

PEST is a quarterly newsletter that provides up-to-date information on existing forest pest problems, exotic management pests, new pest technology, and current pesticide registrations in pine seed orchards and plantations. The newsletter focuses on, but is not limited to, issues occurring in the Western Gulf Region (including, Arkansas, Louisiana, Mississippi, Oklahoma, and Texas).

Announcements:

The Executive Committee next meeting of the Forest Pest Management Cooperative will be held August 13-14, 2014 in Livingston, TX Ag Extension Meeting at the Room. The meeting room is located behind the Ag Extension Building at this address: 602 E. Church St. Livingston TX.

Amanda Zumwalt has joined the FPMC staff as our new Resource Specialist I.



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Two Proposed FPMC Research Projects for 2015:

Efficacy of SivantoTM (Bayer CropScience) and XXpire WGTM (Dow AgroSciences, LLC) for Control of Southern Pine Cone and Seed Insects

Cone and seed insects severely reduce potential yield in southern pine seed orchards that produce geneticallyimproved seed for regeneration programs. Without a comprehensive insect control program, cone and seed insects commonly destroy 50% of the potential seed crop and losses up to 90% are not uncommon. Currently, the use of insecticides is the only known measure for effectively avoiding heavy losses of seeds (Grosman et al., 2002).

Bayer CropScience recently developed a new insecticide called SivantoTM (AI: flupyradifurone) that the company hopes to launch in 2015. SivantoTM targets piercing and sucking

insects, is considered "bee friendly," and has no spray restrictions. SivantoTM can be applied to the soil or used as a foliar treatment. SivantoTM has been tested for control of aphids, psyllids, soft scales, leaf hoppers, whiteflies, thrips and Colorado potato beetle and has been found to control all life stages, including eggs, nymphs (larvae, pupae), and adults.

Dow AgroSciences' product XXpire WG[™] is a combination insecticide for control of chewing and sucking insects. XXpire WG[™] is a water dispersible granule consisting of a 1:1 ratio of spinetoram to isoclast (sulfoxaflor). When applied to the point of spray run-off at 2.0 - 3.5oz/100 gallons of water, XXpire WG[™] has been found to provide excellent control of aphids, lepidopterous larvae, lacebug, certain scales, mealybug, whitefly, and thrips. Spinetoram is derived by chemically modifying naturallyoccurring spinosyns J and L and is a group 5 insecticide like spinosad. Isoclast was discovered by and is proprietary to Dow AgroSciences (Alexander et al. 2014).

The objectives of this research project will be to determine the efficacy of SivantoTM and XXpire WGTM for control of southern cone and seed insects in pine seed orchards. If agreed upon by the FPMC executive committee, this project will begin in September/October 2014 when test orchards, clones, and ramets will be selected.

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Branch Meeting. March 2-5, 2014. Greenville, South Carolina. Presentation.

Grosman, D.M., W.W. Upton, F.A. McCook, and R.F. Billings, 2002. Systemic insecticide injections for control of cone and seed insects in loblolly pine seed orchards-2 year results. Southern Journal of Applied Forestry 26, 146-152.

Phylogeographic Assessment of Nantucket Pine Tip Moth in the United States

The Nantucket pine tip moth (Rhyacionia frustrana) is an important insect pest of pines in the eastern and southern U.S. Its preferred hosts are loblolly (Pinus taeda L), shortleaf (Pinus echinata Mill.) and Virginia (Pinus virginiana Mill.) pine. Larvae feed on buds and new shoots, causing serious damage to young pines, particularly in seed orchards. nurseries, young commercial timber and Christmas tree plantations. Repeated attacks may result in limited growth, stem deformation, loss in wood quality, bushy appearance, reduced cone crop, a lower aesthetic value, and even mortality. Tip moth damage is most severe on seedlings and saplings usually under five years of age and less than 7 m in height (Sun et al., 2000).

