Friends of the Earth International

tackling gmo contamination

making segregation and identity preservation a reality

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Friends of the Earth International is the world's largest grassroots environmental network, uniting 68 diverse national member groups and some 5,000 local activist groups on every continent. With approximately one million members and supporters around the world, we campaign on today's most urgent environmental and social issues. We challenge the current model of economic and corporate globalization, and promote solutions that will help to create environmentally sustainable and socially just societies.

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EXECUTIVE SUMMARY

Tackling contamination: Implementing segregation and identity preservation strategies

The introduction of GMOs and the ongoing contamination cases have generated huge concern among the public worldwide.

- A ship originating from the United States was impounded in Ireland after its cargo was found to include the experimental Bt10 GM maize not authorized for commercialisation anywhere in the world.
- Other contamination cases such as StarLink maize show how difficult it is to control GMOs once they are released. StarLink was not permitted for human consumption but was found in the US food chain in 2000.
- Despite the efforts of US authorities to remove StarLink, and the calculations of biotech company Aventis that by 2004 it would disappear from the food chain, in 2005 it was again found in food aid sent to Central America.

In this context, the demands to guarantee GMO free production and measures to prevent contamination have continued to grow. In order to keep non-GMO products separated from GMOs it is necessary to implement "segregation", and "identity preservation" strategies.

1. Segregation and identity preservation is nothing new

Identity preservation (IP) in the context of GMOs is defined as a mechanism "to segregate biotech products from non-biotech products or particular varieties with specific biotech traits from other varieties".

- These strategies are not new, and constitute an extension of practices already existing. In fact, segregation and identity preservation of crops has been happening for a number of years, especially in the US.
- The Economic Research Service of the US Department for Agriculture (USDA) considers that "segregation of non-biotech grains and oilseeds is essentially an extension of the handling process for specialty grains and oilseeds, which has been in place for some time".
- The market in the US for speciality crops is growing with the move towards "more product differentiation and segregation in grain and oilseed specialty crops and gradually away from a commodity-based industry".
- Major agribusiness firms like ADM and Cargill are already preparing for a shift from traditional volume-dominated systems to the need to handle smaller quantities of specialised products.

2. Segregation and identity preservation already exists in North America

Existing IP programmes have demonstrated up to 99.9 per cent non-GM corn and non-GM soya purity can be economically achieved. In recent years the market has been sending clear signals that the US grain handling systems need to move towards increasing segregation and IP systems.

Segregation and IP non-GMO systems have been implemented in the US since the end of the 1990s. At present, over 1000 elevators across the US are requiring segregation of GM corn from non-GM corn.

Thanks to the premium offered for non-GM crops, segregation is a good business practice. A 1999 University of Illinois study on speciality corn found that the additional costs of handling non-GM corn were relatively low – around 1 cent per bushel - and that “the average premium margin, however was 5.2 cents, the largest for all the corn crops for which costs could be estimated”. Farmers can benefit from implementing IP systems.

A successful example of identity preservation systems is the organic farming experience.

- Organic farming, which excludes GMOs, constitutes a market that has continued to grow over the last decade, especially in the US.
- The North American market for organic products has the highest growth worldwide, having expanded by 12 per cent to $11.75 billion in 2002, and is expected to generate the biggest global revenue in the future.
- The Canadian market has been reporting growth of 15 to 20 per cent per annum since the late 1990s

Whilst still a small percentage compared with the whole US soybean crop, organic acreage has also increased since 1997. During 1993-1999, premiums for organic grain and soybeans were substantial, exceeding 50 percent for corn and in the case of soya the increase between 1997 and 2001 has doubled: “US growers in 32 States produced over 174,400 acres of certified soybeans in 2001, up 28 percent from the previous year”. Organic soybeans are used more for food uses than conventional soya.

The debate over possible new GM applications has also sent clear market signals compelling segregation and IP for such new products. For example, during the debate over GM wheat in 2003, the Minneapolis Grain Exchange, one of the principal markets for hard red spring wheat, approved a rule to allow takers of future spring wheat deliveries the choice of specifying non-genetically modified wheat in fulfilment of delivery obligations. GM wheat was not the only case.

Despite the biotech industry not favouring the segregation of GM crops today in the marketplace, paradoxically the entire industry is already planning identity preserved systems for what they call the “second wave of agbiotech products”, which are supposed to be based on GM crops with specific nutritional properties.

3. Segregation will not overhaul the US grain system

It has often been argued by the biotech industry that segregation and Identity Preservation for GM crops is unfeasible and too costly, suggesting that the grain systems, such as in the US, will be overhauled by such moves.

Such analysis of the costs of implementing segregation and IP systems are based on a homogenous approach and exaggerated conclusions. This approach is fundamentally flawed since the implementation of IP systems in the US grain handling system will be highly diverse, and the costs will in fact vary, depending on the location, farmer practices, the elevator situation, the size and characteristics of the elevator, the crop etc.

In the particular case of GMOs, some studies indicate that the costs for segregating and implementing IP non-GMO systems will be higher than for speciality crops. On the contrary, current research shows that despite the challenges, the current US grain handling system will not require a radical overhaul in order to meet a 99 per cent purity level for non-GM grains. The Economic Research Service of the US Department of Agriculture has recognized that changing from a commodity system to a more specialised system does “not imply that disarray would occur in the grain marketing system if non-biotech crops were handled on a larger scale”.

GMO testing costs have been put forward by some studies as a major economic block to IP systems. However, the experience with GMO testing shows that the costs are likely to continue to fall.

- Testing corn imports has become routine in the US, particularly after the StarLink discovery, and is currently done extensively for Bt10 maize.
- In 2000 lateral flow tests for StarLink cost around $9 retail. This test now costs just $3.50.
- Similarly, DNA tests for StarLink once cost as much as $300 but can now be conducted for under $100.

Despite the ongoing challenges of keeping GM and non-GM crops separate there are diverse strategies that can be implemented to secure adequate IP for non-GM crops, and many of those will not necessarily represent a radical change in current practices.

4. Who pays the costs?

Who should pay for the costs? The GMO producer? The non-GMO farmer? The IP non-GMO operator? The GMO farmer? Importing countries?

Some studies suggest that the main costs would fall on consumers who decide to purchase non-GM products, and on importing countries primarily, due to the effort required to preserve the identity of the non-GM product by keeping it separate from the GM product. Such assumptions are both hypothetical and fundamentally flawed.

In the current world situation it is very difficult to predict how acceptance of GMO food and non-GMO food markets will evolve. It is important to recall that:

- Only 2 countries (the US and Argentina) account for 84 per cent of all GM crops commercially grown in the world.
- Most countries are in the process of building their national biosafety frameworks and all importing countries have the capacity to regulate environmental and human health risks through comprehensive biosafety requirements. It is highly possible that such requirements will move towards shifting the burden of the costs from importing to exporting countries.
- The burden of the costs can be shifted to the GMO producer if, for example, in a country or region the GMO acceptance is low, and the grain handling system is

mostly IP non-GMO based.

GMO exporting countries, the biotech giants and operators exporting crops from North America are already paying the bill for IP mechanisms to guarantee that StarLink and Bt10 are kept out of the food and feed supply in Japan and Europe.

The case of the StarLink recall operation, which cost over one billion dollars, clearly shows that "although effective product differentiation systems may be costly to develop and run, they are cheaper than failure". This is a fundamental aspect that is forgotten in many of the studies that analyse the costs of segregation.

Failures like StarLink and Bt10 are very costly and in the light of the weak regulatory framework in most GMO producing countries, are likely to happen again. The cost-benefit analysis of implementing segregation and IP non-GMO and traceability systems against the cost of failures needs to be taken into account in future studies.

In this context, it cannot be predicted with certainty which stakeholder will absorb the costs for identification, monitoring and testing. Therefore, at present there is not a simple homogeneous answer when it comes to knowing who will pay for the costs.

5. Monsanto pays millions to defend its patents rights

The biotech industry has always opposed labelling and segregation requirements for any of the GM crops on the market today. The industry considers those products as equivalent to existing conventional crops and therefore there is no need for labelling to differentiate them from non-GM products.

Paradoxically, Monsanto has implemented a multi-million dollar "GMO Monitoring and Testing Programme" that looks for their patented genes in farmers' fields in order to find out whether farmers have been illegally planting Monsanto's crops.

Monsanto has been brutally enforcing the technology agreements on American farmers by building "*a department of 75 employees and setting aside an annual budget of $10 million for the sole purpose of investigating and prosecuting farmers for patent infringement*". At present Monsanto has filed 90 lawsuits on the basis of violations of the technology agreement and seed patent, involving over 140 farmers and 39 small businesses and farm companies.

