# Progress or Problem? Responding to Genetically Modified Food and Crops

## Report of the Environment Day Conference

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**Contributions:**

*Left to right:*
*Joe Perry*
*Christopher Jones MBE*
*Martin Hodson*
*John Weaver*

*Genetically Modified Organisms - agriculture, ecology and food; theology and safety*.
Joe Perry: Chair of the Genetically Modified Organisms Panel of the European Food Safety Authority

*An Ethical and Theological reflection on Genetically Modified Crops*
John Weaver: Chair of JRI and formerly lecturer in Practical Theology, and the Dialogue between Christianity and Science at Oxford and Cardiff universities

*Genetically Modified Crops: policy and globalisation issues*.
Martin Hodson: Operations Manager of JRI and Tutor at Oxford Brookes University

*Genetically Modified Crops: a farmer's view*.
Christopher Jones MBE: Honorary President of Farm Crisis Network and formerly its National Co-ordinator

## 1.0 Introduction

Transgenic plants are those that have been genetically modified using recombinant DNA technology. This technology can be used in a number of ways, for example to engineer resistance to abiotic stresses, such as drought, extreme temperature or salinity, and biotic stresses, such as insects and pathogens, that would normally prove detrimental to plant growth or survival.

Joe Perry noted that the main areas of risk when dealing with genetically modified organisms were: genetic effects from transformation; ecological effects; food safety effects; management effects; bioethical effects; and socio-economic concerns. The latter concerns were highlighted by both Martin Hodson and Christopher Jones who noted the issue of globalisation, whereby multi-national biotechnology firms potentially controlled the market in seeds and crop production, although it was recognised that globalisation concerns are really just a symptom of a wider problem in agriculture and society.

Martin Hodson was concerned about policy issues, and saw the main questions as those referring to the environment, food production, ethics, theology, business, politics, and globalisation. He noted that the issues are not necessarily related to whether GM crops are a 'good thing' or not, but how they are used and by whom.

On a global scale there were some 81 million hectares of GM crops are grown in North America; 69 million hectares in Latin America, 19 million hectares in Asia (mostly India and China) and Australia; 4 million hectares in Africa (mostly South Africa); and a negligible amount in Europe in 2012.

Christopher Jones was concerned about the farm level, where the focus would be on choosing the variety of a crop: what was reliable, harvestable, dryable, storable, saleable, and so make the farmer a living. He addressed the question of what difference would GM seed make. For him there are important issues: the drawback of herbicide resistant weeds remaining after growing GM rape. This may also happen if a neighbouring farm grew such rape. This can result in a reliable herbicide such as *Roundup* becoming unusable. He also noted that some farmers in India were committing suicide because GM crops have not delivered the returns to provide a living. Part of the difficulty is the loans to buy into the technology. If something goes wrong the Indian farmers are unable to pay off the debt.

Genetically modified plants have attracted a great deal of media attention in the last twenty years or so. The public is largely unaware of the advantages and disadvantages of this technology. From the very beginning two main areas of concern have emerged: the risk to the environment and the risk to human health, although many of these have proved to be scientifically unfounded. [1]

Various health and environmental risks have been recognized or postulated, for example on human health through allergic reactions and effects on the immune system. For the environment there has been the effect on wildlife, the creation through cross-pollination of super-weeds resistant to herbicides, and a loss of biodiversity. Dean-Drummond notes that such changes impinge not just on those living in these countries but on all exports as well, including processed food, thus entering the global food supply. [2] Added to this, patents taken out by biotechnology companies on GM seed is making access expensive, so denying use of this technology to the poorer nations. This raises issues of justice.

Joe Perry noted the concerns of environmental Christians, who highlighted such issues as: the allocation of research funding; the dependence of GM technology on fossil fuels; possible contamination of fields planted with conventional crops; the maintenance of sustainable agro-ecosystems; the contamination of wild plants; and the build up of weed or insect-resistance in native populations.

**2.0 The global and scientific context of the debate:**

Martin Hodson observed that the first GM plant – a tobacco plant resistant to an antibiotic was developed in the United States in 1983. This was followed by the first GM crop trials in 1985. In 1993 the US Food and Drug Administration allowed companies to market GM seed, and in 1994 'Flavr Savr' tomato was approved. Herbicide tolerant GM soya has been available in US since 1996, which marks the beginning of GM agriculture.

In 2008 Monsanto produced more than 90% of GM crops worldwide, with Syngenta, Bayer, CropScience, Dow and BASF making the rest. This global dominance is under threat as patents on some of the early developments will expire in the next few years. Additionally there has been increasing research into GM crops in China and India.