There have been numerous studies conducted in an effort to control pine tip moth. Of all the studies, not one has addressed population genetics in the United States. A basic understanding of population

Alexander, A., J. Breuninger, D. Loughner, and V. Peterson. 2014. XXpire TM, a new insecticide for control of Ornamental Plant Pests from Dow AgroSciences, LLC. Entomological Society of America, Southeastern

genetic relationships is essential for effective management (Zhu et al., 2011).

Population genetics is the study of gene frequencies in and among subdivided populations. It encompasses estimations of variation in terms of allelic and genotypic frequencies (Krafsur, 2005). Often, historical, geographical, and environmental factors can result in local selection regimes that cause one or more populations to differ biologically (Krafsur, 2005). Biotypes originating from different geographical areas have been shown to have different biological and behavioral characteristics (Landry et al., 1993), such as differences in size, host range, and fecundity (Jiang et al., 1999). These differences can be distinguished through genetic analysis and mapped to determine the regions where particular biotypes are found.

In Japan, two distinct populations of several insect and plant species were found separated by eastern and western samples following genetic analysis (Aoki et al., 2011). Although the same species, these populations may require a distinct approach to management based upon behavioral and/or biological characteristics that genetically differentiate them.

Population genetics can be useful for many pest management applications. For instance, a phylogeographic analysis of bed bug haplotypes has been mapped for the United States. The populations were differentiated based upon bed bug resistance to pesticides, which allows pest control operators to determine which pesticides can be used and where (Zhu et al., 2010).

Population genetics can also be used to support the application of the sterile insect technique for the control of target pest populations in nature (Krafsur, 2005). This application may be useful against the tip moth.

The future of pest management leans towards the development and release of geneticallymodified insects. Genetically-modified mosquitoes have already been released in Brazil to gain control of dengue fever. These mosquitoes reduced the population of indigenous mosquitoes by between 80-96 percent within six months. Geneticallymodified versions of a Diptera species that decimate olive trees are to be released soon in Spain as well. The males are equipped with genes that cause any female offspring they sire to die before they have had a change to reproduce. In lab experiments, the designer flies successfully competed with non-GM males for mates and caused the population to plummet within ten weeks (Coghlan, 2013). **RNA** interference, a process whereby RNA molecules inhibit gene expression, has been successful in laboratory experiments in controlling insect pests by causing larval stunting and mortality (Baum et al., 2007) and through reduction in fecundity (Pitino et al., 2011). **RNA** interference field trials are imminent.

Population genetics and tip moth

Despite its importance, there is still no effective strategy for controlling pine tip moth (Zhu et al., 2013). Currently, the control of this pest is mainly dependent on the use of large quantities of pesticides, which are expensive and cause environmental pollution and insecticide resistance within the insect (Zhu et al., 2013). The accumulation of a considerable body of scientific knowledge about this pest is critical for designing suitable control tactics. However, very little is known about this pest at the molecular level. Such studies would provide fundamental data for a more comprehensive understanding of the life histories and the molecular mechanism of pine tip moth in ecological systems (Zhu et al., 2013).

Nantucket pine tip moth can be found from the northeastern U.S., south to Florida and west to California. There are vast climatic differences across this region, as well as differences in plant species and abundances. It is likely that tip moth populations also differ throughout this range, in at least some biological or behavioral characteristic. We already know that the number of generations each year differs across its range. There may be other factors that differ as well; these factors may require distinct management techniques.

The purpose of this study is to take a first step in elucidating the molecular makeup of Nantucket pine tip moth and other species of tip moth present throughout the Nantucket pine tip moth range in the United States and use this information to map any phylogeographic differences found.

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Emerald Ash Borer Found in Southwestern Arkansas

Melissa Fischer and Ron Billings

The emerald ash borer (EAB), *Agrilus planipennis*, has been found on detection traps in Hot Spring, Clark, and Nevada counties in southwestern Arkansas. This is the first report of EAB in Arkansas. The state will most likely be added to the federal quarantine that prohibits movement of firewood and nursery stock in an effort to slow the spread of this invasive pest.



