

Modified crops reveal hidden cost of resistance

October 26 2009



This photo shows cucumber beetles on a squash flower. Credit: Miruna Sasu, Penn State

Genetically modified squash plants that are resistant to a debilitating viral disease become more vulnerable to a fatal bacterial infection, according to biologists.

"Cultivated squash is susceptible to a variety of viral diseases and that is a major problem for farmers," said Andrew Stephenson, Penn State professor of biology. "Infected plants grow more slowly and their fruit becomes misshapen."

In the mid-1990s, the U.S. Department of Agriculture approved genetically modified squash, which are resistant to three of the most

important viral diseases in cultivated squash. However, while disease-resistant crops have been a boon to commercial farmers, ecologists worry there might be certain hidden costs associated with the modified crops.

"There is concern in the ecological community that, when the transgenes that confer resistance to these viral diseases escape into wild populations, they will (change) those plants," said Stephenson, whose team's findings appear today (Oct. 26) in the [Proceedings of the National Academy of Sciences](#). "That could impact the biodiversity of plant communities where wild squash are native."

Stephenson and his colleagues James A. Winsor, professor of biology; Matthew J. Ferrari, research associate; and Miruna A. Sasu, doctoral student, all at Penn State; and Daolin Du, visiting professor, Jiangsu University, China, crossed the genetically modified squash into wild squash native to the southwestern United States and examined the resulting flower and fruit production.

Unlike a lab experiment, the researchers tried to mimic a real world setting during their three-year study.

The researchers then looked at the effects of the virus-resistant transgenes on prevalence of the three viral diseases, herbivory by cucumber beetles, as well as the occurrence of bacterial wilt disease that is spread by the cucumber beetles.



These squash plants are showing yellowing signs of zucchini yellow virus.
Credit: Andrew Stephenson, Penn State

"When the cucumber beetles start to feed on infected plants they pick up the bacteria through their digestive system," explained Sasu. "This feeding creates open wounds on the leaves and when the bugs' feces falls on these open wounds, the bacteria find their way into the plumbing of the plant."

The researchers discovered that as the viral infection swept the fields containing both genetically modified and wild crops, the damage from cucumber beetles is greater on the genetically modified plants. The modified plants are therefore more susceptible to the fatal bacterial wilt disease.

"Plants that do not have the virus-resistant transgene get the [viral disease](#)," explained Stephenson, whose team's work is funded by the National Science Foundation. "However, since cucumber beetles prefer to feed on healthy plants rather than viral infected plants, the beetles become increasingly concentrated on the healthy -- mostly transgenic -- plants."

During a viral epidemic, the transgene provides modified plants with a fitness advantage over the wild plants. But when both the bacterial and

viral pathogens are present, the beetles tend to avoid the smaller viral infected plants and concentrate on the healthy transgenic plants. This exposes those plants to the bacterial wilt disease against which they have no defense.

"Wild and transgenic plants had the same amount of damage from beetles before viral diseases were prevalent in our fields," said Stephenson. "Once the virus infected the wild plants, the transgenic plants had significantly greater damage from the beetles."

Results from the study show that over the course of three years, the prevalence of bacterial wilt disease was significantly greater on transgenic plants than on non-transgenic plants.

According to the researchers, their findings suggest that the fitness advantage enjoyed by virus-resistant plants comes at a price. Once the virus infects susceptible plants, cucumber beetles find the genetically modified plants a better source for food and mating.

"Our study has sought to uncover the ecological cost that might be associated with modified plants growing in the full community of organisms, including other insects and other diseases," said Ferrari. "We have shown that while genetic engineering has provided a solution to the problem of viral diseases, there are also these unintended consequences in terms of additional susceptibility to other diseases."

Source: Pennsylvania State University ([news](#) : [web](#))

Citation: Modified crops reveal hidden cost of resistance (2009, October 26) retrieved 23 April 2024 from <https://phys.org/news/2009-10-crops-reveal-hidden-resistance.html>

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