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The real GM food scandal

by Dick Taverne

GM foods are safe, healthy and essential if we ever want to achieve decent living standards for the world's growing population. Misplaced moralising about them in the west is costing millions of lives in poor countries

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Dick Taverne is the author of The March of Unreason: Science, Democracy and the New Fundamentalism (OUP)

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Seven years ago, Time magazine featured the Swiss biologist Ingo Potrykus on its cover. As the principal creator of genetically modified rice--or "golden rice"--he was hailed as potentially one of mankind's great benefactors. Golden rice was to be the start of a new green revolution to improve the lives of millions of the poorest people in the world. It would help remedy vitamin A deficiency, the cause of 1-2m deaths a year, and could save up to 500,000 children a year from going blind. It was the flagship of plant biotechnology. No other scientific development in agriculture in recent times held out greater promise.

Seven years later, the most optimistic forecast is that it will take another five or six years before golden rice is grown commercially. The realisation of Potrykus's dream keeps receding. The promised benefits from other GM crops that should reduce hunger and disease have been equally elusive. GM crops should now be growing in areas where no crops can grow: drought-resistant crops in arid soil and salt-resistant crops in soil of high salinity. Plant-based oral vaccines should now be saving millions of deaths from diarrhoea and hepatitis B; they can be ingested in orange juice, bananas or tomatoes, avoiding the need for injection and for trained staff to administer them and refrigeration to store them.

None of these crops is yet on the market. What has gone wrong? Were the promises unrealistic, or is GM technology, as its opponents claim, flawed-- because of possible harm to human safety or the environment or because it is ill-suited to the needs of poor farmers in the developing world? Public discussion of GM food in the British media, and throughout Europe, reflects a persistent suspicion of GM crops. Supermarkets display notices that their products are "GM-free." Sales of organic food, promoted as a natural alternative to the products of modern scientific farming, are increasing by about 20 per cent a year. Indeed, EU regulations, based on the precautionary principle, provide safeguards against "contamination" of organic farms by GM crops; they require any produce containing more than 0.9 per cent GM content to be labelled as such, with the clear implication that it needs a health warning and should be avoided. This causes a major conflict over GM soya beans imported from America. Some GM crops are taking root in some European countries, but in most they are in effect banned. The public is led to believe that GM technology is not only unsafe but harmful to the environment, and that it only serves to profit big

agricultural companies.

Seldom has public perception been more out of line with the facts. The public in Britain and Europe seems unaware of the astonishing success of GM crops in the rest of the world. No new agricultural technology in recent times has spread faster and more widely. Only a decade after their commercial introduction, GM crops are now cultivated in 22 countries on over 100m hectares (an area more than four times the size of Britain) by over 10m farmers, of whom 9m are resource-poor farmers in developing countries, mainly India and China. Most of these small-scale farmers grow pest-resistant GM cotton. In India alone, production tripled last year to over 3.6m hectares. This cotton benefits farmers because it reduces the need for insecticides, thereby increasing their income and also improving their health. It is true that the promised development of staple GM food crops for the developing world has been delayed, but this is not because of technical flaws. It is principally because GM crops, unlike conventional crops, must overcome costly, time-consuming and unnecessary regulatory obstacles before they can be licensed.

The alleged risk to health from GM crops is still the main reason for public disquiet--something nurtured by statements by environmental NGOs, who in 2002 even persuaded the Zambian government to reject food aid from the US at a time of famine because some of it was derived from GM crops. This allegation of harm has been so soundly and frequently refuted that when it is repeated, the temptation is to despair. But unless the charge is confronted, contradicted and disproved whenever it is made, its credibility will persist. The fact is that there is not a shred of any evidence of risk to human health from GM crops. Every academy of science, representing the views of the world's leading experts--the Indian, Chinese, Mexican, Brazilian, French and American academies as well as the Royal Society, which has published four separate reports on the issue--has confirmed this. Independent inquiries have found that the risk from GM crops is no greater than that from conventionally grown crops that do not have to undergo such testing. In 2001, the research directorate of the EU commission released a summary of 81 scientific studies financed by the EU itself--not by private industry--conducted over a 15-year period, to determine whether GM products were unsafe or insufficiently tested: none found evidence of harm to humans or to the environment.

