could become an additional factor contributing to upcoming global food crises. Furthermore, because small-scale producers in developing countries rely on the right to save seeds from their harvest and to exchange them with other communities, the freedom to do this is crucial for the future of food security.

In order to halt these threatening developments it is not enough to wait for patent offices to reject single patent applications or to file more individual oppositions in this field. What is needed most is a clear legal ruling that exempts seeds and farm animals from patent protection. The pending decision at the EPO could become the starting point for a new approach on this issue if the EPO denies *'the patent on broccoli' and 'the patent on wrinkled tomatoes'.*

A patent is the exclusive right to commercially exploit a new invention for a limited period of time. Patents on plants, animals and genes give companies significant control over food production. This temporary monopoly grants companies the exclusive right to sell the seeds and allows them to charge higher prices for the seeds. As applied in most countries patents prohibit farmers from saving seeds from their own harvest; so they must either buy new seeds each year or pay for a license to use patented seeds they have saved. Other companies and plant breeders who want to conduct research on the patented material must generally apply for permission from the patent holder. Patents are an important tool for the big actors in the seed market because only they can afford to apply for a patent and also have the resources to then enforce it. Moreover, patents exacerbate genetic erosion as they promote monoculture by hindering the development of new seed varieties. In sum, the possible, longterm consequences of patents are control of the whole food chain by a few companies and establishment of unsustainable agriculture through monoculture and other factors.

1. Introduction: history and evolution of patents at the EPO

In 2007, the EPO celebrated its 30th anniversary and proudly presented itself as one of the largest patent offices in the world. At the same time, however, alarm bells rang out loudly for the future. The EPO was and is caught in a situation that has been described by several observers as a "patent bubble". It is faced with the enormous burden of deciding on hundreds of thousands of pending patent applications, but within this steadily rising number of patent applications there is a remarkable erosion of inventiveness.

In light of this situation, the EPO addressed the public around the time of its anniversary with a clear message: it would have to undergo substantial changes to fulfil its function and gain the legitimacy necessary for its future work. To our knowledge, this was the first time that a patent office in the industrialised world openly admitted that there is an emerging crisis in the system.

The patent system was created to foster innovation and new inventions by rendering limited monopolies for their commercial utilisation. Through time the system has become distorted by an increase in patent applications that do not present true inventions but instead aim to obtain patent thickets, enabling patent holders to control markets and hamper competition. The general situation is very often described as patent inflation, with hundreds of thousands of applications pending in a backlog and steadily eroding standards of inventiveness. In a report titled "Scenarios for the Future" (EPO, 2007) the office described some problems with the current patent system:

> "The growing use of patents and intellectual property has led to blockages throughout the system .... There are many questions being asked about today's patent system, but one of the key questions we identified was whether it is and can remain 'fit for purpose' by supporting innovation for the benefit of society at large in a post-industrial era. If not, its legitimacy may be open to question."

There are interest groups that are pushing heavily for the lowering of patent standards and the expansion of areas where patents should be granted. The authors of "Scenarios for the Future" warn that if these groups prevail in the next 20 years the patent system could be "collapsing under its own weight". As the president of the EPO Patent Office has announced, the strategy of "raising the bar" (meaning creating higher standards of inventiveness)[1] might be an approach that could be taken to counteract current developments. Most recently, in 2008, for the first time in its history the EPO reported a refusal rate of over 50 % of pending patent applications. This indicates that the EPO is trying to follow the strategy announced by the president in moving toward patent quality.[2]

The issue of the patentability of plants, animals, and processes for breeding is highly relevant here. Since 2007 and 2008, respectively, two precedent setting cases are pending at the Enlarged Board of Appeal--the cases of *'the patent on broccoli'* (registered as G2/07) and *'the patent on wrinkled tomatoes'* (registered as G1/08). The decision reached in these two cases will be decisive for the erosion of standards in patentability as they relate to conventional breeding in plants and animals.[3]

This report will show that companies are prepared for a global rush on patents in the area of traditional, conventional breeding; however, allowing the types of patents analysed in this report (i.e. patents on conventional breeding and related seeds, plants and derived products) would call into question the legitimacy of the patent system by contributing to the problem of erosion in inventiveness. Furthermore, it would create a global threat to the future of food production by contributing to the market

---

1 http://www.epo.org/about-us/events/archive/2008/epf2008/forum-1/details2/closing.html

2 http://www.ip-watch.org/weblog/2009/03/21/european-patent-office-patent-applications-slow-as-rejections-rise/

3 More information at www.no-patents-on-seeds.org

concentration of seed companies, hampering innovation, leading to increases in seed prices and decreases in choices for farmers, and hindering the ability of farmers to exchange seeds and save seeds.

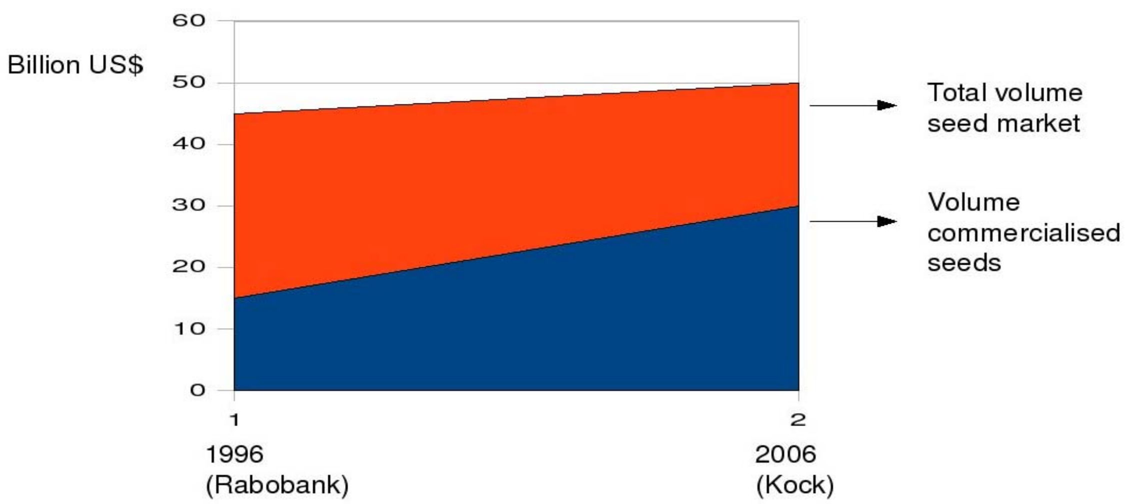
2. Concentration of the seed market

The seed market has been undergoing a permanent process of concentration and restructuring for several decades. According to the expert group ETC[4], just ten companies control two thirds of global seed sales.[5] The process of concentration has not only led to the takeover of big seed companies, such as Pioneer, DeKalb, Advanta and Seminis, by other large companies, but has also caused many smaller companies to simply disappear. The following subsections will discuss the consequences of the concentration of seed businesses into less and less hands, among these consequences are increases in seed prices, decreases in choices for farmers, and antitrust actions.

2.1 Effects of seed market concentration on pricing

Those companies that are the biggest players in seed markets have undergone drastic changes in recent years; and, consequently, the prices in and volume of seed markets have been influenced by their transformation. When we compare the figures on the total volume of the global seed market given by Rabobank in 1996, U.S. Department of Agriculture (USDA) in 2004 (Fernandez-Cornejo, 2004) and Kock (affiliated with Syngenta) in 2006, it becomes apparent that the volume of *commercially traded* seed has enlarged substantially through time, while the *overall volume* (which is not precisely defined by these authors) has shown slower growth. While the overall seed market volume increased from 45 billion U.S. dollars (Rabobank, 1996) to $50 billion (Kock, 2006), commercially traded (purchased) seed doubled from $15 billion in 1996 (Rabobank) to 25 billion in 2004 (Fernandez-Cornejo) and 30 billion in 2006 (Kock, 2006). This data indicates that farmers' reuse and free exchange of seeds has fallen substantially in the last few decades[6]

Graph 1: Volume of international seed market

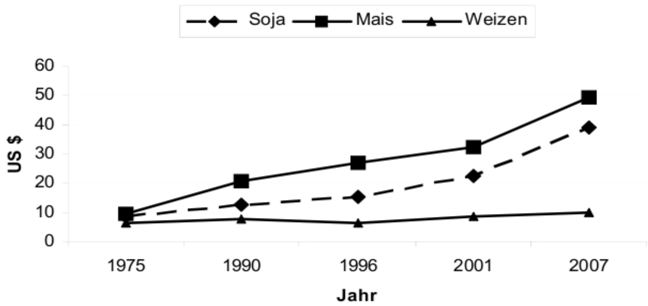


4 www.etcgroup.org/

5 http://www.etcgroup.org/en/materials/publications.html?pub_id=706

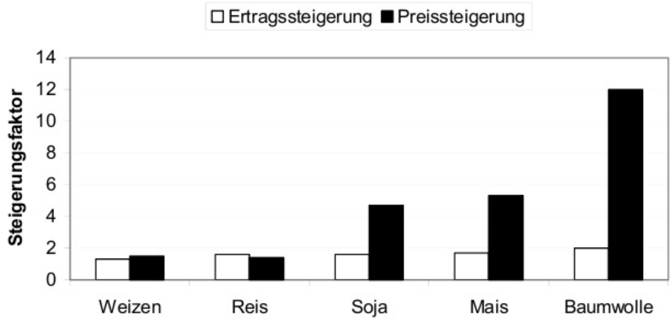
6 It is unclear if Kock, 2006, Fernandez-Cornejo 2004, and Rabobank 1996 really used the same criteria but the authors are nevertheless convinced that these figures represent a real trend.

