"Genetically engineered crops represent a huge and uncontrolled experiment whose outcome is inherently unpredictable."
Dr Barry Commoner, biologist,
City University of New York, 2002[1]

8 Unpredicted effects

With the normal farming uncertainties of the weather and markets, it is important that the characteristics of any crop variety are stable and that there are not going to be completely unpredictable effects. The process of genetically engineering crop plants is described publicly by the biotechnology industry as "deliberate" and "precise", in a way that suggests it is more controlled and predictable then conventional breeding methods.[2] The official process of approving new GM varieties also assumes that any biological changes to the plants are limited. However, some farmers in America have reported experiences of unexpected and occasionally unwelcome effects.

GM feed and livestock

The main use of the GM crops which have been commercialised in North America so far is for animal feed. Maize, oilseed rape and soya are basic components of the intensive meat production industry, so the effect on livestock of these crops is very important. However no, or almost no, animal feeding trials with pigs, cattle or other livestock were carried out before the crops went into commercial production. This is surprising considering the large scale on which these novel crops were going to be used – it might have been expected that extensive, long-term trials would have been carried out. It therefore seems worth highlighting any consistent reports of unexpected effects from farmers since GM crops were introduced. The problem of the pig breeders in Iowa is the most dramatic consequence to have surfaced so far (see panel overleaf). In addition, several farmers have reported their livestock showing a marked preference for non-GM feed:

- *"If a field contained GM and non-GM maize, cattle would always eat the non-GM first".*
  Gale Lush, Nebraska[3]
- *"A neighbour had been growing Pioneer Bt maize. When the cattle were turned out onto the stalks they just wouldn't eat them".*
  Gary Smith, Terry, Montana[4]
- *"I saw an advert from a farmer who was looking for non-Bt corn, as he was getting lower milk yields from the cattle that were eating Bt corn".*
  Tom Wiley, North Dakota[5]
- *"A captive elk escaped and took up residence in our crops of organic maize and soya. It had total access to the neighbouring fields of GM crops, but never went into them".*
  Susan & Mark Fitzgerald,
  western Minnesota[6]
- *"While my cows show a preference for open-pollinated maize over the hybrid varieties, they both beat Bt-maize hands down".*
  Tim Eisenbeis, South Dakota[7]
- *"A student placed two bales of maize in a rodent infested barn. One was Roundup Ready and the other was conventional. Apparently the rodents would not touch the Roundup Ready crop".*
  Roger Lansink, Iowa[8]

An article in 1999 also catalogued several cases of problems with GM feed in the Midwest:

- Cattle refused to graze Bt-maize stubble
- Pigs went off feed when GM grains were included in the ration
- Cattle stopped eating when the farmer switched to GM silage
- Rate of weight gain in cattle dropped when switched to GM feed
- Cattle broke through a fence and walked through RR-maize to mow down a non-GM hybrid, leaving the RR-maize untouched.[9]

Iowa pig breeders

In Iowa, pig breeders believe they have encountered a serious problem with Bt maize, with 17 producers reporting a sharp decline in pig farrowing (conception) rates following the use of Bt maize in their pig feed.

Jerry Rosman experienced an 80 per cent fall in his farrowing rate after using Bt maize and four of his neighbours had the same problem. In each case the animals were exhibiting pseudo-pregnancies. Outwardly the pigs had all the signs of being pregnant but after two to four months the signs disappeared. The breeders had different management styles, breeding methods and swine genetics, but they were all feeding Bt maize.

Jerry did everything he could to find out the cause: he tested for diseases, examined his nutritional programme, verified his insemination rates and sent samples of the maize away to several laboratories. In total he spent over $6000. Laboratory tests eventually revealed that the Bt maize from all five farms had high levels of fusarium mold, suggesting the presence of mycotoxins that can cause pseudo-pregnancies. But this could not be confirmed as the cause as the one mycotoxin which is known to cause this problem was absent and other types have not yet been identified by pathologists and cannot be detected.

"We're working with a problem no one has ever heard of before" said Jerry. One of the operations has stopped feeding Bt maize, and its farrowing rates have returned to normal.

Jerry reported the problem to the state farming journal, the *Iowa Farm Bureau Spokesman*, in May 2002. Within 10 days, another 12 pig producers from various parts of Iowa contacted him with the same problem.[2]

The lack of segregation of GM from non-GM grain is likely to have masked other problems. According to Jerry Rosman, most of those who reported the pig breeding problems in Iowa were smaller producers who were growing all their own feed, generally all of the same variety. The few who were using bought-in feed and reported problems, said they had noticed fluctuating farrowing rates as they went through successive deliveries of feed.[10] Most livestock production in the US involves large, intensive 'feed lots' and bought-in feed. With only a quarter of the maize in the system being GM, the larger producers would not experience a problem consistently in the way smaller farmers would.

These negative experiences of some individual farmers do not add up to proof that there is a general problem with all GM feed. But, it is clear that several farmers (and their animals) have noticed a substantial difference between some GM and non-GM feed. Furthermore, there may be problems that have not been identified in the sector at large.

Unpredicted effects in GM plants

"In the past I would always cut the soy first as it would collapse under the weight of the beans. But now the stems are so tough they wear out the combine."
Nebraska farmer, Gale Lush, found that the RR soya he planted were tougher than the conventional variety.[3]

The commercialisation of GM crops has uncovered a few unexpected problems of plant structure and health. The unexpectedly high levels of fusarium in the Iowan Bt maize has yet to be explained. Several unexpected problems have been reported with RR soya, of which at least two are definitely related to the GM character of the plants.

University of Georgia scientists were alerted by farmers in the southern US states to unexpected soya crop losses and reports of RR soya plants splitting in hot temperatures. On investigation, the scientists found that RR soya plants are producing up to 20 per cent more lignin than other soya plants. This makes the stems more brittle, causing stunting and splitting at a far higher rate than normal soya in hot weather and leading to crop losses of up to 40 per cent. The researchers concluded that the inserted gene that gave resistance to glyphosate was affecting a major metabolic pathway in the

plant which had the side effect of sending lignin production into overdrive.[11]

As reported in chapter 4, RR soya is unexpectedly yielding 10 per cent less than equivalent non-GM varieties. It also seems to be susceptible to certain pests and diseases, and this is believed to be due to the additional genetic material suppressing the plants' stress responses. This might possibly explain why farm advisers at the University of Missouri reported inexplicably high levels of pest attack on the soya crop in 2001. "I don't know what it was this year, but we saw insects eating soybeans that we've never seen before."[12] The reason given was weather, but it could have been an abnormal response of the RR soya to the weather conditions.

Another unexpected problem that could again be due to the use of GM varieties was the poor viability of the 2001 US soya seed supplies. Seed companies reported finding it hard to meet seed germination standards. Germination targets are usually around 95 per cent, yet these were nearer 80 per cent, meaning that more seed needed to be applied per acre. The soyabeans also contained more green seed than usual, indicating that many plants had died prematurely. As with the soya stem problems, this was also linked to hot weather by the University of Missouri.[13]

Inadequate assessment prior to commercialisation

"There is a profound difference between the unintended effects from traditional breeding and genetic engineering."
Dr Louis Pribyl, scientific adviser to the FDA, 1992[14]

Government scientific advisers in the US and Canada have opposed their governments' assessment processes for the approval of GMOs, considering it unscientific. One of their particular concerns was the potential for unpredictable side effects to occur from the genetic engineering process, which would not be identified by the assessment procedures being used. In a review in February 2001, the Royal Society of Canada called the approvals regime "scientifically unjustifiable."[15] In 1992, a majority of the US FDA's scientific advisers did not support the government's proposed assessment regime for GMOs, contrary to the public statements made by the FDA. They believed that animal feeding trials would be needed to pick up undesirable side effects. The assessment procedures were adopted anyway.[16]

The procedures for the assessment of side effects from genetic engineering are based on an analysis of the levels of a limited list of chemicals in the GMO, such as key nutrients and toxins. If the levels of these are similar to those in the equivalent non-GM plants, the GMO as a whole can be deemed "substantially equivalent" to non-GM plants and few further safety trials, such as animal feeding trials, are required. This is especially so in the US. As a consequence, no or almost no animal feeding trials were carried out before GM crops were put on the market.

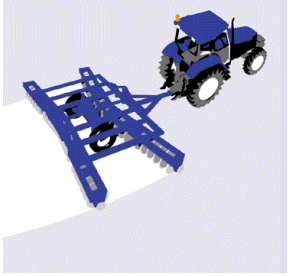
However, unlike the public descriptions of genetic engineering as "precise", the engineering of a GMO has a large random component to the process, so unpredictable side effects are expected. The process involves the foreign gene randomly inserting itself in the plant's natural genetic material, disrupting the existing genes at the point of insertion. Genetic engineers can in theory insert genes in a particular place but in practice this is not done; even if it were there is usually no suitable position which would not be disruptive. The effects of the process are that some of the characteristics and metabolic processes of the plant are likely to be randomly altered. In addition, the gene is not inserted on its own, but as part of a 'construct' with other genes, including a viral promoter gene to activate the functional gene. However, the nature of the promoter means that the inserted genes are liable to be unstable and move out again. Overall, GM plants are therefore generally highly unstable and variable in the functioning of the foreign gene from one generation to the next, as well as being expected to display unintended effects.

Behind the scenes, the biotechnology industry is well aware that the current techniques cause disruption of the plant's genetic material: "The phenomenon of rearrangements at the point of genetic insertion is widely recognised" said Marcia Vincent, technical communications manager, Monsanto, August 2001.[17] "Plant biotechnology … processes cause severe changes to cell metabolism by disrupting existing architectures or by activating defence mechanisms deigned to cope with entirely different assaults" according to two biotechnology consultants.[18] Instability is also a widely encountered problem in the industry. For example, in a survey of at least thirty companies developing GM crops, all had observed some instability of the transgene.[19]

Even when the biotechnology sector started carrying out animal feeding trials

8. **Key points**

- ★ Almost no animal feeding trials were carried out before GM crops were released for commercial growing, though their main use was for animal feed
- ★ The biotechnology companies publicly suggest that genetic engineering is a precise and controlled technique; however, several farmers have reported unexpected effects
- ★ Pig breeders in Iowa have had a major reduction in breeding levels since they started using Bt maize as feed
- ★ Many farmers have reported that cattle show a marked preference for non-GM maize if given a choice
- ★ In certain conditions RR soya has been found to be susceptible to pests and disease and stem splitting due to lignin levels being higher than in non-GM soya
- ★ Government scientific advisers in the US and Canada opposed their governments' assessment procedures for the approval of GM crops as unscientific, on the basis they would not identify undesirable side-effects of the engineering process.



after commercial growing started, they were not initially of farm animals and were often not designed to identify unpredictable effects. For example, they often involved feeding just the protein product of the new gene to the animal, and not the whole GMO. Sometimes too little of the GMO was fed in the diet; in others negative effects did occur but were ignored.[20] Over the last couple of years a few feeding trials with farm animals have been carried out, looking at aspects such as digestibility and weight gain and few significant differences have emerged so far.[21]

Another reason why side effects on the plant's structure or health are not picked up before commercialisation is because, according to one of the FDA's scientific advisers "many of these effects might not be seen by the breeder because of the more or less similar growing conditions in the limited trials that are performed."[14] Hence, it is only when the plants are exposed to the different environmental conditions of widespread commercial growing and fed to animals on farms, that changes to their normal response to environmental stresses and other side effects may emerge.

