Taking New Measures Against Ticks

Ticks are close relatives of mites, spiders and scorpions, but unlike these arachnids, ticks tend to stick around. These parasitic creatures are annoying and sometimes difficult to see. What's worse is they can transmit pathogens that cause life-threatening diseases to humans and animals.

Most of the more than 800 species of ticks are harmless, with the exception of those like the cattle fever tick found mainly along the Texas-Mexico border, and the blacklegged tick that infests the Northeast and Midwest.

These potentially disease-carrying ticks are hard to kill, but Agricultural Research Service (ARS) scientists are finding new ways to control them.

PHOTOS BY SCOTT BAUER COURTESY ARS

A nymph-stage blacklegged tick on a leaf. Infected nymphs transmit the pathogen that causes most cases of Lyme disease.

Giving ticks a taste of nootkatone

Scientists are using nootkatone, a natural compound used in a variety of products such as foods, cosmetics and pharmaceuticals, to kill ticks. A component of oils from grapefruit rinds, Alaskan yellow cedar and other plants, nootkatone is effective against several species of ticks, including the blacklegged tick that transmits the spirochete *Borrelia burgdorferi*, the bacterium that causes Lyme disease in humans and other animals.

Although not fatal, Lyme disease can lead to rheumatoid arthritis-type conditions, affecting the joints, heart and nervous system if left untreated. The latest available report from the Centers for Disease Control and Prevention (CDC) shows more than 29,950 confirmed cases of Lyme disease in the United States in 2009.

While low doses of nootkatone were effective against different tick species in the ARS study, the volatile oil lacked sufficient residual activity to kill tiny, host-seeking nymphs that are more likely to transmit the spirochete that causes Lyme disease.

"We found that when you apply nootkatone, it doesn't last more than three days in the field before control breaks down," says Kirby Stafford, an entomologist at the Connecticut Agricultural Experiment Station in New

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Haven. "Three days is not enough time for the oil to move down into leaf litter from where hiding nymphs will emerge to seek a host."

Robert Behle, an entomologist at the National Center for Agricultural Utilization Research in Peoria, Ill., was able to help provide a solution. Behle and his colleagues in the agency's Crop Bioprotection Research Unit developed and patented a spray-dry procedure that encapsulates nootkatone in lignin, which is extracted from wood, where it functions as a kind of molecular mortar that holds plant cell walls together. Behle and Stafford used the lignin as a semipermeable packaging that lengthens nootkatone's residual activity and improves its efficiency.

In the Peoria laboratory, ARS biological science aide Lina Weiler placed 10 unfed tick nymphs in glass vials coated inside with five different concentrations of nootkatone. After being exposed to nootkatone treatments for 24 hours, all four tick species tested in the study died.

Experiments conducted in the field during June and July of 2009 also yielded promising results. Lignin-encapsulated nootkatone was sprayed along the perimeter of Connecticut homeowners' properties where the yards met the forest. Researchers were not able to detect surface residues of nootkatone, but they did find traces of the oil below the leaf litter where the nymphs dwell. Also, no live ticks were found at the treated sites for the rest of the summer.

Tracking cattle fever ticks

More than 100 years ago, state and federal agencies joined forces to get rid of the cattle fever tick along the Texas-Mexico border. The Cattle Fever Tick Eradication Program worked so well that these ticks were mostly eradicated from the United States by 1943. Now, these blood-feeding parasites have reemerged, reinfesting Texas along the border and Mexico at alarming rates.

Cattle fever ticks cause bovine babesiosis, commonly known as "Texas fever." Animals that contract the disease suffer from high body temperatures, arched backs, loss of appetite, diarrhea, and constipation before dying within three to four days.

To help eliminate cattle fever ticks and curtail this disease, scientists at the ARS Knipling-Bushland U.S. Livestock Insects Research Laboratory in Kerrville, Texas, are developing new strategies.

Entomologist J. Mathews Pound believes increased tick infestations are likely due to the growing populations of white-tailed deer and other wild hoofed animals along the Texas-Mexico border, so he and his colleagues are focusing on technology that eradicates ticks on cattle and wild deer.

A device called the 4-Poster Deer Treatment Bait Station is being used to control ticks on deer. The station lures deer into a feeding apparatus that uses rollers to apply insecticide to the animal's head, ears and neck as the animal eats. Most of the ticks are killed as the deer spreads the insecticide to other parts of its body while grooming.

Pound also helped develop a bait station that automatically applies pesticide-impregnated neckbands to wild deer as they eat.

Taking a different approach, Pound and his colleagues have reformulated a broad-spectrum antiparasitic medication called doramectin for use in an injectable microsphere treatment.

"A single injection of microspheres — akin to time-release capsules in human drugs — greatly reduces the number of treatments needed and protects cattle for up to four months, killing parasites and saving cattle producers considerable expense," Pound says.

The treatment showed exceptional results when tested on the island of St. Croix against the tropical bont tick that transmits heartwater, a deadly cattle disease.

To improve the effectiveness of

treating U.S. cattle for ticks, scientists are working to extend the effective period of the microsphere and neckband treatments to six months or longer, Pound says. Technologies developed also will help manage other species of ticks that transmit the agents causing Lyme disease, babesiosis and two kinds of ehrlichiosis to humans.

For more information about ARS research on ticks, contact Daniel Strickman, leader of ARS National Program #104: Veterinary, Medical and Urban Entomology.

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In the Northeast, the white-tailed deer is the primary host for adult blacklegged ticks.