Photo: Marianne Prue

The emerald ash borer was found along Interstate Highway 30 in Arkansas, just north of the Texas/Louisiana border, which should be a major concern for Texas forest landowners. In recent years, the Texas A&M Forest Service (TFS), in collaboration with the Animal Plant Health Inspection Service (APHIS), Texas A&M AgriLife Extension Service (TAES), Sam Houston State University (SHSU), and other collaborators have conducted annual detection surveys in counties with ash trees in East and Central Texas to detect EAB adults. Fortunately, none have been found to date on any of several thousand detection traps. However, a signed preparedness plan involving multiple state and federal cooperators is in place to address this invasive pest if and when it arrives in Texas.

The emerald ash borer was found in the US for the first time in 2002 in southeastern Michigan. It is thought the borer arrived in the early 1990s inside solid wood packing material carried on cargo ships or airplanes from its native range in China. The beetle is only able to spread a few miles a year by flight, but because people move infested firewood, the borer has spread rapidly over much greater distances. The beetle is now found in 22 states in the US and two provinces in Canada.

In many states where the emerald ash borer has been found, ash trees are being cut down and removed in an effort to prevent the insect's spread. Individual trees can be treated using the pesticide emamectin benzoate, which is now registered for use in protecting ash from the emerald ash borer in several states. Emamectin benzoate is sold by Arborjet, Inc. under the trade name "TREE-äge" and must be purchased and applied by certified pesticide applicators.

Additional efforts are underway to provide long-term protection to ash in forested areas

through the practice of biological control. Several species of parasitic wasps have been collected from Asia where emerald ash borer is native. These wasps kill their hosts by laying eggs inside of the emerald ash borer's eggs or larvae. So far, three wasp species (*Oobius agrili, Spathius agrili*, and *Tetrastichus planipennisi*) have been released into forests currently under attack. There is evidence that at least one of the three wasp species has become established and may eventually be successful in helping to control the emerald ash borer.

Deadly Laurel Wilt Fungus Attacking Everglades Trees

Tampa Bay Times

A fungus carried by an invasive beetle from Southeast Asia is felling trees across the Everglades, and experts have not found a way to stop the blight from spreading. The damage may be leave Florida's fragile wetlands open to an even greater incursion from exotic species, undermining billions of dollars' worth of restoration projects.

Since first detected on the edge of Miami's western suburbs in 2011, laurel wilt has killed swamp bay trees scattered across 330,000 acres of the Everglades, a roughly two million-acre system that includes Everglades National Park. The fungus is spread by the tiny redbay ambrosia beetle, which likely arrived in this country in a shipment of wood packing material.

The same fungus also plagues commercial avocado trees and redbay trees elsewhere in Florida and the Southeast. Hundreds of millions of redbay trees have succumbed across six states since 2002.

While the state of Florida has been working with the avocado industry to mitigate the damage, there has been no way to contain it in swamp bay or redbay trees. Experts say the best defense would be stopping invasive pests from crossing U.S. borders in the first place.

This summer, Jason Smith, an expert in forest pathology at the University of Florida, will survey the national park for living swamp bay trees to collect samples in the hopes of propagating new trees resistant to the pathogen from their cuttings or seeds. The South Florida Water Management District, the state agency that oversees Everglades restoration, also plans to ramp up its monitoring and maintenance of the tree islands where swamp bays are found.

The damage is easily spotted from the air and from the highway that cuts across the Everglades. Gray skeletons of swamp bays that died in the pathogen's first wave and newly dead trees that have turned dry and brown mar the dark green tree islands that dot the vast expanse of pale sawgrass.

Each tree island is losing up to half its tree canopy. This is worrisome because invasive plants may work their way into those open spaces.

Old world climbing fern, melaleuca, Australian pine and Brazilian pepper are the invaders that particularly worry state and federal caretakers of the Everglades. Like the invasive Burmese pythons that are blamed for dramatic drops in the populations of native mammals in the wetlands, the plants have established a home in South Florida's sunny and wet climate.