Genetically modified crops dominate US agriculture accounting for 88% of Maize (corn), 94% of Cotton, and 93% of Soybean, the US's main crops, production. Most of the seed is produced by

Monsanto. Martin Hodson asked whether or not this should be described as a success. There has been opposition to patent law, concern over food safety, and questions concerning food labelling. A third of US consumers are extremely concerned about eating GM foods, although this is a figure that is falling. However, most people do not know that they are eating GM food.

The story of GM production in Europe and the UK is far less positive. In 1994 'Flavr Savr' tomato (Calgene) was approved in US, with GM tomato paste arriving in the UK in 1996. It sold well at first, but withdrawn in 1999, when supermarkets refused to sell GM produce. A national debate on GM crops in 2003 produced an overwhelming on-line negative result. Most people polled were concerned with environmental and globalisation issues.

In the developing world the picture may be seen as more encouraging with the example of Golden Rice. This genetic modification produces beta-carotene, a precursor of Vitamin A, in the grain. Vitamin A deficiency is widespread in the developing world and is estimated to account for the deaths of approximately 2 million children per year. In surviving children it has been identified as the leading cause of blindness.[3]

Research took eight years to complete with the first field trials held in 2004. The philanthropic approach by bio-scientist Ingo Potrykus, supported by the Rockefeller Foundation, persuaded the researchers and producers that this was a humanitarian project, in which golden rice was to be distributed free to poor farmers. In addition, these farmers are permitted to keep and replant seed from one year to the next. Martin Hodson notes that this is good if it works. Opponents have said that there are other sources of Vitamin A, and that this is a 'Trojan Horse' – other genetic modifications coming in on the back of an apparently successful project.

In 2012 a team of British plant scientists won a £6.4m grant from the Gates Foundation to develop GM cereal crops such as corn, wheat and rice that need little or no fertiliser. The work at the John Innes Centre in Norwich is hoped to benefit African farmers who cannot afford fertiliser.

Martin Hodson concluded that while GM plants have a sustainable contribution to make in some environments an ecological approach may achieve a higher level of sustainable productivity in other areas. For example, SRI (System of Rice Intensification) is an organic agricultural method used in regions in Africa and Asia. He notes that the developing world has one resource that can be used to good effect – large numbers of workers able to plant out fields in a more open pattern

than a mechanical approach would achieve. Using this approach rice levels in one part of India are being increased without the use of GM seeds.

This is a complex issue, where there are huge differences between Europe and North America, and very different issues to consider in the developing world. The key battles concern patents and food labelling. Even if the technology is proven to be 'safe' worries over multinational control are real and need to be addressed.

Joe Perry stated that the main work carried out by the EFSA GMO panel was scientific. The panel (2009-2012) is composed of 21 independent academics, who deal with areas such as scientific contamination, and the co-existence of science and the business of farming.

Up to the time of the conference, insect resistant maize is the only GM crop that has been agreed by the EU commission. The EU have approved a further 39 products for feed or food import, in comparison with the USA who have approved 90 products for cultivation and for food or feed import and Canada where 66 products have been approved for cultivation and 89 for food or feed import.

However, Joe Perry stated that in the USA and Canada there is a less stringent risk assessment. The EFSA GMO Panel compare GM with the natural crop and assess risk by comparison, but does not consider the socio-economic aspects.

Joe Perry presented the example of insect-resistant maize, which can be compared with conventional maize, grown safely for over 10,000 years. The environmental risks include the inadvertent killing of other species. The insect- resistant maize is designed to kill moth larvae, but one problem is that non-target *Lepidoptera* such as butterflies are also killed. The level of this side effect is easier to measure in the lab than in the field. Attempts have been made to link mortality with distance from GM crop or with the pollen density. We know that the environment is always affected by farming, but is the GM system giving a bigger effect than conventional farming? There is a reluctance by the biotechnology industry to address the issues holistically. They are not interested in biodiversity, but in the efficiency of production and yield of the GM crop.

Joe Perry observed that in the EU there is a view that we should look at integrated pest

management, where a reduction in the use of pesticides must also be taken into account. While current GM crops are predominantly herbicide- or insect-resistance (98% of worldwide crops) in the future drought and salt tolerance will be addressed.