Although the biotech giants claim that, "GM crops are not different from conventional counterparts", when it comes to patents and claiming their royalties, GM crops are indeed different and constitute an "innovation".

These monitoring and testing programmes are not only implemented in North America but also in Southern countries. For example the company has established a system in which over 95 per cent of the grain elevators in two Brazilian states (Rio Grande de Sul and Santa Catarina) test soybeans for the presence of Monsanto's traits. If detected, the elevator must pay a technology fee to Monsanto. The company plans to implement similar models in other countries, clearly showing the will of Monsanto to establish tough monitoring and testing mechanisms to implement its patenting rights worldwide.

6. The urgent need to protect consumer and farmers' rights

A system of segregation and identity preservation will help to protect and guarantee the right to choose for consumers and farmers in North America. US consumers have clearly stated over the past years their desire to have GMO food clearly labelled and the US Government should not continue to ignore their demands.

There is an urgent need to protect innocent farmers and farm businesses from legal liability for the presence of genetically engineered material in their crops without their knowledge and beyond their control. Friends of the Earth contends that no farmer should be liable for any injuries, claims, losses and expenses, including attorney's fees, caused by the use of a GM crop or part of it, including damages for patent infringement.

It is time to change the burden of the costs for segregation and IP so that Monsanto and other biotech giants cover the costs of their pollution, and are held responsible for the costs related to undesired GM contamination.

A compensation fund paid for by the main biotech giants could be one of the mechanisms that could be explored as a way to shift the burden of the costs of contamination away from conventional and organic farmers.

Legal mechanisms to shift the burden of costs to the polluters are needed to protect non-GMO farmers from losses associated with contamination. There must also be recourse for any farmer to take legal action against the company responsible for any losses caused by the contamination.

Recommendations

Friends of the Earth International urges Parties Governments to take into consideration the following recommendations:

- Governments should promote the establishment of segregation and Identity Preserved systems. Any country that produces/handles GM crops must guarantee measures to prevent GMO contamination and to keep GM crops separated from non-GM products.

- Governments should support the establishment of comprehensive identification documentation for all GM events in a GMO shipment. Failures such as StarLink and Bt10 clearly prove that GM events should be traceable throughout the grain handling system and the food chain. All exporters of GM crops or GMO materials should clearly state in the accompanying documentation that "This product contains GMOs", and provide a detailed list of the GMOs included.

- Governments should request that all exporters guarantee the absence of GMOs not approved either globally or in the country of import. Illegal GMOs should not be present anywhere in the global food chain. This is particularly the case for StarLink, Bt10 and any experimental GM crops not commercialised. All regulators should require means of identifying a GMO prior to allowing any field test (prior to commercialisation). Such requirements would mean that competent authorities could inspect and enforce segregation and labelling issues, as well as detect contamination.

- Governments should enact legal mechanisms that shift the burden of contamination to the polluters. The costs of losses derived from contamination from GM crops should fall on the polluters and not on the non-GM farmers or importing countries. Countries should enact legislation that ensures that farmers are not punished for contamination due to cross-pollination, and that allows recourse for any farmer suffering contamination to take legal action against the company responsible. International mechanisms to shift the burden of costs to the polluters should be explored, such as a compensation fund paid for by the biotech industry.

TACKLING GMO CONTAMINATION: MAKING SEGREGATION AND IDENTITY PRESERVATION A REALITY

I. GMO contamination around the world: From StarLink to Bt10

1. Introduction - GM crops and world trade today: a handful of biotech giants and countries

Global agriculture today is concentrated on just a few crops. According to the Food and Agriculture Organization of the United Nations (FAO), just four crops account for around 50 per cent of the world's arable land use: maize, wheat, rice, and soya. Another four: barley, sorghum, canola and cotton, constitute an additional 15 per cent of the total cultivated acreage of the planet. Just a few key countries (United States, Argentina, Australia, Brazil, Canada, China and the European Union) export most of the key crops that are commercially traded around the world[1].

In recent years four of those main crops, particularly soya, maize, cotton and canola, have been genetically modified (GM) and aggressively introduced into the world market. Just two countries, namely the US and Argentina, and a handful of multinational corporations have propelled GM crops and food into the marketplace. The US and Argentina today account for 84 per cent of all GM crops commercially grown on the planet, followed by Canada, Brazil and China (14 per cent). According to industry sources, soya, maize, cotton and canola constitute 99 per cent of the whole acreage of GM crops, with soya alone covering 60 per cent of the total area[2]. Three companies: Monsanto, Syngenta and Bayer, account for virtually all GM crops commercially released in the world[3]. The products of one company alone, Monsanto, account for over 90 per cent of the total area cultivated with GM crops[4].

In 2004, it was estimated that out of the 86 million hectares of soybean planted globally, 56 per cent were GM; of the 32 million hectares of cotton planted 28 per cent were GM; and of the 140 million hectares of maize grown globally 14 per cent were GM[5].

Numerous cases of contamination of non-GM crops by unauthorised, illegal or undesired GM crops have occurred following the introduction of genetically modified organisms (GMOs) into the environment. From Europe to North America, Asia to Latin America, once a GMO is released contamination has no boundaries. The contamination cases we see today are of huge concern, particularly because the contamination we know about is probably just the tip of the iceberg in comparison to that which we do not yet know.

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[1] Kalaitzandonakes, N. 2004. *The potential impacts of the biosafety Protocol on Agricultural Commodity trade*. International Food and Agricultural Trade Policy Council. IPC Technology Issue Brief. December 26

[2] ISAAA. 2004. *Global Status of Commercialized Biotech/GM crops:* 2004. Executive Summary. http://www.isaaa.org/kc/CBTNews/press_release/briefs32/ESummary/Executive%20Summary%20(English).pdf

[3] Innovest Strategic Value Advisors. 2005. *Monsanto and Genetic Engineering: Risks for Investors. Analysis of company performance on intangible investment risk factors and value drivers.* Innovest. January 2005. http://www.innovestgroup.com/pdfs/2005-01-01_Monsanto_GeneticEngineering.pdf

[4] Monsanto. 2004. *Setting the Standard in the field*. Annual Report. http://www.monsanto.com/monsanto/content/media/pubs/2004/2004_Annual_Report.pdf

[5] ISAAA. 2004. Op. cit.

2. The StarLink scandal

StarLink was a variety of GM maize authorised in the United States for animal feed purposes only. It was not authorised for human consumption as food because of the potential allergenicity of the protein Cry9C that was genetically engineered into the maize[6]. Nevertheless, in 2000 StarLink was discovered in 'Taco Bell' taco shells, a maize-derived food product eaten in the US. StarLink moved into the human food chain.

The magnitude and gravity of the StarLink contamination was breathtaking. More than 300 corn products were recalled across the United States. Despite the fact that StarLink was only planted on 0.4 per cent of total US corn acreage, the number of acres contaminated was much greater. More surprisingly, the contamination was not confined to just StarLink-branded seeds. It was later reported that the Cry9C protein was found in 80 varieties of yellow corn seed, and even more unexpectedly, in a white corn product, although it was previously believed that contamination could only happen between varieties of yellow corn[7]. After the discovery, the US Department for Agriculture (USDA) called on Aventis to purchase the entire StarLink crop for the year 2000 and instructed seed distributors to stop sales of StarLink for planting in 2001[8]. Shortly thereafter, the company agreed to cancel the registration of StarLink so that it could no longer be legally sold or planted[9].

StarLink contamination was not contained within the US, but was also detected in 2000 and 2001 in food shipments to Japan and South Korea[10]. This led to a series of recalls in these countries as well, and an immediate decline in Japanese exports. Since sales of US corn to Japan represent 30 per cent of all US corn exports, Japan requested assurances that StarLink would be kept out of the food chain. Certification of "StarLink free" was required for corn exports to Japan where Japanese inspectors monitored and tested feed corn shipments (See Annex I)[11].

At the June 2002 United Nations World Food Summit in Rome, Latin American NGOs announced that StarLink had been found in US food aid in Bolivia. In February 2005 the presence of StarLink in Central American food aid was also denounced[12]. Five years after its discovery in the human food chain, StarLink still persists, thereby contradicting industry projections for full withdrawal within four years[13]. The StarLink case underlines the unpredictability of releasing a GMO into the environment and the failure on the part of GMO developers to restrict contamination.