The exotic plants can transform sawgrass prairies into impenetrable thickets, and they fuel explosive fires that kill native plants adapted for less intense burns. They're not a food source for native wildlife, and in coastal areas, their roots can disrupt the nests of endangered sea turtles. They're so tenacious and difficult to remove that even if Smith finds a way to propagate swamp bays to replace the ones lost, the invasive plants could prevent them from taking root.

Nonnative plants currently comprise 16 percent of the flora in the Everglades, according to a congressionally mandated restoration progress report published last month by the National Research Council. Billions of dollars have been pledged for Everglades restoration projects that span decades, but those funds are mostly focused on restoring a more natural flow of freshwater through the wetlands south to the Florida Keys.

In spite of the disturbances they cause, invasive species haven't been factored into Everglades restoration planning beyond treating invasive plants that spread during construction, and there's little funding or manpower available to fight them back, according to the report.

The Cause of Colony Collapse Disorder, Disappearing Bees Becoming Clearer

Eric Mack, Forbes

For the past eight years or so, we've been hearing the term "Colony Collapse Disorder" (CCD) to refer to the seemingly spontaneous abandonment of their hives by honeybees. Bees have been abandoning their hives for centuries, but the rate at which such collapses have been observed started to increase more drastically in the 1970s, reaching alarming proportions around 2006. While numerous causes for the phenomenon have been floated, from pathogens and parasites to electromagnetic radiation and a proliferation of genetically-modified crops, new research from the Harvard School of PublicHealth bolsters the case that a certain class of insecticides seems to be to blame.

Working with the Worcester County Beekeepers Association in Massachusetts, the researchers exposed 12 colonies across three locations to a "sub-lethal exposure of neonicotinoids. imidacloprid or clothianidin." Neonicotinoids are popular insecticides that are chemically similar to nicotine. The scientists also observed six untreated control colonies at the same locations. The study found that all the bee colonies went about their business normally through the summer and fall, but by the end of winter six of the twelve hives exposed to the insecticide had been abandoned. One of the six control colonies was also lost due to an infestation by a fungus.

While a sample size of less than 20 colonies does not quite prove the link between certain insecticides and Colony Collapse Disorder beyond a doubt, it remains a compelling demonstration of the potential impact of neonicotinoids on honeybees. A similar study done in 2012 by some of the same researchers actually saw a much higher rate of collapse among hives treated with the insecticides, with 94 percent of the exposed colonies collapsing. Neonicotinoids are often used to prevent insects from destroying crops as early as at the time of planting, and could be carried within the plants and transferred to bees through pollen later in the growing season.



Photo: Treesha Duncan

"We demonstrated again in this study that neonicotinoids are highly likely to be responsible for triggering CCD in honey bee hives that were healthy prior to the arrival of winter," said lead study author Chensheng (Alex) Lu of Harvard in a release. "Future research could help elucidate the biological mechanism that is responsible for linking sub-lethal neonicotinoid exposures to CCD... Hopefully we can reverse the continuing trend of honey bee loss."

Neonicotinoids are currently banned in the European Union. Efforts to initiate a similar ban in the United States are also underway, and the Environmental Protection Agency is currently re-evaluating the pesticides.

Tarantula Venom: A New Selective, Effective Edible Insecticide

Margaret C. Hardy, University of Queensland

In the journal PLOS ONE, one research group has published the first directeddiscovery research program for a new, environmentally-friendly insecticide from the venom of a native Australian tarantula.

Although it is no surprise that spider venoms kill insects, this work is particularly exciting because it is the first time scientists have done oral screens to find new insecticidal venom components.

There are three main benefits of this venombased insecticide:

- 1. High efficacy, particularly with insects that are resistant to conventional insecticides.
- 2. The oral activity of the compound (rather than contact or systemic toxicity of most conventional insecticides).
- 3. The ability to inexpensively produce OAIP-1.

A potent molecule

The molecule, OAIP-1, was tested for insecticidal activity and found to be the most potent insecticidal venom peptide to date. The molecule is also more active against economically important pests, including the cotton bollworm (*Helicoverpa armigera*), than conventional insecticides.



