



The What & How of Plant Modification

Peggy G. Lemaux, Cooperative Extension
University of California

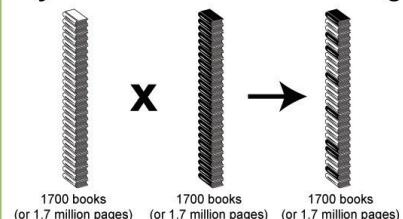
When people decided to stay in one place rather than moving to find food, they began choosing plants that had desirable traits and crossed them. And nearly all food we eat today has been modified in this way by humans. For example, one plant with higher yield can be crossed with another that resists insects. The offspring can then be screened for plants that yield more and are insect-resistant. Virtually every food in the market today has been modified in this way and looks little like its ancient relatives.

What happens when you cross two plants?

Living things are made up of cells. The genetic information in a cell, the DNA, is like a set of recipes, called genes, that determines what traits a plant has – like whether it has yellow or red fruit, whether it is resistant or not to a particular pest? The DNA is made of chemical units and, if the chemical units in, for example, a wheat cell are represented by alphabetic letters, it would take 1.7M pages, to contain all of that information.

What happens when two wheat plants are crossed, each with 1.7M pages? Genetic rules state that you end up with only 1.7M pages, not 3.4M. About half of the “pages” come from one parent, half from the other (see below). And the new plants end up with a random mixture of traits. The person making the cross, the breeder, has little control over which “recipes” are lost and which are kept.

Hybridization or cross breeding

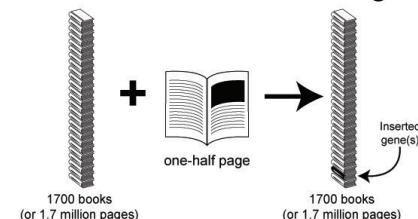


Methods using recombinant DNA, also called biotechnology or genetic engineering, allow breeders to modify plants differently. The “molecular breeder” studies recipes in any organism, equivalent to a half page of information, cuts out a specific recipe with chemical scissors and pastes it into the same organism or a different one.

The two methods of classical and molecular breeding share some similarities and some important differences. In both cases the tools used for cutting and pasting are the same except that the process during classical breeding takes place in the cell while in molecular breeding it occurs in the laboratory. In this sense genetic engineering is similar to classical breeding.

But, there are noticeable differences between the two methods. First, molecular methods permit precise manipulation of single pieces of genetic material, whereas with classical breeding thousands of genes are exchanged and rearranged. Second, with genetic engineering it is possible to control precisely where and when the new product is made, so the new trait can be targeted to the leaves, the roots, or the seeds, while it is difficult, or sometimes even impossible to do this through classical breeding. Lastly, and perhaps most importantly to some people, the source of the genetic material can be any living thing. It does not have to be closely related, as is the case with classical methods. This is because all “recipe books” are written in the same language.

Recombinant DNA methodologies



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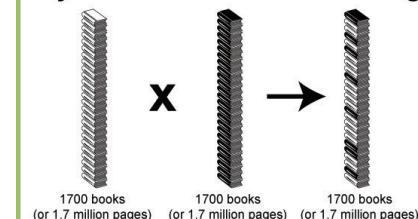
When people decided to stay in one place rather than moving to find food, they began choosing plants that had desirable traits and crossed them. And nearly all food we eat today has been modified in this way by humans. For example, one plant with higher yield can be crossed with another that resists insects. The offspring can then be screened for plants that yield more and are insect-resistant. Virtually every food in the market today has been modified in this way and looks little like its ancient relatives.

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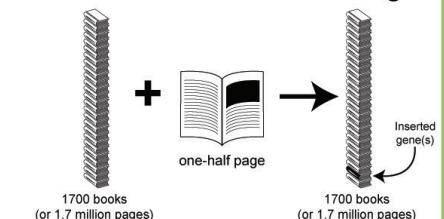


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Recombinant DNA methodologies



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KNOW GMOS

In November 2012, a ballot initiative that would have required labeling of certain foods containing GE ingredients and restrict the use of the word, "natural" on food products. The proposition would have required food sold in retail stores to be labeled if it was GE or contained GE ingredients. Estimates are that 70-80% of processed foods contain such ingredients so most processed foods would have had to have had labels, while most whole foods, except sweet corn, squash and papaya, have only whole GE foods, would not have had to have had labels, while most whole foods will be defeated by a narrow margin. But this issue will be debated and voted on in other states and likely in California again.

