Cisgenesis and Intragenesis in Rosaceae Crops

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Introgression of traits from wild germplasm into pip fruit cultivars by means of classical breeding is painstakingly slow. Introgression of, for example the apple scab resistance gene Vf from Malus floribunda 821 into marketable top quality apple cultivars took more than 50 years. In the mean time Vf resistance has been compromised by new virulent races of Venturia inaequalis in northern Europe. For durable resistance more than one resistance gene should be combined. However, this may take many years. This slow tempo is caused mainly by the long juvenile period and by linkage drag of hundreds of undesired alleles. The process would be much faster if only the allele of interest were inserted, without the other alleles from the wild germplasm. This process is named "cisgenesis". Cisgenesis would allow rapid accumulation of resistance genes or other desired alleles from wild sources.

We have defined cisgenesis as genetic modification of plants, inserting genes of the plant species itself or from crossable relatives. The gene should contain its native introns and be flanked by its native promoter and terminator in sense orientation. A cisgenic plant does not contain genes from outside the gene pool of the conventional breeder. If the plant does contain foreign genes, the plant is named transgenic. Scientific inquiries indicate that acceptance by consumers is better for cisgenic plants than for transgenic plants.

As the phenotypic traits from cisgenesis can in principle also be obtained by means of conventional breeding, induced translocation breeding or mutation breeding, cisgenic plants are at least as safe as conventionally bred plants, or plants from induced translocation breeding or mutation breeding. Therefore we propose to add cisgenesis of plants to the list of GM technologies that are exempted from the GMO regulation in the European Union (Annex 1B of Directive 2001/18/EC).

"Intragenic plants", like cisgenic plants, contain no foreign genes. However, intragenic plants may contain novel combinations of native promoters and native coding sequences. This provides more possibilities to the molecular breeder compared with the very strict approach of cisgenesis. As intragenic plants do not harbour foreign genes or promoters, we propose that in the EU these plants be regulated less stringently than transgenic plants, which do contain foreign genes.

The number of functionally analysed genes in the Rosaceae family is increasing, and will be boosted further by combining whole genome sequences of apple and peach with known genetic loci for interesting traits, gene expression data, and ESTs. Also technologies are available for either introduction of alleles without use of marker genes, or for later excision of marker genes, such as kanamycin resistance gene, the so called "marker-free" technologies. Cisgenesis and intragenesis combine the knowledge of gene sequences and their functions with marker-free technologies.

Cisgenesis and intragenesis are approaches for utilizing the growing wealth of knowledge of plant genes to the benefit of the society in a fast, safe and acceptable way.

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