Public lecture on the GMO-issue

By Rt Hon Michael Meacher MP
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The Nordic House, Reykjavik, Iceland.

I want to thank the Campaign for Information on GMOs, who invited me here to make a contribution towards their aim to encourage public debate on the GM issue, to promote traceability and labelling, and to draw attention to the need for a full assessment of the impacts of GM cultivation on the environment, human health and other non GM agriculture.

I hope I can make a contribution to this, having been the Minister for the Environment in the UK for six years, from 1997 to 2003, having set up GM crops trials in the UK, and having been an active player in international debate on GM both during my time as Minister and thereafter.

Three arguments are normally made in favour of GM –
1. It is a more efficient and focussed scientific technology than traditional cross-breeding;
2. It produces higher crop yields and less pesticide use, to the benefit of the environment;
3. As the world population rises from 6 billion now to 9-10 billion by 2050, GM is needed to feed the world, especially in developing countries.

All three arguments are demonstrably false.
1. It is <u>not</u> a more efficient form of traditional cross-breeding, but a qualitatively different and risky technology which can cross the species barrier, which Nature would never do. Blasting GM DNA into a plant arbitrarily and out of sequence of genes evolved over hundreds of millions of years to optimise functioning of organisms is risky and unpredictable, and bound to destabilise the biochemistry of the plant.
2. Regarding yields and pesticide use, there <u>is</u> evidence from Canada and Argentina that initially yields increased and pesticide use fell, but Benbrook (an independent US scientist who has systematically studied this) has shown that over the last five year period, yields began to fall and pesticide use markedly increased, to counter the development of volunteers and superweeds.
3. GM's capacity to counter world hunger is marginal to the point of invisibility when the real causes of developing countries famine or under-nourishment are:
   - a discriminatory trading system that impoverishes developing countries;
   - bad or corrupt governments that mismanage their economies;
   - gross mal-distribution of land;
   - lack of population management policies.

So, if none of these arguments in favour hold water, are there arguments against GM? There are three main ones –

(a) **GM is a risk to the environment.**

There have never been, either in the UK or anywhere in the world, adequate or systematic testing of the effects of GM crops on the environment. Field Scale Evaluation (FSE) trials in the UK were extremely narrow i.e. limited purely to assessing the effects of using different herbicides (chemical weedkillers) as between GM and non-GM crops. Nothing was tested concerning long-term soil pollution, transgene flow, problems of superweeds or the environmental impacts if crop yields were maximised. All this work still remains to be done.

(b) **Concerning the effects of eating GM foods on human health, almost unbelievably, virtually no direct testing has been done**.
Genes don't operate in isolation; they interact with each other. Genetic engineers have assumed that each gene has only one function, but the recent discovery that human beings have only some 30,000 genes to produce the quarter of a million proteins in the human body shows that this premise is wrong. Most genes are in fact multi-functional. It is not known how to determine artificially a single function of a gene without triggering other unpredicted and undesired effects.

The random position of the GM insert and lack of control of the gene's functions could change any character of the plant, and it might not be evident immediately. What is needed, and not available routinely at present, is a detailed molecular characterisation of all inserts and flanking sequences. Absence of this invalidates any safety tests and make it impossible to identify subtle but important changes in post-release monitoring. It is hardly surprising that foreign genes inserted at random into a cell's genome are destabilising, and indeed it has been found that GM inserts had re-arranged from the structure claimed by the company, and there is plenty of evidence of scrambling of the host genome at the site of insertion. One example of the effect of this is the increased lignin in GM soya which only became apparent in hot weather when the stems began to split. In the US there are already many examples of undesired effects only being identified after approval had been given – one example is GM cotton where the cotton bolls became deformed.

Another problem is that genetic engineers usually introduce other material – viruses or bacteria – into the plant which have the role of promoters, i.e. inserting the gene, activating it, and identifying where transfers have been successful. Viruses in particular are good at inserting their genetic material into other organisms. But that opens up the risk of 'horizontal gene transfer' whereby genes transfer out of the GMO and into other organisms. But we don't know how frequently or intensively this might occur, or what the safety implications might be.

