

Bt Cotton and Pink Bollworm

A cooperative research and education program

by Susan McGinley

Results of a new study published in the November 21 issue of the Proceedings of the National Academy of Sciences may diminish fears about one of the potential pitfalls of genetically modified crops. Bt cotton has a gene transferred from the bacterium Bt (*Bacillus thuringiensis*) that lets plants produce a natural insecticide, thus reducing reliance on sprays of chemical insecticides. The Bt toxin in genetically modified cotton is harmless to people, wildlife and most beneficial insects. A major concern is that pests could quickly evolve resistance to the Bt toxin in genetically modified cotton.

The Extension Arthropod Resistance Management Laboratory (EARML)

Now in its seventh year, this laboratory serves as a central Cooperative Extension facility devoted to long-term development and maintenance of insect resistance management programs. It was established with support from the University of Arizona, and with funding from the USDA-ARS Western Cotton Research Laboratory, Cotton Incorporated, and the Arizona Cotton Growers Association.

To prevent insects from building up resistance to both natural and chemical pesticides, the laboratory conducts extensive collaborative field research and a comprehensive insect monitoring program. EARML's mission is to collect, validate and disseminate information that will allow agricultural and urban pest managers in Arizona to combat the development of resistance to pesticides in arthropods.

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Pink bollworm in cotton boll.

Bt cotton is still effective against pink bollworm in Arizona, according to a UA study published in the November 21 issue of the Proceedings of the National Academy of Sciences. The estimated frequency of resistance pink bollworm to Bt cotton did not increase from 1997 to 1999.

This has not happened yet, according to the new study.

Bt cotton was first grown commercially in the U. S. in 1996 and has accounted for more than half of the cotton acreage in Arizona since 1997. For several years, a team of scientists in the University of Arizona College of Agriculture and Life Sciences and the Arizona Cotton Research and Protection Council has tracked resistance to Bt cotton in pink bollworm caterpillars, which attack bolls of cotton in the southwestern U. S. They discovered that in 1997 the frequency of a resistance gene in pink bollworm was higher than expected.

The estimated frequency of a gene conferring resistance to the toxin in Bt cotton was about 1 in 10 for pink bollworm caterpillars from ten Arizona cotton fields in 1997. This is roughly 100 times higher than estimates for other pests of Bt crops. Based on this relatively high estimate and projections from computer models, rapid increases in resistance were expected in subsequent years. Surprisingly, the estimated frequency of resistance did not increase from 1997 to 1999 and Bt cotton remained effective against pink bollworm.

"Bt cotton is working extremely well in Arizona," said Bruce Tabashnik, UA

entomology professor and lead author of the study. "Resistance has not evolved as quickly as expected." To help delay resistance, the EPA requires that farmers who grow Bt cotton must also plant refuges of cotton without Bt toxin to allow survival of pests that are not resistant.

To understand why resistance has not evolved as predicted, the scientists are developing new computer models that incorporate the latest data and are expanding field monitoring and research on resistance genetics and ecology. Recent results suggest that on ordinary cotton, resistant pests suffer a competitive disadvantage relative to non-resistant pests. Nonetheless, the scientists continue to prepare for resistance problems in the future.

Tim Dennehy, professor of entomology and leader of the Extension Arthropod Resistance Management Laboratory (*see sidebar*), is the principal investigator on a new collaborative project on insect resistance to Bt cotton, with Yves Charrière, assistant professor of entomology, Tabashnik and others. In this effort, funded by the USDA for three years, UA faculty will work with scientists from other organizations in Arizona, New Mexico State University and the California Department of Food and Agriculture. The goals of the project are to better understand the risks and benefits of Bt cotton and to educate growers and the public about Bt cotton.

"Bt cotton has helped to reduce insecticide use in Arizona cotton to the lowest levels in the past 20 years," said co-author Larry Antilla of the grower-supported Arizona Cotton Research and Protection Council. "This benefits the public, farm workers, and the environment." Annual gains to Arizona Bt cotton adopters have averaged between \$6 and 10 million, or \$15,000 per farm. ❖



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