# Current and future availability of non-genetically modified soybean seeds in the U.S., Brazil and Argentina

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Task T3.7

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The analysis and comments made here remain however our sole responsibility.

# Contents

# Introduction

In the U.S., Brazil and Argentina, the leader countries in soybean production, the high adoption rates of GMOs has raised the question of whether non-GM varieties will go on being developed for farmer uses, i.e. whether new competitive non-GM varieties will be bred and released. This issue has become more prominent in 2009 with anecdotal information revealing that some U.S. farmers had difficulties to access non-GM soybean seeds.

In this context, the aim of this report is to provide some information on the current situation on the soybean seed market and on soybean plant breeding for the three leading producers of soybeans, and to discuss to what extent the apparent seed shortage of 2009 in the U.S. is just a short-term issue or whether it reveals a more general trend of strong decline of competitive non-GM seed breeding and supply.

These investigations on non-GM soybean seeds availability in America are of interest to the European Union because they provide new facts and perspectives on the issue of the future non-GM soybean supply in these countries. Europe depends on soybean imports and the question of the future availability of non-GM materials for feed uses, linked for instance to labelling policies, is an important source of debate.[1] Issues like identity preservation in the supply chain have already been tackled in different works but the question of the availability of non-GM seeds for farmers in exporting countries has not been investigated yet.

This focus on research and development of new soybean varieties in countries with different adoption rates of GM soybeans and different economic and legal contexts also gives new information on whether, and how, the development of a GM culture, of any species, in a country might exclude the development of the alternative non-GM culture of the same crop.[2]

Methodologically, this report relies on data from variety registers or from databases on intellectual protection rights, like certificates or patents on varieties, in the three countries; on phone or e-mail interviews with actors of the sectors considered (researchers, plant breeders, farmers, firms or non-profit organizations' employees, civil servants or journalists) in the three countries; on an Internet search on companies' public documents (like variety catalogues); and on scientific and gray literature.

The first section of the report gives an overview of the world soybean GM and non-GM market. It describes the current non-GM soybean production and the current demand for non-GM soybean seeds in the three countries.

The second section presents the different types of intellectual property rights for plant breeders, the market structure in the soybean seed industry, the non-GM soybean breeding activity and the availability of non-GM seeds for farmers in each country.

The third section discusses prospects on the future of non-GM soybean breeding activity.

[1] See for instance the report published by DEFRA and the Food Standards Agency in August 2009: GM Crops and Foods: Follow-up to the *Food Matters* report by Defra and the FSA
http://www.defra.gov.uk/environment/quality/gm/crops/index.htm

[2] A process called "path-dependency". See for instance Vanloqueren G., Baret P. V. (2009) ; Liebowitz S.J., Margolis S.E. (1995); Arthur B. (1989).

# 1 Global overview of the markets of soybeans and soybean seeds and short term issues

This first section is dedicated to an overview of the world soybean market and to a presentation of the market of non-GM soybean seeds in the U.S, Brazil and Argentina.

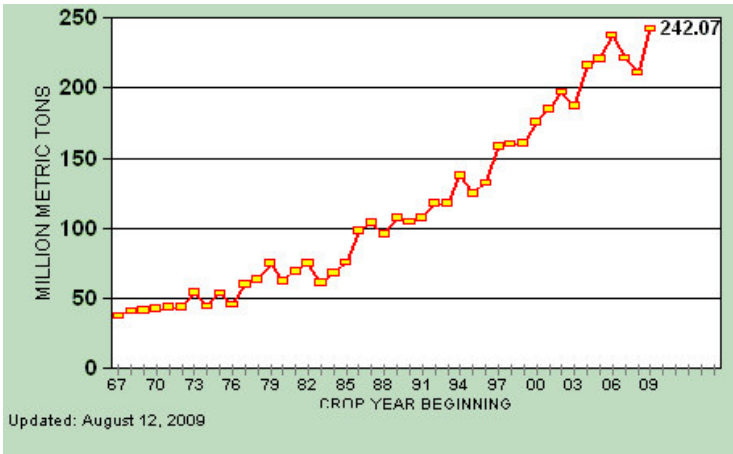
It includes a special focus on the shortage of non-GM soybean seeds that occurred in the U.S. in 2009.

## *1.1 Soybean world market*

This subsection gives a rapid overview of world supply and demand of soybeans.

### 1.1.1 World soybean production[3]

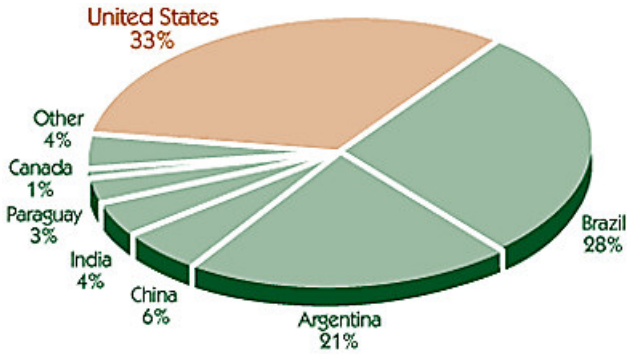
World production of soybeans has significantly increased over the last 25 years (Graph 1).




**Graph 1: World soybean production (Source: www.cmegroup.com)**

- **Production concentrated in three countries: the United States, Brazil and Argentina**

The United States, Brazil and Argentina, the three countries studied in this document, are the world soybean production leaders. In 2008, they accounted for 82% of the world production of soybeans (see below).

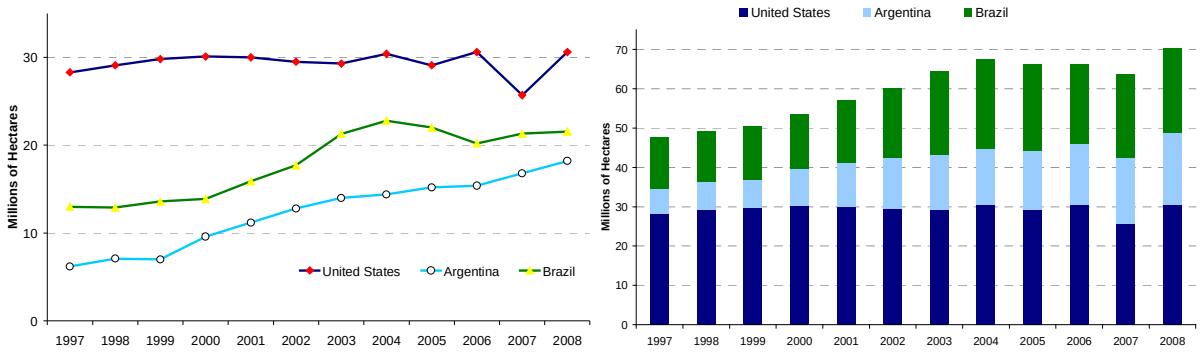



| | Million of Tons | % |
|---|---|---|
| United States | 72.9 | 33.00% |
| Brazil | 61 | 27.61% |
| Argentina | 46.2 | 20.91% |
| China | 14 | 6.34% |
| India | 9.3 | 4.21% |
| Paraguay | 6.8 | 3.08% |
| Canada | 2.7 | 1.22% |
| Other | 8 | 3.62% |
| **Total** | **220.9** | **100%** |

**Graph 2: World soybean production in 2008 (Source: USDA, www.soystats.com)**

[3] An analysis of these different figures is available for instance in "USDA Agricultural Projections to 2018, February 2009" (http://www.ers.usda.gov).

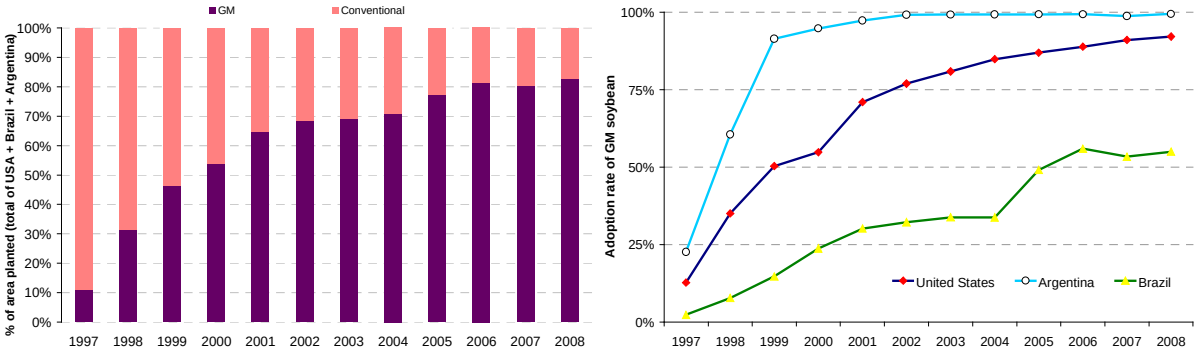
While production has been quite stable in the U.S. in the last decade, it has risen significantly in Argentina and Brazil (Graph 3).




**Graph 3: Planted areas of soybean in Argentina, Brazil and United States (Source: USDA/FAS, ArgenBio, ISAAA, CONAB, www.soystats.com)**

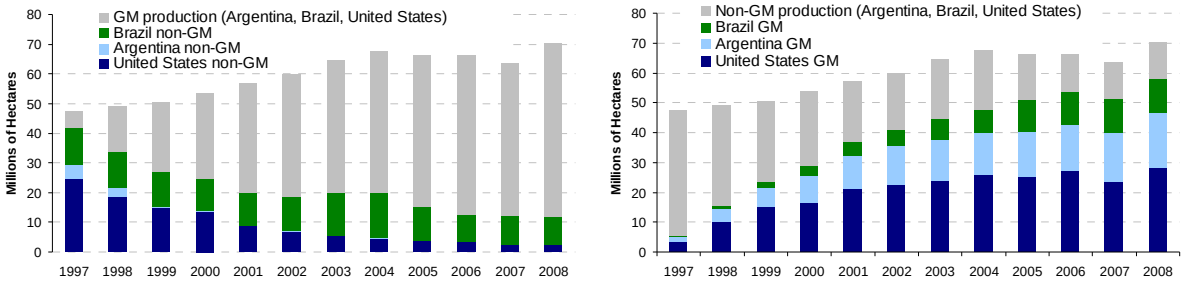
- **Adoption of transgenic soybeans in Argentina, Brazil and the United States**

From 11.2% in 1997, the average adoption rate of transgenic soybeans in these three countries reached more than 85% in 2008, with significant differences between the three countries. Almost all of Argentinean soybeans are transgenic, while 45% of soybean areas are still planted with conventional varieties in Brazil. The United States are in an intermediate position with 8 to 9% of the surface planted with conventional soybeans (Graph 4).




**Graph 4: Evolution of the GM soybean adoption in Argentina, Brazil and the United States (Source: USDA/FAS, ISAAA, ArgenBio, CONAB, www.soystats.com)**

After a decade of constant decrease, the area planted with conventional soybeans increased slightly between 2007 and 2008 in Brazil and in the United States (Graph 5). This move has been reinforced in 2009 in the United States with an increase of more than 400,000 hectares of conventional soybean plantings, that is to say, 1.3% of U.S. soybean areas. This trend is analyzed below (subsection 1.2.1).

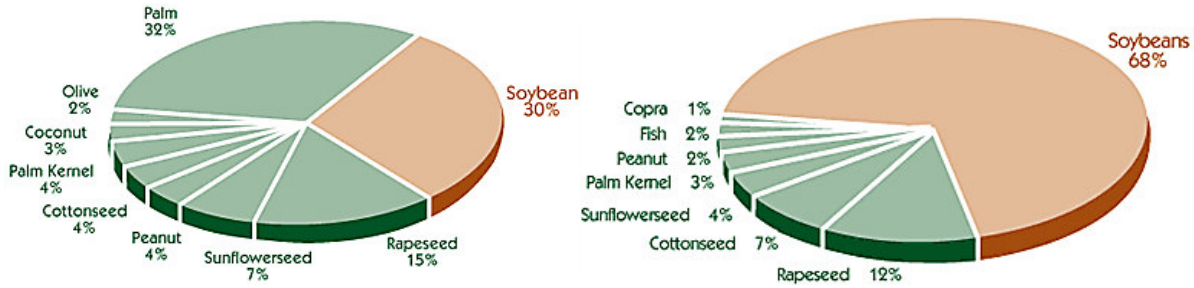



**Graph 5: GM and non-GM soybean areas planted in Argentina, Brazil and the United States (Source: USDA/FAS and ISAAA, ArgenBio, CONAB, www.soystats.com)**

## 1.1.2 World soybean consumption

Soybeans are mainly used for oil and meal production. Industrial uses are also increasing, such as biodiesel in the U.S.

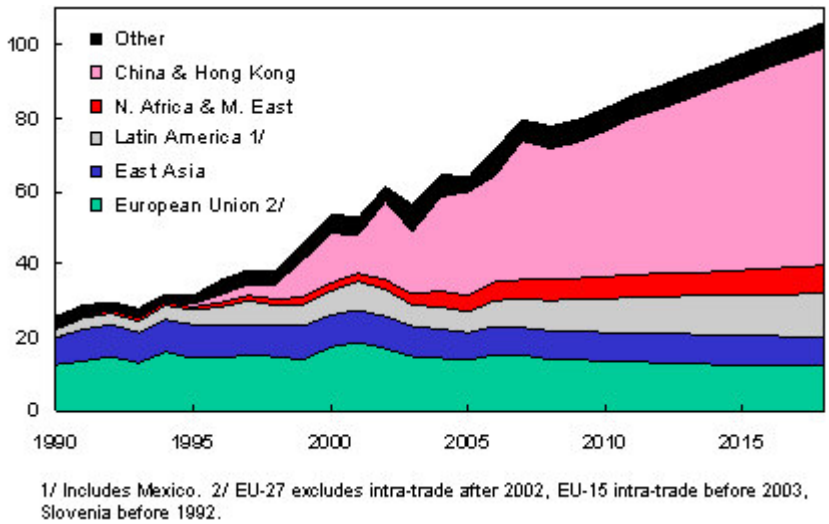
Soybean oil represents 30% of world oil consumption and soybean meal 68% of world protein consumption (Graph 6).




**Graph 6: World vegetable oil (left) and protein (right) consumption in 2008 (Source: USDA; from http://www.soystats.com/2009/Default-frames.htm)**

The increase in soybean production is mainly driven by an increasing demand in developing countries. Higher incomes and population growth generate higher demand for vegetable oil for human food and for protein for livestock production.

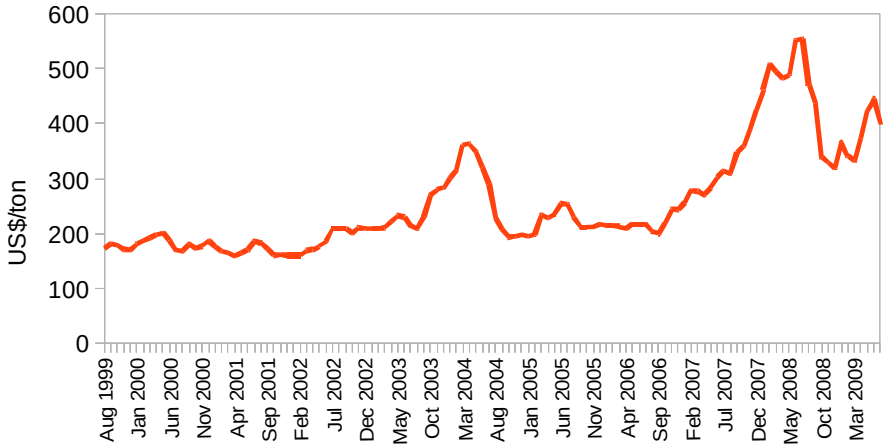
Since the beginning of the century, Chinese imports have been rising strongly, and this trend is expected to go on in the following years (Graph 7).




**Graph 7: Global soybean imports, in million tons (Source: USDA Agricultural Projections to 2018, February 2009, USDA, Economic Research Service)**

### 1.1.3 Soybean prices

Soybean prices increased considerably during the "world food price crisis" of 2007-2008, and were still, after a major decrease in 2008, at a high level in July 2009 (398 US$ per ton at Chicago Board, see Graph 8).




**Graph 8 Monthly price of soybeans (Source: Chicago soybean futures contract, US$/ton).**

### 1.1.4 Non-GM soybean market

Due to the reluctance of consumers, mainly in Europe and Japan, to eat GM products or products from animals fed with GM materials, a non-GM soybean market with identity preservation (IP) has been developing since the beginning of the decade.

- **Different types of non-GM soybeans**

The non-GM soybean market is composed of different product types, with various characteristics, offering premiums to producers. It is mainly divided between soybeans for general use and soybeans with special traits:[4]

- The most common non-GM soybeans are soybeans for general use, sold as a commodity with possibly a premium for non-GM Identity Preservation. These soybeans are mainly used for producing oil for human or industrial use (biodiesel) and soybean meal for animal feed.
- Low and ultra-low linolenic soybeans contain less than 3 percent linolenic acid vs. about 7 percent for conventional soybean varieties. The saturated fat content of low-linolenic oil is lower than that of partially hydrogenated soybean oil.
- Food grade soybeans include traits that are desirable for certain food uses, including high protein products produced from soy milk and fermented food products.
- High protein and/or oil soybeans contain over 35% protein and/or 19% oil.
- Organic soybeans are produced with the organic production standard. They are mainly used in food production.

The term "conventional" soybeans is often used to talk about "non-GM" varieties, but it may lead to some confusion, because it is also used for varieties that are not organic, or for non-GM varieties without special traits. We will therefore use in this report the term "non-GM" to talk about all kinds of non-GM varieties. When used in quotations the term "conventional" has not been changed.

[4] UW Madison Department of Agronomy, Markets for Specialty Soybeans in WI (http://soybean.uwex.edu/documents/marketing_soy_feb_08_rev1.pdf)

Except for the variety description, in section 2, we will not differentiate between the different types of non-GM soybeans. Indeed, data on the production or marketing of different non-GM soybeans are not available.

- **Production of non-GM soybeans**

According to ABRANGE, the association of producers of non-GM soybeans, Brazil is producing approximately 53% of the world's non-GM soy, followed by India and China, countries which produce 18 and 17% of the world's non-GM crop, respectively.

| Country | Millions of tons |
|---|---|
| Brazil | 25,000,000 |
| India | 8,500,000 |
| China | 8,000,000 |
| Others | 5,500,000 |
| **Total** | **47,000,000** |

**Table 1 Non-GM soybean production in volume – 2009 Estimated (Source: Abrange)**

These estimations however did not include the increase of non-GM production in the U.S. in 2009. According to the estimated surface planted, the total production of non-GM soybeans in the US may represent in 2009 around 7 millions tons. (see section 1.2.1)

- **Demand for non-GM soybeans**

The demand for non-GM soybeans mainly originates from Europe and Japan.

In Europe, this demand is driven by the production of animals fed with non-GM soybeans. Until now, this demand has been restricted to quality products, like "Label-Rouge" animal products in France (Milanesi, 2008). However, demand for non-GM soybeans may rise in the future due to recent changes in the German and French labelling policies. In 2008 Germany adopted a law authorizing labelling for products from animals fed with non-GM soybeans, that is, containing less than 0.9% of (authorized) GM grains.[5] The French National Consumer Council (a democratic consultative body attached to the Ministry for consumer affairs) spoke out in May 2009 in favour of a label mentioning "fed without GMO",[6] with conditions similar to Germany. This (not yet legal) label has already been adopted, with a different phrasing, by the leader of the "Label rouge" poultry market, "Les Fermiers de Loué",[7] and several dairy or meat producers.[8] Other poultry producers intend to follow them before the end of 2009.[9] The French government has so far tolerated these labels, and has not brought any legal action against the leading firm. This may indicate that this label will be translated later in the French legal framework, in accordance with the recommendation of the National Consumer Council, allowing producers feeding their animals with non-GM soybeans[10] (for now, approximately 20% of French animal products) to label their products. The Ethical Economic and Social Committee of the French "High Council of Biotechnologies" is currently working on an advice on "GMO free" products.

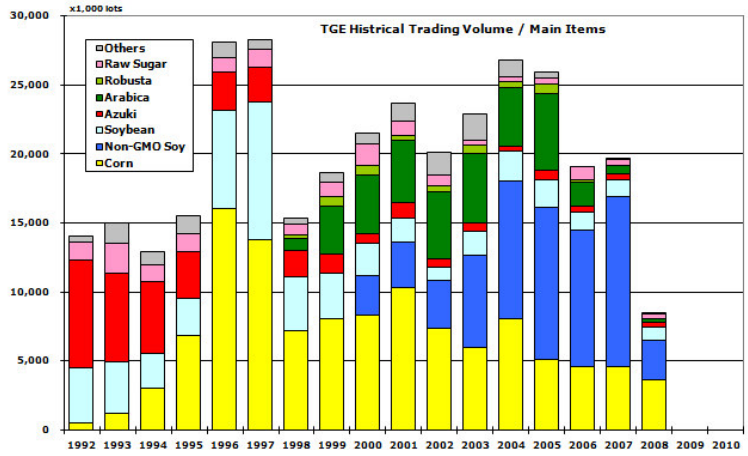
These labelling changes in France and Germany, the first and third agricultural producing countries of the EU, consolidate the non-GM policies of producers who already

[5] http://www.traceconsult.com/images/stories/pdf/nationale_regelungen/EGGenTDurchfG_2008_05_27.pdf
[6] http://www.minefi.gouv.fr/conseilnationalconsommation/avis/2009/190509ogm.pdf
[7] http://www.loue.fr/sans_OGM.asp
[8] http://www.sans-ogm.org/les-filieres-engagees.asp
[9] Personal communication with executives from firms in the sector.
[10] Principally from Parana State of Brazil.

adopted it and may give incentives to others.[11] These producers are indeed paying a premium for non-GM soybeans[12] mainly coming from Brazil, and labelling allows them to value this policy and to pass on the extra costs to consumers.

It may therefore be expected that European demand for non-GM soybeans will stay at the same level (about 1 million tons for France in 2007[13]) or even increase in the coming years, depending on consumer reaction to labels.

Japan is the other important market for non-GM soybeans, mainly for food uses (tofu, natto, miso, soymilk or soy sauce[14]). All Japanese companies producing soy-food indeed require non-GMO varieties from their suppliers[15]. A non-GM soybean market has existed in the Tokyo Grain Exchange since 2000[16] (Parcell, 2001) and in 2006 and 2008 represented more than half of the volume exchanged in this commodity market (Graph 9). GM soybeans from the U.S are also traded in the Kansai commodity exchange (KANEX).[17]



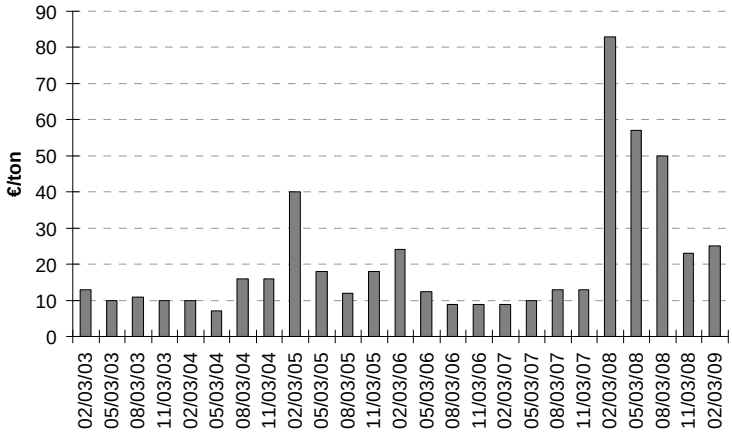

**Graph 9: Trading volume in the Tokyo Grain Exchange (Source: http://www.orionkoeki.co.jp/en/growth.html)**

In 2005, Japanese needs totalled about 1 million tons of soybeans for food uses.[18] Around 80% of these soybean imports were from the U.S.,[19] with a price premium.

- **Price premiums**

Importers of non-GMO soybeans pay premiums (see for instance Graph 10 for premiums paid by a French leader in poultry production) to compensate for segregation costs and give incentives to farmers (Milanesi, 2008).

[11] A network of 260 European regions, the "GMO free regions", also promotes this type of production. (http://www.gmo-free-regions.org/).
[12] Ranging from 20 to 30 €/ton on average.
[13] Data from importers, personal communications.
[14] Kikkoman, Corporate Citizenship Report 2006, Use of Non-GMO (genetically modified) Materials, (http://www.kikkoman.co.jp/kankyou/english/katsudo/6_2.html)
[15] The Organic & Non-GMO Report, July 2006, Japan's non-GMO soybean market update (http://www.non-gmoreport.com/articles/jul06/non_GMO_soybean_market.php)
[16] http://www.tge.or.jp/english/trading/tra_m01.shtml
[17] http://www.kanex.or.jp/english/index-eng.htm
[18] Reuters, 9th of March 2005, Safety Concerns Keep E.Asia Consumers Off GMO Food (http://www.planetark.com/dailynewsstory.cfm/newsid/29856/story.htm).
[19] The Organic and non-GMO report, November 2008, Japanese soy sauce manufacturers want US non-GMO soybeans (http://www.non-gmoreport.com/articles/nov08/japan_soy_sauce_manufactors_US_non-gmo_soybeans.php)

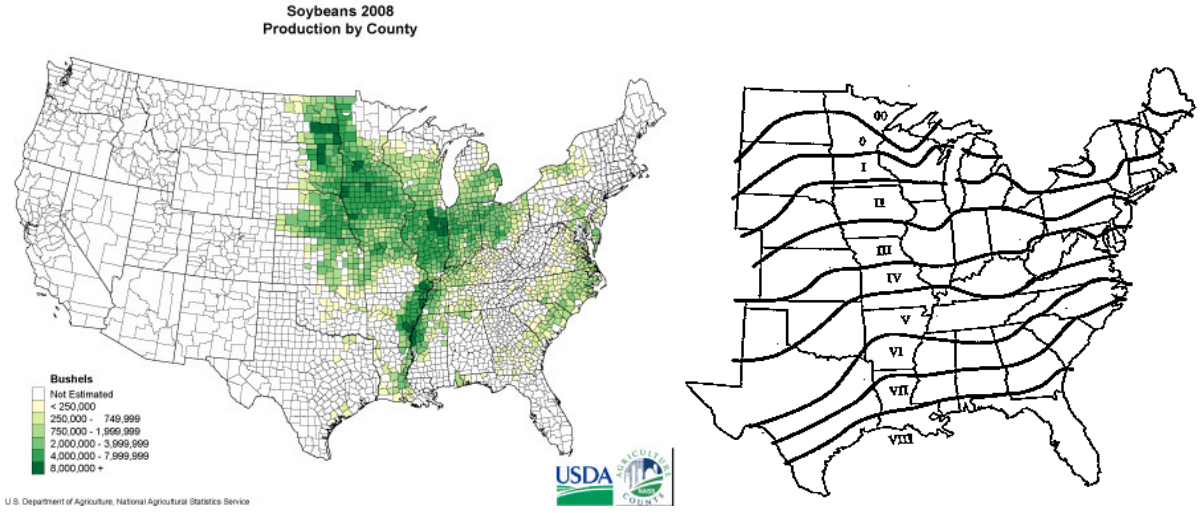



**Graph 10: Premiums paid by a French poultry company for non-GM soybean from Brazil (Source: Personal communication)**

## *1.2 Production of non-GM soybeans in the U.S. and shortage of non-GM soybean seeds*

The U.S. is the world's leading producer of soybeans, representing one third of world production in 2008 (see Graph 2). After corn (34.4 million hectares planted in 2009), soybeans are the second U.S crop production in terms of planted area (ERS/USDA).

Soybean production is mainly located in the Midwest and the Mississippi valley. Maturity groups[20] of varieties range from 00 in the North to VII-VIII in the South (to V for the most commonly used) (Map 1).




**Map 1: Location of soybean production (left) and maturity groups (right) of varieties in the U.S. (Source: NASS/USDA, National Soybean Research Laboratory[21])**

[20] "As soybean breeding developed in the United States and Canada, it became a general practice to group soybeans according to their photoperiod response and general area of adaptation. Thirteen maturity groups (MGs) are now recognized. They are designated by roman numerals, starting with "000" for the earliest maturity group adapted to the long days and short summers of southern Canada and northern United States, and ending with "X" for the latest maturity group, which is adapted to the short days of tropical regions on either side of the equator." (Alliprandini & al., 2009, p.802)

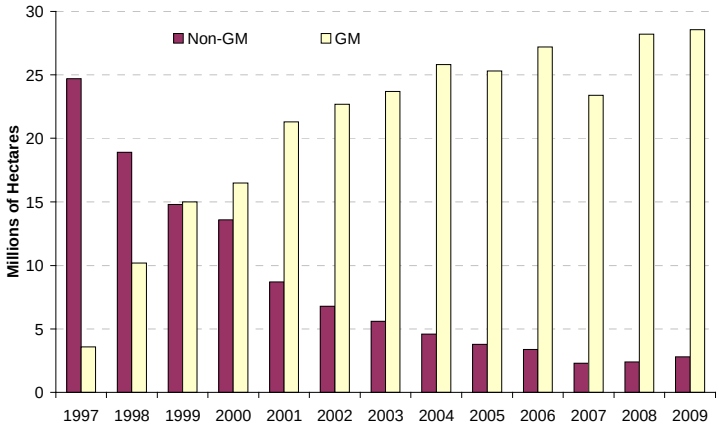
[21] http://www.nass.usda.gov/Charts_and_Maps/Crops_County/sb-pr.asp, and

Due to changes in the relative profitability of GM and non-GM varieties, more U.S. farmers decided to grow non-GM soybean in 2009. As seed producers did not expect this increase, there was a shortage of non-GM seeds in some States. This problem of quantitative availability of non-GM seeds should be solved next year by an increase in seed production.

The following subsection details the main drivers of this increase in non-GM soybean plantings and of the subsequent seed shortage.

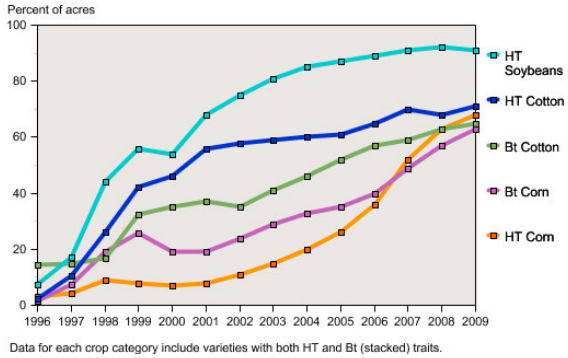
### 1.2.1 An increase in non-GM production

The non-GM soybean area increased by 1 million acres in 2009, from 5.96 million acres (2.4 million hectares) in 2008, to 6.97 million acres (2.8 million hectares).[22] After over a decade of permanent decrease of the non-GM area, this figure confirms the first slight increase that occurred in 2008 (Graph 11).




**Graph 11: GM and non-GM soybean planted area in the U.S., in hectares (Sources: Planted areas based on USDA/FAS March 2009)**

As a result, the share of non-GM soybean plantings increased in 2009 for the first time since 2000. The non-GM soybeans accounted for 9% of a record high 31.4 million hectares of soybeans planted in 2009. In 2008, non-GMO soybeans accounted for 8% of 30.6 million hectares of soybeans (Graph 12).




**Graph 12: Adoption of GM crops in the U.S. (Source: USDA[23])**

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http://www.nsrl.uiuc.edu/aboutsoy/production02.html

[22] Data from USDA.

[23] http://www.ers.usda.gov/Data/BiotechCrops/

The biggest changes occurred in the Ohio and Wisconsin States, where the non-GM acreage increased by 6% and 5%, respectively. The change was also superior to the U.S. average by 1% in Missouri, Mississippi and Indiana. In Minnesota, South Dakota and Illinois, the non-GM acreage decreased, by 3% for the last State (Table 2).

| State | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | Increase of non-GMO acreage (2008-2009), in % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Percent of all soybeans planted* | | | | | | | . | | | |
| Ohio | 48 | 64 | 73 | 74 | 76 | 77 | 82 | 87 | 89 | 83 | 6 |
| Wisconsin | 51 | 63 | 78 | 84 | 82 | 84 | 85 | 88 | 90 | 85 | 5 |
| Missouri | 62 | 69 | 72 | 83 | 87 | 89 | 93 | 91 | 92 | 89 | 3 |
| Mississippi | 48 | 63 | 80 | 89 | 93 | 96 | 96 | 96 | 97 | 94 | 3 |
| Indiana | 63 | 78 | 83 | 88 | 87 | 89 | 92 | 94 | 96 | 94 | 2 |
| Michigan | 50 | 59 | 72 | 73 | 75 | 76 | 81 | 87 | 84 | 83 | 1 |
| Iowa | 59 | 73 | 75 | 84 | 89 | 91 | 91 | 94 | 95 | 94 | 1 |
| Kansas | 66 | 80 | 83 | 87 | 87 | 90 | 85 | 92 | 95 | 94 | 1 |
| Nebraska | 72 | 76 | 85 | 86 | 92 | 91 | 90 | 96 | 97 | 96 | 1 |
| Arkansas | 43 | 60 | 68 | 84 | 92 | 92 | 92 | 92 | 94 | 94 | 0 |
| North Dakota | 22 | 49 | 61 | 74 | 82 | 89 | 90 | 92 | 94 | 94 | 0 |
| Other States | 54 | 64 | 70 | 76 | 82 | 84 | 86 | 86 | 87 | 87 | 0 |
| Minnesota | 46 | 63 | 71 | 79 | 82 | 83 | 88 | 92 | 91 | 92 | -1 |
| South Dakota | 68 | 80 | 89 | 91 | 95 | 95 | 93 | 97 | 97 | 98 | -1 |
| Illinois | 44 | 64 | 71 | 77 | 81 | 81 | 87 | 88 | 87 | 90 | -3 |
| **U.S.** | **54** | **68** | **75** | **81** | **85** | **87** | **89** | **91** | **92** | **91** | **1** |

**Table 2: Genetically engineered (GE) soybean varieties by State and United States, 2000-2009 (Source: USDA[24])**

### 1.2.2 Good global profitability of non-GM soybeans

This global increase in non-GM plantings may be explained by new economic conditions on GM and non-GM soybean cultivation. The July/August 2009 issue of the Organic & Non-GMO Report writes that "a few farmers told [Mark Albertson, director of marketing at the Illinois Soybean Association] they haven't grown non-GMO soybeans in seven or eight years but this year they say the economics favour non-GMO."[25]

Steve Waddle, in Ohio, is one of these farmers. He explains why in 2009, for the first time in years, he is back to planting non-GM soybeans: "because of the economic conditions last year when our expenses rose drastically and that carried over to into this year and then grain prices dropped, we needed to find other ways to make a profit."[26]

According to Jim Beuerlein (Ohio State University), there are "two things that are sparking grower interest: cheaper seed and the grain is worth more. (…) There are a number of markets, both stateside and internationally, that want non-biotech varieties and they are willing to pay the premiums for it". [27]

As seen below this information on the good profitability of non-GM soybean growing has been partially disseminated by universities (Document 1) and small firms (Table 3) providing non-GM seeds and/or marketing non-GM soybeans.

[24] http://www.ers.usda.gov/Data/BiotechCrops/ExtentofAdoptionTable3.htm
[25] The Organic & Non-GMO Report, July/August 2009
[26] WCPN radio, 28th of May 2009 (http://www.wcpn.org/WCPN/news/26357/)
[27] Corn and Soybean Digest, 14th of April 2009, Interest in Non-biotech soybeans growing (http://cornandsoybeandigest.com/soybeans/0414-non-biotech-soybean-interest/index.html)

Due to their commercial objectives, the following output of calculations of non-GM value per acre made by eMerge[28] (Table 3) should be used with caution. They do however show how companies promoting non-GM seeds and production communicate to farmers on the economic gains they can make with non-GM growing and the overall economic rationale to shift from GM to non-GM.

The drivers of this increased relative profitability of non-GM soybeans (compared with GM soybeans) are detailed in the following subsections.

## More Profit from Non-Roundup Ready Soybeans

Dr. Grover Shannon

Roundup Ready (RR) soybean varieties with the trait developed by Monsanto Corporation that gives tolerance to the herbicide glyphosate (Roundup) were widely introduced about 12 years ago. Now they are planted on more than 90% of the US and South American soybean acres. RR varieties have revolutionized weed control as an efficient, easy and inexpensive way to keep soybean fields weed free. Although products made from RR seed are the same as conventional or non-Roundup beans and pose no threat, some countries do not want Roundup Ready soybeans since they are genetically modified. Thus, there is a market for non-RR soybeans in Korea, Taiwan, Japan and other countries who prefer conventional seed to make their soy products.

