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Friends of the Earth

Briefing

Genetically modified crops and food

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Introduction

The debate about the safety and need for genetically modified (GM) crops and foods has raged since the mid '90s. A lot of time and money has been spent by biotechnology companies and scientists, as well as the Government, to convince people that there is really nothing to worry about, and that this new technology will provide benefits to all.

But while GM crops are now being used widely by farmers in the USA, consumers in the European Union and Japan have reacted strongly against them. Although this has slowed the rate at which GM crops and foods are being introduced, the biotech industry is continuing to push ahead with them. This briefing explains why people should still be concerned about GM crops.

What is genetic modification?

For thousands of years farmers and plant breeders have been changing crop plants to improve characteristics such as size, resistance to disease and taste. Plants which grow well, have a higher yield or taste better are selected and bred from. This is still the most widely used technique for developing new varieties of a crop, and is limited by natural barriers which stop different species of organisms from breeding with each other. Genetic modification is very different to these traditional plant breeding techniques. It is a technology which allows scientist to take **genes** (see box) from one organism and put them into another. This changes the characteristics of the organism, or the way it grows and develops.

What are genes?

All organisms, from viruses to humans, contain a unique set of instructions which set down how they develop, grow and live. These instructions are found inside cells on a long molecule called DNA. DNA is divided into small sections which control different aspects of the organism's growth and characteristics, and these sections are called genes. Very simple organisms such as bacteria may have a few thousand genes, while more complicated organisms have many more, for example, it has been estimated that maize has around 50,000 genes. In genetic engineering, DNA is cut up and genes can be moved around from one organism to another.

Transferring DNA and genes from one organism to another is a difficult and fairly haphazard procedure. At present there is no way to control or direct what happens, and so new genes end up being inserted at random into the genetic makeup of the organism[1]. It is now known that genes are found in groups[2], and that inserted genes tend to end up in these – so randomly inserting a new gene has the potential to disrupt the native genes and how they operate. In fact, such disruptions are quite common – inserted genes can sometimes fail to work, or behave in ways that aren't expected, or the functioning of native genes may be affected[3].

Scientists have voiced concern that such disruptions could lead to unexpected toxins being produced, or to changes in the levels of nutrients and naturally occurring toxins[4]. There are examples of genetic modification changing plants in entirely unexpected ways. For example,

when researchers in Germany tried to boost the starch content of potatoes using genes from yeast and bacteria, they found that the starch content actually fell and other, unexpected, compounds were produced[5].

Finding new genes can be a time consuming and expensive process, so the same genes tend to be used again and again. For example, the novel gene '*pat*' (which provides resistance to a type of weedkiller) has been inserted into at least nine different crop plants on the market in the EU and the USA, including GM maize, oilseed rape, sugar beet and soya.

What types of GM crops are there?

Many different types of GM crops are now being developed. In the UK, all the GM crops that are close to gaining commercial approval to be grown by farmers are herbicide (weedkiller) tolerant. These have been engineered to be tolerant to powerful herbicides which kill all plants. This means that only the crop can survive being sprayed, and all other plants in the field die. In the USA, insect resistant crops are widely grown. These have been engineered to produce a bacterial toxin which kills the pests that normally feed on the crop. Other crops have been developed which ripen more slowly, or are more resistant to plant diseases.

Scientists are also working on crops which they hope will be useful for industry, such as plants that produce oil for the cosmetics industry, crops with altered nutritional value, and even crops that produce pharmaceutical drugs.

What are the concerns about GM food?

Genetic engineering is imprecise and unpredictable. By inserting genes from organisms which have never been eaten as food, new proteins are introduced into the human and animal food chains. There is concern that these could cause allergic reactions or other health effects.

The safety testing of GM foods is based on the concept of 'substantial equivalence'. This is the idea that if a GM food can be shown to be 'substantially' the same as a non GM food then it is considered to be safe. It was developed because of the difficulties and cost of conducting traditional safety tests (like those used for new drugs) on GM foods. But it has been severely criticised by some scientists because it is not clear what level of similarity makes something 'substantially' equivalent[6].