When looking at recent figures on the development of seed prices in the United States, one can see that drastic changes have occurred since 1996 and 1997, with seed prices rising, especially in seeds where genetically engineered varieties entered the market, such as cotton, corn and soy. For example, the price for soy and corn seeds more or less doubled between 1996 (when GE seeds were introduced) and 2007. In comparison the prices of seeds for wheat and rice (for which genetically engineered seeds are not prevalent) were increasing much more slowly during that time period of time. Graph 2 shows selected seed prices from 1975 to 2007 for wheat, soy and maize taken from official USDA figures.[7]



Graph 2: Comparison of prices for seeds in soy, maize and wheat (U.S. dollars, per planted acre), United States, 1975-2007. Source: USDA Economic Research Service (graph adopted from Then & Lorch, 2009)

Notably, in the period of time when seed prices for these crops increased dramatically, yields from these crop species did not increase proportionally. While all three crops showed similar developments related to yield, there was an increasing gap between slowly growing yields and much faster increasing prices in those species where GE varieties were introduced. This becomes evident when comparing developments in maize, soy, cotton, rice and wheat, as illustrated in Graph 3.



Graph 3: Correlation between prices of seeds and yield, United States, from 1975-2007, transformed by multiplication factors (factor 2 = 100 % increase). Source: USDA, Economic Research Service (graph adopted from Then & Lorch, 2009)

Further, the proportion between costs for seed and total operating costs is much better in wheat and rice, where GE seeds are not prevalent, compared to cotton, maize and soy, where GE seeds are prevalent. While in the United States price for seed is responsible for about 10 % of the total operating (year 2007) costs in wheat and rice, it is about 17% in cotton, 21% in maize, and 37 % in soy. This effect is not caused by sinking in overall operation costs in genetically engineered seeds, as operating costs are also steadily increasing. (Since 1990 the costs for chemicals only went down for soy beans, but this economic effect was much smaller than the one caused by rising costs for soy seeds.) On the contrary, the high cost of seeds for crops where GE seeds are prevalent is attributable to the high cost of the seeds themselves—seeds that do not provide yields proportionate to their higher costs.

In sum, this data shows that in the newly concentrated seed market farmers are less and less able to rely on the reuse and free exchange of seeds and must pay ever increasing prices for seeds that do not provide proportionally higher yields in crops where GE seeds are prevalent.

2.2 Impacts on farmers

This section will look at the impacts that patents on seeds and related products are having on farmers, specially farmers in the United States, where the issue of seed patents is specially widespread. It will analyze legal issues and cost issues confronted by farmers.

[7] United States Department of Agriculture (USDA) – Economic Research Service 2009, http://www.ers.usda.gov/Data/CostsAndReturns/testpick.htm

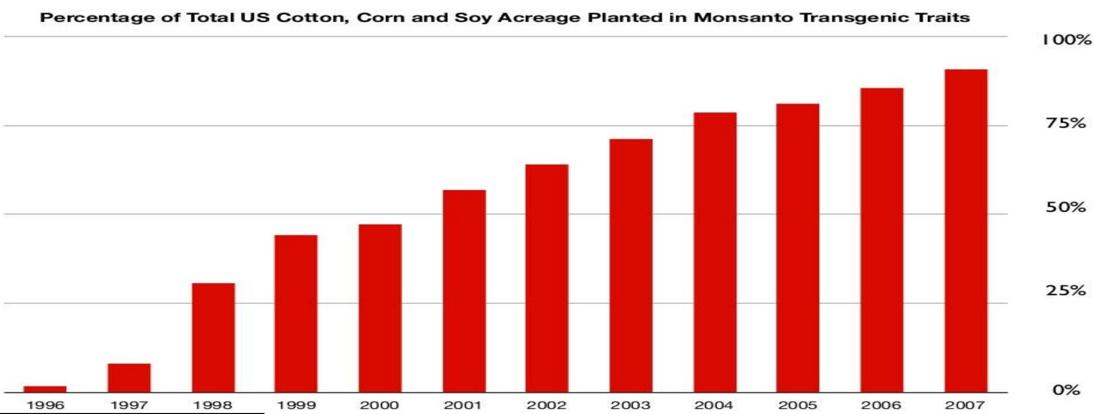
Several reports show that in North America, where many GMOs are grown and patent law on seeds is enforced, the legal situation can become difficult for a farmer if a company starts suing for unauthorised use of seeds. A report from the Center for Food Safety in the United States documents over 100 cases in which farmers were accused of infringing the patent rights of the Monsanto seed company (Center for Food Safety, 2005).[8] A very well known case is that of Percy Schmeiser, a case that was taken to court in Canada after Mr. Schmeiser was accused of illegally using Monsanto's seeds.[9]

Farmers in the United States are not only concerned with direct legal conflicts with patent holders, due to the introduction of genetically engineered seeds by a single company (Monsanto) with a dominant market position, the more generalised problem of exclusive seed monopolies has surfaced.

In addition to legal issues, farmers are facing soaring seed prices and a reduction in choice of products. Although seed prices are not yet among the most important economic factors for farmers in the United States, it appears that they are about to become a bigger issue. For instance, in 2008, when Monsanto announced a new round of higher prices in maize, farmers voiced complaints about high seed prices.[10] [11] Although the company pushed up prices with the promise of higher yields and new technological features,[12] experts are concerned that the increase in seed prices has nothing to do with higher yields, but is instead a product of the high concentration of seed companies and resulting lack of competition in the U.S. seed market. This market does not provide sufficient choice for the farmers and in a sense forces them to purchase seeds at increasing prices.

In response to this problem, the Organization for Competitive Markets (OCM)[13] is running an initiative to increase choice in the seed market by holding Monsanto responsible for abusing its number one position in the seed business. According to OCM's figures, Monsanto maintains an extremely strong position, especially in genetically engineered seeds (see Graph 4).

Graph 4: Percentage of Monsanto's transgenic traits in cotton, maize (corn) and soy. Source: http://www.competitivemarkets.com



8 http://www.vanityfair.com/politics/features/2008/05/monsanto200805?printable=true&currentPage=all

9 www.percyschmeiser.com

10 http://www.dtnprogressivefarmer.com/dtnag/common/link.do?symbolicName=/ag/blogs/template1&blogHandle=business&blogEntryId=8a82c0bc1ae0f224011ae9296a9e005f

11 http://www.competitivemarkets.com/index.php?option=com_content&task=view&id=265&Itemid=80

12 A speaker for Monsanto was quoted in an article about the ongoing increase in prices for corn seeds: "We believe that through breeding and biotechnology, we can double corn yields by 2030." http://farmindustrynews.com/seed/0904_seed_university_prices/

13 http://www.competitivemarkets.com

OCM is advocating for fair seed prices:

> "Monsanto's market power is driving up seed prices and increasing economic risk to farmers. There is no competitive restraint to this price hike. This market power has been quietly accruing over several years and has now begun materially impacting price. The lack of competition and innovation in the marketplace has reduced farmers' choices and enabled Monsanto to raise prices unencumbered."

Indeed some quotes by a speaker from Monsanto (also cited above)[14] indicate that the company simply tries to find out how far it can raise prices in relation to farm income and sets prices accordingly:

> "We are measured on the value of the product we provide to the farm," the Monsanto speaker said. "Even at a 30 to 40% price increase, we're still the most profitable return on investment."

This analysis of the market only makes sense where there is no competition in the market that allows farmers real choices when comparing products of similar quality and price. Of course, this type of true competition is not in the interest of seed producers in the United States. In the same article[15] an expert from the Purdue University is quoted:

> "If such increases are in the future, producers don't really have any options. . . . If everyone raises seed prices, the only option is to not plant corn. So you pay and plant, or stop producing corn."

Farmers are squeezed in this situation; as their revenue from investments rises, the seed company increases the size of its portion of the pie. As BASF is quoted as saying back in 1998:

> "Farmers will be given just enough to keep them interested in growing the crops, but no more. And GM companies and food processors will say very clearly how they want the growers to grow the crops."[16]

According to Wolf (2009) the prices paid in Europe for seeds of Bt maize differ from region to region and are correlated with the likelihood of damage caused by the corn borer. This is a further indication that seed companies are fixing prices without any pressure from market competition. There are also reports from the United States showing similar results. For example, in 2008 a farm magazine reported on research involving 38,000 farms in 48 states:[17]

> "The . . . researchers found that depending on your state, there is an automatic premium added, except for Kentucky. 'Ordered from high to low premium, these states are: Nebraska ($7.50), Iowa ($7.00), Kansas ($6.86), Missouri ($6.31), Illinois ($5.96), Minnesota ($5.24), Colorado ($5.01), South Dakota ($4.75), Pennsylvania ($3.93), and Indiana ($3.70). This shows that the main corn-producing states in the Corn Belt charge more for corn seeds (e.g., Illinois or Iowa). It suggests that seed companies do price discriminate across regions.' "

According to this article, prices for seeds are also higher if stacked genes (which means that several gene constructs are combined in the plants) are introduced into the crops. The more artificial genes are inserted, the higher the revenue that can be expected for the company. This leads to a situation in which the company tries to sell plants with as many artificial genes as possible to increase its revenue.[18] In 2009 it is expected that more than 75% of maize seeds will be triple-stacked in the United States.[19] Herbicide tolerance will be combined with

14 http://farmindustrynews.com/seed/0904_seed_university_prices/

15 http://farmindustrynews.com/seed/0904_seed_university_prices/

16 Friedrich Vogel, head of BASF's crop protection business, Farmers Weekly, 6 November 1998 (the authors were not able to verify this quote).

17 http://www.farmgate.uiuc.edu/archive/2008/09/what_are_you_pa.html

18 http://www.farmgate.uiuc.edu/archive/2008/09/what_are_you_pa.html

19 http://www.dtnprogressivefarmer.com/dtnag/common/link.do?symbolicName=/ag/blogs/template1&blogHandle=business&blogEntryId=8a82c0bc1ae0f224011ae9296a9e005f

insect resistance above and below the soil. Since the expected revenue for triple stacked seeds is higher than for single traits, the company has no interest in offering alternatives with fewer traits, even if some farmers do not have a need for triple-stacked varieties. As an expert at OCM's website writes:[20]

> “I’d love to see a study of farmers purchasing varieties with triple-stacked traits that questioned if they bought them from need, or because their single and even double-stack traits are no longer available. The truth is: Monsanto doesn’t even want competition from its own trait packages. RoundUp Ready resistance is all that you what you want? Tough luck, they only license that trait to your dealer stacked with above and below ground pest protection as well. They see an opportunity to make more money selling you all the add-ons, and so are making it impossible for a farmer to just buy the single trait.”