Recently, some elevators near the Mississippi river have offered growers a premium of $1.00 or more per bushel for non-Roundup soybeans for export. Since RR soybeans are developed almost exclusively by private companies, productive conventional varieties often come from releases from public or university agricultural experiment stations such as the University of Missouri. Studies show that conventional cultivars such as Jake soybean from the University of Missouri are as productive as RR soybeans (Table 1). Reasons that a farmer could profit from growing conventional soybeans are as follows:

1) **Up to $1.25 premium is being offered at certain points on the river for conventional soybeans.**
2) **Seed costs of a conventional soybean variety are half as much as RR seed (about $18/bag versus about $40/bag for RR seed).**
3) **Farmers can save seed of conventional varieties for planting on their farm the following season. RR trait is patented and seed from RR varieties must be sold at elevator. RR seed for planting must be purchased each year.**
4) **Price of Roundup herbicide has more than doubled in price resulting in non-roundup herbicide systems used for weed control in conventional soybeans being cheaper than using Roundup in combination with other herbicides.**
5) **Roundup tolerant weeds are causing farmers to use other herbicides in addition to Roundup for problem weeds. Thus using a Roundup system along with other herbicides for weed control is common and more expensive.**
6) **Based on the higher price of RR seed and Roundup herbicide, producing non-RR soybeans on cleaner fields where weeds are not a major issue can result in more profit than growing non-RR soybeans.**

**Document 1: More profit from non-GM soybean, arguments by Dr Grover Shannon from Missouri University (Source: Delta Center Field day, 2008)**

[28] See 2.2.2.2.8, p.51, for more details about this company

| | Systems | | | | |
|---|---|---|---|---|---|
| **Items** | GMO System without Weed Resistance | GMO System With Weed Resistance | NON-GMO Without Grain Premium | NON-GMO with Premium | NON-GMO with Premium |
| Seed Price | $43 | $43 | $28 | $28 | $28 |
| Preplant Herbicide | $10 | $18 | $18 | $18 | $18 |
| In Season Herbicide | $20 | $25 | $25 | $25 | $25 |
| Identity Preservation | | | | $10 | $10 |
| | | | | | |
| Yield | 50.00 | 50.00 | 50.00 | 50.00 | 50.00 |
| Price per Bushel | $10 | $10 | $10 | $10 | $10 |
| Premium per Bushel | $0 | $0 | $0 | $1.50 | $2.00 |
| | | | | | |
| Gross Revenue per Acre | $500 | $500 | $500 | $575 | $600 |
| Total Seed/Herb Cost per Acre | $73 | $86 | $71 | $71 | $71 |
| | | | | | |
| Gross Revenue Per Acre | $427 | $414 | $429 | $504 | $529 |
| Land, Fert, Machinery | $375 | $375 | $375 | $375 | $375 |
| **Net Revenue per Acre** | **$52** | **$39** | **$54** | **$129** | **$154** |

**Table 3: eMerge "Non-GMO Value per Acre Calculator"[29] (Source: http://www.emergegenetics.com)**

### 1.2.2.1 Premium for non-GM soybeans[30]

Premiums are paid to U.S farmers for several types of non-GM soybeans, for feed or human food use. These premiums are usually set through private contracts between soybean firms and farmers,[31] and there is no market reference price for non-GM soybeans. These premiums vary according to the type of soybean grown and depend on the usual market supply and demand factors. They are re-evaluated each year.

According to non-GM grain traders these premiums varied in 2009 from 1 to 2.75 $ per bushel, that is to say 36.8 $/ton to 101.1 $/ton. They are large when compared with commodity prices that ranged from 330 $/ton to 430€/ton over the last year (see Graph 8). In a context where soybean commodity prices were decreasing at the end of 2008 and in the beginning of 2009, these premiums created a major incentive for farmers to grow non-GM soybeans.

### 1.2.2.2 Increase in the production costs of GM soybeans

Farmers or sector specialists often quote the increase in the cost of Roundup Ready seeds as an influential rationale for the soybean growers' decision. The average cost of GM seeds per acre has indeed more than doubled since the beginning of the decade (Graph 13), and this is a source of concern for the American Farm Bureau Federation: "farmers in general are concerned about the increasing price of biotech seed, reflective of the growing tech fees assigned by life science companies who hold the patents on gene splicing technology."[32]

[29] Assumptions: Land, Tillage, and Machinery costs are equal across all systems. Seed prices based on published Comparables. Planted acre Requires 1 seed unit (50) Pounds. Glyphosate at $10 per trip. Flexstar, Select, First Rate for in season NON-GMO applications. Application Costs are the same for both systems

[30] Most of this information was collected through personal communications with non-GM soybean traders.

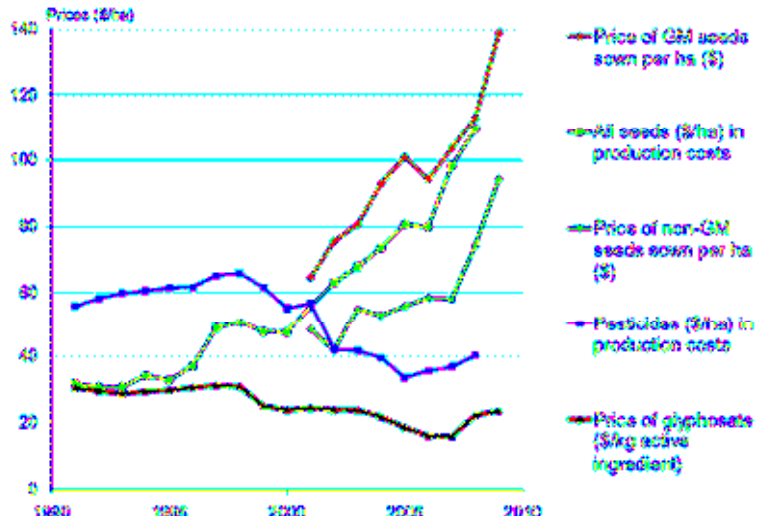
[31] See for instance the IP programs of Rabbe Grain Co., an international Grain exporter: Identity Preserved Non-GMO Soybean Program 2009 Crop (http://www.rabbegrain.com/index.cfm?show=10&mid=63&pid=2) or IP Commodity Non-GMO Soybean Program 2009 Crop (http://www.rabbegrain.com/index.cfm?show=10&mid=63&pid=3)

[32] Biotech Versus Conventional Seed, AFBF Policy Development, May 2009

After years of global increases, the rise was even sharper between 2008 and 2009 and this year; in 2009 some "farmers [were] buying good traditional (non-GMO) soybean seed for $17 per bag when Roundup Ready seed was going for $35 per bag".[33]

According to a recent Monsanto press release, the price of seed in 2010 will be 128 $/ha (52$/acre) for RR soybean and 183$/ha (74$/acre) for the new Roundup Ready 2 Yield soybeans.[34]

But data shows that non-GM seed prices have also increased significantly (Graph 13), and even more than GM seed prices in the last two years.[35] GM seed price increases have therefore not been the major factor in farmers' choices, certainly less than the price premiums paid for non-GM beans and the increase in the cost of herbicides uses.




**Graph 13: Trends in seed & pesticide costs in the production costs of soybean in the U.S. (Source: USDA (NASS and ERS) from Bonny, 2009).**

The relative competitiveness of Roundup Ready seeds versus non-GM was also hindered by the recent increase in the price of glyphosate herbicides (Graph 13). After several years of decline because of the emergence of generic versions, and stabilization in recent years, the price of glyphosate rose in 2009.

As reported by Gill Gullickson, from AgricultureOnline: "generic glyphosate prices recently increased $12 per gallon, and brand name Roundup by Monsanto in February increased in price by 30%. In some areas, farmers report they pay double for glyphosate what they did a year ago." The journalist interviewed Jim Zimmer, vice president of Monsanto's branded business, on this issue. According to him, prices are rising because "from a glyphosate standpoint, global demand is accelerating faster than global supply."

To explain this situation, Jim Zimmer reports that Chinese production plants of glyphosate, which manufacture much of the herbicide for the U.S. market, are running at full

(http://www.michfb.com/files/policy/backgrounders/Biotech%20Versus%20Conventional%20Seed.pdf)

[33] Linn Clarkson, president of Clarkson Grain, a buyer of non-GMO soybeans in: Lynn Grooms, 1st of April 2009, Non-Biotech Soybean Seed: Is there enough?, Corn and Soybean Digest (http://cornandsoybeandigest.com/soybeans/0401-nonbiotech-soybean-seed/)

[34] http://www.bloomberg.com/apps/news?pid=20601103&sid=aLW8VZBkP3PA

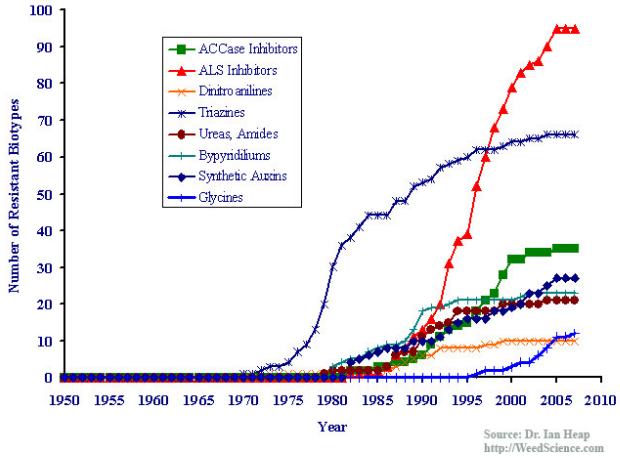
[35] Between 2007 and 2009 non-GM soybean seed prices have increased by 64% and GM soybean seed prices by 34% (Source: USDA/NASS).

capacity. Some factories are also closing because of new environmental regulations and there is a shortage of raw materials like phosphorus.

The demand for glyphosate is increasing in Brazil and Argentina because of the development of conservation tillage. "Any time there is conservation tillage, there is a higher use of glyphosate," says Zimmer.[36]

The cost of using Roundup Ready soybeans is also increasing because of the development of glyphosate-resistant weeds (Graph 14). The high increase in glyphosate use in the U.S. linked to the spread of Roundup Ready varieties "has led to the appearance of weeds resistant to this herbicide. Glyphosate resistant weeds have already appeared in the U.S. in different states (nine weeds at the end of 2008), as well as elsewhere in the world (sixteen weeds in total at the end of 2008)".[37] (Bonny, 2008, p.9)

Farmers therefore have to use more glyphosate and other herbicides to control the resistant weeds. It is more costly and farmers lose part of the agro-economic advantages provided by RR varieties.[38]




**Graph 14: Resistant to glyphosate herbicide worldwide: Glycines curve, in blue (Source: Dr Ian Heap, http://Weedscience.com)**

### 1.2.3 Reduction in distribution channels and problems of production planning

As the number of farmers deciding to plant non-GM soybeans suddenly increased in 2009, the demand for non-GM seeds also increased and some seed sellers sold out these varieties.

John Suber, who runs Ebberts Field Seeds in western Ohio, said for instance to a journalist that "his company usually has booked all its seed orders by January but he was surprised when he sold out of non genetically modified soybean seed early".[39] Jim Orf, a plant breeder from a state university, has collected the same kind of testimony in Minnesota where

[36] Gullickson Gil, What's behind glyphosate and Roundup price hikes?, AgricultureOnline, 27/02/2008 (http://www.agriculture.com/ag/story.jhtml?storyid=/templatedata/ag/story/data/1204134767122.xml)

[37] To get more information on the species of weeds and their locations: http://www.weedscience.org/Summary/UspeciesMOA.asp?lstMOAID=12

[38] On this issue of weed resistance see for instance Bonny (2009), or the Special issue of the Pest Management Science review about "Glyphosate-Resistant Weeds and Crops" (Volume 64 Issue 4 , Pages 317 - 496 (April 2008))

[39] WCPN radio, May 28 2009, http://www.wcpn.org/WCPN/news/26357/

all seed dealers he has talked with "said that they had sold out conventional cultivars."[40] Pioneer has not sold out its non-GM seeds but was close.[41]

The characteristics of seed production explain these shortages. Production must be planned at least one year before selling and at the beginning of 2008, after years of growing demand for GM seeds, seed producers did not foresee that the demand for non-GM seeds would significantly increase in 2009. Moreover, soybean seeds are very fragile and may not be stored easily, which makes it difficult to adapt soybean seed supply to sudden demand changes by use of seed stocks.

In forecast of a new demand increase next year, some seed producers of non-GM seeds decided to multiply their production by two or three.[42] The situation may therefore be back to normal in 2010, unless problems emerge in seed distribution. [43]

This situation in seed production explains the shortage of non-GM seeds reported in spring 2009.

### 1.2.4 Difficulties for U.S. farmers to find non-GM soybean seeds

Because of this seed production (and maybe distribution) planning, non-GM seed availability on the market decreased for U.S. farmers in 2009. But it seems that this situation really began in 2008, the first year of the (slight) increase in non-GM acreage (see above).

In summer 2008, the *Non-GMO and Organic Report*, a newsletter on organic and non-GMO issues, ran "Finding non-GMO soybean seed becoming more difficult" as the headline of an article in which Jim Skiff, the president of the U.S. Soy company, reported a shortage of non-GM soybean seeds.

But the issue of the availability of non-GM soybean seeds in the U.S. market heightened significantly in 2009. *The Morning Sun*, a newspaper from Kansas, noted on January 19, 2009 that "there have been some questions about the availability of conventional non-GM soybean varieties".[44].

This problem was reported a few months later, in April, by two articles published in the *Corn & Soybean Digest.* In the first one, Lynn Groom interviewed "Scott Shriver, who farms 1,800 acres near Jefferson, Iowa". He said that he "has not had problems getting non-biotech seed in the past. But, supplies are getting tighter each year." The journalist specialized in agricultural issues also interviewed "Allen Williams, who farms about 1,300 acres near Cerro Gordo, Illinois" and who "was unable to find organic seed this year".[45] The second article related the same kind of situation in Ohio.[46]

However, the situation might not have been the same in all U.S. States. William Schapaugh, Professor in the Department of Agronomy, Kansas State University, and a specialist in soybean breeding and genetics, notes that "farmers did have to work to source non-GM seeds", but he believes that "if they made the effort, they should have been able to

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[40] Personal communication

[41] Personal communication with a Pioneer executive

[42] WCPN radio, May 28 2009, http://www.wcpn.org/WCPN/news/26357/ or Corn and Soybean Digest, 14th of April 2009, Interest in Non-biotech soybeans growing (http://cornandsoybeandigest.com/soybeans/0414-non-biotech-soybean-interest/ )

[43] Indeed, the view has been expressed that the distribution of conventional seeds is also decreasing because "independent seed dealers have affiliated with large companies" who would prohibit them to sell such seeds. (Organic and non-gmo report, July 2008, http://www.non-gmoreport.com/articles/jul08/non-gmo_soybean_seed.php); an analysis that would need confirmation by further investigation.

[44] The Morning Sun (Kansas, USA), 17th of January 2009, "Conventional soybean varieties" (http://www.morningsun.net/columns/x497796000/NEWS-IN-AGRICULTURE)

[45] Lynn Grooms, 1st of April 2009, Non-Biotech Soybean Seed: Is there enough?, Corn and Soybean Digest (http://cornandsoybeandigest.com/soybeans/0401-nonbiotech-soybean-seed/)

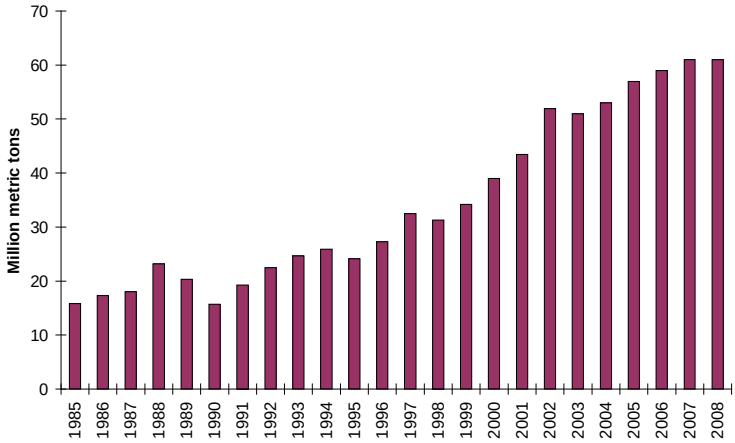
[46] Corn and Soybean Digest, 14th of April 2009, Interest in Non-biotech soybeans growing (http://cornandsoybeandigest.com/soybeans/0414-non-biotech-soybean-interest/index.html)

find seed in the region of a productive public or private conventional variety adapted to their area."[47]

Real seed shortage certainly depended on states, but as seen before tensions appeared in the non-GM seed market in spring 2009. According to the information and data gathered they are more a problem of quantity, due to insufficient production of these seeds, than a problem of global availability of diversified and competitive non-GM seeds, an issue that is dealt with in the next section.

## *1.3 Brazil: the world's leading producer of non-GM soybeans*

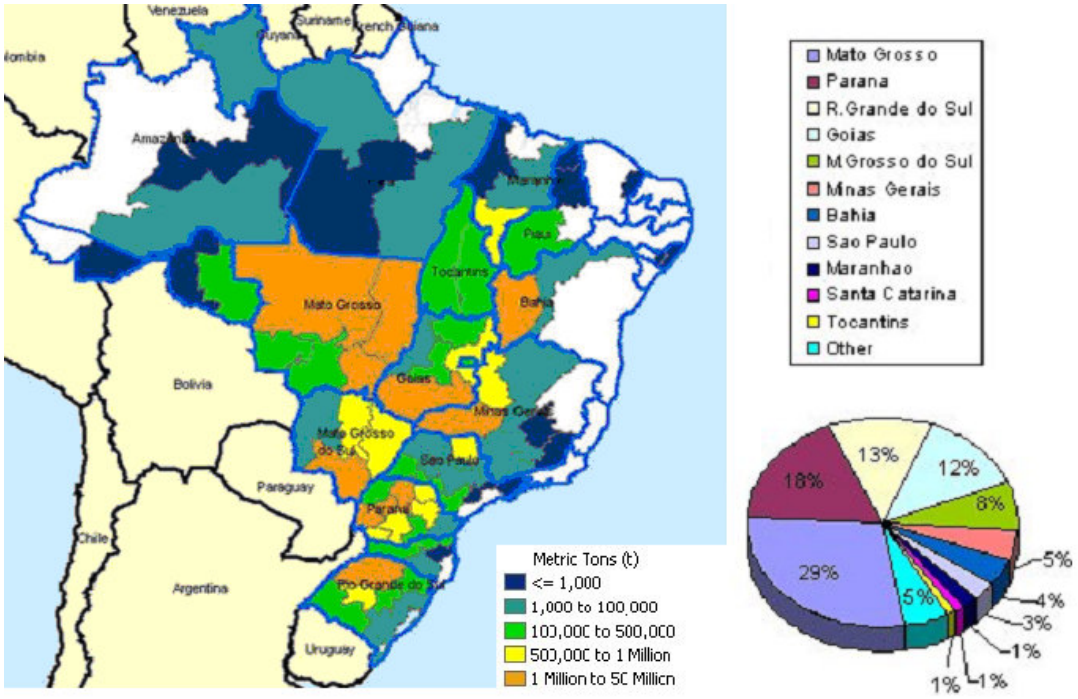
With a production of 61 million tons in 2008 (Graph 15), Brazil was the second largest soy producer in the world, and forecasts predict that it will be the first one by 2012. Soy dominates the Brazilian agro-business (KIIHL, CALVO, 2006). In 2006, approximately 50% of total Brazilian agrochemical sales went to soy culture. The soy industry generated revenues of US$ 18 billion in 2008 (ABIOVE, 2009). That same year the major destinations for Brazilian soy were the EU-27 (European Union), which imported 44%, Eastern Asia with 38%, Southeast Asia with 6% and other European countries, the Middle East and North Africa, with 2% each. Between 1997 and 2008, the average soy contribution to overall Brazilian exports was around 9%. (SECEX/MDIC, 2009)




**Graph 15 : Brazilian soybean production (millions metric tons) (Source: USDA)**

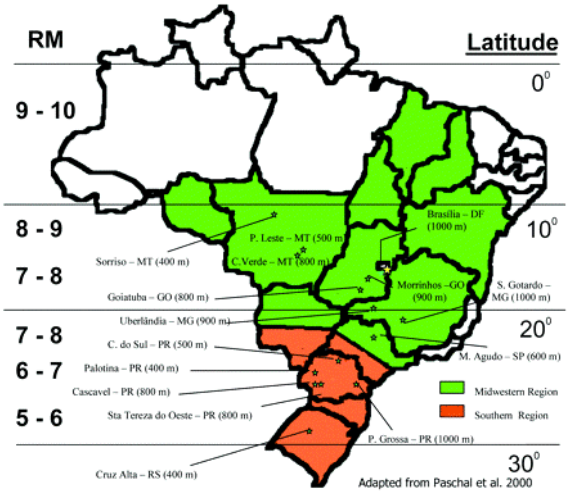
The production is mainly located in five southern and central states: Mato Grosso, Parana, Rio Grande do Sul, Goias and Mato Grosso do Sul (Map 2).

[47] William Schapaugh (2009). Professor at the Department of Agronomy, Kansas State University. Personal communication.



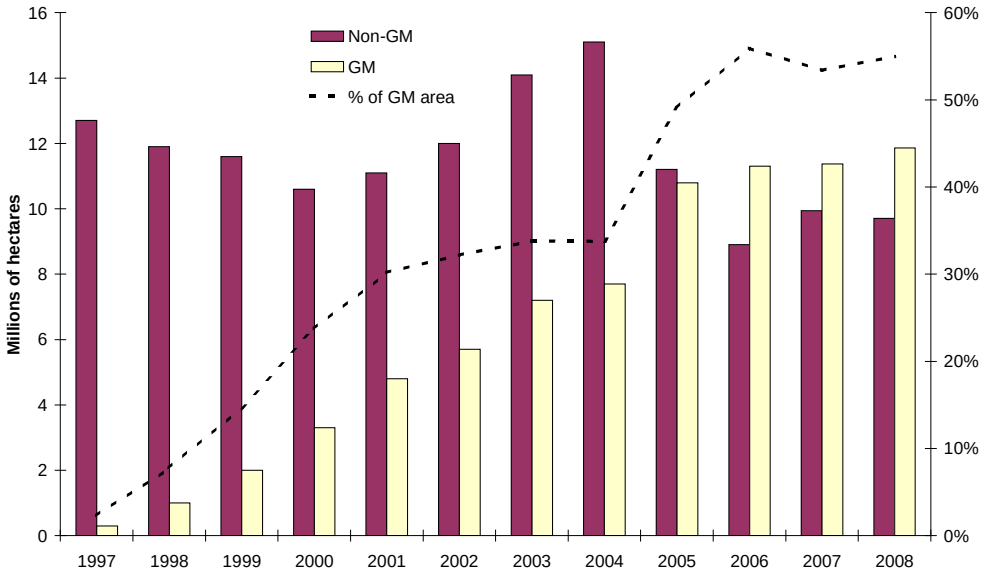

**Map 2 : Average soybean production by state between 2001 and 2005 (Source: USDA)**

According to Alliprandini (2009), "the traditional Brazilian approach of classifying [soybean] varieties as early, medium, and late, by region, is gradually being replaced as more and more private companies entering the commercial soybean market are using the North America system used by their parent companies". In this system, soybean varieties used in Brazil range from maturity group V to X (Map 3).




**Map 3 - The distribution of relative maturity groups (RM) for soybean cultivars in Brazil - and localization of trials for stability analyses, 2002–2003 and 2003–2004 seasons. (From Alliprandini, 2009, p.803)**

In the aftermath of permission for trade in GMOs in Brazil in 2003, the soy industry extended itself to at least two different segments: 1) conventional soy and 2) GM (genetically-modified) soy. The share of area planted with GM varieties has been quite stable around 55% since 2006 (Graph 16).



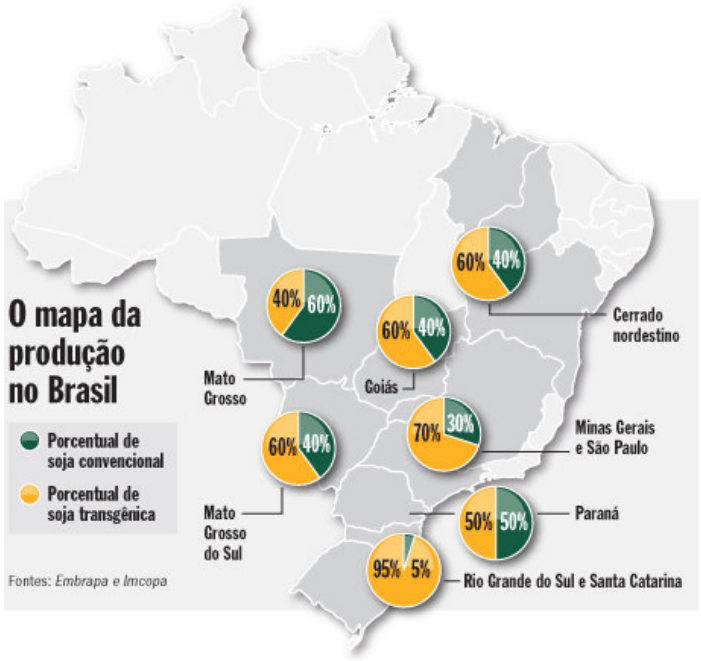

**Graph 16 : GM and non-GM soybean planted area in Brazil, in hectares (Sources: CONAB, www.soystats.com (ISAAA) )**

Table 4 shows production areas and data on productivity for GM and non-GM soybean for the years 2007/2008 and 2008/2009. For these two harvests, areas planted with GM and non-GM soy have remained basically the same, although in Brazil the average productivity has been greater for non-GM soy than for the GM variety during this period.

| | **Field Crop Area** | | | | **Productivity** | | | |
|---|---|---|---|---|---|---|---|---|
| | 2007/2008 | | 2008/2009 | | 2007/2008 | | 2008/2009 | |
| | x1000 ha | % | x1000 ha | % | kg/ha | Productivity differences GMO/NGMO (%) | kg/ha | Productivity differences GMO/NGMO (%) |
| Total | 21.313,10 | 100% | 21.563,10 | 100% | 2.816,00 | - | 2.696,10 | - |
| GMO | 11.935,34 | 56% | 11.859,71 | 55% | 2.765,30 | 0,96 | 2.633,72 | 0,95 |
| NGMO | 9.377,76 | 44% | 9.703,40 | 45% | 2.880,52 | | 2.772,34 | |

**Table 4 - Brazilian GM and non-GM soybean field crop area, productivity in 2007/2008 and 2008/2009 harvest (Source: CONAB, 2009).**

According to the CONAB (The National Company for Food and supply) the national share of the area planted with non-GM soybeans reached 45% of the total soybean area in 2009 (Table 4), but the situation is different between Brazilian states (Map 4).




**Map 4 - Percentage of conventional soy/percentage of genetically-modified soy across Brazil (Source: VEJA Edition 2125 / 12 August 2009)**

Cert-ID (a third party certification company) also confirms a larger availability of non-GM soybeans: "the cartel's claim that Brazil can't supply GM-free soy feed is particularly outrageous. Despite the economic crisis, Brazil's production of non-GMO soybeans is booming, from 0.4 million tons in 2000 to the 8.85 million tons that were audited and available for certified crushing and shipment to Europe, part of the 2009 harvest which took place from February through May. Moreover, the recent trend of increased GM soy planting has petered out, and may reverse in the 2009-2010 season as farmers find that the disadvantages of planting GM soy outweigh its benefits".

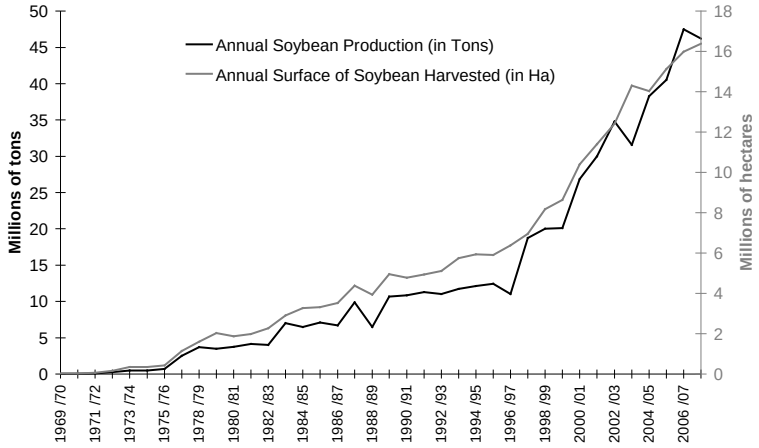
This year (2009), roughly 26 million tons of non-GM soy (i.e. 45 to 50% of Brazil's total soy harvest of 57.3m tonnes) was non-GM. Although lack of demand led most of this non-GM soy to be sold without segregation and traceability, some 10 million tons were produced within IP systems, certified GM-free below a detection limit of 0.01%, and were available for purchase by European buyers. Furthermore, 6.3 million tons of this were additionally certified via the ProTerra standard as both non-GM and sustainable, and were sold and shipped as such."[48]

According to the ABRASEM (Brazilian Association of Plants and Seeds), the soy seed market in Brazil deals yearly with close to 1.5 billion in Brazilian currency (813 million USD), for volumes of 20 million sacks of 40 kg each. Genetically modified seeds make up 60% of this total, equivalent to 900 million in Brazilian currency (488 million USD[49]). Two percent royalties are charged per sack of GM soy.[50]

[48] http://www.cert-id.eu/ProTerra.php
[49] Monthly average exchange rate of august 2009 (1.84431 Brazilian Reals to 1 USD)
[50] Source: Jornal Gazeta Mercantil/Finanças & Mercados, p.10, 17 May 2009.

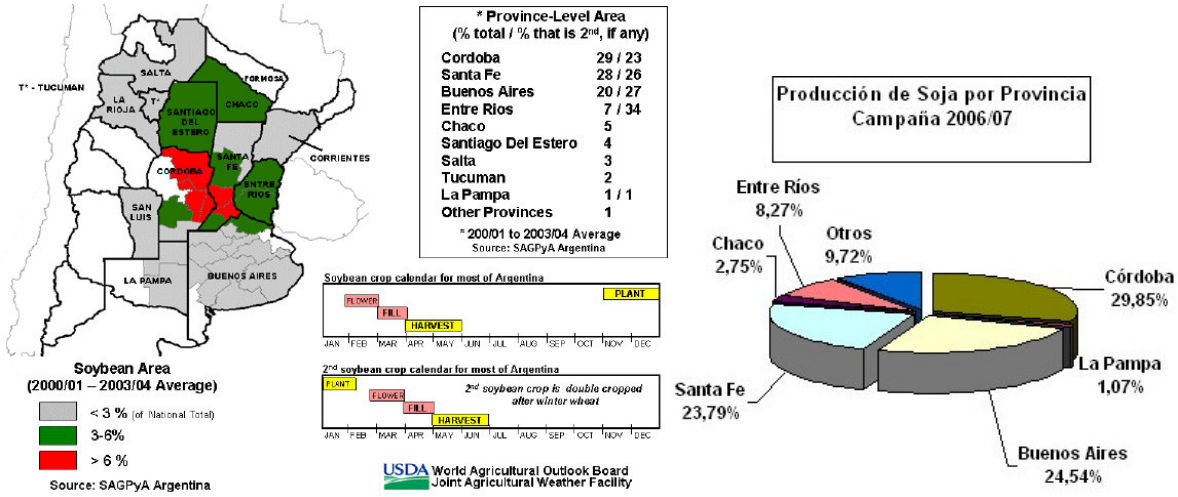
## 1.4 Argentina: Small-scale production of non-GM soybean

Argentina is the world's third-biggest producer of soybean and the biggest exporter of soybean meal and oil (USDA, February 2008). Soybean growing has been principally developed since the 1990s (Graph 17) and soybean is now the most exported product of the Argentinean economy and a major contributor to government incomes.




**Graph 17: Argentinean soybean production (Source: SAGPyA)**

Production is mainly located in the regions of Cordoba, Santa Fe and Buenos Aires (Graph 18), and the diversity of climate conditions allows the use of soybeans from maturity groups II to IX (INTA).

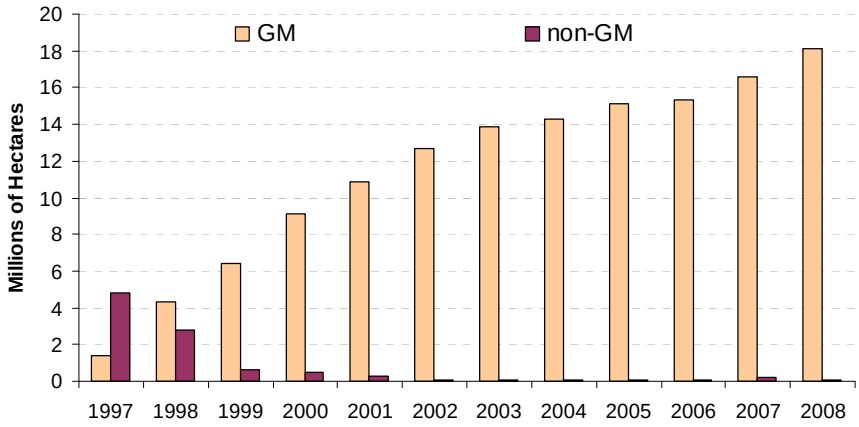



**Graph 18: Geographical distribution of Argentinean soybean production (Source: USDA[51], SAGPyA[52])**

The development of soybean production since the end of the 1990s has been based mainly on glyphosate-resistant GM soybeans. Non-GM soybean production in Argentina has

[51] http://www.usda.gov/oce/weather/pubs/Other/MWCACP/Graphs/Argentina/ArgentinaSoybean.pdf
[52] http://www.sagpya.mecon.gov.ar/SAGPyA/areas/estimaciones_agricolas/02=informes/03-por_cultivo/_archivo/000000_Oleaginosas/000000_Soja/060000_Campa%C3%B1a%202006-2007.php

only represented about 1% of total soybean production in the country for several years (Graph 4 and Graph 19).




**Graph 19: GM and non-GM planted hectares of soybean in Argentina (Source: Soystats (ISAAA), ArgenBio)**

Most of these non-GM soybeans are produced for food use, for local consumption or exportation. A very tiny organic production also exists, and represents less than 10,000 ha, i.e. less than 0.1% of total soybean production.[53] The Argentinean government gives for instance some support to this production through its program PROFEDER (Federal Program of Rural Development), in the city of Comandante Andresito, near the Brazilian border, where a cooperative of farmers created in 2004 produced 270 tons of organic soybean in 2008. Their production is increasing and is sold through Brazil to Switzerland, England and Germany.[54]

Due to this low non-GM soybean production, there is virtually no supply of recent non-GM seed varieties. The producers interviewed use seeds that they saved from the previous harvest, from non-GM varieties that were released more than 10 years ago, either the Kumen variety (soybean for human use) released in 2005, or varieties from Brazil.

[53] Source: SENASA, http://www.senasa.gov.ar/contenido.php?to=n&in=786&io=2946
[54] http://www.inta.gov.ar/montecarlo/Bolet%C3%ADn_mayo.htm

# 2 Soybean plant breeding and availability of non-GM soybean seeds

This section presents Intellectual Property Rights for plant breeders as well as soybean seed industries structures in the U.S., Argentina and Brazil. It details which companies and public actors perform non-GM soybean breeding programs and provide non-GM varieties.

## *2.1 Intellectual Property Rights for plant breeders in Argentina, Brazil and the U.S.*

The nature and scope of Intellectual Property Rights (IPRs) on plant varieties have a major influence on plant breeding activity. This section gives a rapid overview of these IPRs in Argentina, Brazil and USA.

**Patents, plant breeder rights, and the UPOV convention**

IPRs "give the creator the right to prevent others from making unauthorized use of their property for a limited period." The main IP rights used to protect plant varieties are patents and plant breeders' rights (PBRs). A patent is "an exclusive right awarded to an inventor to prevent others from making, selling, distributing, importing or using their invention, without license or authorization, for a fixed period of time." PBRs "are granted to breeders of new, distinct, uniform and stable plant varieties. They normally offer protection for at least fifteen years (counted from granting). Most countries have exceptions for farmers to save and replant seeds, and for the use of protected materials for further breeding."[55]

The convention of the International Union for the Protection of New Varieties of Plants (UPOV) guarantees reciprocity between signatories on protection of new varieties. It was adopted in Paris in 1961 and revised in 1972, 1978 and 1991, with different provisions (Table 5).

| Provisions | UPOV 1978 | UPOV 1991 |
|---|---|---|
| Protection coverage | National definition about which species can be protected | Plant varieties of all genera and species |
| Requirements | Distinctness<br>Uniformity<br>Stability | Novelty<br>Distinctness<br>Uniformity<br>Stability |
| Protection term | Min. 15 years | Min. 20 years |
| Protection scope | Commercial use of reproductivematerial of the variety | Commercial use of all material of the variety |
| Breeder's exemption | Yes | Not for essentially derived varieties |
| Farmer's privilege | Yes | Countries are free to define their rules |
| Prohibition of double protection | Species eligible for Plant Breeder's Rights cannot be patented | No mention |

**Table 5: Comparison of main provisions concerning Plant Breeders' Rights in UPOV 1978, 1971 (Source: Fuck et al., 2008)**

All three countries have specific laws on plant variety protection and have signed the UPOV convention.

[55] Co-Extra, Deliverable D7-1, p.65

**USA**

The U.S. adopted the last UPOV Act (1991) in 1994, after amendments to the Plant Variety Protection Act (PVPA) adopted in 1970, which granted breeders "a Certificate of Protection that gave them exclusive rights to market a new variety for 18 years from the date of issuance. These exclusive rights were subject to two exemptions: (i) a research exemption, which allows the use of the seed to develop new varieties; and (ii) a farmer's exemption, which allows a farmer whose primary occupation is growing crops for sale to save seed from a protected variety to plant on the farmer's land, and to sell from that seed to another farmer whose primary occupation also is to grow crops." The 1994 amendments extend the length of protection from 18 to 20 years from the date of issuance of the certificate. They also "prohibit farmers from selling saved seed of protected varieties without the permission of the variety owner" and introduce an entitlement to protection for "essentially derived" plant varieties. [56] In other words, if the parent variety is granted plant breeders' rights under the UPOV Convention, then the owner of the parent variety has rights over varieties that are essentially derived from it.[57]

Of the three countries under study, only the U.S. authorizes patents on plant varieties. Patenting plants (GM or non-GM) has been possible in the U.S. since the Diamond *vs* Chakrabarty Supreme Court ruling in 1980, which extended patent rights to genetically engineered microorganisms, and a series of subsequent rulings by the Patent and Trademark Office.[58]

Plant breeders may therefore protect their varieties by both PVP certificates and patents. The U.S. legal framework also provides the opportunity of intellectual protection by trade secret rights.[59]

**BRAZIL**

Brazil adhered to the 1978 UPOV Act in 1997 and integrated some elements of the 1991 Act (including that the breeder exemption does not apply to "essentially derived" varieties) through the Plant Variety Protection Law, which came into force in 1997. Breeders may also use the Brazilian legislation on industrial property; however, this legislation excludes patents for plants.[60] (see section 2.3.1 for more details)

**ARGENTINA**

Argentina's first laws on plant protection were adopted during the 1970s,[61] "although enforcement began only in the late 1980s as a result of action by wheat breeders, and later, by soy breeders. […] Argentina's seed law provides for two kinds of plant variety registration, via the National Registry of Cultivars (RNC) and the National Registry of Cultivar Property (RNPC)." Argentina joined the UPOV and adhered to the 1978 Act of the UPOV Convention

[56] Fernandez-Cornejo (2004, pp.18-22). For details on the U.S. Plant Variety Protection Act and its recent amendment, also see Evenson (2000).

