EdenTree SRI Expert Briefing – March 2016

Genetic Modification: The Issues for Responsible Investors

Q. What is a Genetically Modified Organism?

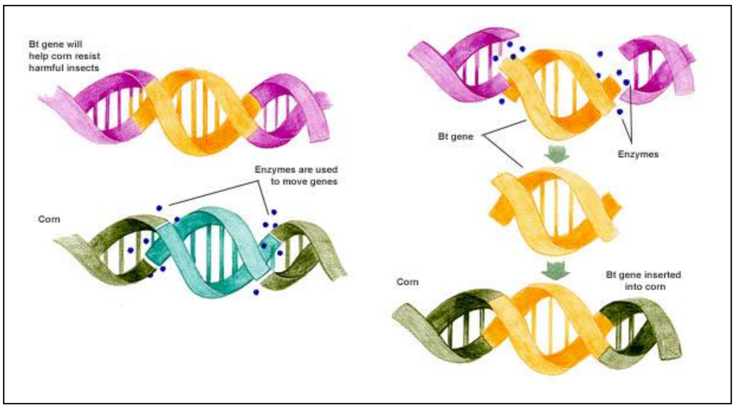
A. Genetic Modification (GM) is a biotechnology technique that changes the genes of an organism (plant or animal) to produce a 'modified' or changed organism. It is a relatively modern technology, made possible by the discovery of DNA in 1953. The first field tests were conducted in 1987 on plants engineered to withstand frost, and the first 'engineered' food (a tomato paste) was licensed for sale in 1992-93.

Q. How does GM differ from conventional breeding techniques?

A. Traditional (mutation) breeding involves finding favourable traits within species and crossing them with the hope of producing a favourable progeny. As conventional breeding involves the random transfer of thousands of genes, outcomes are difficult to predict and may take several breeding cycles to refine. Traditional breeding also relies on genetic compatibility between the two organisms to 'cross breed', whereas GM is a precise method that identifies and isolates desired traits within or between species, and then introduces these to a host organism.

Q. How is genetic modification effected?

A. GM is effected by inserting (or deleting) genes from one organism into another to change or modify the genes of the host organism. There are two defined types of genetic modification: *Cisgenesis* artificially transfers genes between organisms that could be conventionally bred, whilst *transgenesis* entails genes from different species being inserted via *horizontal gene transfer* techniques. In nature, the latter can occur when DNA penetrates the cell membrane for any reason. GM techniques modify the host organism by physically inserting the extra DNA into the host using a micro-syringe or as a coating fired from a gene gun.



Inserting a BT gene into corn DNA using enzymes results in an insect resistant corn that can reduce pesticide use

Q. What are the most common crop types and uses for genetic modification?

A. First generation genetically modified crops are either insect-resistant (Bt crops) or herbicide-tolerant (HT) strains with the aim of making pest and weed control easier. The main crop species in which GM traits have been introduced are maize (corn), soya, cotton and Canola (oil seed rape) which represent around 99% of all GM crops grown. Sugar beet, alfalfa, papaya, squash and eggplant accounts for the remaining 1%[1] and are defined as 'minor GM crops'. Second generation GM crops are being developed with traits such as drought and disease tolerant or that have enhanced nutritional properties (e.g. golden rice), but these have not, so far, been widely commercialised.

Q. Are GM crops overtaking conventional crop cultivation?

A. Since commercialisation in 1996, the amount of land given over to GM cultivation has grown exponentially. Since 2011 an additional 21.5m hectares have been planted so that GM crops are now grown in 28 countries by 18m farmers on 181.5m hectares of land[2]. GM therefore represents the fastest adopted crop technology in recent times and not least in the developing world where it is grown in 20 countries (71% of the total). These regions were responsible for over half of all GM crops grown globally. Bangladesh planted GM crops for the first time in 2014, whilst Indonesia and Vietnam approved biotech crops for cultivation in 2015.

Q. Where are GM crops commonly grown?

A. The United States commits the most land to GM crops with 73.1m hectares under cultivation (40%) in 2014. Brazil is ranked second (42.2m hectares or 23%). These two markets are followed by Argentina (24.3m hectares) and Canada and India both with 11.6m hectares under growth[3]. Of the 28 countries where GM crops are grown, 19 are classed as biotech mega countries where more than 50,000 hectares are under cultivation[4]. 82% of all soybean and 68% of all cotton grown globally is now biotech! Just under half (49%) of the global planting committed to the four main biotech crops is now GM[5].