Compared to the situation in the United States, where there is precise data on rising prices and market concentration, the impact of patents in developing countries is poorly documented. Nevertheless, economical and legal developments regarding this issue receive much attention — for example, in discussions on a new seed bill in India[21] or where the patentability of regional varieties is concerned.[22] There is also concern in developing countries about the growing economical impact of multinationals in the area of agriculture, as expressed, for example, in notes made by the UN Committee on Economic, Social and Cultural Rights (in its fortieth session in April/May 2008) regarding the situation in India:

> "The Committee is deeply concerned that the extreme hardship being experienced by farmers has led to an increasing incidence of suicides by farmers over the past decade. The Committee is particularly concerned that the extreme poverty among small-hold farmers caused by the lack of land, access to credit and adequate rural infrastructures, has been exacerbated by the introduction of genetically modified seeds by multinational corporations and the ensuing escalation of prices of seeds, fertilisers and pesticides, particularly in the cotton industry. "[23]

The implications of patented seeds on developing countries are also expressed by many experts in the field of patent law. For instance, the UK Commission on Intellectual Property Rights stated in its report in 2002:[24]

> "Because of the generally negative effects of patents in plant breeding, the UK Commission on Intellectual Property Rights explicitly advises developing countries to completely ban patents on plants and seeds."

In addition, Gary Toenniessen of the Rockefeller Foundation was quoted in Nature magazine in 2004 as saying:

> "If this trend isn't halted, some experts claim, tomorrow's supercrops may end up like many of today's medicines: priced out of the reach of much of the developing world's growing population. `We are headed down the same path that public-sector vaccine and drug research went down a couple of decades ago,´ says Gary Toenniessen, director of food security at the Rockefeller Foundation in New York."[25]

2.3 Monsanto in antitrust procedures

Given the situation in the United States, it is not surprising that several antitrust actions have been filed against seed businesses in that country.

---

20 http://www.competitivemarkets.com/index.php?option=com_content&task=view&id=265&Itemid=80

21 www.genecampaign.org/Publication/Article/seed_bill/Seeds%20Bill-%20JPC-19.pdf

22 http://www.navdanya.org/articles/articles27.htm

23 http://www2.ohchr.org/english/bodies/cescr/docs/co/E.C.12.IND.CO.5.doc

24 UK Commission on Intellectual Property Rights, 2002, Integrating Intellectual Property Rights and Development Policy, http://www.iprcommission.org

25 Knight, J., 2003, Crop improvement: A dying breed, Nature 421: 568-570, Feb 6, 2003.

One of the most recent cases was filed against Monsanto in October 2008 by a company from Texas named Texas Grain Storage (Case 5:07-cv-00673-OLG, in Texas Western District Court).[26] Its complaint combines the issue of seed monopolies with the pricing of pesticides. It is a highly interesting case because Texas Grain Storage has worked with Monsanto in the past. It sold Monsanto's herbicide glyphosate (brand name Roundup), so it is familiar with how Monsanto operates to achieve and keep its dominant market position. For Monsanto the herbicide glyphosate is a key blockbuster; sales of this product were greater than two billion dollars in 2006 (Monsanto's total sales in 2006 were more than seven billion dollars). According to the complaint, Monsanto's share of the U.S. market for glyphosate was about 60-80%, even years after the patent expired. Monsanto is alleged to have used its dominant, monopoly power in an unlawful way. According to the complaint, in 1996 the company developed a "Monsanto Maize Protection Business Plan" providing:

> "Patents for Roundup Ready genes have been issued. Using these patents and agreements with maize seed companies, Monsanto can prevent the use of any other glyphosate product (...)." (page 19 of the complaint)

The complaint explains that Monsanto's strategy for securing the market and hampering competition operated on several levels—through contracts and agreements with other companies (which include the possibility that other companies could buy Monsanto's original Roundup Ready product and resell it under their own brand names) and patents on genes and seeds to block access to technology and genetic material. These factors then got bundled in its contracts with customers. As the text of the complaint explains:

> "In other words, if seed companies do not sufficiently support the maintenance of Monsanto's market share in the markets for glyphosate-tolerant seed-traits, then Monsanto will penalize them. By financially bundling its pest-resistant seed-traits with its glyphosate-tolerant traits, Monsanto has used its monopoly power in pest-resistant and herbicide-tolerant traits to exclude competition in the relevant herbicide market, and obtain and maintain monopoly power in that market." (page 21 of the complaint)

This strategy was supported on a further level: Monsanto blocked innovation and breeding at competing companies. For example, when Monsanto's market rival Dupont tried to develop its own herbicide resistant seeds through conventional breeding in collaboration with Asgrow, a soybean seed company, Monsanto not only bought Asgrow but (according to the complaint by Texas Grain Storage), it forced Asgrow to breach existing contracts with Dupont, thus preventing the company from developing its own products. Thus, gradually and through reliance on several methods, Monsanto was successful in establishing a network of dependencies, licenses, ownerships and penalties, which tied consumers to its product.

Texas Grain Storage's complaint is not the only antitrust action currently under way against Monsanto. The American Corn Growers have also filed a case in U.S. Federal Court.[27] And in the past there have been similar attempts to start antitrust procedures against Monsanto. In 2000, for example, an initiative was started by the National Family Farm Coalition.[28] Rival companies in the seed business, such as Syngenta, have also alleged in the past that Monsanto violated competition standards, but achieved a settlement that more less strengthened the market power of these agrochemical companies.[29] In sum, Monsanto's history for the past 20 years has been visited by legal cases with farmers, companies, and various other institutions in the United States.[30] These cases point to the company's strategy for

[26] http://www.competitivemarkets.com/index.php?option=com_docman&task=cat_view&gid=27&Itemid=32

[27] http://www.acga.org/index.php?option=com_content&task=view&id=40&Itemid=42

[28] http://www.corpwatch.org/article.php?id=574

[29] http://www.patentdocs.org/2008/05/monsanto-and-sy.html

[30] http://www.nationalaglawcenter.org/assets/caseindexes/biotechnology.html

dominating the pesticides and seeds markets in a way that has been detrimental to farmers and to healthy market competition.

The antitrust complaint filed by Texas Grain Storage and the abovementioned court cases show the general problems that arise when there is a highly concentrated seed market, when there are only a few (or one) dominant players, and when patents are widely used as a decisive tool in controlling access to genetic material. So far this situation, i.e. the situation of the United States, seems to be atypical for many regions of the world. There are specific reasons why in Europe, for instance, farmers do not now suffer such consequences due to seed patents. It is largely because so far these patents mainly concern genetically engineered seeds and GE crops are grown on a large scale in very few regions of Europe. But if seed patents are extended to conventional breeding processes, farmers will be affected by new seed monopolies in Europe as they have been in the United States, and this will not only be the case in Europe, but also throughout many parts of the world.

3. Patents in conventional plant breeding

This section analyses the current and impending situation regarding patents in conventional breeding. It examines how many and what kinds of patent applications are pending at the EPO and investigates the extent to which patents involving conventional breeding have already been granted in Europe. Then, this section goes on to discuss the potential impacts of the process of patenting conventional breeding. In section four the report provides more detailed examples of patents that have already been granted and in section five explains some of the legal background.

As was mentioned earlier in the report, the background to this report is a pending, precedent-setting decision at the EPO. For the first time in its history the EPO will issue a general decision on the patentability of processes for breeding conventional seeds and plants. The patent cases under discussion in this decision are *'the patent on broccoli'* (**EP1069819**) and *'the patent on wrinkled tomatoes'* (**EP1211926**), both derived from conventional breeding (the legal cases related to these patents are registered at the EPO as G2/07 and G1/08, respectively).[31]

In both cases some technical tools were used during the process of breeding, and in both cases the patent holders argue that these technical tools provide sufficient reason to turn the whole process of conventional breeding into an inventive process for the production of plants. Further, those claiming the patens also argue that the seeds, resulting plants, and edible parts of the plants should all be part of the patents. If these two patents are upheld at the EPO, the consequence will be that minor technical inputs in plant and animal breeding processes will be sufficient to allow companies to claim conventional seeds and animals as their intellectual property, as is already the case with genetically engineered seeds.

3.1 Overall trends in plant breeding

There has been an interesting trend in plant breeding in the last few years. Innovation has been shifting from genetic engineering back to conventional methods supported by some technical tools. These tools include methods like marker assisted breeding (MAB), which are offering a more efficient approach to many goals in plant breeding when compared to methods used for genetically engineered seeds. Tools like marker assisted breeding, however, simply support conventional breeding to make it more efficient and do not require the same level of input as genetic engineering.

With these conventional plant breeding methods, existing biological diversity in plant genetic resources is screened for important genetic conditions, such as drought and pest tolerance. In most cases such seed qualities are not based on single DNA sequences but on complex genetic patterns and, thus, these qualities can normally be captured more effectively by using traditional breeding than by relying on genetic engineering. Conventional breeding has been making significant progress in relevant goals like yield and pest and stress resistance, some of the results are listed in an FAO report (2007).

These developments in conventional breeding are highly relevant for companies such as Monsanto, Dupont and Syngenta, the main drivers in GE seeds. These companies have access to a broad range of high quality genetic material owned by the seed companies that they bought within the last few years during the process of market concentration discussed above. Faced now with the new shift toward conventional breeding these companies are highly interested in extending patent monopolies to the area of conventional breeding.

In fact, companies such as Monsanto, Syngenta and Dupont are filing more and more patents on plants and seeds derived from conventional breeding. As our recent research for the ***no patents on seeds*** initiative shows, the number of patents claims on methods and products in conventional plant breeding has been steadily increasing and has now reached more than 500 in number. In 2008 nearly 25% of all patent applications at the EPO related to plants were directed at conventional breeding. Some years before, patent applications centred on conventional breeding processes had been the rare exception.