GM technology also often involves producing novel substances which may cause allergic reactions. If such substances are used in food, consumers may quite often be exposed to this risk. It was recently found, for example, that a GM soya with a brazil nut gene could cause strong allergic reactions.

A further health risk is that creating herbicide (weedkiller) resistant plants allows the application of much more toxic herbicides to the growing plants. People therefore become exposed to more toxic residues than previously. In the recent case of one recent GM forage maize (corn), the herbicide used was glufosinate, a neurotoxin and a teratogen (i.e. it damages embryos and produces deformations).

Given that there is so much uncertainty, it might be expected that there would be routine testing of GMOs for health effects as a legal requirement. This applies to new pharmaceutical drugs which are subjected to lengthy trials so that all side-effects can be uncovered. However, whilst it is often claimed that all GMOs have been 'rigorously tested', all that this testing amounts to is deciding whether a GM crop is similar in terms of its composition to the non-GM plant. This is justified under the rubric of 'substantial equivalence', which was originally a marketing term, but it is scientifically vacuous.

It is really extraordinary that there have so far been virtually no independent studies of the health effects of GM. What there is has mostly been done by the companies themselves. We are constantly told that there is no evidence of any greater health risk from a GM crop than from its non-GM counterpart. What is not added is that there have been no health checks to find out. Indeed, the only Government-sponsored work ever carried out on the health impacts of GMOs was Dr Pusztai's work on rats and GM potatoes, and then when it found negative

effects, he was promptly sacked and vilified, his research was closed down, and his work widely rubbished in Government circles, even though his paper had been peer-reviewed six times before publication.

These uncertainties have however been acknowledged by some of the leading UK institutions. The Royal Society, the UK premier scientific institution, in its report last year, said that the potential health effects of GM foods should be rigorously investigated before allowing them into baby food or to be marketed to pregnant or breast-feeding women, elderly people, and those with chronic disease. This was because GM "could lead to unpredicted harmful changes in the nutritional state of foods".

Any baby food containing GM products could lead to a dramatic rise in allergies, and unexpected shifts in oestrogen levels in GM soya-based infant feed might affect sexual development in children. Infants, the report said, are very vulnerable because they have such a narrow diet. If there were any nutritional deficiencies in their food, such as fewer fatty acids, their health would suffer, especially in the infant bowel function since even small nutritional changes could cause bowel obstruction.

Similarly, the only human GM trial, commissioned ironically by the Food Standards Agency, found that GM DNA did in fact transfer to bacteria in the human gut. Previously many scientists had denied that this was possible. But instead of this finding being regarded as a serious discovery which should be checked and re-checked, the spin was that this was nothing new and did not involve any health risk.

A recent BMA report noted that "any conclusion on the safety of introducing GM materials into the UK is premature as there is insufficient evidence to inform the decision-making process at the moment". In their report to the Scottish Parliament two years ago, the BMA stated that "there has not yet been a robust and thorough search into the potentially harmful effects of GM foodstuffs on human health …. In the UK not enough is known to enable us to give an accurate risk assessment of the health impact of GM crops on the health of local communities".

Equally, a recent report from the General Medical Council state that GM could switch on 'silent' genes whose effects we know little about or know to be toxic. They also noted that GM elements in good might be taken up by bacteria in the gut, and this could alter the balance of bacteria in the gut, leading to possible instability or further modification of GM food in later generations. Their conclusion was that more knowledge was needed of the effects of GM on metabolism, organ development, immune and endocrine systems, and gut flora.

Finally, it is often claimed by the biotech companies that there have been millions of people consuming GM foods over several years in the US, but without any ill-effects. However, there have actually been no epidemiological studies to support this claim. What is known is that coinciding with the introduction of GMOs in food in the US, food-derived illnesses are believed by the official US Centres for Disease Control to have doubled over the last seven years. And there are many reports of a coincident rise in allergies – indeed a 50% increase in soya allergies has been reported in the UK since imports of GM soya began. None of this of course proves the connection with GM, but it certainly suggests an urgent need for further investigation of this possible link. Typically, however, this has not been forthcoming.

What is most worrying of all is that none of these results, whilst being rubbished by the scientific establishment, were ever followed up with further tests to confirm and/or refute the original findings – the preference has been for personality vilification to a logical genuine inquiry.

