

# Genetically Engineered Foods

## Plant Virus Resistance

A Series from Cornell Cooperative Extension's Genetically Engineered Organisms Public Issues Education (GEO-PIE) Project

THREE CROP SPECIES—YELLOW SQUASH, PAPAYA, AND POTATOES—HAVE BEEN GENETICALLY ENGINEERED (GE) TO BE RESISTANT TO IMPORTANT PLANT VIRUSES. IN ADDITION, THE GE TRAIT WAS TRANSFERRED FROM YELLOW SQUASH TO ZUCCHINI BY CONVENTIONAL BREEDING.

### Frequently Asked Questions

#### How does genetically engineered virus resistance work?

Many plants are susceptible to diseases caused by viruses, often transmitted by insects, such as aphids, from plant to plant across a field. Controlling the spread of viral diseases can be very difficult and can cause devastating losses to crops. Viruses are primitive organisms composed of little more than a protein-based "coat" encasing a short piece of genetic material. After a virus infects a plant cell, it removes its protein coat and reproduces by tricking the infected cell into manufacturing copies of its proteins and genetic material. New viruses assemble themselves from the newly made parts and then escape to infect other cells. Disease symptoms in the plant-- leaf mottling and yellowing, stunted plant growth, and deformed fruit-- are the result of cellular damage caused by the viruses.

When plant cells are genetically engineering to deliberately overproduce one of the genes important to the virus (usually the "coat protein" gene), the virus is not able to reproduce correctly. This is thought to work by a process called cosuppression-- the plant cell senses that a gene is being overproduced, and responds by blocking both the engineered gene and the virus' copy of the gene. The disease resistance strategy of engineering a virus gene into a plant is often called coat protein-mediated viral resistance.

### Yellow Squash and Zucchini

#### Am I eating genetically engineered squash or zucchini?

It is possible, but very unlikely. Seeds for several GE varieties of both yellow crooked-neck squash and green zucchini are marketed, but very few farmers have adopted them.

#### What is the history of GE squash and zucchini?

The first variety of genetically engineered yellow squash, resistant to zucchini yellow mosaic virus and watermelon mottle virus 2, was developed by the Asgrow Seed Co. and

first planted by farmers in 1995. By 1996, Asgrow had transferred the GE virus-resistance from yellow squash to zucchini by conventional breeding (yellow squash and zucchini are the same species and readily interbreed). By 1997, Asgrow had genetically engineered its squash variety to be resistant to a third virus, cucumber mosaic virus, and this triply resistant variety was first planted by growers in 1998.

The adoption of Asgrow's GE varieties has still been very limited because of the multiple-virus problem: when squashes are infected by viral disease, they are often infected by several different viruses at once. If a GE variety is resistant to some viruses but not others, the farmer still has to continue using the same control measures and will see little cost savings to offset the higher-priced GE seeds.

### Papayas

#### Am I eating genetically engineered papaya?

It's possible but is less likely in the Northeast than in Hawaii and West Coast markets. All commercial production of GE papayas is in Hawaii. However, most of the papayas sold in the continental United States are imported from Brazil, Mexico, and the Caribbean (and not genetically engineered).

#### The history and prevalence of GE papayas

Beginning in 1992, a devastating outbreak of papaya ring spot virus (PRSV) swept through the papaya plantations of Hawaii; papaya production dropped 40 percent in the course of five years. Control of the disease was limited to careful observation to remove infected plants. Researchers at Cornell University and at the University of Hawaii developed two virus-resistant varieties of GE papaya--"Rainbow" and "SunUp"—using coat protein-mediated resistance. These varieties were approved for commercial plantings in late 1996. The Hawaiian Papaya Administrative Committee negotiated agreements with various patent holders to allow the GE seeds to be given free to Hawaiian papaya growers, and the first commercial plantings were made in May of 1998. The new varieties were so successful in resisting the viral epidemic that by the next year "Rainbow" and "SunUp" were planted on more than 30

percent of Hawaii's papaya acreage, and have since expanded to about 50 percent of the total crop.

U.S. researchers are currently collaborating with public-sector scientists in many other papaya-growing countries-- that face epidemics of the same papaya virus-- to help them employ the technology to develop their own resistant lines.

## Potatoes

### Am I eating genetically engineered potatoes?

Probably not. Varieties of GE potatoes never reached more than 2 to 3 percent of the potato market, and in early 2001 these varieties were discontinued by their developer. Strictly speaking, GE potatoes could still be present in a variety of processed foods from potatoes grown before the GE varieties were discontinued, but the likelihood of this is increasingly smaller.

## The history and prevalence of GE potatoes

In late 1998, Monsanto genetically engineered resistance to the potato leaf roll virus into its "New Leaf" line— potato varieties which had already been engineered to be resistant to the Colorado potato beetle using another GE technology—and dubbed it "New Leaf Plus." Shortly after that, in 1999, Monsanto added another GE potato, "New Leaf Y," which incorporated potato virus Y resistance into the "New Leaf."

Monsanto discontinued the "New Leaf" line of potatoes in March 2001, citing poor sales. GE potatoes never amounted to more than 2 to 3 percent of the total U.S. potato market, and plantings of the GE varieties had declined slightly over their last few years. Their failure was attributed to several causes. First, just before the GE potatoes were introduced, a new insecticide was approved that effectively controlled the insect pests the GE potatoes targeted. Most farmers chose to use the new insecticide. Second, several large potato processors-- including McDonald's, Burger King, Frito-Lay, and Procter & Gamble— made pledges to their consumers to use only non-GE potato varieties.

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