New Test for Pesticide Resistance in Cattle Fever Ticks

Cattle fever ticks—which include the southern cattle tick, *Boophilus microplus,* and the cattle tick, *B. annulatus*—became infamous in the years after the Civil War, when southern ranchers drove cattle to northern markets. Southern cattle had acquired immunity to bovine babesiosis—the disease transmitted by these ticks. But the cattle drives carried the disease and the ticks to vulnerable northern herds.

Although cattle fever ticks were eradicated from the United States in about 1943, they are plentiful in Mexico today. A quarantine zone in South Texas along the Mexican border is currently the only barrier to their reentry into the United States, where all cattle are susceptible to the disease.

Cattle entering the United States from Mexico are routinely dipped in the organophosphate coumaphos, the only pesticide approved for use in dipping vats. "Coumaphos is the most effective product we have to use, but concerns about coumaphos resistance have prompted a search for alternatives. Our project focuses on resistance to several classes of pesticides," says ARS physiologist Felix D. Guerrero. He and ARS microbiologist John H. Pruett, at the Knipling-Bushland U.S. Livestock Insects Research Laboratory in Kerrville, Texas, are finding ways to identify pesticide resistance in cattle fever ticks.

They have identified two independent mechanisms by which ticks become resistant to pyrethroids. They've found one strain of resistant Mexican tick possessing a gene that produces a large amount of a specific esterase protein, called CzEst9, which is involved in the breakdown of pyrethroids.

The protein's name reflects the Mexican city of Coatzacoalcos, where Mexican scientists originally collected these ticks. Pruett isolated CzEst9 from this strain of tick, which is reared at ARS' quarantine facility in Mission, Texas. Pruett's work dovetailed with subsequent studies in which Guerrero cloned the CzEst9 gene. Together, Guerrero and Pruett are working on a quick test to measure the amount of CzEst9 in ticks as an indicator of resistance to pyrethroids.

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Quarantined cow goes through a tick treatment bath at an APHIS facility in McAllen, Texas.

Guerrero has already devised a rapid test for pyrethroid resistance. A tick larva is squashed in a tube to extract its DNA, which is then analyzed by polymerase chain reaction followed by gel electrophoresis. A diagnostic band on the gel, produced by resistant ticks, indicates the presence of a DNA mutation responsible for conferring pyrethroid resistance.

Though widespread, pyrethroid resistance is not ubiquitous in Mexico. So pyrethroids can still play a role in killing ticks that are resistant to organophosphates, like coumaphos.

At the border, it takes at least 6 weeks to test ticks for coumaphos resistance, because many live tick larvae are needed. Pruett has adapted a faster laboratory test that uses color to distinguish coumaphos-resistant ticks from nonresistant ones. This test takes only a day to complete and can be performed on either crushed tick larvae or a dissected adult tick brain. If the tick is resistant to coumaphos, the medium in the test vial turns yellow; if not, it stays clear.

Meanwhile, Guerrero is striving to develop a field detection kit to identify resistant Mexican ticks. "Someday we hope to have a laboratory in a suitcase for identifying resistant tick strains in the field, so that we won't need to transport them or rear them in a lab," he says.—By **Linda McGraw,** formerly with ARS.

This research is part of Arthropod Pests of Animals and Humans, an ARS National Program (#104) described on the World Wide Web at http://www.nps.ars.usda.gov.

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