

Types of New Breeding Technologies (NBTs)

Information from [Whelan, A.I. and Lema, M.A., 2015. Regulatory framework for gene editing and other new breeding techniques \(NBTs\) in Argentina. GM Crops & Food, 6\(4\), pp.253-265](#) and the [EPSO Crop Genetic Improvement Techniques Fact sheet \(March 2016\)](#)

- **Site-directed nucleases**
 - Nucleases are used to induce DNA breaks near a defined target sequence. DNA repair mechanisms and, sometimes, the use of additional nucleic acid molecules, lead to site-specific mutations.
 - Examples: Zinc finger nucleases, TAL effector nucleases (TALENs), CRISPR-Cas9
- **Epigenetic modification**
 - The addition of heritable epigenetic modifications to the genome without changing the primary genomic sequence.
 - Example: RNA-dependent DNA methylation
- **Reverse breeding**
 - A successful hybrid is selected and transformed with a gene to prevent recombination of genes during meiosis, leaving the individual chromosomes exactly as they were in the homozygous parental lines, rather than being reshuffled. The transgene is removed and the reconstituted parental lines can be used.
- **Accelerated breeding**
 - A transgene is added to reduce the length of generations in the plant, speeding up the breeding process. The transgene is later removed by outcrossing.
- **Grafting onto GM rootstock**
 - The non-GM scion remains free of transgenic DNA
- **Agro-infiltration**
 - Transient expression of transgenes by infiltrating tissues with a suspension of *Agrobacterium* containing a genetic construct.
- **Oligonucleotide-directed mutation**
 - Synthetic oligonucleotides of the target sequence with a small mutation are introduced to the cells and modify the target sequence after being recognized by the DNA repair mechanism.
- **Cisgenesis**
 - The incorporation of a gene from the crop plant itself or a sexually compatible species into a plant, which in theory could have been moved from one species to the other using traditional breeding to get equivalent results
- **Intragenesis**
 - Gene comprised of functional elements found in a traditional breeding gene pool, such as promoters or the coding sequence, found in the same plant or a sexually compatible species, assembled into a manmade genetic construct.