In California, several counties in the mid-2000's had ballot initiatives or supermajority votes to ban the growth and propagation of GM plants (GMOs) in their counties. Other counties passed resolutions in favor of their growth. While Mendocino County was the first to pass the anti-GMO legislation (March 2004), Fresno County was the first to pass a pro-GMO resolution (February 2004). In the end five anti-GMO ballot measures passed; four were defeated and eleven pro-GMO

GE Legislation

Recently plants and algae are being created that can make alternative sources of industrial oils and fuels. As with other technologies developed in the past, like the domestication of plants and animals, agricultural mechanization, chemical fertilizers and pesticides, these new genetic tools bring questions about risks and benefits. While few, if any, activities in today's environment risk, people look to minimize human and environmental risk. We must be educated about these technologies and participate in informed debate about their future.

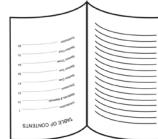
With genetic engineering you can use genes from the same plant, a different plant or even a different organism, like a bacterium. Some such products have already been commercialized, i.e., insect-resistant cotton or herbicide-tolerant soybean or canola. Other approaches are in development in university laboratories and private companies and they include cell-free synthesis, and increased nutrient uptake.

In contrast, the two traits you can find in a common wild relative of your crop won't work if you can't find the trait in a compatible relative. You can cross the two plants and use MAS to introgress the desired trait. But this approach is time-consuming and relatively expensive. So if you can find a trait in the offspring, you can use it directly.

It's also possible to breed a new variety that has the trait you want. This is called backcrossing. You can do this by crossing a plant with the trait you want with a plant that doesn't have the trait. The offspring will have some of the traits of each parent. If you repeat this process several times, you will end up with a plant that has most of the traits of the plant with the trait you want.

Another way to introduce a trait into a plant is to use genetic transformation. This involves taking a gene from one plant and putting it into another plant. This can be done using a vector, such as a virus or a bacterium, which carries the gene into the plant cell. Once the gene is inserted, it can be expressed, producing the desired trait.

Genetic transformation can be used to introduce a wide range of traits into a plant, including resistance to pests and diseases, tolerance to environmental stresses, and improved品质. It can also be used to create transgenic plants that produce pharmaceuticals or other valuable products.





The diagram shows an open book with a vertical list of chapter titles on the left page and a vertical list of page numbers on the right page. The left page title is 'Table of Contents'.

- Once the DNA is in the cell, the challenge is to identify which cells received the DNA. This can be done by introducing a gene that gives a selective advantage to the engorged cell, like the ability to use an unusual sugar or resistance to an antibiotic.
- The cells are then coaxed to reform a plant, through manipulation of the leaves and then the roots, through growth medium. Then you have a plant hormone in the cell of which contains the new genes.

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In California, several counties in the mid-2000's had ballot initiatives of supervisory districts to ban the growth and propagation of GM plants (GMO's) in their counties. Other counties passed resolutions in favor of their growth. Mendocino County was the first to pass the anti-GMO resolution (March 2004), while Fresno County was the first to pass a GMO-GMO ballot measure (February 2004). In the five anti-GMO ballot measures passed, four were defeated and eleven pro-GMO

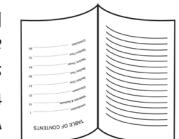
The Legislation

As with other technologies developed at each plant, plants and algae are being treated to extract oil and make alternative sources of industrial fuels. The past, like the domestication of plants and animals, agricultural mechanization, chemical tools bring questions about risks and benefits. While few, if any, activities in today's world involve zero risk, people look to minimize human and environmental risks. We must be educated about these technologies and participate in formed debate about their future.

tell the breeder what genetic information has been kept in the offspring. So if you can find compatible relatives that has the trait you want you can cross those two plants and use MAS to introduce the trait. But this approach won't work if you can't find the trait in a compatible relative.

With genetic engineering you can use different plant species that have already been commercialized, like a bacete or even a different organism, like a bacterium. Some such products have already been approved-tolerant soybean or cotton or plants with increased yields, better drought tolerance, reduced anti-nutrients like and salt tolerance, reduced allergens, and increased antioxidants and micro-nutrients like follic acid and iron. Most approaches are in development in university and private laboratories and they include approaches that are in development in universities and private companies.

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Once the DNA is in the cell, the challenge can be done by introducing the DNA. This can be done by introducing your gene into a eukaryotic cell which receives the DNA. This another gene that gives a selective advantage to the engorged cell, like the ability to use an unusual sugar or resistance to an antibiotic. The cells are then coaxed to reform a plant, first the leaves and then the roots, through manipulation of the plant hormones in the growth medium. Then you have a plant, each cell of which contains the new genes.

How is genetic engineering done? A part of a plant, like a leaf or a seed, is removed and a gene of interest is introduced into a small cell of physical means. The biological method uses a naturally occurring bacterium, Agrobacter, which can infect plant cells and insert its DNA into the plant's genetic material. To speed up the process, another method involves using microscopical "bullets", which are shot at high speed into the cell where the DNA comes off and inserts into the plant's DNA.