INTEGRATED PEST MANAGEMENT

Insights

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Integrated Pest Management

Northeastern IPM Center

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Inside

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Signature Programs

How to Tell Pests to Stay Away

ATTENTION PESTS: KEEP OUT. If only posted signs would scare the pests away. Exclusion, or prevention—it's a fundamental principle of IPM, but why does it matter and how does one do it?

"Prevention is the practice of keeping a pest from infesting a field or a site," Jim Farrar and coauthors wrote in a paper about the adoption of IPM Practices.[1]

Prevention is the best defense, yet knowledge barriers often keep people from adopting IPM. A 2009 survey of growers revealed that fewer of them reported such barriers than previously recorded—between 8 and 23 percent, apart from the largest barrier, lack of knowledge, which 62 percent reported.

Reaping the Rewards of Prevention

To be sure, once the knowledge barrier is overcome, people readily choose a sustainable pest management approach, such as IPM. For a recent example in the headlines, public health officials around the world are showing interest in the sterile insect technique (SIT) to control mosquitoes before they transmit diseases such as Zika. In California, the benefit of preventing the glassy-winged sharpshooter, an insect pest, was estimated at $185 million. An online decision-aid system for Pacific Northwest tree fruit, meanwhile, is estimated to be worth $16 million annually in Washington state alone. In the Lodi wine grape-growing region of California, more than 50 percent of growers report using the IPM technique of leaf pulling to avoid insect, mite, and disease problems on grape clusters. Knowledge barriers fall as people seek out information from trustworthy sources, and society benefits from a greater, and more sustainable, biological security.

Once the ***knowledge barrier*** *is overcome, people readily choose a* ***sustainable*** *pest management approach, such as IPM.*

In California, the benefit of preventing the glassy-winged sharpshooter, an insect pest, was estimated at $185 million. Photo by Elena Zhukova. Copyright 2013 The Regents of the University of California. Used by permission.

Preventing Weeds from Ever Starting

Eric and Anne Nordell own and operate Trout Run Farm, a two-person venture in Trout Run, Pennsylvania. They found that keeping weed pressure down before seeding crops helped significantly control weeds.

The Nordells employed two cover crops: winter hardy rye and sweet clover. The Nordells call their system "controlled rotational cover crops," which refers to their practice of rotating the timing and types of cover crops. Their efforts prevent weeds from becoming a problem *before* they start, and all in all reduce labor and material inputs. For details on the Nordell's cover cropping system, see http://neipmc.org/go/TQaQ

Exclusion from Structures

For Jody Gangloff-Kauffmann, an entomologist at Cornell University and New York State IPM, exclusion is the number one pest management technique.

In 2015, the Northeastern IPM Center awarded her team, SCOPE 2020, a two-year grant to focus on excluding pests from residential buildings; the North

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Preventing Deer from Becoming Pests

Deer eat gardens. Spread Lyme disease. Collide with cars, threating human lives. Native generalist white-tailed deer have increased fifteen-fold since the 1990s in eastern North America.

Experts are using IPM techniques to prevent deer from destroying ecosystems, disrupting habitat enough to put wild birds at risk, and boosting the presence of invasive plants that move into voids left by excessive grazing. For example, ecologists are trying to figure out how the presence of too many deer in an area might affect the balance of native and introduced plants. Meanwhile, other researchers are making attempts to control deer numbers, with interesting results.

New research shows that even when deer prefer to eat a plant, rather than reducing its numbers, they might spread it more widely through their feces. Also, deer don't particularly care whether a plant is native or introduced (or invasive). Deer avoid certain invasive plants that are increasing in abundance, and attack some native plants.

White-tailed deer have increased fifteen-fold since the 1990s in eastern North America. Photo: USDA Forest Service, Southern Research Station, Bugwood.org.

Deer Eat What's in Season and Available

Kristine Averill, a research associate in Cornell University's Soil and Crop Sciences Section, led research on the topic as a graduate student in ecology at Penn State. Her results were recently published in the journal *Biological Invasions*.

Averill and her team tested herbivore preference for common plants in the Eastern US, categorized by native or introduced status, and by species.