"There is no choice. It is so difficult to find guaranteed non-GM soya, and you end up with poorer varieties."
Gale Lush, farmer growing GM soya, Nebraska[1]

9 Farmer choice

With the introduction of GM crops, farmers have suffered a severe loss of choice about how they farm. Many are finding themselves forced to avoid certain crops or even to grow GM crops simply because of a lack of choice, not because of the particular GM attributes of the GM crops. Farmers who grow GM crops can then find themselves effectively 'locked-in' to growing GM crops.

Farmers are also reporting that the availability of good non-GM seed varieties is rapidly disappearing, as good varieties are increasingly only available in a GM form. Sharon Rempel, organic crop researcher from Alberta explained: "It is more and more difficult to get seed varieties, catalogues are getting thinner." And it is not just the choice in seeds that is evaporating. "In 1900 there were around 2000 seed companies in North America, now there are less than 200." Sharon is particularly concerned about control "The hand that holds the seed controls the food supply."[2]

GM contamination has exacerbated this problem. Seed and crop contamination and the lack of segregation in the marketplace has meant that many farmers do not have the option of supplying the higher value GM-free or organic markets (in much of Canada, organic rape production is no longer an option). Moreover, crop contamination has introduced the worrying uncertainty of whether a non-GM farmer might be accused by a biotechnology company of growing unlicensed GM crops.

If this happens, and it seems to have very often, the consequences are expensive and unpleasant (see chapter 12). Farmers who are already growing GM crops are susceptible to the 'lock-in' effect of GM crops – their contracts allow biotechnology company inspectors access to their farms and they may be struggling with GM herbicide resistant volunteers, making them vulnerable to claims of growing unlicensed crops. The experience of Troy Roush (p42) indicates that if a GM farmer is accused, and intimidated, he can feel that growing more, rather than less, GM crops is the best way to reduce the chances of the problem continuing.

The problem is that the leading Midwestern seed companies have been bought up by the biotechnology companies, who now only sell the most popular hybrids of the seed companies genetically engineered with HT or Bt genes.[3] DuPont and Monsanto are now the two largest seed companies in the world with combined sales in excess of $3.5 billion in 2000.[4]

Sharon Rempel

Sharon Rempel, organic crop researcher from Alberta explained "It is more and more difficult to get seed varieties, catalogues are getting thinner."[2]

Gale Lush

Gale Lush farms nearly 3,000 acres with his father and three brothers near Ragan, Nebraska. He is growing Roundup Ready soya but has been looking into identity preserved soya with a hope of gaining the reported premiums. "If I could get hold of the seed and market then I would stop growing Roundup Ready."

But he has not found it as easy as he thought because good non-GM varieties have become harder to obtain. "There is no choice," he explained. "It is so difficult to find guaranteed non-GM soya, and you end up with poorer varieties." This is compounded by the problems of transport and storage.[1]

Jim Stiegelmeier

Jim Stiegelmeier farms 4,000 acres of organic land near Selby, South Dakota. Soya, spring wheat, buckwheat, rye and cattle form the basis of his enterprise. Until recently his only involvement with GM crops had been lobbying against them – helping to draft resolutions for the state senate and talking about the risks. But GM crops have now forced him to change the way he farms. He has had to stop growing organic maize due to problems finding GM-free seed, and the worries of pollen drift from GM maize-growing neighbours. As for soya: "We will probably just stop growing soya if we get any contamination issues. We will just move towards more animal production."[5]

9. Key points

★ Farmers have suffered a severe loss of choice about how they farm, as a result of GM contamination and a reduction in choice of seed

★ Some farmers growing GM crops have felt themselves 'locked-in' to GM crops because of the difficulty obtaining non-GM seed and accessing the non-GM markets

★ A farmer who was accused of growing unlicensed GM crops, despite evidence to the contrary, decided to start growing GM crops just to avoid further accusations

★ Organic farmers are being forced to avoid certain crops because of contamination

★ Many seed companies have been bought up by the biotechnology companies which had led to a sharp reduction in the availability of good non-GM varieties

★ The continued large area of GM crops may be as much to do with the 'lock-in' effect of a lack of choice, than the attributes of GM crops.

Troy Roush

In 1999 Troy Roush and his family grew 492 acres of Roundup Ready soya under licence on their Indiana farm, alongside 1,328 acres of conventional soya beans. During harvest time Monsanto sent investigators to their land who claim to have sampled 16 fields. They alleged that 15 of these samples contained Roundup Ready soybeans.

Troy Roush was startled by this claim. To start with, the investigators were never seen by his staff on the land, despite it being the busiest time of year on the farm. He was also confused as to how they allegedly found RR soya in his fields of popcorn. This could be because some of the fields they sampled were not Roush's land. Checking back over his chemical records he could prove that only two of the fields sampled were planted with the GM seed. To be on the safe side, he asked his lawyer to get an independent review undertaken of his planting and chemical records. In a sworn deposition the consultants stated that the Roushes simply did not purchase enough Roundup seed or herbicide to account for the claims made by Monsanto.

But in May 2000, Monsanto filed a lawsuit against the family accusing them of having illegally grown Monsanto GM soya. They also sent more investigators to the farm – but this time the Roushes were ready and shadowed them, taking similar samples along with Global Positioning System readings. None of their samples showed up as positive for RR soya, yet they had been planted with seed saved from their previous year's crop. The crop that Monsanto claimed to have been a Roundup Ready crop.

In June 2001 Monsanto's lawyers sent a letter to over 900 seed suppliers, farmers and agricultural extension agents in Indiana, Michigan and Ohio stating that the company did not authorise the sale of any of their products to the Roush family.[6] In the legal battles that have continued, Monsanto have rescinded this letter. But the damage has been done. Troy said, "I wouldn't trade $100 million for the damage they've done to our family's reputation."

The family have spent $150,000 to defend themselves, but have not been able to get Monsanto to turn up in court to finish the business. In the meantime, to prevent the possibility of a similar accusation being made again, Troy has taken a radical decision: to plant every acre of his soya crop to (licensed and paid for) GM Roundup Ready beans.[7]

"Farmers are really starting to question the profit enhancing ability of products that seem to be shutting them out of markets worldwide."
Cory Ollikka, president of Canada's National Farmers Union calling for a moratorium on GM crops, December 2000[1]

10 National farm economy

GM crops were meant to have improved the competitiveness of American farming. Instead, they have turned out to be a major burden on the agricultural economy. Not only have GM crops reduced the average profitability of farming but they have made it less market-oriented: as GM crops were being introduced, so the GM market was shrinking. As a result, American farming has become more dependent on state subsidies.

10.1 International trade

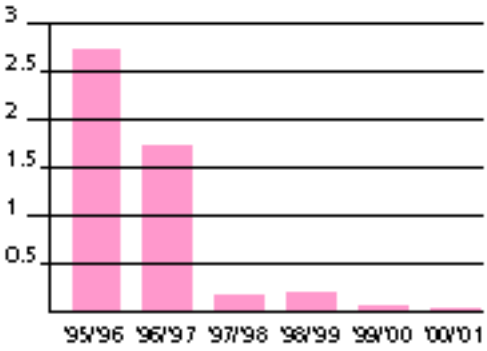
"Biotech corn has already proven to be a market destructor for US corn farmers."
Keith Dittrich, maize farmer and president of the American Corn Growers Association, January 2002.[2]

"It seems there are problems with GMO products in that they cannot be controlled in the field, they cannot be kept separated in the marketing chain and there has been inadequate independent testing of their long-term health effects. I believe the impact these products are having on our trading relationships is very troubling."
Kent Conrad, North Dakota's senator, February 2001.[3]

The most dramatic result of GM crops has been the complete collapse of major export markets. The North American experience has shown that the market for GM crops is much more restricted than it is for non-GM crops; in fact many markets are almost closed to GM produce. GM varieties only account for a part of national production but, without segregation in the industry, they have handicapped the whole trade in those sectors, GM and non-GM, at great cost to the US and Canada.

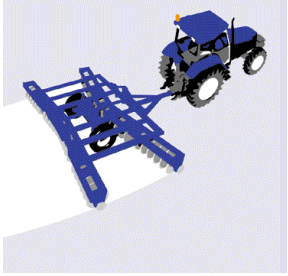
European markets in particular have rejected GM crops. Within a few years of the introduction of GM maize, US maize exports to Europe almost completely disappeared, though three-quarters of US maize was non-GM. From 1996 to 2001, according to USDA data, the value of US maize exports to the EU dropped 99.4 per cent, from $305 million (2.8 million tonnes) to $1.8 million (6,300 tonnes). In total, the US lost an estimated $2 billion in trade with Europe.[4] Canadian oilseed rape suffered a similar fate. Canada is the world's largest exporter of oilseed rape.[5] GM rape was introduced in 1996 and just two years later almost the entire $300–400 million of annual sales to Europe had vanished.[1] The trade for Canadian honey has been almost completely destroyed due to GM contamination.[6] The EU is also the largest US market for maize gluten meal (82 per cent), and US exports to Europe dropped by a fifth, from 5.5 million tonnes in 1995–96 to 4.4 million tonnes in 2000–01.[7]

US maize exports to the EU since the introduction of GM crops (in millions of tonnes)



10.1 **Key points**

- ★ GM crops have turned out to be a market failure internationally and, because of a lack of segregation, they have undermined the total trade in those commodities
- ★ Major export markets have completely collapsed, including the entire $300 million annual US maize exports to the EU and the entire $300 million annual Canadian rape exports to the EU
- ★ The US share of the world soya market has fallen from 57 per cent to 46 per cent while the share of Brazil, which prohibits GM soya, has risen from 24 per cent to 30 per cent
- ★ Almost the entire European food market has banned GM ingredients, and the US and Asian markets appear to be following suit
- ★ While only four countries are significant growers of GM crops, over 35 countries have labelling requirements or other government restrictions on GM crops
- ★ North American farm prices have fallen as a result of the market problems and many US farming organisations are now urging farmers not to plant GM seed this year.