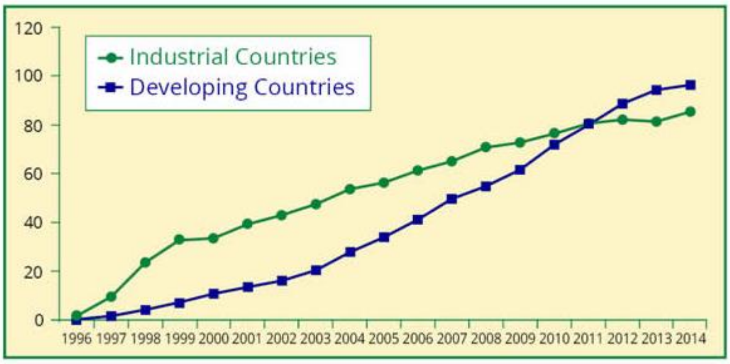


Fig 1: Global area of biotech crops 1996-2014 (industrial and developing countries (million hectares)

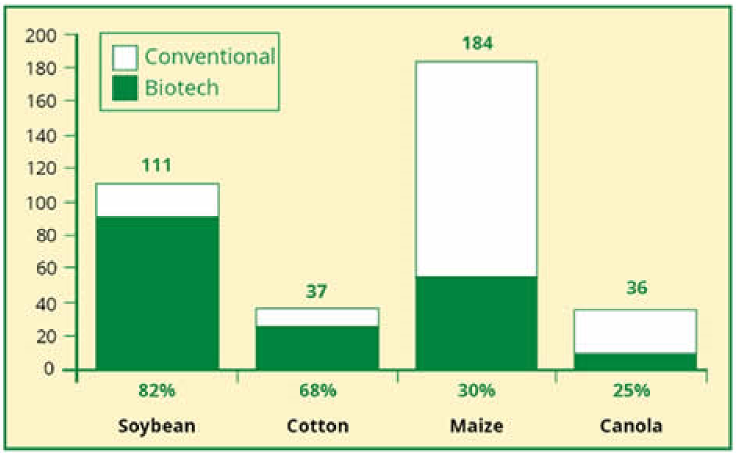


Fig 2: Biotech crop area as % of global area of principal crops 2014 (million hectares)

Q. What is the position in Europe?

A. The EU remains the largest territorial block resistant to widespread GM cultivation. Under EU legislation GMOs can only be released into the environment if a science-based risk assessment has shown no safety compromise. Individual member states can impose a 'safeguard clause' that effectively blocks and prohibits the use of GM products within its jurisdiction. France and Germany are the main opponents of GM in Europe four other countries have effectively imposed 'safeguard clauses' on their cultivation (Austria, Greece, Hungary and Luxembourg). Just two crops have been approved for commercial cultivation in the EU; insect-resistant maize and a potato with modified starch content for industrial-chemical use. Spain is the largest cultivator of GM crops in the European Union with 100,000 hectares under cultivation[6]. Smaller amounts are cultivated in Portugal, the Czech Republic, Slovakia and Romania. More than half of the member states of the EU have effectively 'banned' the cultivation of GM crops under rules introduced in April 2015 that allowed member states to self-decide.

Q. Does that mean GM is legally acceptable in the UK?

A. Yes. The UK has not imposed a 'safeguard clause', but there are no commercial crops being grown or licensed in the UK (the two crops licensed in the EU are not suitable for UK cultivation). The UK Government remains committed to good science, recognising that GM technology could deliver benefits providing it is safely deployed. The UK has been among the leading EU voices for 'proportionate' regulation, and supports pragmatic measures to segregate GM crops from conventional and organic crops. However, within the devolved administrations, only England (through the UK Government) has expressed a positive view of GM; Wales, Scotland and Northern Ireland all oppose GM cultivation. Imported GM material, mostly soya, is allowed, principally in animal feed, but also in some food products.

Q. Does that make the cultivating of GM crops more likely?

A. Not necessarily as the only GM strain currently licensed for release are not suitable for growing in the UK. There appears to be little appetite at the wider EU level to license more genetically modified strains, and in the UK the number of field trials have reduced considerably from their peak. Recent field trials have included GM wheat, potatoes and 'false flax' which accumulates high levels of Omega 3 oil and could be used as feed in factory fish farming as a health supplement. Most of the field trials are conducted by Rothamstead Research, an independent charitable company and the oldest arable crop research institute in the world.