Tarantula fangs

Perhaps most importantly, OAIP-1 is synergistic with imidacloprid, a currently available insecticide. By using OAIPs in tandem with existing insecticides, we may be able to better control insect pests. This will be an especially effective approach for insects that are resistant to conventional insecticides.

Targeting the bad guys

Determining the degree of interaction with non-target organisms will be an important next step. Minimal toxicity to beneficial insects has become an important feature of any new insecticide. These insects include pollinators (such as bees) and predators (such as ladybugs).

Because our compound is orally active, rather than a contact insecticide, we expect non-target insects will be less affected by OAIPs than they are by conventional insecticides. Advanced formulation and the use of baits and attractants will also help minimize the total amount of OAIP-1 that needs to be used.

Previously published neurotoxic insecticidal peptides have been shown to be lethal to insects but safe for vertebrates. This is because the nervous system of insects and vertebrates is very different, and as a result those compounds that act on insects are relatively harmless in humans and other mammals.

Mass production

For future experiments and commercial will **OAIPs** be products. produced recombinantly in yeast by integrating DNA into the yeast genome. Many human pharmaceuticals are regularly produced this way, including hirudin (an anticoagulant) and human insulin. Production in yeast is safe, cost effective, and can be carefully monitored.

First Chikungunya Case Acquired in the United States Reported in Florida

CDC

Seven months after the mosquito-borne virus chikungunya was recognized in the

Western Hemisphere, the first locally acquired case of the disease has surfaced in the continental United States. The case was reported in Florida in a male who had not recently traveled outside the United States. The Center for Disease Control and Prevention (CDC) is working closely with the Florida Department of Health to investigate how the patient contracted the virus; CDC will also monitor for additional locally acquired U.S. cases in the coming weeks and months.

Since 2006, the United States has averaged 28 imported cases of chikungunya (chik-un-GUHN-ya) per year in travelers returning from countries where the virus is common. To date this year, 243 travel-associated cases have been reported in 31 states and two territories. However, the newly reported case represents the first time that mosquitoes in the continental United States are thought to have spread the virus to a non-traveler. This year, Puerto Rico and the U.S. Virgin Islands reported 121 and two cases of locally acquired chikungunya, respectively.

"The arrival of chikungunya virus, first in the tropical Americas and now in the United States, underscores the risks posed by this and other exotic pathogens," said Roger Nasci, Ph.D., chief of CDC's Arboviral Diseases Branch. "This emphasizes the importance of CDC's health security initiatives designed to maintain effective surveillance networks, diagnostic laboratories and mosquito control programs both in the United States and around the world."

Chikungunya virus is transmitted to people by two species of mosquitoes, *Aedes aegypti* and *Aedes albopictus*. Both species are found in the southeastern United States and limited parts of the southwest; *Aedes albopictus* is also found further north up the East Coast, through the Mid-Atlantic States and is also found in the lower Midwest.

CDC and the Florida Department of Health are assessing whether there are additional locally acquired cases and are providing consultation to the public on ways to prevent further spread of the virus by controlling mosquitoes and educating people about personal and household protection measures to avoid mosquito bites. CDC has asked state health departments to report cases of chikungunya to help track the virus in the United States. Local transmission occurs when a mosquito bites someone who is infected with the virus and then bites another person.

It is not known what course chikungunya will take now in the United States. CDC officials believe chikungunya will behave like dengue virus in the United States, where imported cases have resulted in sporadic local transmission but have not caused widespread outbreaks. None of the more than 200 imported chikungunya cases between 2006 and 2013 have triggered a local outbreak. However, more chikungunya-infected travelers coming into the United States increases the likelihood that local chikungunya transmission will occur.

Outbreaks of chikungunya have been previously reported from countries in Africa, Asia, Europe, India, and the Middle East, and on the French side of the Caribbean island of St. Martin. The virus spread quickly in St. Martin through the Caribbean in December 2013 and into South and Central America. Local transmission has been reported in 23 countries in the hemisphere prior to the U.S. case.