Asian countries have also rejected North American imports. After the StarLink maize fiasco in 2000, Japan and South Korea, the biggest foreign buyers of US maize, rejected US maize over contamination concerns.[4] US maize exports to Japan dropped 52 million bushels in 2001 (1.3 million tonnes).[2] China has also become reluctant to accept GM crops. In 2000, the state of Saskatchewan exported C$123 million of oilseed rape to China, but new regulations requiring proof that GMOs are safe has put this trade in doubt. "As it stands now, we will not be allowed to ship canola into China" said Bill Mooney of Pioneer Grain.[8] China is believed to have cancelled about one million tonnes of maize this year from the US.[7]

Animal feed is the main market supporting the remaining trade in GM crops, but even this large outlet is now shrinking. In May 2001, the USDA announced: "Over the last 12 months, demand for certified biotech-free soybean meal has grown from near zero to 20–25 per cent of the EU market according to officials in the compound feed industry."[1] The US share of the world soya market has now fallen from 57 per cent to 46 per cent.[9]

The importing countries have turned elsewhere for GM-free supplies. Europe is still importing very large quantities of maize but non-GM producing countries such as Brazil and Hungary have replaced US suppliers.[7] Brazil and India are supplying non-GM soya.[1] Brazil prohibits the growing and import of GM soya, and over the last two years its share of the world soya market has risen from 24 per cent to 30 per cent.[9] It is now under intense pressure from Monsanto to allow GM soya to be grown, but the Brazilian government is resisting; its exporters have a profitable trade in non-GM soya.[1] There are now calls from the European farm sector to expand production and supply the domestic GM-free market.[10]

With the loss of markets farm commodity prices have been falling. The farming sector is starting to despair about the effect of GM crops on their trade and the farmers in non-GM countries are exploiting the situation. The main response of the US government has been to try to press other countries to accept GM crops. But farming organisations like the American Corn Growers Association (AGCA) are arguing that this is "Hardly a consumer-oriented approach" and that the best response commercially would be to try to supply market demand.[7] Twenty-six farm groups are now urging farmers to plant non-GM seeds this year to preserve their markets. Fearing Monsanto's planned introduction of GM wheat will destroy the highly valuable wheat market, the US and Canadian wheat sector is now lobbying fiercely against this.[4, 11]

International reaction

The collapse of the North American export trade has resulted from a combination of market rejection of GM food and, increasingly, of GM animal feed as well, and government rules on GM food. These factors have been compounded by the lack of segregation in the industry.

Almost the entire European food retail and manufacturing industry has adopted a ban on GM ingredients in their products (for example, Nestle, Unilever, Heinz, and the major supermarkets).[1] Publicly, the major UK retailers are stressing the non-GM nature of their own brand products, and many of them have also committed to extend their GM-free policies to animal feed for their meat and dairy products (for example Asda, the Co-op, Safeways, Sainsburys and Tesco). A number of Japanese food companies are also adopting GM-free policies.[12] China, which accounts for 12 per cent of the world soya import market has been using GM crops only for animal feed, but has started to pressure soya traders to supply non-GM soya.[1]

Underpinning these market forces are government policies on GMOs. While only four countries are heading down a GM path, there are now more than 35 countries with either laws in place, or in the pipeline, that impose special labelling or import rules on foods with GM ingredients. In total more than half the world's population is covered by restrictions on the use and sale of GM crops, and this is tightening all the time.[1]

Most of these 35 countries have adopted GM labelling rules. They include the EU, Japan (which takes 20 per cent of US food exports), China, Australia, New Zealand, Russia and the Czech Republic.[1] The EU's labelling rules cover food containing GM material, and there are proposals to extend them to also cover food derived from GMOs and GM animal feed sold to livestock producers.[13] In addition, the EU has only approved certain GM varieties for import, which means that bulk shipments containing mixtures of approved and unapproved varieties are not accepted.[12]

At an international level, the adoption of the Biosafety Protocol (signed by the US in 2000) allows importing countries to block GM products on "precautionary" grounds.[12]

Several countries such as France, Germany, Austria and Portugal have banned the import of specific GM varieties; some such as Bolivia and Croatia have imposed total bans on all GMOs.[1] Representatives of the Russian government said in 2000 they would not buy GM crops "unless there was such a desperate need to justify it."[14]

Domestic markets

The US market is now beginning to follow Europe and Asia. First, major health food retail chains such as Whole Foods and Wild Oats rejected GMOs. Now mainstream American retailer Trader Joe's has followed suit as a result of market research: "The majority of our customers would prefer to have products made without genetically engineered ingredients." Other US-based food companies, including Frito-Lay, Gerber, Heinz, Seagram and Hain, have also decided not to use GMOs in their products.[15]

A study by Rutgers University Food Policy Institute in November 2001 also revealed that the vast majority of the US population want GM food to be labelled.[1] So far the only US state to have enacted any laws on GM labelling and contamination is Maine.[16] However, the US congress is now considering GM labelling legislation.[17] The Canadian health minister also called for mandatory labelling of GM food.[18]

Interestingly, the negative market reception to GM maize, rape and soya has been replicated in several other sectors, leading to many proposed new GM crops being abandoned by the biotechnology companies. GM varieties of sugar beet, tomatoes, tobacco, flax, and rice have all been withdrawn after a negative reception from the industry and markets. GM potatoes, for example, were withdrawn from the US market after rejections by McDonald's, Burger King, McCain's and Pringles.[1]

Food aid

With mixed GM and non-GM produce piling up in warehouses, the US seems to be getting desperate to find outlets for its crops. There have been, for example, reports of a major increase in 'veggie-burger' production to use up the supplies.[19] One outlet which does not require segregation has been food aid. More than two million tonnes of food aid is sent directly from the US to developing countries each year. The World Food Programme distributes another one and a half million tonnes on behalf of the US.[20] In December 2000, the US gave $300 million to the Global Food for Education programme, a scheme to deliver 680,000 tonnes of surplus grain to countries in need. It is believed that this action was partly to support the beleaguered maize market after the StarLink crisis.[21]

This aid has not been welcomed by all the recipients. Consumer groups in Bolivia, Columbia and Equador sent samples to a laboratory which revealed levels of GMOs in soya and maize to be as high as 90 per cent. Much of this was in children's foods. Dr Elizabeth Bravo, of Acción Ecológica in Equador, said: "In Europe and the US, many baby food companies don't use engineered ingredients in their products, but the US has sent it to our children."[21] In June 2002 a Bolivian NGO announced that a sample of maize donated by the US as food aid had tested positive for StarLink. "The US considers this genetically engineered corn unfit for human consumption and has banned it for years. Yet it has been sent to Bolivia as food aid" said Gabriel Hervas, president of the Bolivian Forum on Environment and Development.[22]

10.2 **Subsidies**

"Were it not for the… income support payments… that act as a kind of limited economic damage control system… farmers would be feeling a much greater negative impact from the export sales lost as a result of GMOs."
Dan McGuire, policy chairman, American Corn Growers Association, March 2002[7]

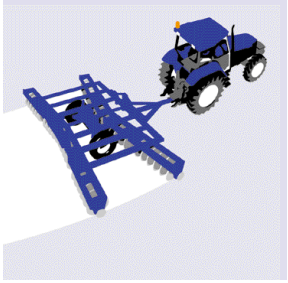
The market failure of GM crops seems to have made the agricultural sectors affected more dependent on state subsidies in the US. GM crops are certainly not the only factor, but federal farm support for these sectors has risen to record levels since their introduction and further high inputs of taxpayers' money have just been agreed.

The introduction, in 1996, of the Federal Agriculture Improvement and Reform Act (FAIR), referred to as the 'freedom to farm act', was intended to herald a major decrease in subsidies over the next seven years and move US farming towards a greater reliance on market supply and demand.[23] In 1997, the USDA predicted that total farm support would fall to $1.2 billion annually by the year 2000.[24]

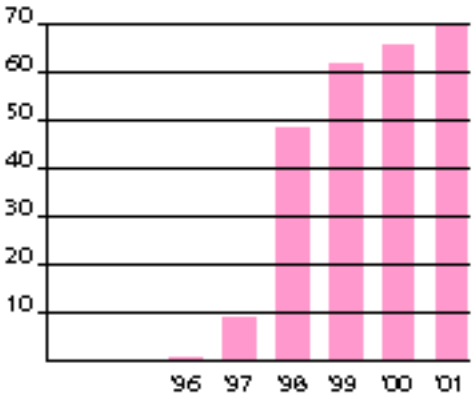
There was, instead, an "orgy of supplemental spending bills" during this

10.2 **Key points**

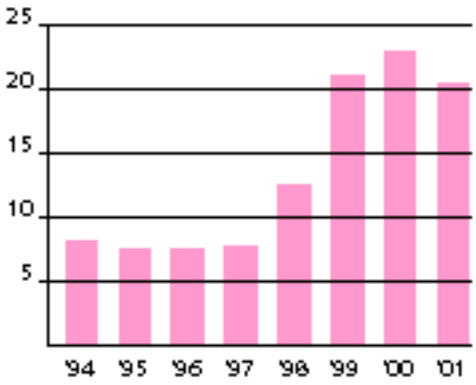
- ★ The market failure of GM crops has made US agriculture more dependent on government subsidies
- ★ US farm subsidies were meant to have decreased over the last six years but increased dramatically in line with the growth in the area of GM crops
- ★ Over this period, a series of emergency 'market loss assistance' schemes were introduced to support farmers
- ★ The soya and maize sectors received 50 per cent of the total subsidies
- ★ The loss of export markets as a result of GM crops may have required extra subsidies in the order of $10 billion over the last few years.



*Area planted to GM maize and soya in the US (in millions of acres)**



*Direct government payments to US farmers (in $billions)**



period, according to the free market think tank, the Cato Institute. Market prices for the crops the subsidy regimes support fell to near historic lows and, as a result, total direct payments to farmers rose from an average of $9 billion a year in the early 1990s to over $20 billion a year since 1998.[23]

Much of this increase came through a series of 'emergency' bills.[23] The emergencies were not primarily drought or floods but low commodity prices and disappearing export markets. Of the many different schemes by which money is passed onto the farming community, the largest is 'market loss assistance' which arrived with the wide uptake of GM crops, in October 1998. Under it, total payments rose from $3 billion in 1999 to $11.1 billion in 2000.[25]

The subsidies are far from evenly distributed across the farm sectors but the sectors with the main GM crops are all generously supported. Fifty per cent of the total subsidy money goes to the soya and maize sectors. Another 40 per cent goes to the cotton, wheat and rice sectors.[25] Soya only came into the equation in 1998, around the time GM varieties started to make an impact but it is now subsidised to 20–25 per cent of the market value of the crop.[26]

GM crops are unlikely to be the only reason why the profitability of US farming fell over the last five years. The opening of farm trade, through NAFTA (North American Free Trade Agreement) in 1994 and the Uruguay Round of the GATT (General Agreement on Tariffs and Trade) from July 1995, is likely to be a major cause. The continued rationalisation of the food and agricultural supply chain up and down stream from the farmers is likely to be another. However, GM crops appear to have been a key contributor. There is certainly a good parallel between the growth in the area planted to GM crops and the amount of money paid to farmers in subsidies (see graphs above).

Some US farm analysts have now concluded that GM crops have partly caused the rise in subsidies. According to the AGCA, as well as the higher priced seed, "the export markets that are lost as a result of GMOs cause even lower grain prices, further reducing farm incomes, while raising farm programme expenditures."[7] The AGCA calculates that the lost maize exports added about 29 per cent to the US's end of year stocks, reducing the average maize price by 13–20 per cent. After excluding subsidies, Dr Benbrook has calculated that maize production losses have exceeded $100 per acre since 1999, and that growers have only been kept afloat by the dramatic increase in subsidies.[29] He estimates that the loss of export markets has required a $3 to $5 billion increase in annual government farm subsidies.[30] This suggests that GM crops may have required total extra government subsidies of the order of $10 billion over the last few years. As GM crops are less profitable than non-GM crops, they must be more dependent than non-GM crops on these subsidies.

Despite subsidies being at record levels, the farm incomes of the majority of US farmers are still very low. Nevertheless, the subsidies have helped to mask the economic failure of GM crops from farmers.