(c) **GM crops will cross-contaminate conventional and organic crops**.
Let us be honest, no separation distance will wholly prevent this, and 'co-existence' is a mirage and impossible. Yet there is no statutory liability provision in place, or planned, to protect conventional and organic crops.

So, the question is do we really want to licence GM crops, which nobody wants and for which there is no market, at the expense of organic crops that people do want and where the market is growing fast?

So, on the long-term health and environmental effects of GM, the necessary evidence is unquestionably not yet available. This largely reflects the way the regulatory system currently works. The safety data is nearly all produced by the biotechnology industry and is not checked by other experts (peer-reviewed). Most of the evidence is not available for public or independent scrutiny. Those undertaking the research are not required to release data which show negative or harmful effects on health. Problems have only come to light in some cases when the results have been forcibly made public by lawsuits or when scientists blow the whistle.

What the companies do is assess the level of various nutrients, allergens and toxins in a GM product and its non-GM counterpart, and if the GM plant has similar levels to the non-GM variety, it is assumed to be safe in all respects. This procedure is called 'substantial equivalence'. So the complete range of side effects is never tested. Yet what consumers want to know is, not whether the GM product is substantially equivalent to something else, but whether it itself is totally safe or not and whether all the tests necessary to establish this have been exhaustively checked and re-checked.

In addition, this claim by the companies of substantial equivalence is anyway often open to doubt. In the current case of GM forage maize that I spoke about, for example, it was claimed it made no nutritional difference. However, a peer review of the company data revealed significant variation in fat, protein and fibre content.

Other claims made by the biotech companies need to be treated with considerable scepticism. They say that when GM ingredients are processed into animal feed or food, no trace of genetic modification is left. Yet a recent study by the Advisory Committee on Animal Feedingstuffs found that "DNA fragments large enough to contain potentially functioning genes" did survive the processing of GM foods for animal feed. This could have disturbing consequences.

So what trials on humans of the results of eating GM food have been carried out? Amazingly, only one, but that is very significant. This was carried out last year by the University of Newcastle – seven people were given a meal containing GM soya and it was found that in three of the people the GM material had moved out of the food and entered their gut bacteria after only one meal. Now, it may be that this had happened previously as a result of eating GM food imported from the US, but either way it is highly significant.

This raises potentially serious health questions since GM antibiotic marker genes spreading round the stomach would compromise antibiotic resistance. Yet this alarming finding was dismissed by the Government's Food Standards Agency as nothing new and with no risk to health.

So what other actual effects of GM on human health have so far come to light, even though not through deliberate research studies? In 2000 many US food products were accidentally contaminated with GM StarLink maize. This is now believed to have caused allergic reactions in over 50 Americans, some serious. According to the government as they were advised on

the StarLink case, the reactions "varied from just abdominal pain and diarrhoea and skin rashes to some patients, a very small group, having very severe life-threatening reactions."

Some animal feeding trials have also shown negative effects of GM food, though in some cases the food has still been approved to be eaten by humans or animals. Feeding Flavr Savr tomatoes to rats resulted in their stomachs developing moderate to severe gastritis, though the tomatoes were still approved and sold in America (but now taken off supermarket shelves). Dr Arpad Pusztai at the Rowett Institute found damage to the guts of rats following consumption of GM potatoes with the gene for lectin production; the rats were unaffected by non-GM potatoes or lectin alone. And in the case of GM forage maize (Chardon LL), twice as many chickens fed the GM protein died as those fed non-GM feed, yet the Government still approved the maize for commercial growing in the UK.

Scientists writing in Science Journal in December 2000 concluded that as risks from GM can be long-term and the result of complex interactions with other factors, we don't yet even have the capacity to identify all the possible risks, let alone assess them. Worse, in the absence of relevant evidence being sought, doubters are being expected to prove that GMOs are unsafe, rather than the biotech companies being required to prove they are safe. The onus of proof should be reversed.

Clearly the long-term clinical and biochemical effects of GM on human health are not yet known in anything like the depth and coverage that is needed before they can be launched on the nation's food supply. There is too much uncertainty about possible unpredictable future consequences. There is only one sensible response in this situation: to invoke the precautionary principle and defer decision-making until all the necessary testing has been done and systematically assessed. That response is permitted under the EU legislation.