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[6] Friends of the Earth US. Regulatory History of StarLink corn. http://www.foe.org/camps/comm/safefood/gefood/foodaid/StarLink_regulatory_history.pdf

[7] Friends of the Earth US. Chronology of the Exposé of Genetically Engineered StarLink™ Corn Not Approved for Human Consumption. http://www.foe.org/camps/comm/safefood/gefood/foodaid/news.html

[8] USDA. 2000. StarLink Corn. The USDA and the EPA. Washington, September 29, 2000. http://allergies.about.com/library/blusdanews-starlink.htm

[9] Segarra, A., Rawson, J. 2001. StarLink Corn Controversy: Background. CRS Report for Congress. January 10, 2001. http://www.ncseonline.org/nle/crsreports/agriculture/ag-101.cfm

[10] Friends of the Earth International. 2002. GMO Contamination around the world. http://www.foei.org/publications/pdfs/contamination2eng.pdf

[11] Segarra, A. Rawson, J. 2001. op. cit.

[12] Alianza Centroamericana de Protección a la Biodiversidad. 2005. World Food Programme and the United States denounced for the distribution of genetically modified organisms in Central America and the Caribbean. February 16. http://www.humboldt.org.ni/transgenicos/denuncia_englishfeb16.htm

[13] Segarra, A, Rawson, J. 2001. op. cit.

3. Biopharmaceuticals

The US experience provides another example of a major concern for the environment: "biopharmaceuticals". "Biopharming" is an experimental application of biotechnology in which plants are genetically engineered to produce pharmaceutical proteins and chemicals that they do not produce naturally[14]. A few known examples include a contraceptive, potent growth hormones, a blood clotting agent, blood thinners, industrial enzymes, and vaccines.

In November 2002, the first significant case of contamination by biopharmaceuticals was reported[15]. The company involved, ProdiGene, conducted a range of open-air tests of crops containing pharmaceuticals and industrial products. In this incident, ProdiGene failed to properly remove all of the maize remnants from a field cultivated in 2002. Consequently, some seed remained in the ground, and these "volunteer" seeds germinated in 2003, contaminating a crop of soya. When the soya had been harvested and was at a grain elevator in Nebraska, it was discovered that it had been contaminated by the ProdiGene maize. Five hundred thousand bushels of soya worth some $2.7 million were quarantined by the US Department of Agriculture and later ordered to be destroyed.

> **"In the absence of demonstrated effective controls and procedures to ensure against any contamination of the food or feed supply, National Food Processors Association (NFPA) vigorously opposes the use of food or feed crops to produce plant made pharmaceuticals"**
>
> Dr. Rhona Applebaum, NFPA's Executive Vice President and Chief Science Officer.

It should take no more than this one case to prove that open-air cultivation of biopharm crops threatens global food supplies, jeopardises non-biopharm crops with contamination and may pose potential problems for wildlife and ecosystems, not to mention human health. In the US, some 300 cases of open-air cultivation have occurred between 1991 to 2002, but only seven environmental assessments were carried out.

Strong opposition from consumer groups, the food industry, and a growing number of scientists can take credit for a drop from a peak of 42 field trials in the US in 2000 to just 6 in 2003[16]. In April 2005 new plans to introduce biopharm rice in Missouri were abandoned due to the opposition of Anheuser-Busch, the world's largest beermaker[17]. Nevertheless BIO, the umbrella organization of the US biotech industry, still supports the development of these types of crops[18], despite the demonstrated contamination risks and the failure of plant-based "biopharming" to deliver even one FDA-approved drug

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[14] Friends of the Earth US. Manufacturing Drugs and Chemicals in Crops: Biopharming Poses New Risks to Consumers, Farmers, Food Companies and the Environment. http://www.foe.org/biopharm/qanda.html

[15] Friends of the Earth US. 2000. Reckless USDA Policy Fails to Keep Biopharmaceuticals out of Food Supply Coalition Calls on the USDA for Contamination Information Including Name of Drug or Chemical Being Withheld. November 13, 2002 http://www.foe.org/new/releases/1102biopharm.html

[16] Nature Biotechnology. 2005. Drugs in crops—the unpalatable truth. February 2004, Vol. 22, Number 2, p. 133. http://www.nature.com/cgi-taf/DynaPage.taf?file=/nbt/journal/v22/n2/full/nbt0204-133.html; NFPA. 2003. "No Use of Food or Feed Crops for Plant-Made Pharmaceutical Production Without A '100% Guarantee' Against Any Contamination, Says NFPA," National Food Processors Association, Feb. 6, 2003; Grocery Manufacturers of America. 2003. GMA says stringent FDA and USDA bio-pharma regs needed to maintain food supply purity. February 6, 2003. http://www.gmabrands.com/news/docs/NewsRelease.cfm?DocID=1063

[17] St Louis Post Dispatch. 2005. Biotech firm puts off rice crop here. 2005. 28 April 2005

[18] BIO. 2005. Plant-made pharmaceuticals background and key points. http://www.bio.org/healthcare/pmp/keypoints.asp

over the past 14 years.

4. Bt10: experimental transgenic corn contaminates food supply for four years

Bt10 is a variety of GM corn developed by Syngenta for experimental purposes but never commercialised. In March 2005, it became known that, by mistake, hundreds of tonnes of Bt10 were distributed by Syngenta to farmers between 2001 and 2004[19].

Syngenta initially claimed that Bt10 was identical to the previously approved Bt11 corn, but were later forced to admit that Bt10 contained a marker gene conferring resistance to ampicillin, a commonly used antibiotic[20]. The Europe Food Safety Authority (EFSA) has recommended that these types of antibiotic resistance marker genes "should not be present in genetically modified plants placed on the market"[21]. Ampicillin is widely used to tackle infections of the middle ear, sinuses, bladder, kidney, meningitis and other infections and one of the concerns is that the consumption of Bt10 will lead bacteria in the stomach to pick up the resistance gene and become resistant to the antibiotic, making it less effective against infections[22].

In Europe it became known that approximately one thousand tonnes of the unapproved biotech corn strain had been imported from the US into the EU since 2001. As with Japanese measures taken in the case of StarLink in 2000-2001, the European Union introduced strict requirements on corn products from the US. On 15 April 2005, the EU voted to introduce emergency measures restricting the import of GM feed corn from the US, requiring all imports to be accompanied by certification that the import is free of the illegal GM corn Bt10[23]. The measures require that "consignments of corn gluten feed and brewers grain from the USA can only be placed on the EU market if they are accompanied by an analytical report by an accredited laboratory which demonstrates, based on a suitable and validated method, that the product does not contain Bt10". This means that at present any ship originating from the US containing maize gluten feed and brewers grain derived from maize is obliged to provide an original analytical report demonstrating that the product does not contain Bt10 maize[24].

On 25 May 2005, the European Commission notified that it confirmed the presence of Bt10 in a US shipment of animal feed to Irish ports[25].

II. Tackling contamination: Implementing segregation and identity preservation strategies

[19] Nature. 2005. US launches probe into sales of unapproved transgenic corn. 22 March; Nature. 2005. Stray seeds had antibiotic-resistance genes. 29 March.

[20] Nature. 2005.Stray seeds had antibiotic-resistance genes. op. cit.; Syngenta. 2005. Backgrounder on Bt10. http://www.syngenta.com/site/savedialog.aspx?file=/en/downloads/050427_Bt10_Backgrounder.pdf

[21] European Food Safety Authority. 2005. EFSA provides scientific support to the European Commission on issues related to the safety of Bt10 maize. 12 April http://www.efsa.eu.int/press_room/press_statements/884/efsa_statement_bt10maize_en1.pdf

[22] BRIDGES Trade BioRes, Vol. 5 no. 7, 15 April 2005

[23] European Commission. 2005. Bt10: Commission requires certification of US exports to stop unauthorised GMO entering the EU. 15 April 2005

[24] Syngenta. 2005. EU Certification measure. 26 April 2005 http://www.syngenta.com/site/savedialog.aspx?file=/en/downloads/050427_Bt10_certification.pdf

[25] European Commission. 2005. Bt10: Ireland notifies contaminated consignment stopped in port. Press Release IP/05/608. 25 May

1. Segregation and identity preservation is nothing new

The introduction of GMOs and the ongoing contamination cases have generated huge societal concern worldwide. Requests to guarantee GM free production and measures to prevent contamination continue to grow. After the StarLink debate many experts, among them former US Secretary of Agriculture Dan Glickman, said that "agriculture must do a better job of segregating GM crops from conventional varieties"[26].

