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## Cisgenesis

### *'Flowers from the same garden'*

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Does it matter where a gene comes from? Some may argue it is an irrelevant question, since all genetic material is made up by the same basic building blocks - the four different nucleotides in DNA. However, the origin of a particular gene may sometimes require our attention. Transgenic plants are familiar examples of genetically modified organisms, or GMOs, carrying one or more genes from any other organism. Another category is *cisgenic* plants, designated for those carrying artificially inserted genes only from the same, or from a cross-compatible, plant species. Mostly applied in potato and apple so far, the final cisgenic products are difficult to distinguish from those developed by conventional breeding despite being developed by a GM technique.

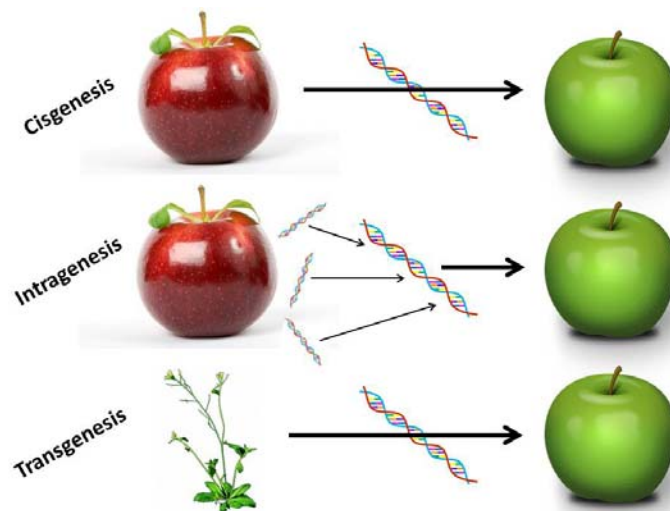


#### **Benefits**

Compared to conventional breeding, cisgenesis enjoys the advantages of GM techniques such as specificity and efficiency. One major advantage is to avoid the tedious and time-consuming linkage drag, which is when a conventional cross between two plants carries along many unwanted genes that have to be 'cleaned up' by backcrossings. Another advantage is that for clonally propagated crops, such as potato, apple, strawberry and grapevine, it is feasible to keep the original cultivar and add for example disease resistance from a crossable plant. That is not possible for these crops by conventional breeding.

## Scientific description

A GMO, as discussed back in the 1980s and outlined in the EU Directives, carries genetic material – often from a completely different species – that has been prepared outside of the organism and in a way that normally does not occur in nature. In the early 2000s though, another category within plant breeding techniques was proposed, called cisgenic plants. This category resembles transgenic plants but with the difference that only genes from a sexually cross-compatible plant have been inserted. A variation called *intragenesis* is sometimes also proposed, where rearrangements of the genetic material are allowed. The methods of gene transfer are the same, such as the commonly used *Agrobacterium* or biolistics. Since the available gene pool in cisgenic plant breeding is limited to cross-compatible species, the end products are difficult to distinguish from those achieved by conventional breeding.



## Applications

Cisgenesis has been widely applied both in research and in breeding. The most investigated traits and crops have been disease resistance in potato and apple, however it has also been applied for fungal disease resistance in grapevine, strawberry and melon, higher feed quality in barley, baking quality in wheat, drought tolerance in perennial ryegrass and to limit acrylamide in french fries. In 2010, an intragenic potato with industrial starch quality, on field trial since 1994, was approved for commercial cultivation in the EU and grown in Sweden, Germany and Czech Republic. A cisgenic potato with strong late blight-resistance has also been developed and is waiting in the pipeline.

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