The high levels of agricultural spending are set to continue. In May 2002, the US Senate ratified a new farm bill that will provide a record $180 billion over the next 10 years in subsidy – about 60 cents for each dollar of output, according to USDA figures. Again, this will be almost exclusively for maize, corn, soya, cotton, wheat and rice.[31]

"Farmers are being sued for having GMOs on their property that they did not buy, do not want, will not use and cannot sell."
Tom Wiley, farmer, North Dakota[1]

11 Legal issues

GM contamination has introduced North American farmers to a range of complex legal problems. A morass of litigation in the US and Canada is embracing all levels of the industry: farmers, processors, retailers, consumers, and the biotechnology companies. It includes biotechnology companies suing farmers for the effects of contamination, farmers suing the biotechnology companies for the effects of contamination, and calls from the farming industry for new GM varieties to be banned and new legislation to be introduced.

The legal issues include severe problems connected with alleged patent infringement, with Monsanto demanding money from farmers for the presence of unlicensed GM plants found on their land. It also includes lawsuits following the loss of farmers' sales and concerns over farmers' exposure to liability risks following from contamination.

The level of the problems has been such that it has led to the interest and involvement of Congress. Proposals have been tabled for comprehensive legislation to address the problems of GM crops.

11.1 Patent infringement

One of the most unpleasant outcomes of GM crop contamination is how it has made farmers vulnerable to claims that they have infringed patent rights. While disowning responsibility for the negative effects of contamination, Monsanto is pursuing its rights to its patented varieties vigorously and extensively. Farmers are told they have planted GM varieties and, backed up by the threat of legal action, many have been asked to pay large sums of money. Monsanto has even set up a special telephone number to encourage suspects to be reported to them.

At least some of the claims are contested, and, most worryingly, Percy Schmeiser's case shows that contamination of a farmers' non-GM crop constitutes a patent infringement too. Monsanto also seems to be not just asking for the fee on the proportion of the crop that is GM but for the whole crop.

The examples overleaf and that of Troy Roush (see chapter 9) are rare cases where the farmers have fought back. The most usual outcome is that farmers have agreed to pay the sums demanded. For example, in a 1998 press release, Monsanto listed five examples where they had successfully extracted money from farmers who had been "illegally pirating seed":

- David Chaney from Kentucky agreed to pay Monsanto a $35,000 royalty
- Another Kentucky farmer agreed to pay $25,000
- An Iowa farmer agreed to pay $16,000
- Two Illinois farmers paid $15,000 and $10,000.

As part of the settlements, the farmers have to sign gagging clauses and agree to Monsanto having access to their land for the following years. But as this press release shows, while the farmers are bound to silence, Monsanto has felt free to publicise the 'villains' to the rest of the farming community. The press release also states "other actions taken in 1998 include crop destruction and confiscation of seed."

It appears that Monsanto is currently taking dozens of farmers to court and threatening many more with legal action if they do not agree to pay. It has recently brought actions similar to that against Percy Schmeiser against farmers in North Dakota, South Dakota, Indiana and Louisiana.[5] It is impossible to assess the exact number of people in this situation due to the use of gagging orders with those who have settled.

Percy Schmeiser

In 1998, Percy Schmeiser, a farmer from Humbolt, Saskatchewan was served a lawsuit claiming that he had infringed a Monsanto patent by growing Roundup Ready oilseed rape without a licence. Percy is adamant that he did not grow GM rape and it could only have arrived by contamination. "In my case, I never had anything to do with Monsanto, outside of buying chemicals." If there were any GM plants among his crops, then they threatened to destroy 50 years of his work breeding conventional oilseed rape.

Percy Schmeiser decided to fight. Initially Monsanto said that they had received a 'tip-off' that he was 'brown-bagging', that is saving seed that he had no licence for. This was disputed and in the end the company admitted that there was no evidence of him cheating. But Monsanto still believed he had some of 'their' plants on his land. Indeed they claimed that over 90 per cent of his crop was GM. However, independent tests done for Percy found varying levels of RR rape from zero per cent in most samples, but one with over 60 per cent.

Percy said that he had simply planted his field with seed saved from the previous year, as he had always done. He had noticed, however, many RR rape volunteers growing near a field of a neighbour who had been growing RR rape, and thinks that is how his land became contaminated.

The matter came to court. Percy argued that he had not planted RR rape and if his crop was contaminated, he had in no way benefited, so Monsanto's claim was completely unjustified.

On 29 March 2001, Judge W Andrew MacKay's ruling sent shock waves through the farming community, and left Percy Schmeiser with a bill for some $600,000. The judgement ruled that the "source of the Roundup resistant canola … is really not significant for the issue of infringement" This means that by having Monsanto's GM seed contaminating his land, through no fault of his own, Percy Schmeiser was liable to pay the corporation for the seed's presence and indeed for his whole crop.

Schmeiser's costs were made up of about $250,000 in legal fees, $105,000 in profits that Monsanto claim Schmeiser made on the 1998 crop, $13,500 for technology fees to the company ($15 an acre), and $25,000 in punitive damages. On top of this, Schmeiser says he has spent $160,000 on legal fees and another $40,000 in time, travel and compensation for labour he had to hire when he was away from the farm. He thinks that Monsanto asked for such a large amount to intimidate others from standing up to the corporation.

"My wife always says that if she went down to Monsanto's headquarters and destroyed some of their plants by cross-pollination or contamination, she is certain she would be thrown in jail. Why does Monsanto have such a right? They admitted at my trial that they knew it would cross-pollinate or contaminate" says Percy Schmeiser.

Percy and his wife, both in their 70s, are appealing against the decision. They had been intending to retire before this all started. Now they have been forced into the limelight and asked to speak all around the world of their experiences.[2]

The Nelson Family

The Nelson family has built up a successful farming enterprise, working nearly 9,000 acres of land, in Amenia, North Dakota. When two investigators from Monsanto arrived on Rodney Nelson's doorstep in November 1999, apparently acting on a tip-off, he had no reason to worry. He had used Monsanto products but always followed the agreements.

In 1998 he had grown 62 acres of Roundup Ready soya as a trial run but was very disappointed with the variety's performance. Even if he had been interested in 'brown-bagging', this would not have been the seed to save. In 1999, he had tried a different variety of RR soya over 1,500 acres – about a third of his soya crop.[3] Aside from the $56,240 seed bill, he had paid a technology fee of $18,800 to Monsanto. But the Roundup Ready plants had again yielded poorly. Growing next to fields with conventional varieties, the modified plants yielded up to 12 bushels/acre less.[3]

The investigators set out to sample his fields. They refused to allow Rodney Nelson to accompany them. At the time he was surprised at how little time it took them to complete their work, but that was the last he expected to hear from them.

The letter that arrived in late July the following year from a New Orleans law firm came as a shock. The Nelsons found themselves accused of saving seed by Monsanto. Rodney decided to fight. The more he found out about the way Monsanto had 'investigated' them, the more determined he became to see the case through.

When he eventually managed to get Monsanto to hand over details of the allegations, he found that around 50 per cent of the samples claimed to have been collected by the 'inspectors' were not from his land. One was taken from a field of sugar beet and another was from a neighbour's field twelve miles away. When asked, Monsanto refused to say what percentage of Rodney's land had been found to have Roundup Ready soya.

Rodney also looked at what the inspectors had claimed to have done in their search – and found that it would have been physically impossible to cover all the ground claimed in the time they spent on his land.

So he was surprised that Monsanto persisted in claiming he had been pirating seed. In mid-October 2000, the company filed a lawsuit against the family, suing them for planting saved Roundup Ready soya. Rodney then spent a small fortune collecting evidence to counter their claims. As it turned out Monsanto gave in – settling the case, but still managed to get a gagging clause over the Nelsons. All Rodney was able to say was that "we are still hurting, emotionally and financially."

He would have liked to turn down the Monsanto offer and have his case vindicated in court. But with his father seriously ill, he felt he could not continue with the traumatic process.[4]

How demands for payment are made

There seems to be a well-established procedure by which seed piracy is alleged. Farmers and seed suppliers are encouraged to contact Monsanto if they have any information about suspected seed piracy. A freephone number has been specially set up in the US: 1-800-ROUNDUP.[6] When called in February 2002, Gail Outtrim of Monsanto admitted it was a 'snitch line'. It was made clear that any information given by suspicious farmers would be treated in absolute confidence. "If you see a neighbour keeping seed, you can call us, anonymously, and give us the details … We may get a call from a retailer who has noticed that a farmer is buying Roundup the year after buying Roundup Ready seeds."[7]

Hired inspectors arrive at farms to take crop samples for testing. Scott Good, a soya farmer from New Jersey described their arrival: "They showed up at my door at six o'clock in the morning. They flipped a badge out. It wasn't polite what they were saying. They acted like the FBI. I was scared."[8] It seems they usually refuse to be accompanied by the farmer.

The next stage is a letter from the company lawyers making a clear set of demands, backed up with the threat of prosecution. In November 1998, a letter was sent to an elderly farmer in Saskatchewan, who has asked to remain anonymous. The letter was from Keith MacMillan, director of legal affairs at Monsanto Canada. He stated that Monsanto had completed their investigation of the farm, with the help of Robinson Investigation Ltd, "and have very good evidence to believe that Roundup Ready Canola was planted on approximately 250 acres of land … in violation of Monsanto's proprietary rights … Prior to making any final decision as to what steps we will be taking, and in an attempt to resolve this issue in a timely and economical manner, we are prepared to refrain from commencing any legal proceedings against you subject to the following:

- You forthwith pay to Monsanto the following sum, 250A x $115/A = $28,750
- You acknowledge Monsanto has the right to take samples from all your owned or leased land and storage bins for three years from the date of this letter
- You agree not to disclose the specific terms and conditions of this settlement agreement to any third party
- You agree that Monsanto shall at its sole discretion have the right to disclose the

Carlyle Moritz

On 23 January 2002, Aaron Mitchell, the intellectual property protection manager of Monsanto, wrote to Carlyle Moritz, a farmer from Bruno, Saskatchewan. The letter stated that as a result of an investigation carried out by Robinson Investigations the previous year, "Monsanto has concluded that Roundup Ready canola was improperly planted on 140 acres." A specific location was cited.

Carlyle Moritz is one of the farmers who testified on behalf of Percy Schmeiser. He had felt it prudent to take a few precautions in the event of Monsanto taking action against him. So his attorney responded with a letter that indicated his preparedness. "In response to Mr Moritz's belief that Monsanto might attempt to set him up, and in accordance with legal advice, he took several steps to protect evidence in order that he could adequately defend himself."

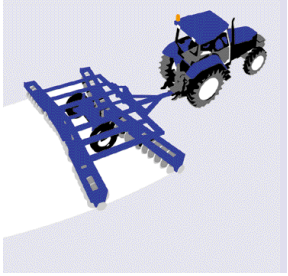
These steps included the use of independent agronomists to visit the farm and retain samples of the seeds that were sown, and getting an independent record of the type of grain sown, the acreage involved, and the GPS measurements indicating the locations.