[57] More precisely, "Although this has never been tested in the courts, the American Seed Trade Association and UPOV subcommittees are working to more clearly define when a variety is essentially derived. For example, the percentage of the genetics that must be shared to qualify as an essentially derived variety seems to depend on the crop" (Strachan, p. 88).

[58] "The Patent and Trademark Office's board of appeals and Interferences widened the scope of patent protection for genetically engineered organisms by including plants and nonhuman animals. These rulings extend IPR to a wide range of new biotechnology products in the form of utility patents awarded under the Patent Act. Products protected under the rulings include seeds, plants, plant parts, genes, traits, and biotechnology processes" (Fernandez-Cornejo, 2004, p.21).

[59] Evenson (2000, p.12).

[60] Fuck & al, 2008, p.227.

[61] Kesan & Gallo, 2005, p.120.

in 1994 but with a longer protection period than the 1978 Act. [62] Patent protection for plants is not possible in Argentina.

The IPR of plant breeders in Argentina and Brazil have, however, been challenged in recent years by the development of a large-scale parallel black market.[63]

Table 6 below summarizes the main characteristics of plant variety protection in the three countries.

| | Plant variety protection | | | | | Possibility of patents for plants |
|---|---|---|---|---|---|---|
| | **Year of adhesion to UPOV** | **Farmers' privilege** | **Essentially derived variety** | **Breeder's exemption** | **Protection period (years)** | |
| **Argentina** | 1994 (1978 Act) | Yes | No | Yes | 20 | No |
| **Brazil** | 1997 (1978 Act and elements of 1991 Act) | Yes | Yes | Yes | 15 temporary crops / 18 permanent crops | No |
| **USA** | 1994 (1991 Act) | Yes | Yes | Yes | 20 | Yes |

**Table 6: Comparison of plant variety protection systems in Argentina, Brazil and USA (Source: Fuck et al. (2008), Fernandez-Cornejo (2004))**

## *2.2 Non-GM breeding and seeds in the U.S.*

Due to the recent shortage of non-GM seeds (see section 1.2.4), the availability of competitive non-GM varieties, in terms of phenotypic diversity, has emerged as a topic of interest in the soybean farmer community. For instance, a document from the American Farm Bureau Federation asserted in May 2009 that "the availability of alternative varieties of conventional seed with up-to-date germplasm has been greatly reduced". This assertion is partly founded on the observation that fewer breeders are breeding non-GM soybeans.

The objective of this section is to examine whether available data on non-GM soybean breeders and on non-GM varieties currently available to farmers corroborate this asserted decrease in non-GM breeding activity.

As the seed industry has substantially changed these last two decades due to mergers and acquisitions and because no recent synthetic data is available on the structure of soybean seed industry, the first part of this sub-section will be dedicated to an analysis of the concentration of the soybean seed industry. The decrease in the number of firms breeding non-GM soybeans could indeed be a logical consequence of the numerous mergers and acquisitions that occurred on the sector. Few data are available on market shares in the soybean seed industry, and such data is not necessarily a good proxy for research and development activities. Therefore, the concentration of the sector will be mainly assessed through Intellectual Property Rights on soybean varieties (variety certificates and patents). As patent data also give information on germplasm ownership, these data will be also useful for the prospective analysis developed in the next chapter about the future of non-GM soybean development.

The second part of this sub-section will be dedicated to an assessment of the main companies and universities still breeding non-GM soybean varieties for farmers. The analysis of their line-up will then be used to give an overview of the non-GM varieties currently available to farmers.

[62] Fuck & al, 2008, p.228.
[63] See for instance Fuck & al (2008), Kesan & Gallo (2005), or Rapela & al (2006)

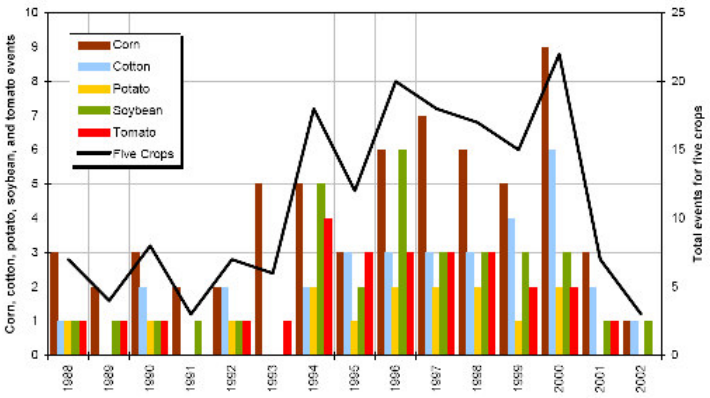
### 2.2.1 Market concentration

During the Organization for Competitive Market's annual conference[64] held on August 7, 2009, in Saint Louis, Missouri, Deputy Assistant Attorney General Phil Weiser announced that "the Antitrust Division [was] planning to look, in cooperation with the USDA, into the state of competition in agriculture markets". He added that they "understand that there are concerns regarding the levels of concentration in the seed industry--particularly for corn and soybeans. In studying this market, [they] will evaluate the emerging industry structure, explore whether new entrants are able to introduce innovations, and examine any practices that potentially threaten competition."[65]

Concerns about high concentration in the soybean industry may be understood by examining mergers and acquisitions in the sector as well as concentration in the soybean seed market, in soybean breeding activity and in germplasm ownership (see below).

#### 2.2.1.1 Mergers and acquisitions (M&A) in the soybean seed industry

Widespread literature exists about the seed industry and its concentration process. Jorge Fernandez-Cornejo (2006, pp 32-35), in the most complete study to date of the U.S. seed market, traces the evolution of the major seed companies. Similar information can also be found in the AgBioForum special issue "Innovation and dynamic efficiency in agricultural biotechnology"[66] (Volume 8, number 2 &3, 2005) and particularly in the article by Pray, Oehmke and Naseem (Graph 20). The Canadian non-profit group ETC[67] also published in 2005 detailed information on subsidiaries and acquisitions of the main seed companies.[68]




**Graph 20: Number of M&A events by crop and total of five crops, 1988-2002 (From Pray et al., 2005)**

But the most visual presentation of this process of concentration is certainly provided by Phil Howard, assistant professor at the Michigan University, who built a Network Animation of Changes in the seed industry between 1996 and 2008. A Quick Time animation

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[64] "The Organization for Competitive Markets is a national, non-profit public policy research organization headquartered in Lincoln, Nebraska. OCM believes America must work together, across all commodities, toward the common purpose of returning its food and agricultural sector to true supply and demand-based competition. Antitrust, competition and fair trade are important areas of interest to OCM." (About OCM, www.competitivemarkets.com/index.php)

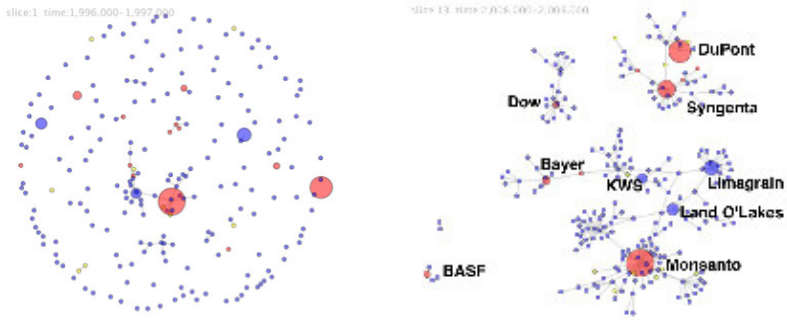
[65] http://www.usdoj.gov/atr/public/speeches/248858.htm

[66] http://www.agbioforum.org/v8n23/index.htm

[67] ETC group, September/October 2005, Global seed concentration, Communiqué. http://www.etcgroup.org/upload/publication/pdf_file/48

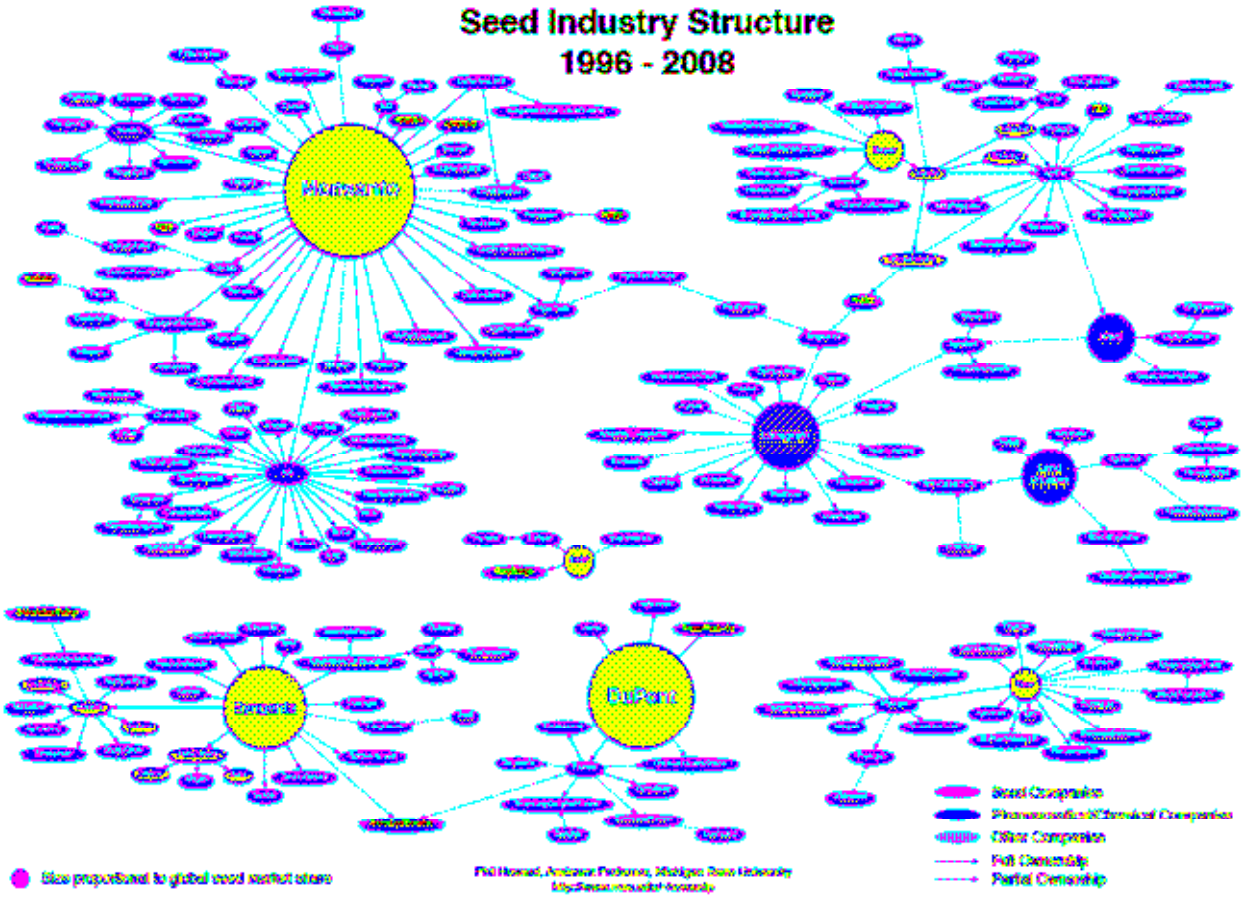
[68] See also Fulton M. & Giannakas K., 2001

of this work is available on his website,[69] showing the evolution of the seed industry between 1996 and 2009 (Graph 21).




**Graph 21: Seed Industry structure in 1996 and in 2009. Pharmaceutical/chemical companies are in red, seed companies in blue (Source: Phil Howard, http://www.msu.edu/~howardp/)**

Another diagram by Phil Howard depicts the seed industry in detail, with the names of all companies, leaders or subsidiaries.




**Graph 22: Seed industry structure (Source: Phil Howard, http://www.msu.edu/~howardp/)**

[69] http://www.msu.edu/~howardp/seedindustry.html

This concentration has been initiated and led by chemical and pharmaceutical companies and affects the whole seed production supply chain, from biotechnology research activities to the food or feed industry. Focusing on the horizontal concentration of the soybean breeding industry, the widest scope of mergers and acquisitions has been achieved by Monsanto.[70]

The first seed company acquired by Monsanto was Jacob Hartz Seed Co., bought in 1982 and known for its soybean seeds[71]. After the invention of the Roundup Ready traits in 1993, Monsanto acquired Asgrow agronomics, the U.S. leader in soybean breeding, in 1997. The company also bought Dekalb Genetics in 1998, a leader in the seed industry which in 1988 was selling more than 5% of U.S. soybean seeds (Fernandez-Cornejo, 2004), and combined their breeding programs.[72]

After having acquired a majority stake in First Line Seeds in 1998, Monsanto completed its purchase of the Canadian soybean seed company in 2004,[73] complementing its germplasm resources with early maturity groups.

In 2006, Monsanto bought Delta and Pine Land, a company that "has long been recognized as a leader in developing and marketing soybean varieties that provide strong performance for Southern farmers". The company from St Louis announced in 2008 that "Delta and Pine Land's soybean varieties [were] being transitioned to Monsanto's Asgrow soybean brand", meaning an integration process of the breeding activities of the two firms .[74] This recent acquisition is not included in Figure 1 below, in which Monsanto outlines its soybean breeding resources.

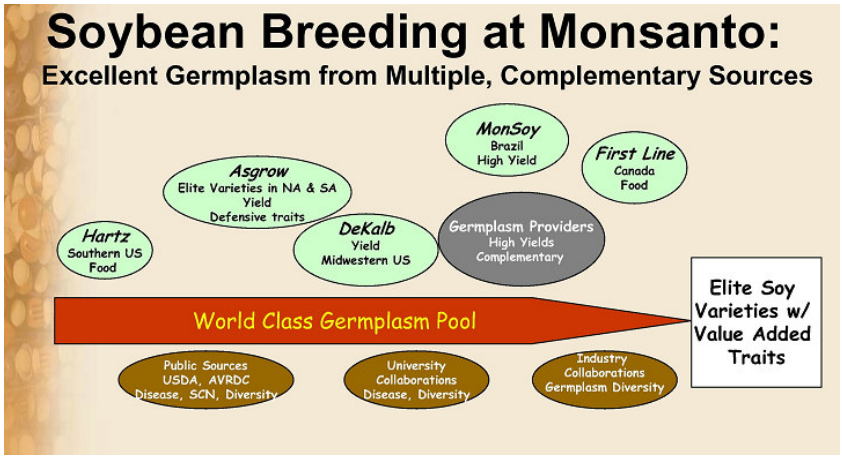



**Figure 1: Monsanto's soybean breeding and germplasm resources (source: Monsanto, http://www.monsanto.com/pdf/investors/2006/07-31-06b.pdf)**

DuPont acquired Pioneer Hi-Bred in 1997 (20% of the company at that date) and 1999 (the remaining 80%). Pioneer Hi-Bred had been an important actor on the soybean seed market in the U.S. since its 1973 acquisition of Peterson seeds (Fernandez-Cornejo, 2004, p. 33).

[70] For a broad overview of Monsanto's acquisitions, see: http://www.competitivemarkets.com/index2.php?option=com_docman&task=doc_view&gid=5&Itemid=32
[71] http://www.monsanto.com/who_we_are/history.asp
[72] Agrimarketing, September 2006, The Monsanto Miracle (http://www.agrimarketing.com/show_story.php?id=43340)
[73] http://claria13.securesites.net/News/releases/2004/february/7827.htm
[74] http://www.seedquest.com/News/releases/2008/august/23388.htm

Syngenta, the world's third largest seed group, was formed in 2000 by the mergers of AstraZeneca and Novartis. The latter had been created in 1996 by the merger of two Swiss Science giants, Ciba-Geigy and Sandoz, which both brought seed companies in the new group, including some with soybean breeding activity. Syngenta then acquired Garst Seeds in 2004, and increased its market share in soybean seeds.

### 2.2.1.2 Concentration of soybean seed sellers

To determine the extent of increased market concentration brought about by these mergers and acquisitions between seed companies, a first indicator is given by the market shares in soybean seed sales.

According to Fernandez-Cornejo (2004, p.36), "the development of soybean seed varieties was dominated by the public sector until the 1980s. (…) In 1980, over 70 percent of soybean acres harvested in the United States were planted with publicly developed varieties, but by the mid-1990s, the public share had decreased to as low as 10 percent of the market."

The last official data existing on market share of soybean seed companies in the U.S. is for 1998. It was published in the 2004 USDA report "The seed industry in US agriculture" (Table 7 and Table 8).

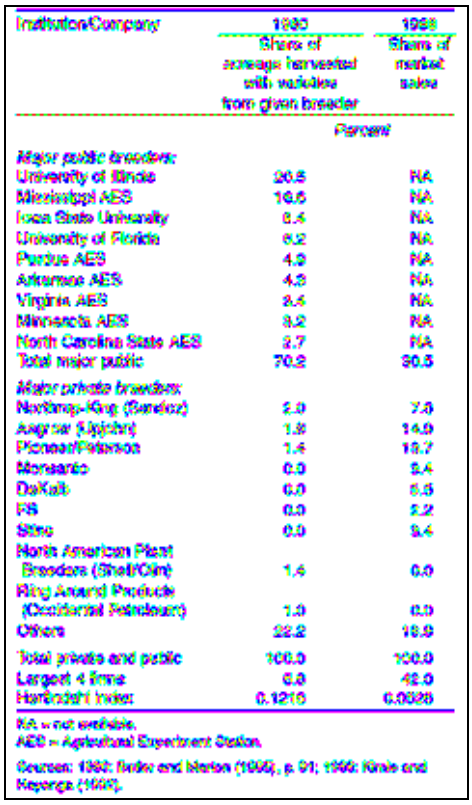


**Table 7: U.S. market shares of soybean seed varieties (Source: Fernandez Cornejo, 2004, p.36)**

| Company | 1994 | 1997 | 1998 |
|---|---|---|---|
| | | *Percent* | |
| Dupont/Pioneer Hi-Bred[1] | 22.0 | 19.0 | 17.0 |
| Monsanto[2] | | 19.0 | 24.0 |
| Asgrow | 15.0 | 11.0 | 16.0 |
| DeKalb | 19.0 | 8.0 | 8.0 |
| Novartis | | 5.0 | 5.0 |
| Dow Agrosciences/Mycogen[3] | 3.7 | 4.0 | 3.0 |
| Stine | 4.0 | 4.0 | 4.0 |
| FS | 3.9 | | |
| Jacques | | | |
| Others | 41.2 | 39.0 | 39.0 |
| Public | 3.2 | 10.0 | 10.0 |
| Largest 8 firms[4] | NA | NA | NA |
| Largest 4 firms | 60.0 | 47.0 | 50.0 |
| Herfindahl index[5] | 0.1115 | 0.0779 | 0.0915 |

NA = not available.
[1] Pioneer Hi-Bred was fully bought by Dupont in 1999.
[2] Monsanto acquired Asgrow in 1997 and DeKalb in 1998.
[3] Mycogen was acquired by Dow Agro in 1998.
[4] The market shares of only six companies were available in 1994, and only five in 1997/8.
[5] The "others" category was not included in calculation of the Herfindahl index because the category is very large and the number of companies in the others category is also unknown. Public varieties were also not included in this figure.

Sources: 1994: Kalaitzandonakes (1997); Hayenga (1998); 1998: Kalaitzandonakes and Hayenga (1999).

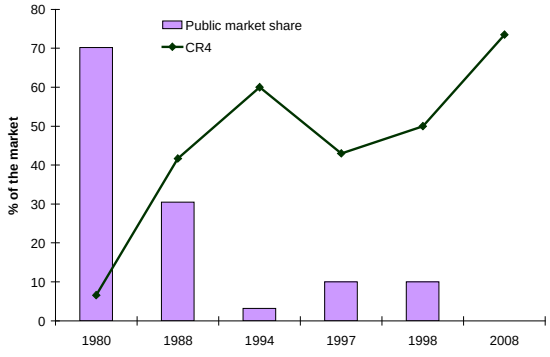
**Table 8: U.S. market shares of soybean seed, by company (Source: Fernandez Cornejo, 2004, p.36)**

More recent data, gathered from firms' annual reports or news releases, show an increase in the market share of market leaders:[75]

[75] Much of the information used and communicated by companies may come from the market studies of Doane's Marketing Research. The information published by this private company from St. Louis is not publicly available.

- Monsanto, with its American Seed subsidiary, a grouping of regional seed businesses, estimates that their market share in 2008 was 29%;[76]
- According to various news releases, Pioneer market share should be in the 25-30% range in recent years;[77]
- Syngenta (formerly Novartis) purchased Golden Harvest and Garst Seeds in 2004. Their soybean market share "has been estimated at 13-13.5% at a couple of points between 2005 and 2008".[78]

Assuming that the fourth company has, like in 1998, a market share of 4%, the evolution of the Concentration Ratio (CR4) can be traced from 1980 to 2008 (Graph 23).




| Company constituing or included in: | | | | | |
|---|---|---|---|---|---|
| Dupont (Pioneer) | | Syngenta | | Monsanto | |
| **1980** | | **1988** | | **1994** | |
| NK (Sandoz) | 2 | Asgrow | 14,9 | Dupont (Pioneer) | 22 |
| Asgrow | 1,8 | Pioneer | 13,7 | Dekalb | 19 |
| Pioneer/Peterson | 1,4 | NK (Sandoz) | 7,6 | Asgrow | 15 |
| NAPB (Shell/Olin) | 1,4 | Dekalb | 5,5 | Stine | 4 |
| **CR4** | **6,6** | | **41,7** | | **60** |
| **Public market share** | **70,2** | | **30,5** | | **3,2** |
| **1997** | | **1998** | | **2008** | |
| Dupont (Pioneer) | 19 | Monsanto | 24 | Monsanto | 29 |
| Monsanto (Asgrow) | 11 | Dupont (Pioneer) | 17 | Dupont (Pioneer) | 27,5 |
| Dekalb | 8 | Novartis | 5 | Syngenta | 13 |
| Novartis | 5 | Stine | 4 | *?* | *4* |
| **CR4** | **43** | | **50** | | **73,5** |
| **Public market share** | **10** | | **10** | | **?** |

**Graph 23: Own estimation of the evolution (in %) of market shares for soybean seed varieties, for public breeders and for the four market leaders (Source: see text)**

After a first movement towards strong concentration in the 1980s in parallel with a withdrawal of public breeding from the market, the four market leaders lost almost 20% of market share in the middle of the 1990s. Since 1997, the CR4 has increased by 30%, reaching an unprecedented level of 73.5% in 2008, according to the available data (using a conservative assumption on the fourth company).

The HHI index,[79] calculated for 2008 with the market shares of the top four companies, reaches 1,782 points. It would be higher and would most certainly rise above the level of 1,800 points if the market share data of other companies were included.

This HHI index is used by the Antitrust Division of the U.S. Department of Justice to evaluate the level of concentration of a market: "Markets in which the HHI is between 1,000 and 1,800 points are considered to be moderately concentrated, and those in which the HHI is in excess of 1800 points are considered to be concentrated. Transactions that increase the HHI by more than 100 points in concentrated markets presumptively raise antitrust concerns under

[76] 20% for Asgrow and a 9% market share for ASI. Source: Paul Heisey (USDA), personal communication.
[77] Pioneer claim in various press releases that they are the market leader for soybean seeds, which means that they sell more than Monsanto (29%) or Asgrow (20%). Some press releases suggested that they may have been estimating a market share of about 25% in 2006 or 2007. The company also claimed in 2008 that they had gained six market share points over the last eight years, and three more points in 2009.
[78] Source: Paul Heisey (USDA), personal communication.
[79] "HHI" stands for the Herfindahl-Hirschman Index, a commonly accepted measure of market concentration. It is calculated by squaring the market share of each firm competing in the market and then summing the resulting numbers. For example, for a market consisting of four firms with shares of thirty, thirty, twenty and twenty percent, the HHI is 2600 ($30^2 + 30^2 + 20^2 + 20^2 = 2600$). (http://www.usdoj.gov/atr/public/testimony/hhi.htm)
For a discussion of the HHI, see: Rhoades Stephen A., 1995, Market share inequality, the HHI, and other measures of the firm-composition of a market, Review of Industrial Organization, Volume 10, Number 6 / December 1995, 657-674

the Horizontal Merger Guidelines issued by the U.S. Department of Justice and the Federal Trade Commission."[80]

More data would be needed to calculate the exact level of the HHI index, but the figure calculated here is consistent with the recent statement by the Deputy Assistant Attorney General Phil Weiser (see above) concerning the interest of the Antitrust Division in the corn and soybean seed markets.

### 2.2.1.3 Analysis of patents and PVP certificates on soybeans

The data on market shares of seed sales presented above does not necessarily reflect the concentration of plant breeding activity. The Federal Trade Commission is now looking at competition at the stage of innovation to assess the level of concentration and the impact of mergers in the seed sector.[81]

To assess innovation competition (that is, competition in research activities), R&D expenditures are generally not available, or not at a disaggregated level, because they are commercially sensitive. Data on IPRs have therefore been used these last years as a proxy to measure the research efforts in the seed sector, by using a patent database when focusing on biotechnologies (Pray et al., 2005; Schimmelpfennig & al, 2004; Brennan & al, 2005), or a database on patents and Plant Variety Protection (PVP) certificates when studying a particular crop, like corn by Nolan et al. (2009). These latter authors suggested that "the share of ownership of germplasm, as an essential input for modern varieties of corn, could be used as a proxy measure of market concentration in the corn seed market." They used "data from the databases of the United States Patent and Trademark Office (USPTO) and the United States Plant Variety Protection Office (PVPO)". The same methodology is used below to evaluate concentration in the U.S. soybean breeding industry.[82] To this aim, a specific database has been built on patents and PVP protection on soybean cultivars, from 1990 to 2007. It is then used to evaluate the concentration in soybean germplasm property at the end of 2007.

- **Database**

The patent data on soybean cultivars originates from the USPTO database. "A consortium of University and USDA researchers has filtered the USPTO database to create a database of agricultural biotechnology patents",[83] in which the particular data on soybean varieties are provided by the USDA.[84] This data covers a period from 1986 to 2007. Only one patent, issued in 1986 and therefore expired at the end of 2007, has been excluded from this original database. The final database contains 982 patents.

The PVP certificates data for soybean have been extracted from the PVPO listing.[85] To fit with the patents database, all certificates that expired by the end of 2007 have been excluded from the original data. There remain only 842 operating certificates issued between 1990 and 2007 in the database .[86]

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[80] http://www.usdoj.gov/atr/public/testimony/hhi.htm

[81] Fulton M. & Giannakas K., 2000, p.138

[82] Data from biotech field trials, which are mandatory in the U.S. biotech regulatory process (and not for non-biotech varieties), have also been used as a measure of market concentration, but this method concerns only GM varieties.

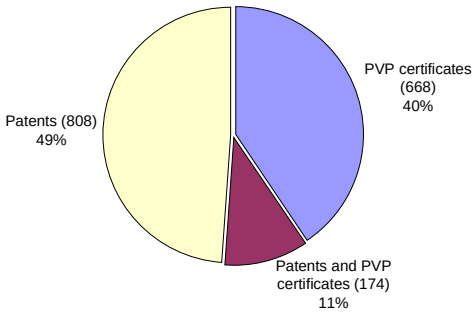
[83] Pray et al., 2005, p.54. The database is available at this address: http://www.ers.usda.gov/data/AgBiotechIP

[84] Paul Heisey, personal communication.

[85] Downloaded on 29th June 2009 from the PVPO website: http://www.ars-grin.gov/cgi-bin/npgs/html/pvp.pl?Soybean

[86] Certificates issued before 1995 expire 18 years later. At the end of 2007, the current certificates were therefore issued between January 1990 and December 2007.

One hundred seventy four (174) cultivars are both protected by certificate and patent.[87]




**Graph 24: Database on IPR on soybean germplasm resources in 2007 (Source: USDA, PVPO)**

This data may be analyzed as a stock or as a flow. The stock of IPR in 2007 (as shown on Graph 24) represents the protected germplasm resources existing in the U.S. in 2007, i.e. all soybean varieties protected at the end of 2007 by a PVP certificate and/or a patent. This data gives information about the ownership of recently protected germplasm resources for soybeans.

The flow of IPR is the number of PVP certificates or patents issued per year on soybean varieties. This flow gives information about the annual activity of soybean breeding and about the relative use of patents or PVP certificates per year or per company.

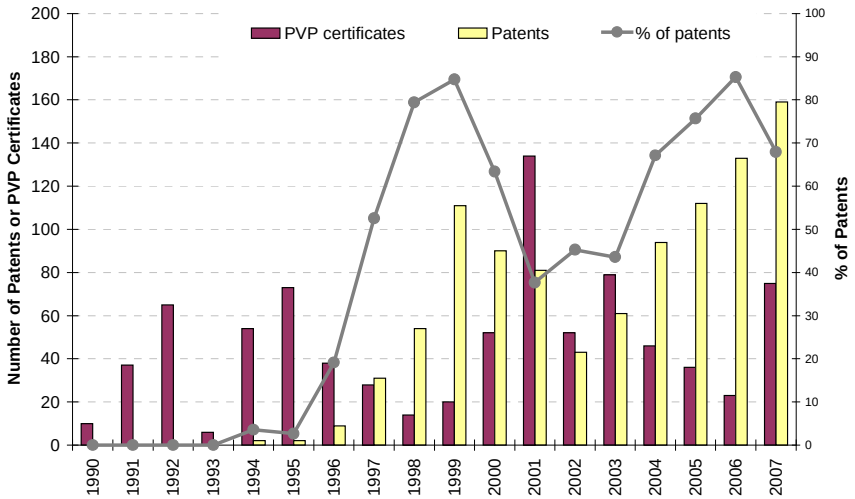
Other types of protection, like trade or license agreements between companies, do exist, but this information is kept proprietary by companies. The following developments are made under the assumption that data on PVP certificates and patents reliably reflect the situation in soybean breeding and germplasm activity.

- **Concentration of soybean breeding activity**

The first patent on a soybean variety was issued in 1986 for the company DeKalb Pfizer Genetics; but most soybean patents were granted after the mid-1990s. Table 16 below shows that they have significantly increased since that time; while PVP certificates, except for a rise in 2001, remain between ranges of 20 and 80 varieties issued per year, similarly to the situation at the beginning of the 1990s.[88]

[87] 56% of these varieties have been patented after certificated (one to five year after), 13% have been patented and certificated the same year and 31% have been certificated after patented (one to three years after).

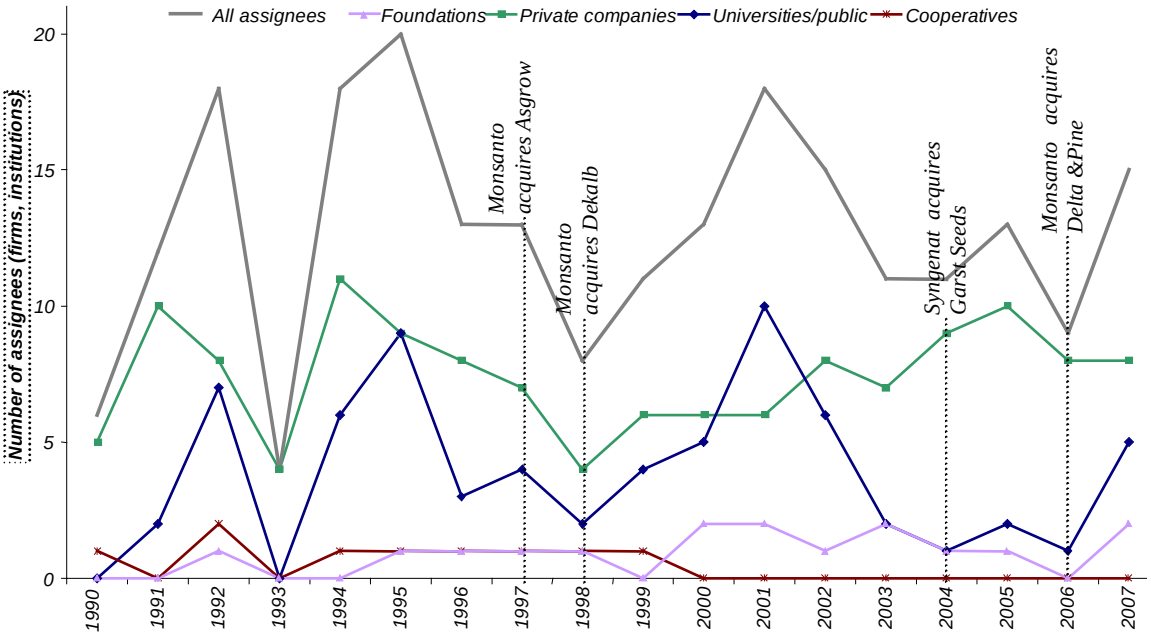
[88] As detailed above, utility patents and PVP certificates provide different levels of IP. PVP certificates do not provide complete ownership (with exclusion) because they include a research exemption, allowing plant breeders to use germplasm resources to develop new varieties under certain conditions. Conversely, owners of patents can exclude other plant breeders from the use of their patented varieties.




**Graph 25: Number of PVP certificates or patents issued per year for soybean varieties (Source: USDA, PVPO)**

This data therefore shows that the number of soybean varieties with IPRs has significantly increased since the beginning of the century. This may have resulted from a development of research efforts on this plant and/or an intensification of the use of intellectual protection.

Seventy seven (77) companies, universities, or diverse institutions have protected at least one new soybean variety with a PVP certificate or a patent since 1990 (see Table 24 in annexes), with never more than 21 per year (which happened in 1995) (Graph 26).




**Graph 26: Number of assignees of patents or PVP certificates for soybean varieties per year (Source: PVPO, USDA)[89]**

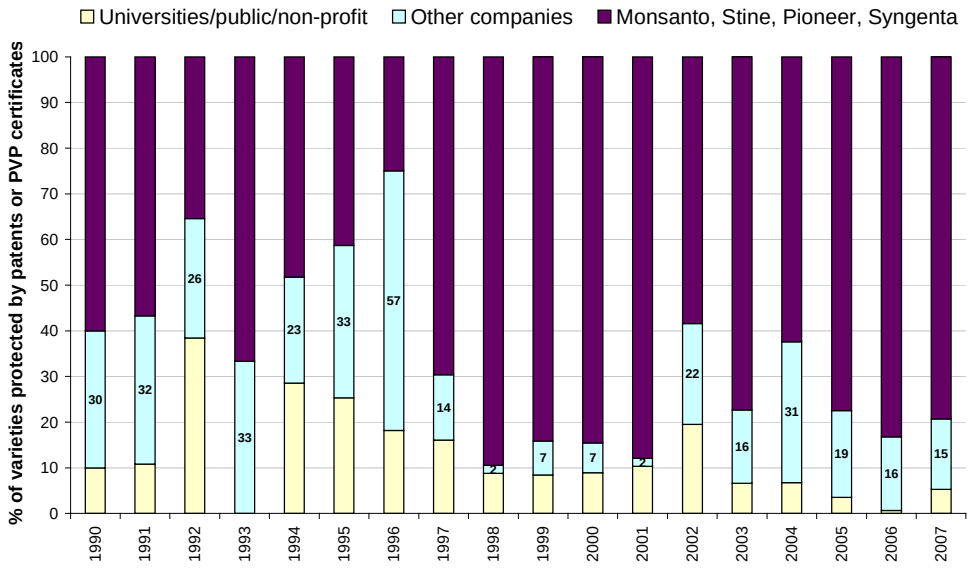
[89] Some varieties are protected both by a patent and a PVP certificate, issued in different years by different companies. In such cases, the last year and company have been selected for graphs and statistics.

The number of assignees per year gives information on the number of plant breeders working on soybean varieties. After a significant decrease in the number of private companies between 1994 and 1998, due to mergers and acquisitions, new entrants inverted the trend. Lastly, eight private companies were protecting soybean varieties in 2007, that is, as many as in 1996 or in 1992.

As long as IPR data properly reflects plant breeding activity, this data therefore does not indicate any decrease in the number of soybean breeders.

New entrants are however small enterprises with a low "market" share (see Table 25 in annexes).

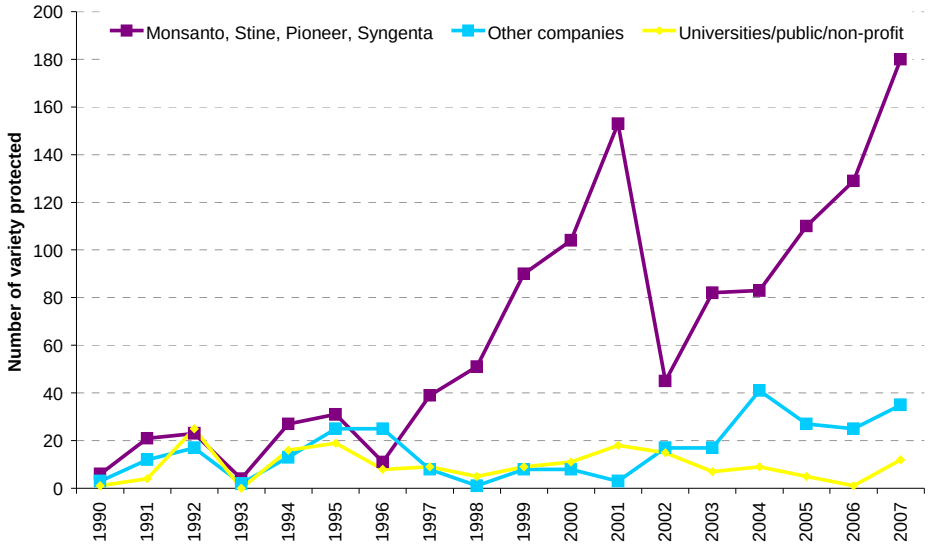
The share of the "big four" (Monsanto, Stine, Pioneer, Syngenta) in patents or certificates issued per year increased after the acquisition of Asgrow by Monsanto in 1996. More recently, from 2002 to 2007, the relatively high number of varieties issued by the other private enterprises is mainly due to Delta & Pine, which was bought by Monsanto in 2006, and Mertec Seeds, which entered the market in 2003 and is the main "small" company, representing respectively 16%, 10%, 14% and 7% of varieties issued in 2004, 2005, 2006 and 2007 (see Table 25 in annexes).




