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Directed Evolution

The western corn rootworm beetle (Photo 1) resembles the crop it likes to eat. If you cultivate a lawn, grow fruits and/or vegetables, or keep just a few ornamental plants in a window box, you know that these horticultural living organisms need protection from the bugs that want to eat them.

People who practice organic farming reject pesticides and synthetic chemical fertilizers because they don't consider these technologies socially or environmentally friendly. Organic farmers and gardeners try to keep insects in check using the weapons that evolution and natural selection have developed over millions of years. They advocate using only approaches found in nature that have kept plants and insects from destroying each other for millions of years—long before farmers turned to chemicals and pesticides to increase crop yields.

A collaborative effort between Monsanto and Devgen scientists has recently achieved a major breakthrough in directed evolution. They have developed a technology called RNA interference (RNAi), which can eliminate proteins in plants that insects need to digest the plants.

The technology doesn't involve the use of chemicals or pesticides. It just speeds up and directs evolution, creating changes that might take place over time in our natural world without human assistance.

This technology silences the RNA of a specific plant gene to keep the plant from producing a protein that the targeted insect needs for normal digestion. Since the insect doesn't have the intelligence to avoid eating the crop, it is killed off without the use of toxic chemicals or pesticides.

For example, by silencing only one naturally occurring corn gene, the Monsanto-Devgen team created

corn plants that lack a necessary protein that the western corn rootworm beetle needs to convert what they eat into energy. The beetles



Photo 1 (above)—
Western corn
rootworm beetle

Photo 2 (right)—
Root comparison



presented with RNAi-altered corn plants died because they could no longer properly digest the corn's vegetation. Photo 2 shows evidence of the effectiveness of this form of directed evolution. The healthy set of corn roots belong to an RNAi protected plant and the decimated roots belong to a natural corn plant.

This method is very different from past genetic engineering approaches that created genetically modified (GM) crops that produced their own toxins to chemically kill the insects that eat them. RNAi technology doesn't produce toxins or pesticides so it shouldn't kill Mon-

arch butterflies or other insects not specifically targeted.

Scientists must now determine if this technology is as safe as Monsanto and Devgen current research indicates. Their RNAi technology builds on the work of two 2006 Nobel prize winners, Andrew Fire and Craig Mello, who identified the occurrence of natural RNAi processes in living organisms.

Can the harnessing of this natural process negatively speed up its natural occurrence in other living things? Could food crops protected by RNAi cause unexpected digestive problems or new food allergies in people? Will the technology kill insects and other living organisms that are not part of the intended target population. Once used in open fields, could cross-pollination with other crop species spread the RNAi effect to other plants?

These are just a few of the questions that must be answered before

this technology will be ready for USDA and FDA approval.

Recalling the Facts

1. When it comes to protecting a crop from insects, how is RNAi technology different from the current genetic modification approach?
2. Do you think that people who advocate organic farming will accept crop seeds that have been created by RNAi-directed evolution? Why? ©

Alan Pierce, Ed.D., CSIT, is a technology education consultant. Visit www.technologytoday.us for past columns and teacher resources.