[31] For more details see: www.no-patents-on-seeds.org

At the same time, the number of patent applications in the field of genetic engineering has been decreasing for several years. Currently some patent applications reflect the technical limitations of genetic engineering in plants as compared to conventional breeding. By way of illustration, one can read this telling quote in Monsanto's patent application **WO 2004053055** (*'the patent on unintended effects'*):

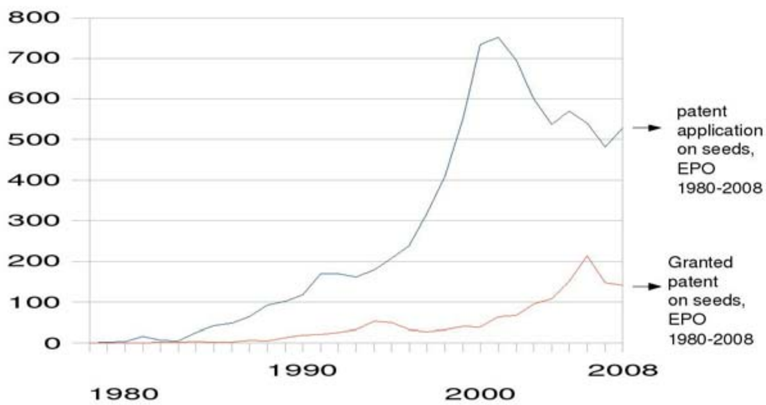
> "Nonetheless, the frequency of success of enhancing the transgenic plant is low due to a number of factors including the low predictability of the effects of a specific gene on the plant's growth, development and environmental response, the low frequency of maize transformation, the lack of highly predictable control of the gene once introduced into the genome, and other undesirable effects of the transformation event and tissue culture process." (page 2)

Similar passages can be found in **WO 2007078286** (*'the patent on misexpressed genes'*) applied for by the U.S. company, Ceres, and in application **WO 2008076834** (*'the patent on speculative gene functions'*) made by the U.S. company, Agrinomics. Patent applications by Syngenta also follow this trend, thus applauding the methods of conventional breeding and at the same time calling into question the technical advantages of genetic engineering. Relevant statements can be found in some of the most recent patent applications, such as **WO 2008087185**, **WO 2008087208**, and **WO 2008087208**. For example in **WO 2008087208** (*'the patent on complex traits'*) it is stated:

> "Most phenotypic traits of interest are controlled by more than one genetic locus, each of which typically influences the given trait to a greater or lesser degree (...) Generally, the term "quantitative trait" has been used to describe a phenotype that exhibits continuous variability in expression and is the net result of multiple genetic loci presumably interacting with each other and/or with the environment." (page 1)

When reading these patent applications it becomes evident that there has been a shift in strategical approach in plant breeding (at least when it comes to more complex patterns in heritage). (This new approach is driven by companies like Syngenta, which, interestingly, have been trying for years to promote GE seeds.)

Graph 5 shows the number of patent applications and patents granted at the EPO in the field of seeds and plants (with and without genetic engineering). The reduction in number is mainly due to a decrease in patent applications in genetic engineering during a period when applications encompassing conventional breeding are increasing (see below, graph 6).



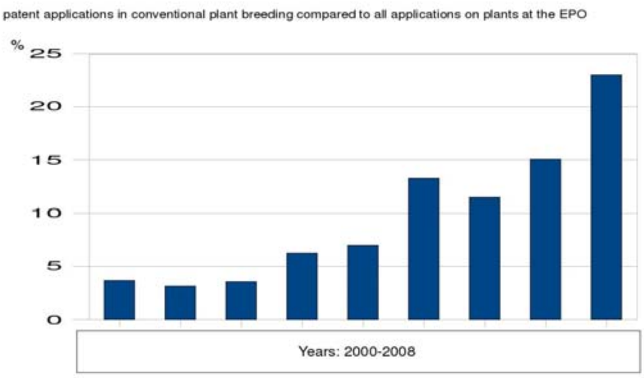
Graph 5: number of patent applications in plant breeding, 1980-2008 (source: Espace Access Vol. 2009/001 and EP-B Vol. 2009/00)

3.2 An overview of patent applications in conventional breeding

Our research found that the EPO has experienced an increase in patent applications involving conventional breeding in recent years. Almost all patent applications involving conventional breeding methods analysed for this report have been applied for via the World Intellectual Property Organisation in Geneva and then registered as pending at the EPO. The same applications will also be registered at many other patent offices around the world; therefore, these applications are not only relevant to Europe but to many parts of the world.

Graph 6 (below) shows the rise in patent applications in conventional breeding compared to all patent applications in the field of plants and seeds at the EPO. The data was compiled by screening patent applications at the EPO along certain classifications and names of relevant companies. Then the screened applications were studied in detail. Most of the studied applications concerned plant breeding without any reliance on GE, some encompassed a combination of GE and conventional breeding, and, lastly, some patent applications were mainly directed at the use of genetic engineering but also included conventional breeding as an additional option.

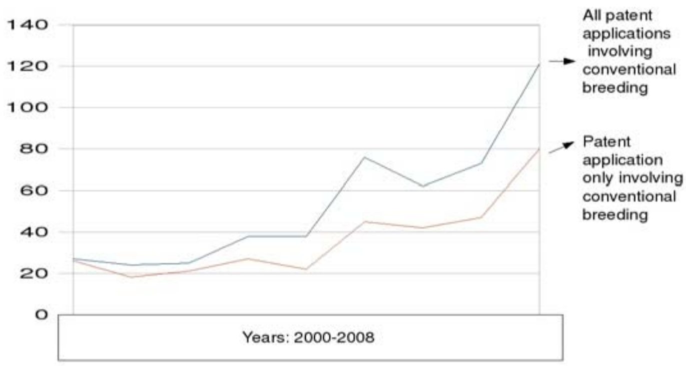
All in all, more than 500 patent applications were identified as including conventional breeding in plants, and most of these were filed not only in Europe but globally. The figures presented below are far from being complete in all aspects; nevertheless, this research is the most comprehensive ever done on the matter and provides the most realistic picture we have to date on the current situation of patents on conventional plant breeding processes at the EPO.



Graph 6: percentage of patent applications on conventional plant breeding compared to all applications in plants, 2000-2008, at the European Patent Office (source: own figures)

These approximately 500 applications were spread out at a rate of about 30 applications per year from 2000 to 2002, rising significantly to about 120 applications in 2008.[32] (Our estimation is that the true number of all relevant patent applications is at least 10 to 20 % higher than what we found through this research.) Of these patent applications, more than 60 can be directly linked to companies belonging to Monsanto, and around 30 applications can be linked to each Dupont and Syngenta. Both BASF (in cooperation with Cropdesign) and Bayer (in cooperation with Agrinomics) also filed a quite important number of patents, but in the applications from these two companies the use of GE seeds seems to be dominant and conventional breeding is only mentioned as an additional option.

Some of the patent applications studied involved both conventional breeding and genetic engineering, but most were directed only at conventional breeding. This can be seen in Graph 7, below.



Graph 7: Comparison of patents involving conventional breeding and partially also genetic engineering to those only involving only conventional breeding

3.3 Categories of patent applications and technologies used

In our analysis of the patents we found that companies relied on several methods to claim seeds and plants as intellectual property. The patent applications we studied in the field of conventional breeding were, for example, directed at the:

- content of compounds in plants (such as oil or protein)
- phenotypical features (such as number of leaves or size of plants, yield, growth, biomass)
- resistance against biotic or abiotic stress
- screening for naturally occurring genetic conditions (with methods such as marker assisted breeding)
- methods of breeding (like variations in

[32] The high number of patent applications for 2008 in this figure might be partially due to more in-depth research during that year.

hybrid technologies)
- methods for certain types of selecting and crossing
- mutagenesis (also including more recently targeted methods such as tilling)

Many of the technologies used to support conventional breeding were directed at analysing the naturally occurring genetic diversity of crop plants (all of these methods have been known for years). Some of them are listed here with a short overview:

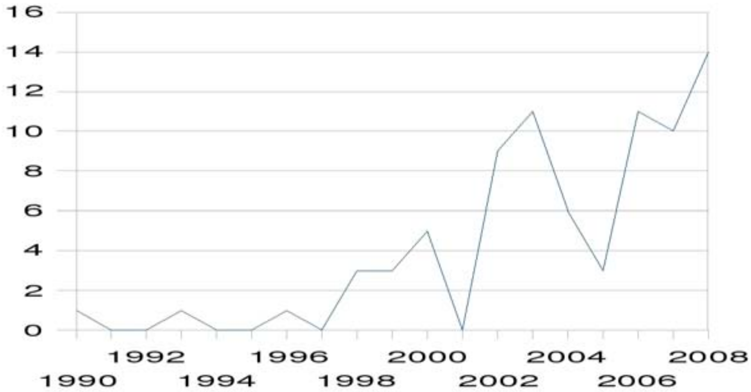
- **Genetic fingerprinting:** Genetic fingerprinting is not directed at specific, single regions of the genome, but reveals the distribution of general elements and structures in the genome. The resulting patterns are characteristic for each individual. The method is often used in crime investigation to identify persons, but can be applied to the genome of plants and animals as well. The results are not linked directly to genetic qualities, but might be used for further comparison of different genetic fingerprints, thus looking for statistical correlation with phenotypical characteristics. Fingerprinting can be performed by several methods; the most well known is Restriction Fragment Length Polymorphism (RFLP). In this method an enzyme is used to cut the genome in parts and pieces at locations with certain structures identified by the enzyme. Another method is haplotyping, which looks for genetic structures that are transmitted together from generation to generation.
- **Marker assisted breeding** (MAB): This method looks for correlation of specific DNA sequences with wanted phenotypical characteristics. It is more specific than genetic fingerprinting. Another term sometimes used for this method is genotyping.
- **Quantitative trait locus** (QTL): This method tries to find correlations between genetic markers and genetic conditions (traits) that cannot be reduced to a single gene locus but are based on the interactivity of several parts of the genome. The way these traits are expressed in the plants can follow quantitative patterns.
- **TILLING** (Targeting induced local lesions in genomes): This method is a kind of targeted mutagenesis. The plant is exposed to stimuli that can trigger mutations in the plant. The resulting plants are selected by screening for desired genetic structures.