Q. What about animal modification - is also a reality?

The piglet on the left was injected with a jelly fish gene that allows it to become fluorescent. This kind of science remains controversial

A. Yes. Animals can be modified in the same way as plants through the introduction of genes intra species or between species. It is subject to the same overarching regulation as crops. Whilst the risk of gene escape is very low, the modification of animals raises complex ethical issues and remains controversial, especially if cloning is the result. Genetically modified mice are widely used in scientific research, whilst livestock can potentially be modified to enhance yield or alter their products. Mongolian scientists have modified cattle to produce healthier milk for those who are lactose intolerant, whilst Chinese scientists successfully introduced human genes into 300 dairy cows to produce milk more consistent with human breast milk. These developments remain controversial. Other examples include the Roslin Institute modifying chickens to resist bird flu, provide a potential treatment for liver damage and weaning birds off antibiotics, and sheep modified to produce a drug capable of treating cystic fibrosis. The first GM animal to be licensed for human consumption was approved by the US FDA (Food & Drug Administration) in November 2015 for a salmon containing growth hormone genes taken from two other species to accelerate the salmon's growth. A UK company, Oxitec is pioneering the modification of insects to help control or eradicate diseases such as Dengue Fever.

Q: Are there any new developments in gene technology?

A. Genome editing is attracting considerable attention. Gene editing differs from genetic modification in that it does not require inserting a gene into an organism, but 'editing' an existing gene to change its properties. By switching off individual genes, for instance in barley, scientists believe they can develop a strain that will make its own nitrogen fertilisers. Other work includes gene-editing beetroot to produce L-Dopa, a drug used in the treatment of Parkinson's disease. L-Dopa is produced naturally in beetroot, but other genes turn this compound into dyes that make the beetroot purple. Turning off those pathways would allow L-Dopa to accumulate and be a source of medicine, particularly in poorer countries. The European Commission is set to decide whether gene editing should be considered to be GM, and therefore covered by current GM regulations. Scientists who argue that gene editing is just accelerated natural breeding warn of the potential loss in therapeutic benefits if the research becomes subject to restrictive GM regulation. Detractors however argue that gene editing carries the same potential for unforeseeable disruption of the genome as genetic modification such that intervening in that genome may lead to unpredictable outcomes.

Q. What are the benefits usually cited for genetic modification?

A. Proponents of GM cite a range of benefits. If crops can be made more resistant to pests, crop failure can be mitigated. Similar benefits accrue from crops becoming drought, frost and heat resistant. If world population continues to grow to a projected 9bn by 2050, crop yields will need to increase in order to respond to human demand. More food could, as a consequence, be produced from less land if existing land banks yield more. Equally, marginal land previously viewed as unproductive could potentially be brought into use as a result of hardier, saline tolerant crops being cultivated in contaminated saline conditions. One environmental positive often stressed is reduced pesticide use (as plants become pest resistant), which in turn could enable biodiversity to flourish having been in some cases all but extinguished by the use of chemicals. New generation technologies hold out the prospect of vaccine and medicine development, enhanced nutritional properties, the removal of allergens and 'fingerprinting' animal and plant diseases with a view to their genetic elimination.

Q. And what are the drawbacks?

A. Some GM opponents cite ethical and environmental objections to an 'unnatural' science. The science remains widely mistrusted in the UK and Europe, partly on the back of agricultural scandals such as BSE, and scepticism surrounding artificial manipulation of nature. Ethical concerns therefore tend to centre on human intervention to produce 'unnatural' outcomes such as mixed gene organisms. Cloning or the exact replication of an individual organism via genetic intervention tends to excite most opposition, as does the genetic manipulation of animals where there may be long-term health and welfare issues. Arguments used against GM centre on the long-term unknown consequences of genetic contamination via 'gene escape' and the hypothetical mutation of genes once inserted into an organism. The long-term stability of the host organism is often questioned for which proven scientific evidence is at present absent. GMOs could theoretically breed with wild and natural species, contaminate non-GM or organic crops and create hybrid plants as an unintended consequence. In the UK, with its integrated field system and hedgerows this has been a pertinent concern, with government regulating separation margins between crops. Biodiversity risk is also put forward as a potential downside given there is little field analysis on the impact of horizontal gene flow of GM pollen to bees and other species. The proprietary rights of biotechnology and its accretion by a small number of large corporations may lead to a lack of choice on the part of farmers and consumers. Terminator technologies have caused wide consternation as they would, if applied, prevent a crop from being grown the following year from its own seed; a terminator gene effectively ‘switching off’ the plant’s ability to self-germinate.