This allowed the attorneys to point out to Monsanto that their figures were extremely inaccurate. For example, the field in question only had 84 acres planted, 34 acres seeded to non-GM oilseed rape and another 50 acres seeded to wheat in 2001. So how they determined that there were 140 acres planted to GM oilseed rape on the field is a mystery.

The attorneys conclude that "the acreages are ludicrous, the testing appears to be inaccurate … Please be assured that any further attempts to obtain payment or litigation will be met with full legal defences, including a claim for punitive damages based on the apparent disregard for any factual basis for the claim."[2]

11.1 Key points

- ★ Monsanto is accusing many farmers of growing unlicensed GM crops and demanding large sums of money or threatening legal action
- ★ Even non-GM farmers whose crops become contaminated can be successfully sued – whether they intentionally grew unlicensed seeds or had their crop contaminated is considered irrelevant under Canadian law
- ★ At least some of these claims seem to be unfounded. Some farmers have contested the claims; most have paid Monsanto up to $35,000
- ★ The accusations have far-reaching effects, with company inspectors taking crop samples, payment demands by company lawyers, gagging orders, and the farmers being required to let the company inspect their farms for the next few years
- ★ Monsanto has set-up a 'snitch-line' to encourage farmers to report on neighbours whom they suspect
- ★ To defend themselves, some farmers are now paying for independently verified crop samples and monitoring of their activities.



facts and settlement terms associated with the investigation and this settlement agreement."[9]

As Rodney Nelson explained, it does not matter how much of the GM variety is present: "They don't test for a percentage, they just test with an 'elisa' test which gives them a 'yes' or 'no'. In other words you could have a sample of 1,000 beans that were non-GMO and have one bean in there that was GMO and Monsanto would get a positive test and you would be infringing on their patent. At least that's what they claim when they are suing you."[10]

In the above instance, the farmer fought and had the case against him dropped. Only one case has been argued through in court, Monsanto vs. Percy Schmeiser. This ended with the judgement being based not on the origin of the GM plants but simply their presence, and the judge favouring the biotechnology company. The case studies show that even if a claim is unjustified, the decision to contest the company's claim can be very expensive, painful and high risk.

A legal quagmire for farmers

If a farmer grows a GM crop without paying a technology fee to the biotechnology company that developed and patented it, they can be accused of stealing the intellectual property of that company. The farmer is infringing the company's patent. On the same grounds, farmers growing GM crops are prohibited, by the technology agreements they sign with the companies, from saving GM seed from the harvest for the following year. They have to buy new seed each year. No doubt some farmers have saved GM seed illegally; after all, saving seed has been a traditional practice in farming for a long time.

However, the farmer could easily be innocent. They could have bought some seed that someone else had saved in breach of contract, or their field might have become contaminated through airborne pollen or seeds, through hired machinery, new livestock, floodwater, or through volunteers from a previous licensed GM crop. As this report has shown, widespread GM contamination of crops is inevitable when GM crops are widely grown in a region. Farmers growing GM crops are especially vulnerable as the technology agreement allows the companies access to their land, and they may already be struggling with GM volunteers.

The Schmeiser case raises a very serious problem. If the way the seed arrives is deemed immaterial, then farmers in North America can be held accountable for the air or insect-borne transfer of patented varieties. Though they are not intentionally growing the GM crop, they can still be held responsible for GM plants appearing on their land. A non-GM farmer has few means of preventing contamination if he is in a GM growing area. The strategies that he could employ to mitigate the risk, such as planting hedges and changing his rotation, are not foolproof and would be at a cost to him. Indeed, the affected farmers feel that they are the injured party if their land has been contaminated, particularly if they are trying to supply the GM-free or organic markets or control GM volunteers.

Professor Anne Clark, from the University of Guelph, believes that the whole issue of contamination raises a legal and practical conundrum for farmers:

> "To appreciate the gravity of the choice on offer, you need to appreciate how Monsanto's hired investigators operate. They come to the door, advise you that you're suspected of brown-bagging, and offer you a letter stipulating what you must pay to avoid being formally prosecuted. Should you choose to pay the fee, you are also obliged to sign a letter which states that signing obliges you to remain silent and tell no one about what has happened, or face further prosecution.
>
> Let's say you know that you have one or more of Roundup Ready, Liberty Link, Navigator/Compas or SMART canola on your land. You know this because, like Schmeiser, the plants didn't die when you used the corresponding herbicide. So – what do you do? Do you call up the company … inform them that you have infringed upon their respective patent(s), and ask them to come out for a visit – then hope they arrive with a sprayer and not a subpoena? If the latter, no one will ever know, will they? Or do you wait for a neighbour to report you for suspected brown-bagging, using the anonymous hotline set up by Monsanto for that purpose?
>
> If the respective companies come out and actually do spray out the offending plants, do you call them back again a few weeks later, when late germinating canola has emerged in your wheat or pea crop? Will they compensate you for damage done to your crop in the process?

Arnold Taylor

Organic farmer, and president of the Saskatchewan Organic Directorate, Arnold Taylor has had to abandon growing oilseed rape on his 3,500 acre farm in Saskatchewan. This costs him C$20,000 a year as a direct loss and also restricts his crop rotation choices.[12]

The Stiegelmeiers' neighbour

Jim and Emily Stiegelmeier farm in South Dakota. They reckon that 85 per cent of the soya and at least 60 per cent of the corn in the state are now GM varieties. A neighbouring organic grower had a crop that could not be sold to the organic market as a result of contamination. He received a 'no-blame' compensation deal – there was no admission of liability.[13]

> What if it was canola you were intending to plant in the contaminated field? You know that you will not be able to distinguish volunteer HT canola from whatever canola you've planted. You know that volunteer HT canola will set seed and shatter … re-contaminating the land with patent-infringing seed. Where you had one HT plant this year, you could have dozens next year. So – do you abstain from growing canola entirely?
>
> Do you take responsibility yourself for eliminating the proprietary plants? Do you adjust your crop rotation, your herbicide expenditures – and your bottom line – to cope with contamination that you did not want and could not stop, and that will reoccur annually so long as neighbours choose to grow HT canola?"[11]

The options open to the farmer who is then faced with an unfounded or unjustified claims, are even more unpleasant. Farmers can either pay a considerable sum, or contest it. If they chose the latter, they will be locked into a complex, demanding and uncertain legal battle with a powerful company for years. From the case studies, it appears that the only way for a farmer to be able to defend himself against a claim, is to keep detailed and independently verified records of all his relevant cropping and agrochemical actions. While this effort was well justified in the case of Carlyle Moritz, it does not seem reasonable that all farmers should have to do this.

Contamination has very serious implications, for farmers growing GM crops and those trying to avoid them. The very presence of unwanted crops can result in legal action against the farmer who has suffered contamination. For farmers who fear an accusation of patent infringement, they may feel the most practical approach is simply to grow GM crops and leave no doubt, as Troy Roush did (chapter 9). Perhaps the continued large acreage of GM crops is partly to do with farmers being locked into a situation they feel they cannot escape from, rather than any real desire to be growing GM crops.

11.2 **Compensation**

As contamination spreads and the markets for guaranteed GM-free and organic products continue to grow, more and more farmers are losing business. There is a growing movement of farmers in North

Saskatchewan Organic Directorate class action

The Saskatchewan Organic Directorate (SOD) is one of Canada's leading organic sector groups. On 10 January 2002 two SOD members, Larry Hoffman and Dale Beaudoin, launched a class action against Monsanto and Aventis on behalf of all certified organic grain farmers in Saskatchewan.[14] They are seeking compensation for damages for financial loss from the destruction of the province's organic rape market that resulted from the spread of RR rape into organic varieties. They are also seeking an injunction to prevent Monsanto from introducing GM wheat into the state.[15]

Also on the table is the possibility of including the federal government in the suit because of its role in allowing the introduction of transgenic crops, said Terry Zakreski, the lawyer representing the SOD.[16]

Their claim alleges that GM oilseed rape has "spread across the prairies and contaminated conventional crops so extensively that most certified organic grain farmers no longer attempt to grow canola."[15]

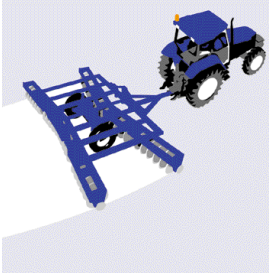
It goes on to say "when Monsanto and Aventis introduced their GE canolas they knew, or ought to have known, that the genetically engineered canola would spread and contaminate the environment. The companies had no regard for the damage these crops would cause to organic agriculture. The claim alleges that the loss of canola as an organic crop has robbed organic farmers of a high paying and growing market."[15]

The suit seeks to hold Monsanto and Aventis responsible for the economic damages of GM contamination on multiple grounds including negligence, nuisance, trespass, pollution and failure to conduct an environmental assessment.[15] Estimates for the damages run into millions of dollars.[14]

11.2 Key points

★ Farmers are turning to the courts for compensation from the biotechnology companies for the loss of sales and markets as a result of contamination

★ In Saskatchewan, a class action has been launched against Monsanto and Aventis for the loss of nearly the whole organic rape sector in the province.



America now turning to the courts to seek compensation. In the US in 2001, the National Farmers Union adopted a policy on GMOs which said that market losses must be fully reimbursed to the farmer. In Canada, the Saskatchewan Organic Directorate launched an even more ambitious project at the beginning of this year on behalf of the whole organic sector in Saskatchewan for damages for the loss of the whole organic rape market.

11.3 **Liability**

"If I contaminate my neighbor's property, I am held responsible. Farmers need legal protection to ensure that if the biotech industry contaminates their crops with GMOs, the industry is held responsible."
Tom Wiley, North Dakota Farmer[17]

Farmers considering the costs and benefits of growing GM crops have to factor in many legal liability issues. Monsanto is clear about its liability: in its 2000 technology guide, it states: "In no event shall Monsanto or any other seller be liable for any incidental, consequential, special or punitive damages … the limit of the liability of Monsanto … shall be the purchase price paid by the user."[19]

Many things can go wrong with GM crops as a result of contamination and farmers are vulnerable to being held accountable for these. The Farmers' Legal Action Group, a non-profit law advisory centre based in Minnesota, says the risks of liability for farmers growing GM crops or in an area with GM crops include:

- Tort-based liability – such as claims of damages from a neighbouring farm which has suffered economic losses from genetic drift and crop contamination. This could be based on claims of trespass, through GM pollen crossing the boundary of his farm. Alternatively, it could be based on private nuisance, through the pollen drift interfering with the use of the farm or decreasing its value
- Contract-based liability – this could result from breaching a clause in the technology agreement signed by the farmer, for example, by the farmer saving GM seed or having a contaminated crop, not planting a buffer zone, or not preventing the sold GM crop from later co-mingling with and contaminating non-GM produce. It could also result from a farmer's sales contract,

StarLink Bt maize

The legal fall out from the StarLink contamination crisis in September 2000 has affected farmers, the food industry, consumers and Aventis, the biotechnology company which developed the maize. By November 2001, nine class actions had been filed against Aventis, as individuals and companies tried to recover millions of dollars in losses and costs.