**3.0 Positive and Negative Arguments**

Some of the key arguments surfaced in the Oxford Farming Conference, 3rd January 2013, which Martin Hodson highlighted. At this meeting Owen Paterson (UK Environment Secretary) said: 'We should not be afraid of making the case to the public about the potential benefits of GM beyond the food chain – for example, reducing the use of pesticides and inputs such as diesel. I believe that GM offers great opportunities but I also recognise that we owe a duty to the public to reassure them that it is a safe and beneficial innovation.'

Mark Lynas (environmentalist and a former GM protester) at the same conference said: 'My conclusion is very clear: the GM debate is over. It is finished. We no longer need to discuss whether or not it is safe – over a decade and a half with three trillion GM meals eaten there has never been a single substantiated case of harm. You are more likely to get hit by an asteroid than to get hurt by GM food.' A *Guardian newspaper* poll on the same day as the Oxford Farming Conference showed that only 28% of those asked were convinced that GM food is both safe and beneficial, 72% were unconvinced. Jo Perry observed that Europe's distrust of GM organisms reflects a wider distrust of science, and noted that even in the US, while there is a general acceptance of crop science there is a distrust of climate science and geological science.

The Soil Association[4] believe that GM crops are making farming less fair, more risky and not more sustainable. GM crops have locked farmers into depending on costly inputs from a handful of powerful chemical companies, which have been sold on false promises. The Soil Association observe that three corporations – Monsanto, Syngenta, and Bayer – are responsible for virtually all commercially released genetically modified crops in the world. This corporate control of agriculture means farmers have less choice.

Christopher Jones was concerned about the affordability of GM seed for developing world farmers, and the locating of power and control in global multi-national biotechnology corporations. He questioned the awarding of patents for discoveries of particular genes. He considered the scale of operations - on a small scale it may be appropriate and beneficial, but on a

large scale may put production in the hands of multi-national companies. Is humanitarian vision or profit motive the driving force. He was also concerned that the *Roundup* herbicide was not produced to be used over and over again over wide areas, and that genetically identical crops are more susceptible to disease as was the case with Dutch Elm disease, where the elms were all the same genetic species.

**4.0 So we ask: why produce GM crops?**

In the developing world 840 million people are chronically undernourished, surviving on fewer than 2000 Kcal/day. Approximately 1.3 billion people are living on less than US$1/day and do not have secure access to food. Many of these are rural farmers in developing countries, depending entirely on small-scale agriculture for their own subsistence and to make their living. Most cannot afford the cost of irrigation, herbicides and pesticides leading to a vicious circle of poor crop growth, falling yields and susceptibility to pests. The world population is growing rapidly: 6 billion in 2000; 7 billion in 2011; and a forecast 9-10 billion by 2050. The largest proportion of the population are to be found in developing countries. It can be argued that GM crops are one way of increasing food security.[5]

Possible improvement in global food security has come through various techniques of genetic engineering such as insect-resistant maize and herbicide-resistant soybean plants.[6]

Genetic modification can give us enhanced plants, such as: rice with added vitamin A; potatoes with more protein; food crops with reduced levels of allergens; low-flatulence beans; and watermelons without seeds.

GM plants could also produce plastics, or new vaccines and drugs. GM technology might be cheaper and cleaner than conventional chemical factories. GM bacteria that thrive on pollutants could help clean up soil contamination. Of significance to the medical field is the use of GM plants for production of recombinant pharmaceuticals. Human serum albumin, antibodies, blood products, hormones and vaccines have all been expressed in plants.[7] It is possible to create insulin synthetically using genetically modified bacteria.

Set against these benefits are potential risks: it is possible that genes from modified crops might escape into wild plants, protecting them from their natural pests, or from weed killers.

Critics say that there is a risk of playing with the unknown in much of this technology.

Yet, as James Watson points out, in the 1960s pest control was mainly through chemical insecticides, which were poisoning the ground and the people.[8] GM alternatives avoid such detrimental effects.

Whilst being cautious we might accept that where GM crops are nutritionally and environmentally safe they should be used. For example the Chinese attitude is entirely pragmatic: with 23 percent of the world's population but only seven percent of its arable land, China needs the increased yields and added nutritional value of GM crops if it is to feed its population. And with global warming leading to increasingly large areas of the earth's surface subject to drought there will be an ever increasing emphasis on food security.

**5.0 Ethical issues**

Firstly we can consider the issue of justice, which for example occur with new hybrid varieties, where 'no longer could the producer use his own seed for the following year because a hybrid plant produces new and unfavourable mixtures amongst its offspring.' More recently, the new 'terminator technology' potentially goes a step further in preventing engineered plants from setting seed and forcing farmers to buy new seed for every harvest.[9] However Martin Hodson observed that terminator genes restrict the use of GM plants by causing second generation seeds to be sterile, which would also prevent gene movement, stopping genes crossing from one species to another.