**Graph 27: Distribution of assignees (firms or institutions) of PVP certificates or patents on soybean varieties, by year (Sources: USDA, PVPO)**

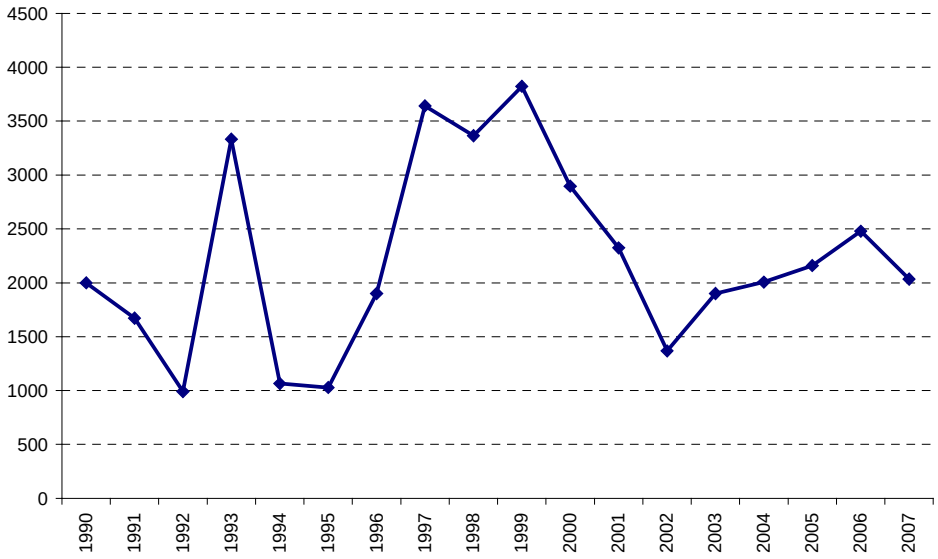
Other recent entrants represent only a small share of soybean protections issued per year. They are Nidera SA, the Argentinean seed leader, Soygenetics (a soybean research company created in 1999 by Limagrain, Land O'Lakes and FFR Cooperatives), and Schillinger, Hornbeck and Tennessee Advanced Genetics, three independent companies.

The share of soybean varieties protected by universities decreases each year, mainly because of the large rise in private varieties patented (Graph 28).




**Graph 28: Number of soybean varieties protected (by patents or PVP certificates) per group of assignees and per year (Source: USDA, PVPO)**

Soybean breeding activity is highly concentrated in the top four companies, which have represented from 60% to 90% of IPR activity per year in soybeans since 1996. Except in 2002, where it dropped to 1,300 points, the HHI index has ranged from 1,900 to more than 3,800 points (Graph 29).

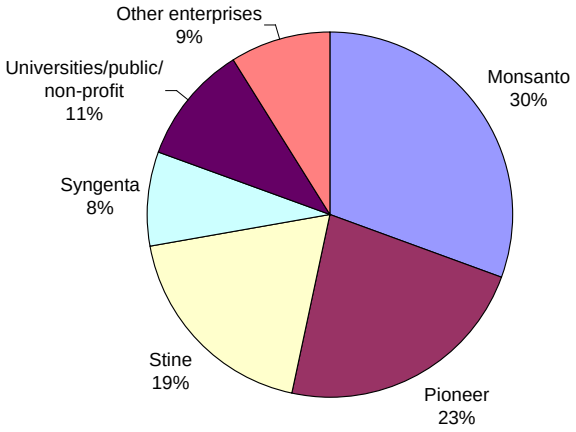



**Graph 29: HHI index for patents and PVP certificates issued per year (Source: USDA, PVPO)**

- **Concentration of germplasm ownership**

The data on the ownership (stock) of germplasm resources gives complementary information on the level of concentration of the soybean breeding industry. Using this data (from Table 23, in annexes), if no merger and acquisition had taken place between 1990 and 2007, the concentration ratio (CR4) of ownership of soybean germplasm resources in 2007 would be 61.7% and the value of the HHI index would be 1,155.7. Including actual mergers

and acquisitions in the calculation, the CR4 reaches more than 80.4%, meaning that the top four firms (Monsanto, Pioneer, Stine and Syngenta) own more than 80% of U.S. soybean protected germplasm resources. Public and non-profit institutions own 10.5 % and 17 other enterprises share the remaining 9%. The HHI index confirms this high level of concentration with a value of 1,958.7 points.




| Patents and PVP certificates assignees (post-mergers) | **Number of Patents and PVP certificates** | **%** |
|---|---|---|
| Monsanto | **506** | 30.67 |
| Pioneer | **372** | 22.55 |
| Stine | **313** | 18.97 |
| Syngenta | **136** | 8.24 |
| Universities/public/non-profit | **174** | 10.55 |
| Other private enterprises | **149** | 9.03 |
| **Total** | **1650** | **100** |

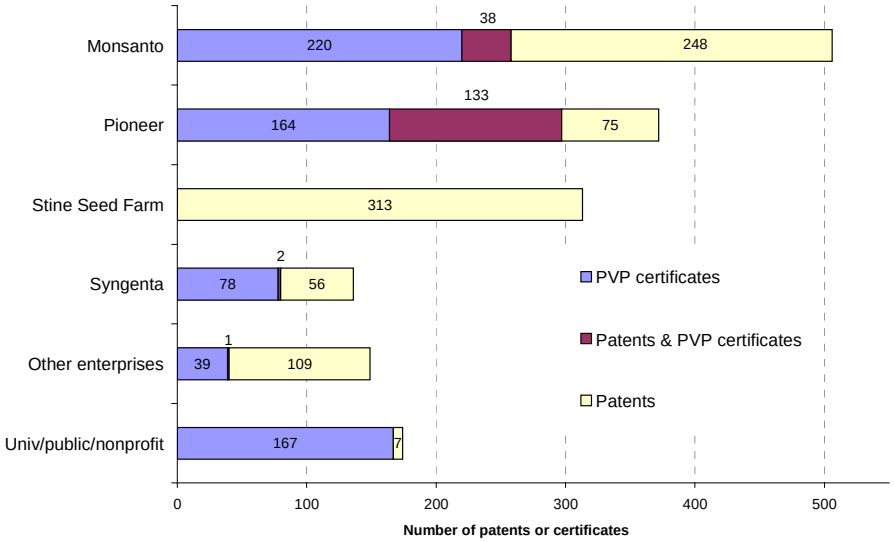
**Graph 30: Ownership of soybean germplasm resources (patents and PVP certificates) in 2007 (Source: USDA, PVPO)**

Mergers and acquisitions in the seed industry therefore had an important impact on concentration of recent soybean germplasm ownership.

But the impact of this concentration of germplasm resources on soybean breeding activity itself depends on the type of IPRs used by the largest firms.

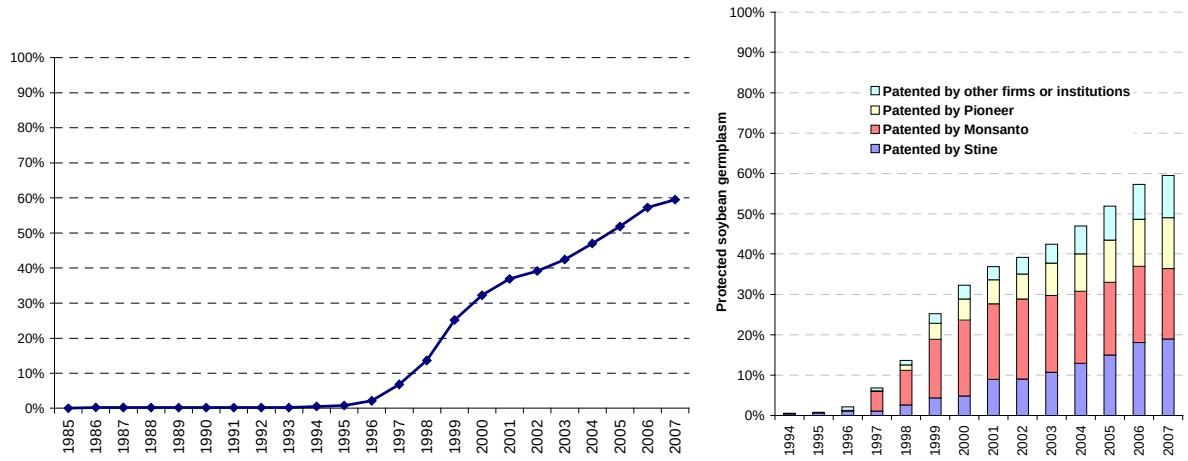
The IPR policy differs from one company to the next. Stine (which licenses a large proportion of its products to other companies for commercialization) only uses patents to protect its varieties while Pioneer still makes large-scale use of PVP certificates, often combined with patents. Monsanto's practices are more difficult to assess because these figures include different companies that the firm has acquired since 1990. But the global data shows that after wide use of patents at the end of the 1990s (mainly by Asgrow), the company and its subsidiaries were still using PVP certificates in 2007 (22 certificates and 17 patents).

Universities and public or non-profit organizations mainly use PVP certificates. The only 7 patents of this group have been granted by the Iowa State University Research Foundation. Patent ownership for soybean varieties is therefore 99.3% private (Graph 31).




**Graph 31: IPR policy by soybean breeding companies and public institution between 1997 and 2007 (Source: USDA, PVPO)**

As private companies are patenting more varieties every year, the share of patented soybean germplasm resources is increasing. From 0% in 1985, this percentage reached 60% in 2007 (Graph 32).

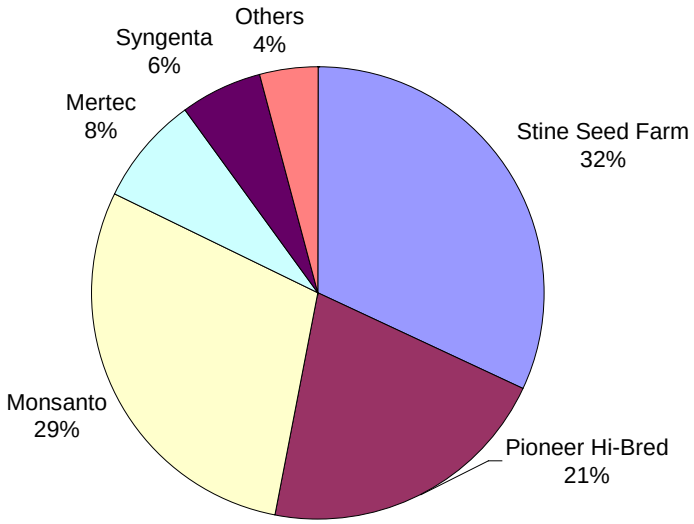



**Graph 32: Percentage of protected soybean germplasm resources patented (USDA, PVPO)**

The figures shown in the graphs above mean that in 1985, a plant breeder had free access to all the U.S. soybean germplasm resources in order to perform his plant crosses. PVP certificates, with research exemptions, were the only intellectual protection used by plant breeders. As the use of patents has increased, the share of freely accessible recent soybean germplasm resources[90] has fallen, below 80% in 1999 and below 50% in 2005. In 2007, only 40% of protected soybean germplasm resources for plant breeding had free access.

Plant breeders from small companies and universities are the most affected by this decrease in free-access germplasm resources. Indeed, the patents are owned by a handful of large companies (Graph 33).

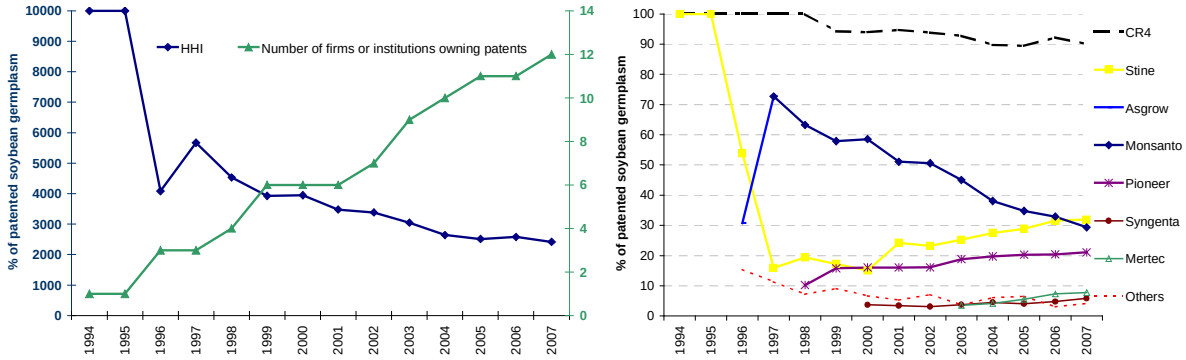
[90] Protected during the past 18 or 20 years




**Graph 33: Patent ownership for soybean varieties in 2007 (Source: USDA)**

Four companies, Stine, Monsanto, Pioneer and Mertec, own around 90% percent of patents on soybean germplasm, while the fifth company, Syngenta, has a 6% share. The value of the HHI index is 2,435.

Concentration of soybean patents ownership is therefore very high, even though it is decreasing slightly (see CR4 and HHI in Table 30 below) because of new entrants (see Table 27), like Mertec in 2003.




**Graph 34: Concentration of patents' ownership of soybean varieties (Source: USDA)**

### 2.2.2 Non-GM seed breeders and availability of non-GM seeds

The concentration of the seed industry certainly had an impact on the development of non-GM varieties. Some firms, like Asgrow, First Line, NK or Garst, for instance, who were releasing non-GM seeds some years ago, are now part of groups (Monsanto and Syngenta) that have stopped this business in the U.S.

As the number of firms breeding and releasing non-GM soybean has decreased, the diversity of varieties has also decreased. But it seems that diversity still exists for U.S. farmers willing to grow non-GM soybeans. There are much more transgenic than non-GM varieties available on the market, and therefore there is more diversity in the GM market. Still, we could list 162 different non-GM private or public soybean varieties for the 2009 or 2010 seasons (Table 9).

All State Universities breed and release non-GM varieties; in addition, while Syngenta U.S. and Monsanto have withdrawn from the non-GM market, Pioneer and Stine still perform non-GM breeding, as do several small companies. The data presented in Table 9 is not exhaustive, as small breeding companies have certainly been forgotten and also because we could not get information on the activities of Mertec LLC and Soygenetics, two middle-size companies breeding soybeans which may also breed non-GM varieties.

| Firms/Universities | Type of soybean varieties bred (GM or non-GM) | Number of GM varieties in the last line-up | Number of Non-GM varieties in the last line-up |
|---|---|---|---|
| **North-Dakota S.U.** | Only non-GM | | 7 |
| **Minnesota S.U.** | Both | | 13 |
| **South-Dakota S.U.** | Both | | 3 |
| **Iowa S.U.** | Both | | 34 |
| **Ohio S.U.** | Only non-GM | | 10 |
| **Missouri S.U.** | Both | | 3 |
| **Arkansas S.U.** | Only non-GM | | 3 |
| **Kansas S.U.** | Both | | 5 |
| **Pioneer** | Both | | 8 |
| **Stine** | Both | 118 | 20 |
| **Hornbeck - Soytech** | Both | 41 | 7 |
| **NuTech Seeds** | Both | 55 | 5 |
| **Galena Genetics** | Only non-GM | 0 | 5 |
| **EMerge Genetics** | Only non-GM | 0 | 25 |
| **Dairyland (Dow)** | Both | 38 | 2 |
| **Syngenta Canada** | Both | 20 | 12 |
| **Syngenta U.S. (Garst, Golden Harvest, NK)** | Only GM | 80 | - |
| **Monsanto (Asgrow, Dekalb, Delta & Pine, First Line)** | Only GM | 52 | - |
| **Mycogen (Dow)** | Only GM | 44 | - |
| **Ag Reliant (Great Lakes Hybrid, Pride Seeds, LG seeds)** | No soybean breeding program | - | - |

**Table 9 – Availability of non-GM seeds in the U.S. (Source: Companies' websites and personal communications)**

We now present, with more details, the non-GM breeders and some characteristics of their non-GM varieties. We begin by public breeding in State Universities.

### 2.2.2.1 State universities

Breeding programs in State Universities have the three global objectives of developing new cultivars, developing improved germplasm lines and performing basic research on plant breeding (Sleper, D.A. & Shannon, J.G, 2003). Through these activities, and particularly through the development of new cultivars, on which we focus below, they are a now a central actor in non-GM breeding in the U.S.

According to James Orf, Professor of agronomy and plant genetics in the State University of Minnesota, "much of the breeding work for non-GMO varieties is now done at state universities".[91] Shannon Grover, his counterpart at the university of Missouri, confirms that without "public programs, there would be little choice for farmers".[92]

In this study, the activity of State Universities has been investigated, especially through contacts with heads of breeding programs, in order to assess this breeding activity, to understand its rationale and characteristics, to list its output in term of varieties and to draw some of its future prospects.

Information has been collected on eight universities located in the eleven leading states in terms of soybean production, ranging from areas of production for soybeans of maturity groups 00 to VI. From North to South, these universities are from the states of North-Dakota, Minnesota, South-Dakota, Iowa, Ohio, Missouri, Kansas and Arkansas.

| State University | Breeding of GM or non-GM varieties | Number of non-GM varieties available to farmers | Maturity groups | Varieties types: for general use or for human food products |
|---|---|---|---|---|
| **North-Dakota** | Only non-GM | 7 | 00 - 0 | Both |
| **Minnesota** | Both (mainly non-GM) | 13 | 00, 0, I, II. | Both |
| **South-Dakota** | Both | 3 | 0 - I - II | General use |
| **Iowa**[93] | Both | 34 | I-II-III-IV | Both |
| **Ohio** | Only non-GM | 10 | II-III-IV | Both |
| **Missouri** | Both | 3 | IV and V | General use |
| **Arkansas** | Only non-GM | 3 | IV and V | General use |
| **Kansas** | Both | 5 | 4,6 - 5 - 5,5 | Both |

**Graph 35: Breeding activities and non-GM varieties released by State Universities (source: personal communications)**

As developed in the next paragraph, these State Universities are all developing non-GM soybean varieties, mainly because of the low level of private activity in this niche market. These varieties are competitive and cover a relatively wide range of characteristics; but public breeding programs have tended, over these last years, to put more emphasis on varieties for specialty crops on Identity Preserved markets.

#### 2.2.2.1.1 Why breed non-GM soybeans?

All the universities studied have a non-GM breeding program, and this seems to be the case of all U.S. States Universities. According to William Schapaugh, Professor of soybean breeding and genetics at Kansas State University, "the major public soybean breeding programs have a significant portion, or all of their resources devoted to the improvement of conventional germplasm."[94]

[91] The Organic and Non-GMO Report, July 2008
[92] Conventional soybeans draw interest, Apr 3, 2009, By David Bennett, Farm Press Editorial Staff.
[93] For details on varieties characteristics: http://www.ag.iastate.edu/centers/cad/MZ1.html
[94] Personal communication

There is no federal instruction for breeding non-GM soybeans; this decision is made at the university level through agreements with soybean farmers who fund research programs through soybean checkoffs.

Most universities breed GM and non-GM soybeans; but some, like those of Arkansas, North Dakota or Ohio, breed only non-GM. Steve St Martin, who led the soybean breeding program at Ohio State University between 1991 and 2008, "initially attempted to incorporate Monsanto's gene for glyphosate resistance", but abandoned it because he "could never get high-yielding varieties with it." Ted Helms, his counterpart at North-Dakota University, also recently abandoned GM breeding because he could not get good performances compared to private varieties.[95]

There are also specific rationales for breeding non-GM varieties: to provide varieties to producers of this niche market and to build improved germplasm that is easy to transfer to other breeders.

Rather than compete with Monsanto and other big seed companies, and duplicate their efforts on GM breeding, Ted Helms considers that his research efforts are more useful on non-GM breeding. This is reinforced by the current context, where "there is a good bit of interest in non-GM soybeans because of the increase in weed control costs due to roundup tolerant weeds and the high cost of GM seeds."[96] So, "the development and release of conventional cultivars provides farmers with an alternative to buying GMO cultivars from private companies".[97] This public alternative is important in some states, like North Dakota, where the public soybean breeding program "is virtually the only supplier of genetically improved conventional cultivars". [98]

Universities may therefore consider non-GM breeding of varieties for general use or Identity Preserved production for human use, as "a niche market that is not being pursued by the private sector".[99]

But along with providing varieties to farmers, another research duty of State Universities is to enhance germplasm resources for plant breeders. And as mentioned by Jim Orf, "the breeding of non-GM varieties makes the material available to anyone without restrictions where GM varieties require the permission of the company owning the GMO trait in order for there to be transfer of material". [100]

#### 2.2.2.1.2 Characteristics and performances of non-GM varieties released

The list of non-GM varieties released for farmers by the State Universities studied (Graph 35) shows a relatively global diversity in their characteristics. This does not however necessarily mean that they cover all farmers' needs in all areas considered. A more complete assessment of the varieties and their characteristics would have to be implemented, in relation with the local farming contexts and farmers' demand, to get a complete picture of the situation. But the data collected gives a first overview of the situation.

The maturity groups of the varieties released by universities range from 00 to V, which completely covers the area studied. But according to Grover Shannon, there is a lack of Group 4 non-GM varieties.[101]

Public breeders develop non-GM soybean for general use or for Identity Preserved markets like human food use.

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[95] Ted Helms, Hatch Project 2008.
[96] Shannon Grover, personal communication
[97] Ted Helms, Hatch Project 2008.
[98] Ted Helms, Hatch Project 2008.
[99] Jim Orf, personal communication
[100] Personal communication
[101] Conventional soybeans draw interest, Apr 3, 2009, By David Bennett, Farm Press Editorial Staff

Breeding general-use varieties generally aims, as in North-Dakota, at "[developing] cultivars that have high yield in the most productive environments, but also have tolerance to both biotic and abiotic stresses."[102] These varieties seem to be competitive compared to private ones. Several breeders interviewed, like Pengyin Chen from Arkansas, reckon that non-GM varieties yield like private RR varieties. Grover Shannon, from Missouri, released for instance in 2006 a variety named "Jake" (mid-group V, with broad resistance to soybean cyst nematode populations, resistance to southern root knot nematode, and resistance to reniform nematode) which has yielded in field trials "as well as some of the better Roundup Ready varieties in the same maturity group".[103]

But some universities are now shifting their breeding programs to the development of varieties for specialty crops in Identity Preserved markets, like food types. For instance, after a few years of gradually greater emphasis on this activity, James Orf, from Minnesota, spends now about half of his time on food-grade varieties. Kansas State University has also developed several varieties for special use: with large seeds, yellow hila, high protein for the production of soymilk or tofu, or high protein varieties for high-protein feed, or blended with low-protein to meet specific standards.[104] The varieties from Ohio State University, "FG1" to "FG5", for soy-food production, have also been adopted by farmers exporting their production to Japan.

Almost all the State Universities release their varieties under PVP certificates and some only through licenses with seed producers. Missouri University also plans to apply for patents in some cases.

Seeds from new varieties developed by the universities are generally marketed by seed producers via license agreements.

### 2.2.2.2 Private companies

Some private companies are still breeding non-GMO soybeans, including market leaders like Pioneer, Stine or Syngenta, which still have a (small) non-GM breeding program, as well as some smaller companies, specialized in germplasm research, in particular locations or in IP soybean for human food use.

#### 2.2.2.2.1 Pioneer

Pioneer® is still producing and developing non-GM varieties. In 2009-2010, this company is marketing eight non-GM patented varieties (Table 31).

| Variety | Relative Maturity |
|---|---|
| 91M10 | 11 |
| 92M10 | 21 |
| 93M72 | 27 |
| 93M14 | 31 |
| 93M52 | 35 |
| 93M62 | 36 |
| 93B82 | 38 |
| 94Y21* | 42 |

* NEW

**Table 10: 2009-2010 non-GM Pioneer® brand soybean varieties (Source: Pioneer®)**

[102] Ted Helms, Hatch Project 2008.
[103] Conventional soybeans draw interest, Apr 3, 2009 10:56 AM, By David Bennett, Farm Press Editorial Staff
[104] Schappaugh William, 2006, p.87.

The more recent non-GM variety marketed (94Y21) is part of the 32 new seed varieties of the "*Y series"*. According to Pioneer, these new varieties should "deliver unprecedented productivity gains to North American soybean growers" with "a 5 percent yield advantage over competitive soybean varieties".[105] After years of low increase in soybean yields, these new products obtained through traditional breeding programs using molecular marker technologies will compete with the new Monsanto series of "RReady2Yield".

All the other Pioneer non-GM varieties are older. Over the last 4 years, Pioneer has marketed 4 new non-GM varieties (including 94Y21) and 94 new GM varieties (Table 11).

| | 2006[106] | 2007[107] | 2008[108] | 2009[109] |
|---|---|---|---|---|
| New GM varieties | 22 | 19 | 21 | 32 |
| New non-GM varieties | 0 | 1 | 2 | 1 |

**Table 12: New GM and non-GM Pioneer soybean varieties (Source: Pioneer)**

According to an executive from Pioneer Hi-bred International, their non-GM products "yield very well so the growers are not giving up yield *vs.* RR beans, fact is in many cases the yields may be higher than RR beans." They "believe that there is currently a stable amount of demand for non-GMO beans and we will continue to offer the products as long as a viable market exists for them."[110]

#### 2.2.2.2.2 Stine

Stine Seed Farm Inc. defines itself as "the nation's largest independent seed company" operating the "industry's largest corn and soybean breeding and development program, advancing and testing nearly 1 million unique soybean varieties and more than 100,000 preliminary corn hybrids annually. For nearly four decades, Stine's soybean research program has been regarded as the soybean genetics supplier of choice to the seed industry and Stine has consistently led the Patent Board's Food, Beverage and Tobacco industry segment in growth and industry impact."[111] (see Graph 33)

Stine licenses most of its seed genetics to other seed companies who sell it under their own brand name. The firm develops soybean varieties with different traits and non-GM varieties. There are 20 non-GM varieties in the 2010 line-up, including 11 new (Table 13), and ranging from maturity 02 to 54. All the varieties are patented.

| | Brand Number | Maturity |
|---|---|---|
| | 0200-0 | 02 |
| New | 0500-0 | 05 |
| New | 1700-0 | 17 |
| New | 2000-0 | 20 |
| | 2100-2 | 21 |
| | 2400-0 | 24 |
| | 2500-2 | 25 |
| New | 3300-0 | 33 |

[105] *http://www.pioneer.com/web/site/portal/menuitem.f81a6a756f6546d022712271d10093a0/*
[106] *http://www.pioneer.com/web/site/portal/menuitem.1c4f9f8caf70579724d533d0d10093a0/*
[107] *http://www.pioneer.com/web/site/portal/menuitem.9bc3c93f2837d930f671a226d10093a0/*
[108] *http://www.plantmanagementnetwork.org/pub/cm/news/2007/23Varieties/*
[109] *http://www.pioneer.com/web/site/portal/menuitem.f81a6a756f6546d022712271d10093a0/*
[110] Personal communication
[111] http://www.stineseed.com/about-stine/news-releases/stine-seed-introduces-2010-corn-and-soybean-lineup/

| | | |
|---|---|---|
| | 3300-2 | 33 |
| | 3308-2 | 33 |
| New | 3400-0 | 34 |
| | 3400-2 | 34 |
| | 3870-0 | 39/7 |
| New | 3900-2 | 39 |
| | 4100-2 | 41 |
| New | 4300-2 | 43 |
| New | 4400-2 | 44 |
| New | 4500-2 | 45 |
| New | 4800-2 | 48 |
| New | 5400-0 | 54 |

**Table 13: Stine 2010 line-up of non-GM soybean varieties (Source: http://www.stineseed.com/)**

In 2010, Stine has also released 118 transgenic varieties, including 71 new. These varieties have Liberty Link or Round Ready or Genuity™ RoundupReady® 2 yield (RR2Y) traits (Table 14).

| *Number of varieties* | Non-GM | Liberty Link | RR | Genuity RR2Y |
|---|---|---|---|---|
| **2010** | 20 | 22 | 52 | 44 |
| **2009** | 11 | 12 | 48 | |

**Table 14: Number of GM and non-GM varieties in 2009 and 2010 Stine soybean line-up (Source: http://www.stineseed.com/)**

Stine has released more soybean varieties for 2010 cultures (138) than for 2009 (71), mainly because of the increase in non-GM and Liberty Link varieties (+11) and the development of a new line up with new Monsanto traits (RR2Y).

As seen in Table 15 there are also more "new varieties" in 2010 than in 2009, including 71 new GM (against 28 in 2009) and 11 new non-GM (against 7 in 2009).

| *Number of varieties* | 2009 | 2010 |
|---|---|---|
| **New GM** | 28 | 71 |
| **New non-GM** | 7 | 11 |

**Table 15: Number of GM and non-GM new varieties in 2009 and 2010 Stine soybean line-up (Source: http://www.stineseed.com/)**

### 2.2.2.2.3 Syngenta Canada

Syngenta and its subsidiaries in the U.S. (Garst Seed, NK, Golden Harvest) neither breed nor distribute any non-GM varieties. Syngenta Canada, however, is "the only major seed company in Canada that has a breeding program for non-GMO soybeans"[112] and its varieties can be grown in northern states of the U.S.

There are 20 GM varieties in the Syngenta Canada line-up and 12 non-GM varieties (for commodity or food grade).

[112] Don McClure, from Syngenta Canada. (The Organic & Non-GMO Report July/August 2008.)

| Product Name | Maturity Group | Feature |
|---|---|---|
| S 08-80 | 0.8 | Strong Disease Protection |
| S03-W4 | 0.3 | High Yielding Food-Grade Soybean |
| S05-T6 | 0.5 | High Yielding Early Soybean |
| S10-B7 | 1.0 | High Yielding Food-Grade Soybean |
| S12-A5 | 1.2 | Expect Big Yields |
| S14-P6 | 1.4 | Yield Punch For High Performance |
| S18-R6 | 1.8 | Top Yields Plus SCN |
| S19-90 | 1.9 | Consistent Yields and Strong Disease |
| S20-G7 | 2.0 | Strong Disease Protection |
| S23-T5 | 2.3 | Yield plus SCN plus Food-Grade |
| S25-D3 | 2.5 | Soybean For Food-Grade Market |
| S26-F9 | 2.6 | Top Yields Plus SCN |

**Table 16: Syngenta Canada non-GM line-up (Source: http://www.nkcanada.com/en/Products.aspx?prod_type=soybeans)**

According to Don McClure, from Syngenta Canada, it is a good market for them, and they "want to stay in".[113]

#### 2.2.2.2.4 Dairyland Seed (Dow)

Dairyland Seed, a company born in 1907 in West Bend, WI, has a long history of plant breeding in corn, alfalfa and soybean. Dow bought the company in August 2008.

In 2009 the company had a line-up of 40 soybean varieties, which included 2 non-GM varieties: DSR-3590, maturity group 3.6 and the new variety DSR-2118, maturity group 2.1.[114]

#### 2.2.2.2.5 Hornbeck – SoyTech

"Hornbeck agricultural",[115] a company from the U.S. Midwest, develops and sells seven non-GM varieties through its two subsidiaries Hornbeck Seeds and Worldwide SoyTechnologies who license its products to other companies.

| Brand | Number | Maturity |
|---|---|---|
| Hornbeck | HBK C4926 | 4.9 |
| Hornbeck | HBK C5025 | 5.0 |
| Hornbeck | HBK C5894 | 5.8 |
| SoyTec | S043987 | 4.8 |
| SoyTec | SO44046C | 4.9 |
| SoyTec | SO32482 | 5.5 |
| SoyTec | SO22010 | 5.6 |

Table 17: Hornbeck non-GM line-up (Source: http://www.hbkseed.com and http://www.soytec.us/html/index.html)

Hornbeck Seeds also has 10 GM varieties in its line-up[116] and SoyTech has 31 other GM varieties in its catalogue.

[113] The Organic & Non-GMO Report July/August 2008
[114] http://www.dairylandseed.com/product.asp?type=Soy
[115] http://www.hornbeckag.com/
[116] See details of varieties characteristics in annexes.

#### 2.2.2.2.6 NuTech Seed

NuTech Seed is an independent seed company from the Midwest (Iowa), resulting from the merger of Agsource Seed and NuTech Seed[117] in 2006. The firm claims to have "the enviable position of combining the most comprehensive soybean genetic access in the industry with a unique proprietary breeding and research program".[118]

Its soybean line-up includes 5 non-GM and 55 GM varieties.

| Brand Name | Maturity |
|---|---|
| 154 | 1.5 |
| 176 | 1.7 |
| 236 | 2.3 |
| 245 | 2.4 |
| 278 | 2.7 |

Table 18: NuTech Non-GM line-up (Source: http://www.nutechseed.com/content/variety_search.php?cropPkey=104)

#### 2.2.2.2.7 Galena Genetics, LLC

"Galena Genetics, LLC is a soybean breeding company focused on the breeding and development of non-GMO soybean varieties. Galena Genetics is wholly-owned by North Country Seed, LLC, a company focused on contract production and international marketing of soybean to various end-users, and especially food-grade soy processors around the world. North Country Seed contract produces non-GMO soybean with farmers in the Midwestern USA, buys back that grain production, cleans the grain, and exports it to end-use customers.

Galena Genetics develops and provides non-GMO soybean genetics to North Country Seed as part of this marketing strategy. Hence, there is vertical integration of the entire process from development of new non-GMO genetics, production of non-GMO grain, buy-back of that grain production, and grain export to end-users."[119]

Galena genetics also has in its catalogue some GM varieties (RR) which are under license from another genetics supplier, and does not breed transgenic varieties. The company sells six non-GM varieties with different premium programs (IP or commodity) (Table 20).

| Variety name | Premium program | Maturity group | Yield (mean) | Protein | Oil | Price ($/unit) |
|---|---|---|---|---|---|---|
| 19G01 | Identity Preserved | 1,9 | 43,9 | 42% | 20,90% | 32 |
| 19G02 | Identity Preserved | 1,9 | 46,3 | 40,90% | 22,70% | 32 |
| 21G02 | Commodity | 1,9 | 46,5 | 41,7 | 21,7 | 32 |
| 23G03 | Commodity | 2,3 | 49,5 | 41,5 | 20,6 | 32 |
| 23G07 | Commodity | 2,3 | 53,4 | 41,2 | 20,8 | 32 |
| 25G01 | Commodity | 2,3 | 46,2 | 41,9 | 21,3 | 32 |

**Table 19: Galena Genetics 2010 line-up (Source: http://www.rabbegrain.com/index.cfm?show=10&mid=63)**

[117] AgSource Seeds and NuTech Seed Join Forces, Jul 18, 2006, Indiana Prairie Farmer (http://indianaprairiefarmer.com/story.aspx?s=7200&c=8)
[118] http://www.nutechseed.com/content/page.php?pagePkey=6
[119] Personal communication from Galena Genetics

### 2.2.2.2.8 eMerge Genetics (Schillinger)

Schillinger Seed, Inc. is a recent seed company created by John Schillinger who left the presidency of Asgrow in 1999 to create a company dedicated to breeding non-GM soybeans for the soy-food market. eMerge Genetics, created in 2009, is now the brand developing this activity in Schillinger, also with the objective to link food manufacturers with seed distributors, grain handlers, and farmers.[120]

eMerge Genetics has a clear strategy of investing in the non-GM soybean market in the U.S and abroad: "today's largest seed companies are all focused on GMO crops. But demand for non-GMO grain from consumers and food companies continues to grow both overseas and domestically. We've made it our mission to bring those who demand non-GMO grain together with those who grow it."[121]

They have a line-up dedicated to soybeans with "traits that are in higher demand from food companies and other end users" and that "means higher premiums", that is to say "traits like high-protein levels, healthier oils and taste". [122]

| Variety | Relative Maturity | Characteristics | Comments | SCN |
|---|---|---|---|---|
| 119F.Y | 19 | Early YHC | Exciting Early Maturity with Breautiful Grain Quality | S |
| 209F.HPC | 20 | High Protein with SCN | Earliest High Protein on the Market | R3 |
| 230N | 23 | Elite Yield and Defense | Beautiful Variety | MR3 |
| 2388 | 23 | 1% Ultra Low Lin | Early Ultra Low Lin Variety with Nice Yield Punch | S |
| 240F.Y | 24 | Tofu Type with Med Protein | Premium Tofu Type, High Management | S |
| 247F.HD | 24 | High Digestibility | Medium Protein and Superior Quality with Solid Yield | S |
| 248F.HP | 24 | High Protein | Brand New High Protein | S |
| 258F.HPC | 25 | High Protein with SCN | Brand New High Protein + SCN | R3 |
| 277F.HD | 27 | High Digestibility | Medium Protein and Superior Quality with Solid Yield | S |
| 29Y115 | 29 | Tofu Type with Avg Protein | Large Seeded, Bushy Plant Type Gives a Quick Canopy | S |
| 317.TC | 31 | Elite Yield and Defense | Great New Addition as an Elite Early 3 Choice | R3 |
| 348.TC | 34 | Elite Yield and Defense | The New Standard in Group 3 Non GMO, Yielded 7% higher than all Checks in 2007 | R3 |
| 365F.Y | 36 | Yellow Hilum with SCN | Great Protein in a YHC Variety | MR3 |
| 3867SCN | 39 | 1% Low Lin with SCN | The Best Group 3 Ultra Low Lin out There! | R3 |
| 388.TC | 38 | Elite Yield and Defense | Great Yields! Great Maturity! | R3 |
| 389F.YC | 38 | Yellow Hillum with SCN | This will be a Major Player in YHC Markets | R3 |
| 414F.Y | 41 | Tofu Type with Med Protein | Great Western Variety! | S |
| 428F.HPC | 42 | High Protein with SCN | Brand New High Protein | R3 |
| 4328 | | | | |
| 435.TCS | 43 | Elite Yield and Defense with STS | SCN/STS Stacked and Fabulous Yields. Great Barge Variety! | R3 |
| 446F.HP | 42 | High Protein and STS | Good Eastern High Protein | S |
| 447.TC | 44 | Elite Yield and Defense | 44% Protein with Excellent Agronomics | R3 |
| 448F.HPC | 44 | High Protein with SCN | Brand New High Protein | R3 |
| 477.TCS | 47 | Elite Yield and Defense with STS | Excellent Yield in a Late Maturity + STS and SCN. | R3 |
| 528F.Y | 52 | Group V YHC | Brand New YHC. Very Stable Yield Package! | S |

**Table 20: eMerge Genetics 2010 line-up (Source: http://www.emergegenetics.com/products/)**

[120] eMerge Genetics launches "non-GMO revolution", The Organic & Non-GMO Report, May 2009
[121] http://www.emergegenetics.com/our_story/
[122] http://www.emergegenetics.com/

### 2.2.2.3 Characteristics of non-GM varieties

One hundred sixty two (162) non-GM varieties have been listed from the above breeders,[123] of which 85 (52%) have been developed by private breeders and 77 (48%) by public breeders. 64% of the varieties have been developed for general use and 36% for special use. The data confirms the lack of group IV non-GM varieties, of which only 3 are available (Table 21).

| Maturity groups / Type of use (number of varieties) | General use | Special use | Total | Total (%) |
|---|---|---|---|---|
| **00** | 10 | 5 | 15 | 9.32% |
| **0** | 19 | 11 | 30 | 18.63% |
| **I** | 21 | 26 | 47 | 29.19% |
| **II** | 23 | 7 | 30 | 18.63% |
| **III** | 15 | 6 | 21 | 13.66% |
| **IV** | 3 | | 3 | 1.86% |
| **V** | 12 | 2 | 14 | 8.70% |
| **Total** | 103 | 57 | 160 | 100% |
| **Total (%)** | 64.4% | 35.6% | 100% | |

**Table 21: Maturity groups and type of use of non-GM, number of varieties and % (Source: Private and public line-up of non-GM varieties)**

Yield performance depends on how the varieties are adapted to the particular characteristics of the fields and areas of growth, which we cannot assess at a general level. Varieties can only be compared on a local basis, using field trials by state universities.