Q. Finally, what are the issues for responsible investors?

A. We support responsible, evidence based scientific research where results are published and are subject to independent peer review. To that end, we support government led field trials that aim to understand the risks and opportunities from commercialising GM in the UK. The world faces serious impending food shortages for a combination of reasons, including population growth. Under this scenario, GM may afford an attractive solution if modified pest resistant crops can be made to grow in challenging or marginal climates. In the UK and Europe, segregation is going to become increasingly problematic as GM harvested crops increase in volume - 82% of all soy planted and which is a staple in animal feed is now GM[7] – so that keeping it out of the human food chain may, ultimately, be impossible. As responsible investors we look to the scientific community for leadership; the Nuffield Council on Bio-ethics noted that “*all forms of plant breeding have directly and indirectly changed individual crops or biodiversity. Risks and benefits of specific interventions need to be considered in individual cases. We do not think that arguments about ‘naturalness’ are convincing enough to rule out the responsible exploration of the potential of GM*. The Council also supports gene flow assessment on a case by case basis as far as environmental risk is concerned: “*Gene flow occurs widely throughout nature. Whether or not it is acceptable depends primarily on its consequences. The possible risk would depend largely on the particular crop and trait’*[8] Crops that readily cross pollinate will require stronger margins for control than those that cannot, such as wheat. GM companies have a role to play in fostering consumer and public confidence in the science, and ultimately in GM itself. They should conduct their research in accordance with sound science and with ethical rigour, whilst meeting all legal and regulatory requirements, and providing farmers with choice. The modification of animals remains largely experimental and research based at present. However, this area of research remains highly controversial, and a justifiable medical or pharmacological imperative would seem to be a minimum requirement if companies are to enter this field more widely and for commercial advantage. We would expect to review any such proposals on a case by case basis.

GM wheat looks much the same as conventional wheat, but what are the risks?

Best Ethical Investment Provider

Best Ethical Investment Provider

The EdenTree SRI Team

We have a specialist in-house Socially Responsible Investment (SRI) team who carry out thematic and stock-specific research to identify ethically responsible investment ideas for our range of **Amity Funds**. Headed up by Neville White, Head of SRI Policy & Research, and supported by Associate Fund Manager Ketan Patel and Responsible Investment Analyst Esmé van Herwijnen, the team is also responsible for creating an on-going dialogue with companies, allowing us to engage on a wide variety of ethical and socially responsible investment concerns. For investors, it’s an added layer of assurance that client money is being invested in companies that are operating in a responsible and sustainable way. Our ethical and responsible investment process is overseen by an independent Amity Panel that meets three times a year, and comprises industry and business experts, appointed for their specialist knowledge.

This information is for investment professional only and should not be relied upon by private investors.

EdenTree – Ethical Investment Specialist

Since launching the **Amity UK Fund** in 1988, EdenTree has taken a leadership role in managing ethical investments through our research, engagement and strong fund performance. Consequently, we were delighted to receive the Moneyfacts Award for Best Ethical Investment Provider 2015, the seventh consecutive year **of** winning this award. We were particularly pleased to win as it is voted for by the Adviser community. We were also awarded Money Observer Best Ethical-SRI Bond Fund for the **Amity Sterling Bond Fund**; the **Amity UK Fund** won Best Equity Fund in the 2014 Money Observer Ethical/SRI category, and we were nominated for an award in the category of Best Thought Leadership Paper on Sustainable Investing, in the Investment Week Sustainable Investment Awards 2014. Today we offer six SRI funds under our Amity under our Amity brand, four retail funds and two for charity investors, covering the major markets and investment classes.

Further information

For further information on EdenTree's SRI range of Amity Funds please contact your EdenTree Business Development Manager, visit www.edentreeim.com or call our IFA support team on 0800 011 3821.

Notes:

[1] International Service for the Acquisition of Agri-biotech Applications http://www.isaaa.org/resources/publications/pocketk/16/

[2] ibid ISAAA

[3] ibid ISAAA

[4] ibid ISAAA

[5] ibid ISAAA

[6] ibid ISAAA

[7] ibid ISAAA

[8] Nuffield Council on Bioethics www.uffieldbioethcs.org