Professor Janet Bainbridge, Chair of the Advisory Committee on Novel Food & Processes commented that "*Current regulation in the UK appears so far to have protected the public from any potential hazards of GM foods. However, we do not know what we may have missed. The presumption of safety of novel GM plants on the basis of substantial equivalence lacks scientific credibility, given modern expectations of standards of evidence*."[7]

The safety of GM foods depends on government assessment of tests conducted by the GM companies themselves. Most of these tests have never been published or subjected to independent peer review. For example, a Spanish researcher who investigated this in 2000 could find only eight published safety studies on food from different GM crops[8], but there are over 40 GM crops approved for sale around the world.

Antibiotics

Many GM crops contain genes which provide resistance to commonly used antibiotics such as ampicillin. There is concern that these genes could be passed from food to bacteria in the guts of humans and animals. In the Netherlands, researchers used a model of a human gut to look at what would happen to GM food after it is eaten. They predicted that six per cent of the genes from GM tomatoes would survive digestion[9] and considered that the genes could survive for long enough for bacteria to pick them up. In 2002, research published by the Food Standards Agency showed this happening for the first time, when GM genes were found to have been picked up by gut bacteria of human volunteers[10]. The Government's own advisory body on the safety of GM foods has expressed concerns about just this issue[11], but this has not stopped such foods being put on the market.

What GM foods are on sale in the UK?

The European Union grants approvals for GM foods to be sold in Europe and the UK. This is done under the Novel Foods Regulation, which came into force in 1997. The Regulation requires a full safety assessment of any GM food and consideration by all member states before it can be sold. But two GM foods – Monsanto's 'Roundup Ready' soya and Novartis's 'Bt176' maize – were already on sale in the EU before the law came into force. These two GM foods did not have to go through the full safety assessment because the law could not be back dated.

In addition, the Novel Foods Regulation contains a fast track route for processed GM foods. This fast track route does not require a full safety assessment either. As long as a company can claim that its food is 'substantially equivalent' to non GM foods, then all it has to do is tell the European Commission that it wants to start selling the food in Europe. So far, foods from four types of GM maize and oil from seven types of GM oilseed rape have been approved in this way[12].

Although food from 12 GM crops has been approved for sale in the EU, most supermarkets and food manufacturers in the UK have removed GM ingredients from their produce.

What are the concerns about growing GM crops?

Threats to wildlife

Wildlife in UK farmland is already in severe decline because of intensive, chemical farming. For example, plants which were considered to be arable weeds 40 years ago are now listed as rare or scarce and some are endangered species[13]. Similarly more than 20 bird species including the tree sparrow, grey partridge and song thrush have shown drastic declines in numbers since the 1970s[14]. There is widespread concern that the use of GM herbicide tolerant crops could make this worse.

GM herbicide tolerant crops allow farmers to apply 'broad spectrum' weedkillers to their field, which kill all other plants. There is concern that this will continue the decline of farmland wildlife because the use of these GM crops could lead to the removal of weeds from all crops in the normal arable rotation. This will reduce the food supply for insects and birds. These

concerns led English Nature to state in 1998 that the "*untested introduction of GM crops could be the final blow for such species as the skylark, corn bunting and the linnet, as the seeds an insects on which they feed disappear*."[15]

The biotech industry body SCIMAC (the Supply Chain Initiative on Modified Agricultural Crops) has produced guidelines for farmers which aim to ensure best practice as regards GM agriculture and the environment – but they provide no advice to farmers on how to protect wildlife. Baroness Young, then Chair of English Nature, pointed out that "*farmers could follow the code to the letter, but using these new crops could still remove all wildlife using their fields*."[16]

The farm scale trials were introduced in response to these concerns, but they have been criticized from the outset (see 'The Farm Scale Trials' below).

