Out of the Lyme-Light

Technician Kenneth Young applies acaricide to paint rollers on the ARS-developed four-poster device. The acaricide rubs off on deer as they feed on corn bait dispensed by the device.

SCOTT BAUER (K9405-1)

Tick Control Device Reduces Lyme Disease

Ticks aren't insects; they're acarines, closer kin to spiders. Unlike an insect's, a tick's head and body are one unit, resting entirely on eight legs. Even with so many legs, they can't get far without help from their hosts. It's a fact that ticks live where their hosts live.

White-tailed deer are the keystone host for maintaining populations of the tick *Ixodes scapularis*. In the Northeast, this tick was initially described as the deer tick because it was first found on deer. Since then, scientists have shown that the deer tick is actually the blacklegged tick.

In the Northeast, these ticks are notorious for transmitting the agent that causes human Lyme disease: *Borrelia burgdorferi*. They also transmit lesser known human diseases like ehrlichiosis and babesiosis—microbial infections characterized by flulike symptoms but much shorter-lived than Lyme disease.

Populations of blacklegged ticks are spreading to new locations each year. More than 10,000 human cases of Lyme disease are reported annually in the United States, according to the Centers for Disease Control and Prevention, in Atlanta, Georgia.

Lyme disease occurs mainly in suburban areas with an overabundance of deer. That's why USDA implemented a 5-year tick-control project in the Northeast in 1997. The project uses a device developed and patented by ARS scientists in Kerrville, Texas. The device, named the "four-poster," is being tested in four areas where the incidence of Lyme disease was among the highest in the country when the project started—Old Lyme, Connecticut; Bedford, New York; Colts Neck, New Jersey; and Narragansett, Rhode Island—and also at the Beltsville Agricultural Research Center (BARC) in Maryland. With a goal of reducing 90 percent of the nymphs, the researchers set out 25 four-posters at each of the five 1,280-acre treatment sites.

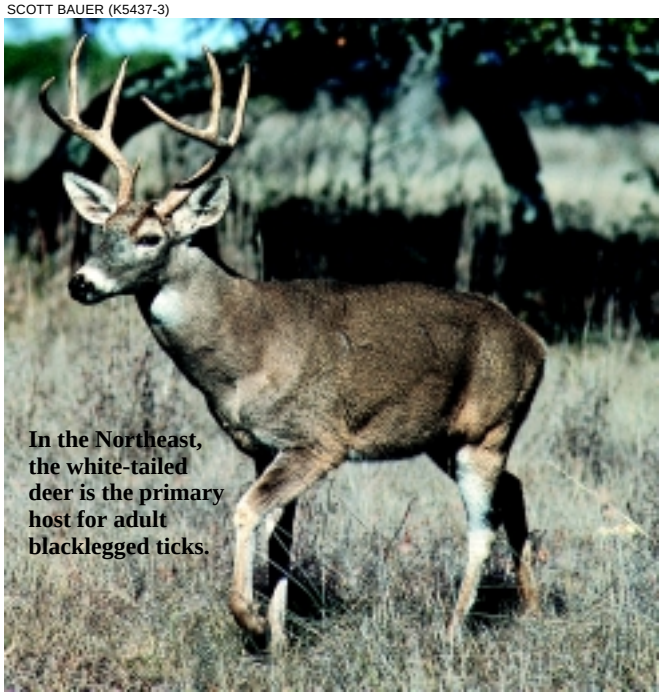
SCOTT BAUER (K9411-2)

An adult female blacklegged tick, engorged after a blood meal, rests on a leaf.

Safety First

"People and deer will be able to live together without fear of Lyme disease," says ARS entomologist J. Mathews Pound. Pound is optimistic because he, ARS agricultural engineer J. Allen Miller, and ARS biological technician Craig LeMeilleur at the Knipling-Bushland U.S. Livestock Insects Research Laboratory in Kerrville invented the four-poster as an alternative to eliminating deer populations or applying chemical sprays to the environment.

SCOTT BAUER (K5437-3)



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

The four-poster consists of a bin filled with whole-kernel corn. "On the four corners of the bin are paint rollers, which hold one of the safest acaricides we could find—amitraz," says Pound. The corn lures deer to the feeding station, where they brush up against the paint rollers. The acaricide rubs off and kills ticks on the animal's head and neck, where 90 percent of adult ticks are found. As the animal grooms itself, the acaricide is spread to other areas of the body.

Amitraz targets ticks and mites without harming beneficial insects. It is currently approved for use on livestock, so the U.S. Environmental Protection Agency (EPA) granted the researchers special permission to use it on white-tailed deer during the 5-year project.

"Choosing amitraz helped us gain public acceptance of the project. Even during hunting season—from October through December, which also coincides with the time most adult black-legged ticks feed on deer—amitraz is considered safe.

"Currently, no pesticide is approved for use on white-tailed deer. But this situation may soon change. The technology and its implementation are reminiscent of the chicken-or-the-egg story. No one was willing to try to get a pesticide approved for white-tailed deer until there was an application device. Vice versa, no one can make good use of the applicator without an approved pesticide," says Pound.

