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Success of new bug-fighting approach may vary from field to field

March 11 2014, by Diana Yates

(Phys.org) —A new technique to fight crop insect pests may affect different insect populations differently, researchers report. They analyzed RNA interference (RNAi), a method that uses genetic material to "silence" specific genes – in this case genes known to give insect pests an advantage. The researchers found that western corn rootworm beetles that are already resistant to crop rotation are in some cases also less vulnerable to RNAi.

The study is reported in the journal *Pesticide Biochemistry and Physiology*.

"Our results indicate that the effectiveness of RNAi treatments could potentially vary among field populations depending on their genetic and physiological backgrounds," the researchers wrote.

The western corn rootworm will likely be one of the first crop pests to be targeted with RNAi technology, said Manfredo Seufferheld, a former University of Illinois crop sciences professor who led the study with crop sciences graduate student Chia-Ching Chu, entomology research associate Weilin Sun, Illinois Natural History Survey insect behaviorist Joseph Spencer and U. of I. entomology professor Barry Pittendrigh.

Controlling the western corn rootworm costs growers more than $1 billion a year in the U.S. Current methods for keeping the bug in check – crop rotation and genetically modified corn – face challenges from populations of resistant western corn rootworms at various locations across the Corn Belt, Spencer said.

Seufferheld and his colleagues recently discovered an important factor that helps rootworms overcome crop rotation, the practice of alternately planting soybeans and corn in the same field year to year. They found that microbes in the guts of rotation-resistant rootworms help those beetles that stray into soybean fields survive on soybean leaves for a few days – just long enough for the females to lay their eggs in soil that will be planted in corn the following year.

Rather than studying a laboratory population of insects, in the new analysis the team tested RNAi on rootworm beetles collected from fields in three locations in the Midwest – two in Illinois with established rotation-resistant populations and the third from an area in Missouri with no evidence of rotation resistance.

"After generations in the laboratory, insects gradually lose their natural diversity," Seufferheld said. This makes it easier to control them, and may not accurately reflect actual insect responses in the field, he said. Seufferheld now works for Monsanto and is based in Buenos Aires, where he is in charge of insect resistance management.

The team targeted two genes that are regulated differently in rotation-resistant and non-resistant rootworms. The first, DvRs5, codes for an enzyme that helps the rootworms digest plant proteins. The second, att 1, aids in the insects' immune response. These genes have been found to play a role in rootworm resistance to crop rotation.

The team looked at how treatment with RNAi (which involves feeding it to the bugs) influenced enzyme activity in the rootworm gut. They also recorded how long the beetles survived on soybean leaves after ingesting RNAi.

As expected, the RNAi targeting DvRs5 reduced that enzyme's activity in all three rootworm populations. But the treatment had less of an effect on rotation-resistant beetles (activity dropped to about 48 percent) than on their nonresistant counterparts (enzyme activity dropped to 24 percent).

The researchers were surprised to find that the RNAi targeting the gene att1 had no effect, or even may have aided rotation-resistant rootworms, which survived slightly longer than they would have without the treatment. The same RNAi treatment undermined survival in the nonresistant rootworms.

This does not represent an immediate concern for RNAi technology, the researchers said, as they tested genes that are unlikely to be used in commercial crops. But the study does offer important insights into the complexity of insect biology, Seufferheld said.

"Nature is not static, but interactive and dynamic," he said. "As we better understand the relationships between broad-scale human changes to crop diversity and the insects that feed on those crops, this knowledge will help us develop better pest-management strategies that are more in tune with nature."

The findings suggest that targeting a single gene to control a pest species is not the best strategy, Spencer said.

"We now know that disrupting a particular target gene may enhance undesirable pest characteristic, such as rotation resistance, while also undermining desirable traits," he said. "With insecticides, our instruments of destruction were relatively crude and unfocused," he said. "With RNAi, we are trying to subtly subvert important processes very precisely to bring about pest death." Such precision requires "a deeper appreciation of how the system works," he said. "This study shows how variation among crop pests may alter the outcome of a seemingly straightforward manipulation."

"This is important evidence that insect populations vary in their response to RNAi and might be influenced by other selective events," Pittendrigh said. The findings might be of interest to agricultural biotech firms that are hoping to add RNAi to their pest-killing arsenals, he said.

More information: The paper, "Differential Effects of RNAi Treatments on Field Populati of the Western Corn Rootworm," is available online: www.sciencedirect.com/science/ … ii/S0048357514000273

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