They conducted the study at the 22-acre Pennsylvania State University Deer Research Center in State College, where a captive population of 75–100 deer reside in nine pens ranging in size from 0.3 to 3.5 acres.

Deer were offered a choice of fifteen plant species; researchers replicated fifteen trials in spring, summer, and autumn.

"Deer really do seem to avoid eating garlic mustard, Japanese stiltgrass, and barberry," Averill said. "While this appeared to be the case based on field work, we showed the same pattern in a controlled setting. Deer avoidance of these species helps explain why they are so invasive in forest understories."

Sterilize or Hunt Them?

As reported in a *Washington Post* article by Jackson Landers, Cornell University made an attempt to reduce deer populations through a sterilization program, with interesting results.

Cornell had considered culling deer through hunting, but in 2009 began a sterilization program.

What they hadn't counted on: Bucks can travel for miles in search of does in heat. They would need to target a large number of does for sterilization.

At a cost of roughly $1200 per deer, 77 does were captured and sterilized through tubal ligation. (Costs would have been higher without the help of the Cornell University College of Veterinary Medicine.)

Yet the total number of deer remained steady over five years.

Population numbers were offset by increases in buck numbers. There were about 100 deer on campus when the program started, and there were still about 100 deer five years later.

The program had inadvertently created a population of buck magnets that drew in new deer from the surrounding area.

"I'm an ecologist looking at the literature," Bernd Blossey, chair of the Cornell Deer Research and Management Committee, said in the *Washington Post*. "I thought that sterilization in an open population where things can move in and out won't work. Maybe it was worth doing it in a sophisticated way to say we tried in the best possible way and it didn't make a difference."

The tubal ligation program was halted, replaced by a combination of professional trapping and volunteer archers. After nuisance deer removal in 2014, cameras estimated about 58 deer on campus.

The sometimes controversial issue of what to do about deer simmers on, and occasionally boils over. Meanwhile, ecologists are using IPM techniques to study deer behavior and feeding preferences, in hopes of protecting nature and preventing deer from spreading Lyme disease, colliding with cars, or turning your garden, suburban landscape, or nature preserve into a wasteland. ■

For further reading

Landers, J. Trying to limit the number of deer, with surprising results. September 29, 2014. Washington Post.

Averill, K., et al. (2016). Deer feeding selectivity for invasive plants. Biol Invasions (2016) 18:1247–1263 doi:10.1007/s10530-016-1063-z

Keeping Stink Bugs Out of Your House, and Your Island Nation

Ports of entry in New Zealand are working hard to keep out brown marmorated stink bug (BMSB), relying in part on information and resources provided by the Northeastern IPM Center for identification and control.

Officials from the island nation requested, in April, about twenty odd dead insect specimens preserved in bottles of hand sanitizer. Part of the "BMSB identification kit," these specimens are available for free through the StopBMSB.org website. See http://neipmc.org/go/kits

The Northeastern IPM Center provides information to visitors every day about excluding stink bugs from ordinary houses. Now we are defending the landing grounds, beaches, and farms of distant countries. In this article, we'll discuss keeping stink bugs out of your house, and your island nation.

New Zealand topographic image. NASA.

Home Invasion

"Brown marmorated stink bugs are rude guests, as they eat your garden and then move in with you," said William Quarles, an IPM specialist and managing editor of the *IPM Practitioner*.[1]

If your house is invaded by 25,000 *Halyomorpha halys*, as has happened,[2] this group of bugs could produce a summer population of almost three million in the immediate vicinity of your home.[3,4]

"The best approach is exclusion," Quarles said. "Pay special attention to the side of the house facing the sunset. Caulk up all holes, and make sure that window screens fit tightly. Pay attention to sealing around window air conditioners. Cover attic and foundation vents with screens. Make sure the chimney is protected with a screen. Weather-strip doors, and make sure each one has a functional door sweep."

High Level Exclusion

In a video frequently promoted by the Northeastern IPM Center and StopBMSB.org, Mike Raupp of the University of Maryland Extension recommends a similar strategy. Check weather stripping around screens, windows, and doors. Inspect for cracks and holes, especially where utilities pass in and out, and seal them with caulk (small gaps) or foam (large ones). Stink bugs prefer attics; check screens there. Also check air conditioning units for gaps around them; cover them when not in use. To exterminate the rascals, don't flush them, as it wastes water.