In most cases the technical input for the overall breeding process in the above-listed methods is low (further insight is given by some patent examples below). Monsanto, for example, has been trying to monopolize large parts of the maize and soy genome by using a kind of unspecific genetic fingerprinting, trying to link the fingerprint with some genetic conditions of economic interest, such as yield or pest resistance with the use of statistical methods. This type of genetic fingerprinting is not directed at a single piece of DNA, but is more or less aimed at representing the whole genome and can be applied to various genetic conditions. In fact, the scope of these patents is very often not technically defined.

Finally, the patent applications identified by our research are especially relevant to the centres of biological diversity and to developing countries, from which many of the most important global crop plants originate. Screening for interesting gene material seems most promising in so-called "exotic" varieties, which are not used in high yielding crops in industrialised agriculture. Thus, patent applications based on methods such as marker assisted breeding or genetic fingerprinting open the way for a new kind of systematic biopiracy in developing countries (see below).

3.4 An overview on granted patents

Unfortunately, our findings show that the patent applications now pending at the EPO, which are highly relevant to the problems discussed in earlier sections, have a chance of being granted. So far the EPO has not stopped the granting of patents in the field of essentially biological processes, despite the opportunity to do so in response to the pending cases G2/07 ('*the patent on broccoli*') and G1/08 (`*the patent on wrinkled tomatoes*'). On the contrary, in 2007 and 2008 many patents involving essentially biological processes were granted. We found 78 granted patents involving conventional plant breeding methods.



Graph 8: grant of patents in conventional breeding of plants at the EPO from 1990 to 2008 (source: own figures)

The most problematic patents are those that in a very general way claim methods for fingerprinting and other methods such as genotyping, MAB and QTL, which can be used for the description and analysis of any genetic resources. These patents are not confined to concrete technical features or specific genetic characteristics.

One example that can help to explain this kind of patent stems from animal breeding. **EP 1651777** (‘*the patent on pig breeding*’) was granted in 2008 by the EPO; it deals with breeding pigs and marker assisted breeding (MAB). It was applied for by Monsanto and has now been sold to Newsham Choice Genetics (U.S.). It describes some genetic variations which can be found in all pig populations, without saying which of the variations is the most relevant. The patent claims usage of any of those variations as far as they might help to enhance breeding in pigs (related to characteristics such as lean meat and quicker growth). This patent can be applied to all sorts of pigs. Pigs selected (produced) by the method described can become the intellectual property of the patent holder, even if they were used by breeders and farmers in the past. To visualize this, one may imagine a patent granted on living beings that can be studied in a certain region of the being’s body by applying a microscope.

While the example above (‘*the patent on pig breeding*’) was directed at a certain gene locus (but technically not confined to distinct conditions), patent **EP 0483514** (granted in the year 2000 to Advanced Technologies, Cambridge, UK, ‘*the patent on tree breeding* ’) covers general genetic fingerprinting on trees. Any breeding of trees that uses the well known technical tool of fingerprinting, and even the resulting trees, are covered by this patent. In contrast to the example in the previous paragraph (‘*the patent on pig breeding*’), this case is like a patent on living beings that can be identified by looking at them through a simple magnifier (see more details below).

These last two patents violate a very general principle in patent law. Patents must be defined technically in such a way that the reader of the patent can identify what features and content are actually covered by the patent's claims. But these patents violate this principle, as they are not restricted to detailed (new) technological features or specific genetic characteristics. As a result, these patents can be misused to systematically grab genetic resources simply by analysing the latter. Further, these patents can be used as a tool to hamper competitors through legal uncertainties; because it is difficult for competitors to figure out the exact scope of the patents, they may be hesitant to proceed with their own creations. The consequence is that access to basic methods in breeding and plant genetic material can be severely limited or even blocked for other breeders. (And this brings us back to what was discussed in earlier section regarding limited choices and increased prices for farmers.)

3.5 Some possible impacts of patents on traditional breeding

Monsanto and other companies have on their agenda the systematic combination of varieties derived from conventional breeding with GE traits. For example, it is likely that new varieties of cotton with better drought resistance derived from conventional breeding will soon appear on the market only in combination with Monsanto GE traits.[33] Similarly, in another relevant case a soybean variety named Vistive, which has higher oil quality as a result of conventional breeding, is being placed on the market after first being combined with Monsanto’s gen constructs for herbicide resistance. In a third related example, in patent application **WO 2008150892**, Monsanto is explicitly

33 http://southwestfarmpress.com/cotton/gene-technology-1117/

claiming the combination of new conventionally bred varieties with GE traits such as herbicide and insect resistance (‘*the patent on GE in combination package*’).

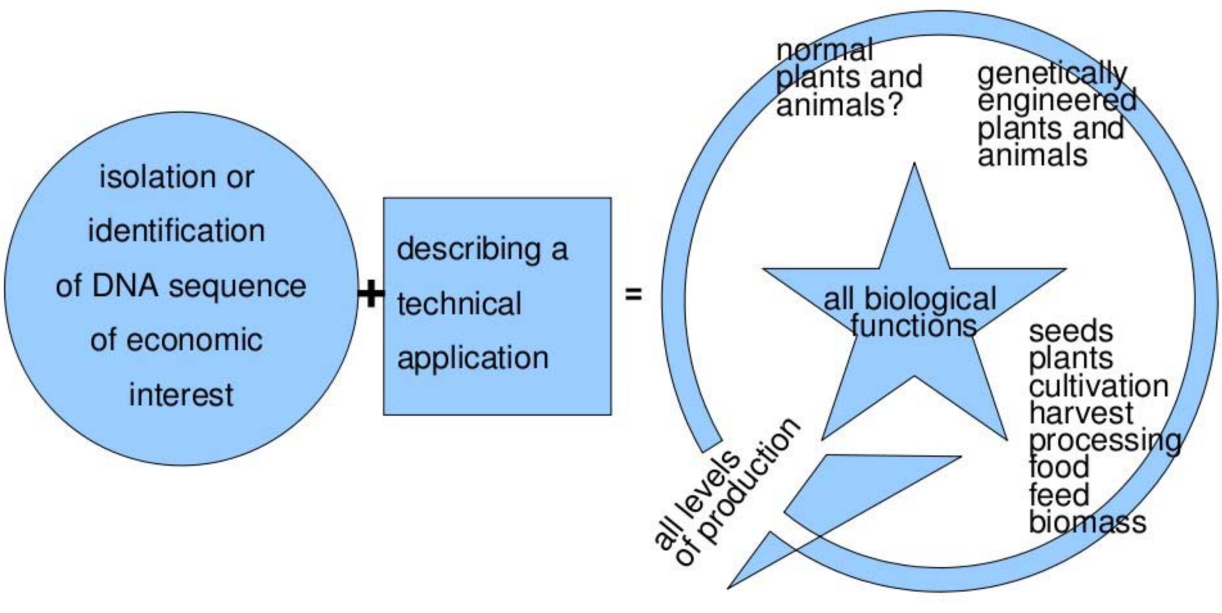
Situation such as those described above are likely to undermine the availability of true choice between seeds with and seeds without genetic engineering. As the case of Asgrow described earlier in this report shows (see above), some companies have gone as far as acquiring other, competing companies to stop them from producing competing products. The antitrust complaint filed by Texas Grain Storage mentions several companies involved in such practices, such as Holdens, Agracetus, Ecogen, Calgene, and Plant Breeding International. The combination of market concentration with the ability to patent and control both seeds with and without genetic engineering would open the way for a comprehensive takeover of genetic resources, seeds, and even derived products.

Moreover, it is important to note that patents are not restricted to seed production, they can cover the whole food production chain. For example the ‘*patent on broccoli’* (**EP 1069819**) (G2/07)**,** covers not only plants and seeds, but also all edible parts of the plant. Thus, patents involving conventional breeding can have serious impacts on the food market and other markets for agricultural products. In our current global situation, patents (in combination with other instruments for market control) could contribute to soaring food prices, worsening global food crises (see also Greenpeace, 2008).

Finally, it is important to note that in Europe patents on the production of plants and animals have a broader scope than in other parts of the world. The European Directive on Protection of Biotechnological Inventions (98/44 EC) provides that even in cases where only processes are claimed, the patents can cover all downstream products, future generations, and crossings (Art. 8.2 of the Directive, see also section 5).

Graph 9 shows that patents on seeds travel through the whole chain of production, impacting markets for seeds, food, feed and biomass. Currently, various patent applications and some granted patents (examples provided in the next section) have been found which cover the following food products: beer, lettuce, tomato, broccoli, soy milk, tofu, infant formula, melons, noodles, carrots, cauliflower, oil, meal and protein.

Graph 9: Patents on seeds and genetic resources and their possible impact on chain of food and biomass production



4. Examples of patents

Our research identified over 500 patent applications in Europe involving conventional breeding in plants. These patents could be used to misappropriate genetic resources and to gain control over food production. To explain the patterns and strategies behind these patents, we have selected a few examples and categorized them into three groups: (1) Basic methods in breeding; (2) Strategies of biopiracy; and (3) Controlling the chain of food production. In each category some examples are given of applications as well as of granted European patents.

Picture: Greenpeace activity to collect material for genetic fingerprints of politicians, 2007.

4.1 Basic methods in breeding

When in 2007 Greenpeace filed a European '*patent on politicians*' (**EP 1975245**), which described the selection of politicians and other living beings based on genetic fingerprinting and marker assisted breeding, the environmental organisation sought to show the absurdity of the current patent system. Greenpeace claimed that the selection of living beings (such as politicians) by use of this method would turn the living beings into a part of the invention.