In order to keep non-GM products separated from GMOs it is necessary to implement "segregation", and "identity preservation" strategies[27]. The USDA Advisory Committee on Biotechnology and 21st Century Agriculture (AC21) has defined identity preservation in the context of GMOs as a mechanism "to segregate biotech products from non-biotech products or particular varieties with specific biotech traits from other varieties"[28]. In the case of GM crops the IP system needs to extend from the breeder right up to the retailer. This is necessary in order to guarantee that consumers are provided with information about the provenance of the product, even when it is not visible or detectable in the product itself[29].

HANDLING SPECIALTY CORN AND SOYBEANS IN ILLINOIS

"Of the firms/locations handling specialty corn or soybeans in 1998, 66 percent indicated that they made no special or additional investment to handle specialty crops. Of the 68 firms providing information about the type of equipment added, 62 had added near infra-red testing equipment, three had added equipment to test for stress cracks, two had acquired an iodine test, and one had added a slotted screen test. For country elevators, most indicated that they devoted a particular location for receiving, storing, and handling a specialty crop, avoiding additional investment for handling or storage facilities. Fifteen percent of the firms indicated they added or remodelled storage space, while 10 percent invested in training of personnel to test or handle specialty crops"

Source: Good et al.

These strategies are not new, and constitute an extension of existing practices[30]. The Economic Research Service of USDA considers that "segregation of non-biotech grains and oilseeds is essentially an extension of the handling process for specialty grains and oilseeds, which has been in place for some time"[31].

2. Experiences in the US with handling of specialised crops

The market in the US for speciality crops is growing with the move towards "more product differentiation and segregation in grain and oilseed specialty crops and

[26] Roseboro K. 2001. IP Systems – the wave of the future. Seed World March 2001. Vol. 139 n. 3. http://www.seedworld.com/sw/index.cfm/powergrid/rfah=%7Ccfap=/fuseaction/showArticle/articleID/2253
[27] USDA-ERS. 2000. US grain handlers look ahead. Agricultural Outlook. April 2000
[28] USDA Advisory Committee on Biotechnology and 21st Century Agriculture (AC21). 2005. Global Traceability and labelling requirements for agricultural biotechnology-derived products: impacts and implications for the United States. http://www.usda.gov/wps/portal/usdahome?contentidonly=true&contentid=event_15.xml
[29] Smyth S & Phillips P. 2002. Product differentiation alternatives: Identity preservation, segregation, and traceability. AgBioforum. http://www.agbioforum.org/v5n2/v5n2a01-smyth.htm
[30] USDA-ERS. 2000. op. cit; Economic Research Service/USDA. 1999. Value-Enhanced Crops: Biotechnology's Next Stage. Agriculture Outlook. March 1999.
[31] Economic Research Service/USDA. 2000. Segregating non-biotech crops: What could it cost?. Agriculture Outlook. April 2000

gradually away from a commodity-based industry"[32]. Major agribusiness firms have been preparing for market shifts from traditional volume-dominated systems to the need to handle smaller quantities of specialised products[33]. For example, as early as 1998 Archer Daniels Midland, one of the largest grain firms in the world, recognised that "growing, handling and transporting crops on an identity-preserved basis will become an increasingly large part of the domestic and export grain market"[34].

A 1999 survey of country elevators, river elevators, brokers, speciality grain firms, truckers and feed firms in Illinois identified that 25 percent of country elevators located in Illinois were involved in handling speciality corn and soybean crops[35]. Excluding speciality crop firms, speciality crops represented on average around 15 to 17 per cent of the total volume of crops handled in 1998, although for some individual elevator locations they represented 100 percent of the volume handled[36].

3. Segregation of GM crops: the experience in North America

As we have seen, segregation and identity preservation of crops is a well developed system for handling speciality crops. Segregation and IP non-GMO systems have also been implemented since the end of the 1990s.

Over 1000 elevators across the US are requiring segregation of GM corn from non-GM corn. The American Corn Growers Foundation conducted a survey of 1194 grain elevators across the US in 2004 and found that nearly one-quarter (23.7 per cent) reported that they are requiring segregation of GM corn from non-GM corn varieties. Over twelve per cent (12.6 per cent) reported offering premiums for non-GM, conventional corn varieties over GM varieties, ranging from five to thirty cents per bushel[37]. While the level of purity of non-GM systems can be a concern, in fact, suppliers of IP non-GM grain, for example Clarkson Grain, utilise IP Programmes that can provide 99.9 per cent non-GM corn and soya[38]. Clarkson Grain started supplying organic grains and oilseeds to Japan in 1991 and today operates more than 25,000 tons of dedicated commercial organic storage.

[32] Miranowski J, Jensen H, Batres-Marquez S, Ishdorj A.. 2004. Product differentiation and segregation in agricultural systems: non-genetically modified and specialty corn and soybean crops in Iowa. Center for Agricultural and Rural Development Iowa State University. Working Paper 04.WP 354. http://www.card.iastate.edu/publications/DBS/PDFFiles/04wp354.pdf

[33] Economic Research Service/USDA. 1999. Value-Enhanced Crops: Biotechnology's next stage. Agricultural Outlook/March 1999.

[34] Ibid

[35] Good D, Bender K, Hill L. 2000. Marketing of Specialty Corn and Soybean crops. Department of Agricultural and Consumer Economics. College of Agricultural, Consumer and Environmental Sciences. University of Illinois at Urbana-Champaign. March. http://web.aces.uiuc.edu/value/marketingspecialty.pdf. The report says that: "A total of 1030 grain handling locations were identified, with 88 percent being country elevators. Of those locations, 255 were handling specialty crops in 1999. Other than specialty crop firms, river elevators and brokers had the highest percentage of locations handling specialty crops".

[36] Good et al. 2000. op. cit.

[37] ACGA. 2004. Survey of 1000 plus grain elevators shows 24 percent require GMO corn segregation, 12 percent offer premiums for non-transgenic corn. Monday October 25.

[38] Clarkson Grain Co., Inc home page: http://www.clarksongrain.com/2002CGweb_files/page0003.htm

The non-GMO soybean market has been spurred on by consumer concerns in Japan and Europe about the long-term safety of GMO crops and food products. Approximately 14 million acres of non-GMO soybeans are now under production in the United States. The marketing of non-GMO soybeans is dependent on local processing demand and available to anyone who has kept non-GMO soybeans identity preserved (IP). Producing non-GMO soybeans may or may not require on farm storage. Premiums generally range from $0.25 to $0.50 per bushel over Chicago Board of Trade prices.

Source: Illinois Specialty Farm Products. 2003. Non-GMO Soybeans. http://web.aces.uiuc.edu/value/factsheets/soy/fact-nongmo-soy.htm

The market has already acknowledged the need for methods to create and preserve the identity of non-genetically modified seeds and grains. For example, an international patent filed at WIPO for an identity preservation method for non-GMO says that "the prevalence of genetically altered products has given rise to a market for non-genetically modified seeds, grains, and processed products created therefrom"[41].

"If specifically requested in writing by the taker of delivery at the time load-out instructions are submitted, elevators regular for deliver of Hard Red Spring Wheat shall provide a certificate stating the wheat delivered meets the standards established by the Board of Directors by Resolution for non-genetically modified wheat."

Rule 803.02 Minneapolis Grain Exchange Board of Directors

Marketplace demands for segregation include GM products not yet commercialised. Clear market signals have compelled segregation and IP even before a particular GM technology was introduced. For example, during the debate over GM wheat in 2003, the Minneapolis Grain Exchange, one of the principal markets for hard red spring wheat, approved a rule to allow takers of spring wheat futures deliveries the choice of specifying non-genetically modified wheat in fulfilment of delivery obligations[42]. GM wheat has not been the only case. Despite opposition within the biotech industry for segregation of GM crops, paradoxically the entire industry is already planning identity preserved systems for what they call the "second wave of agbiotech

[39] Good et al. op. cit.

[40] Bullock D, Desquilbet M, Nitsi E. 2000. The Economics of Non-GMO Segregation and Identity Preservation. October 21, 2000.

[41] WIPO. 2000. International Patent Application. International Publication Number: WO 00/48454. 24 August 2000 http://www.wipo.int/ipdl/IPDL-CIMAGES/images3.jsp?WEEK=34/2000&DOC=00/048454&TYPE=A1&TIME=1117032524

[42] Minneapolis Grain Exchange. 2003. Minneapolis Grain Exchange board of Directors approves rules allowing spring wheat delivery takers the choice of specifying non-genetically modified wheat. News Release. May 9, 2003

products" based on GM crops with specific nutritional properties[43].