Farmers in Wisconsin who lost money due to the fall in maize prices following the crisis have filed a class action (Southview Farms vs Aventis). In another class action (Mulholland vs Aventis), farmers are suing for the domestic and foreign markets that they claim were lost because Aventis failed to prevent StarLink maize from entering the food supply. They are alleging public nuisance, consumer fraud, deceptive business practices, and negligence.[14]

Consumers have brought a class action against Aventis and several food companies, based on the allergic reactions that have been suffered. In a recent settlement the companies agreed to pay $9 million. Companies involved in the lawsuit included Kraft Foods, Azteca Foods and AstraZeneca affiliate Garst Seed.[18]

Thousands of Taco Bell restaurant franchises and other Mexican food companies have filed another class action against Aventis. They claim that the discovery of StarLink in their products resulted in the company becoming the "Poster child for concerns about GMOs."[5]

However, liability is very unclear in the StarLink case and farmers could find themselves held liable for damages. Aventis had meant to get farmers to sign a grower agreement requiring them to plant 660 foot buffer strips of non-StarLink maize around the fields and explaining that the maize was not approved for human consumption. However, many farmers claim that they were unaware of a marketing restriction and many agreements were not signed before planting. Also, StarLink maize was in many cases planted directly next to a neighbour's non-StarLink maize. Many of these then tested positive for the StarLink Cry9C protein.[5]

Just one per cent of the national corn harvest contaminated almost half the total US maize supply, which leads to some difficult legal questions. Who is liable for contaminated maize 'infecting' entire shipments of maize? Who is liable for the contamination not being picked up until the maize had been processed into a wide range of products? Who is liable for StarLink crops contaminating neighbouring crops of non-StarLink maize?

11.3 Key points

- ★ Nine class actions have been filed against Monsanto following the StarLink contamination incident
- ★ Two are by farmers for the fall in maize prices and the loss of domestic and export markets that followed
- ★ Farmers themselves may face legal challenges for problems caused by contamination
- ★ GM farmers could be held liable for contaminating the non-GM crops of their neighbours or for not preventing contamination of non-GM crops in the supply chain
- ★ Non-GM farmers could be held liable for patent infringement or breach of a GM-free sales contract
- ★ The food and farming industry are now discussing the need for an agreed framework for GM liability.

for example, for supplying GM contaminated crops on a GM-free contract

- Regulatory liability – this would apply to non-GM farmers whose crops become contaminated by GM varieties and are considered to have infringed company patent rights as a result of having unlicensed plants on their land.[5]

Frameworks for GM liability

The food and farming industry in North America is now discussing the need for a framework that establishes where liability lies for GM contamination incidents. The lack of a clear framework has meant striking inconsistencies have developed and farmers are very uncertain about their legal position. On the one hand, a contaminated crop is a liability for farmers, who can be sued by the biotechnology companies for having unlicensed GM plants on their land. On the other, farmers who have had crops contaminated are holding the biotechnology companies liable for the loss of their markets.

A framework would also mean that farmers, the industry and the government can avoid unreasonable financial costs and have means of redress. Farmers are angry that the biotechnology companies are having it both ways: claiming their economic rights to GM varieties even when they are spreading by contamination, whilst disowning liability for the negative impacts of their spread on the income of farmers.[17]

Congress is now considering a bill on liability (see chapter 11.5). Last year at least four states considered legislation on GM liability. Not surprisingly, the biotechnology industry was very active in challenging these.[20]

Strategies for managing the legal risks of contamination were also considered at a conference in Minneapolis in November 2001, which included the USDA, academia and the biotechnology industry. One recommendation was the establishment of an indemnity fund to cover the market losses caused by contamination of non-GM and organic crops, possibly through a federal crop insurance programme. Alternatively, the biotechnology companies could indemnify farmers against liability in the event of a contamination lawsuit. Another recommendation was the establishment of a standard of behaviour for GM farmers, including to identify the duty of care they owe neighbours who grow non-GM crops.[14]

11.4 **Legal bans**

"By the time it became evident to everyone that we were losing EU markets, it was basically too late…When they announced they were going to apply the GMO process to wheat, alarm bells went off."
Todd Leake, North Dakota wheat farmer and backer of state legislation prohibiting GM wheat.[21]

It is not just the organic sector but groups from the whole farming sector in North America that are trying to prevent the introduction of GM wheat. Having seen the severe economic problems with GM rape, maize and corn, the whole wheat industry in the US and Canada has been lobbying desperately for ways to prevent the same thing happening to wheat, the most valuable farm sector. They have been pursuing this in a number of different ways.

In Canada, as well as the SOD class action, more than 210 groups including the National Farmers Union and the Canadian Wheat Board demanded the halt of the approval of GM wheat last July.[23]

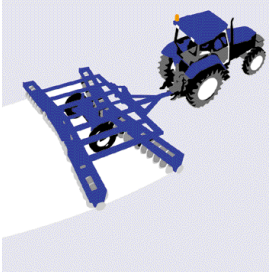
In the US, North Dakota and Montana farm representatives have sought legislation restricting GM wheat production. Terry Wanzek, chairman of North Dakota's senate agriculture committee said: "These bills are surfacing in North Dakota because of a genuine, sincere concern for the market. Our major wheat customers say they won't accept any wheat that has genetically enhanced characteristics, and we're listening to our customers."[24] In South Dakota, state senator John Koskan is working on a resolution that would prevent farmers in the state growing GM wheat.[25]

In 2001 the US National Farmers Union adopted a policy supporting a moratorium on the introduction, certification and commercialisation of genetically engineered wheat until issues of cross-pollination, liability, commodity and seed stock segregation, and market development are addressed.[26]

There are already precedents for state bans on crop varieties which threaten the trade or genetic purity of existing crops in the US. California has been requiring pre-market permits for new rice varieties and not approving those which are unapproved for export, as a way of preventing co-mingling of approved and unapproved varieties. Over 30 years ago, California outlawed some cotton varieties to maintain the genetic purity of the cotton being grown there.[27]

11.4 Key points

- ★ The North American farming community is now actively opposing the planned introduction of GM wheat
- ★ More than 200 Canadian groups, including the National Farmers Union, Wheat Board and organic farming bodies are seeking a halt to the approval of GM wheat
- ★ In the US, the NFU supports a moratorium on GM wheat and legislation banning GM wheat has been sought in some states
- ★ There are already precedents for state bans on crop varieties which threaten the trade or genetic purity of existing crops in the US.



Wheat

Across the prairies, wheat is the most important crop. Nearly 70 per cent of Canadian wheat and more than 50 per cent of US wheat is exported.[28] Currently wheat exports from Canada are over seven million tonnes a year, accounting for C$5 billion annual exports.[29] It would be devastating if the wheat industry were to suffer similar losses as the maize and oilseed rape sectors. If some of the wheat crop was GM, it would be a nightmare for the industry to manage adequate segregation after harvest.[30] For organic farmers, wheat is a major crop and essential for organic crop rotations. Losing wheat to GM contamination could destroy North American organic farming.[15]

It seems that the market will not accept contaminated or GM wheat. According to Canadian Wheat Board estimates, two-thirds of international buyers do not want to buy genetically modified wheat. A survey of the US customer base for hard spring wheat indicated that 65 per cent are opposed to GM wheat.[28] According to the American Corn Growers Association, European millers have described GM wheat as a 'market destructor' for the US.[31]

Agricultural economist Hartley Furtan has made an assessment of the likely impacts of growing RR wheat. He concluded that while there might be a small direct economic benefit, this would be swamped by the loss of premiums, costs of testing and segregation and having to rely on lower market prices.[32]

Monsanto has now pushed back its planned introduction of GM wheat from 2003 to 2004 or 2005 and has said publicly that it will only do so if it can first gain pre-acceptance from buyers.[24]

11.5 **Legislation**

"This technology is totally different from traditional breeding techniques… Current laws… were not written with this technology in mind."
Dennis Kucinich, congressman, May 2002, primary sponsor of new US legislation to regulate the GM sector.[33]

The severity of the problems with GM crops over the last few years has now convinced many US politicians that the issues require resolution at a national level. On 22 May 2002, legislation was introduced to Congress to address the economic, market and legal problems of GMOs. The five bills would

Saskatchewan Organic Directorate class action

The lawsuit by the Saskatchewan Organic Directorate (SOD) not only claims for economic damages already done, it seeks to prevent further trade losses. To prevent the loss of the organic wheat market as well, it is seeking an injunction on the release of GM wheat.

The organic community views the arrival of GM wheat with fear. Currently wheat is the most important grain grown by certified organic grain growers in Saskatchewan, and their largest export. Arnold Taylor, president of SOD said "If [GM] wheat were allowed, it would decimate the organic industry."[12]

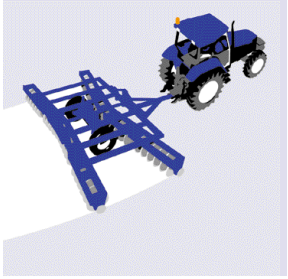
In a presentation to the Canadian House of Commons, the group said:

"This is a situation that needs immediate attention … If crops free of unintended genetic contamination cannot be grown, Canada will not be able to service the expanding markets for certified organic food. If GE wheat is allowed to be registered for continued confined trials and especially for unconfined release into the Canadian environment, there will be very negative impacts on certified organic food production."[22]

Saskatchewan farmers feel they have no choice but to take legal action. Arnold Taylor says "We've been forced to live with GE canola. We've asked for a moratorium on GE wheat, we've lobbied to change the variety registration process, and we've just hit a brick wall. We feel we have no choice left but to pursue legal action. This is a matter of survival for organic agriculture in Saskatchewan."[15]

11.5 Key points

★ In May 2002, legislation was introduced to the US Congress to address the problems of GM crops
★ One bill will introduce protection for farmers, allowing the saving of seed and compensation for crop failures
★ One bill will require all GM food to be labelled
★ One bill will make the biotechnology companies liable for all negative impacts of GMOs.



introduce legal protection for farmers, increase GM food safety, introduce mandatory labelling for all foods containing or produced with GMOs, address developing country issues, and assign liability for damages. The bills have been endorsed by the National Farmers Organisation, the Center for Food Safety, Organic Trade Association and the American Corn Growers Association. A summary of three of the bills is provided below.

HR 4812: The Genetically Engineered Crop and Animal Farmer Protection Act of 2002
A bill to provide additional protections for farmers who may be harmed economically by genetically engineered seeds, plants, or animals, to ensure fairness for farmers in their dealings with biotech companies that sell genetically engineered seeds, plants, or animals, and for other purposes.

This bill provides several farmer rights and protections to maintain the opportunity to farm:

- Farmers may save seeds and seek compensation from biotechnology companies for failed genetically engineered crops
- Biotechnology companies may not shift liability to farmers, nor require access to farmers' property, nor mandate arbitration, nor mandate court of jurisdiction, nor require damages beyond actual fees, or any other unfair condition
- Farmers must be informed of the risks of using genetically engineered crops
- Seed companies must ensure seeds labelled non-GE are accurate and provide clear instructions to reduce cross pollination, which contaminates other fields
- The Environmental Protection Agency is required to evaluate the concern of Bt resistant pests and take actions necessary to prevent resistance to Bt, an important organic pesticide.

HR 4814: The Genetically Engineered Food Right To Know Act of 2002
A bill to amend the Federal Food, Drug, and Cosmetic Act, the Federal Meat Inspection Act, and the Poultry Products Inspection Act to require that food that contains a genetically engineered material, or that is produced with a genetically engineered material, be labelled accordingly.

