

BRIEFING NOTES ON THE GENETIC MODIFICATION OF PLANTS

What is genetic modification (GM)?

- GM is a method that enables the alteration or addition of genetic material (specific DNA sequences) in a way that might not occur outside the laboratory.
- GM includes a range of techniques that allow specific DNA sequences to be moved with a high level of precision, often between different organisms.

Why do people genetically modify plants?

- The GM method enables plant scientists to achieve things which cannot be done via conventional breeding such as introducing simple or complex characteristics without introducing unwanted ones. It can be used to transfer genetic material between species that cannot be crossed using conventional breeding methods.
- Conventional breeding can achieve results which GM can't: the approaches are complementary.
- Introducing desirable traits to crops offers potential benefits to farmers, such as more productive crop varieties, as well as to consumers, such as enhanced nutritional composition and lower prices.
- The GM method does not provide benefits per se, and each use of the method must be evaluated on a case by case basis.

Where and how are GM plants grown and used?

- The first commercially grown GM crop variety was a tomato called "Flavr Savr" licensed in the US for human consumption in 1994. No adverse health impacts have been documented from the consumption of GM crops.
- In 2014 about 18 million farmers in 28 countries were growing GM crops on 181 million hectares, which is 13% of the world's arable land.
- No GM crops are currently being grown commercially in the UK
- Only one GM crop is licensed for cultivation in the EU, a variety of maize which produces *Bacillus thuringiensis* (Bt) crystal protein, a protein that is only toxic to Lepidopteran caterpillars.
- Authorisation for a GM potato with enhanced starch content was annulled in December 2013.
- GM crops can also be imported and used to produce ingredients for human consumption and for animal feed. There are currently 47 varieties of GM plant which can be imported into the EU and UK.

Where does the scientific community stand on GM?

- The overwhelming majority of plant scientists support the use of GM as a research tool, and its contribution to current and future plant breeding.
- GM is widely used by agricultural scientists, including conventional plant breeders.
- There are some UK plant scientists who have reservations about corporate control of GM crops.
- In the broader scientific community there are a few who express concerns about the safety of GM. The GM method is not inherently dangerous, and individual uses must be judged on a case-by-case basis.

Why do people oppose the use of GM?

- Different critics oppose the use of the GM method for a variety of different reasons. The following concerns are expressed by those who oppose GM crops and are addressed overleaf:

Contamination

Environmental impacts

Control by big business

Human health impacts

Claims for alleviation of poverty and hunger

Tolerance to pest resistance

Concerns expressed about GM crops

Contamination

Three distinct issues get referred to as 'contamination'. (i) Seed of a GM crop might get spilled, leading to "volunteer" plants growing outside the field. (ii) Pollen might spread from a GM field and pollinate non-GM crops. (iii) There might be mixing of GM and non-GM seeds in the food chain. Like conventional crops, most GM crops die quickly outside the field as they can't compete with wild plants. Genetic crossing with non-GM crops or wild plants is possible, but this possibility varies between species and their processes of pollination, and will only affect future plantings if the resulting seed is planted in subsequent years. Some seed mixing can't be ruled out due to farming, transport and trading practice, though this does not pose a risk to human health (see below).

Environmental impacts

Individual uses of GM technology should be assessed on a case-by-case for environmental impact. For example, there have been cases where herbicide tolerant GM crops have resulted in negative environmental impacts due to overuse of herbicides and selection of herbicide-resistant weeds. On the other hand, Bt-insect resistant crops reduce the need for pesticides, leading to a greater diversity of insect life.

Big Business

Large corporations control the seed trade, whether GM or not, and it is common practice to insist farmers pay royalties to save or replant seeds. F1 hybrid seeds which have been used for nearly a century are less productive if replanted. This issue is separate to the use of GM technology. There is an increasing amount of publicly funded GM research producing varieties that benefit consumers and farmers, and corporations contribute only a small fraction of the funding for all major UK plant research centres.

Terminator seeds: Monsanto owns the patent for producing infertile second generation seeds, referred to as 'terminator seeds', but concept has never been made to work, and has never been deployed.

Indian farmer suicides: GM opponents have argued that suicides by Indian farmers growing Bt cotton reveal the exploitative nature of seed corporations that push GM. While there are conflicting assessments of whether Bt cotton has had a positive or negative overall impact on Indian subsistence farmers, the first year Bt cotton was released, severe drought and resulting financial losses led to high suicide rates among farmers growing both Bt and standard cotton.

Alleviating poverty and hunger

The proponents of GM crops have been alleged to over-claim for the potential contribution GM crops could make to alleviating poverty and hunger. GM technology is one tool in the toolbox for addressing food security, and the vast majority of farmers growing GM crops are in the developing world (over 90%), where [surveys have shown attitudes are predominantly positive](#).

Human health impacts

All studies to date have found no greater risk from consumption of existing varieties of GM crops than from conventional crops. Any GM or GM derived product intended for sale in the EU undergoes safety assessment by the European Food Safety Authority. GM technology has the potential to produce crops with positive health benefits and enhanced nutritional content.

Tolerance

The evolution of tolerance to a pest or disease control measure by the targeted organism can be a problem in both GM and conventional, chemically-sprayed crops.

Links to further information:

A [background summary of the regulation of GM](#) from the Food Standards Agency.

Summaries of the use of GM crops for food security in Europe and developing countries from the UK Parliamentary Office of Science and Technology.

www.parliament.uk/briefing-papers/POST-PN-386.pdf

www.parliament.uk/briefing-papers/POST-PN-412.pdf

[The European Association for Bioindustries](#) is the voice of biotech industry at the EU level and has written several position papers on the use and regulation of GMO.

The [Genetic Literacy Project](#) explores the intersection of DNA research and real world applications of genetics with the media and policy worlds.

The Panel on Genetically Modified Organisms at the European Food Safety Authority (EFSA) deals with genetically modified organisms and genetically modified food and feed.

<http://www.efsa.europa.eu/en/panels/gmo.htm>

<http://www.efsa.europa.eu/en/topics/topic/gmo.htm>

[ISAAA](#) is an international not-for-profit that shares the benefits of crop biotechnology, particularly to resource-poor farmers in developing countries.

[GMO Compass](#) is an EU based website that demystifies the current policies and practices regarding GMOs, as well as their safety and regulation.

[Information on GMOs](#) produced by public-sector scientists active in biotechnology research and by farmer organisations.

These Briefing Notes have been written by the Science Media Centre in consultation with a number of scientists, science press officers and broadcast journalists. They are not intended as a comprehensive summary on a subject, but rather a snapshot of the basics, of points of controversy and a pointer towards sources of more detailed information. They are subject to change and will be updated as and when the science moves on.

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