Up to 1.4 billion resource-poor farmers in the developing world depend on farm-saved seed and seeds exchanged with neighbours as their primary seed source. A technology that restricts farmer expertise in selecting seed and developing locally-adapted strains is a threat to food security and agricultural biodiversity, especially for the poor.

With patent applications on the world's two most critical food crops - rice and wheat, staple crops for three-quarters of the world's poor - their production potentially enters the realm of private monopoly. At present United Nations legislation does not allow such restrictive patenting of seeds. So while GM crops are being grown in increasing amounts in more and more countries,

there will remain concerns over safeguarding the interests of economically weaker nations and the biodiversity of the planet, while also allowing scientific progress to be made.[10]

Heap, Comim and Wilkes note the importance of food security in this debate. Consumption of food is now increasing faster than population growth as more people adopt a lifestyle and diet once limited to the rich nations.[11] They maintain that in terms of food security, current agricultural practices in many countries are unsustainable. The amount of cultivated land supporting food production was 0.44 hectares (ha) per capita (person) in 1961; today it is about 0.26 ha; by 2050 it will be in the vicinity of 0.15 ha per capita.[12] They question whether or not the future lies in new technologies that bring about positive effects for food security through reduced pesticide use and better carbon balances. The International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) report in 2009 stated that the way in which the world grows its food would have to change radically to better serve the poor and hungry if the world was to cope with a growing population and climate change while avoiding social breakdown and environmental collapse.[13]

Deane-Drummond rightly observes that the secular philosophical basis for or against genetic engineering is pragmatic, expressed through a consequentialist philosophical framework, namely, the outcomes being judged by whether or not there are more benefits than risks.[14] She notes that the Roman Catholic interpretation of humanity as co-workers in genetic engineering is within such a perspective.[15] Thus GM crop production which potentially increases food production in areas of the world where there are shortages is good. In addition those genetic modifications that improve health, such as providing a source of Vitamin A or D are to be gratefully adopted.

However, those who argue against GM crops do not simply urge us to understand the risks, they also point to the self-deception involved, whereby we ignore the political and social causes of world poverty. There is also the argument of people usurping the role of the Creator: ‘playing God’. Some describe GM crop production as ‘unnatural’, (against natural law) although this accusation could be levelled at all our food, which has been produced over millennia by artificial breeding.

**6.0 A Christian theological perspective**

In her worship Israel celebrated in song (Psalms 148, 65, 104, 19, 8) its deepest faith in God as her creator, sustainer and redeemer. In his parables Jesus presented the faithfulness of the creator and the dependability of creation.

The human-centred model of control and exploitation of creation has been challenged by modern ecology, which recognizes that we are intimately involved with creation. We are challenged by the recognition that the human impact on the world may be triggering irreversible and catastrophic changes in the environment.[16]

The decline in biodiversity affects the capacity of the earth to sustain human needs and reduces the resources of plant and animal species. The environment is an issue of justice, and when the environment is damaged it is often the poor who suffer most. These are important questions for the Christian church to address: conservation; pollution; ecology; stewardship; and justice, as we seek for a theology for earthkeeping.

The Roman Catholic Church has drawn attention to the threat posed by modern Agro-industrial methods to many indigenous peoples.[17] In considering biotechnology the RC Council looks at its use and acceptability from a moral standpoint and the possible consequences for human health and their impact on the environment. However they recognise that nature is not a divine or sacred reality to be left alone.[18] Rather it is a gift of God entrusted to humanity for their responsible care. They maintain that interventions that damage the environment deserve condemnation but those that improve it are praiseworthy, so there needs to be evaluation of benefits and risks. But bio-technology entrepreneurs should consider the common good as well as legitimate profit.

The Council states that the doctrine of the Church reminds humanity that the goods of the earth were created by God to be used wisely by all. Greed is condemned, and the Council concludes that serious ecological problems call for an effective change of mentality leading to the adoption of a new lifestyle.[19]

We clearly need help in coming to a balanced decision in such a complex debate. Paul Fiddes[20] observes that in the Bible we find two kinds of wisdom: observable factual wisdom based on experience and the senses; and in addition there is Lady Wisdom who invites us to discover

deeper truths - the wisdom of God. These are seen in the book of Job, where we find in chapter 28 factual observations about the world, earth, rocks and minerals. But this is not all the truth there is to know as we discover at the end of the book of Job (38-40), where God leads Job on a walk through creation. Here we learn that to understand the nature of God, the world and the nature of suffering, Job needs to be in tune with God.