This bill acknowledges consumers have a right to know what genetically engineered foods they are eating:

- Requires food companies to label all foods that contain or are produced with genetically engineered material
- Requires the Food and Drug Administration to periodically test products to ensure compliance (a threshold of one per cent is established for accidental contamination)
- Voluntary, non-GE food labels are authorised
- A legal framework is established to ensure the accuracy of labelling without creating significant economic hardship on the food production system.

HR 4816: The Genetically Engineered Organism Liability Act of 2002
A bill to assign liability for injury caused by genetically engineered organisms.

- The bill places all liability for negative impacts of genetically engineered organisms upon the biotechnology companies that created the genetically engineered organism
- Farmers are granted indemnification to protect them from the liabilities of biotechnology companies
- The bill prohibits any transfer of liability away from the biotechnology companies that created the genetically engineered organism.

12 Discussion

12.1 Results

Until now most public statements about GM crops in North America have been positive. The US government and the chemical companies have stressed the widespread growing of GM crops and absence of reported problems as evidence of the desirability and safety of GM crops. As a result, some farmers' leaders in the UK have expressed concern about the UK being left behind in growing GM crops.

We have not set out to do a comprehensive survey of all experiences of North American farmers with GM crops. We wanted to see if the industry view that GM crops have been an unqualified success was true or not. We therefore sought out negative experiences and not positive ones.

The results of our research have been far more dramatic than was envisaged. We have uncovered a great variety of negative experiences for both those avoiding and those growing GM crops. These reveal fundamental problems with GM crops for the whole agriculture sector. The wider impacts of GM crops have been particularly surprising, and, until now, unpublicised.

The evidence we have uncovered shows that, however numerous the positive experiences are, the introduction of GM soya, maize and oilseed rape has been an overall failure. The failures have been on several levels, but particularly economic. We cannot identify any net benefits except the apparent convenience of HT and Bt crops. Most worrying, GM crops have been critically disruptive for the organic sector.

For farmers considering growing GM crops, the crops have not, overall, delivered on their promises of higher yields, better returns and lower agrochemical use. The only exception is Bt maize yields, though there was no net income benefit. In most cases they have performed worse than non-GM crops, including substantially lower yields for RR soya. The greater freedom to use herbicides repeatedly and the weed and volunteer problems of HT crops, must be a cause of concern for the future. The lost trade, fall in market prices, the decline in farmers' choice over their farming options and the legal liability problems have been major unexpected problems for all farmers.

Particular problems have emerged for each of the three GM crops we studied:

- *RR soya*
  At least six per cent lower yields, greater reliance on herbicides, new emerging weed problems, and plant health and structural problems in certain conditions
- *Bt maize*
  Practical constraints on growing Bt maize, lost export markets, and possible animal feed problems
- *HT rape*
  Greater herbicide use, herbicide resistant volunteers, end of most organic rape production in Saskatchewan, lost export markets.

The most serious problem that this report has uncovered is the widespread contamination which has undermined the viability of the whole farming industry. We are greatly concerned that the organic sector has been severely hit, with one Canadian province having almost lost its whole organic rape sector, many organic farmers having lost sales income and all struggling practically and economically with the effects of contamination on their businesses. In our research, we found that the organic farming community felt that they were in a critical situation. They were glad of the robust approach that Europe was taking on GMOs and hoped it would help them in North America. John Koskan, state senator for Wood, South Dakota and also an organic farmer said "The Europeans are driving this issue, and I thank them for that."[1]

Contamination has significantly increased the costs and risks of the whole industry. Non-GM farmers have found it hard, or impossible, to grow GM-free crops and access the GM-free markets for soya, maize and rape. For those that try, there is the risk of losing the sale. The threat of being accused by a biotechnology company of infringing their patent is a particularly unpleasant problem to have emerged.

The most dramatic outcome of GM crops has been the disruption to the food and farming economy. Not only have GM farmers found their crops fetching lower prices than non-GM crops, but the fall in market prices from the billions of dollars in lost trade as

a result of the lack of segregation must be a great concern. This has required roughly $10 billion in extra farm subsidies to keep farmers, particularly GM farmers, afloat over the last few years. Contamination has been a major burden on the food industry too, with the StarLink incident costing the companies involved well over a $1 billion. The only helpful aspect has been the market premiums for non-GM crops, which will be helping to offset the price fall for those growing non-GM crops. In total, with the lower profitability of GM crops, the loss of foreign trade, the lower market prices, the costs of StarLink and other incidents, the farm subsidy rise, and the lost IP and organic market opportunities, GM crops could have cost the US economy some $12 billion net from 1999 to 2001.[2]

Many of the contamination problems can be ascribed to inadequate crop separation distances and a lack of segregation in the distribution system. Though these issues are now being addressed, the costs are being borne by the whole industry, not just the GM sector, and the measures have yet to prove themselves. Overall, this report confirms the findings of the European Commission study on the theoretical risks, published earlier this year. This concluded that the introduction of GM crops would be very expensive for the European farming industry, due to the costs of managing contamination. It stated that producing GM-free crops would be extremely difficult even with significant changes in farming practice and compliance with a one per cent adventitious contamination threshold in non-GM crops could add 1–10 per cent to production costs.[3] In other words, the real and theoretical evidence is that GM crops disrupt GM-free production and greatly reduce overall agricultural competitiveness.

The ultimate confirmation of our findings must be that so many in the North American farming community are now opposing GM crops, lobbying for a moratorium on GM wheat and urging farmers to plant non-GM crops, or supporting federal labelling and liability rules to regulate the GM sector .

12.2 Why are farmers growing GM crops?

Our conclusion that GM crops have been negative for farmers and the industry in general calls into question, why so many North American farmers adopted GM crops and are still growing them. Our research has provided several possible explanations which we believe together account for the current situation:

- Initial farmer ignorance over GM crops and a very bad economic situation made farmers vulnerable to the promises being made by the biotechnology industry
- Some farmers have recounted that initially they were not told that the seed they were buying was GM – they were simply told it was a new hybrid and they did not sign any agreement prohibiting the saving of seed[4]
- The availability of many of the most popular seed varieties only in GM form after the biotechnology companies bought the leading seed companies
- Some farm businesses have experienced yield, agrochemical and overall income benefits from GM crops depending on the conditions in that area or year
- The greater convenience of HT and Bt crops, and the culture of farmers of aiming for completely weed-free fields has been assisted by HT crops
- A lack of awareness of the agronomic and market problems. Farming is an irregular business with many variable factors outside the control of the farmer, so agronomic or market problems over a few years would not necessarily be ascribed to GM crops
- The herbicide price war, apparently involving subsidised chemicals being offered to farmers, has offset the costs of higher herbicide use
- Continued heavy marketing by the biotechnology companies of the supposed benefits of GM crops. According to Shannon Story, women's president of the Canadian NFU , "the increase in acreage is the result, more than anything, of a lot of salesmanship"[5]
- A shortage of independent information – farmers need independent information to be able to judge the pros and cons of a technical development
- The 'lock-in' effect. Many factors have meant that it is not easy for GM farmers to stop growing GM crops: the shortage of good non-GM varieties, crop contamination risks, the lack of access to premium GM-free markets, and the accusations of patent infringement. The latter may have the effect of making farmers grow more GM crops, as growing less would not necessarily reduce the problems farmers face, while growing more GM crops under licence reduces the potential for dispute.

- The gagging orders used by the biotechnology companies, after patent infringement allegations, have hidden the scale of these problems from other farmers
- Farmers were told by the US government and the biotechnology companies that the international market problems were due to foreign governments putting up barriers to trade, and that the US government was addressing this. They were not told about the safety concerns and market rejection
- The ready provision of substantial extra subsidies by the US government, has masked the economic problems of GM crops.

12.3 HT crops and the biotechnology companies

It is helpful to understand the importance of HT crops to the biotechnology companies. These companies are major producers of agrochemicals. Hence the dependence of the current GM varieties on their products and the probability that HT crops will not significantly reduce the use of herbicides. Glyphosate is the world's highest selling herbicide and its sales are of fundamental importance to Monsanto. The company developed and introduced the chemical nearly 30 years ago, and has since been built on it. In 2000, Monsanto gained about half its agricultural revenue from glyphosate, some $2.8 billion.[6]

Monsanto's US patent for glyphosate, however, expired in 2000, meaning that other companies can produce the chemical, which is why herbicide prices have fallen. The technology agreements make up for the price fall. Farmers of HT crops have to pay for these and they also bind them to using the company's own brand of glyphosate. In the case of Monsanto, this is Roundup. Roundup Ready crops were the centrepiece of Monsanto's strategy to ensure its continued sales of glyphosate.[7] While publicly telling farmers that RR crops would reduce their use of herbicides, behind the scenes the company increased its production of glyphosate to coincide with the release of RR crops.[8]

To ensure an unobstructed market for their HT crops, the biotechnology industry also successfully lobbied for higher levels of glyphosate residue to be allowed on soyabeans. In 1997, the UK government raised the maximum permitted residue levels (MRL) of glyphosate on soyabeans for human consumption 200 fold.[9] The new level is 20 mg/kg.[10]

12.4 What the biotechnology companies say

The biotechnology industry has a number of arguments for their proposition that GM crops have been successful:

- They must be successful because so many farmers are growing them. This is possibly the industry's favourite argument. The list in 12.2, however, provides many less positive reasons why farmers are growing GM crops so widely in North America
- A recent industry sponsored study said that US yields have increased by 1.8 million tonnes, with Bt maize accounting for 1.5 million tonnes.[11] It is true that Bt maize has increased yields by about 2.6 per cent on the circa 25 per cent of the total maize area on which it is grown, but this was not enough to cover the higher production costs of Bt maize. Though 1.5 million tonnes is only 0.6 per cent of the total maize grown in the US each year, with the lost export markets, greater yields are only adding to maize stocks and having a negative effect on US farm prices. In contrast, the lower yields of GM soya should have reduced the total soya production
- The study also said that GM crops had reduced farmer production costs by $1.2 billion a year, with $1 billion accounted for by HT soya. It is hard to see how this can be right. The technology fee is a significant extra cost of GM crops and while herbicide costs have indeed fallen for farmers using HT crops, this is mostly due to the large fall in herbicide prices, rather than the attributes of HT crops which are encouraging farmers to apply more herbicide. In addition, the industry figure of a $1.2 billion saving has to be balanced against the costs to individual farmers of the lower market prices and the contamination problems
- HT crops lead to lower herbicide use. There is much evidence referred to by the biotechnology industry showing that HT crops lower herbicide use. But according to the independent researcher Dr Benbrook, many of the claims that RR soya reduces herbicide use can only be

made with "a little misinformation and a major dose of missing information."[12]
- HT crops help the environment because they facilitate no-till. No-till has certainly been one of the main ways in which farmers have reduced soil erosion in the American Midwest. No-till is likely to be a popular practice with the biotechnology companies because it is dependent on herbicide use, a feature that is fine for them but means this system is not necessarily better environmentally.

12.5 The political situation in the UK

UK agriculture is still suffering economically from a number of high profile, costly health scares and a poor trading climate. It is hard to see that it could withstand a new economic burden, and the government would not be ready to increase farm subsidies in the way that the US government has following the introduction of GM crops.