A much more environmentally sound way is to put them in a reusable plastic food storage container and toss them in the freezer for a couple of days. "That will chill them out," says Raupp. Dead stink bugs can be emptied outdoors or onto your compost pile. See http://neipmc.org/go/thLr

We Shall Defend Our Island, Whatever the Cost May Be

New Zealand attracts worldwide fame for its high value, low pesticide fruit and vegetable industry. BMSB poses a significant threat to the island's economic base. David Teulon, an official in New Zealand working with an organization called Better Border Biosecurity, or B3, recently contacted the Northeastern IPM Center to obtain some of our ID kits to assist pre-border detection of BMSB. The bugs often stow away in cargo, freight, and packages and finding them before they arrive is a critical prevention strategy.

In work by a New Zealand researcher, Laura Nixon, a Ph.D. student at Lincoln University in Christchurch, designed a study to detect scents emitted by BMSB during overseas shipping. Her partner, Amy Tabb, who works in Tracy Leskey's USDA lab in West Virginia, programmed a robot to simulate the movement of a package carried by a forklift and a ship on its journey. The package is designed to serve as an overwintering shelter containing BMSB. The robot, mimicking the lifting of machin-

Laura Nixon and Tracy Leskey in front of a robot that simulates the effect of overseas shipping on the brown marmorated stink bug. Photo by David Teulon.

ery and the waves of the ocean, shifts and undulates the package. The machinery then identifies the chemistry of scents emitted by the insects. The aim is to see if such typical disturbances of the insects during shipping can be detected automatically. See https://youtu.be/h19hrwp9eUw ■

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2 Inkley, D.B. 2012. Characteristics of home invasion by the brown marmorated stink bug. *J. Entomol. Sci.* 47(2):125–130.

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4 Kawada, H. and C. Kitamura. 1983. The reproductive behavior of the brown marmorated stink bug, *Halyomorpha mista*. *Appl. Ent. Zool.* 18(2):234–242.

Exclusion: The case of SWD

Exclusion can be decisive in the battle against spotted wing drosophila (SWD). Since its discovery in 2008, this tiny vinegar fly (*Drosophila suzukii*) has established outposts in nearly every fruit and berry-growing region of North America. Unlike most vinegar flies, this one attacks undamaged fruit.

Screening may protect individual plants or crops in protected culture such as high tunnels or greenhouses. In Japan, using extremely fine mesh with openings less than .039 inches (.98 millimeter) wide (18 mesh or finer) protected blueberries. If screening is used, venting can be problematic; fans may be needed to increase airflow. You will need to introduce pollinators if the crop is in bloom.[1]

Spotted wing drosophila on a raspberry. Photo by Hannah Burrack, NC State University, Bugwood.org.

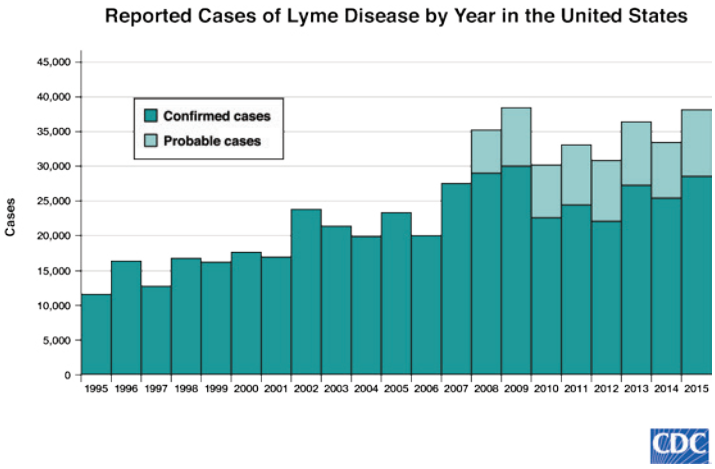
1 Demchak, K., Biddinger, D., and Butler, B. 2012. Spotted Wing Drosophila, Part 4: Management. Penn State Extension. http://neipmc.org/go/NhjM Accessed May 19, 2017.