According to the private or public breeders interviewed, the yields of existing non-GM varieties are higher or similar to RR varieties, excluding for some special-trait soybeans which yield less (with high protein level, for instance).

[123] See Table 30 in annexes for details of variety characteristics.

## *2.3 Brazil*

This section attempts to define the legal framework that undergirds research on genetic improvement in Brazil, for which purposes the National Cultivar Registry (RNC)) and the Law of Cultivar Protection (LPC) have been analyzed. From there we go on to describe the Brazilian seed industry and the seed sector market structure. Given the measurement difficulties that emerge regarding data for this industry, firms that registered their cultivars at the RNC during the 1998 to-2008 period are used as a proxy. Some Brazilian programs for genetic improvement are also described.

### 2.3.1 Legal framework for plant breeding

Basically four laws make up the regulatory framework for the development of improved and certified seeds in Brazil. The Patent Law (Law no.9.279, dated 05/14/96) and the Cultivar Protection Law (Law no. 9.456, dated 04/25/97) deal with issues related to intellectual property. The Seed Law (Law no. 10.711, 08/05/03) deals with the production and sales of seeds. At least, the Biosecurity Law (Law 11.105, dated 24/03/2005) deals with GM seeds.

During the 1990s, there was some pressure to create regulation in conformity with the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPs) of the World Trade Organization (WTO). Thus, in 1991 a bill for a patent law was presented *(approved in 1996)*, extending monopoly rights in intellectual property to food-related cases.[124] That same year, procedures regarding the Cultivar Law were initiated, conceding rights to cultivar monopoly to firms devoted to genetic modification. Both laws went into effect in 1997.

The definition of a legal framework for the commercial use of GMOs and the possibility of restricting access to genetic material provided for by the cultivar protection and seed laws created incentives for the multinational acquisition of a number of Brazilian firms, such as the 1996 acquisition of the FT Sementes' (leader in soy) soy sector and of the Agroceres' (largest Brazilian seed firm at the time) corn sector in 1997 by the Monsanto Company. In 1998, the Dow AgroScience company bought four Brazilian companies and Monsanto acquired part of another three multinationals that were active in Brazil. In 1999, the Agrevo Company, later acquired by Bayer, bought three Brazilian firms in the corn and soy business. This same year, DuPont bought a Brazilian firm in the corn sector as well as the corn sector of Pioneer, a company that had been in Brazil since the 1970s. In 2005, Nidera acquired 100% of Bayer's property in soy and corn programs in Brazil. In 2007, Dow AgroScience bought Agromen's seed division (which at that time held 11% of the national market in corn seeds). Also in 2007, Monsanto acquired 100% of Agroeste, another Brazilian firm that was also a leader in the hybrid corn seed sector (Cordeiro, Perez and Guazzelli, 2007). Processes of market concentration are growing and continuous. In 2008 and 2009 these acquisitions continued, as we are able to note in the processes of concentration and acquisition presented to the Administrative Council for Economic Defense (CADE) that is linked to the Ministry of Justice.[125]

[124] On March 14, 1996, Law n 9.279/96 which regulates industrial property in Brazil was created, and underwent regulation in 1997, at the same time that it was put into effect (May 15th). From the time that the Patent Law went into effect, patenting of medications and foods declared as ¨inventions¨ could also be patented, as well as biotechnological processes resulting from new biotechnologies and genetically modified microorganisms. (Art. 18)

[125] http://www.cade.gov.br

### 2.3.1.1 Cultivar Law

The backround for the creation of cultivar protection law is that research for genetic improvement is costly and time consuming. Furthermore, in the case of autogamous plants, plant breeding may escape control.

Before the approval of the Cultivar Protection Law (LPC) in April of 1997[126], cultivars belonged to the public domain. In other words, there was free access to cultivars as raw material for programs for seed multiplication and trade.

The Law of Cultivar Protection (LCP) was motivated by the following interests: (i) to guarantee the sustainability of research through strengthening Intellectual Property of vegetable varieties; (ii) to guarantee competitiveness in the generation of agricultural technologies; (iii) to attract private national and international investment in research on genetic improvement; (iv) to help combat piracy in seeds; (v) to reduce vulnerability in protecting species characterized by vegetative reproduction.

After LCP approval, genetic improvement firms began to receive a Protection Certificate. Thus, for commercial use of cultivars, authorization became necessary. According to Carraro (2005), LCP promulgation brought about changes in the autogamous seed market in Brazil. It led to the establishment of a new business environment in Brazil, insofar as technology transfer and contract relations between breeder and licensed became necessary. According to Luchesi (2002, p.2) "use of protected vegetable material, that is, of a registered cultivar can only be carried out through previous authorization by license-holder and against payment of royalties." From 2001 to 2005 there was an intense increase in cultivar royalty collection and on the number of contracts signed (EMBRAPA, 2005).

There are three juridical figures in the LCP. The first is the breeder, or research firm that creates new cultivars. This is the party that holds cultivar protection rights. It is the breeder that licenses the basic seed that the multiplier uses. The multiplier, in turn, is the firm that will reproduce the seed at a larger scale. This is the party that buys the basic seed, multiplies it and sells it to the users (farmers). The multiplier pays the breeder royalties on the purchased seeds. The user purchases the seeds from the multiplier and cultivates commercial crops. The user only pays royalties in a few situations.

Within this system of protection, protection arises from recognition of property rights for the use of technology that generates profit and augments innovation. The main points of the LCP may be found in its Articles 8 and 9. The first guarantees protection solely with regard to reproductive material, seeds and other structures of vegetative multiplication for the plant as a whole. The second guarantees the breeder's right to commercial exploitation of the new cultivar, to which third parties are thus prohibited without express authorization.[127]

In addition to the LCP which is managed by the National System of Cultivar Protection (SNPC), there is also the National Cultivar Registry (RNC). The purpose of the SNPC is the protection of intellectual property, which has its own legislation guaranteeing rights to commercial exploitation in cultivar use, i.e. it allows royalty collection. It is linked to international regulations on intellectual protection. The NCR, in turn, is based on Seed Law and certifies cultivars for production and commercialization, that is, it does not guarantee property rights. Rather, it provides the legal bases that undergird the entire chain of seed production.

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[126] Law 9456/97 available on *http://www.planalto.gov.br/ccivil_03/leis/L9456.htm*

[127] 2008 Ministry of Agriculture, Livestock and Food Supply Brazilian Regulation on Plant Variety Protection Brasília/Brazil 2008 Available on English version on: http://www.agricultura.gov.br/pls/portal/docs/PAGE/MAPA/SERVICOS/CULTIVARES/PROTECAO/PUBLICACOES_PROTECAO/LEGISLA%C7%C3O%20BRASILEIRA%20SOBRE%20PROTE%C7%C3O%20DE%20CULTIVARES%20-%202008_0.PDF

The NCR has a current registry of approximately 23,000 cultivars and the SNPC has 1,400 (genetically modified and conventional) ones, more than half of which pertain to the *Glycine max* (L.) species. The main activities of this organ are:

(i) Analysis of protection processes and emission of Protection Certificates;
(ii) Monitoring of all protected cultivars;
(iii) Testing of cultivar differentiation;
(iv) Elaboration of descriptive characteristics;
(v) Elaboration of regulations;
(vi) Dissemination and promotion of cultivar protection system and its use;
(vii) Institutional representation;
(viii) Storing, conservation and maintenance of live samples of protected cultivars;
(ix) Laboratory testing on cultivar characteristics and differentiation;
(x) Analysis of seed samples in cases of fiscal lawsuits.

Cultivar protection, in this case, is exercised over reproductive material or over the vegetative multiplication of the whole plant. This protection guarantees the bearer's right to reproduce the cultivar throughout Brazil, while impeding its usage by a third party for commercial purposes, as well as denying privileges for commercializing or selling cultivar reproduction material without the bearer's permission during the period in which protection is in effect.

We should also give salience to the existing exceptions to the bearer's rights: (i) use or sale of the product obtained from the crop as food or raw material; (ii) keeping and planting seeds for one's own usage; (iii) family farmer's multiplication of seeds for donation or exchange and; (iv) use of the cultivar as a source of variation in genetic improvement and scientific research.

Furthermore, according to the LCP, rights become extinct when the stipulated protection period is over. The cultivar also becomes a part of public domain when the bearer of rights renounces to them, or when certification is cancelled. The latter occurs when there is a loss of product homogeneity or stability, when annuities are not paid, or when a live sample is not duly provided or when a product has had noxious environmental consequences.

It is also necessary to point out that GM cultivars protected by the LCP are entitled to technology license and royalty payments while non-GM cultivars are entitled only to the former.

After LCP creation, several transformations in the seed market occurred, and others that should occur in virtue of the introduction of new technologies are still expected. According to Vieira (2003), immediately following the approval of the law there was a 10% increase in programs for the improvement of autogamous plants (cotton, rice, soy, wheat and beans). Furthermore, according to the author, public investments remained or fell, while private ones went so far as to triple, as represented by a 200% increase in the launching of autogamous plant cultivars (VIEIRA, 2003).

The LCP has been criticized by associations of family farmers and associations for the defense of environmentally-sound agriculture, such as the AS-PTA (Advisory and Services of Alternative Agriculture Projects. The entity believes that set of norms and regulatory mechanisms established by the LCP for registered seed production made it easier for large firms to exercise control over markets as well as to establish barriers blocking the presence and entrance of farmers' cooperatives and small firms into circuits of mercantile production. After the LCP was promulgated, the few organizations of organic family farmers that existed

in the Brazilian market began to experience so monumental difficulties posing a threat to their economic activities continuity[128].

Indeed, with LCP establishment, royalty payments were introduced and the cooperative lost its position as a source of lower cost seeds, since it was now obliged to incorporate royalty payments into production costs. Yet royalties are not required where the seed that is purchased is reused for planting, thus preserving farmers' rights. In the case of genetically-modified seeds, the latter cannot be reused for planting, and to do so require payment of penalties, as stipulated by contract. The producer would be further subjected to sanctions in the event that part of the harvest was sold, in seed form, to neighbours[129]. Thus, the informal market is adversely affected. Small farmers become directly dependent on the seed industry which, in turn, incorporates the entirety of chemical and biological inputs or is left limited to an old genetic basis which is not under LCP jurisdiction, and is also subjected to increasing disadvantages in productivity and adaptability.[130]

### 2.3.1.2 The Seed Law

The first legal framework for seed production in Brazil emerged in 1965, when norms for seed trade control were established. Inspection and control of seed trade underwent regulation ten years later and then remain unchanged until 2003, when Law n° 10.771 was promulgated (08 May 2003)[131] creating the National System of Plants and Seeds (SNSM). The Ministry of Agriculture, Fishing and Supplying – MAPA) has promoted, coordinated, established norms for, supervised, audited and kept watch over actions resulting from SNSM codes, the Seed Law and its regulation. It is up to the states of the Federation to elaborate norms and complementary procedures regarding the production of plants and seeds, as well as to carry out inspection of state-wide trade. Inspection and trade in seed and plant commerce is carried out by the MAPA, whenever solicited by the federal government. This legislation extinguishes seed inspection by types, where there has been no control over successive generations, and implements seed classification along the following lines: genetic, basic, certified first generation (C1), certified second generation (C2). The Seed Law also recognizes two other types that lie outside the certification system: S1 and S2, produced from C2. This law also recognizes the so-called "Creole seed" cultivars selected by family farmers and Indians, establishing an exchange among communities. With the Seed Law control over seed quality (certification), which was previously the exclusive province of public organs, now falls within the domain of private institutions as well.

### 2.3.1.3 GMO seeds

The Biosecurity Law[132] regulates planting, commercialization and research with genetically modified seeds. It attributes decision-making ability on regarding which genetically modified seeds may be produced in Brazil to the National Technical Commission on Biosecurity (CTNBio[133]) The CTNBio "is a multidisciplinary collegiate body, whose purpose is to provide technical support and consultative advice to the Federal Government in

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[128] WAR ON WANT and AS-PTA, set.2008. p.3

[129] LPC allows for an exception in the case of farmers who are defined as small scale according to official criteria that sustain their right to multiply seeds bought for donation or exchange with other small scale or family farmers.

[130] Wilkinson, 2001

[131] The Seed Law, Law no 10.771, dated August 5, 2003, regulated by Decree no 5.153, July 23, 2004, implemented the National System of Seeds and Plants. Its goal is to guarantee the identity and quality of all material for vegetable multiplication and reproduction that is produced, commercialized and used in Brazil.

132 Law No. 11105 from 24 March 2005

133 Ministry of Science and Technology

the formulation, updating and Implementation of National Biosafety Policy for GMOs, and in establishing standards of safety and technical advice relating to the protection of human health, living organisms and the environment, for activities involving the construction, experimentation, cultivation, manipulation, transportation, marketing, consumption, storage, release and disposal of GMOs and derived"[134]. The commercial release of GMOs and their derivatives follows the standards of the Normative Resolution No. 05 of 12 March 2008 and requires the completion of other legal obligations applicable to the case. Commitment to free trade may be suspended or revoked by CTNBio, at any time, if it has discovered adverse effects on the environment, human and animal health arising from the known results of post-commercial release or through the evidence provided by new scientific knowledge.

Nine GM corn, five GM cotton and one soybean GM varieties have been approved (CTNBio). The only GM soybean variety approved (and its derivative) is the Round-up Ready Soybean (GTS 40-3-2) from Monsanto. Its commercial use remained officially suspended by court injunction, from 1998 to 2005, In June 1998, Monsanto apply to the Biosafety National Technical Commission (CTNBio) to authorize the commercial release of Roundup Ready herbicide tolerant soybean (lawsuit 01200.002402/98-60). Reacting to this request, the Brazilian Institute of Consumer Defense (IDEC), counter sued to prevent this trade (lawsuit 1998.34.00.027681-8 CLASS 9200). Also Greenpeace and the Brazilian Institute of the Environment and Natural Resources (IBAMA) filed a public civil lawsuit to prevent any activity related to RR soybeans. Thus, understanding that CTNBio had extrapolated its duties and authorized the cultivation of RR soybeans without the presentation of a preliminary environmental impact study, as determined by the Biosafety Law, the authorization was suspended. During this legal moratorium several Federal States tried to become GMO-free areas and passed their own laws on the subject The State of Paraná is an example, through State Law N°. 14162, October 27, 2003, it prohibits the cultivation, handling, import, export, industrialization, trade and financing of GMOs. The issue related to the effective possibility of the cultivation of GM seeds in Brazil was closed with the new Law on Biosafety of March 24, 2005, which established that CTNBIO was responsible for the analysis, processing and decision on the requirements for any activity related to GMO in Brazil.

#### 2.3.1.4 Access to genetic patrimony

Access to and collection of Brazilian genetic patrimony is regulated by the Provisional Measure (MP) 2.186-16, from 2001, which then became a law. This MP created the Council for the Management of Genetic Patrimony (CGEN) The CGEN's responsibilities are to set regulations, authorize access to Brazil's genetic resources and ensure that indigenous knowledge is compensated for when used for commercial purposes. This body has been the target of criticism from the scientific community, considered an obstacle to technological research and innovation. In September of 2009, the Ministry of the Environment sent a bill out to other ministries which reformulates current regulations and will later be sent off to the Brazilian National Congress. [135]

### 2.3.2 Market structure

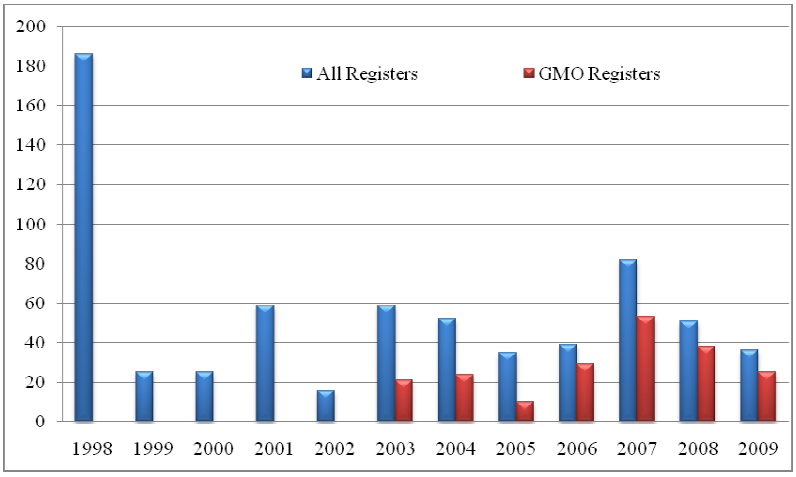
The present section attempts to give an overview of the market structure and concentration in the soybean seed sector in Brazil.

134 Ministry of Science and Technology website.

[135] *According to the Secretary of Biodiversity and Forests of the MMA, Maria Cecília Wey de Brito, in an interview given to the "Jornal da Ciência"*

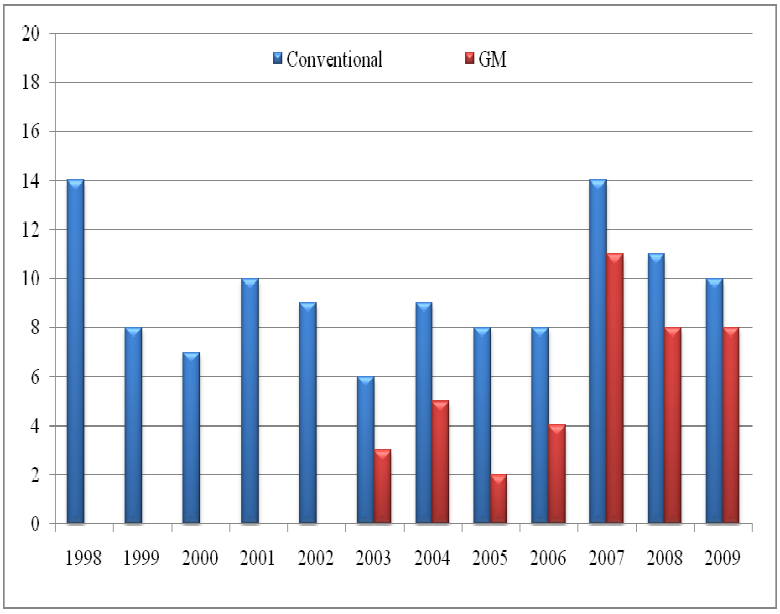
In light of difficulties for obtaining data for this sector, we use the number of firms that have requested registration in the Cultivar Registry as a Proxy. The archive of the Cultivar Registry spans the 1999-2009 period. Regarding GM cultivars, it is only in the aftermath of their release (for planting) in 2003 that research on improvement and protection requests came into usage.

During the period spanning 1999 to 2009, 665 registries were made. Of this total number, 200 were related to GM soy. Graph 36 presents data on the number of cultivars registered on a yearly basis. According to what we see on the graph, from 2003 to 2009, the proportion of GM seeds in relation to the total is growing. It has jumped from 36% in 2003 to 69% in 2009.




**Graph 36 -Soybean registers in the NATIONAL SYSTEM OF CULTIVAR PROTECTION - 1999-2009 Source: SNPC, 2009.**

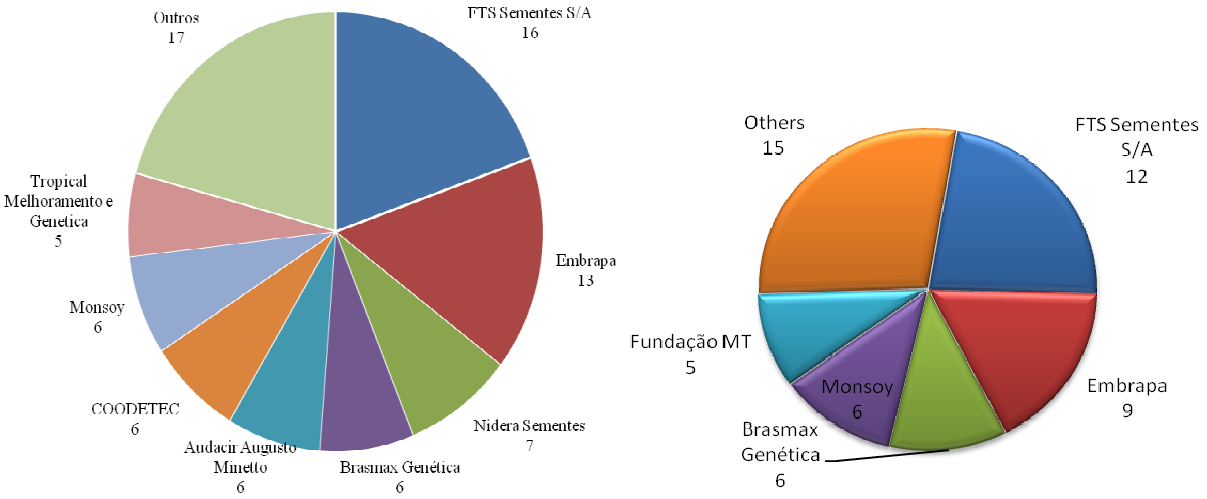
Graph 37 shows the total number of companies producing seeds in the 1999 to 2009 period. The number of firms that produce conventional soy seeds has remained relatively constant, while that of firms that produce GM soy seeds rose throughout 2007, dropped in 2008 and remained constant in 2009.




**Graph 37 Total soybean seed companies (conventional and GM) 1999-2009 (Source: SNPC, 2009).**

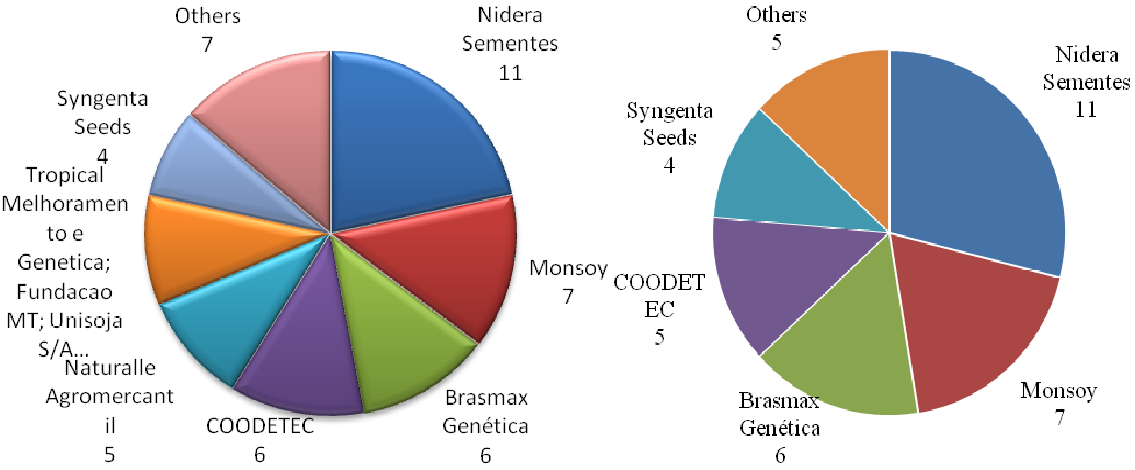
In 2007 82 cultivars (conventional and GM) were registered. FTS Seeds was the firm that registered the most, a proportion of approximately 20%, followed by Embrapa and Nidera Seeds, responsible for 16% and 18% respectively. Regarding genetically modified seeds, the leading firm – according to Graph 8 – was FTS Seeds, followed by Embrapa, Monsoy and Brasmax Genética with 23%, 17%, 11% and 11% of all registries.

Both in the soy seed market, covering both conventional and GM seeds, and in the segment restricted only to GMOs, in 2007, FTS was the leading firm, responsible for a one-fifth of both markets.




**Graph 38 – Number of soybean varieties (left) and GM soybean varieties (right) registered to by companies in 2007 (Source: SNPC, 2009).**

In 2008 there were some changes. Nidera Seeds[136] became the leader with a total of 21.6% of all soy cultivar registration, followed by Monsoy, Brasmax Genética and Coodetec, with 13,7%, 11,8% e 11,8% respectively.




**Graph 39– Number of soybean varieties (left) and GM soybean varieties (right) registered to by companies in 2008 (Source: SNPC, 2009).**

[136] In 2008 Nidera Seeds made a commercial agreement with Monsanto, for commercial exploitation of RR Technology in Brazil, that is, seed production and commercialization

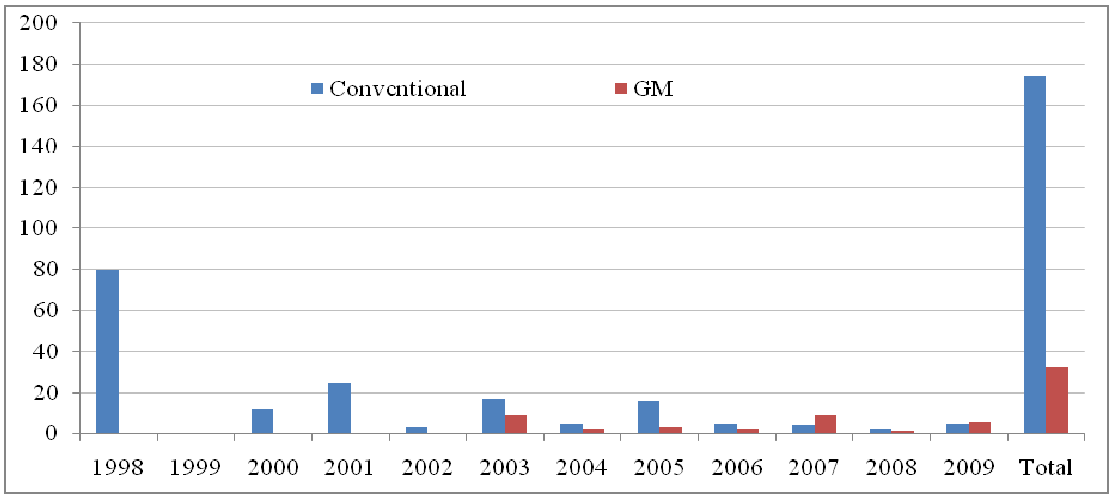
Regarding registration of GM soy cultivars, the situation was also modified in relation to 2007. Nidera Seeds was the company with the greatest number of cultivars registered, followed by Monsoy, with 28,9% and 18,4% of the market, respectively. Although both companies together held almost half the market, it is hard to consider the situation as an "oligopoly", since leadership during the previous year was represented by other firms.

The following graphs will analyze registration of cultivar protection for the 6 main firms, from the 1999 to the 2009 period. They are Embrapa, Coodetec, Monsoy, Pioneer, Fundação MT, and FTS Sementes.

- ***Embrapa***

EMBRAPA is the public enterprise that holds the largest germplasm bank in the world. The firm, as can be seen in Annexes 1 and 2, carries out several partnerships with other private and public institutions. As Fuck et al have shown (2008) EMBRAPA establishes partnerships with the private sector in the development of seeds for small and medium-sized farmers that organize themselves around such public foundations: in Brazil, "the national public research organization competes to some extent with seed companies by creating, appropriating and controlling the diffusion of its own genetic material." (Fuck & al, 2008, p. 231)

In the period analyzed (1998 to 2009) EMBRAPA requested the protection of 206 cultivars, 174 of which were non-GM soy and 32, GM cultivars. Yet we know that the commercial release of GM soy did not occur in Brazil until after 2003. From 2003 to 2009, 86 new cultivars were created, 63% of which were non-GM and 37% of which were genetically modified.




**Graph 40– Embrapa Soybean Registers at SNPC (Source: SNPC, 2009.)**

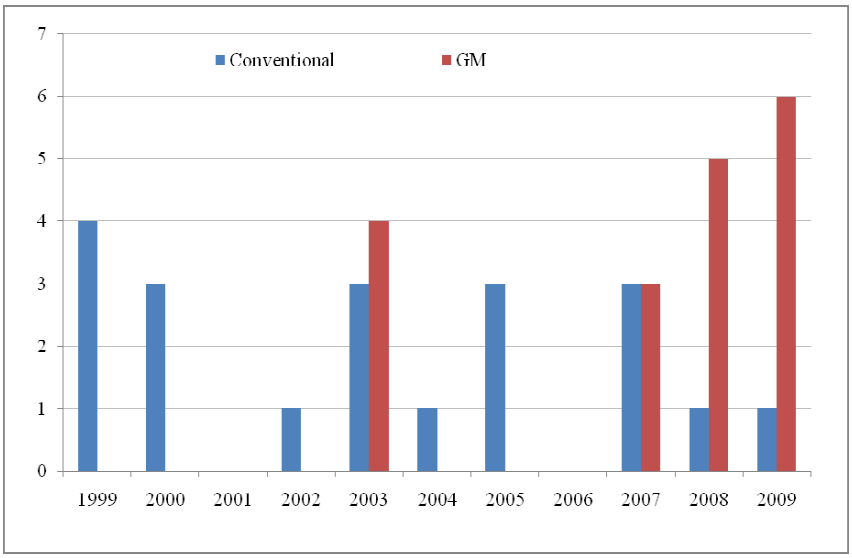
According to the Fourth Directive Plan for EMBRAPA Genetic Resources and Biotechnology, the firm recognizes as among its major opportunities: "increasing knowledge and sustainable use of biodiversity" and "development of technologies and products that guarantee the sustainability of agricultural production."

These two opportunities indicate that the organization has assumed a commitment to improve conventional and GM cultivars, since the Directive Plan affirms sustainable use of biodiversity and given the fact that without the conventional bean there is no way to manage genetic improvement of the GMOs. The second opportunity is to ensure the sustainability of

agricultural production, and thus there is concern with the possible oligopoly or monopoly of other firms that could undermine sustainability through excessive royalty costs.

- **Coodetec**

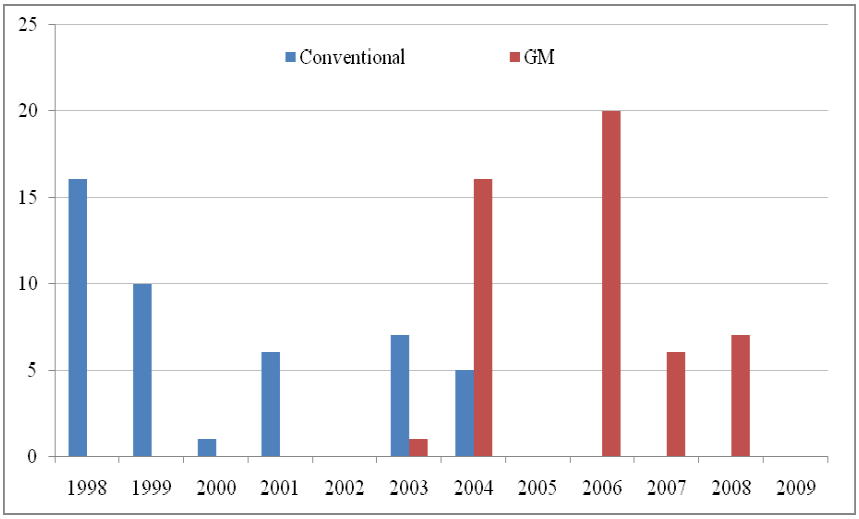
Another important firm in new cultivar production is the Coodetec (Central Cooperativa for Agricultural Research or Cooperativa Central de Pesquisa Agrícola) which is a private organization and maintains the largest private germoplasm bank in the country. For the 2003 to 2009 period, 60% of all protected cultivars are genetically modified, and what we are able to note in Graph 41 is a drop in conventional cultivars (just one in 2008 and one in 2009) in relation to GMs.




**Graph 41– Coodetec Soybean Registers at SNPC (Source: SNPC, 2009.)**

- **Monsoy**

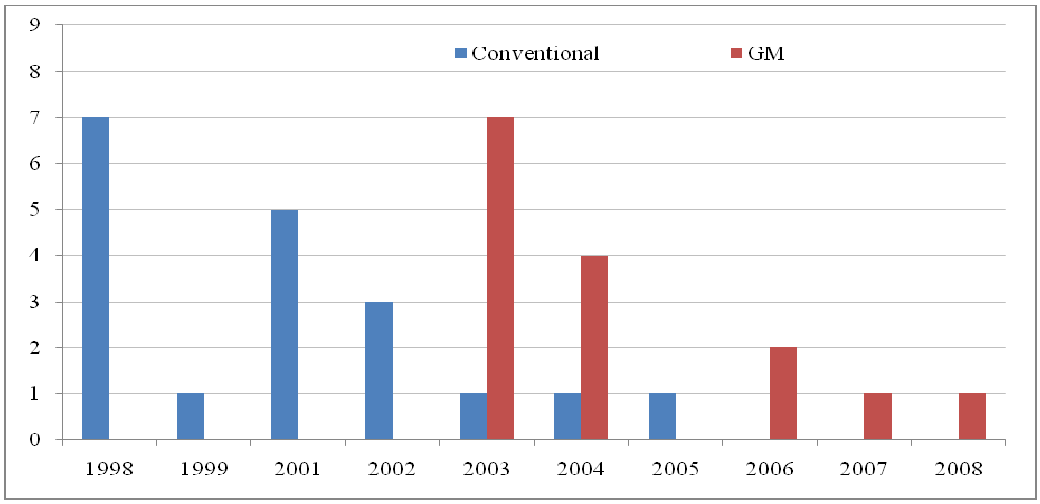
Monsanto strategies over the last four years have turned to research on genetic improvement of GM cultivars. The year 2009 is not yet over, but if the current tendency persists, it will have brought no improvements in conventional soy cultivars. From 2003 to 2009, patents for 62 soy cultivars were requested, of which 12 were conventional and 50, genetically-modified.




**Graph 42– Monsoy Soybean Registers at SNPC (Source: SNPC, 2009.)**

- **Pioneer**

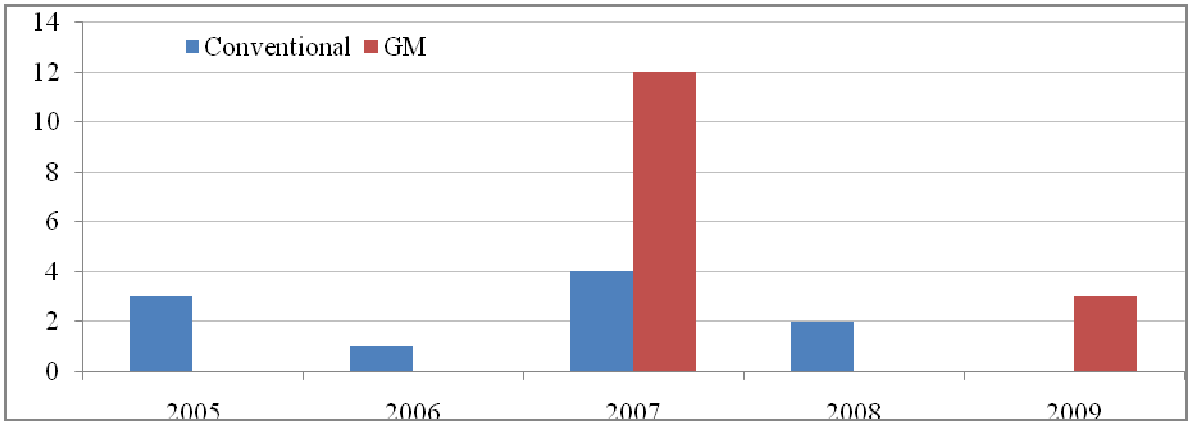
Graph 43 shows Pioneer protection registration. After the release of commerce in genetically modified products, the organization carried out research on genetic improvement, during the years 2003 and 2004. If on the one hand, in 2005 the firm registered just one conventional cultivar, on the other, in 2006, two were GM and in 2007 and 2008, each registered one GM.