Contamination

One of the main difficulties which farmers will encounter when growing GM crops is that there is no way to contain pollen movement. In the case of oilseed rape, researchers have found that its pollen can travel up to 4km and can escape from fields even when they are surrounded by barrier crops to prevent this[17 18]. The Government has separation distance requirements between GM and non-GM crops. These only require farmers to leave a distance of 50-200m between GM and non-GM oilseed rape, 6-600m for sugar/fodder beet and 50-200m for maize. But the evidence shows that this is clearly not enough to protect farmers and consumers from GM contamination. There have already been several serious incidents of GM contamination, despite the fact that GM crops are only grown by a minority of farmers worldwide.

In spring 2000, the seed company Advanta announced that they had discovered that batches of oilseed rape seeds they had sold to farmers in France, Germany, Sweden and the UK were contaminated with a GM oilseed rape variety. The GM oilseed rape, produced by Monsanto, was not authorized for cultivation in the European Union. Advanta blamed the contamination on cross pollination of their seed crop with a GM crop that had been at least 4km away[19]. Over 5,000 hectares of contaminated seed were grown in the UK[20] and the farmers affected could not sell their crops or were forced to destroy them.

Later in 2000, it was found that a GM maize called StarLink, which was not approved for human consumption, had contaminated foods across the USA. Suspected allergic reactions were reported, and more than 300 brands of taco shells, crisps and other maize products had to be withdrawn from shops. The US Government was forced to buy up stocks and Kelloggs closed production lines for two weeks. The cost to the US economy has been estimated at billions of dollars.

In November 2002, it was reported that half a million bushels of soya, worth about $2.7 million, was contaminated by GM maize plants used to produce a pharmaceutical or industrial chemical The soya was planted on the same site used to grow GM "pharmaceutical" maize by biotech firm ProdiGene the previous year. Seeds dropped by the maize grew and contaminated the new crop.

The GM oilseed rape supplied by Aventis for the farm scale trials in England and Scotland was found to be contaminated with an unauthorized GM variety containing antibiotic

resistance markers. The contaminated seed had been planted at more than 20 sites since 1999.

As can be seen, GM contamination is already a problem. The long distances that viable pollen can travel mean that the separation distances between GM and other crops would have to be very large to be effective.

Liability

In a recent legal case in Canada, it was declared that Monsanto owns any seeds containing the novel genes it has developed and so must be paid for their use. This is the case if someone buys seeds from Monsanto, but also if seeds blow onto their land, or even if the seeds result from cross pollination of non-GM crops with GM pollen from neighbouring fields[21]. Regardless of how the genes arrive in the crops on farmers' land, they still must pay Monsanto a fee. Yet there is no system in place to protect farmers or the public from the damage that could be caused by these plants, or the financial loss caused by contamination from a GM crop.

The principle that "the polluter should pay" is part of EU law and is generally agreed to be fair and effective at preventing damage. Legislation specifying who is liable for any damage and allowing citizens to seek redress can be a very effective way of ensuring that the polluter pays. In particular, a civil liability regime can help to balance the powerful commercial interests of producers with the protection of the environment, public health and the livelihoods of other business people.

In the event of damage by the release of genetically modified organisms (GMOs) into the environment and food chain, under current European law, the biotechnology industry would largely avoid liability for compensating those affected or restoring the environment. The proposed EU Environmental Liability Directive will fail to deliver satisfactory liability for GMOs. It will only provide a 'general framework' which will ignore the unique nature of GM pollution and restrict liability for biodiversity damage to a small number of protected habitats. Crucially for GM it will exempt companies from damage that could not be predicted according to 'best science' at the time of release or from products that have a Government permit.

International law offers no immediate solution for the liability 'gap' in EU law. Although the Cartagena Protocol on Biosafety includes an international liability and redress regime for transboundary movements of GMOs, it is still a long way from implementation. In the absence of an adequate EU regime, Friends of the Earth believes that the UK Government should introduce national liability legislation before the commercial growing of GM crops in the UK.