Knowing a Good Thing When You See It

"When I found out about the four-poster, I immediately started the licensing process," says David Weld, executive director of the American Lyme Disease Foundation, which is forming a subsidiary company to market the four-posters. Concurrently, Y-Tex Corporation, an animal health company in Cody, Wyoming, began seeking EPA approval to register one of its products containing the insecticide permethrin for use on white-tailed deer. The Y-Tex product, Brute, is made and sold commercially for killing ticks on cattle and swine.

In a separate study from 1996 to 1998, NASA researcher Vickie Solberg reported using several four-posters in a secured area at the Goddard Space Flight Center in Greenbelt, Maryland. Her control site was the Patuxent Wildlife Research Center in Laurel, Maryland. By the second year, she says, "we saw 98 percent control of nymphs and 100 percent control of adult ticks using the four-posters with permethrin. So we know the chemical works." Permethrin is already known by many consumers as an ingredient in head lice shampoos for children.

Previous ARS trials with the four-poster proved its ability to kill and reduce populations of another tick, the lone star tick, *Amblyomma americanum,* in Texas. But when the researchers in the Northeast used the same methods, they found some surprising differences between Texas deer and northeastern deer. "Deer in the Northeast are more numerous, are larger, and have bigger appetites and thicker haircoats. So the first reality check was that we had to use lots more corn and more pesticide," says Pound.

SCOTT BAUER (K9403-2)

At a heavily used four-poster in a Maryland suburb, entomologist John Carroll (left) and Kenneth Young examine acaricide-impregnated paint rollers for signs of wear.

"Deer are as attracted to whole-kernel corn as children are to chocolate candy," says Pound. But, the researchers at four of the Northeast treatment sites—to varying degrees and in different years—encountered competition from the number of acorns dropping from trees in the fall. "The deer ate the acorns instead of the corn in our feeders. It was certainly something we hadn't expected," he explains.

Life Cycles

In the Northeast, *I. scapularis* has a 2-year life cycle. Larvae become infected during their first summer, when they feed on white-footed mice and other small mammals and birds, which are reservoirs for the spirochete *B. burgdorferi*. Nymphs—the stage after larvae—survive winter and spread *B. burgdorferi* the following spring and summer. By their second fall, nymphs

have turned into adult ticks, and the females begin seeking a host that offers a large blood meal, most often the large population of white-tailed deer.

"If there are fewer adult ticks to reproduce, we can expect fewer larvae in the spring. Infected nymphs, smaller than a pinhead, transmit the most cases of Lyme disease because their presence can go unnoticed until the infection is established and because they are biting in the summer when people are outside in shorts and T-shirts," says Pound.

Ticked Off in Maryland

The spring of 1998 was a busy time for ARS entomologist John F. Carroll, technicians Kenneth W. Young and Eliseo N. Miramontes, and others at BARC. That's when they set out four-posters at BARC and at two other locations in the Baltimore-Washington area—Loch Raven and Gibson Island, Maryland. The devices were placed along trails and in areas where deer congregate.

On fall and spring days, and on winter days when the temperature stays above 45˚F, the researchers spend their time stocking the feeders with corn and applying acaricide to the rollers. "That's when adult blacklegged ticks look for a blood meal," explains Carroll, "and nearly all female ticks feed on deer."

Carroll says they are targeting female adults to prevent them from laying eggs. "A female tick can lay up to 3,000 eggs in her lifetime," says Carroll.

In the third year of treatment in Maryland, Carroll says, "it looks like we're having an effect—but not yet at the level we had anticipated."

At the Loch Raven site, numbers of blacklegged tick nymphs were 71 percent lower in treated areas in 2000 than in 1998. Reductions were nearly as good at BARC—68 percent. And they were promising on Gibson Island—59 percent—the last site to go into operation.

Reductions of lone star tick nymphs were similar. The Maryland and New Jersey sites are the only project sites to have deer that play host to the lone star tick, which transmits a bacterium that causes human monocytic ehrlichiosis.

"If during 2 or 3 years, you can reduce nymph numbers by half, after 4 years you can reasonably expect to reduce them by 75 percent or more," says Carroll. To calculate the level of control, he uses a mathematical formula that accounts for the natural rise and fall of tick populations in any given season, depending on weather and other factors.

Thanks to the American Lyme Disease Foundation, Lyme disease has become a household word. Although there is currently one Lyme disease vaccine on the market, its effectiveness hasn't been established for total disease prevention. For more information about Lyme disease, see the Foundation's web site at http://www.aldf.com.

"In terms of having an impact on Lyme disease risk over a community-based area, the four-poster is the only current technology I know of that can do the job," says Pound. "I believe we are having an impact on tick populations in the Northeast, and there's still time to reach our goal."—By **Linda McGraw** and **Judy McBride,** 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.

To reach scientists mentioned in this article, contact Linda McGraw, phone (309) 681-6530, e-mail mcgraw@ars.usda.gov, or Judy McBride, phone (301) 504-1628, e-mail jmcbride@ars.usda.gov. u

SCOTT BAUER (K9414-1)

Kenneth Young examines leaf litter for blacklegged tick nymphs.

SCOTT BAUER (K9409-1)

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