

Genetically modified corn present in streams

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President of the Cary Institute, William Schlesinger, talks with Cary scientist Emma Rosi-Marshall before her lecture on the potential non-targeted effects of genetically modified agriculture on Oct. 22.

MILLBROOK — Emma Rosi-Marshall gave a free public lecture on Friday night, Oct. 22, to the intellectually curious crowd that packs every free event at the Cary Institute for Ecosystem Studies. Her fact-filled, fast-paced talk was titled, "Genetically Modified Foods and The Environment: An Evolving Story."

Some in the audience thought the lecture might caution against eating genetically modified food, but Rosi-Marshall assured them that humans don't get genes in their food. What they did learn was a lot about Bt corn and the scientific method.

The effect of genetically modified corn, known as Bt corn, on invertebrates in freshwater streams was the focus of Rosi-Marshall's presentation. She began by explaining how humans manipulate genetic material by taking desirable genes from one species and adding them to another's genome. These modifications are made to increase resistance to herbicide, pests and viruses and to enhance food quality.

A startling example was the slide of a standard North Atlantic salmon compared to the much larger genetically-altered fish containing genes from the Coho salmon.

While there are many benefits, there are potential costs in non-targeted effects such as spreading the gene to wild populations of the species and, in the case of row crops, increasing the cost to farmers who cannot legally harvest the seeds and replant them and the unmeasured effects on ecosystems.

Agrobacterium tumefaciens is a gall formation that infects trees. By inserting its genetic material into corn, genetically modified Bt corn is created with a built-in protection against the European corn borer, which destroys cornfields.

Other genetic modifications include "Round Up ready" plants which can survive a spraying of Round Up to kill weeds. Rice with high Vitamin A can be grown, as can drought-resistant plants.

Rosi-Marshall showed a lengthy

chart with the list of plants from alfalfa to squash that have been genetically improved.

Twenty-five countries now harvest genetically altered crops, including large portions of the world's maize, soybeans, cotton and canola production. In the United States, 63 percent of the corn raised is genetically altered Bt corn, which produces a crystalline protein that kills insects that ingest the corn. When approving the use of Bt corn, the Environmental Protection Agency (EPA) had to test its safety and fed Bt corn pollen to a species of Daphnia and concluded, "No freshwater aquatic invertebrates are damaged."

The EPA seems to have overlooked the fact that Daphnia magna is not a freshwater invertebrate, and that is where Rosi-Marshall's research on the effects of Bt corn on the common caddisfly, used by fly fisherman as a lure, began. The caddisfly populates fresh water streams and ditches in the high-density row crop agriculture of the Midwest where 90 percent of the land is devoted to growing corn or soy. The caddisfly is an important part of the food web of streams, eating larvae and leaves and then supplying food to fish, lizards, birds, bats and spiders.

Rosi-Marshall's research proceeded in three logical steps. Does maize enter and persist in the streams that flow through these fields? Do laboratory studies demonstrate sensitivity to Bt corn? And finally, can the effects of Bt corn be identified in the field in agricultural ecosystems?

Steps one and two were easy.

Rosi-Marshall and her students collected samples from the streams during the July pollen shed and after corn harvest. They traced how far the material traveled downstream. The samples showed the presence of the Cry1Ab protein in 67 percent of the streams. In Iowa, Illinois and Indiana, 91 percent of fresh water streams are within 500 meters of a cornfield.

The second step was to examine the effect of this protein on the caddisfly in the laboratory. The results were very clear: Caddisfly mortality increased and growth decreased when fed Bt corn pollen. This result suggests a diminished food supply for the creatures up the food chain that eat the caddisfly.

Because of the already degraded condition of these streams, the last step of showing the effects on the caddisfly outside the laboratory was difficult and to date inconclusive. While it is clear that the EPA overlooked completely the impact of Bt corn on streams flowing through the fields, more research needs to be done on stream ecosystems.

Rosi-Marshall commented, "Our research adds to the growing body of evidence that corn crop byproducts can be dispersed through a stream network, and that the compounds associated with genetically-modified crops, such as insecticidal proteins, can enter nearby water bodies. The tight linkage between cornfield and streams warrants further research into how corn byproducts, including Cr1Ab insecticidal proteins

potentially impact non-target ecosystems, such as stream and wetlands."

The questions after the lecture were well-informed. Asked how long the corn will remain resistant, Rosi-Marshall explained that all farmers must plant a "refuge" crop surrounding their Bt planting. These refuge plants become hosts for the corn borers, which mate with insects attacking the resistant plants and prevent the spread of resistant species.

In the cotton fields of India where this practice has not been enforced, resistance to genetically modified cotton grew quickly.

Another inquisitive member of the audience asked if, given the huge amounts of money at stake, Rosi-Marshall had received threats from agribusiness. Rosi-Marshall admitted that doing research in this area is contentious and said that in 2007 Monsanto took the unusual step of convening a conference to refute her findings.

"Who was the head of the EPA in the late 1990s when Bt corn was approved?" asked another.

"Carol Browner, appointed by President Clinton, served as head of the agency through both terms," Rosi-Marshall responded and mentioned that the Daphnia study was actually conducted by Monsanto. Further, now that Bt corn has been approved, its use is unregulated.

"Why has Germany outlawed genetically grown food?" asked another. Rosi-Marshall guessed that the strong influence of Greenpeace and German suspicions about genes in their food played a role.

Rosi-Marshall is an aquatic ecologist who joined the research scientists at the Cary Institute 18 months ago from a tenured professorship at Loyola of Chicago.

The Cary Institute is a private, not-for-profit environmental research and education organization in Millbrook whose scientists have been investigating the complex interactions that govern the natural world for more than 25 years. Focal areas include air and water pollution, climate change, invasive species and the ecological dimensions of infectious disease. Learn more at caryinstitute.org.