4. The market for organics

Organic farming excludes GMOs. Organic agriculture is growing in the US, with certified organic acreage increasing and markets for products expanding. In 1991 seven per cent of all organic products in the US were sold in conventional supermarkets, but by 2000 this had increased dramatically to 49 per cent. A recent USDA report noted that "organic products are now available in nearly 20,000 natural food stores and 73 percent of conventional grocery stores, and account for approximately 1-2 per cent of total food sales in the US"[44]

Reports of approximately 24 million hectares now under organic management combined with a growing market valued at $23 billion show the magnitude of consumer demand[45]. The North American market for organic products has the highest growth worldwide, having grown by 12 per cent in 2002 to $11.75 billion in sales of organic food. The US market is expected to account for most global revenues in the future[46]. While the US market is the biggest in North America, the Canadian market has reported growth of 15 to 20 per cent per annum since the late 1990s[47]. A Whole Food Market survey in 2004 indicated that "54 per cent of US consumers have tried organic foods, and that 14 per cent of the US population consumed more than in the prior year,… that nearly 1 in 10 Americans consume organic products regularly (several times per week)"[48].

Organic acreage of soybean has undoubtedly increased since 1997[49]. Between 1993 and 1999 premiums for organic grain and soybeans were substantial, exceeding 50 per cent for corn and soybeans[50]. Though only 0.12 and 0.24 per cent respectively of the top US crops, corn and soya, were grown under certified organic farming systems, it must be noted than in the case of soya the rate of increase between 1997 and 2001 doubled: "US growers in 32 States produced over 174,400 acres of certified soybeans in 2001, up 28 percent from the previous year", with organic soybeans specified more for food uses than conventional soya[51].

The USDA Foreign Agricultural Service (FAS) estimates organic food exports from the US in 2002 were between $125 million and $250 million, with soybeans one of the largest export categories for organic foods[52]. Continuing market growth is expected for processed products such as baby food; sales of organic baby food in 1999 comprised 4.5 per cent of all baby food sales for that year[53].

[43] Stave. J., Durandetta, D. 2000. GM Crop testing grows amid controversy. Today's Chemist at work. Vol. 9. June 2000.
[44] Dimitri, C., Green, C. 2002. Recent Growth Patterns in the US Organic Foods Market. Agriculture Information Bulletin No. (AIB777) September 2002. http://www.ers.usda.gov/publications/aib777/
[45] BioFrach, FIBL, SOL. 2004. The World of Organic Agriculture 2004-Statistics and Future Prospects, February 2004. www.soel.de/inahlte/publikationen/s/s_74.pdf
[46] Ibid
[47] Ibid
[48] Oberholtzer, L, Dimitri, C, Greene, C. 2005. Price premiums hold on as US organic produce market expands. USDA Economic research service. May 2005. http://www.ers.usda.gov/Publications/vgs/may05/VGS30801/
[49] Dimitri, C., Greene, C. 2002. op. cit.
[50] Greene, C., Kremen, A. 2003. US. Organic Farming in 2000-2001: Adoption of Certified Systems. Agriculture Information Bulletin. April 2003
[51] Ibid
[52] Ibid
[53] Dimitri, C., Green, C. 2002. op. cit.

5. Will segregation overhaul the US grain system?

Segregation of GM crops is possible and feasible[54]. In fact as we have seen, though yet on a small scale, it is already implemented in the United States. The shifting from a predominantly grain commodity marketing system to an increased identity preserved system will entail additional costs along the supply chain. As the USDA AC21 describes it: "With such supply chains involving specific grain sourcing and special programs to avoid commingling of sourced grain with bulk commodity grain, the fungibility of the product and the flexibility of the production systems are reduced and increased costs are absorbed somewhere along the supply chain."[55] However, it is important to acknowledge that the implementation of IP non-GMO systems does not necessarily mean that the costs will be significantly higher for all the actors along the supply chain, and for all the crops. In fact the costs will vary depending on location, farming practices, elevators etc. There is still no solid economic model to comprehensively analyse the costs of developing IP non-GMO systems for the multiplicity of situations that will influence the costs of segregation and IP strategies.

The experience with IP systems for speciality grains in the US has shown that it has led to some changes in the US grain handling infrastructure, but these changes have been relatively small[56]. However, current available studies indicate that the costs for segregating and implementing IP non-GMO systems will be higher than for speciality crops. But this should not be interpreted as meaning that the IP non-GMO measures will radically alter all the steps of the current grain-handling system[57]. A University of Illinois study about the economics of segregation and identity preservation supports this latter hypothesis and identifies the challenges in the process of securing segregation and preventing contamination. The study analyses in detail the different steps in any IP process and identifies the most and least challenging issues for costs and operational factors in moving to an IP non-GMO system. The study clearly shows that the costs cannot be assumed to be the same for all operators in a homogeneous way, but will vary depending on the geographical area, the farming practices, the elevator situation, the size and characteristics of the elevator, the crop, etc. In fact the study conclusions suggest that implementing IP non-GMO strategies may trigger only modest additional costs in the grain handling system as described below:

- Maintaining non-GM purity on the farm. To secure non-GM purity on the farm while planting, "the costs of the farmer of keeping the planter sufficiently clean to assure adequate non-GMO purity do not seem especially high", and some practices are suggested in which the planter will not need to be cleaned any more than under conventional practices[58].

- Maintaining purity during harvest. The study also concludes that few additional costs are expected for soybeans since soybeans do not cross pollinate[59]. However, in the case of corn, the costs of keeping out contamination and

[54] ERS/USDA. 2000. Segregating non-biotech crops: what could it cost? op. cit.
[55] AC21. op. cit.
[56] Bullock, D et al. 2000. op. cit.
[57] ERS/USDA. 2000. op. cit.
[58] Bullock, D. Et al. 2000. The Economics of Non-GMO Segregation and Identity Preservation. October 21, 2000. To back this the report indicates that "first of all, a farmer could simply choose to produce all non-GM or all GM grain, in which case the planter would need to be cleaned any more than under conventional practices"
[59] Ibid

preventing cross-pollination with neighbouring GM corn varieties will be more challenging.

- Transportation off the farm. With regard to transportation off the farm after grain is harvested, in principle "keeping trucks sufficiently clean to maintain adequate non-GMO purity would not entail much cost". However the costs can increase if delays are produced in the harvesting due to longer queues in the country elevators due to, for example, GMO testing.

- County elevators. After the truck with grain arrives at the elevator, the costs of segregation may vary significantly among the different elevators. Some elevators could manage facilities to distinguish GM and non-GM at relatively low cost. Moreover, specialisation across elevators, with some handling biotech, others non-biotech, could result in fewer costs to the handling system. Country elevators in the US are already dedicating some elevators as GMO storage only and others as non-GMO. Some elevators have facilities with multiple grain paths, thereby dedicating separate paths for GMOs and non-GMOs. Newer elevators and those under construction are taking into consideration the new needs of segregation and identity preservation[60].

- The export of bulk corn or soybeans. The export of bulk corn or soybeans can be received by export elevators via barge, train or truck, and US law already obliges all ship holds to be cleaned between shipments. Thus, "maintaining the identity of non-GM grains in barges and ocean going vessel holds, which are already cleaned between each shipment, does not entail much additional cost". As with country elevators, river elevators can dedicate separate grain paths to non-GM and GM grains, and some of them have already begun segregating.

"In fall 1999 an export elevator owned by the Andersons company near the mouth of the Maumee River at Lake Erie near Toledo, Ohio loaded a one-million bu ocean-going vessel with non-GM soybeans, which had been segregated and identify preserved. The destination of the shipment was Japan, where the beans were to be processed to make tofu for human consumption. Sample testing of the grain after it was loaded on the ship suggested that 98-99% of the soybeans were indeed non-GMO".

Source: Bullock D et al. 2000.

One of the most challenging steps in the process, and that which may entail more difficulties for the non-GMO farmer, is the prevention of cross-pollination from GM crops, particularly in the case of corn. Multiple strategies or a combination of these to prevent cross-pollination can be implemented, such as isolation zones, improvement of communication with neighbouring farmers, etc[61]. The Grain Quality Task Force of Purdue University describes some important elements for pollen drift control for farmers in Indiana:

> "Farmers should find out what corn hybrids will be planted adjacent to their fields of non-transgenic corn, and document the hybrid seed lot information and planting dates. In Indiana the risk of pollen drift is greatest from fields of corn planted to the southwest of the field in question because of the direction of the prevailing winds of mid-summer. Taking the time to note the dates of pollen

[60] Ibid
[61] Ibid

shed in your field and adjacent fields will help you determine the relative risk of pollen drift.