The organisation applauded the EPO when in 2008 it rejected this application, which consisted of a combination of incredibly broad claims and trivial technical features. But in carrying out research for this report it has become evident that patents like the one proposed by Greenpeace have been filed by several companies. And, even worse, some of these patents have been granted in Europe[34].

4.1.1 Patent applications on basic breeding methods

Monsanto recently filed several such patent applications. For instance, **WO 08143993**, '*the patent of monsantosizing maize*'**,** claims marker assisted breeding and genetic fingerprinting in maize; and **WO 08153804**, '*the patent of monsantosizing soy*'**,** claims the same features in soy. In both of these patent applications Monsanto claims whole libraries of DNA markers. Further, their use in any statistical evaluation is part of the so-called invention. As the patent claims in **WO 08143993** ('*the patent of monsantosizing maize*') read:

> "What is claimed is a library of nucleic acid molecules" (claim 1)
>
> . . . .
>
> " a computer based system for reading, sorting or analysing corn genotype data" (claim 24)
>
> . . . .
>
> "a method of genotyping a corn plant to select a parent plant, a progeny plant (...) for breeding" (claim 37).

Each of the two patents lists 100 claims. By applying these patents, the genomes of maize and soy could be turned into a minefield for

[34] Such as EP0483514, '*the patent on tree breeding*'

other breeders. In theory the claims cover all possible characteristics of the plants. These patents seem to show that Monsanto is devising a strategy for claiming more or less all possible goals in plant breeding for two of the most important crop plants in the world.

Patent application **WO 2008021413**, '*the patent of monsantosizing maize and soy*', also uses similar methods, such as genetic fingerprinting (in this case based on a method called haplotyping). In more than 1000 pages and 175 claims Monsanto enumerates various relevant markers, especially in soy and maize. Monsanto even goes as far as explicitly claiming all maize and soy plants that incorporate the described genetic patterns in their genomes. And Monsanto asserts that the method used on plants are also applicable to animals:

> "the methods of the present invention can be used for breeding any non human organism. Specifically, the methods of the present invention can be used in breeding mammals, such as mice, swine, and cattle, and birds such as poultry or livestock." (page 1037)

In another related example, the Syngenta company's patent application **WO 2008087208**, '*the patent on yield of maize*', is based on the description of Quantitative Trait Locus (QTL) in maize for characteristics such as grain yield, moisture of harvest and architecture of tassel. Syngenta claims all relevant genetic markers, the plants which inherit the relevant genes, all products derived, and:

> "processed maize products, particularly maize grains and kernels obtainable from a plant to any of the proceeding claims." (claim 31).

Monsanto's patent application **WO 08054546**, '*the patent on detected resistance*', shows another strategy for the misappropriation of plant genetic resources. This patent application claims soy bean plants that are resistant against several diseases. This was done simply by selecting those plants which have a natural resistance against the diseases. Claim 1 reads:

> "A method for assaying a soybean plant for disease resistance, immunity, or susceptibility comprising the steps of: detaching a plant tissue from said soybean plant. . . . exposing said tissue to a plant pathogen; and assessing said tissue for resistance, immunity, or susceptibility to disease caused by said pathogen."

All soybeans derived from these procedures are claimed as the company's intellectual property.

Several patent applications include these conventional breeding techniques combined with genetic engineering. And in some patents the use of gene sequences in their isolated form (for genetic engineering) is claimed as well as their usage for conventional breeding. One example that combines several conventional breeding procedures with genetic engineering, thereby showing some of the essential limitations of GE in plants, is the application by the U.S. company Agrinomics, **WO 2008076834**, '*the patent on speculative gene functions*'. (Agrinomics works in cooperation with Bayer.) This patent aims to appropriate as many plant genes as possible that are likely to influence fibre, protein, oil or energy content in plants. Interestingly, the biological function of the genes listed is unknown. Agrinomics names these genes HIO (from **hi**gh **o**il content) and explains their functioning rather vaguely on page 18:

> "The HIO (...) does not necessarily relate to a plant having high oil (HIO) phenotype. As used herein, the gene (...) refers to any polypeptide sequence (or nucleic acid sequences that encodes it) that when expressed in plant causes an altered phenotype in any part of the plant, for example the seeds."

The gene sequences referred to could even be mis-expressed in a plant (as is happening in many cases with genetic engineering in plants). Nevertheless the plants produced would be covered by the patent as long as they were of any economical value. A technical failure of genetic engineering in plants that has been criticised from many sides could now be turned into an economic advantage:

> "In yet other preferred embodiments, mis-expression of the HIO polypeptide causes unchanged oil, high protein (...) and/or low fiber (...) phenotype in the plant."

Consequently a broad range of qualities in plants are being claimed (with lowered or enhanced contents of several compounds), as are a broad range of plants, such as corn, soy, cotton, cocoa, oil palm, coconut palm, peanuts, wheat and rice.

4.1.2 European patents granted on basic methods in breeding

An important question is whether the kinds of patents described above could be granted in Europe and elsewhere. At least for Europe the chilling answer is: YES. In fact, patents have already been granted on fingerprinting in plants and animals. Some examples:

The previously mentioned **EP 0483514**, '*the patent on tree breeding*', covers genetic fingerprinting in breeding trees in general. It was granted to Advanced Technologies (Cambridge) Ltd in the year 2000. This patent is based on a technology called Restriction Fragment Length Polymorphism (RFLP), which simply works due to the phenomena that DNA, cut in pieces by certain enzymes, will show individual patterns. It is one of the most common methods in genetic fingerprinting. The patent was granted for any kind of breeding purposes in trees. Claim one reads:

> "A method of forest tree breeding wherein Restriction Fragment Length Polymorphism (RFLP) technology is applied to samples of tree material from a plurality of forest trees; the data derived from said RFLP technology is statistically analysed thereby to cluster genetically similar trees of said plurality of said trees; two of said trees of genetic diversity are selected based on the statistically analysed RFLP data; and a further tree or trees is/are derived from the two selected trees. "

Another example is **EP 0537178**, '*the patent of genotyping for oil*', which was granted to the Dupont company in 2007. This patent refers to the use of fingerprinting in soy to select soy with a certain quality in its oil. In claim 13, the use of RFLP is patented to screen soybeans derived from conventional breeding for the relevant genetic condition.

A third example can be found in **EP 1465475**, '*the patent on sunflowers*' (Pioneer, granted 2006), which claims sunflowers with resistance against a certain pest, this feature having been derived using similar methods as described by Monsanto's **WO 20008054546** ('*the patent on detected resistance*'). The same company, Pioneer, holds a European patent, **EP 1042507** (granted in 2008), which generally and very broadly claims the use of methods such as QTL and MAB, and statistical evaluation based on these methods ('*the patent on mixed tools for breeding*').

BASF holds patents such as **EP 1268830** and **EP 1294912** (granted in 2007), and **EP 1311693** and **EP 1373530** (granted in 2006), which could be called '*the patents on open door to traditional breeding*'. These patents are mainly directed at genetic engineering, but also explicitly open the door for claiming conventional breeding methods related to stress and drought resistance in plants. (It appears that BASF has been consistently following this strategic approach in many of its patents.)

In yet another example, OM Partners Hortica's **EP 1129615** patent (granted in 2003) is very interesting in several aspects. The patent violates not only the prohibition of patents on essentially biological processes, it lists among its claims statistical methods and formulas (which are excluded from patentability as well) for the evaluation of data in breeding. Further, the patent covers both plants *and* animals. And, most surprisingly, the patent is completely lacking in any kind of invention, it simply describes very general, normal methods in breeding. This patent might be called '*the patent on one size fits all*'.

Furthermore, even if recent patent applications involving conventional plant breeding are not granted in the end, they can have an impact on other breeders. As long as these kinds of patents can be granted in Europe and elsewhere, breeders must cope with great legal uncertainty because their seeds and their work could infringe on one of these patents in the future. In many cases researchers and breeders avoid this type of uncertainty by avoiding the use any features claimed by other companies. This situation obstructs the use of genetic material and breeding methods, and ultimately hampers innovation. In fact, it is well known that the filing of strategic patent applications, even in cases where they will likely never be granted, is a strategy in the patent world that is used to block true competition.

As long as the types of patents discussed in this section are not definitely excluded, companies like Monsanto will go on filing numerous patents in this area, thus pushing competing companies out of the business, obstructing innovation, and hampering diversity and choice in seeds and food.

4.2 Strategies of biopiracy and theft of seeds

The case of the *Enola bean* or *yellow bean* gives some insight into how modern patent law can be abused to steal seeds and promote biopiracy. The yellow bean, long used in Mexico, was claimed by Larry Proctor as his invention. In 1999, he successfully applied for a U.S. patent, which was granted (U.S. patent number 5,894,079) and followed up by accusing Mexican farmers of infringing his patent by selling yellow beans in the United States. As a result, shipments of yellow beans from Mexico were stopped at the US-Mexico border, and Mexican farmers lost access to lucrative markets. It then took eight years for the patent to be battled out successfully.[35]

More recent patents on methods like genetic fingerprinting are much broader and effective than the Enola bean (yellow bean) patent, and are also much more difficult to identify as cases of actual biopiracy. Patents on basic methods in plant breeding, such as genetic fingerprinting, QTL and MAB, can be applied on an undefined and large group of plant species. They are a perfect tool for systematic biopiracy, as they enable the patent holder to turn global commons, essential for food production, into private property by simply describing them using technical means. Many of these patents are nothing but well-organised theft and global robbery supported by patent offices and certain political institutions in industrialised countries.

Moreover, several patent applications show that this method of biopiracy is a systematically applied strategy. As Monsanto explains in patent application **WO 2008121291** (‘*the patent of monsantosizing biodiversity*’):

> “The genetic base of cultivated soybean is narrow compared to other field crops (...) Due to the narrow genetic base, soybean is more likely to be impacted by disease and insect attacks. (...) Exotic germplasm possesses such key traits as disease resistance, insect resistance, nematode resistance, an tolerance to environmental stress (...) Markers associated with plant maturity facilitate the use of exotic germplasm. Breeders create crosses between exotic and cultivated germplasm.” (page 81)

In the patent Monsanto claims the crossing of soy varieties that are not common in the U.S. market. Because the origin of soy is in Asian countries, it is likely that this patent aims at the misappropriation of biodiversity in those regions of the world in particular.

