PlantPower
Gene technologies

GM, genome editing and CRISPR are all in the news, with hot debate over how new techniques should be regulated. Over the past 50 years, our ability to make specific changes to DNA in plants and animals has been revolutionised. New techniques of genome editing allow us to make precise changes to individual genes. But what's the science behind the different technologies?

1930

Mutagenesis
1930s onwards

Large numbers of seeds are exposed to ionising radiation or mutagenic chemicals, causing random mutations in the DNA. Plant breeders grow on plants with beneficial mutations, cross-breeding them with existing plants to develop improved varieties.

Mutagenesis has been widely used in Europe for crop breeding for many years – including the barley for classic Scottish whiskies – and the resulting plants are not covered by GMO regulations.

1990

Transgenics (known as 'GM')
1990s onwards

Scientists use Agrobacterium to transfer desired genes into an unspecified location in a plant's DNA. These genes could come from the same species or an entirely different one. The plant cell with the added genes is cultured up into a new plant, which is grown on to identify the effects of the new gene.

Transgenics have been used to breed new crop varieties, including insect-resistant cotton. Transgenic plants are risk assessed and closely regulated in Europe.

2015

Type 1 genome editing
2010 onwards

Type 1 genome editing prevents individual genes functioning. The edited plants do not contain any additional genes.

'Site-specific nucleases' (enzymes) cut the DNA in a cell at a precise point, triggering the natural DNA repair mechanisms. The DNA repairs itself, but imperfectly, and the gene ceases to function. The cell is cultured up to produce a whole plant, with the altered DNA in every cell.

An example is herbicide-tolerant canola (a cabbage relative). The EU has not yet decided how to regulate new plant varieties made using genome editing.

2015

Type 3 genome editing
2010 onwards

Type 3 genome editing allows a new gene to be inserted at a precise location in the DNA. The new gene might be from the same species or a different one.

'Site-specific nucleases' (enzymes) cut the DNA in a cell at a precise point. The molecule includes a 'repair template' with the desired gene within it. When the DNA repairs itself, it uses the repair template, and incorporates the new gene at the intended location. The cell is cultured up with the altered DNA in every cell of the resulting plant.

There are not yet any commercial crops bred using this technology.

Find out more at
www.saps.org.uk/genetech

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Science & Plants for Schools