Preventing Ticks and Lyme Disease: Scientists Test New Strategy

Throughout human history, ticks have performed notorious roles, usually as bloodthirsty villains. According to DreamBible.com, "to dream of ticks represents an annoyance in your life that forces you to be extra careful." The third plague sent upon Egypt, described in Exodus 8:16–18, describes lice miraculously forming from dust; some scholars have proposed that the word denotes not lice, but ticks. In Shakespeare's *Troilus and Cressida*, to imagine oneself as a tick serves as an insult:

> Would the fountain of your mind were clear again,
> that I might water an ass at it! I had rather be a
> tick in a sheep than such a valiant ignorance.

Today, ticks appear in scientific and medical literature, usually after they have done their worst damage. Scientists are seeking ways to prevent infected ticks from biting deer, mice, or people, because that is how ticks share the bacteria that cause Lyme disease. Once those bacteria get kicking, people have chills, fever, even palsy that can last a lifetime. There were over 150,000 confirmed and probable cases of Lyme in the U.S. in five recent years, reflecting a steadily increasing trend over previous years.



Money for Good Work

The Northeastern IPM Center is funding research to foil the villains while reducing the use of pesticides. We've funded research on rosemary oil, a food-grade compound that ticks hate as much as synthetic pesticides. Then came deer-feeding stations. Ticks cling to the necks of deer as they feed on corn, but these contraptions swab them with a deadly solution to rub out the bad actors.

In 2016, the Center awarded Andrew Li of the USDA Agricultural Research Service $49,469 to evaluate integrated control measures for keeping ticks off of school grounds. They'll bring out the deer feeding stations for a return performance, along with rodent bait boxes. The bait targets rodents that carry the blacklegged tick, one of the most significant vectors of Lyme.

The bait boxes consist of three components: a child-resistant box, a non-toxic bait block attractant, and an applicator that applies fipronil, the same insecticide as the commercial pet product Frontline for flea and tick control. It kills ticks, not the bacteria that cause Lyme. When a rodent (typically a mouse or a chipmunk) enters the box to feed or investigate, it is treated with the insecticide, interrupting the Lyme transmission cycle.

> *"To dream of ticks represents an annoyance in your life that forces you to be extra careful."*
> *— DreamBible.com*

Prevention for Schools

"Tick-borne Lyme disease is the most important vector-borne human disease in the United States," Li said. "It is anticipated that the risk for tick bite and Lyme disease can be reduced by significantly lowering the population density of questing nymphs in environment."

According to the National Climate Assessment, it is unclear how climate change will impact Lyme disease, yet "several studies in the Northeast have linked tick activity and Lyme disease incidence to climate, specifically abundant late spring and early summer moisture."[1]

The authors of the National Climate Assessment also point to increased favorable habitat for ticks, a lengthened season when disease can be transmitted, higher tick densities due to milder winters and increased rodent populations, and people spending increased time outdoors.[2]

"To the best of my knowledge," Li added, "this is the first host-targeted tick IPM project conducted on school grounds. Anything we learn from this project would help improve tick control and Lyme prevention efforts in the Northeast." ■

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Exclusion

Continued from Cover Page

Central IPM Center, meanwhile, sponsors a group working on commercial buildings.

Gangloff-Kauffmann's team has developed an exclusion checklist for use in residential and commercial buildings, now in the testing phase.

"This checklist allows building managers to look at their building envelope and make sure it is pest-proof," says Gangloff-Kauffmann.

The Northeastern IPM Center publishes on its website an extensive collection of Best Management Practices, or BMPs, for excluding pests from structures. For these and other exclusion techniques, see http://neipmc.org/go/XGEN

The BMPs are targeted for use in schools, but the principles can be applied in many other settings. And the science certainly will serve you better than nailing up "Keep Out" signs for pests. ■

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1 Farrar, J., Baur, M., and Elliott, S., "Adoption of IPM Practices in Grape, Tree Fruit, and Nut Production in the Western United States," *Journal of Integrated Pest Management*, (2016) 7(1): 8; 1–8 doi:10.1093/jipm/pmw007

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