Similarly, Pioneer/Dupont claims crossing with so called “exotic varieties” of soy beans to achieve better resistance against common plant pests (**WO 2006017833**, **WO 200605585**, ‘*patents of biopiracy in exotics*’). Pioneer also claims MAB for selecting high oil varieties in maize (**WO 2006055851**, ‘*the patent Nr2 on Mexican maize*’), which are known to be common in Latin America but not in the United States.

In the past few years several cases of biopiracy of this kind at the EPO have been brought to light by organisations like Greenpeace, Misereor, No Patents on Life! and the Declaration of Berne—for example, Dupont's patent on high oil maize varieties from Mexico (**EP 744888,** *‘the patent Nr1 on Mexican maize’*), granted in year 2000, and Monsanto's patent on wheat from India (**EP 445929** *‘the patent on Indian wheat’*), granted in 2003. Both of these patents were revoked (or withdrawn) after legal oppositions were filed. The only way to protect the centres of biological diversity from being pirated in this way by international companies is to issue a clear regulation in patent law, excluding all patents on conventional breeding of plants. The development of biopiracy can no longer be sustainably and effectively controlled by single opposition procedures.

---

[35] The story of the yellow bean patent can be found in detail at the ETC website: http://www.etcgroup.org/en/materials/publications.html?pub_id=683

4.3 Controlling the chain of food production

As a recent report by Greenpeace Germany (2008) showed companies such as Monsanto have not restricted their property claims to seed and plant varieties, but have aimed to control the whole chain of food and biomass production. Greenpeace Germany's finding were confirmed by our research, which revealed several new examples of such broad-sweeping patents.

We found that Bayer, for example, has claimed certain methods and genetic resources with and without genetic engineering in its patent application **WO 2006079567** ('*the patent on anything derived from plants*'), which is directed at oil seed varieties. As the company explained in the patent application:

> "as used herein 'plant product' includes anything derived from plants of the invention, including plant parts such as seeds, meals, fats or oils" (page 2)

Seminis, which is owned by Monsanto, has claimed patents on seeds and vegetables, such as '*the patent on cauliflower*' (**WO 2008042392**) and '*the patent on carrots*' (**WO 2008049071**), going as far as mentioning the process of harvesting:

> "methods of producing carrots comprising:
>
> (a) obtaining the plant (...), wherein the plant has been cultivated to maturity; and
>
> (b) collecting carrots from the plant." (claim 35)

One can even find '*patents on beer*' and '*patents on noodles*'. The Carlsberg brewery claims everything from breeding barley to beer (**WO 20050879349**), and the Australian Commonwealth Scientific and Industrial Research Organisation claims breeding in wheat for pasta, such as noodles. (**WO 2005120214**).

Recently, Monsanto has presented a new example of its monopoly grasping strategy. In patent application **WO 2008150892**, '*the patent on monsantosizing food feed fuel*', the company claims breeding for soy beans with an oil content of between 23 and 35 %, which have been derived from conventional breeding and combined with transgenic traits, such as herbicide resistance. Monsanto claims the plants and their derived food products, listing the whole chain of production in the claims. For example claim 7 reads:

> "A method of producing food, feed, fuel or an industrial product comprising the steps of:
>
> (a) obtaining seed from the plant ...
>
> (b) planting and growing the seed into mature plant
>
> (c) harvesting seed from the mature plant; and
>
> (d) preparing food, feed, fuel or an industrial product from the harvested seed."

There have already been several granted patents that cover the food production chain from seed to food, such as '*the patent on broccoli*' (**EP 1069819**, granted 2002 for Plant Bioscience Limited), which set the precedent for the EPO to decide on this patent (G2/07). Further examples of cases covering the chain from seed to food are '*the patent on salad*' (**EP 942643**, granted in 2008 for the Rijk Zwaan Zaadtelt en Zaadhandel B.V. company), and '*the patent on melons*' (**EP 1587933**, granted in 2008 for Syngenta). In addition, the Cargill company holds a European patent on breeding of Brassica plants, which covers industrial lubricant (**EP 1100310**, granted 2008, '*the patent on use of plant oil*') and Dupont holds a patent on breeding in soy beans (**EP 0973913**, granted 2005, '*the patent on tofu*') that covers soy sauce, tofu, natto, miso, tempeh and yuba, soy protein concentrates, soy protein isolates, textured soy protein, soy milk and infant formula. In another patent (**EP 0537178**, granted 2007, '*the patent on crushing seeds*'), Dupont used genetic fingerprinting to identify soy with a certain oil quality and claim seeds, plants and crushing of the seeds for the production of oil.

The direct impacts that these patents may have on farmers and consumers cannot be expressed in concrete figures. Nevertheless, all of these patents contribute to a food market enmeshed in a spider web of exclusive monopoly rights that make it possible for companies to fix prices, distribute commodities and control access to resources. Normal food producers and smaller trading companies are likely to get lost in this morass of intellectual property claims, while some large companies will survive, cooperating and also struggling with one other. These larger companies will likely control the chain of production, if not more, of the most important food and biofuel plants on the world market. (This scenario is already a reality in some markets, such as biofuel production using maize in the United States.) Ultimately, patents and market concentration will probably change international markets dramatically; soaring prices and rising hunger will most likely be the eventual results of these developments.

5. Legal situation in Europe

Until 1980 it was generally assumed that living materials, including plants, animals, and microorganisms, were, due to their very nature, not capable of being invented and therefore not patentable (Emmott, 2001). With the rise of genetic engineering, companies started lobbying heavily for patents covering microorganisms, gene sequences, plants and animals. In the United States a patent on a microorganism in 1980 (the so-called Chakrabarty case)[36] was seen as a turning point, while in Europe the adoption of the European directive "On legal protection of biotechnological inventions" (98/44 EC) was the turning point. The European directive was discussed for more than ten years and adopted by the European Parliament in 1998. It was adopted by the EPO in 1999. The directive allows patents on plants, animals and genetic resources, and even on parts of the human body.

5.1 Plant varieties and genetically engineered plants at the EPO

The EPO started granting patents on plants and animals in the late 1980s and the beginning of the 1990s, but it was then stopped by a legal challenge brought by Greenpeace in 1995 (decision T356/93), where Greenpeace relied on the European Patent Convention (EPC), Art. 53b, which excludes patents on plant varieties from patentability. Following this challenge, no more plants and animals were patented for some years.

But the European patent directive 98/44 drastically changed this situation, undermining the prohibition of patents on plant varieties by allowing patents on all plant material that cannot be identified as specific varieties. Article 4 (2):

> "Inventions which concern plants or animals shall be patentable if the technical feasibility of the invention is not confined to a particular plant or animal variety"

From its very beginning directive 98/44 was drafted as a European regulation specifically serving the interests of industry. The patent directive was then adopted by the EPO, and, following this, the EPO's Enlarged Board of Appeal decided that the previous decision on the Greenpeace case should no longer be applied (G1/98).

Paradoxically, this has led to a situation where patents on GE plants can be granted, and can even cover plant varieties, as long as specific, single varieties are not claimed. Since 1999, the patent office has granted more than 1000 patents on seeds and plants based on this questionable legal construct. Put simply, the prohibition on patents on plant varieties (which is still part of the EPC) has not been relevant since then. This has been especially true for plants derived from genetic engineering (GE), which incorporate genetic constructs that can be transferred from one plant species to another. Patents on GE seeds are routinely granted by the EPO; they cover all relevant material, such as seeds, plants and harvest, and subsequent crossings and generations.

5.2 Conventional breeding

Because conventional breeding has become more and more important in comparison to genetic engineering in the last few years (for various reasons discussed in section 3, above), a second prohibition in European patent law has become an issue of major dispute. According to EPC Art. 53b it is forbidden to grant patents on "essentially biological methods for the production of plants and animals". European patent directive 98/44, however, also offers an industry-friendly solution to this problem—the legal definition of "essentially biological processes" can hardly be applied and therefore is open to a broad range of interpretations. Article 2 of 98/44 EC reads:

> "A process for the production of plants or animals is essentially biological if it consists entirely of natural phenomena such as crossing or selection."

The Board of Appeal at the EPO decided that this legal definition of "essentially biological process" must be interpreted by the Enlarged

36 http://en.wikipedia.org/wiki/Diamond_v._Chakrabarty

Board. In decision T83/05 (the starting point for G2/07) the Board of Appeal held:

> "The wording of Article 2 (2) Biotech Directive and Rule 23b (5) EPC is, in the view of the board, somewhat difficult to understand. On the one hand, only processes which consist entirely of natural phenomena are considered to be essentially biological processes for the production of plants. On the other hand, crossing and selection are given as examples of natural phenomena. This appears to be self-contradictory to some extent since the systematic crossing and selection as carried out in traditional plant breeding would not occur in nature without the intervention of man." (page 336/37, paragraph 53)

Thus the way was opened for the case of '*the patent on broccoli* ', **EP 1069819** (G2/07), and '*the patent on wrinkled tomato*', **EP 1211926** (G1/08).

Under these conditions, companies like Syngenta follow a simple line of argumentation—the exemption from patentability should only be used in those very rare cases without any technical interventions. According to Syngenta, the exemption should be applied to natural processes for selection as described by Charles Darwin, but not in plant breeding:

> "While such natural processes are exempted from patentability, biological processes of plant breeding which comprise technical steps and represent a technical process should be patentable (...) Under these prerequisites also processes which are only based on crossing and selection are in general patentable as long as they represent a technical teaching." (Syngenta's statement in the G2/07 case, page 13)

The consequences of this line of argumentation can be seen in many of the patent applications and granted patents listed in this report.