Indeed, the nature of GM technology makes it unlikely that it is more dangerous than conventional farming. Throughout history, farmers have sought to improve their crops by cross-breeding plants with desirable characteristics. Cross-breeding, however, is a lottery and its consequences cannot be easily predicted. Small genetic changes that are desirable may be accompanied by others that are undesirable. It may take generations of back-crossing to eliminate unwanted characteristics. The process is therefore not only unpredictable but slow and expensive, and may even be risky. One of the most effective standard methods of breeding to obtain improved crops is to bombard seeds and plants with gamma rays to alter their DNA by causing mutations, some of which can then be selected for a desired trait. (Incidentally, organic farmers, in their desire to avoid artificial chemicals, are even more dependent than conventional farmers on crop varieties generated by irradiation.) Irradiation alters both chromosome structure and genome sequence in a way that is quite random. Moreover, there is no legal requirement to test such irradiated products either for effects on health or for what they might do to the environment. By contrast, genetic modification in the laboratory introduces a well-characterised gene or genes into an established genetic background without big disruption. What such modification does is what plant breeding has always done, but more quickly and accurately. Opponents often argue that GM technology is different because it can transfer genes between species. But again, this is nothing new, as during evolutionary time genes have moved between species naturally. That is why we have such a diversity of plant life.

Also, those who oppose genetic modification in agriculture often embrace the technology in medicine. The human insulin

used to treat diabetes, for example, is genetically engineered: the human gene that codes for insulin has been transferred into bacteria and yeast, a process that involves crossing the species barrier. By what rationale can the technology be safe and ethical when saving lives in medical treatment, but not when used to make plants resistant to pests in order to save people from hunger?

Some opponents of GM crops, who seem to have realised that the argument based on lack of safety has no basis, now focus their opposition on environmental concerns, arguing that GM crops destroy biodiversity. It would be wrong to claim that the planting of GM crops could never have adverse environmental effects. But their impact depends on circumstances, on the particular crop and environment in which it is grown. Such effects occur with all sorts of agriculture. Worldwide experience of GM crops to date provides strong evidence that they actually benefit the environment. They reduce reliance on agrochemical sprays, save energy, use less fossil fuels in their production and reduce the emissions of greenhouse gases. And by improving yields, they make better use of scarce agricultural land.

These findings were reported by Graham Brookes and Peter Barfoot of PG Economics in a careful study of the global effects of GM crops in their first ten years of commercial use, from 1996 to 2005. They concluded that the "environmental impact" of pesticide and herbicide use in GM-growing countries had been reduced by 15 per cent and 20 per cent respectively. Energy-intensive cultivation is being replaced by no-till or low-till agriculture. More than a third of the soya bean crop grown in the US is now grown in unploughed fields. Apart from using less energy, avoiding the plough has many environmental advantages. It improves soil quality, causes less disturbance to life within it and diminishes the emission of methane and other greenhouse gases. The study concluded that "the carbon savings from reduced fuel use and soil carbon sequestration in 2005 were equal to removing 4m cars from the road (equal to 17 per cent of all registered cars in the UK)."

One other effect of GM crops may be the most significant of all. In the next half century, the world will have to more than double its food production to feed the over 800m people who now go hungry, the extra 3bn expected by 2050 and the hundreds of millions of people who will, as living standards rise, acquire a more western lifestyle and eat a great deal more meat. At the same time, the world is running out of good farming land and water resources. Shortage of land already causes subsistence farmers in Indonesia and South America to slash and burn tropical forests. More droughts and desertification caused by global warming will make matters worse. So will the manufacture of biofuels from wheat, corn and other food crops that further diminishes the supply of land for growing food and thus pushes up prices. Improved yields from GM technology lead to better use of land and prevent the destruction of forests with its effect on global warming. By contrast, the environmentalist James Lovelock has estimated that if all farming became organic, we would only be able to feed one third of even the present world population.

Given the evidence about the safety of GM crops and their beneficial environmental impact, and given the global success of GM cotton, maize and soya, why have so few staple GM food crops been licensed for commercial growth? Why are the benefits of golden rice, drought or salt-resistant crops, plant-based vaccines and other GM products with special promise for the developing world so long delayed?

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The story of Potrykus's golden rice suggests one explanation. The development of the product itself was a great scientific achievement. A bacterial gene together with two genes from the daffodil were inserted into rice to make it synthesise the micronutrient "ß-carotene," which when eaten is converted into vitamin A. This process took ten years. Many more years were spent, with the help of Syngenta and other biotech companies, in solving the patent problems to enable golden rice to be made available to small-scale farmers without royalty payments. Then began the struggle to obtain regulatory approval.

First, although it is agreed even by those opposed to the technology that the presence of ß-carotene in the rice grain presents no possible risk to the environment, no experimental small-scale field trials are permitted. So all rice plants must be grown in specific plant growth chambers in greenhouses-- processes that take three years. Each plant must be shown to be the product of one gene transfer into the same part of its DNA. Then its proteins must be extracted and fractionated, characterised biochemically and their function confirmed--analyses that take at least two years of intensive work in a well-equipped laboratory. Next, feeding experiments in rodents are required, though most people have happily eaten these genes and the proteins they code for from other sources throughout their lives and though the proteins produced from the daffodil genes bear no relation to any toxin or allergen. No slight hypothetical risk may be left untested.

It is ironic that other varieties of rice grown all over southeast Asia have been shown to be "genetically modified" too, but accidentally as the result of mutations, chromosomal recombinations, translocations of pieces of DNA and even deletions of sections of DNA. This rice is consumed everywhere without the requirement of any laboratory tests.