Are GM crops being grown in the UK?

GM crops are now grown in many countries, but particularly in the USA. In 2000, over 50 per cent of the soya crop in the USA was GM. In the UK, there are no crops approved for wide scale commercial growing, but the crops most likely to come onto the market in the next three to five years are GM oilseed rape (winter and spring), sugar beet, fodder beet and fodder maize, all of which have been modified to resist herbicides which kill all other plants.

Concerns about the introduction of these crops have been expressed by a range of conservation organizations, consumer groups and other groups, such as the Women's Institute and the British Medical Association.

There are large areas of GM crops being grown at test sites around the UK. Also, as part of a voluntary agreement between the Government and the biotechnology industry[22], additional 'farm scale' evaluations of GM herbicide crops have been occurring and are due to end in 2003. These trials are being paid for by the Government and are run in co-operation with the influential biotechnology industry lobby group SCIMAC. The crops included in these trials are Aventis/Bayer's herbicide tolerant fodder maize and spring/winter oilseed rape, and Monsanto's herbicide tolerant sugar beet and fodder beet.

The farm scale trials

There have been more than 100 farm scale trials around the UK, each covering an area of seven to ten hectares. Many groups, including Friends of the Earth, have grave concerns about the safety of the farm scale trials, and remain unconvinced about their scientific legitimacy.

The farm scale trials are meant to be examining changes in wildlife biodiversity in fields put over to GM crops. But, as was pointed out in a 1999 report by the Government's Pesticide Safety Directorate[23], very little is known about the biodiversity of non GM crops and so it will be difficult to make comparisons. The farm scale trials have gone ahead without attempting to fill this knowledge gap.

Many different factors play a part in determining the diversity and abundance of wildlife in crop fields. These include soil type, weather, previous crops, what pesticides were used in the past, as well as the pesticides used during the GM trials. In addition, the plants and insects being measured in the trials vary a lot in numbers from place to place. All this means that there is likely to be a high level of variation within and between the fields used in the trials[24]. When there is already a lot of variation, it becomes much harder to detect any additional differences. Friends of the Earth believes that important changes in wildlife biodiversity could easily go undetected in these trials.

Some changes in biodiversity take place over a longer timescale than will be examined. If no significant differences are found in three years then the crops will be given a clean bill of health, but major changes may not become apparent until GM crops have been grown on the same farm over a prolonged period.

The benefits of GM herbicide tolerant crops are already being promoted to farmers. In the future envisaged by the biotechnology industry, the UK will be "*carpeted*"[25] in GM crops. It is very doubtful that the farm scale trials will be able to tell us what will happen to UK farmland wildlife in these circumstances. There has been widespread opposition to the trial sites across the UK.

Failures of Government

It is often claimed that GM crops and food are very carefully controlled by the Government and so there is no need for concern. However, Friends of the Earth does not believe that the regulatory procedures are anywhere near as thorough as they should be.

For example, the biotech company Aventis/Bayer has approvals to sell a GM maize for human food and animal feed in the UK and the EU. When Friends of the Earth investigated how Aventis got approval for this GM crop, known as 'T25', a catalogue of bad science was revealed. Friends of the Earth has serious questions about the quality of decisions made by the scientific advisors and regulatory committees charged with protecting human and animal health and the environment.

In Aventis/Bayer's application for EU approval for the GM maize, only one page out of the 85 looked at its potential environmental impacts. The impact of growing the GM crop on wildlife was not even mentioned. In the UK, the application was considered for its environmental safety by the Government's Advisory Committee on Releases to the Environment (ACRE). But draft 'advice' from the committee, which stated that the product did not pose a risk to the environment or human health, was circulated by civil servants *one day before* members of ACRE had even seen the application[26].

Four years **after** T25 maize received marketing approval and was considered "safe" for the environment, the crop is still being tested for impacts on wildlife in the farm scale trials programme.