The risk of pollen drift from neighbouring transgenic corn fields may require the harvesting and segregation of a certain amount of corn around the perimeters of a non-transgenic field, certainly no less than 660 feet from the field edge. Corn harvested from those buffer strips should be fed on the farm or channelled to elevators willing to accept transgenic corn".[62]

Another important element of the IP non-GMO system will be the implementation of monitoring and testing strategies for GMOs which will create additional costs. Different testing methodologies are available and prices of detection technologies have declined progressively in the last four years. For example, lateral flow tests for StarLink cost around $9 retail in 2000, but cost $3.50 per test today. DNA tests for StarLink once cost as much as $300, but may now be conducted for under $100. In the future, technological improvements of testing methods will continue to bring testing costs down. Testing corn imports has become routine in the US, becoming particularly intense after the StarLink discovery, and reinforced by the current Bt10 discoveries in Europe. The US Government and many operators have been implementing testing and monitoring activities for the last five years.

Despite the challenges, the study from the University of Illinois concluded that the current US grain handling system will not require a radical overhaul in order to meet a 99% purity level for non-GM grains. The study found that the current US grain handling system will not require a new infrastructure, but rather a "reshuffling" of elevator uses, such as using multiple bins and separate facilities for IP grains[63]. Even the Economic Research Service of the USDA has recognised that the challenges of changing from a commodity system to a more specialised system "do not imply that disarray would occur in the grain marketing system if non-biotech crops were handled on a larger scale"[64]. Despite the ongoing challenges of keeping GM and non-GM crops separate, there are multiple and diverse strategies that can be implemented to secure adequate IP for non-GM crops, many of them consistent with current best practices.

[62] Grain Quality Task Force Purdue University. 2001. GMO Issues facing Indiana Farmers in 2001. April 4, 2001.
[63] Bullock, D et al. 2000, op. cit..
[64] ERS/USDA. 2000. Segregating non-biotech crops: what could it cost?

III. Making segregation and identity preservation a reality: who pays for the costs?

1. The debate over costs and who will pay for it

Two key costs associated with the IP systems must be differentiated: there are costs to prevent the commingling of GMOs and non-GMOs, such as preventing cross-pollination, cleaning farm equipment, handling, transportation, etc. and there are costs to ensure the accuracy of the non-GM claim, like testing and certification mechanisms[65].

Who pays for these costs is a key question. Several studies suggest that the main costs would fall on consumers who decide to purchase non-GM products, and on importing countries primarily[66]. Giannakas and Fulton for example argue that "while both non-GM and GM producers may face some segregation costs, these costs will always be higher for producers of the IP good than for producers of the GM good, due to the effort required in preserving the identity of the non-GM good by keeping it separate from the GM good"[67]. Other authors like Kalaitzandonakes present a very negative scenario where non-GM production is too costly, and assumes that the costs will increase due to the increasing adoption of GM crops in the world, with such costs being paid by importing countries:

> "Most key exporters of grains and oilseeds are Living Modified Organisms (LMO) users. In their domestic markets, LMOs are equivalent by regulation to conventional crops and their use implies no incremental handling costs. In export markets, LMO cargoes would incur compliance costs associated with the Biosafety Protocol (BSP) but these costs would be similar across all exporting countries. Under these conditions, the compliance costs associated with the implementation of the BSP, much like with IP costs in non-LMO segments, will become "costs of selling" in export markets, meaning that importers will pay the price"[68].

Such assumptions are hypothetical and fundamentally flawed. In the current world situation it is very difficult to predict how the acceptance of GM food and non-GM food markets will evolve. It is important to recall that only two countries account for 84 per cent of all GM crops commercially grown in the world. Most countries are in the process of building their national biosafety frameworks and all importing countries have the capacity to regulate environmental and human health risks through comprehensive biosafety requirements. It is highly possible that such requirements will move towards shifting the burden of costs from importing to exporting countries. Moreover, the burden of costs can be shifted to the GMO producer in, for example, a country or region where GMO acceptance is low, and the grain handling system is mostly IP non-GMO based (see Annex III). Taking into account the current situation in Europe and the major movement by European regions to guarantee GM free zones, it is not hard to envisage a scenario where the costs for GMO production are higher than for non-GMO production.

[65] Desquilbet, M., Bullock, D. 2001. Who pays the costs of non-GMO segregation and identity preservation? Paper presented at the International Agricultural Trade Research Consortium. December 2001

[66] Desquilbet, M., Bullock, D. 2001. ibid; Kalaitzandonakes, N. 2004. , op. cit.

[67] Desquilbet, M., Bullock, D. 2001. op. cit.

[68] Kalaitzandonakes, N. 2004. op. cit.

So, who should pay for the costs? The GMO producer, the non-GM farmer, the IP non-GMO operator, the GMO farmer, importing countries?

While the debate rages on regarding who will pay for identification, monitoring and testing, a precedent has already been set. GMO exporting countries, the biotech giants, and operators exporting crops from North America are already paying the bill for identity preserved mechanisms to guarantee that StarLink and Bt10 are kept out of the food and feed supply to Japan and Europe. Moreover, the costs of these IP mechanisms, absorbed mostly within the exporting GMO country, could decrease due to economies of scale if, for example, other corn importers around the world requested the implementation of similar mechanisms.

2. Segregation and IP Strategies cheaper than failure

The cases of contamination with StarLink, Bt10, and other experimental crops like biopharmaceuticals clearly exposed the fundamental flaws in the US regulatory system and showed the need for urgent reform. Japan's requirement for a certificate of StarLink-free status and the European Union's similar demand for Bt10-free certification of corn imports are the first of a predictable avalanche of such requirements by importing countries committed to protecting their food and feed supplies from GM contamination.

If segregation and IP strategies had been in place, such failures could have been prevented and/or tracked sooner and more effectively. IP allows for differentiation and traceability, facilitating at the same time rapid response recalls if necessary. The case of StarLink, whose recall operations cost over one billion dollars[69], clearly shows that "although effective product differentiation systems may be costly to develop and run, they are cheaper than failure"[70]. This is a fundamental aspect which is forgotten in many of the studies which analyse the costs of segregation. Failures like StarLink and Bt10 are very costly and, in the light of the weak regulatory framework in most GMO-producing countries, these failures are likely to happen again in the future. The costs of these failures must be factored into future cost-benefit analysis of implementing segregation, IP non-GMO and traceability systems.

3. The Monsanto Paradox: implementing a "Global GMO Monitoring and Testing Programme" for patent rights

The biotech industry has consistently opposed labelling and segregation requirements for any of the GM crops on the market today. The industry considers those products as equivalent to existing conventional crops and therefore argues that there is no need for labelling to differentiate them from non-GM products. Paradoxically, Monsanto has implemented a multi-million dollar "GMO Monitoring and Testing Programme" to test crops for its patented genes in farmers' fields. Although the biotech giants claim that "GM crops are not different from conventional counterparts", when it comes to patents and claiming their royalties, GM crops are indeed different and constitute an

[69] Nature. 2005. US launches probe into sales of unapproved transgenic corn. 22 March. http://www.nature.com/news/2005/050321/full/nature03570.html
[70] Smyth, S., Philips, P. 2002. op. cit.

"innovation".

Monsanto today dominates the US seed market and is the leading producer of GM seeds in the world. Its seed technology has been introduced in at least 90 per cent of all GM crops on the planet[71]. Monsanto has over 600 patents, more than any other biotech company[72]. Farmers possessing patented seed are prevented from freely saving the seed for use next season. In fact Monsanto requires farmers in countries such as the US who use seed containing their patented technology to sign a technology agreement that forces the farmer to buy new seed every season.

This level of domination and control over the farmer has no precedent and has had serious negative impacts on the livelihoods of American farmers. Some farmers who decided to replant Monsanto seed have faced financial penalties, forcing some to go into bankruptcy. More worrying are cases of farmers whose fields have been contaminated with Monsanto varieties, but who never bought its seed voluntarily. Such farmers have been penalised after patented material from Monsanto was found in their fields. Monsanto has been taking care to brutally enforce the technology agreements upon American farmers by building "a department of 75 employees and setting aside an annual budget of $10 million for the sole purpose of investigating and prosecuting farmers for patent infringement"[73]. The Washington Post reported that "the company has hired full-time Pinkerton investigators and, north of the border, retired Canadian Mounted Police, to deal with the growing work load, a total now of more than 525 cases, about half of which have been settled"[74]. At present, Monsanto has filed 90 lawsuits on the basis of violations of the technology agreement and seed patent, involving over 140 farmers and 39 small businesses and farm companies[75].