It is often said there is no evidence that GM food is not safe. In fact, there is quite a lot. Several animal tests have already have already revealed striking results, which are negative and worrying.

In a study in the early 1990s, rats were fed GM tomatoes. Well actually, the rats refused to eat them. They were force-fed. Several developed stomach lesions and seven out of 40 died within two weeks. Scientists at the US Food and Drug Administration (FDA who reviewed the study agreed that it did show harm. Agency scientists warned that GM foods in general might create unpredicted allergies, toxins, antibiotic resistant diseases, and nutritional problems.

Internal FDA memos made public from a lawsuit, which we would not otherwise have known, urged their superiors to require long-term safety testing to catch these hard-to-detect side effects. But the person in charge of FDA policy was a former attorney for Monsanto (and later its vice president). The FDA policy thus ignored, and even denied, the scientists' warnings. The agency does not now require safety studies. Instead, if the makers of the GM foods claim that they are safe, the FDA has no further questions. The GM tomato was approved in 1994.

In a UK government-funded study, rats fed a GM potato developed potentially pre-cancerous cell growth, damaged immune systems, partial atrophy of the liver, and inhibited development of their brains, livers and testicles. When the lead scientist Arpad Pusztai wen public with his concerns, he was a hero at the prestigious Rowett Institute in Scotland for two days. Then, two phone calls were allegedly placed from the Prime Minister's office, forwarded through the receptionist, to the director. The next morning, Dr Pusztai was fired from his job after 35 years and silenced with threats of a lawsuit. His research, which was later published in 'The Lancet', revealed that the cause of the damage appeared to be from the process of engineering the potato, and not the specific trait that the GM potato expressed.

In another study, rats fed GM corn had problems with blood cell, kidney and liver formation. Mice fed GM soy had problems with liver cell formation and pancreatic function. Pigs fed GM corn on about 25 farms in North America became sterile, had false pregnancies or gave birth to bags of water. A dozen cows fed GM corn in Germany died mysteriously. And in the UK in another study, twice the number of chickens died when fed GM corn compared to those fed with natural corn.

Most recently, Australian scientists engineered a GM pea that would be resistant to pea weevil by introducing a gene normally found in kidney beans which, when fully cooked, is safe for humans. They found that the GM peas had an immune response to GM protein, became more sensitive to other substances, and might cause allergic reactions in humans. They found that the most likely cause of this was that when sugar chains become attached to proteins (glycosylatim) it can turn a harmless protein into a dangerous allergen. What is worrying is that the world's strictest regulatory bodies only require that GM crops be evaluated for allergenicity by testing protein stability in test tubes and comparing amino acid sequences with known allergens. The peas would have passed those tests.

Preliminary evidence from the Philippines, for example, shows that people living next to a Bt cornfield developed skin, intestinal, and respiratory reactions and fever while the corn was pollinating. This occurred the following year too, again during the time the corn was pollinating. Mice fed Bt developed an immune response equal to that of cholera toxin, as well as abnormal and excessive cell growth in their small intestine. So, consider what might happen if the Bt gene were to transfer from corn into our gut bacteria. It could theoretically transform our intestinal flora into living pesticide factories.

Most worrying of all, no one monitors human health impacts of GM foods. If the foods are creating health problems in the US population, it might take years or decades before we have identified the cause. One epidemic in the 1980s provides a chilling example. A new disease was caused by a brand of the food supplement L-tryptophan, which had been created through genetic modification and contained tiny traces of contaminants. The disease killed about 100 Americans and caused sickness or disability in about 5,000-10,000 others. The only reason that doctors were able to identify that an epidemic was occurring was because the disease had three simultaneous characteristics: it was rare, acute, and fast acting. Even then it went unnoticed from 1984-1989 and was nearly missed entirely.

Turning now to the politics of GM in the UK. I was the Minister for the Environment who organised the Field Scale Evaluation Trials (FSE) which revealed, after four year pilots, that in the case of two out of three crops, oil seed rape and beet, GM cultivation had a significantly more adverse effect on biodiversity and the environment than the same non-GM crops. In the case of the third crop, maize (corn), the opposite appeared to be the case.

