Genetically Modified Maize

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IMPACTS ON STREAMS

A recent study by scientists at several midwestern universities determined that genetically modified (GM) crops may not be quite as benign as they have been thought to be. Farmers first began growing GM crops commercially in 1996, when they planted 1.66 million hectares of herbicide-tolerant and insect-resistant transgenic crops. Since then, the area devoted to GM plantings worldwide has risen to more than 100 million hectares, over half of which are in the United States. This year, US farmers planted 19 million hectares of corn that has been modified to carry the gene for *Bacillus thuringiensis* (Bt) insecticidal protein.

Initially, Bt corn was engineered to target only the the European corn borer (*Ostrinia nubilalis*); in 2003, a variety of Bt corn that is resistant to corn rootworm (*Diabrotica* spp.) was introduced. These biopesticides have been considered safe for use in transgenics because most organisms are not affected. The Cry toxins produced by the soil-dwelling bacterium *B. thuringiensis* are toxic to certain lepidopteran species, as well as to some dipteran and coleopteran species, because they bind to specific receptors in the guts of susceptible insects. Monarch butterflies are sensitive to Cry toxins, but they are rarely exposed to enough of the toxin for it to affect their populations.

The initial tests to determine Bt toxicity before its registration (now set to expire on 15 October 2008) focused on a single aquatic invertebrate, the freshwater crustacean *Daphnia magna*, which was not affected. However, when Emma Rosi-Marshall (Loyola University Chicago), Jennifer Tank (University of Notre Dame), Matt Whiles (Southern Illinois University), and Todd Royer (Indiana University) looked at the effect of Bt corn products on caddisflies, trichopteran insects closely related to lepidopterans, they found significantly reduced growth rates (19 October issue of *Proceedings of the National Academy of Sciences*).

The authors also monitored 12 headwater streams near cornfields in northern Indiana; their results showed that both pollen and postharvest plant byproducts enter nearby (and sometimes distant) streams, where they are broken down and consumed or carried downstream.

Caddisflies and other detritus-feeding insect larvae are an important food source for aquatic predators, so the negative effects that Bt corn has on them could affect stream ecosystems. "We believe," say the authors, "that the future assessment of novel crops, including genetically engineered varieties, should include examination of potential effects on adjacent stream ecosystems and stream-dwelling organisms."

CREATING A NEW CONSTRUCT

A new tool for improving crop varieties may be on the horizon. Molecular geneticists at Chromatin, Inc., have turned their knowledge of centromeres to practical advantage by constructing minichromosomes that may make traditional methods for producing transgenic plants obsolete.

With traditional approaches to creating transgenic plants, beneficial genes from another source (such as those from *B. thuringiensis,* which confer insect resistance) must be integrated into the genome of host plants. The sequences integrate at random locations, so scientists screen hundreds of transgenic plants for the ones with suitable levels of transgene expression. Stacking multiple transgenes, for both herbicide tolerance and pest resistance, say, requires an even more laborious process.

By constructing a separate, heritable maize minichromosome (MMC), Daphne Preuss, Chromatin's president and chief scientific officer, and colleagues have assembled a vehicle for adding multiple new genes to plants more quickly and reliably. Using sequences from maize centromeres and two marker genes, the scientists have shown that MMCs are maintained in hosts through four generations. Their work appears in the 19 October 2007 issue of *PLoS Genetics.*

In May, Chromatin entered a nonexclusive partnership with Monsanto to use minichromosome technology in corn, cotton, soybeans, and canola. Chromatin plans to license its "enabling technology" to other companies, according to news releases, "potentially capturing most of the US corn market."

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