GM halo effect: Can GM crops protect conventional and organic farming?

Farmers growing conventional crops next to genetically modified crops can benefit from the reduction in crop-destroying pests without paying the premium for GM seeds. It's called the "halo effect," a term used to describe the sustainability benefits that accrue to non-GM crops when a genetically modified crop is planted nearby.

The most powerful example of this has emerged in Hawaii, where the papaya crop was threatened with extinction before being rescued by genetic engineering. Papaya is Hawaii's second most important fruit crop and 85% of its exports go to satisfy demand for the fruit in the mainland and Japan. Beginning in the 1940s, however, the state battled the papaya ringspot virus (PRSV), a costly scourge that has on more than one occasion threatened the vitality of the state's papaya industry.

Although not unique to Hawaii, PRSV is the most widespread and impactful virus affecting papaya crops worldwide. Due to the virus's ability to spread rapidly, Hawaii faced devastating damage to its papaya crop in the mid 1980s. To combat this damage, scientists engineered a transgenic papaya resistant to the virus, which has helped save the state's papaya industry.

The genetically engineered Rainbow papaya resulted in some unintended, and very positive, side effects for non-GM farmer. Dennis Gonsalves, the lead scientist in engineering the GM Rainbow papaya, found that the transgenic fruit also helped non-transgenic varieties grow in the areas where the GM trees had been planted–the "halo effect."

In the case of the Hawaiian papaya, scientists planted an "island" of nontransgenic variety in an "ocean" of transgenic papaya as a means of securing the nontransgenic variety. The specially modified traits of GM crops helped to kill off pests, control water intake and provide a sort of refuge for non-modified crops in nearby acres.

> The PRSV-resistant transgenic papaya has been commercially grown in Hawaii since 1998, and has played the most major role in saving the papaya industry from economical demise. The resistance has held up extremely well in Hawaii. The transgenic papaya case also illustrates the importance of developing control measures in advance of anticipated problems. Lastly, the case in Hawaii also shows that the transgenic papaya has helped growers to raise nontransgenic papaya in Puna by reducing the overall virus pressure in Puna and serving as buffer zones. In summary, the observations suggest that virus-resistant transgenic crops can directly control the virus and also serve as a tool to minimize infection to nontransgenic crops that are grown the area.

This halo effect has been seen not just in papayas, but also in other crops that are vital to many states and countries. Genetically modified Bt corn naturally produces toxins taken from a soil bacterium called *Bacillus thuringiensis* that is deadly to the European corn borer, a moth whose caterpillars eat into corn stalks and topple the plants. A study in *Science* examined 14 years of records in the top US corn-

producing states of Minnesota, Illinois, Iowa, Nebraska and Wisconsin, found that the GM Bt corn killed off pests like the European corn borer, but in doing so it also helped the “refuge” acres of non-modified crops. Because the corn borers that attack the genetically modified crops die, there are fewer of them to go after the non-modified version.

The data showed that in neighboring non-GMO fields the pest populations shrank by 28-78%, depending on how much GM corn was being grown in the surrounding area. The study also found that the caterpillar-killing GM varieties grown in the vast US corn belt had retained their potency 14 years after being first sown (1996), showing the pests had not developed resistance.

Bruce Tabashnik, an entomologist from the University of Arizona, who was not part of the research team, called it “a wonderful success story. It’s a great example of a technology working how it should.”

It’s estimated that the corn borer costs U.S. farmers $1 billion a year. According to the *Atlantic*, researchers were surprised to find that non-Bt corn acres actually reaped 62 percent of the benefit, or $4.3 billion. That’s because of the pest-control effect and because non-Bt seed is cheaper. The genetically modified plants had a total estimated economic benefit of $6.9 billion over the course of the 14 years studied.

A 2012 study in *Nature* on the halo effect Bt cotton in China reported similar findings:

> We found that Bt cotton significantly decreased the population density of pink bollworm on non-Bt cotton…Previously reported evidence of the early stages of evolution of pink bollworm resistance to Bt cotton in China has raised concerns that if unchecked, such resistance could eventually diminish or eliminate the benefits of Bt cotton. The results reported here suggest that it might be possible to find a percentage of Bt cotton lower than the current level that causes sufficient regional pest suppression and reduces the risk of resistance.

The abundance of such reports suggests that GM crops can positively impact agriculture in a number of different ways. This “halo effect” is an excellent example not just of recent innovation in agriculture but also some of the unexpected and positive changes that result from this type of innovation.

Additional Resources:

- GM maize offers windfall for conventional farms, Nature
- GM Crops, Organic Food, & Delicious Irony, RealClearScience