**Graph 43– Pioneer Soybean Registers at SNPC (Source: SNPC, 2009.)**

- **FTS**

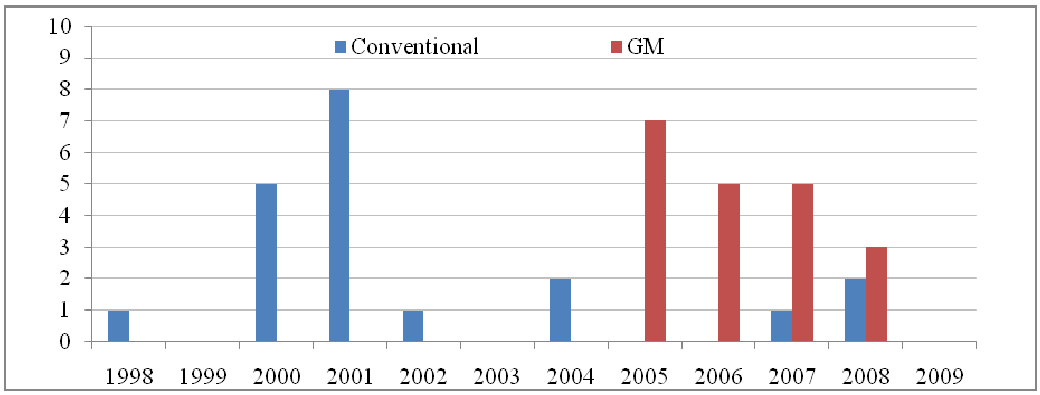
Graph 44 shows that FTS strategies are not sharply differentiated for research on GM soy cultivars and conventional ones. Thus, in 2005, 2006 and 2008 genetic improvements on conventional plants were carried out, but in 2007 and 2009, they were only carried out for GM varieties.




**Graph 44– FTS Soybean Registers at SNPC (Source: SNPC, 2009.)**

- **MT Foundation**

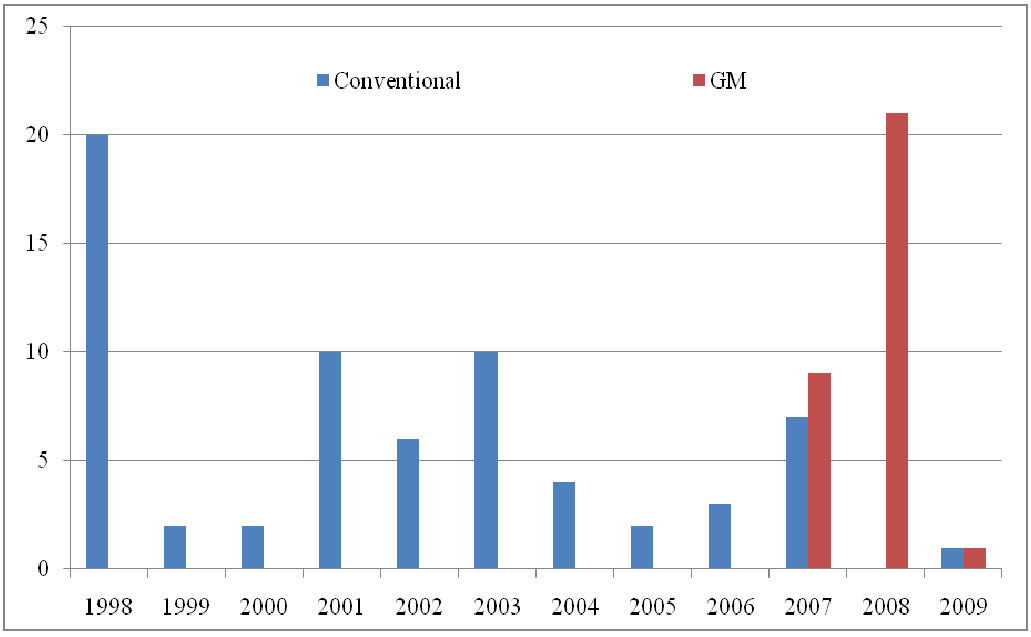
Although this information may be somewhat premature, analysis of Graph 15 shows a tendency of decreasing research in genetic improvement for GM soy cultivars and growth of research on conventional cultivars at the MT Foundation.




**Graph 45– MT Foundation soybean Registers at SNPC (Source: SNPC, 2009.)**

- **Other companies**

Other companies that made registry requests at the SNPC and that represent 33.5% of all registries of conventional soy cultivars, 6.7% of GM cultivars and 14.7% of total registries, during the 2003-2006 period, only carried out research on conventional cultivars; on the other hand, during 2007 and 2008 they expanded their research to GM cultivars.




**Graph 46– Other companies' soybean Registers at SNPC (Source: SNPC, 2009.)**

## 2.4 Extinction of non-GM soybean seed releases in Argentina

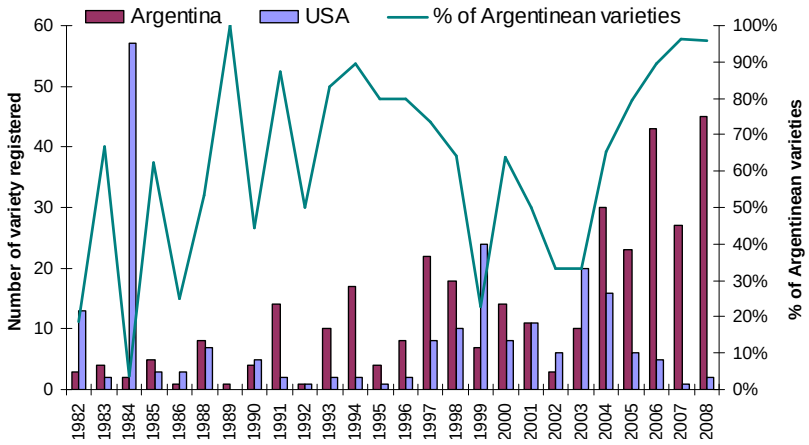
Based on the official quantities of soybean seed sales and the actual area planted with soybeans, 21.4% of the soybean seeds used by Argentinean farmers in 2004 have been legally bought (Rapela, 2006, p. 39).[137] The remaining were illegal seeds (called "bolsa blanca") or seeds kept from the past harvest. Therefore, getting reliable data on the soybean seed market is not possible.

All marketed varieties must however be registered in the National Register of Cultivars,[138] with their different characteristics, including transgenic events. These data are used here to give some information on seed market concentration and transgenic characteristics of authorized varieties. They provide a trend on how the commercial availability of new non-GM seeds has evolved. The results are quite clear: the last non-GM seeds were registered in 2005.

### 2.4.1 Argentinean soybean seed breeding industry

The Argentinean soybean seed leaders are not the world leaders in the industry. Monsanto, which had been in the top four soybean seed sellers in Argentina, suspended its sales, research and development of soybean seeds in this country in 2004 because of the black market.[139] For the same reason, Pioneer is reluctant to invest locally, and had no soybean breeding program in 2003.[140]

This withdrawal of foreign companies from the Argentinean soybean market can be observed through the origins of varieties registered at the RNC (Graph 47). After a big increase in foreign varieties registered between 1997 and 2004, the number drops in 2005 and during the following years. Between 1998 and 2004 Monsanto had, for instance, registered 25 varieties from the USA, 3 from Brazil and 4 developed in Argentina. In 2005 and 2006 the company only registered 2 varieties from the USA and 5 varieties from Argentina, none later.




**Graph 47: Origin of varieties registered at the RNC (Source: RNC, INASE)**

[137] Rapela, 2006, p.39

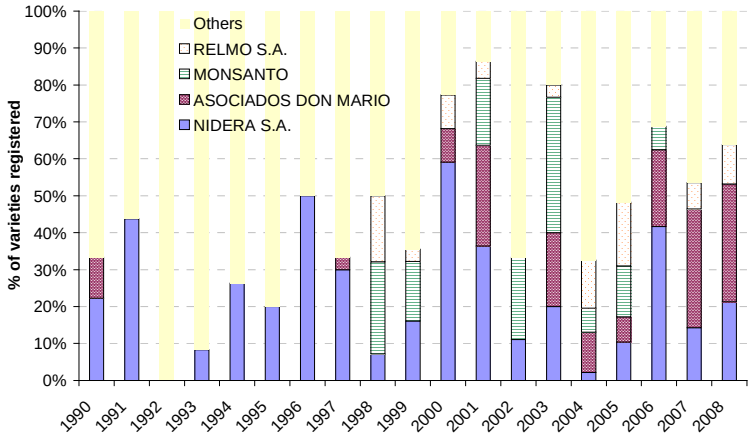
[138] Registro Nacional de Cultivares, http://www.inase.gov.ar/tikiwiki/tiki-index.php?page=RNC

[139] "We are suspending our soybean business ... because it's simply not profitable for us," said Federico Ovejero, a spokesman for Monsanto Argentina. (Associated Press, 01-19-2004). See also http://www.nytimes.com/2004/01/21/business/argentine-soy-exports-are-up-but-monsanto-is-not-amused.html?sec=health.
Monsanto and the Argentinean government are opposed in a legal dispute in Europe founded on royalties that Argentinean farmers did not pay for Roundup Ready soybean seeds. (See for instance Correa, Carlos (2007), The Monsanto vs. Argentina Dispute on GM Soybean, Resurgence, Number 203-204, pp. 13-16.)

[140] Goldsmith Peter, Ramos Gabriel and Steiger Carlos, 2003, A tale of two business: IPR and the marketing of agricultural biotechnology, Choices, Third Quarter 2003

Graph 47 shows that this disengagement by foreign companies was followed by a big increase in varieties developed in Argentina. Argentinean companies did indeed develop their breeding programs. The company Don Mario for instance, had registered only 21 varieties, all from the U.S., between 1990 and 2004, while it has registered 35 varieties, all developed in Argentina, from 2005 to 2008.

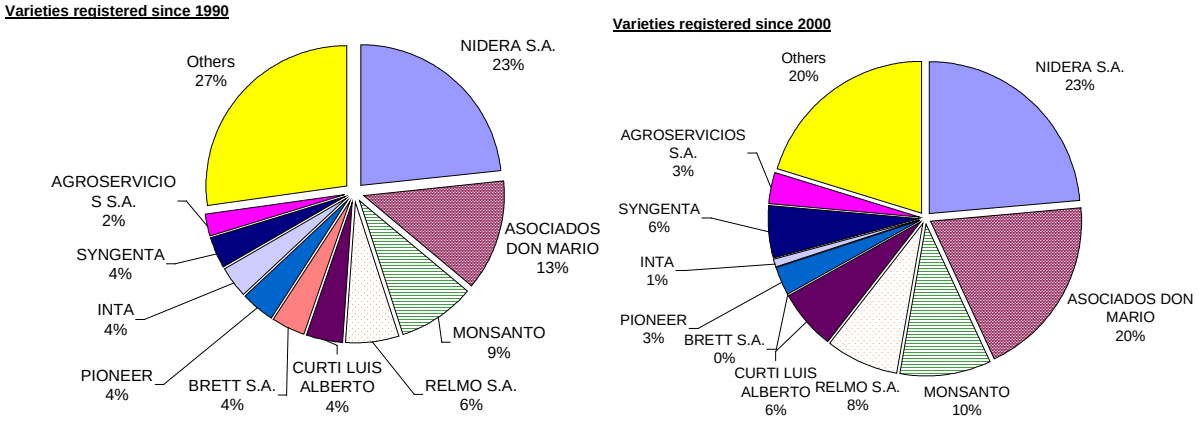
The progressive withdrawal of Monsanto, as well as the evolution of the three other seed industry leaders (in terms of variety registration), are also shown in Graph 48 below.[141]




**Graph 48: Evolution of the share of soybean varieties registered by the four soybean seed leaders between 1990 and 2008 (Source: RNC, INASE)**

The largest firm in terms of varieties registered per year in the National Register of Cultivars is Nidera Semillas S.A. This company is an independent division of Nidera, a multinational corporation originated from Holland with subsidiaries and delegations in 23 countries. Nidera Semillas was created in Argentina in 1988 with the acquisition of facilities and licences of Asgrow Argentina. The firm now markets RR soybean seeds under licence with Monsanto[142] (23% of all the varieties registered between 1990 and 2008).

The two other leaders over the last 10 and 20 years are the Argentinean based companies Associados Don Mario and Relmo S.A.




**Graph 49: Percentage share of soybean varieties registered between 1990 and 2008 and between 2000 and 2008 (Source: RNC, INASE)**

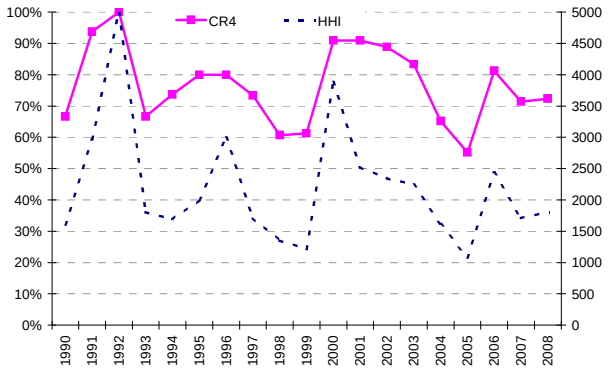
[141] For complete data on varieties registered per company and per year, see Table 28 and Table 29 in annexes.
[142] Rapela, 2006, p.47.

The share of Associados Don Mario in variety registration has increased in the last two decades and represented 20% of all varieties registered between 2000 and 2008. The company was created in 1982 and was first specialized in the development and adaptation of varieties from the maturity group IV, before developing its own program of soybean breeding. It is now the second largest soybean seed company in Argentina.[143]

The third company in 2007 and 2008, and fourth over the last 8 and 18 years, is RELMO S.A. It was the first private company to initiate a soybean breeding program in Argentina and the first to register an Argentinean soybean variety. [144]

As can be seen in the graphs above, plant breeding activities for soybeans in Argentina are mainly performed by the private sector, and this trend has been reinforced in the last decade. After having registered varieties almost every year in the 1990s, the INTA (National Institute for Agricultural Technology), which is the main public research actor in agriculture in Argentina, registered only two varieties (both non-GM) from 2000 to 2008. According to Fuck et al. (2008), "INTA's presence [in the soy segment] mainly takes the form of providing techniques for crop management, pest and disease control, and sowing,[…] it is not a major player in plant breeding, at least compared with Embrapa" (in Brazil). "This is the result of two different institutional research policies. In Argentina public research in this area focuses on the development, adaptation and diffusion of new agricultural practices. In Brazil the process is more verticalized: the national public research organization competes to some extent with seed companies by creating, appropriating and controlling the diffusion of its own genetic material. This difference explains some specificities of the two countries' seed market structures. In Argentina, INTA's linkages with the private sector are also based on a strategy of retaining property rights to its germplasm bank and building closer ties in the seed market. It has striven to enhance relations with private enterprises via a policy of technological linkages, mainly: technology transfer, with or without royalties; shared R&D, which may include licensing clauses, as also in the case of technology transfer; technical and scientific assistance; incubation of technology-based companies; the sale of products and specialized technical services; and institutional partnerships both at home and abroad."

With regard to market structure (measured with variety registrations), the concentration level changes rapidly but often reaches high levels. The four leaders in plant variety registration represented, between 1990 and 2008, from 55% to 100% of the total number of registrations. This variation in the CR4 is confirmed by the HHI which ranges from 1082 points (in 2005), to 5000 (in 1992). Over the last 18 years, the HHI has been above 1800 points (which is the level for considering that a market is concentrated) in eleven years.

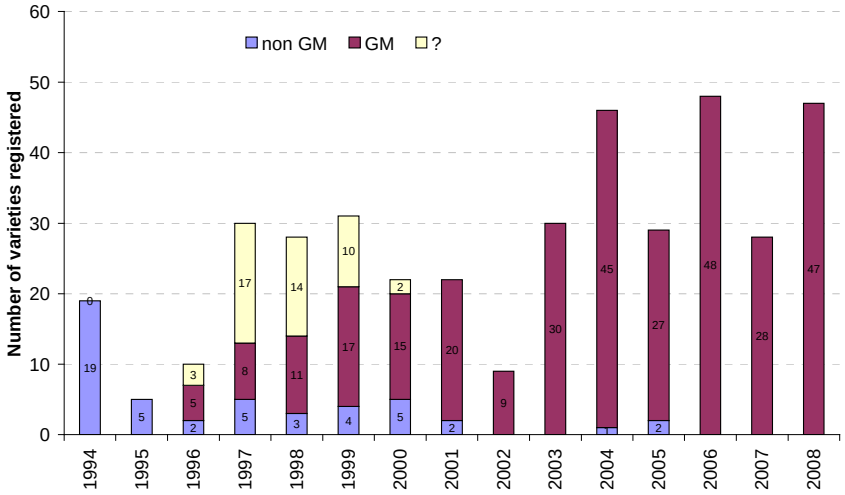



**Graph 50: Concentration in the Argentinean soybean seed industry. CR4 and HHI on plant registration activity (Source: INASE)**

[143] Rapela, 2006, p.45.
[144] Rapela, 2006, p.49.

## 2.4.2 Availability of non-GM seeds

Due to the development of GM soybeans, breeding companies have virtually stopped releasing non-GM soybeans. The National Register of Cultivars (Graph 51) shows that the last non-GM soybean varieties for general use were registered in 2005, by the INTA, the main public research institute.




**Graph 51: Number of GM and non-GM varieties for general use protected per year in Argentina (source: INASE)[145]**

Four varieties are also registered in the category of "soybean for human consumption", all non-GM. The last one, called Kumen 4500, was registered in 2005 (Document 2). It is the last non-GM private soybean variety released in Argentina. The variety was introduced from the U.S. by the company Areco Semillas, which is now a subsidiary of Don Mario.

KUMEN areco 4500

**KUMEN: "Soja no Transgénica" para consumo Humano**

Las raíces argentinas le dieron el nombre **"Kumen"**. Su significado del mapuche "ser bueno, ser apto".

**KUMEN** es la única variedad de soja en la argentina, inscripta y aprobada por el INASE como apta para consumo humano.

| | |
|---|---|
| **Grupo de Madurez** | 4.5 |
| **Color de Flor** | Blanco |
| **Color de Pubescencia** | Gris |
| **Color de Chaucha** | Marrón |
| **Color de Hilo** | Amarillo |
| **Altura en cm.** | 91 |
| **Rango de Porcentaje de Aceite** | 22.20 - 24.94 |
| **Rango de Porcentaje de Proteina** | 38.64 - 40.14 |
| **Semillas / Kilogramo** | 4672 |
| **Peso 1000 Semillas** | 214 |
| **Largo Semilla (L)** | 0,78 |
| **Ancho Semilla (A)** | 0.75 |
| **Espesor Semilla (E)** | 0.66 |
| **L / A** | 1.04 |
| **L / E** | 1.18 |
| **E / A** | 0.88 |
| **Transgénica** | NO |
| **Observaciones** | Extraordinarias cualidades para industrialización |

**Document 2:Non-GM variety Kumen 4500 (source: http://www.arecosemillas.com/productos.asp)**

[145] For some of the oldest varieties, it has been impossible to find information on transgenic characteristics (varieties mentioned with "?")

Another seed producer, Feria de Norte Semillas,[146] also produces and markets non-GM varieties for food grade. The varieties are introduced from the U.S.A too, from eMerge Genetics (356F.Y, 446F.HP, 428f.HPC, see 2.2.2.2.8). Two varieties are in the process of registration and four more will be released in the coming years.

According to Eduardo Cucagna, the owner of the company, they recently developed this supply of non-GM seeds because the demand for this kind of soybean is increasing, from the Argentinean market but mostly from abroad.[147]

[146] http://fnsemillas.com/nuevos-productos-fn-sojas-no-gmo.html
[147] Personal communication

# 3 The Future of non-GM plant breeding

Banks of germplasm resources (in which the global genetic heritage is kept) do exist for soybeans, in the U.S. and in other countries (like China). But these resources are not readily available for the development of high-performance varieties for production. The future availability for farmers of high-performing non-GM varieties depends on the existence of non-GM elite lines, i.e. varieties that integrate the recent breeding efforts in terms of yield or resistance to disease.

This section attempts to draw some prospects regarding the availability of such non-GM elite lines in the near future, and their use by breeders, in the different countries considered. The demand for non-GM soybeans, the possibility (or not) of patenting plants and the technical constraints created by new traits may have a decisive influence on the final availability of high-performing non-GM seeds.

Before detailing these possible futures in each country, we address the decisive technical issue of breeders' choice between backcross and forward breeding for transgenic events integration.

## *3.1 Forward Breeding* vs. *Backcross*

The availability of competitive non-GM varieties in the future depends on the existence of non-GM breeding programs developing varieties with equivalent basic performance to GM varieties. In companies mainly developing GM varieties, the size of such non-GM breeding programs is subordinated to the breeding program's characteristics, and especially to the choice between forward breeding and backcross techniques to insert transgenic events.

"Backcross breeding involves repeated crossing with selection to an elite inbred, with the goal of recovering a derived line that essentially resembles this elite parent with the addition of one or a small number of favourable alleles from the non recurrent parent"(Mumm R., 2007, p.166). With this method the transgenic trait is therefore added at the end of the breeding process, into an elite non-GM inbred. The basic breeding program is made on a non-GM basis, which means that non-GM varieties equivalent to GM varieties do exist.

"Forward breeding refers to any system of inbred line development, irrespective of the number of loci involved or the balance of favourable alleles among the parents of the population, involving the creation of a source population followed by inbreeding with selection, with the goal of recovering an improved line for one or more traits (e.g., pedigree selection)" (Mumm R., 2007, p.166). With this technique the breeding program is conducted on a GM basis, and there is no non-GM equivalent output at the end of the process.

Private companies (and some public breeding programs) predominantly used forward breeding for the development of RR soybean lines.[148] According to top executives of Monsanto, retracing the history of RoundupReady® soybeans, the trait for herbicide tolerance had been first widely inserted in elite varieties:

"An extensive breeding and backcrossing program was initiated in 1991 between Monsanto and Asgrow researchers. Other soybean breeding companies were also included in this effort in order to ensure that the trait was broadly available to farmers. Crosses between susceptible and tolerant genotypes were made on a large scale. Line 40-3-2 was backcrossed three times or forward crossed to a wide range of genetic backgrounds over all maturity groups to ensure that the Roundup Ready trait would be available in a diverse set of genetic background. (…)"

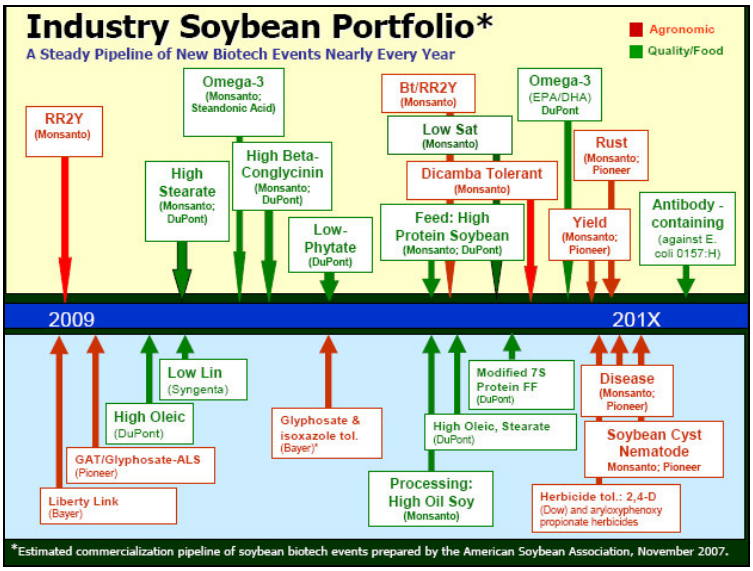
[148] Personal communication with public or plant breeders.

At least six breeding companies initially sold RoundupReady® soybeans in 1996, with the majority of companies introducing RoundupReady® soybeans in 1997. (…)

By 2000, most breeders used the RoundupReady® gene as a base trait in a high percentage of breeding populations. Forward breeding with the Roundup Ready trait on a large commercial breeding scale was relatively straightforward and inexpensive, and today the transgene is present in thousands of breeding crosses while maintaining historical rates of genetic gain."(Crosbie T. et al., 2006)[149]

Monsanto then abandoned the development of non-GM varieties (see2.2.2) but also non-GM breeding. Indeed, they stopped their soybean breeding programs in Europe, consisting in adapting American varieties to local conditions, because they no longer had non-GM elite varieties available.[150]

Most other companies that developed RR soybean varieties through forward breeding and non-GM varieties had two separated breeding programs, one GM and one non-GM. The "main disadvantage of this system is that [they] have narrower genetic base to select new lines from non-GMO program".[151] This could have led to lower performance for non-GM varieties but the situation seems to have changed due to new traits (Document 3).




**Document 3: Pipeline of new Biotech events (Source: ASA, 2008)**

Monsanto still has its whole breeding program on a GM base, with RR2Y event, but many companies are now developing breeding programs in non-GM background to backcross the new traits (like glyphosate or GAT) into the elite lines. According to several public and private breeders, from Argentina or the U.S., this solution gives more flexibility, it is "easier, faster and cheaper".[152] One breeder from Argentina even says that the companies that kept a large percentage of their breeding programs on non-GM background are now in a better position for the introduction of new traits.[153]

[149] Except Kendall Lamkey, for Iowa State University, all authors were working for Monsanto when writing this paper. Theodore Crosbie was for instance vice-president of global plant breeding, Sam Eathington was director of breeding applications and Alan Walker was director of global soybean breeding.
[150] Personal communication with a Monsanto executive.
[151] Personal communication with an executive from one of these compamies.
[152] Personal communications.
[153] Personal communication.

This may however be true for companies that breed varieties with different traits (via licenses) but different for companies that develop their own trait (like GAT for Pioneer) and breed and market only that one.

The development of several new biotech traits could therefore paradoxically lead to better availability of resources on non-GM elite lines, but the situation may be different between countries, depending on the breeding industry structure and the type of companies operating.

## *3.2 U.S.A.: Dependency on industry leaders*

Non-GM seeds are currently provided in the U.S. market by universities, some small companies and two or three industry leaders. The characteristics of the breeding industry, the increase in patents on varieties and the changes in public breeding activities may however lead to a genuinely different situation in the future, where the availability of non-GM competitive varieties would be dependent on the decision of few industry leaders.

### 3.2.1 Future of public research on soybean breeding

If present trends continue in the U.S. breeding sector, State universities may no longer be a competitive source of non-GM soybean varieties in the future. As mentioned by Sleper and Shannon "intellectual property protection, the ability to earn a good return on research investment, and reductions in public budgets have shifted the majority of the soybean breeding effort from the public to the private sector" (Sleper, D.A. & Shannon, J.G, 2003). As is already the case now, universities will most probably become upstream partners of private companies, in charge of germplasm development, basic research and education of future breeders, while moving away from near-market activities.

#### 3.2.1.1 Decrease in public financial resources

Over the last years and decades, in a context of a dramatic increase in private research investment, the budgets of public sector breeding research have been declining (Heisey & al, 2001).[154] Breeding departments have therefore had to find partnership with private companies or farmer organizations (Coffman et al., 2003).

A plant breeder from a State University deplores this situation. In his opinion, "the future of public soybean breeding is in serious jeopardy." He argues that "the Agriculture Administration does not support his efforts either financially nor do they even support the concept of public soybean breeding", and he therefore must rely on "farmers who do not understand the breeding process and do not understand the amount of funding required for a successful breeding effort."[155]

Jim Orf, plant breeder in Minnesota University, also sees financial difficulties hindering his breeding activities: "we are dependent on the public (state and federal governments) for support and budgets have been going down rather than increasing so our programs are shrinking in size rather than increasing. And in plant breeding more resources mean the potential for more progress."[156]

But the situation is not considered that bad for all breeders. One just finds the situation "fine at present" and Steve St Martin, from Ohio, considers that "right now is a nice time to be in soybean breeding" and that "there has been no other time in [his] career that [their]

[154] About funding source of US public agricultural research see also Schimmelpfennig David and Heisey Paul (2009)
[155] Personal communication
[156] Personal communication

breeding program has gotten so much attention and support".[157] His program, "part of Ohio State's Ohio Agricultural Research and Development Center (OARDC), has expanded its personnel and technology over the past four years, enabling researchers to increase the number of test plots, genetic crosses and varieties released. (…) Through grant support from the Ohio Soybean Council and funding and marketing opportunities through Ohio State's Ohio Bioproducts Innovation Center (an organization that links university resources with industry), OARDC's soybean breeding program has been able to keep the state's soybean industry thriving with high performance, improved yield, disease-resistant field or food-grade varieties."[158]

If some Universities can develop their breeding activities through private funds, one of the main consequences may be that the needs and interests of these new partners drive germplasm and breeding programs, hindering the development of new (non-GM) competitive varieties from universities.

#### 3.2.1.2 Decrease in access to germplasm resources

With the decline in public financial resources, public breeders also have to face the drop in germplasm resources available for their activity due to the development of patents on soybean cultivars (see above). As noted by Sleper and Shannon (2003) "because of intellectual property rights, private companies [indeed] rarely share germplasm for crossing".

In the universities studied, only one plant breeder said that he was using both private and public germplasm for his activity. All the others no longer use private resources, or only on a few occasions, with material transfer agreements.

James Orf for instance, has "not been using private varieties for several years because of the "freedom to operate" issue. The companies want rights into the grandparent and even the great-grandparent generations and that is too difficult if we exchange materials among public breeders in the USA and other parts of the world." He considers that "it is an important loss for [his] activities since [he] can not "build" on the progress that other breeders have made (especially in the private sector), thus it limits the progress [he] can make."[159]

This restriction of free germplasm exchange and utilization through the development of patents therefore impedes the relative competitiveness of State universities with respect to private companies that have patented their varieties.

#### 3.2.1.3 Future global competitiveness of public breeding

Though public non-GM varieties released in recent years are competitive against private RR varieties in terms of yields (see above), and provide an alternative solution for farmers willing to grow non-GM soybeans, this may not be the case in the coming years.

It would be indeed difficult, if not impossible, for public soybean breeding programs to stay competitive with two handicaps, in terms of financial and germplasm resources, while companies like Pioneer and Monsanto will release new varieties based on large germplasm resources and costly technology.

Pioneer for instance has one of the largest germplasm bases, has access to public germplasm, and has developed a Marker Assisted Selection (MAS) on a large scale in order to identify "yield genes" and develop its "Y series". Most public plant breeders, when asked if they will be able to compete with such programs, consider that the question is not about MAS, a technique that they also use. Ted Helms even believes that "Pioneer's "yield accelerated

[157] Soybean Breeding Program Growing to Meet Industry Demands, 06/05/2007, Candace Pollock, Ohio State University Extension (http://extension.osu.edu/~news/story.php?id=4130)
[158] Ibid
[159] Personal communication

technologies" will not be successful" and (…) is a bogus scheme that does not have a scientific basis." Some express doubts and first want to see the results, but several insist that the problem is more about resources, like Grover Shannon: "we certainly do not have the financial resources to accomplish what Pioneer and Monsanto have accomplished (…) it is a numbers game. Private companies have the resources and personnel to conduct very large breeding programs."[160] Jim Orf also emphasizes the diversity of their tasks, compared to private breeders: "the private programs are much larger than public programs (on the order of 5-10 times larger) and the only thing private breeders do is select for commercial varieties while public breeders do a lot of work with graduate students on genetic studies, exotic germplasm incorporation and disease resistance breeding as well as teach classes so it is much harder to make as much breeding progress as private breeders. (…) We just do not have the resources (and time) that the large companies have".

Steve St Martin, on the same issue, anticipates the future of plant breeding, noting that due to the size and costs of these private programs it "will be more difficult for universities to develop a finished product, i.e., a variety that has all the traits that growers demand. But public breeders can supply a component, through release of germplasm, and then it will be up to the companies to put it all together."

#### 3.2.1.4 Focus on germplasm improvement

As Sleper and Shannon (2003) note, "the public sector soybean breeders conduct [already] most of the research in the area of germplasm enhancement". Due to its low competitiveness in the development of new cultivars and its dependence on private funds, public breeding is likely to focus on this activity in the future. This trend is already initiated in some universities, like in Kansas, where they are "placing less emphasis on developing varieties that would be directly used by farmers, and placing more emphasis on developing varieties and germplasm that would be useful to private breeders to enhance crop performance."[161] William Schapaugh, head of the breeding program in this university, justifies this change by the fact that "relatively few farmers are planting varieties developed by state or USDA breeding programs." He thinks "it is beneficial that [their] material is useful to private breeders, and that these breeders can use [their] material to develop varieties that will be sold to farmers." This results, in his opinion, "in the public receiving a good return on their investment in the public breeding programs."[162]

Though all his counterparts do not share this optimistic view of the situation, almost all believe that they will have to put more emphasis on germplasm development for private companies in their future activities. The Agricultural Research Service of the USDA already made this move at the end of the 1990s (Coffman et al., 2003).

This means a change in the organization of the global U.S. breeding system, where public breeders would no longer compete with private companies on new varieties but instead would be upstream research partners of these companies, developing improved germplasm with specialized traits and licensing them.

The public sector may also continue to develop varieties for Identity Preserved markets that private companies would not produce, will go on with basic research and methodology development and will of course continue to provide the education and training for people that are employed by the private sector (Heisey et al., 2001).

[160] Personal communication
[161] Personal communication, William Schapaugh
[162] Personal communication

### 3.2.2 Difficulty for small breeders to be competitive

The situation for small companies breeding non-GM soybeans may be difficult in the coming years. Because of high R&D expenditures and regulatory costs, the seed industry is characterized by strong economies of scale and scope, which means incentives for industry concentration. Then "those that do not get large are vulnerable to being driven out of the market by larger and more cost efficient firms." (Fulton & Giannakas, 2001, p.143) The existing trends (IPR reinforcement and costly MAS technologies) may reinforce this process (Sleper, D.A. & Shannon, J.G, 2003).

Also, small companies compete with industry leaders but rely on their technology, like transgenic traits, and are exposed to their willingness to supply it.[163] They therefore have difficult access to the latest technologies, and they are also progressively losing easy access to recent germplasm resources.

The development of plants patenting by industry leaders does indeed create a dramatic challenge for these small companies by making their access to recent germplasm resources costly and uncertain (Graff & al., 2004). With the former system of plant protection, with PVP certificates, small companies could integrate the industry leaders' research efforts into their breeding and could therefore be competitive in basic breeding activities. Without this access they will have to compete with their own germplasm and public resources with firms owning considerable germplasm and variety resources.

Even if they succeed in business agreements to get access to these technological and germplasm resources, the future of small companies seems to be jeopardized… unless they find niche markets, for special traits for instance.

Like universities, small companies may therefore not be a source of competitive non-GM varieties for general uses in the coming years and farmers may have to rely only on releases of such varieties by industry leaders.

### 3.2.3 Which strategy for industry leaders?

Considering the concentration of patents on elite varieties (see Graph 33), the near future of non-GM soybean breeding and therefore the existence of competitive non-GM soybean varieties with a broad range of phenotypic diversity depends on three to five companies. If Pioneer, Stine and Syngenta Canada decide to stop releasing non-GM varieties, the availability of competitive non-GM varieties for general use may be seriously jeopardized in the coming years.

Moreover if, as explained above, universities and small companies exit this market, these large companies will have to expand their line-up of these varieties to guarantee good phenotypic diversity. In 2009, Pioneer, Syngenta Canada and Stine were supplying 36 different varieties (Table 22), with for instance no group 00 variety and only 2 group 0. Without an expansion of their non-GM line-up, the non-GM choice may be restricted or impossible for farmers.

[163] Small Seed Companies Fit in Future http://www.contextnet.com/Focus%20Papers/Seed/Consolidation%20Direction%20Where%20and%20Why%20the%20Seed%20Industry%20is%20Headed%20Sieker%204%2008.pdf

| | Maturity groups | | | | | | |
|---|---|---|---|---|---|---|---|
| **Number of varieties** | **0** | **I** | **II** | **III** | **IV** | **V** | **Total** |
| **Pioneer** | | 1 | 2 | 4 | 1 | | **8** |
| **Stine** | | 1 | 5 | 7 | 5 | 2 | **20** |
| **Syngenta Canada** | 2 | 4 | 2 | | | | **8** |
| **Total** | **2** | **6** | **9** | **11** | **6** | **2** | **36** |

**Table 22: Supply of non-GM varieties for general use in 2009 by industry leaders (Source: 2009 line-up of companies)**

The availability of non-GM soybean seeds in the future will therefore depend on the ability and the will of the industry leaders to develop this type of variety.

They will first need to have large non-GM breeding programs. As seen above (section 3.1), the appearance of new traits may lead to the development of backcross instead of forward breeding. This solution would offer more flexibility for companies like Stine, who breed varieties with different traits. In this situation, as breeding would be done in a non-GM background, non-GM elite lines would be available.

But companies like Pioneer, which develop their own traits (like Optimum GAT), may have more interest in having a breeding program dedicated to this new trait (as Monsanto for RR and for RR2Y traits), and therefore having a separate breeding program for non-GM varieties if they also want to develop these varieties. In this case, the resources used for non-GM breeding will be inferior to the ones used for GM breeding, and non-GM varieties may be, in a long-term perspective, less competitive.

The breeding system chosen by the leading companies will therefore have important consequences on their ability to provide good non-GM varieties. Their production and marketing strategy will of course be decisive too, particularly concerning the new traits.

Until now, these companies were marketing transgenic soybeans with the RR trait from Monsanto, and did not have any particular strategic interest in marketing only this kind of soybean, as Monsanto does. But the situation may change in the coming years as new biotech events from Pioneer or Syngenta get marketed (Document 3).

Finally, the strategy of these firms in the production and marketing of non-GM seeds may be driven by the demand for this kind of variety. As seen before, demand for non-GM seeds exists today, based on consumers' (and animals' producers) demand for non-GM soybeans and on the relative decrease in competitiveness of Roundup-Ready soybeans. A decrease in this demand may reduce the interest of these companies in releasing non-GM varieties, and lead to a decrease in their supply. Conversely, sustainable demand for non-GM soybeans would probably result in a significant supply of non-GM varieties.

## 3.3 The central position of EMBRAPA in Brazil

Private sector participation in the soy market is not as high as it could be, since EMBRAPA, a public enterprise (see 2.3.2) is responsible for a large portion of the market, although the SNPC reports greater private sector participation. Thus, we see that the public sector stands out in terms of technological issues while the private sector has been carrying out research through its affiliates (Monsoy, Pioneer).