The farm health problems of BSE/CJD, E.coli and salmonella, foot and mouth disease and concerns over GMOs, have led to a public crisis of confidence over the government's ability to handle risks in agriculture and to reflect consumer interests. This was the main reason for the establishment of the Food Standards Agency (FSA) in April 2000. However, the FSA has yet to take a precautionary, consumer-oriented position on GMOs, in the way it has for BSE.

There is clear public opposition to GM food and crops, as shown by numerous surveys and strong local opposition to GM crop sites. Current GMOs offer no benefit to consumers, only a set of poorly researched risks. The public have clearly expressed their wish to retain the choice of GM-free food and for labelling to enable this choice. A recent survey by the Consumers Association found 94 per cent of consumers want GM food to be labelled.[13] With the GM-free policies of all the major food retailers there is no market for GM food in the UK and the market for GM feed is disappearing. As long as a large proportion of consumers continue to demand GM-free food, these companies are unlikely to change their policies. In other words, unlike North American farmers, UK farmers would not even have a domestic market were they to grow GM crops.

The public instead support a return to less intensive food production methods, based on more natural processes. Research commissioned by the FSA of consumer views, including those of low-income consumers, concluded that the preference of consumers is for "farming to become less intensive."[14] In particular, there is a strong demand for organic food and an expansion of organic farming. Three-quarters of households bought some organic food in 2001,[15] and surveys show that 65 per cent of people think that at least 30 per cent of farmland should be organic (MORI, February 2001) and 85 per cent want the government to do more to encourage organic food (NOP, March 2001). The organic sector also offers important economic opportunities for UK farmers. It is a high value and growing market, worth £800 million in April 2001, with 70 per cent being supplied by imports.

The government has already invested in the development of organic farming in the UK, through research and support for farmer conversion. In the year to 2001, it spent over £20 million on the organic sector, and over a seven year period from 2001, it has budgeted to spend £140 million on farmer conversion in England alone.

A primary policy objective of the Department for Environment, Food and Rural Affairs is "to promote a sustainable, competitive and safe food supply chain which meets consumers' requirements."[16] The findings of this report show that GM crops would obstruct the government in meeting its objectives for food and farming.

Finally, the government is publicly committed to ensuring that the expansion of organic farming is not undermined by GM crops. One of the government's 'public service agreements', is an expansion of organic farming. In 1998 the UK minister for food safety, Jeff Rooker, told the House of Commons that the government would "ensure that the expansion of organic farming is not compromised by the introduction of genetically modified crops … Given the extremely tight public expenditure restrictions to which we are subject as part of our contract with the electorate, it would be stupid for the government to push more money into converting to organic farming while allowing the farmers who take that brave step to be damaged by other actions." He went on to say, "I genuinely mean that – those are not words to be put in *Hansard* and forgotten about; I shall follow through."

13 Conclusions

The findings of our report are that GM soya, maize and oilseed rape have overall been very negative for North American farmers and the farming industry in general. While we have not researched the positive experiences, the independent evidence and feedback from the industry is that overall these GM crops have mostly failed to realise their claimed agronomic benefits and have overall been a disaster economically for the whole farming industry and especially for the organic sector.

The large number of problems and negative experiences include the loss of most of the organic oilseed rape sector in Canada; lost income for organic and other GM-free producers; problems of yield; greater reliance on herbicide use; reduced farm incomes, herbicide resistant volunteers; widespread contamination of seed resources, crops, the food system and bulk commodities; a decline in farmer choice over their business options; lost export trade; farm price falls; an increased need for government subsidies; and legal liability problems for farmers over company patent rights on GM plants. The main benefit for farmers seems to have been the convenience of HT crops, but this has not translated into income benefits. The other positive aspect has been the increase in Bt maize yields, but this too has not produced net income benefits.

The findings show that GM crops would obstruct the UK government from meeting its public commitments and policy objectives: to ensure that the expansion of organic farming is not undermined by the introduction of GM crops and that farming should be competitive and meet consumer requirements.

The Soil Association hopes this report will be the start of a more balanced and realistic debate on the likely impacts of GM crops on farming in the UK, and help ensure an informed decision on whether to allow commercial growing of GM crops or remain GM-free. We hope that the UK farming community and government will base their decisions on the independent and industry evidence of the impacts of GM crops on farmers in North America.

Appendices

A1 Glossary

Brown-bagging
The saving of some seed from a harvest by a farmer to use for planting in the following year, in contravention of company licence agreements.

Bt
The soil bacteria, *Bacillus thuringiensis*, which produces an insecticidal toxin. Bt is used by organic farmers as a form of biological pest control. Some crops have been genetically engineered to continuously produce the Bt toxin – Bt crops.

Bushel
a measure of volume, equivalent to 64 US pints (35.2 litres). One-hundred bushels of maize is approximately 2.5 metric tonnes.

Canola
The American term for oilseed rape.

Class action
A legal action brought by a few people, acting for a larger group.

Corn
The American term for maize.

Elevator
The first destination for harvested grain crops in North America, where they are cleaned and sorted before being taken to processing plants.

FDA
Food and Drug Administration, a US government agency.

Gene flow
The introduction of genes, and hence the associated characteristics, into a population usually as a consequence of cross fertilisation.

Gene stacking
The occurrence of several genetically engineered traits in a single plant. This can either be intentional or the result of gene flow.

Genetic engineering
A process by which the genetic make up, and thus the characteristics, of an organism is altered artificially, usually by inserting specific sequences of DNA into the organisms' own DNA. It is completely different to natural reproductive processes. Often DNA is used from a different species with which normal breeding would be impossible.

Glyphosate
A broad spectrum herbicide, developed by Monsanto. Now the world's widest selling herbicide, sold in many formulations, including Roundup.

Glufosinate
A broad spectrum herbicide, marketed by Aventis under the name Liberty.

GM
Genetically modified. GM, genetically engineered, or transgenic are all terms that describe an organism or product of an organism that has undergone genetic engineering. GMO = genetically modified organism.

GM-free/non-GM
In the report, GM-free refers to seeds or crops which are not of GM varieties and are free from any adventitious GM contamination. Non-GM refers to seeds or crops that are meant to be only of varieties that have not been genetically modified, but which have or may have a low level of GMOs present as contamination, because measures have not been taken to avoid the risks of contamination where such risks exist.

Herbicide/pesticide/agrochemical
Throughout the report herbicide refers to chemicals which are used to kill weeds; pesticide refers to chemicals such as insecticides used to kill animal pests; and agrochemicals for the whole range of chemicals used in agriculture. However, in some quotes 'pesticide' is used in its American meaning to cover herbicides as well.

HT
Herbicide tolerant. HT crops are resistant to the effects of a particular herbicide, usually as a result of genetic engineering, for example, Roundup Ready soya.

IP
Identity Preserved. A process of managing seed, crops, food or other products to guarantee the integrity of the final product with respect to its original ingredients, for example to guarantee that the product is not contaminated with GMOs. It may involve GM testing, segregated processing facilities, the cleaning of equipment between GM and non-GM lots, record keeping, and independent auditing. IP systems are used by manufacturers and retailers to sell produce as GM-free.

Isolation distances/separation distances/buffer strips
Distances used to separate GM from non-GM crops to reduce the chances of GM contamination by pollen transfer.

Multiple resistance
The development of resistance to several herbicides in one plant, such as would result from gene stacking of separate herbicide tolerant traits.

No/low-till farming & minimum till
The practice of sowing land after no or only very shallow soil cultivation, instead of the traditional practice of ploughing land. It involves clearing the land chemically of weeds instead and drilling seeds directly into the soil. It is used commonly to reduce soil erosion in the American Midwest, though it involves a greater use of herbicides than systems based on mechanical ploughing and cultivation.

Pollen drift/transfer
The movement of pollen by air or insects often far from the original plant, which can transfer genetically engineered traits to compatible non-GM crops.

RR
Roundup Ready. RR crops have been genetically engineered to be tolerant to Roundup, a brand name for glyphosate herbicide.

Saving seed
The saving by a farmer of a proportion of the seed from his harvest for sowing another crop in subsequent seasons. This is a traditional practice carried out by approximately 20–25 per cent of farmers, mainly small farmers, in the US and UK.

Substantially equivalent
A term used to describe GM crops that have similar levels of certain chemicals, usually nutrients and toxins, to their non-GM counterparts and are as a consequence considered otherwise similar to the non-GM crops by regulatory authorities. This approach forms the basis for the approval of GMOs and has been heavily criticised for its use as a replacement to full safety testing.

Superweeds
Wild or domestic plants that have developed immunity to herbicides, usually through gene transfer from GM herbicide tolerant crops, meaning that they cannot be chemically controlled as easily as other weeds.

Technology fee
Additional charges that GM seed companies add to the price of buying GM seeds.

Technology use/grower agreement
Contracts between the biotechnology company or GM seed distributor and the farmer. They allow the farmer to use the GM seeds in exchange for complying with all of the company's management requirements, such as separation distances. They may allow the company access to the farmers' fields to inspect crops to look for any GM crops that are not covered by the agreement.

Tort
Part of the civil law (as opposed to criminal) where private citizens are able to sue each other, corporate bodies or the state.

Transgenic
Genetically modified. See 'GM'. Transgenes refers to the foreign genes which have been genetically engineered into a GM organism. They may be found in non-GM plants following cross-pollination with a GM variety.

USDA
United States Department of Agriculture, the US ministry for agriculture.

Volunteers
Unwanted crop plants, that were either planted in a previous season and failed to germinate then or that grow from spilt seed from a previous harvest.

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Soil Association

The Soil Association is a membership charity which was founded in 1946 by a group of farmers, scientists and nutritionists who were concerned about the way food was produced. It is at the centre of the campaign for safe, healthy food, an unpolluted countryside and a sustainable farming policy in Britain and worldwide.

The organisation has now grown in scope and complexity but the core principle is essentially simple; there are direct links between the health of the soil, plants, animals and humans, and organic agriculture is a sustainable system of food production which is based on these interconnections: healthy soil, healthy food, healthy people.

To achieve this end, the Soil Association is working in many different areas:

- Policy. Working to achieve change in food and farming systems through lobbying and policy work.
- Campaigns. Joining forces with members, supporters and other like minded groups to campaign for the elimination of GMOs from the food chain; promoting the responsible use of antibiotics in farming; working in partnership with conservation agencies to protect wildlife and biodiversity.
- Setting organic standards to ensure the integrity of organic food and other products. Soil Association Certification Ltd, a subsidiary company, runs the certification scheme used by 80 per cent of UK licensed operators and awards the Soil Association symbol.
- Providing professional, technical support to farmers and growers with the aim of increasing the amount of land farmed organically and providing more jobs in the countryside.
- Promoting organic food so that people everywhere will have the opportunity to buy and eat organic food, be it from a local market, a box scheme, a corner shop or a supermarket.

The Soil Association provides modern, practical solutions to the challenges facing society today.

Soil Association
Bristol House
40–56 Victoria Street
Bristol BS1 6BY, UK

T 0117 929 0661
F 0117 925 2504
E info@soilassociation.org

www.soilassociation.org

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