The decision by the biotech company, Bayer CropScience, to pull their GM Chardon LL maize so soon after the Government authorised its cultivation in the UK is a huge setback for the industry and a major embarrassment for the Prime Minister's championship of GM. The blow however is not yet fatal.

The reason Bayer gave is that the conditions imposed by the Government were too restrictive – which is richly ironic when the Government is leaving no stone unturned to get GM crops approved and grown in the UK. Ministers had already gone out of their way to waive through GM maize following the FSE trials, even though the conclusion of those trials did not justify that decision. But this trial was flawed on at least two counts.

First, the chemical weedkiller used on almost all the conventional (i.e. non-GM) maize was atrazine, and atrazine, a highly toxic chemical with very damaging side-effects, has now been banned throughout the EU. Therefore any tests based on atrazine as a comparator are now

irrelevant. The Government however has breezily waived this aside, so anxious is it to get GM cultivation under way, as the biotech companies want.

But the GM maize trials were flawed in other respects too. The chemical weedkiller used on the FM maize was glufosinate ammonium (brand name Liberty). In the US by contrast, farmers growing GM maize have to use Liberty ATZ, a more powerful and environmentally harmful tank mix of Liberty and atrazine, rather than Liberty alone, in order to obtain necessary weed control and maintain yields. Bayer must have known that Liberty on its own was ineffective, and that therefore using it alone would allow more weeds to survive and would register better environmental results for the wildlife that depends on those weeds. Their hope must have been to secure marketing consent for GM maize crops, and then switch the pesticide recommendations to ATZ-type tank mixes.

As if t this weren't enough, a further device was used to try to influence the results of the trials. Most of the GM maize crops were sprayed only once with Liberty, whereas any farmer in the real world concerned to maximise crop yields would spray at least twice. In addition, the single spraying of Liberty was carried out (according to the FSE report, p.1815) at rates averaging only 3.5 litres of glufosinate per hectare, again clearly designed to allow weeds to flourish. The significance of that can be seen by comparison with the Government's own pesticide rules saying that a maximum total dose of 8 litres of glufosinate per hectare was permitted in the efficacy trials aimed to kill weeds efficiently.

As for the FSE trials, these tactics nearly paid off. Just two things went wrong. One was that the Government's Advisory Committee on Releases to the Environment (ACRE), motivated by all the political furore over the trials, proposed that in order to get the same environmental results if GM maize cultivation were allowed to go ahead, the same regime would have to be followed as in the FSE trials. That was a big problem for the industry. Without the option to use the much stronger Liberty ATZ mix, too many weeds would survive, making the crop yields uneconomic for most farmers.

The second thing that went wrong was even more damaging for the industry. The biotech companies had always maintained that there was really no problem over cross-contamination of organic and conventional crops because separation distances ensured that almost none occurred or, if it did, it could be dealt with quite easily by the GM farmer taking out insurance. This pious hope then fell apart for two reasons. No insurance company (very prudently) would provide insurance cover for GM crops, and the Government very properly refused to use taxpayers' money to bail out the industry if anything went wrong. The industry was hoist on its own petard. They were invited to cover the costs of what they themselves roundly declared to be virtually a non-existent problem, and they baulked at it. Their big claim was exposed. Rather than risk what could be ruinously prohibitive costs in compensating organic or conventional farmers driven out of business by GM contamination, they cut their losses and pulled out.

I turn now to the international politics of GM. As is well known, the US took the EU to the WTO claiming unreasonable restraint on trade in GM crops as a result of the so called EU moratorium.

First the US argued there is no evidence of any greater health risk from GM than from non-GM. The EU responded that there have been no health tests done to find out. As to the argument that there are no untoward effects from people eating GM foods in North America, again, no epidemiological tests have been done to find out.

The second EU argument against was that if we accept GM, are we going to lose organic crops, for which there is an expanding market and which people want more of, in order to licence GM, for which there is no market and which virtually nobody wants? The way out of

this dilemma would be much greater separation distances, and/or regional exclusion zones to keep GM and organic/conventional crops apart. But the US categorically rejects this.