Nonetheless, as Martinelli has shown (2006) EMBRAPA is the key institution in the formulation of technological arrangements in the seed industry, responsible for synergies and spillovers with regard to local agents and thus limiting the power of multinational corporations within the Brazilian seed market. Corroborating this information, Fuck et all (2008, p. 232) state: "EMBRAPA began establishing partnerships with multinational corporations and grower's foundations with the aim of developing new varieties as well as assuring its leadership of the seed market. It is no exaggeration to say that EMBRAPA's partnership approach has been fundamental to the development of germplasm adapted to tropical conditions, enabling soy to be grown in various regions of Brazil."

With regard to research on genetic improvement, the use of GM soy has not yet been institutionalized, and proof of this can be found in the EMBRAPA's Directive Plan, according to which one of the main threats for the 2008-2023 period is agricultural producers' resistance to genetically modified products and their derivatives. Thus, programs tend to fluctuate between efforts to improve genetically modified and conventional cultivars.

## 3.4 Argentina: No high-performing non-GM seeds in a large scale for years to come

As almost all Argentinean soybeans have been GM for several years, the main seed producers have stopped producing and selling non-GM soybean seeds. According to Leonardo Milanesi, a soybean breeder from the company Asociacion Cooperativas Argentinas, "in general terms, the largest soybean breeding enterprises have not kept breeding programs for non-GM varieties."[164] It was already the case in 2004, as reported in a report from the SAGPyA (the Argentinean ministry of agriculture) and the Food and Agriculture Organization (FAO). This report also noticed that two seed industry leaders keep "minimum programs" and concluded that "improvements on non-GM lines are at least three years behind and at least two years are necessary to achieve a consistent production of commercial seeds. As a conclusion, it would need at least five years to get a variety with substantial performances and produced in quantities covering a low level of demand." (SAGPyA/FAO, 2004, p.27). All private plant breeders do however not accept this conclusion.

As noticed in the SAGPyA/FAO report, some industry leaders indeed still have non-GM breeding programs. This was confirmed by our investigations, they were at least two firms in 2009, Asociados Don Mario and another company[165] to dedicate respectively 30% and less than 5% of their soybean breeding program to non-GM breeding. A smaller company, Asociacion Cooperativas Argentinas, also kept a small program.

Companies keep these non-GM breeding programs because they sometimes have sales' opportunities for non-GM varieties (through direct sales to growers, without registration), but mainly to maintain non-GM lines, which are more flexible for integration of new transgenic traits. According to a breeder of a large company, "these last years, the interest for non-GM germplasm has increased internationally, because it is easier, faster and cheaper to integrate new traits (RR2Y, GAT or others) in non-GM background than in RR

[164] Personal communication.
[165] This company asked for confidentiality.

background."[166] In his opinion, "companies which have kept a significant non-GM breeding program are now in a good position for the integration of new traits".

But these programs aim at improving germplasm resources and not developing new varieties. According to Leonardo Milanesi, "for the research on non-GM soybeans, there is no off-season development to increase the number of generations, comparative field trials on yield performance are not done, or only in one location, when field trials for GMO varieties are done in at least 15 locations. It reduces the yield improvements for non-GM varieties compared to GM ones."[167] Another breeder from a big company confirms that few resources are generally dedicated to these programs and that "the genetic gains for non-GM varieties have been low these last years."[168]

The breeding engineer from Asociacion Cooperativas Argentinas therefore valids the conclusion of the report from SAGPyA and FAO. He adds, "if the market was changing in favour of non-GM varieties (what I do not believe), at least three years would be necessary to release non-GM seeds. You indeed need two years of field trials for registration, in at least three locations, and during this period you would be able to multiply some of the most promising materials."

According to Marcos Quiroga, its Research Director, the company Asociacion Don Mario would however be ready to release competitive non-GM varieties in a short period. He contests the conclusion of the SAGPyA /FAO report, at least for his company. He argues that private companies do not divulge the details of their breeding programs and the report may be based on variety registration, which does not reflect companies' breeding programs. He adds, "it's sure that we do not have important volumes of non-GM seeds (except for the KUMEN project [see section 2.4.2]) and that we would need a couple of years to produce substantial volumes, but the varieties of our company are not behind GM seeds in term of yield performances."

According to the authors of the SAGPyA/FAO report, this paragraph is based on "investigations on the soybean breeding programs existing in Argentina at this moment"[169]. The situation may however have changed since 2004, due to the arrival of new traits, and seems therefore to be different from a company to another one.

As a conclusion, except for one industry leader, the non-GM breeding programs in Argentina are confidential and dedicated to germplasm enhancement but may expand in the coming years due to the development of varieties with new traits. With the current situation, most seed companies could however not release competitive non-GM seeds before several years.

Public breeding at INTA is not focused on variety development (Fuck & al., 2008), therefore these private breeding programs may be the only sources of non-GM varieties. Some varieties could also be imported from the U.S., as it is the case already for food-grade varieties (see section 2.4.2).

[166] Personal communication.
[167] Personal communication.
[168] Personal communication.
[169] Personal communication.

# 4 Conclusion:

The first objective of this study was to assess the current availability of non-GM seeds in the U.S., Brazil and Argentina. The information gathered in this report gives a quite clear picture of the situation:

- In the U.S., some farmers had difficulties to get non-GM soybean seeds in 2009, but it was a short term problem, caused by an increase in the demand for these seeds that had not been forecast by seed producers and sellers, with non-GM soybeans up to about 9% of soybean plantings. It is expected to be solved next year by increases in non-GM seed production. In terms of diversity, at least 162 non-GM public or private varieties are currently available for farmers.
- In Brazil, around 45% of soybeans produced in 2009 were non-GM and the public enterprise EMBRAPA guarantees the availability of non-GM seeds.
- In Argentina, were almost all the soybean production is genetically modified, no new non-GM seeds have been registered since 2005. Most of the few non-GM producers are using old varieties.

The second objective of the study was to identify the main drivers that shape the non-GM breeding activity and determine the future availability of non-GM seeds. We identified several factors that interact on that matter:

- The level of the demand for non-GM soybeans, and therefore, for non-GM soybean seeds, creates incentives to private producers to develop such varieties. In Argentina where almost all producers grow GM soybeans, local seed breeders, that dominate the seed market, see no need to release non-GM seeds. At the opposite, in Brazil, the European demand for non-GM soybeans provides good market opportunities for non-GM growers and seed producers. In the U.S., the Japanese demand for non-GM soybeans for food uses, resulting in high premiums paid to farmers, also stimulates the activity of small companies developing these varieties and controlling the whole supply chain from seed breeding to exports. Similarly, leading breeders in the U.S. still develop non-GM soybeans and claim that they will develop such varieties as long as a demand exists, although this may not necessarily be the case if this demand becomes very low.
- The public sector also has a strong influence on the availability of non-GM seeds. Without the breeding activities of State universities, the availability of such seeds would be limited in the U.S. and the foreseeable decrease of these breeding programs may seriously challenge the future availability of new competitive non-GM varieties for farmers. In Argentina, the last new non-GM varieties for general use were registered in 2005 by INTA, and this public institution does not anymore focus its activities on soybean breeding. This situation shows that when demand is low, public sector programs are necessary to guarantee that farmers have a choice between GM and non-GM seeds. In a very different context, the activity of the public company EMBRAPA still guarantees a good availability of non-GM varieties in Brazil.
- The legal framework on intellectual property rights for seeds, and particularly the right to patent new varieties, has significant consequences on the global breeding activities and may result in less competitive non-GM varieties being developed. Because seed companies may have difficulties or simply not be able to access patented varieties developed by other firms, in the next years they may have to develop varieties relying only on their own (and on the public) germplasm resources. Patents may therefore lead to the eviction of companies with smaller germplasm

resources, and make non-GM varieties available only depending on the ability and will of industry leaders to breed and release them.

- More generally, mergers and acquisitions, by decreasing the number of firms breeding soybean, may reduce the number of firms breeding non-GM soybeans.
- Lastly, the techniques used by breeders to integrate GM traits in their varieties influence significantly the existence of non-GM elite lines that, if released, compete with GM varieties. The development of RR varieties, mainly done through forward breeding, has hindered the development of non-GM programs so far. But the release of new genetic traits (like RR2Y or GAT) may change this situation. It is indeed more flexible for firms developing different types of varieties, with different traits, to develop their new varieties in a non-GM background. But still, the companies that will release their own new genetic traits may chose, as Monsanto did in the 1990s, to develop all their varieties in a GM background and abandon non-GM breeding.

Further investigations would be needed at a firm scale to clarify the different incentives and strategies generated by the emergence of these new genetic events and their consequences on firms choices to breed and release, or not, non-GM varieties.

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# 6 Tables of figures

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## *Figures*

# 7 Annexes

| Assignees | *Parent company in 2007 (date of merger or acquisition)* | **Number of patents or PVP certificates** | **%** |
|---|---|---|---|
| Pioneer Hi-Bred International | | **370** | 22.42 |
| Stine Seed Farm | | **303** | 18.36 |
| Asgrow Seed Company | *Monsanto (1997)* | **183** | 11.09 |
| Monsanto | | **162** | 9.82 |
| Delta and Pine Land Company | *Monsanto (2006)* | **88** | 5.33 |
| Mertec LLC | | **76** | 4.61 |
| Novartis | *Syngenta (2000)* | **76** | 4.61 |
| DEKALB | *Monsanto (1998)* | **48** | 2.91 |
| Syngenta | | **38** | 2.30 |
| Minnesota Agricultural Experiment Station | | **29** | 1.76 |
| Hartz Seed Company | *Monsanto (1982)* | **18** | 1.09 |
| NDSU Research Foundation | | **18** | 1.09 |
| FFR Cooperative | | **17** | 1.03 |
| Advanta USA | *Syngenta (2004)* | **13** | 0.79 |
| Soygenetics | | **12** | 0.73 |
| Dairyland Seed Company | *Dow (2008)* | **11** | 0.67 |
| Midwest Oilseeds, Inc. | *Stine Seed Farm (subsidiary)* | **10** | 0.61 |
| Ohio Agricultural Research and Development Center, Ohio State University | | **10** | 0.61 |
| Garst Seed Company | *Syngenta (2004)* | **9** | 0.55 |
| Iowa State University Research Foundation | | **8** | 0.48 |
| South Dakota Agricultural Experiment Station | | **7** | 0.42 |
| University of Georgia Research Foundation, Inc. | | **7** | 0.42 |
| Kansas Agricultural Experiment Station | | **6** | 0.36 |
| Nidera S.A. | | **6** | 0.36 |
| None | | **6** | 0.36 |
| Ziller Seed Company, Inc. | | **6** | 0.36 |
| Terral Seed, Inc. | | **6** | 0.36 |
| Curators of the University of Missouri | | **5** | 0.30 |
| Illinois Agricultural Experiment Station | | **5** | 0.30 |
| University of Illinois | | **5** | 0.30 |
| Hornbeck Seed Company | | **4** | 0.24 |
| Kentucky Agricultural Experiment Station | | **4** | 0.24 |
| South Carolina Agricultural Experiment Station | | **4** | 0.24 |
| USDA/Agriculture Research Service and N.C. Agriculture Research Service | | **4** | 0.24 |
| USDA | | **4** | 0.24 |
| First Line Seeds | *Monsanto (1998)* | **3** | 0.18 |
| Growmark, Inc. | | **3** | 0.18 |
| Latham Seed Company | | **3** | 0.18 |
| North Carolina Agricultural Research Service and USDA-ARS | | **3** | 0.18 |
| Ohio Agricultural Research and Development Center and | | **3** | 0.18 |
| Southern States Cooperative, Inc. | | **3** | 0.18 |
| Tennessee Advanced Genetics | | **3** | 0.18 |
| Curators of the University of Missouri | | **3** | 0.18 |
| Virginia Agricultural Experiment Station | | **3** | 0.18 |
| Virginia State University and U.S. Government | | **3** | 0.18 |
| Brushvale Seeds | | **2** | 0.12 |
| DEKALB | *Monsanto (1998)* | **2** | 0.12 |
| Genecorp | | **2** | 0.12 |
| Iowa Agriculture and Home Economics Experiment Station | | **2** | 0.12 |
| Kaneko Seeds Company, Ltd. | | **2** | 0.12 |
| King Agro Inc. | | **2** | 0.12 |
| Maryland Agricultural Experiment Station | | **2** | 0.12 |
| Purdue University, Indiana Agricultural Experiment Station | | **2** | 0.12 |
| Schillinger Seed, Inc. | | **2** | 0.12 |
| U.S. Government, as represented by the Secretary of | | **2** | 0.12 |
| Virginia Tech Intellectual Properties, Inc. | | **2** | 0.12 |
| Agriculture Canada | | **1** | 0.06 |
| Arkansas Agricultural Experimental Station, University of | | **1** | 0.06 |
| E. I. du Pont de Nemours and Company | *Pioneer Hi Bred International (1997)* | **1** | 0.06 |
| First Line Seeds Ltd./Monsanto Technology, L.L.C. | *Monsanto (1998)* | **1** | 0.06 |
| Florida Agricultural Experiment Station University of Florida, | | **1** | 0.06 |
| Genecorp, Inc./Asgrow Seed Company | | **1** | 0.06 |
| Land O'Lakes, Inc. | | **1** | 0.06 |
| Louisiana Agricultural Experiment Station | | **1** | 0.06 |
| Monsanto Technology LLC/DeKalb Genetics Corporation | *Monsanto (1998)* | **1** | 0.06 |
| National Agricultural Research Organization | | **1** | 0.06 |
| National Agriculture and Food Organization | | **1** | 0.06 |
| North Carolina Agriculture Research Service | | **1** | 0.06 |
| Pioneer Hi-Bred International, Inc./DeKalb Genetics Corporation | | **1** | 0.06 |
| South Carolina Agriculture and Forestry Research System | | **1** | 0.06 |
| T J Seed Company | | **1** | 0.06 |
| The Ohio State University | | **1** | 0.06 |
| Tohoku National Agricultural Experiment Station, Ministry of Agriculture | | **1** | 0.06 |
| University of Arkansas Agricultural Experiment Station | | **1** | 0.06 |
| University of Maryland | | **1** | 0.06 |
| Virginia Polytechnic Institute and State University | | **1** | 0.06 |
| **Total** | | **1650** | **100** |

**Table 23: Assignees of Patents and PVP certificates, from 1990 to 2007 in the U.S. (PVPO, USDA).**

| Assignees of Patents and PVP certificates (number of varieties protected per year) | | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monsanto (including Hartz seed and First Line) | Monsanto | 2 | 2 | 2 | 1 | 3 | 4 | 1 | 33 | 29 | 63 | 58 | 42 | 23 | 27 | 2 | 25 | 28 | 32 | 377 |
| Asgrow Seed Company | Monsanto (1997) | | 2 | 10 | | 4 | 9 | 5 | Acquisition | | | | | | | | | | | 30 |
| DEKALB | Monsanto (1998) | | 2 | 3 | | 1 | 4 | 17 | | Acquisition | | | | | | | | | | 27 |
| Delta and Pine Land Company | Monsanto (2006) | 2 | | 1 | | 1 | 9 | 2 | 2 | | 7 | 7 | 2 | 5 | 12 | 14 | 8 | Acquisition | | 72 |
| Syngenta (including Novartis and Garst Seeds) | Syngenta | 1 | 12 | 11 | | 12 | 9 | 4 | 3 | | 5 | 9 | 10 | 9 | 6 | 6 | 2 | 11 | 18 | 128 |
| Advanta USA | Syngenta (2004) | | 2 | | | 2 | 1 | | | 1 | | | | | 2 | Acquisition | | | | 8 |
| Pioneer Hi-Bred International | Pioneer | 3 | 7 | 10 | 3 | 10 | 16 | 3 | 3 | 10 | 5 | 28 | 54 | 7 | 25 | 38 | 43 | 29 | 77 | 371 |
| E. I. du Pont de Nemours and Company | Pioneer (1997) | | | | 1 | | | | Acquisition | | | | | | | | | | | 1 |
| Stine Seed Farm (including Midwest Oil) | Stine Seed Farm | | | | | 2 | 2 | 3 | | 12 | 17 | 9 | 47 | 6 | 24 | 37 | 40 | 61 | 53 | 313 |
| Brushvale Seeds | Other Companies | | | | | | | | | | | | | 2 | | | | | | 2 |
| Dairyland Seed Company | Other Companies | | | | | 2 | | | | | | | | | | 2 | | | 7 | 11 |
| Genecorp | Other Companies | | | | | | | | 3 | | | | | | | | | | | 3 |
| Growmark, Inc. | Other Companies | | 2 | 1 | | | | | | | | | | | | | | | | 3 |
| Hornbeck Seed Company | Other Companies | | | | | | | | | | | | | 3 | | | | 1 | | 4 |
| Kaneko Seeds Company, Ltd. | Other Companies | | | | | | | | | | | | | 2 | | | | | | 2 |
| King Agro Inc. | Other Companies | 1 | 1 | | | | | | | | | | | | | | | | | 2 |
| Land O'Lakes, Inc. | Other Companies | | 1 | | | | | | | | | | | | | | | | | 1 |
| Latham Seed Company | Other Companies | | 2 | | | 1 | | | | | | | | | | | | | | 3 |
| Mertec LLC | Other Companies | | | | | | | | | | | | | | 3 | 21 | 14 | 22 | 16 | 76 |
| Nidera S.A. | Other Companies | | | | | | | | | | | | | | | | | | 6 | 6 |
| None | Other Companies | | | | | | | | | | | | | 5 | | | 1 | | | 6 |
| Schillinger Seed, Inc. | Other Companies | | | | | | | | | | | | | | | | 1 | 1 | | 2 |
| Soygenetics | Other Companies | | | | | | | | | | | | | | | 3 | 2 | 1 | 6 | 12 |
| T J Seed Company | Other Companies | | | | | | | | | | | | 1 | | | | | | | 1 |
| Tennessee Advanced Genetics | Other Companies | | | | | | | | | | | 1 | | | | 1 | 1 | | | 3 |
| Terral Seed, Inc. | Other Companies | | | | | | 2 | 1 | 2 | | 1 | | | | | | | | | 6 |
| Ziller Seed Company, Inc. | Other Companies | | | 2 | 1 | 2 | | | 1 | | | | | | | | | | | 6 |
| FFR Cooperative | Cooperative | | | 5 | | 4 | 3 | 1 | 1 | 1 | 2 | | | | | | | | | 17 |
| Southern States Cooperative, Inc. | Cooperative | 1 | | 2 | | | | | | | | | | | | | | | | 3 |
| Iowa State University Research Foundation | Foundation | | | 1 | | | | 2 | 3 | 2 | | | | | | | | | | 8 |
| NDSU Research Foundation | Foundation | | | | | | | | | | | 1 | 2 | 1 | 2 | 6 | 3 | | 3 | 18 |
| University of Georgia Research Foundation, Inc. | Foundation | | | | | | 3 | | | | | 1 | 1 | | 1 | | | | 1 | 7 |
| Agriculture Canada | University/public | | | | | | | | | 1 | | | | | | | | | | 1 |
| Arkansas Agricultural Experimental Station | University/public | | | | | | | | | | | | | | | | | | 1 | 1 |
| Curators of the University of Missouri | University/public | | | 3 | | 2 | | | | | | 3 | | | | | | | | 8 |
| Florida Agricultural Experiment Station University of Florida | University/public | | | | | | | | | | | | | | | | 1 | | | 1 |
| Illinois Agricultural Experiment Station | University/public | | 1 | | | | 1 | | | | | 2 | 1 | | | | | | | 5 |
| Iowa Agriculture and Home Economics Experiment Station | University/public | | | 2 | | | | | | | | | | | | | | | | 2 |
| Kansas Agricultural Experiment Station | University/public | | | | | 1 | 1 | 1 | 1 | | | | | 2 | | | | | | 6 |
| Kentucky Agricultural Experiment Station | University/public | | | | | | 1 | | | | 1 | 2 | | | | | | | | 4 |
| Louisiana Agricultural Experiment Station | University/public | | | 1 | | | | | | | | | | | | | | | | 1 |
| Maryland Agricultural Experiment Station | University/public | | | | | 2 | | | | | | | | | | | | | | 2 |

| *Assignees of Patents and PVP certificates (number of varieties protected per year)* | | *1990* | *1991* | *1992* | *1993* | *1994* | *1995* | *1996* | *1997* | *1998* | *1999* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Minnesota Agricultural Experiment Station* | *University/public* | | | 3 | | 4 | 1 | 2 | 2 | 1 | | 1 | 5 | 5 | | | | | 2 | **29** |
| *National Agricultural Research Organization* | *University/public* | | | | | | | | | | | | | | | | 1 | | 0 | **1** |
| *National Agriculture and Food Organization* | *University/public* | | | | | | | | | | | | | | | | | | 1 | **1** |
| *North Carolina Agricultural Research Service and USDA* | *University/public* | | | | | | 2 | | 1 | | | | 1 | | | | | | | **4** |
| *Ohio Agricultural Research and Development Center, OSU* | *University/public* | | | 3 | | 2 | 3 | 2 | | | | | 1 | 1 | | | | 1 | | **13** |
| *Purdue University, Indiana Agricultural Experiment Station* | *University/public* | | | | | | 1 | | 1 | | | | | | | | | | | **2** |
| *South Carolina Agricultural Experiment Station* | *University/public* | | | | | | 1 | | | | 2 | | 1 | | | | | | | **4** |
| *South Carolina Agriculture and Forestry Research System* | *University/public* | | | | | | | | | | | | 1 | | | | | | | **1** |
| *South Dakota Agricultural Experiment Station* | *University/public* | | | | | | | | | | | | 2 | 1 | 2 | | | | 2 | **7** |
| *The Ohio State University* | *University/public* | | | | | | 1 | | | | | | | | | | | | | **1** |
| *Tohoku National Agricultural Experiment Station* | *University/public* | | | 1 | | | | | | | | | | | | | | | | **1** |
| *U.S. Government, Secretary of Agriculture* | *University/public* | | | | | | | | | | | | | | 2 | | | | | **2** |
| *University of Arkansas Agricultural Experiment Station* | *University/public* | | | | | | | | | | | | 1 | | | | | | | **1** |
| *University of Illinois* | *University/public* | | | 4 | | 1 | | | | | | | | | | | | | | **5** |
| *University of Maryland* | *University/public* | | | | | | | | | | 1 | | | | | | | | | **1** |
| *USDA* | *University/public* | | | | | | | | | | 3 | | 1 | 4 | | | | | | **8** |
| *Virginia Agricultural Experiment Station* | *University/public* | | | | | | | | | | | 1 | 1 | 1 | | | | | | **3** |
| *Virginia Polytechnic Institute and State University* | *University/public* | | | | | | 1 | | | | | | | | | | | | | **1** |
| *Virginia State University and U.S. Government* | *University/public* | | | | | | | | | | | | | | | 3 | | | | **3** |
| *Virginia Tech Intellectual Properties, Inc.* | *University/public* | | | | | | | | | | | | | | | | | | 2 | **2** |
| ***Total*** | | **10** | **37** | **65** | **6** | **56** | **75** | **44** | **56** | **57** | **107** | **123** | **174** | **77** | **106** | **133** | **142** | **155** | **227** | **1650** |
| | **PVP certificates** | 10 | 37 | 65 | 6 | 54 | 73 | 37 | 25 | 12 | 19 | 34 | 59 | 34 | 45 | 39 | 29 | 21 | 69 | **668** |
| | **Patent and PVP certificates** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 18 | 46 | 8 | 24 | 14 | 29 | 14 | 14 | **174** |
| | **Patents** | 0 | 0 | 0 | 0 | 2 | 2 | 7 | 28 | 44 | 85 | 71 | 69 | 35 | 37 | 80 | 84 | 120 | 144 | **808** |
| | ***Monsanto, Stine, Pioneer, Syngenta*** | 6 | 21 | 23 | 4 | 27 | 31 | 11 | 39 | 51 | 90 | 104 | 153 | 45 | 82 | 83 | 110 | 129 | 180 | |
| | ***Other companies*** | 3 | 12 | 17 | 2 | 13 | 25 | 25 | 8 | 1 | 8 | 8 | 3 | 17 | 17 | 41 | 27 | 25 | 35 | |
| | ***Universities/public/non-profit*** | 1 | 4 | 25 | 0 | 16 | 19 | 8 | 9 | 5 | 9 | 11 | 18 | 15 | 7 | 9 | 5 | 1 | 12 | |

**Table 24: Number of soybean varieties protected (by patents or PVP certificates) per assignee (including M&A) and per year in the U.S. (Source: USDA, PVPO)**

| Assignees of Patents and PVP certificates (% of varieties protected per year) | | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monsanto (including Hartz seed and First Line) | Monsanto | 20,0 | 5,4 | 3,1 | 16,7 | 5,4 | 5,3 | 2,3 | 58,9 | 50,9 | 58,9 | 47,2 | 24,1 | 29,9 | 25,5 | 1,5 | 17,6 | 18,1 | 14,1 | **22,85** |
| Asgrow Seed Company | Monsanto (1997) | | 5,4 | 15,4 | | 7,1 | 12,0 | 11,4 | Acquisition | | | | | | | | | | | **1,82** |
| DEKALB | Monsanto (1998) | | 5,4 | 4,6 | | 1,8 | 5,3 | 38,6 | | Acquisition | | | | | | | | | | **1,64** |
| Delta and Pine Land Company | Monsanto (2006) | 20,0 | | 1,5 | | 1,8 | 12,0 | 4,5 | 3,6 | | 6,5 | 5,7 | 1,1 | 6,5 | 11,3 | 10,5 | 5,6 | Acquisition | | **4,36** |
| Syngenta (including Novartis and Garst Seeds) | Syngenta | 10,0 | 32,4 | 16,9 | | 21,4 | 12,0 | 9,1 | 5,4 | | 4,7 | 7,3 | 5,7 | 11,7 | 5,7 | 4,5 | 1,4 | 7,1 | 7,9 | **7,76** |
| Advanta USA | Syngenta (2004) | | 5,4 | | | 3,6 | 1,3 | | | 1,8 | | | | | 1,9 | Acquisition | | | | **0,48** |
| Pioneer Hi-Bred International | Pioneer | 30,0 | 18,9 | 15,4 | 50,0 | 17,9 | 21,3 | 6,8 | 5,4 | 17,5 | 4,7 | 22,8 | 31,0 | 9,1 | 23,6 | 28,6 | 30,3 | 18,7 | 33,9 | **22,48** |
| E. I. du Pont de Nemours and Company | Pioneer (1997) | | | | 16,7 | | | | Acquisition | | | | | | | | | | | **0,06** |
| Stine Seed Farm (including Midwest Oil) | Stine Seed Farm | | | | | 3,6 | 2,7 | 6,8 | | 21,1 | 15,9 | 7,3 | 27,0 | 7,8 | 22,6 | 27,8 | 28,2 | 39,4 | 23,3 | **18,97** |
| Brushvale Seeds | Other Companies | | | | | | | | | | | | | 2,6 | | | | | | **0,12** |
| Dairyland Seed Company | Other Companies | | | | | 3,6 | | | | | | | | | | 1,5 | | | 3,1 | **0,67** |
| Genecorp | Other Companies | | | | | | | | 5,4 | | | | | | | | | | | **0,18** |
| Growmark, Inc. | Other Companies | | 5,4 | 1,5 | | | | | | | | | | | | | | | | **0,18** |
| Hornbeck Seed Company | Other Companies | | | | | | | | | | | | | 3,9 | | | | 0,6 | | **0,24** |
| Kaneko Seeds Company, Ltd. | Other Companies | | | | | | | | | | | | | 2,6 | | | | | | **0,12** |
| King Agro Inc. | Other Companies | 10,0 | 2,7 | | | | | | | | | | | | | | | | | **0,12** |
| Land O'Lakes, Inc. | Other Companies | | 2,7 | | | | | | | | | | | | | | | | | **0,06** |
| Latham Seed Company | Other Companies | | 5,4 | | | 1,8 | | | | | | | | | | | | | | **0,18** |
| Mertec LLC | Other Companies | | | | | | | | | | | | | | 2,8 | 15,8 | 9,9 | 14,2 | 7,0 | **4,61** |
| Nidera S.A. | Other Companies | | | | | | | | | | | | | | | | | | 2,6 | **0,36** |
| None | Other Companies | | | | | | | | | | | | | 6,5 | | | 0,7 | | | **0,36** |
| Schillinger Seed, Inc. | Other Companies | | | | | | | | | | | | | | | | 0,7 | 0,6 | | **0,12** |
| Soygenetics | Other Companies | | | | | | | | | | | | | | | 2,3 | 1,4 | 0,6 | 2,6 | **0,73** |
| T J Seed Company | Other Companies | | | | | | | | | | | | 0,6 | | | | | | | **0,06** |
| Tennessee Advanced Genetics | Other Companies | | | | | | | | | | | 0,8 | | | | 0,8 | 0,7 | | | **0,18** |
| Terral Seed, Inc. | Other Companies | | | | | 0,0 | 2,7 | 2,3 | 3,6 | 0,0 | 0,9 | | | | | | | | | **0,36** |
| Ziller Seed Company, Inc. | Other Companies | | | 3,1 | 16,7 | 3,6 | | | 1,8 | | | | | | | | | | | **0,36** |
| FFR Cooperative | Cooperative | | | 7,7 | | 7,1 | 4,0 | 2,3 | 1,8 | 1,8 | 1,9 | | | | | | | | | **1,03** |
| Southern States Cooperative, Inc. | Cooperative | 10,0 | | 3,1 | | | | | | | | | | | | | | | | **0,18** |
| Iowa State University Research Foundation | Foundation | | | 1,5 | | | | 4,5 | 5,4 | 3,5 | | | | | | | | | | **0,48** |
| NDSU Research Foundation | Foundation | | | | | | | | | | | 0,8 | 1,1 | 1,3 | 1,9 | 4,5 | 2,1 | | 1,3 | **1,09** |
| University of Georgia Research Foundation, Inc. | Foundation | | | | | | 4,0 | | | | | 0,8 | 0,6 | | 0,9 | | | | 0,4 | **0,42** |
| Agriculture Canada | University/public | | | | | | | | | 1,8 | | | | | | | | | | **0,06** |
| Arkansas Agricultural Experimental Station | University/public | | | | | | | | | | | | | | | | | | 0,4 | **0,06** |
| Curators of the University of Missouri | University/public | | | 4,6 | | 3,6 | | | | | | 2,4 | | | | | | | | **0,48** |
| Florida Agricultural Experiment Station University of Florida | University/public | | | | | | | | | | | 0,0 | | | | | 0,7 | | | **0,06** |
| Illinois Agricultural Experiment Station | University/public | | 2,7 | | | | 1,3 | | | | | 1,6 | 0,6 | | | | | | | **0,30** |
| Iowa Agriculture and Home Economics Experiment Station | University/public | | | 3,1 | | | | | | | | | | | | | | | | **0,12** |
| Kansas Agricultural Experiment Station | University/public | | | | | 1,8 | 1,3 | 2,3 | 1,8 | | | | | 2,6 | | | | | | **0,36** |
| Kentucky Agricultural Experiment Station | University/public | | | | | | 1,3 | | | | 0,9 | 1,6 | | 0,0 | | | | | | **0,24** |
| Louisiana Agricultural Experiment Station | University/public | | | 1,5 | | | | | | | | | | | | | | | | **0,06** |
| Maryland Agricultural Experiment Station | University/public | | | | | 3,6 | | | | | | | | | | | | | | **0,12** |
| Minnesota Agricultural Experiment Station | University/public | | 8,1 | 4,6 | | 7,1 | 1,3 | 4,5 | 3,6 | 1,8 | | 0,8 | 2,9 | 6,5 | | | | | 0,9 | **1,76** |

| Assignees of Patens and PVP certificates | | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| National Agricultural Research Organization | University/public | | | | | | | | | | | | | | | | 0,7 | | | 0,06 |
| National Agriculture and Food Organization | University/public | | | | | | | | | | | | | | | | | | 0,4 | 0,06 |
| North Carolina Agricultural Research Service and USDA | University/public | | | | | | 2,7 | | 1,8 | | | | 0,6 | | | | | | | 0,24 |
| Ohio Agricultural Research and Development Center, OSU | University/public | | | 4,6 | | 3,6 | 4,0 | 4,5 | | | | | 0,6 | 1,3 | | | | 0,6 | | 0,79 |
| Purdue University, Indiana Agricultural Experiment Station | University/public | | | | | | 1,3 | | 1,8 | | | | | | | | | | | 0,12 |
| South Carolina Agricultural Experiment Station | University/public | | | | | | 1,3 | | | | 1,9 | | 0,6 | | | | | | | 0,24 |
| South Carolina Agriculture and Forestry Research System | University/public | | | | | | | | | | | | 0,6 | | | | | | | 0,06 |
| South Dakota Agricultural Experiment Station | University/public | | | | | | | | | | | | 1,1 | 1,3 | 1,9 | | | | 0,9 | 0,42 |
| The Ohio State University | University/public | | | | | | 1,3 | | | | | | | | | | | | | 0,06 |
| Tohoku National Agricultural Experiment Station | University/public | | | 1,5 | | | | | | | | | | | | | | | | 0,06 |
| U.S. Government, Secretary of Agriculture | University/public | | | | | | | | | | | | | | 1,9 | | | | | 0,12 |
| University of Arkansas Agricultural Experiment Station | University/public | | | | | | | | | | | | 0,6 | | | | | | | 0,06 |
| University of Illinois | University/public | | | 6,2 | | 1,8 | | | | | | | | | | | | | | 0,30 |
| University of Maryland | University/public | | | | | | | | | | 0,9 | | | | | | | | | 0,06 |
| USDA | University/public | | | | | | | | | | 2,8 | | 0,6 | 5,2 | | | | | | 0,48 |
| Virginia Agricultural Experiment Station | University/public | | | | | | | | | | | 0,8 | 0,6 | 1,3 | | | | | | 0,18 |
| Virginia Polytechnic Institute and State University | University/public | | | | | | 1,3 | | | | | | | | | | | | | 0,06 |
| Virginia State University and U.S. Government | University/public | | | | | | | | | | | | | | | 2,3 | | | | 0,18 |
| Virginia Tech Intellectual Properties, Inc. | University/public | | | | | | | | | | | | | | | | | | 0,9 | 0,12 |
| **Total** | | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| **Monsanto, Stine, Pioneer, Syngenta** | | 60,0 | 56,8 | 35,4 | 66,7 | 48,2 | 41,3 | 25,0 | 69,6 | 89,5 | 84,1 | 84,6 | 87,9 | 58,4 | 77,4 | 62,4 | 77,5 | 83,2 | 79,3 | |
| **Other companies** | | 30,0 | 32,4 | 26,2 | 33,3 | 23,2 | 33,3 | 56,8 | 14,3 | 1,8 | 7,5 | 6,5 | 1,7 | 22,1 | 16,0 | 30,8 | 19,0 | 16,1 | 15,4 | |
| **Universities/public/non-profit** | | 10,0 | 10,8 | 38,5 | 0,0 | 28,6 | 25,3 | 18,2 | 16,1 | 8,8 | 8,4 | 8,9 | 10,3 | 19,5 | 6,6 | 6,8 | 3,5 | 0,6 | 5,3 | |
| **HHI** | | 2000 | 1673 | 991,7 | 3333 | 1065 | 1029 | 1901 | 3642 | 3364 | 3823 | 2896 | 2324 | 1368 | 1901 | 2006 | 2160 | 2479 | 2035 | |

**Table 25: Percentage share and concentration of assignees (including M&A) on intellectual protection (patents or PVP certificates) for soybean varieties issued per year in the U.S. (Source: USDA, PVPO)**

| Number of patents | 1986 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stine Seed Farm, Inc. | | 2 | 2 | 3 | | 12 | 17 | 9 | 47 | 6 | 24 | 37 | 40 | 61 | 53 | **313** |
| Pioneer Hi-Bred International, Inc. | 1 | | | | | 10 | 23 | 15 | 13 | 7 | 23 | 23 | 26 | 28 | 39 | **207** |
| Asgrow Seed Company | | | | 4 | 28 | 28 | 8 | 12 | 16 | 19 | 1 | 1 | | | | **117** |
| Monsanto | | | | | | 1 | 42 | 32 | 3 | | | | 18 | 6 | 8 | **110** |
| Mertec LLC | | | | | | | | | | | 3 | 21 | 14 | 22 | 16 | **76** |
| Delta and Pine Land Company | | | | | | | 7 | 6 | | 4 | | | 6 | 2 | 9 | **34** |
| Syngenta | | | | | | | | | 1 | | 5 | 2 | 1 | 7 | 13 | **29** |
| DeKalb | | | | | | 1 | 9 | 10 | | 1 | 3 | 1 | | | | **25** |
| Novartis AG | | | | | | | 5 | 6 | 1 | | | | | | | **12** |
| Soygenetics LLC | | | | | | | | | | | | 3 | 2 | 1 | 6 | **12** |
| Dairyland Seed Co., Inc. | | | | | | | | | | | | 2 | | | 7 | **9** |
| Garst Seed Company | | | | | | | | | | | | | | 4 | 5 | **9** |
| Advanta U.S.A., Inc. | | | | | | | | | | | 2 | 4 | 1 | | | **7** |
| Iowa State University Research Foundation | | | | 2 | 3 | 2 | | | | | | | | | | **7** |
| None | | | | | | | | | | 6 | | | 1 | | | **7** |
| Nidera Semillas S.A. | | | | | | | | | | | | | | | 3 | **3** |
| First Line Seeds Ltd. | | | | | | | | | | | | | 2 | | | **2** |
| Schillinger Seed, Inc. | | | | | | | | | | | | | 1 | 1 | | **2** |
| Hornbeck Seed Co., Inc. | | | | | | | | | | | | | | 1 | | **1** |
| **Total** | **1** | **2** | **2** | **9** | **31** | **54** | **111** | **90** | **81** | **43** | **61** | **94** | **112** | **133** | **159** | **982** |

