



Resource Sheet

Genetically Modified Organisms

Genetically Modified Organisms (GMOs) or Genetically Engineered Crops (GE Crops) have been in existence since the 1980s in China and the 1990s in the United States. They have been developed for and are widely used in the United States in agriculture. Most genes used are for herbicide, insect and viral disease resistance in crops, such as corn, cotton, canola and soybeans.

Most of the acreage of these crops in the continental United States is planted with GMOs. The estimates range between 75 and 90 percent of the acres grown. For example, papaya production in Hawaii depends greatly on GMO-based virus resistance to be successful. Approximately 75 percent of that crop is transgenic. Controversy continues regarding the safety and use of GMOs. However, research is ongoing, and the public is encouraged to read more on this subject and make logical decisions as to consuming products created from transgenic plants. There is no evidence that currently available GMO plants and products produced from them are unsafe for consumption. *GMOs are prohibited in organic food products.*

For an historical perspective on plant breeding, including GMO and related views, the following links can be helpful:

www.gmeducation.org/faqs/
www.bostonreview.net/forum/pamela-ronald-gmo-food
www.nature.com/news/specials/gmcrops/index.html
www.gmeducation.org

Glossary (*referencing vegetables*)

Traditional Breeding

Traditional breeding is done by allowing two parent plants with the desired traits to cross-pollinate – either naturally or hand pollinated in a controlled environment. The seeds generated contain those desirable traits, such as yield, disease resistance, flower color, fruit size, fruit color, or growth habit. Those desirable traits are often closely associated with a number of other traits that also transferred into seeds that will be the next generation (F₁).

GMO Breeding

GMO breeding involves plant breeding at the molecular level, working with DNA, genes and cells rather than whole plants. Plant breeders begin with a plant bred to have desired traits through traditional breeding techniques. Then, the plant breeder inserts a singular gene from an unrelated plant or organism, which will impart the new desired trait into the seeds produced, in addition to those traits already in place. It should be noted that disease-resistant genes in squash and apples have been transferred from one variety to another respectfully, by molecular means, and this also produces a GMO.

Examples of GMO Breeding Techniques*

Once a desirable gene has been located – for example a gene for herbicide resistance in the DNA of a microbe – the plant breeder moves that gene into the DNA of the crop plant being bred.

Genetic markers in this gene are used to ensure the new trait is successfully transferred by locating them again at the genetic level after the insertion of this genetic material has been made. One established method of transferring DNA uses a bacterium that has the desired trait inserted into its DNA, naturally transferring the trait to the crop plant being bred. Another method injects the desired trait directly into the plant cells, which is confirmed using the markers noted above. The cells are grown out to become plants, which are subjected to additional testing to confirm resistance in a field setting.

Parent Lines

Parent lines are bred by traditional methods, crossing and backcrossing, to provide a set of parents that when crossed to produce the first generation (F₁) can reliably guarantee that the desired traits are transferred into that offspring.

F₁ Hybrid

F₁ is the designation used to identify the first generation of plants produced by crossing two parent lines.

Heirloom Seeds

Heirloom varieties, which we have used for decades, flower and set seeds that usually come true-to-type when open pollinated. Heirloom seeds are commercially produced in a controlled setting to ensure true-to-type F₁ offspring. Heirloom seeds are not automatically considered organic unless grown in that manner.

True-to-Type

To be true-to-type, open-pollinated varieties or hybrids are uniform for important and obvious traits, such as appearance and vigor, and after seed production, the next generation of seed is consistent with the previous one. For hybrids, both parents have similar dominant traits, so when crossed, the F₁ generation will look like and produce flowers and fruit consistent with the parents. Examples include heirloom varieties and commercial breeding lines.

Organic Seeds

Organic seeds are produced using certified organic methods, including approved organic pesticides and other products.

Hybrid Seeds

Hybrid seeds are any seed cross-pollinated in a controlled or non-controlled environment, grown traditionally or using organic methods using parent lines. Hybrid seeds could be, organic or GMO/GE.

Transgenic

Transgenic is a term used to describe a plant that has its DNA altered by the transfer of a gene or genes from another species.

Additional GMO Breeding Technologies

*Additional methods are cell fusion, microencapsulation and macroencapsulation, and recombinant DNA technology, including gene deletion, gene doubling, introducing a foreign gene, and changing the positions of genes when achieved by recombinant DNA technology.

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