People infected with chikungunya virus typically develop fever and joint pain. Other symptoms can include muscle aches, headaches, joint swelling or rash. Travelers returning from areas with chikungunya activity and those living in areas where the virus has been reported in the United States should seek medical care if they experience chikungunya symptoms. Health care providers in areas with reported cases should be on the alert for possible cases. People infected with chikungunya should protect themselves by wearing insect repellents, using air conditioning or window and door screens to keep mosquitoes out, wearing long pants and long-sleeved shirts when possible, and emptying standing water outside your home. Protecting yourself and others from mosquito bites during the first few days of illness can help prevent other mosquitoes from becoming infected and reduce the risk of further spread.

Infection with chikungunya virus is rarely fatal, but the joint pain can often be severe and debilitating. This virus is not spread person to person. There is no vaccine and no specific treatment for infection, but research is underway in both areas. Patients recover in about a week, although long-term joint pain occurs in some people. According to CDC, infection is thought to provide lifelong immunity.

Plants Can Hear Themselves Being Eaten

by Janet Fang

A small, flowering plant *called Arabidopsis thaliana* can hear the vibrations that caterpillars trigger when they chew on its leaves. According to a new study, the plants can hear danger loud and clear, and they respond by launching a chemical defense.

From anecdotes and previous studies, we know that plants respond to wind, touch, and acoustic energy. "The field is somewhat haunted by its history of playing music to plants. That sort of stimulus is so divorced from the natural ecology of plants that it's very difficult to interpret any plant responses," says Rex Cocroft from the University of Missouri, Columbia. "We're trying to think about the plant's acoustical environment and what it might be listening for."

In this first example of plants responding to ecologically relevant vibrational sounds (i.e. predation); Cocroft and Mizzou's Heidi Appel combined audio and chemical analyses. First, they placed a tiny piece of reflective tape on a leaf; that way, using a laser beam, they can measure the leaf's movements as the caterpillar munches.



Cabbage Butterfly Caterpillar feeding on Arabidopsis plant where, on an adjacent leaf, a piece of reflective tape helps record vibrations / Roger Meissen

After they recorded the seemingly inaudible vibrational sounds of caterpillar chewing, they played the recordings back to one set of *Arabidopsis* plants, while silence was played to another set. To mimic the acoustic signature of feeding, they used piezoelectric actuators, tiny speakers that play vibrations instead of airborne sound. "It's a delicate process to vibrate leaves the way a caterpillar does while feeding, because the leaf surface is only vibrated up and down by about 1/10,000 of an inch," Cocroft explains in an university blog post. "But we can attach an actuator to the leaf with wax and very precisely play back a segment of caterpillar feeding to recreate a typical 2hour feeding session."

Then, they let cabbage butterfly caterpillars eat about a third of three leaves on each plant from both sets. They gave the plants 24 to 48 hours to respond to the attack, after which the leaves were harvested. "We looked at glucosinolates that make mustards spicy and have anticancer properties and anthocyanins that give red wine its color and provide some of the health benefits to chocolate," Appel says. "When the levels of these are higher, the insects walk away or just don't start feeding."

Plants with prior exposure to feeding vibrations released higher amounts of

glucosinolates (like mustard oil), an unappealing chemical for the bugs. Feeding vibrations signal changes in the plant cells' metabolism, Appel explains, creating more defensive chemicals to repel the attack. The work was recently published in Oecologia.

Remarkably, plants exposed to vibrations from wind or different insect sounds didn't increase their chemical defenses. They seem to tell the difference between feeding vibrations and other common sources.

"This research also opens the window of plant behavior a little wider, showing that plants have many of the same responses to outside influences than animals do, even though the responses look different," Appel says in a news release. The duo is working on figuring out how vibrations are sensed by the plants.

Here's a great video where you can see and hear caterpillars chomping on plants: https://www.youtube.com/watch?v=TKQ-CIX9afA

Forest Pest Management Cooperative's **P.E.S.T. Newsletter**

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