The scientific way of ensuring that crops are safe is to test the product, not the process. Perversely, regulations in the US as well as Europe require the opposite. The result is that it takes much longer and costs at least ten times as much to bring a new GM crop to market as an equivalent conventionally bred crop. As Potrykus has pointed out, no scientist or scientific institution in the public domain has the funding or the motivation to go through such an expensive and drawn-out procedure. Only large companies or the most richly funded charities can and the only projects companies are likely to back are those that make big profits. Producing rice that saves the lives or the eyesight of millions of the poorest peasants offers no great financial rewards.

Why is a technology which has so much to contribute impeded by regulations that make no sense? Part of the blame lies with the large agrobusinesses. They initially welcomed elaborate regulation to discourage competition from small companies that could not afford the cost. Indeed, they successfully resisted every attempt by advisers in the Reagan administration to regulate each GM crop simply as a new product, rather than by the process by which it was derived, an approach that would have treated GM and conventionally grown crops similarly and made more scientific sense. But the large companies won, and the concentration of agricultural biotechnology in the hands of a few giants, like Monsanto, is the result. Furthermore, although tight regulation was backed by some supporters of GM who believed it would reassure the public, it has had the opposite effect. If governments appear to think it necessary to take extreme precautions, the public will conclude that the technology must be dangerous. A third element has been mistrust of multinationals. This has intensified opposition to GM crops because it is widely felt that companies are the main, if not the only, beneficiaries--and that, since they are responsible for most of the development of the crops, this must be subject to the strictest possible regulation. The inept PR that accompanied Monsanto's introduction of GM crops to Europe was also bitterly criticised by other agrobusinesses.

The broader driving force behind the excessive regulation of GM crops, however, is the cult of "back to nature," which has also inspired the propaganda against agricultural biotechnology as a whole. This cult has many manifestations. One is the popularity of organic farming, which is based on the manifestly false principle that artificial chemicals are bad and natural chemicals good. Another is the rising fashion for alternative, non-evidence based medicine. The dogmatic opponents of GM crops in Europe believe that interference with the genetic make-up of plants is essentially a moral issue. It is to be condemned as part of mankind's sinful attempt to control nature, which contributes to global warming, to epidemics of cancer and all the blights of modern life.

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In the light of this undercurrent of anti-science sentiment, what are the chances that the obstacles to the spread of GM crops will be overcome? There are grounds for hope. In 2006, the House of Commons select committee on science and technology recommended "that the term 'precautionary principle' should not be used" and should "cease to be included in policy guidance." The principle has long been a major impediment to good sense in public policy. It is either so obvious as to be otiose ("if there is cause for concern, be careful"), or so vague as to be meaningless. But in its most common application--"where an activity raises threats of harm to the environment or human health, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically"--it has been an invaluable tool for those who want to stop any new scientific development that they dislike.

There are also encouraging signals from the British government. Earlier this year, the then environment secretary, David Miliband, announced that there was no evidence that organic food is more nutritious than conventionally grown food. In principle, the government has declared itself ready to license GM crops and has supported their promotion in Europe. Furthermore, there are significant signs of change in several European countries. Spain has successfully grown GM maize for some years. But the biggest change of attitude seems to be in France, where the number of hectares on which GM crops are cultivated has increased from 500 to 50,000 in three years. The fact that French farmers are becoming convinced of the commercial benefits of GM is likely to have a big impact on the rest of Europe.

But most important is GM's rapid spread in India and China. The Chinese government has declared that biotechnology could become its fastest-growing industry in the next 15 years. According to Clive James, author of the annual "Global Status of Commercialised Biotech/GM Crops" report, half the research and development of GM crops in the world will soon be done in China and will naturally concern crops that benefit the developing world. China is already ahead in testing new strains of GM rice of potential benefit to 250m farmers. While China's exports to Europe must comply with EU regulations, it also has a huge home market. India is not far behind and favours a light regulatory regime.

Finally, in Africa the Gates Foundation is committed to the improvement by genetic engineering of the staple crops on which most of the population depends. Two years ago, the foundation announced its investment of millions of dollars in an ambitious programme building on the work of Potrykus and his colleagues, which aims to add the essential nutrients vitamins A and E, iron, zinc and improved protein to bananas, cassava, rice and sorghum.

There can be little doubt that GM crops will be accepted worldwide in time, even in Europe. But in delaying cultivation, the anti-GM lobbies have exacted a heavy price. Their opposition has undermined agrobusiness in Europe and has driven abroad much research into plant biotechnology--an area in which Britain formerly excelled. Over-regulation may well cause the costs of the technology to remain higher than they need be. Above all, delay has caused the needless loss of millions of lives in the developing world. These lobbies and their friends in the organic movement have much to answer for.

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