

Genetic modification – introduction

What is genetic modification?

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What is genetic modification?

- Definition from EU Directive 2001/18/EC:
 - “an organism, with the exception of human beings, in which the genetic material has been altered in a way that does not occur naturally by mating and/or natural recombination”
- This definition encompasses:
 - “Classical” (random) mutagenesis
 - Cell fusion (somatic hybridization)
 - Plant transformation producing transgenic plants
- The first two are specifically exempted from regulation, therefore, count as conventional techniques in EU

“Classical” mutagenesis uses radiation or chemical mutagens, such as EMS, to produce random mutations. Desirable traits need to be selected from treated materials and accompanying undesirable mutations need to be filtered out by (back)crossing. In cell fusion, protoplasts from different genotypes (e.g. species) are fused and the fusion products are regenerated to new hybrid plants. In this way, plant species can be hybridized that are difficult to cross. Moreover, new combinations of nuclear and cytoplasmic genomes can be made. The latter is important for introducing cytoplasmic male sterility (usually based on mitochondrial genomes, e.g. Ogura cytoplasm in *Brassica*) important to hybrid cultivar production, see Hybrid cultivars ppt. Provided the cell fusion product could also be produced by classical crossing, the plant is exempted from EU regulation, like “classical” mutagenesis. In both cases, without knowledge about their origin, the plants are basically indistinguishable from conventional breeding products. In addition, both types of plants are thought to have a “history” of safe use”. More details on regulation in the Regulation ppt.

What is genetic modification?

- Debates on genetic modification are usually about transgenic plants produced by transformation using:
 - *Agrobacterium tumefaciens* specially adapted for this purpose, or:
 - Direct gene transfer, e.g. by Particle gun
- Sometimes (particularly in the US) transgenic plants are called “genetically engineered” (GE)

The idea behind “genetically engineered” is that it more clearly distinguishes transgenic plants from conventional plant breeding products, as basically all products of plant breeding could be called “genetically modified”. The basic elements in the transgenic construct make transgenic plants clearly recognizable from conventional plant breeding products. Cisgenic plants are produced in this manner but the construct basically only contains “native” genetic material, that is, from the crop’s normal genepool (cross-compatible species), see NPBT ppt.

What is genetic modification?

- For plant transformation, a transgenic construct is used containing:
 - Promoter, e.g. promoter from Cauliflower mosaic virus 35S gene (pCaMV35S)
 - Gene from a source outside the normal crop genepool, e.g. a bacterium, adapted to expression in the plant
 - Terminator, e.g. from the *Agrobacterium* nopaline synthase gene (tnos)

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What is genetic modification?

- The new plant breeding techniques (NPBTs) generally use genetic modification (plant transformation), but the final plant product usually does not contain foreign DNA (transgenes)
 - Usually, the transgene is removed by (back)crossing
- This makes the products of NPBTs difficult to distinguish from conventional plant breeding products without prior knowledge
 - This is an important aspect to the complexity in the discussion about their treatment with regard to regulation (EU Directive 2001/18/EC), which has not yet been resolved until now

Cisgenic plants are an exception in that the construct introduced is not removed but basically only contains “native” genetic material, that is, from the crop’s normal gene pool (cross-compatible species). More details are in the NPBT ppt.