The third EU argument is that if GM were introduced, a large majority of people in the EU have made clear they want assured access to GM-free food. It's called consumer choice. But the US strongly opposes labelling and traceability provisions designed to deliver consumer choice. Even the EU proposal for a 0.9% threshold for labelling will not deliver real consumer choice, because people in supermarkets will not know whether any packet or tin is GM-free or contains GM up to nearly 1%. But the US opposes this even more strongly.

The EU have argued that countries have not only a right, but a duty, to exercise the precautionary principle legistatively permitted under EU Directive 2001/18, Article 5 of Phytosanitary Agreement, until such time as this testing has been fully and properly carried out. The US view is that the precautionary principle is a non-tariff barrier and a trade protectionist device. The answer to that is it clearly is not – it features in international legislation which the US has signed up to. If there are genuine concerns about how the precautionary principle is actually implemented, then the US and EU should sit down and prepare detailed guidelines which should justify exactly when and how the precautionary principle could be legitimately brought into play.

To satisfy consumer choice, the US should accept that trade in GM must be based on consent, not coercion. GM is currently gown, overwhelmingly, in just four countries – the US, with 66% of the total world GM production, Argentina with 23%, Canada with 6%, China with 4% and the rest of the world with less than 1%.

The Cartagena Protocol, which came into force in September 2003, writes into international law the precautionary principle and prior informed consent. That principle should be universally applied, not compromised by offering food aid for famine in Southern Africa, but only if it's GM, and not compromised by, for instance, offering funds to fight HIV-AIDS in Southern Africa, but only if they take GM food. Short of prison, you cannot force people to take food they adamantly do not want.

In the WTO verdict, the US won the dispute, but with significant qualifications. However, EU countries will still not allow GM products on their territories, and the main US aim is now to enforce the GM regime on developing countries.

One other aspect of GM international politics which I must refer to is Genetic Utilisation Restriction Technologies (GURTS). Six years ago, the UN Convention on Biological Diversity passed a resolution to create a de facto moratorium on field testing and commercialisation of these technologies, because of their potential to create negative socio-economic impacts. In Curitiba, Brazil, at the end of March, they will discuss the text again, and there is a real threat it will be overturned or severely weakened.

The economic pressures driving such moves are clear. Twenty years ago the Chakrabaty case in the USA opened the floodgates to patents on living organisms. The industry has discovered that patents on plants are almost impossible to enforce. That's where GURTS come in. As far back as 2000, the Royal Society report on 'Transgenic plants and world agriculture' identified GURTS as primarily a physical tool for enforcing patents – as indeed does the biotech industry when it's talking to the business world.

But agribusiness has even bigger plans. Seventy-four per cent of the world's farmers – a majority of them women (2 billion) – depend on farm-saved seed, meaning that they have no reason to come back and buy new each season. If they could be made to do so, the global seed market would expand massively, as of course would profits.

The negative impact and instability for the farmers – and indeed for the food security of whole countries – would be equally huge. Bearing in mind that a mere handful of multinational business own 80% of the world's seed companies, and most of these also promote genetic engineering, this means fat profits for very few.

GURTS works by chemical applications switching on and off various plant functions, this involves the production on a non-viable endosperm in the seeds. That's the theory anyway. While no peer-reviewed papers have been published to say that scientists have managed to make the whole package work in a plant, it is understood that they have got all the constituent parts to work individually. So the technology has developed somewhere beyond the concept, but is not quite out of the test tube as yet.

The patent for GURTS is held jointly by Delta and PineLand Co and the US Department of Agriculture. In an ironical twist, the technology is now being promoted as a bio-safety tool to stop the spread of GM pollution – something the biotech industry promised would never happen, but is now rampant around the world. Even if the technology was 100% certain to work, which many scientists doubt, plants still produce pollen, thus potentially infecting neighbouring crops with the sterility mechanism or other transgenes.

For all these reason, I conclude that no Government has a mandate to proceed with commercial GM crops, above all if it eliminates the organic sector which is fast-growing and widely popular. It may be justified to take a risk if the benefit is huge and the risk is small. With GM the opposite applies – there are no consumer benefits at all, but the potential downside risks to health and the environment are enormous. GM is not needed, it is not necessary to feed the world (and couldn't ever remotely do so), so no Government, at least at this stage of our scientific knowledge should take irreversible risks with the nation's food supply where the science is still so largely untested.

Michael Meacher
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