Although the exact costs of their total monitoring and inspection programmes are not known, the magnitude of the costs spent on prosecuting farmers can be estimated by considering individual cases. For example, in one of the lawsuits the costs that Monsanto was claiming from the farmers were around one million dollars:

> "in Monsanto Co et al v. Thomason et al, which involved two plaintiffs, Monsanto Company and Delta Pine, the defendants had to pay $447,797.05 to Monsanto and $222,748.00 to Delta Pine in damages. In addition, they also faced $279,741.00 in attorney fees to Monsanto, $57,469.13 in costs and advanced expenses, and $75,545.83 for testing fields, as well as additional attorney fees to Delta Pine to the tune of $82,281.75 and $5,801.00 in costs and advanced expenses."[76]

In the case Monsanto v. Dawson, Monsanto won a monetary award of $2,586,325. Of that sum, $700,000 was for "Monsanto's attorneys' fees and related costs - including its inspection fees and costs"[77]. In another case, a farmer from Arkansas reported that

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[71] The Center for Food Safety. 2004. *Monsanto vs. US farmers*. http://www.centerforfoodsafety.org
[72] Ibid
[73] Monsanto. 2003. Seed Piracy Update; Monsanto Reaps some anger with hard line on reusing seed. St. Louis Post-Dispatch. 12 May 2003.
[74] Washington Post. 1999. Seeds of Discord – Monsanto's Gene Police Raise Alarm on Farmers' Rights, Rural Tradition. 2/03/99.
[75] The Center For Food Safety. op. cit.
[76] Ibid
[77] Monsanto vs. Dawson. (98-CV-2004).Final Consent Judgement. 12/19/01

Monsanto itself spent $250,000 hiring Pinkerton investigators to spend three to four weeks inspecting his property, which was planted with around 10,000 acres of soybeans[78].

These monitoring and testing programmes are not only implemented in North America, but also in Southern countries[79]. For example, the company has established a system in which over 95 per cent of the grain elevators in two Brazilian states (Rio Grande de Sul and Santa Catarina) are testing soybeans for the presence of Monsanto's traits, and if this is detected the elevator must pay a technology fee to Monsanto. The company plans to implement similar models in other countries in the world, clearly showing the will of Monsanto to establish tough monitoring and testing mechanisms to implement its patenting rights worldwide."[80]

4. Protecting consumer and farmers' rights

Adequate information and the labelling of GM foods and crops is something that US consumers have been requesting for many years. As the USDA Advisory Committee on Biotechnology recently stated:

> "Consumers purchase (GM) products, frequently unaware that they were made using biotech ingredients. US consumers who want non-biotech products have reduced choices that are generally higher priced. Consumer research shows a substantial majority of US consumers want more information about their food. When US consumers are asked if they want food containing genetically engineered products labelled, they usually say "yes"."[81]

A system of segregation and identity preservation will help to implement labelling requirements in the US. Such a segregation and IP system will contribute to improving food safety, environmental protection and will guarantee the right to choose for US consumers.

As we have seen, although companies such as Monsanto reject segregation and controls to limit contamination, they are more then happy to implement one of the biggest and most expensive monitoring and testing programmes in the world, not for food safety and environmental protection reasons, but for claiming its patenting rights.

The introduction of GMOs, together with scandals such as StarLink, has made thousands of American farmers angry about the loss of agricultural markets. As Larry Mitchell, Chief Executive Officer of the American Corn Growers Association said, "If the crafters of the current US farm policy still believe it is 'export oriented' they should require the biotech companies to get onboard. Biotech arrogance is losing US exports. Maybe those same biotech companies should be sent the bill for lost corn markets, low corn prices and the resulting high cost of the farm program."[82]

In addition, farmers whose crops have been contaminated, but not voluntarily planted,

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[78] Anonymous Farmer, Arkansas. Based on interview by the Center for Food Safety

[79] UBS. 2004. *Monsanto*. UBS Investment Research. 22 November 2004.

[80] Ibid

[81] AC21. op. cit.

[82] American Corn Growers Association. 2005. American corn growers Foundation raises concerns about lost corn gluten market-low corn prices due to biotech blundering. Washington, D.C., May 9, 2005

are being prosecuted and held liable. In this context the issue of liability and who pays is moving to the fore in the US. At present several Bills are being tabled at the State level to protect farmers and tackle the problem of liability. A Bill in California recognises that "the liability for the uncontrollable movement of genetically engineered material is being unfairly passed from manufacturers of genetically engineered plants to innocent and unsuspecting farmers"[83]. This Bill acknowledges the urgent need to protect "innocent farmers and farm businesses from legal liability for the presence of genetically engineered material in their crops without knowledge and beyond their control".

Like the Californian Bill, in Vermont another Bill aims to exempt innocent farmers from liability:

> "A farmer who is not in breach of a contract for the purchase or use of genetically engineered seed or plant parts and unknowingly comes into possession or uses such seeds or plant parts as a result of natural reproduction, cross-pollination, or other contamination shall not be liable for any injuries, claims, losses, and expenses, including attorney's fees, caused by the use of a genetically engineered seed or plant part, including damages for patent infringement"[84].

It is time to change the burden of costs for segregation and IP so that Monsanto and other biotech corporations cover the costs of their pollution, and are held responsible for the costs related to undesired contamination. Legal mechanisms to shift the burden of costs to the polluters are needed to protect non-GM farmers from losses associated with contamination. There should also be recourse for any farmer suffering contamination to take legal action against the company responsible for any losses caused by the contamination. A compensation fund paid by the main biotech giants could be a mechanism to shift the burden of the costs of contamination away from conventional and organic farmers.

> **"Blundering biotech companies and their arrogance toward world buyers and consumers cost the U.S. the valuable, cash paying European Union (EU-25) corn market since 1996, and caused substantial corn export reductions to Japan. Now, adding insult to economic injury, some biotech companies and their carelessness is putting the EU-25 import market for U.S. corn gluten feed and meal in serious jeopardy, with the EU-25 now testing every cargo. Foreign demand for U.S. corn gluten is extremely important for the economic future of corn processing ethanol plants. The EU bought 5 million metric tons (MMT) with an export value of $403,726,000 as recently as the 1999-00 marketing year. But in the most recent 2004 marketing year, the EU-25's imports of US corn gluten had dropped to 3.6 MMT with a value of only $377,636,000. In the current 2005 marketing year (September through February) EU-25 imports are only 1.2 MMT compared to 1.9 MMT the year earlier".**
>
> Dan McGuire, CEO of the American Corn Growers Foundation and project director of the ACGF Farmer Choice-Customer First program

[83] Assembly Bill. 2005. An act to add Section 1714.43 to the Civil Code, relating to liability. California legislature 2005-06 regular session. N. 984. Introduced by Assembly Member Laird. February 18, 2005.
[84] An act relating to liability resulting from the use of genetically engineered seeds and plant parts. 2005. Vermont

IV. Conclusion

Contamination poses a real threat to biosafety worldwide. The current trends of GMO contamination must be stopped, and contamination must become the exception, not the rule. Every country in the world has the right to ensure that GMOs not approved at national level do not enter the country, and must be able to clearly identify any GMO that will be imported.

In order to tackle GMO contamination and ensure comprehensive identification of GM events, segregation and identity preservation are necessary. Such systems are key to guarantee an adequate level of food safety and environmental protection from the potential risks of GMOs. Such systems would guarantee that GM crops are kept away from non-GM crops, and that GM events are traceable through the whole food chain. The experience with illegal contamination by StarLink and experimental crops such as Bt10 and biopharmaceuticals clearly shows that the US *laissez faire* approach to regulation does not work.

Segregation and identity preserved systems are not new in the US and constitute an extension of other speciality systems implemented over recent years. The changes needed to implement GMO segregation do not imply an overhaul of the whole North American grain handling system and need not be costly.

In the case of GMO contamination, the non-GMO farmer should not be punished, and the burden of the costs should be shifted towards the main culprit for the pollution, which in most cases is the biotech industry. Paradoxically, while the industry refuses to pay for monitoring and testing for food safety and environmental protection, the biggest biotech giant, Monsanto, proceeds to invest in a multi-million dollar monitoring and testing programme to protect its patented genes in crops in farmers' fields.

In considering the contamination cases of StarLink, Bt10, and the numerous cases of contamination of organic/conventional crops by GM crops, one can identify the polluters clearly as the biotech giants and their products - Aventis was responsible for StarLink, Syngenta for Bt10, and Monsanto for illegal and/or undesired contamination of farm fields in numerous places including Europe, South America, India and Canada[85]. Rather than impose the cost of pollution on those affected, whether consumers, taxpayers or importing countries, it is time to shift the burden of costs from contamination to the real polluters. It's time to make the polluters pay.

[85] Friends of the Earth International. 2002. GMO Contamination around the world.