5.3 Scope of patents

There is a regulation in Europe that is unique in patent law worldwide (see Tvedt, 2008). Under directive 98/44 EC, the scope of *patents on processes* for the production of plant and animals can extend to later generations and all related products from crossing and selection.

According to international patent law standards, patents on processes normally end with the product directly obtained by any given procedure. In Europe, however, the scope of patents involving the breeding of plants and animals goes beyond this. As Article 8 (2) of directive 98/44 EC reads:

> "The protection conferred by a patent on a process (...) shall extend to biological material directly obtained through that process and to any other biological material derived from the directly obtained biological material through propagation or multiplication in an identical or divergent form and possessing those same characteristics"

Thus, under this regulation, a process for marker assisted breeding in plants or animals would not only cover the method, but all related seeds and plants, even after further crossing and propagation. This offers immense potential for problems with these patents; based on trivial technical processes, a patents' scope can easily be extended to misappropriate the genetic resources themselves, at least as long as they have the specific patented characteristics.

In addition, the same problem applies if seeds or animals are directly claimed as products. In these cases all further use of these seeds is covered by the patent, no matter if the seeds are sold directly or first used for crossing and selection. (This regulation on patented products is in place not only in Europe but also in other industrialised countries, such as the United States.) This extremely broad patent scope creates far reaching dependencies for farmers, breeders and any other producer downstream in the processing of food and biomass, and can also lead to the accumulation of patents in seeds and plants after each step of crossing.

5.4 How to patent something that already existed

The patenting of seeds selected by methods like marker assisted breeding violates a very general principal in patent law. Patent rights apply only in relation to an object which would not exist if it had not been created by an inventor. Otherwise, if this principle did not exist, things that are already in existence, and are perhaps already being used for some purposes, could be monopolised by patents. Clearly, such a situation would be contrary to the fundamental principles of modern patent law (see for example Haugen, 2007).

Hence, this principle can only be put aside in a few, very distinct cases. For example, it can be put aside when a compound already in existence in nature reveals surprising new qualities after technological processing. A well-known example of this from patent literature is the case of a toxic mushroom that exhibits a chemical compound that can be used for healing intoxication (the so-called Antanamid case, a decision taken in 1977 by a German court).

In contrast, the use of tools like genetic fingerprinting, marker assisted breeding, and analyses of oil and protein are aimed at finding qualities in seeds that have a high probability of being found (that are fairly obvious); therefore, the use of these tools to find these qualities is not an invention.[37]

5.5 European patent system in conflict with international obligations

Due to the aforementioned developments, patent law is likely to come into conflict, not only with its own principles, but also with international legal obligations. If access to food and means of food production are hampered by these patents, Intellectual Property Rights (Haugen, 2007) could come into conflict with the International Covenant on Economic, Social and Cultural Rights (ICESCR), for example. This UN covenant requires physical and economic accessibility to goods such as medicines and seeds (recognized in articles 12 and 11 of the ICESCR).[38]

In addition, if patents on seeds reduce choice and diversity, thereby contributing to genetic erosion and becoming a threat to long-term food security, they could come into conflict with Farmers' Rights, as recognised in the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA, see also http://www.farmersrights.org). The latter treaty puts farmers in a position to conserve and sustainably use plant genetic resources to provide a sustainable food supply. Lastly, the ITPGRFA prohibits claims on exclusive rights to genetic resources stemming from international gene banks, which are under the supervision of the Consultative Group on International Agricultural Resources (CGIAR). Because patents on genetic finger printing and marker assisted breeding are systematically used to screen the accessible gene pool and transform genetic resources into private property, they are in conflict with the International Treaty on Plant Genetic Resources for Food and Agriculture.

---

[37] This problem has also been debated in the context of the patentability of human genes. The European parliament, which passed directive 98/44 EC, mandated that patents can only cover new technical functions, and not gene sequences (European parliament resolution on patents for biotechnological inventions, 26 October 2005).

[38] The UN committee on economic, social and cultural rights underscored this principle with regard to access to seeds in a statement from a session in April/May 2008. http://www2.ohchr.org/english/bodies/cescr/docs/co/E.C.12.IND.CO.5.doc

6. Some conclusions and political demands

Patents on seeds and plants derived from conventional breeding can severely obstruct access to plant (and animal) genetic resources necessary for plant breeding and agricultural production. The spread of such patents will foster concentration, cause price increases, and create even stronger dependencies for farmers and breeders and, in the longer run, also for consumers.

The current situation of patents has been heavily criticised by International Assessment of Agricultural Science and Technology for Development (IAASTD), a global consultative initiated by the World Bank and the Food and Agriculture Organization of the United Nations, and conducted by 400 scientists over a period of three years. The assessment concluded that,

> "In developing countries especially, instruments such as patents may drive up costs, restrict experimentation by the individual farmer or public researcher while also potentially undermining local practices that enhance food security and economic sustainability."[39]

And the European Group on Ethics in Science and New Technologies wrote in its Opinion No. 24 in October 2008:

> "The Group supports promotion of innovation in agriculture but is concerned about the impact of patents on agricultural crops."

Specifically in light of the UN's millennium goal to reduce global hunger substantially within the next years, recent developments in conventional plant breeding patents are counterproductive and will likely lead to greater inequality, hunger and poverty. As Miguel d'Escoto Brockmann, President of the General Assembly, remarked on September 25, 2008 at an important event on the millennium development goals:

> "The essential purpose of food, which is to nourish people , has been subordinated to the economic aims of a handful of multinational corporations that monopolize all aspects of food production, from seeds to major distribution chains (...)"[40]

Patents on seeds and methods for conventional breeding interrupt the process of innovation in plant breeding and block access to essential plant genetic resources. Furthermore, they foster market concentration, hamper competition, and serve to promote unjust monopoly rights. Such patents have nothing to do with the traditional understanding of patent law or with giving fair rewards and incentives for innovation and inventions. Based largely on trivial technical features, such patents abuse patent law, using it as a tool of misappropriation that turns common agricultural resources needed for food production into the intellectual property of some companies.

Moreover, certain methods, genetic conditions or plant characteristics are being claimed in parallel by several companies by just varying a few technical details. In the future, these claims are likely to create legal uncertainties for all breeders and cause many court battles due to patent infringements. While large companies may (eventually) find solutions to this situation, smaller enterprises, breeders, and farmers will get lost in a jungle of 'patent thickets' and monopoly claims. This will further foster market concentration, leaving only a few dominant companies standing. In this scenario, the future of seeds and foods in Europe and other areas could look like the present situation in the United States with respect to genetically engineered plants. Competition, choice for farmers and diversity in crops are all in danger of rapidly shrinking if large seed companies take global control.

---

[39] http://www.greenfacts.org/en/agriculture-iaastd/l-2/3-biotechnology-for-development.htm#0

[40] http://appablog.wordpress.com/2008/09/26/opening-remarks-by-h-e-m-miguel-d%E2%80%99escoto-brockmann-president-of-the-general-assembly-at-the-high-level-event-on-the-millennium-development-goals-25-september-2008-united-nations-new-york/

There are several possibilities for counteracting this process politically and legally:

- Providing a clear interpretation of the exemption of essentially biological processes at the EPO that excludes patents on conventional breeding and derived products;
- Revising the European patent system to reinforce the exemption of plant and animals varieties;
- Revising patent law to exclude all kinds of genetic material (such as human, animal or plant genes) from patentability;
- Revising the TRIPs agreement to prohibit patents on seeds and animals for agricultural purposes;
- Supporting open source systems in plant and animal breeding with adequate incentives for breeders, without hampering usage of genetic resources.

References

Center for Food Safety, 2005, Monsanto vrs US Farmers, www.centerforfoodsafety.org

EGE, The European Group on Ethics in Science and New Technologies to the European Commission (2008), Ethics of modern developments in agriculture technologies, Opinion No 24, http://ec.europa.eu/european_group_ethics/index_en.htm

Emmott, Steve (2001): "No Patents on Life: The Incredible Ten-year Campaign against the European Patent Directive", in Brian Tokar (ed) (2001): *Redesigning Life? The Worldwide challenge to Genetic Engineering"*, Zed books, London and New York

European Patent Office, 2007, "Scenarios for the Future, How might IP regimes evolve by 2025? What global legitimacy might such regimes have?" Summary, http://www.epo.org/topics/patent-system/scenarios-for-the-future.html

FAO (2007) MARKER-ASSISTED SELECTION , Current status and future perspectives in crops, livestock, forestry and fish , FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, Rome, http://www.fao.org/docrep/010/a1120e/a1120e00.HTM

Fernandez-Cornejo, Jorge, 2004, The seed industry in U.S. Agriculture, USDA, Agriculture information bulletin, no. 786

Greenpeace, 2008, Patents on Hunger? Christoph Then & Ruth Tippe, http://www.greenpeace.de/fileadmin/gpd/user_upload/themen/patente_auf_leben/Patents_on_Hunger_report.pdf

Haugen, Hans Morten (2007), Patent Rights and Human Rights: Exploring their Relationships, The Journal of World Intellectual Property, Vol. 10, no. 2, pp. 97–124

Kock, M. et al, 2006, "The Legal Protection of Plant-Biotechnological Inventions and Plant Varieties in Light of the EC Biopatent Directive", in: International Review of Intellectual Property and Competition Law, Vol 37, No 2/2006, pages 135-244.

Rabobank, 1996 (second edition), The World Seed Market, Rabobank international marketing, Netherlands

Then, Ch. und Lorch, A., 2009, Schadensbericht Gentechnik, published by BÖLW, http://www.boelw.de/pm+M5f5fe69ec0d.html

Tvedt, Morten Walløe and Finckenhagen, Magnus, 2008, Scope of Process Patents in Farm Animal Breeding, The Journal of World Intellectual Property (2008) Vol. 11, no. 3, pp. 203–228

Wolf, D. und Albisser-Vögeli G., 2009, Ökonomischer Nutzen von Bt Mais ist relativ, AGRARForschung 16 (1): 4-9