**Table 26: Patents on soybean varieties issued per year and per assignees in the U.S. (Source: USDA, PVPO)**

| Number of patents | 1986 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stine | | 2 | 4 | 7 | 7 | 19 | 36 | 45 | 92 | 98 | 122 | 159 | 199 | 260 | 313 |
| Monsanto (DEKALB, First Line) | | | | | 32 | 62 | 121 | 175 | 194 | 214 | 218 | 220 | 240 | 271 | 288 |
| Asgrow | | | | 4 | Acquisition Monsanto | | | | | | | | | | |
| Delta and Pine Land Company | | | | | | | 7 | 13 | 13 | 17 | 17 | 17 | 23 | Acquisition Monsanto | |
| Pioneer | 1 | | | | | 11 | 34 | 49 | 62 | 69 | 92 | 115 | 141 | 168 | 207 |
| Syngenta (Novartis, Garst Seed) | | | | | | | 5 | 11 | 13 | 13 | 18 | 26 | 28 | 39 | 57 |
| Advanta U.S.A., Inc. | | | | | | | | | | | 2 | Acquisition Syngenta | | | |
| Mertec | | | | | | | | | | | 17 | 24 | 38 | 60 | 76 |
| Soygenetics LLC | | | | | | | | | | | | 3 | 5 | 6 | 12 |
| Dairyland Seed Co., Inc. | | | | | | | | | | | | 2 | 2 | 2 | 9 |
| Iowa State University Research Foundation | | | | 2 | 5 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| None | | | | | | | | | | 6 | 6 | 6 | 7 | 7 | 7 |
| Nidera Semillas S.A. | | | | | | | | | | | | | | | 3 |
| Schillinger Seed, Inc. | | | | | | | | | | | | | 1 | 2 | 2 |
| Hornbeck Seed Co., Inc. | | | | | | | | | | | | | | 1 | 1 |
| **Total** | **1** | **2** | **4** | **13** | **44** | **99** | **210** | **300** | **381** | **424** | **499** | **579** | **691** | **823** | **982** |

**Table 27Ownership of patents on soybean germplasm in the U.S. (Source: USDA, PVPO)[170]**

[170] Calculated by cumulating annual patents and including mergers and acquisition in the sector. As patents' rights expire after 20 year, the patent from 1986 is not included in years 2006 and 2007.

| Number of varieties registered | Total | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NIDERA S.A. | 103 | 2 | 7 | | 1 | 5 | 1 | 5 | 9 | 2 | 5 | 13 | 8 | 1 | 6 | 1 | 3 | 20 | 4 | 10 |
| ASOCIADOS DON MARIO | 57 | 1 | | | | | | | 1 | | | 2 | 6 | | 6 | 5 | 2 | 10 | 9 | 15 |
| MONSANTO | 39 | | | | | | | | | 7 | 5 | | 4 | 2 | 11 | 3 | 4 | 3 | | |
| RELMO S.A. | 28 | | | | | | | | | 5 | 1 | 2 | 1 | | 1 | 6 | 5 | | 2 | 5 |
| CURTI LUIS ALBERTO | 18 | | | | | | | | | | | | | | 1 | 15 | 1 | | 1 | |
| BRETT S.A. | 17 | 2 | 4 | | 4 | | | | 5 | 2 | | | | | | | | | | |
| PIONEER | 17 | | | | | | | | 2 | 2 | 4 | | | 1 | 1 | 1 | 1 | 1 | 1 | 3 |
| INTA | 16 | | 1 | | 1 | 4 | | 1 | 1 | 3 | 3 | | | | | | 2 | | | |
| SYNGENTA | 16 | | | | | | | | | | | | | | | 4 | 1 | 3 | 4 | 4 |
| AGROSERVICIOS S.A. | 11 | | | | | | | | | 2 | | | | 2 | | 4 | | | 3 | |
| SEMINIUM S.A. | 10 | | | | | | | | | | | | | | | | 4 | | 2 | 4 |
| COOP.PROV.SERV.AGR.SANTA ROSA | 8 | | | | | | | | | | | | | | | | | 6 | 1 | 1 |
| DEKALB ARGENTINA S.A. | 8 | 1 | | | 2 | | | 1 | 4 | | | | | | | | | | | |
| LA TIJERETA | 7 | | | | | | | | | 1 | 2 | | 1 | | 1 | 2 | | | | |
| CRIADERO SANTA ROSA | 6 | | | | | | | | | | | | | | | 2 | 2 | 1 | 1 | |
| ENEKA SEMILLAS S.A. | 6 | 1 | | | 1 | 1 | | | 3 | | | | | | | | | | | |
| NOVARTIS ARGENTINA S.A. | 6 | | | | | | | | | 1 | 5 | | | | | | | | | |
| ASOCIACION DE COOPERATIVAS ARGENTINAS | 5 | | | | | 2 | 1 | | | | | | | | 2 | | | | | |
| CARGILL S.A. | 5 | | 3 | | 1 | | 1 | | | | | | | | | | | | | |
| OFPEC S.R.L. | 5 | | | 1 | 1 | 3 | | | | | | | | | | | | | | |
| DAIRYLAND SEED CO., INC. | 4 | | | | | | | | | | | | | | | | 3 | 1 | | |
| EE.AGROINDUST.OBISPO COLOMBRES | 4 | | | | | | | | | 2 | | | 2 | | | | | | | |
| J.G.LIMITED,INC | 4 | | | | | | | | | | | | | 3 | | 1 | | | | |
| MAXIMO JUAN ROBLEDO PUCH | 4 | | | | | | | | | | 3 | 1 | | | | | | | | |
| SANDOZ ARGENTINA S.A.I.C. | 4 | | | | | | | | 4 | | | | | | | | | | | |
| AGROMANIA S.A. | 3 | | | | | 2 | | | | | | | | | 1 | | | | | |
| AL 1281 FAC.CS. AGR.ENTRE RIOS | 3 | | | | | | | | | | | 3 | | | | | | | | |
| ATAR SEMILLAS HIBRIDAS SA | 3 | | | | | | | | | | | | | | | | 1 | 2 | | |
| CRIAD.DE SEM.COOP.ADH.A FACA | 3 | | | | | | | | | | | 1 | | | | 2 | | | | |
| UNIV.NAC.ENTRE RIOS | 3 | 1 | | | | 1 | | | 1 | | | | | | | | | | | |
| ASOC. COOP. ARG. COOP. LTDA. | 2 | | | | | | | | | | | | | | | | | 1 | | 1 |
| FOUNDATION S.A. | 2 | | | | | 1 | 1 | | | | | | | | | | | | | |
| GRANCER S.A. | 2 | | | | | | | | | 1 | 1 | | | | | | | | | |
| KWS ARGENTINA S.A. | 2 | 1 | | 1 | | | | | | | | | | | | | | | | |
| SURSEM S.A | 2 | | | | | | | | | | | | | | | | | | | 2 |
| AGRIGENETICS S.A. | 1 | | | | | | | 1 | | | | | | | | | | | | |
| AGRISEED S.A. | 1 | | | | | | | | | | | | | | | | | | | 1 |
| COMPAÑIA SEMILLERA DEL NORTE | 1 | | | | 1 | | | | | | | | | | | | | | | |
| CRIADERO DE SEMILLAS HIB. ACA | 1 | | | | | | | 1 | | | | | | | | | | | | |
| CRIADERO FACA | 1 | | | | | | | 1 | | | | | | | | | | | | |
| CRIADERO SPS S.A. | 1 | | | | | | | | | | 1 | | | | | | | | | |
| HOECHST SCHERING AGREVO S.A | 1 | | | | | | | | | | 1 | | | | | | | | | |
| OBISPO COLOMBRES ESTAC.EXPER. | 1 | | | | | | 1 | | | | | | | | | | | | | |
| PRODUSEM S.R.L. | 1 | | 1 | | | | | | | | | | | | | | | | | |
| SPS ARGENTINA SA | 1 | | | | | | | | | | | | | | | | | | | 1 |
| **Total** | 443 | 9 | 16 | 2 | 12 | 19 | 5 | 10 | 30 | 28 | 31 | 22 | 22 | 9 | 30 | 46 | 29 | 48 | 28 | 47 |

**Table 28: Number of soybean varieties registered per year in Argentina (Source: INASE)**

| % of variety registered per year | Total | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NIDERA S.A. | 23,3% | 22,2% | 43,8% | | 8,3% | 26,3% | 20,0% | 50,0% | 30,0% | 7,1% | 16,1% | 59,1% | 36,4% | 11,1% | 20,0% | 2,2% | 10,3% | 41,7% | 14,3% | 21,3% |
| ASOCIADOS DON MARIO | 12,9% | 11,1% | | | | | | | 3,3% | | | 9,1% | 27,3% | | 20,0% | 10,9% | 6,9% | 20,8% | 32,1% | 31,9% |
| MONSANTO | 8,8% | | | | | | | | | 25,0% | 16,1% | | 18,2% | 22,2% | 36,7% | 6,5% | 13,8% | 6,3% | | |
| RELMO S.A. | 6,3% | | | | | | | | | 17,9% | 3,2% | 9,1% | 4,5% | | 3,3% | 13,0% | 17,2% | | 7,1% | 10,6% |
| CURTI LUIS ALBERTO | 4,1% | | | | | | | | | | | | | | 3,3% | 32,6% | 3,4% | | 3,6% | |
| BRETT S.A. | 3,8% | 22,2% | 25,0% | | 33,3% | | | | 16,7% | 7,1% | | | | | | | | | | |
| PIONEER | 3,8% | | | | | | | | 6,7% | 7,1% | 12,9% | | | 11,1% | 3,3% | 2,2% | 3,4% | 2,1% | 3,6% | 6,4% |
| INTA | 3,6% | | 6,3% | | 8,3% | 21,1% | | 10,0% | 3,3% | 10,7% | 9,7% | | | | | | 6,9% | | | |
| SYNGENTA | 3,6% | | | | | | | | | | | | | | | 8,7% | 3,4% | 6,3% | 14,3% | 8,5% |
| AGROSERVICIOS S.A. | 2,5% | | | | | | | | | 7,1% | | | | 22,2% | | 8,7% | | | 10,7% | |
| SEMINIUM S.A. | 2,3% | | | | | | | | | | | | | | | | 13,8% | | 7,1% | 8,5% |
| COOP.PROV.SERV.AGR.SANTA ROSA | 1,8% | | | | | | | | | | | | | | | | | 12,5% | 3,6% | 2,1% |
| DEKALB ARGENTINA S.A. | 1,8% | 11,1% | | | 16,7% | | | 10,0% | 13,3% | | | | | | | | | | | |
| LA TIJERETA | 1,6% | | | | | | | | | 3,6% | 6,5% | | 4,5% | | 3,3% | 4,3% | | | | |
| CRIADERO SANTA ROSA | 1,4% | | | | | | | | | | | | | | | 4,3% | 6,9% | 2,1% | 3,6% | |
| ENEKA SEMILLAS S.A. | 1,4% | 11,1% | | | 8,3% | 5,3% | | | 10,0% | | | | | | | | | | | |
| NOVARTIS ARGENTINA S.A. | 1,4% | | | | | | | | | 3,6% | 16,1% | | | | | | | | | |
| ASOCIACION DE COOPERATIVAS ARGENTINAS | 1,1% | | | | | 10,5% | 20,0% | | | | | | | | 6,7% | | | | | |
| CARGILL S.A. | 1,1% | | 18,8% | | 8,3% | | 20,0% | | | | | | | | | | | | | |
| OFPEC S.R.L. | 1,1% | | | 50,0% | 8,3% | 15,8% | | | | | | | | | | | | | | |
| DAIRYLAND SEED CO., INC. | 0,9% | | | | | | | | | | | | | | | | 10,3% | 2,1% | | |
| EE.AGROINDUST.OBISPO COLOMBRES | 0,9% | | | | | | | | | 7,1% | | | 9,1% | | | | | | | |
| J.G.LIMITED,INC | 0,9% | | | | | | | | | | | | | 33,3% | | 2,2% | | | | |
| MAXIMO JUAN ROBLEDO PUCH | 0,9% | | | | | | | | | | 9,7% | 4,5% | | | | | | | | |
| SANDOZ ARGENTINA S.A.I.C. | 0,9% | | | | | | | | 13,3% | | | | | | | | | | | |
| AGROMANIA S.A. | 0,7% | | | | | 10,5% | | | | | | | | | 3,3% | | | | | |
| AL 1281 FAC.CS. AGR.ENTRE RIOS | 0,7% | | | | | | | | | | | 13,6% | | | | | | | | |
| ATAR SEMILLAS HIBRIDAS SA | 0,7% | | | | | | | | | | | | | | | | 3,4% | 4,2% | | |
| CRIAD.DE SEM.COOP.ADH.A FACA | 0,7% | | | | | | | | | | | 4,5% | | | | 4,3% | | | | |
| UNIV.NAC.ENTRE RIOS | 0,7% | 11,1% | | | | 5,3% | | | 3,3% | | | | | | | | | | | |
| ASOC. COOP. ARG. COOP. LTDA. | 0,5% | | | | | | | | | | | | | | | | | 2,1% | | 2,1% |
| FOUNDATION S.A. | 0,5% | | | | | 5,3% | 20,0% | | | | | | | | | | | | | |
| GRANCER S.A. | 0,5% | | | | | | | | | 3,6% | 3,2% | | | | | | | | | |
| KWS ARGENTINA S.A. | 0,5% | 11,1% | | 50,0% | | | | | | | | | | | | | | | | |
| SURSEM S.A | 0,5% | | | | | | | | | | | | | | | | | | | 4,3% |
| AGRIGENETICS S.A. | 0,2% | | | | | | | 10,0% | | | | | | | | | | | | |
| AGRISEED S.A. | 0,2% | | | | | | | | | | | | | | | | | | | 2,1% |
| COMPANIA SEMILLERA DEL NORTE | 0,2% | | | | 8,3% | | | | | | | | | | | | | | | |
| CRIADERO DE SEMILLAS HIB. ACA | 0,2% | | | | | | | 10,0% | | | | | | | | | | | | |
| CRIADERO FACA | 0,2% | | | | | | | 10,0% | | | | | | | | | | | | |
| CRIADERO SPS S.A. | 0,2% | | | | | | | | | | 3,2% | | | | | | | | | |
| HOECHST SCHERING AGREVO S.A | 0,2% | | | | | | | | | | 3,2% | | | | | | | | | |
| OBISPO COLOMBRES ESTAC.EXPER. | 0,2% | | | | | | 20,0% | | | | | | | | | | | | | |
| PRODUSEM S.R.L. | 0,2% | | 6,3% | | | | | | | | | | | | | | | | | |
| SPS ARGENTINA SA | 0,2% | | | | | | | | | | | | | | | | | | | 2,1% |
| Total | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| CR4 | 66,7% | 93,8% | 100,0% | 66,7% | 73,7% | 80,0% | 80,0% | 73,3% | 60,7% | 61,3% | 90,9% | 90,9% | 88,9% | 83,3% | 65,2% | 55,2% | 81,3% | 71,4% | 72,3% | |
| HHI | 1604,9 | 2968,8 | 5000 | 1805,6 | 1689,8 | 2000 | 3000 | 1711,1 | 1352 | 1217,5 | 3884,3 | 2520,7 | 2345,7 | 2244,4 | 1616,3 | 1082 | 2439,2 | 1709,2 | 1806,2 | |

**Table 29: Percentage of soybean varieties registered per year in Argentina and concentration indexes (Source: INASE)**

| of varieties registered | Total | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S.A. | 103 | 2 | 7 | | 1 | 5 | 1 | 5 | 9 | 2 | 5 | 13 | 8 | 1 | 6 | 1 | 3 | 20 | 4 |
| OS DON MARIO | 57 | 1 | | | | | | | 1 | | | 2 | 6 | | 6 | 5 | 2 | 10 | 9 |
| TO | 39 | | | | | | | | | 7 | 5 | | 4 | 2 | 11 | 3 | 4 | 3 | |
| A. | 28 | | | | | | | | | 5 | 1 | 2 | 1 | | 1 | 6 | 5 | | 2 |
| IS ALBERTO | 18 | | | | | | | | | | | | | | 1 | 15 | 1 | | 1 |
| A. | 17 | 2 | 4 | | 4 | | | | 5 | 2 | | | | | | | | | |
| | 17 | | | | | | | | 2 | 2 | 4 | | | 1 | 1 | 1 | 1 | 1 | 1 |
| | 16 | | 1 | | 1 | 4 | | 1 | 1 | 3 | 3 | | | | | | 2 | | |
| TA | 16 | | | | | | | | | | | | | | | 4 | 1 | 3 | 4 |
| RVICIOS S.A. | 11 | | | | | | | | | 2 | | | | 2 | | 4 | | | 3 |
| I S.A. | 10 | | | | | | | | | | | | | | | | 4 | | 2 |
| OV.SERV.AGR.SANTA ROSA | 8 | | | | | | | | | | | | | | | | | 6 | 1 |
| ARGENTINA S.A. | 8 | 1 | | | 2 | | | 1 | 4 | | | | | | | | | | |
| ETA | 7 | | | | | | | | | 1 | 2 | | 1 | | 1 | 2 | | | |
| O SANTA ROSA | 6 | | | | | | | | | | | | | | | 2 | 2 | 1 | 1 |
| EMILLAS S.A. | 6 | 1 | | | 1 | 1 | | | 3 | | | | | | | | | | |
| S ARGENTINA S.A. | 6 | | | | | | | | | 1 | 5 | | | | | | | | |
| ION DE COOPERATIVAS ARGENTINAS | 5 | | | | | 2 | 1 | | | | | | | | 2 | | | | |
| S.A. | 5 | | 3 | | 1 | | 1 | | | | | | | | | | | | |
| R.L. | 5 | | | 1 | 1 | 3 | | | | | | | | | | | | | |
| ND SEED CO., INC. | 4 | | | | | | | | | | | | | | | | 3 | 1 | |
| INDUST.OBISPO COLOMBRES | 4 | | | | | | | | | 2 | | | 2 | | | | | | |
| ED,INC | 4 | | | | | | | | | | | | | 3 | | 1 | | | |
| JUAN ROBLEDO PUCH | 4 | | | | | | | | | | 3 | 1 | | | | | | | |
| ARGENTINA S.A.I.C. | 4 | | | | | | | | 4 | | | | | | | | | | |
| NIA S.A. | 3 | | | | | 2 | | | | | | | | | 1 | | | | |
| AC.CS. AGR.ENTRE RIOS | 3 | | | | | | | | | | | 3 | | | | | | | |
| MILLAS HIBRIDAS SA | 3 | | | | | | | | | | | | | | | | 1 | 2 | |
| SEM.COOP.ADH.A FACA | 3 | | | | | | | | | | | 1 | | | | 2 | | | |
| ENTRE RIOS | 3 | 1 | | | | 1 | | | 1 | | | | | | | | | | |
| OP. ARG. COOP. LTDA. | 2 | | | | | | | | | | | | | | | | | 1 | |
| TION S.A. | 2 | | | | | 1 | 1 | | | | | | | | | | | | |
| R S.A. | 2 | | | | | | | | | 1 | 1 | | | | | | | | |
| ENTINA S.A. | 2 | 1 | | 1 | | | | | | | | | | | | | | | |
| S.A | 2 | | | | | | | | | | | | | | | | | | |
| ETICS S.A. | 1 | | | | | | | 1 | | | | | | | | | | | |
| D S.A. | 1 | | | | | | | | | | | | | | | | | | |
| A SEMILLERA DEL NORTE | 1 | | | | 1 | | | | | | | | | | | | | | |
| O DE SEMILLAS HIB. ACA | 1 | | | | | | | 1 | | | | | | | | | | | |
| O FACA | 1 | | | | | | | 1 | | | | | | | | | | | |
| O SPS S.A. | 1 | | | | | | | | | | 1 | | | | | | | | |
| T SCHERING AGREVO S.A | 1 | | | | | | | | | | 1 | | | | | | | | |
| COLOMBRES ESTAC.EXPER. | 1 | | | | | | 1 | | | | | | | | | | | | |
| EM S.R.L. | 1 | | 1 | | | | | | | | | | | | | | | | |
| ENTINA SA | 1 | | | | | | | | | | | | | | | | | | |
| | 443 | 9 | 16 | 2 | 12 | 19 | 5 | 10 | 30 | 28 | 31 | 22 | 22 | 9 | 30 | 46 | 29 | 48 | 28 |

**Table 25: Number of soybean varieties registered per year in Argentina (Source: INASE)**

| variety registered per year | Total | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 23,3% | 22,2% | 43,8% | | 8,3% | 26,3% | 20,0% | 50,0% | 30,0% | 7,1% | 16,1% | 59,1% | 36,4% | 11,1% | 20,0% | 2,2% | 10,3% | 41,7% | 14 |
| ON MARIO | 12,9% | 11,1% | | | | | | | 3,3% | | | 9,1% | 27,3% | | 20,0% | 10,9% | 6,9% | 20,8% | 32 |
| | 8,8% | | | | | | | | | 25,0% | 16,1% | | 18,2% | 22,2% | 36,7% | 6,5% | 13,8% | 6,3% | |
| | 6,3% | | | | | | | | | 17,9% | 3,2% | 9,1% | 4,5% | | 3,3% | 13,0% | 17,2% | | 7 |
| BERTO | 4,1% | | | | | | | | | | | | | | 3,3% | 32,6% | 3,4% | | 3 |
| | 3,8% | 22,2% | 25,0% | | 33,3% | | | | 16,7% | 7,1% | | | | | | | | | |
| | 3,8% | | | | | | | | 6,7% | 7,1% | 12,9% | | | 11,1% | 3,3% | 2,2% | 3,4% | 2,1% | 3 |
| | 3,6% | | 6,3% | | 8,3% | 21,1% | | 10,0% | 3,3% | 10,7% | 9,7% | | | | | | 6,9% | | |
| | 3,6% | | | | | | | | | | | | | | | 8,7% | 3,4% | 6,3% | 14 |
| OS S.A. | 2,5% | | | | | | | | | 7,1% | | | | 22,2% | | 8,7% | | | 10 |
| | 2,3% | | | | | | | | | | | | | | | | 13,8% | | 7 |
| ERV.AGR.SANTA ROSA | 1,8% | | | | | | | | | | | | | | | | | 12,5% | 3 |
| NTINA S.A. | 1,8% | 11,1% | | | 16,7% | | | 10,0% | 13,3% | | | | | | | | | | |
| | 1,6% | | | | | | | | | 3,6% | 6,5% | | 4,5% | | 3,3% | 4,3% | | | |
| NTA ROSA | 1,4% | | | | | | | | | | | | | | | 4,3% | 6,9% | 2,1% | 3 |
| AS S.A. | 1,4% | 11,1% | | | 8,3% | 5,3% | | | 10,0% | | | | | | | | | | |
| GENTINA S.A. | 1,4% | | | | | | | | | 3,6% | 16,1% | | | | | | | | |
| E COOPERATIVAS ARGENTINAS | 1,1% | | | | | 10,5% | 20,0% | | | | | | | | 6,7% | | | | |
| | 1,1% | | 18,8% | | 8,3% | | 20,0% | | | | | | | | | | | | |
| | 1,1% | | | 50,0% | 8,3% | 15,8% | | | | | | | | | | | | | |
| ED CO., INC. | 0,9% | | | | | | | | | | | | | | | | 10,3% | 2,1% | |
| ST.OBISPO COLOMBRES | 0,9% | | | | | | | | | 7,1% | | | 9,1% | | | | | | |
| C | 0,9% | | | | | | | | | | | | | 33,3% | | 2,2% | | | |
| ROBLEDO PUCH | 0,9% | | | | | | | | | | 9,7% | 4,5% | | | | | | | |
| NTINA S.A.I.C. | 0,9% | | | | | | | | 13,3% | | | | | | | | | | |
| A. | 0,7% | | | | | 10,5% | | | | | | | | | 3,3% | | | | |
| S. AGR.ENTRE RIOS | 0,7% | | | | | | | | | | | 13,6% | | | | | | | |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S HIBRIDAS SA | 0,7% | | | | | | | | | | | | | | | | 3,4% | 4,2% | |
| COOP.ADH.A FACA | 0,7% | | | | | | | | | | | 4,5% | | | | 4,3% | | | |
| RE RIOS | 0,7% | 11,1% | | | 5,3% | | | 3,3% | | | | | | | | | | | |
| ARG. COOP. LTDA. | 0,5% | | | | | | | | | | | | | | | | | 2,1% | |
| S.A. | 0,5% | | | | 5,3% | 20,0% | | | | | | | | | | | | | |
| | 0,5% | | | | | | | | 3,6% | 3,2% | | | | | | | | | |
| NA S.A. | 0,5% | 11,1% | | 50,0% | | | | | | | | | | | | | | | |
| | 0,5% | | | | | | | | | | | | | | | | | | |
| S S.A. | 0,2% | | | | | 10,0% | | | | | | | | | | | | | |
| | 0,2% | | | | | | | | | | | | | | | | | | |
| ILLERA DEL NORTE | 0,2% | | | 8,3% | | | | | | | | | | | | | | | |
| SEMILLAS HIB. ACA | 0,2% | | | | | 10,0% | | | | | | | | | | | | | |
| CA | 0,2% | | | | | 10,0% | | | | | | | | | | | | | |
| S S.A. | 0,2% | | | | | | | | | 3,2% | | | | | | | | | |
| ERING AGREVO S.A | 0,2% | | | | | | | | | 3,2% | | | | | | | | | |
| MBRES ESTAC.EXPER. | 0,2% | | | | | 20,0% | | | | | | | | | | | | | |
| R.L. | 0,2% | | 6,3% | | | | | | | | | | | | | | | | |
| A SA | 0,2% | | | | | | | | | | | | | | | | | | |
| | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 1 |
| | CR4 | 66,7% | 93,8% | 100,0% | 66,7% | 73,7% | 80,0% | 80,0% | 73,3% | 60,7% | 61,3% | 90,9% | 90,9% | 88,9% | 83,3% | 65,2% | 55,2% | 81,3% | 7 |
| | HHI | 1604,9 | 2968,8 | 5000 | 1805,6 | 1689,8 | 2000 | 3000 | 1711,1 | 1352 | 1217,5 | 3884,3 | 2520,7 | 2345,7 | 2244,4 | 1616,3 | 1082 | 2439,2 | 17 |

**Table 30: List of non-GM soybean varieties existing in 2009 public and private surveyed breeders' line-up**

~~**Table 26: Percentage of soybean varieties registered per year in Argentina and concentration indexes (Source: INASE)**~~

| Company | Variety name | Maturity Group | Type / Characteristics | Public /private |
|---|---|---|---|---|
| NorthDakota State University | Pembina | 00 | Commodity | Public |
| NorthDakota State University | Cavalier | 00.7 | Commodity | Public |
| Minnesota State University | MN0071 | 00.7 | General Purpose | Public |
| South Dakota State University | | 0 | Commodity | Public |
| Minnesota State University | MN0105 | 0.1 | General Purpose | Public |
| Minnesota State University | MN0304 | 0.3 | General Purpose | Public |
| Syngenta Canada | S03-W4 | 0.3 | High Yielding Food-Grade Soybean | private |
| NorthDakota State University | Nornatto | 0.4 | Specialty natto | Public |
| NorthDakota State University | Nannonatto | 0.4 | Specialty natto | Public |
| Syngenta Canada | S05-T6 | 0.5 | High Yielding Early Soybean | private |
| NorthDakota State University | LaMoure | 0.7 | Commodity | Public |
| NorthDakota State University | ProSoy | 0.8 | Specialty tofu | Public |
| NorthDakota State University | Sheyenne | 0.8 | Commodity | Public |
| Minnesota State University | Toyopro | 0.8 | Higher Protein | Public |
| Syngenta Canada | S 08-80 | 0.8 | Strong Disease Protection | private |
| Minnesota State University | MN0901 | 0.9 | General Purpose | Public |
| Minnesota State University | Surge | 0.9 | General Purpose | Public |
| Iowa State University | A05-312025 | I | Commodity, yellow hilum | Public |
| Iowa State University | IA1008 | I | SCN resistant, yellow hilum | Public |
| Iowa State University | IA1008LF | I | Lipoxygenase free | Public |
| Iowa State University | IA1010 | I | Large seed | Public |
| Iowa State University | IA1010LF | I | Lipoxygenase free | Public |
| Iowa State University | IA1013 | I | Large seed & high protein | Public |
| Iowa State University | IA1016 | I | Small seed | Public |
| Iowa State University | IA1018 | I | Large seed & high protein | Public |
| Iowa State University | IA1021 | I | Commodity, yellow hilum | Public |
| South Dakota State University | | I | Commodity | Public |
| Iowa State University | IA1022 | I | SCN resistant, yellow hilum | Public |
| Iowa State University | IA1023 | I | Commodity, yellow hilum | Public |
| Minnesota State University | MN1011CN | 1 | Organic | Public |
| Syngenta Canada | S10-B7 | 1 | High Yielding Food-Grade Soybean | private |
| Pioneer | 91M10 | 1.1 | Commodity | private |
| Syngenta Canada | S12-A5 | 1.2 | Expect Big Yields | private |

| | | | | |
|---|---|---|---|---|
| Minnesota State University | MN1410 | 1.4 | Organic | Public |
| Syngenta Canada | S14-P6 | 1.4 | Yield Punch For High Performance Acres | private |
| Minnesota State University | MN1505SP | 1.5 | Large Seed, Higher Protein | Public |
| NuTech | 154 | 1.5 | Commodity | private |
| Minnesota State University | MN1607SP | 1.6 | Large Seed, Higher Protein | Public |
| Stine | 1700-0 New | 1.7 | Commodity | private |
| NuTech | 176 | 1.7 | Commodity | private |
| Minnesota State University | MN1801 | 1.8 | General Purpose | Public |
| Syngenta Canada | S18-R6 | 1.8 | Top Yields Plus SCN | private |
| eMerge Genetics | 119F.Y | 1.9 | Early YHC | private |
| Galena Genetics | 19G01 | 1.9 | Identity Preserved | private |
| Galena Genetics | 19G02 | 1.9 | Identity Preserved | private |
| Galena Genetics | 21G02 | 1.9 | Commodity | private |
| Syngenta Canada | S19-90 | 1.9 | Consistant Yields and Strong Disease Protection | private |
| Iowa State University | IA2011 | II | Lacks lipoxygenase-2 | Public |
| Iowa State University | IA2012 | II | Large seed | Public |
| Iowa State University | IA2040 | II | Large seed | Public |
| Iowa State University | IA2041 | II | Large seed & high protein | Public |
| Iowa State University | IA2042 | II | Large seed & high protein | Public |
| Iowa State University | IA2046 | II | Large seed & high protein | Public |
| Iowa State University | IA2053 | II | Large seed & high protein | Public |
| Iowa State University | IA2054 | II | Large seed & high protein | Public |
| Iowa State University | IA2063 | II | Large seed | Public |
| Iowa State University | IA2067 | II | Large seed & high protein | Public |
| Iowa State University | IA2068 | II | SCN resistant, yellow hilum | Public |
| Iowa State University | IA2074 | II | Large seed & high protein | Public |
| Iowa State University | IA2076 | II | Large seed | Public |
| Iowa State University | IA2093 | II | Commodity, yellow hilum | Public |
| Iowa State University | IA2094 | II | Commodity, yellow hilum | Public |
| South Dakota State University | | II | Commodity | Public |
| Minnesota State University | MN2001SP | 2 | Large Seed, Higher Protein | Public |
| eMerge Genetics | 209F.HPC | 2 | High Protein with SCN | private |
| Stine | 0200-0 | 2 | Commodity | private |
| Stine | 2000-0 New | 2 | Commodity | private |
| Syngenta Canada | S20-G7 | 2 | Strong Disease Protection | private |
| Stine | 2100-2 | 2.1 | Commodity | private |
| Dairyland | DSR9-2118 | 2.1 | Commodity | private |
| Pioneer | 92M10 | 2.1 | Commodity | private |
| eMerge Genetics | 230N | 2.3 | Elite Yield and Defense | private |
| eMerge Genetics | 2388 | 2.3 | 1% Ultra Low Lin | private |
| Galena Genetics | 23G03 | 2.3 | Commodity | private |
| Galena Genetics | 23G07 | 2.3 | Commodity | private |
| Galena Genetics | 25G01 | 2.3 | Commodity | private |
| NuTech | 236 | 2.3 | Commodity | private |
| Syngenta Canada | S23-T5 | 2.3 | Yield plus SCN plus Food-Grade Characteristics | private |
| eMerge Genetics | 240F.Y | 2.4 | Tofu Type with Med Protein | private |
| eMerge Genetics | 247F.HD | 2.4 | High Digestibility | private |
| eMerge Genetics | 248F.HP | 2.4 | High Protein | private |
| NuTech | 245 | 2.4 | Commodity | private |
| Stine | 2400-0 | 2.4 | Commodity | private |
| Stine | 2500-2 | 2.5 | Commodity | private |
| eMerge Genetics | 258F.HPC | 2.5 | High Protein with SCN | private |
| Syngenta Canada | S25-D3 | 2.5 | Soybean For Food-Grade Market | private |

| | | | | |
|---|---|---|---|---|
| Syngenta Canada | S26-F9 | 2.6 | Top Yields Plus SCN | private |
| Ohio State University | HS96-3136 | 2.6 | Food production | Public |
| eMerge Genetics | 277F.HD | 2.7 | High Digestibility | private |
| NuTech | 278 | 2.7 | Commodity | private |
| Pioneer | 92M72 | 2.7 | Commodity | private |
| eMerge Genetics | 29Y115 | 2.9 | Tofu Type with Avg Protein | private |
| Ohio State University | Ohio FG3 | 2.7 | Food production | Public |
| Ohio State University | Wyandot | 2.9 | Food production | Public |
| Iowa State University | IA3011 | III | Large seed & high protein | Public |
| Iowa State University | IA3021 | III | Large seed & high protein | Public |
| Iowa State University | IA3022 | III | Large seed & high protein | Public |
| Iowa State University | IA3023 | III | Commodity check | Public |
| Iowa State University | IA3024 | III | Commodity check | Public |
| Iowa State University | IA3027 | III | Large seed & high protein | Public |
| Iowa State University | IA3027LF | III | Lipoxygenase free | Public |
| Ohio State University | Ohio FG4 | III | Food production | Public |
| Ohio State University | Dilworth | 3.1 | Commodity | Public |
| Ohio State University | HS0-3243 | 3.1 | Commodity | Public |
| Pioneer | 92M14 | 3.1 | Commodity | private |
| eMerge Genetics | 317.TC | 3.1 | Elite Yield and Defense | private |
| Stine | 3300-0 New | 3.3 | Commodity | private |
| Stine | 3300-2 | 3.3 | Commodity | private |
| Stine | 3308-2 | 3.3 | Commodity | private |
| Stine | 3400-0 New | 3.4 | Commodity | private |
| Stine | 3400-2 | 3.4 | Commodity | private |
| eMerge Genetics | 348.TC | 3.4 | Elite Yield and Defense | private |
| Pioneer | 93M52 | 3.5 | Commodity | private |
| Ohio State University | Dennison | 3.5 | Commodity | Public |
| Dairyland | DSR-3590 | 3.6 | Commodity | private |
| eMerge Genetics | 365F.Y | 3.6 | Yellow Hilum with SCN | private |
| Pioneer | 93M62 | 3.6 | Commodity | private |
| Ohio State University | Kottman | 3.7 | Commodity | Public |
| Pioneer | 93B82 | 3.8 | Commodity | private |
| eMerge Genetics | 388.TC | 3.8 | Elite Yield and Defense | private |
| eMerge Genetics | 389F.YC | 3.8 | Yellow Hillum with SCN | private |
| eMerge Genetics | 3867SCN | 3.9 | 1% Low Lin with SCN | private |
| Stine | 3900-2 New | 3.9 | Commodity | private |
| Stine | 3870-0 | 3.9 | Commodity | private |
| Iowa State University | IA4003 | IV | Large seed & high protein | Public |
| Ohio State University | Ohio FG5 | IV | Food production | Public |
| eMerge Genetics | 414F.Y | 4.1 | Tofu Type with Med Protein | private |
| Stine | 4100-2 | 4.1 | Commodity | private |
| eMerge Genetics | 428F.HPC | 4.2 | High Protein with SCN | private |
| eMerge Genetics | 446F.HP | 4.2 | High Protein and STS | private |
| Missouri State University | MPV 4238N | 4.2 | Commodity | Public |
| Pioneer | 94Y21 | 4.2 | Commodity | private |
| eMerge Genetics | 4328 | 4.3 | | private |
| eMerge Genetics | 435.TCS | 4.3 | Elite Yield and Defense with STS | private |
| Stine | 4300-2 New | 4.3 | Commodity | private |
| eMerge Genetics | 447.TC | 4.4 | Elite Yield and Defense | private |
| eMerge Genetics | 448F.HPC | 4.4 | High Protein with SCN | private |
| Stine | 4400-2 New | 4.4 | Commodity | private |
| Stine | 4500-2 New | 4.5 | Commodity | private |
| Kansas State University | KS4607 | 4.6 | Commodity | Public |

| | | | | |
|---|---|---|---|---|
| eMerge Genetics | 477.TCS | 4.7 | Elite Yield and Defense with STS | private |
| Arkansas State University | UA 4805’ | 4.8 | Commodity | Public |
| Hornbeck | HBK C4926 | 4.9 | Commodity | private |
| SoyTec | S043987 | 4.8 | Commodity | private |
| Stine | 4800-2 New | 4.8 | Commodity | private |
| SoyTec | SO44046C | 4.9 | Commodity | private |
| Arkansas State University | Osage | V | Commodity | Public |
| Arkansas State University | Ozark | V | Commodity | Public |
| Kansas State University | KS5004N | 5 | Commodity | Public |
| Kansas State University | KS5007sp | 5 | Average linolenic acid concentration of 3% | Public |
| Stine | 0500-0 New | 5 | Commodity | private |
| Hornbeck | HBK C5025 | 5 | Commodity | private |
| Missouri State University | Stoddard | 5.1 | Commodity | Public |
| eMerge Genetics | 528F.Y | 5.2 | Group V YHC | private |
| Stine | 5400-0 New | 5.4 | Commodity | private |
| SoyTec | SO32482 | 5.5 | Commodity | private |
| Kansas State University | KS5502N | 5.5 | Commodity | Public |
| Kansas State University | KS5505sp | 5.5 | Above-average seed size and protein content | Public |
| SoyTec | SO22010 | 5.6 | Commodity | private |
| Hornbeck | HBK C5894 | 5.8 | Commodity | private |
| Ohio State University | HS98-3818 | | low linolenic acid variety | Public |