V. Recommendations

Friends of the Earth International urges Governments to take into consideration the following recommendations:

- Governments should promote the establishment of segregation and Identity Preserved systems. Any country that produces/handles GM crops must guarantee measures to prevent GMO contamination and to keep GM crops separated from non-GM products.

- Governments should support the establishment of comprehensive identification documentation for all GM events in a GMO shipment. Failures such as StarLink and Bt10 clearly prove that GM events should be traceable throughout the grain handling system and the food chain. All exporters of GM crops or GM material should clearly state in the accompanying documentation that "This product contains GMOs", and provide a detailed list of all GMOs included.

- Governments should request that all exporters guarantee the absence of GMOs not approved either globally or in the country of import. Illegal GMOs should not be present anywhere in the global food chain. This is particularly the case for StarLink, Bt10 and any experimental GM crops not commercialised. All regulators should require means of identifying a GMO prior to allowing any field test (prior to commercialisation). Such requirements would mean that competent authorities could inspect and enforce segregation and labelling issues, as well as detect contamination.

- Governments should enact legal mechanisms at the national level that shift the burden of contamination to the polluters. The costs of losses derived from contamination from GM crops should fall on the polluters and not on the non-GM farmers or importing countries. Countries should enact legislation that ensures that farmers are not punished for contamination due to cross-pollination, and that allows recourse for any farmer suffering contamination to take legal action against the company responsible. International mechanisms to shift the burden of costs to the polluters should be explored, such as a compensation fund paid for by the biotech industry.

Annex I

PROTOCOL FOR EXPORTS OF MAIZE TO JAPAN

The protocol provides for corn exported to Japan for food purposes to be tested for the presence of StarLink at interior US locations and its identity preserved to the export vessel. The protocol demands that:

At Interior Shipping Points:
1. Interior sampling and testing services will be conducted either by USDA or in accordance with USDA procedures, as specified in the terms of the export sales contract.
2. Barges and railcars at interior loading sites will be cleaned according to USDA standards.
3. During barge and railcar loading at interior shipping points, a representative sample will be taken using official USDA sampling procedures.
4. Samples will be tested for each consignment of corn using lateral flow methodology. The number and size of samples should be consistent with US Government guidelines for domestic food use, but no fewer than three 440-kernel samples. If no StarLink corn is detected in these tests, the railcar or barge will be sealed and its identity preserved (IP) to the export location.
5. Samples selected randomly from these consignments at an agreed-upon ratio shall be provided to the Government of Japan.

At Export Location:
1. USDA will monitor industry cleaning of elevator unloading equipment, conveyors, scales, storage bins, etc. to prevent inadvertent commingling.
2. USDA will monitor the unloading of incoming railcar or barge shipments.
3. USDA will examine the stowage space of each export vessel to ensure cleanliness.
4. USDA will sample all export corn in accordance with US Grains Standards Act.
5. USDA will retain a representative file sample of each export shipment for 90 days in accordance with USDA regulations. This sample will be available for monitoring purposes.

At Import:
The following documentation will be made available upon request: Interior test results, Documentation on IP handling (e.g., seal certification number), Vessel stowage exam certificate from USDA.

Source: Binas online. 2000. US Maize Exports to Japan Resume[86].

[86] Binas online. 2000. US Maize Exports to Japan Resume.
http://binas.unido.org/binas/show.php?id=261&type=html&table=news_sources&dir=news

ANNEX II

Non-GM Identity Preserved (IP) Programmes

Like other IP systems, non-GM IP systems seek to maintain product identity, in this case non-GMO status, throughout the product life cycle. Effective implementation of non-GM IP systems requires:

- Sourcing from non-GM seed stock
- A commitment by players in the supply chain not to co-mingle GM with non-GM produce
- The maintenance of fully documented records at each stage of the product life-cycle (traceability)
- Periodic inspections and audits to ensure that the systems in place are capable of delivering IP non-GM products
- Routine testing to verify the integrity of the supply chain

Typical Non-GMO Identity Preserved System

A typical non-GM Identity Preserved system might contain the following components:

On Farm

- Purchase of non-GM seed varieties
- Crop registers – no mixing of batches
- Cleaning of farm to field harvesting equipment/storage facilities
- Sufficient distance from neighbouring GM crops

Transport/Storage

- Control and cleaning of transport/storage equipment
- Effective product segregation
- Total product traceability

Manufacturing/Processing

- Purchase of certified non-GM produce
- Effective product segregation
- Control and cleaning of production lines when necessary
- Total product traceability

Retailer

- Total product traceability – certification from suppliers
- Effective product segregation, where necessary

At each stage of the product life cycle, traceability is underpinned by fully documented records highlighting the measures taken to maintain GM and non-GM product status. Furthermore, the efficacy of the system is verified by routine product testing, at designated risk points.

Source: Identigen. Genetic Testing Services[87].

[87] Identigen. Genetic Testing Services. http://www.identigen.com/

ANNEX III

COSTS OF IP NON-GM SYSTEMS IN VARIOUS SITUATIONS

Farm costs of segregation and IP

It is possible to cite three IP costs that vary among farmers, that depend on the size of the IP channel or that arise for both producers of the regular good or producers of the IP good. The first is the cost of transporting IP grain to an elevator willing to accept it. Currently in the US, IP crops make up a small share of the total supply, and only a fraction of all elevators are participating in the IP channel. Moreover, some of these elevators are only receiving IP crops from farmers during specified periods, and not near harvest time.

In this situation, the additional costs of delivering IP grain to an accepting elevator vary among farmers. The additional cost is small for a farmer located near an elevator accepting IP grain at harvest time, or for a farmer possessing adequate on-farm storage and located near an elevator accepting IP grain only out of harvest time. On the contrary, the additional cost is likely to be dissuasive for a farmer located far away from an elevator accepting IP grain, or for a farmer possessing inadequate on-farm storage capacity, even though he may be located near an elevator accepting IP grain only out of harvest time.

In addition, for a given farmer, the cost of delivering IP grain to an elevator accepting it depends on the size of the IP channel. If the share of IP crops in the total supply increases, some new elevators will start to accept IP crops, or will accept them during wider periods of time. The costs of participating in an IP channel will then decrease for farmers located near these elevators. Yet simultaneously, as the size of the IP channel grows, a similar cost of participating in the GMO channel will arise for producers of the regular good. In the extreme situation where the size of the GMO channel is very small, the cost of transporting GMO grain to an elevator willing to accept it could become dissuasive for many farmers.

The second type of farm IP cost that varies among farmers is the cost of preventing cross-pollination by GM plants. For cross-pollinated species, pollen from neighbouring GM fields can fertilise plants in a non-GM field and lead to the commingling of GM and non-GM seed or grain. To prevent cross pollination, it is necessary to adopt costly measures such as increasing distance between one's non-GM fields and GM fields, or harvesting border rows separately.

Here again, this cost varies among farms (for example, depending on the presence of natural barriers or depending on wind direction). It also varies for a given farmer depending on the share of GM crops in total supply.

The third type of farm IP cost that varies among farmers is the opportunity cost born from not using GM technology in production. Several studies underline that economic benefits from adopting GMOs vary widely between farmers. One main reason is that different farmers face different weed situations, or different insect pressures, so that pesticide cost reductions or yield changes following from GMO adoption vary among them. Then, the potential indirect cost of not using a GM seed in order to grow an IP crop varies among farmers.

Handling and processing costs of segregation and IP

At the handling stage, some examples show that IP costs vary among handlers and vary depending on the size of the IP channel in total supply. In the current situation where the IP channel is small in the USA, because of the physical design of their facilities, some elevators have smaller costs than others participating in the IP channel. For example, strict tolerance levels can be attained more easily in storage locations that have multiple paths (as opposed to a single path) of dump pits, legs, conveyors belts, etc, along which grain is moved before being stored. It is also easier to segregate IP crops in a facility with multiple small storage bins rather than few large bins. Moreover, having different elevators in close proximity is an advantage for some handlers that may dedicate some elevator locations to GMOs and other to non-GMOs. This situation will change if the share of IP crops in the handling system increases and new elevators enter the IP channel. In the EU, where only IP crops are supplied, all facilities are used exclusively for IP crops. In this case, this physical design and location of elevators does not create IP cost differences among handlers. Similarly regular crops may also bear a cost of segregation. For while regular crops need not be kept clean of non-GM crops, segregation still can lead to costs of capacity underuse, cleaning costs, and management costs to organise more complicated grain flows. Similar cost differences and variations of cost with the size of the IP channel apply to food processors.

Source: Based on Desquilbet, M. Bullock, D. 2001. op. cit.

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