In support of its GM crop, Aventis/Bayer also provided the Government with a report on a feeding trial in which the GM maize, intended for cows, was fed to chickens. In this trial, twice as many chickens died when fed GM maize than when fed non-GM maize (although this was not statistically significant), and there was much greater variation in factors like body weight and weight gain in the GM-fed group. Independent scientists from Bristol University said these results were "*suspicious*" and should have prompted further investigation. They were very critical of the way the experiment had been done with one scientist stating that "*it is very basic science that has fallen down at this stage, and I am amazed that it has not been picked up*."[27]

The safety of this GM maize for use in animal feed was considered in 1996 by the Government's Interdepartmental Group on Novel Feed Developments. This was set up in the wake of the BSE crisis to advise the Government on animal feed issues. They strongly criticized the safety evidence presented by Aventis/Bayer and said that "*the current concerns over BSE mean that MAFF must take the precautionary response…*"[28] They recommended that further testing take place, particularly testing the safety of T25 maize for the animal to which it would be fed. However, this advice was ignored, and approval was given anyway.

The EU's decision to approve T25 maize for human consumption as based on a report produced by the UK's Advisory Committee on Novel Foods and Processes (ACNFP). The ACNFP's report stated that the GM food was safe for humans, but when they wrote it they had not even seen the chicken feeding study described above.

Friends of the Earth has only had the resources to investigate one GM crop approval this thoroughly. However, we believe that these are likely to be common errors and failures of government, rather than being unusual.

Don't we need GM to feed the world?

It is often claimed that one reason for having GM crops is that they will help to feed the world's growing population in the coming century by increasing yields and fighting crop

diseases. However, many people in the world are suffering from malnutrition and hunger because they cannot afford to buy food, not because it is unavailable. Complex social, political and economic forces affect how people have access to land, money and resources. It is these forces, much more than the level of food production which determine who gets to eat, and who does not.

It is not just a simple case of there being more people, so more food should be grown. There is more than enough food to feed everyone very well at the moment, yet hundreds of millions of people go hungry and nearly two billion are malnourished. For example, in 1998 it is estimated that 36 million people, including 14 million children, were hungry or on the brink of hunger in the USA[29], one of the richest countries in the world.

Friends of the Earth does not believe that the best way to feed people in developing countries is to grow GM crops. Most GM crops being grown at the moment are destined for markets in rich countries. Soya and maize are used mainly for animal feed and for adding to processed food in rich countries. Such products will not help to feed the poor and hungry of the world. The majority of GM crops being grown around the world at the moment are herbicide tolerant. These crops are designed for use in intensive farming systems, with single crops in large fields requiring heavy use of chemical inputs. Many farmers in developing countries are small scale, growing many different crops and they often cannot afford the chemicals needed.

Several countries that have faced serious food shortages have raised concerns about the use of GM crops in food aid. These concerns have focused on the health and environmental effects of introducing GM crops and foods during emergency situations, often in countries lacking biosafety regulations. One area of concern is the unknown impact of feeding GM food as the main constituent in the diets of immuno-compromised populations (through hunger and often HIV/AIDS). Scientists have already raised similar concerns about the feeding of GM in high quantities to both farm animals[30] and babies[31] .Scientists working for the Zambian Government which rejected GM food aid stated that "*While it is often said that GM maize is consumed by millions of Americans, it was noted that it is eaten in highly processed form and is not a staple food in the USA. In Zambia maize is the staple food and is usually the only carbohydrate source.*"

Is there an alternative?

Yes! Friends of the Earth believes that there are real alternatives to GM crops and food. We believe that the future of farming does not lie with the technological fix of GM crops, but with farming that produces safe, wholesome food and that protects rural communities, the environment and our landscape. Friends of the Earth is calling on the Government to support farming that uses less chemicals and works to protect wildlife and enhance the countryside, and to:

- Stop GM crops being planted in the UK until their safety and need are proven
- End pesticide residues in our food
- Support local producers and markets
- Give a fair deal for farmers who safeguard our future
- Save food and farming from unfair global trade rules.

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