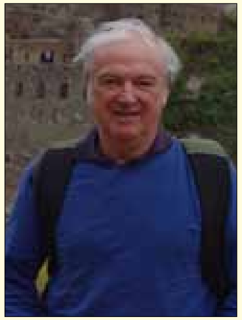
At the last count, at the end of 2012, these crops were grown in 26 countries, including several that are classified as less developed. GM crops are now grown on 12% of the world's arable land. The USA and Brazil are the biggest users but China and India are in the top five, especially for GM cotton. Indeed, 80% of the world's cotton and 80% of the world's soya bean products now come from GM plants. Plant scientists insist that there is no *a priori* reason why crops bred by GM techniques are any more hazardous to human health or to the environment than crops bred by other methods. Indeed, the experience of the past 20 years shows us that this is so. Yet in the EU, including the UK, environmental campaigners have convinced the public that these crops are unsafe. There is thus very little growth of GM crops in the EU, with the exception of Spain, where GM insect-resistant maize is grown for animal feed. Farmers and plant scientists alike are frustrated that useful crop varieties bred by GM techniques are not approved for commercial use.

How should Christians react to this? We would not expect the Bible to speak on GM or indeed on any bioethical topics, although it does encourage us to treat humanely the animals that we use for work and food. In general then we need to use Christian virtue and wisdom in applying Christian principles, acknowledging at the same time that science itself is both a gift from God and a means of worshipping him. Scientific advances need to be judged in the light of our stewardship of the environment and of our love for our neighbour (including the need to feed a hungry world). We will be wary of situations that enable the rich to exploit the poor, sadly a feature of much modern technology-based commerce. However, we cannot define a 'Christian view' because different Christians reach different views, as they do on other bioethical topics, as is explored more fully in the Bioethics leaflet in this series.



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Further information

www.cis.org.uk – Christians in Science

Further Reading

Bryant J (2007) *Ethical Issues in Genetic Modification.* Faraday Paper No 7

Bryant J (2013) *Beyond Human?* Lion, Oxford

Bryant J, la Velle LB, Searle J (2005), *Introduction to Bioethics,* Wiley, Chichester

Bryant J, Willmott C (2012) *Science, Ethics and Christianity. In Lion Handbook of Science and Christianity,* ed, Berry RJ. Lion, Oxford

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addressing questions of science and faith

Genetic Modification

Why is Genetic Modification such a controversial topic?

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Thinking about...

Genetic Modification

Prof John Bryant

What does Genetic Modification involve?

Genetic modification (previously known as genetic engineering) does 'exactly what it says on the tin'. It is the modification of the genetic makeup of a living organism, usually by adding a small number of genes (often just one) to the chromosomes of that organism. In more recent developments it can also mean changing the ways in which genes are controlled, for example by altering their 'on-off' switches. The over-arching methodology therefore is to take a 'piece' of DNA (the stuff of which genes are made), corresponding to a particular gene, from one organism and transfer it to another.

This does not change the essential character of the receiving organism; it simply confers on it a new genetic trait. Insect-resistant maize is still maize.

Transfer of genetic material occurs widely in nature and in 1973, scientists in California used a natural mechanism to transfer a new gene into bacterial cells. The technique caught on very fast and became widely used in research on the genes of all types of living organisms because it was now possible to 'grow' genes in bacterial cells. It was also possible to get bacterial cells to make new products. For example, if the human insulin gene is transferred to bacteria, they will make human insulin . Indeed, for over 30 years now, human insulin from GM bacteria has been prescribed for insulin-dependent diabetes. Forty years from the initial pioneering experiments, GM microbes are widely used to make medical and veterinary products and even to make enzymes used in food processing.

Animal GM followed within a few years. As with bacterial GM, we do not hear much about it in the general news. By far the most widespread use is in medical research, in which, over the years, millions of rodents (mostly mice) have received human 'disease genes' in order that those diseases may be studied in the lab. Some GM animals fluoresce ('glow in the dark') when particular genes are switched on or when the animals encounter damaging chemicals in their environment. There is some commercial use of this too: glow-in-the-dark fish are sold as novelty pets. Another potential medical and/or veterinary use is the production of vaccines and other therapeutic products in milk. This has been achieved for several mammals, including sheep, goats and camels but despite early hopes has not yet come to commercial fruition.

More controversial are applications of animal GM in food production. Attempts to increase yield (body mass) of farm animals have not been successful because of unwanted side-effects (such as skeletal problems). Some applications are regarded as morally repugnant, e.g., the breeding of featherless poultry which would, if produced commercially, avoid the need for plucking. However, GM farmed fish, especially salmon, which grow faster than non-GM fish (but do not grow larger) have been approved for human nutrition. In several countries the meat from cloned (but otherwise not genetically modified) cattle has also been approved for our consumption.

The first successful plant GM experiments were performed in 1983, again using a naturally-occurring gene transfer mechanism. Plant scientists were delighted because it opened up new avenues in research and because it added a powerful and much more precise new method to plant breeders' 'tool kits'. So far the main commercial uses have been the addition of genetic traits that help farmers to grow their crops more efficiently; for example, resistance to insect pests or tolerance of weed-killers. The main GM crops across the world are soya bean, oil-seed rape, maize and cotton. There has also been some commercial production of veterinary vaccines while a vitamin-A-enhanced rice ('Golden Rice') for human consumption is likely to be grown commercially for the first time in 2014. Other GM rice varieties are under development, especially in China. GM breeding techniques are also been used to develop crops that are tolerant of environmental stresses such as drought.

Are GM crops dangerous, and should we oppose them?

Over the two decades in which GM crops have been grown commercially, their use has increased dramatically.