In the NT the prologue to the Gospel according to John (John 1.1-18) and Colossians 1.15-20 express the relationship between Christ and creation. The Apostle John presents Jesus as the Wisdom of God (the Logos, the Word) in the creation of the universe. John tells us that Law comes through Moses, but the truth - reality, wisdom - comes through Jesus.

Before his crucifixion Jesus tells his disciples that he is the way, the truth, and the life, and that no one comes to the Father except through him (John 14:6). In effect he is saying that truth - the reality of God and God's world - is discovered through a relationship with Jesus - walking through life in his company. He goes on to promise another Counsellor, the Spirit of Wisdom and Truth, who will be present with the disciples after Jesus has returned to God.

We can discover a great deal through scientific observation and research, experiment and testing, and through our five senses (sight, hearing, smell, taste and touch), but there is still a sixth sense. There is the knowledge that comes from being attuned to God's wisdom - walking with God in God's world; living with Jesus; knowing the presence of the Holy Spirit - leading us into all truth, and understanding the reality and meaning of God's world.[21]

We can ask 'How far should we be allowed to become co-creators with God in engineering crops and animals for our own benefit? How far should we take transgenic experimentation? How do we distinguish one research project from another in terms of its likely risk and benefit for humanity and the earth?' A theology of Wisdom serves to unite themes of creation and redemption by identifying Christ the Redeemer and the divine Logos with Sophia, the Wisdom of God involved in the creation of the world.'[22]

We need wisdom to recognize the presence of God in the new technologies. There are key questions to which we need answers: are we achieving God's purposes? Do we know what God intends? Are we excluding God from our discussions? [23] As Fiddes suggests, the answer is to be found through being attuned to God's wisdom.

[1] Key, S., K-C Ma, J & Drake, P M W, 'Genetically modified plants and human health', *Journal of the Royal Society of Medicine 2008: 101: 290-298.*

[2] Deane-Drummond, C.E., *Biology and Theology Today,* London: SCM, 2001, pp. 120-122

[3] Key, Ma & Drake, 'Genetically modified plants', *p.292*

[4] http://www.soilassociation.org/gm?gclid=CJySkqT9lLUCFcjKtAodyEgATg accessed 01.02.13

[5] Key, Ma & Drake, 'Genetically modified plants', *pp.291-2*

[6] Jones, S., *The Language of the Genes: Biology, History and the Evolutionary Future*, London:Flamingo/HarperColiins, 2000, p.276

[7] Key, Ma & Drake, 'Genetically modified plants', *p.293*

[8] Watson, J., 2003, *DNA The Secret of Life*, London: Arrow Books, pp.135-6

[9] Jones, *The Language of the Genes*, p.275

[10] Hodson, M.J. & Hodson, M.R. *Cherishing the Earth: How to Care for God's Creation*, Oxford: Monarch, 2008, p.184-8

[11] Heap, B., Comim, F. & Wilkes, G., 'International governance and root causes of unsustainability' in White, R.S. (editor), 2009, *Creation in Crisis. Christian Perspectives on Sustainability*, London: SPCK, p.73

[12] Heap, Comim & Wilkes, 'International governance' in White, *Creation in Crisis,* p.74

[13] Heap, Comim & Wilkes, 'International governance' in White, *Creation in Crisis*, p.75-6

[14] Deane-Drummond, *Biology and Theology*, p.119

[15] Deane-Drummond, *Biology and Theology*, p.101

[16] Church of England's Mission and Public Affairs Council, 2005, *Sharing God's Planet*, London: Church House Publishing, p.3

[17] 'Safeguarding the Environment' Chapter 10, *Compendium of the Social Doctrine of the Church*, Liberia Editrice Vaticana, English translation, 2005, reprinted 2009, para.470

[18] 'Safeguarding the Environment', para.473

[19] 'Safeguarding the Environment', para.486

[20] Fiddes, P.S., 'Ancient and Modern Wisdom: The Intersection of Clinical and Theological Understanding of Health' in Finamore, S & Weaver, J (eds) *Wisdom, Science and the Scriptures; Essays in Honour of Ernest Lucas* , Oxford: Regent's Park, 2012)

[21] see also Haymes, B., 'The Way of Practical Modesty' in Finamore and Weaver, 2012

[22] Deane-Drummond, *Biology and Theology*, pp.94-5

[23] Deane-Drummond, *Biology and Theology*, pp.98-9