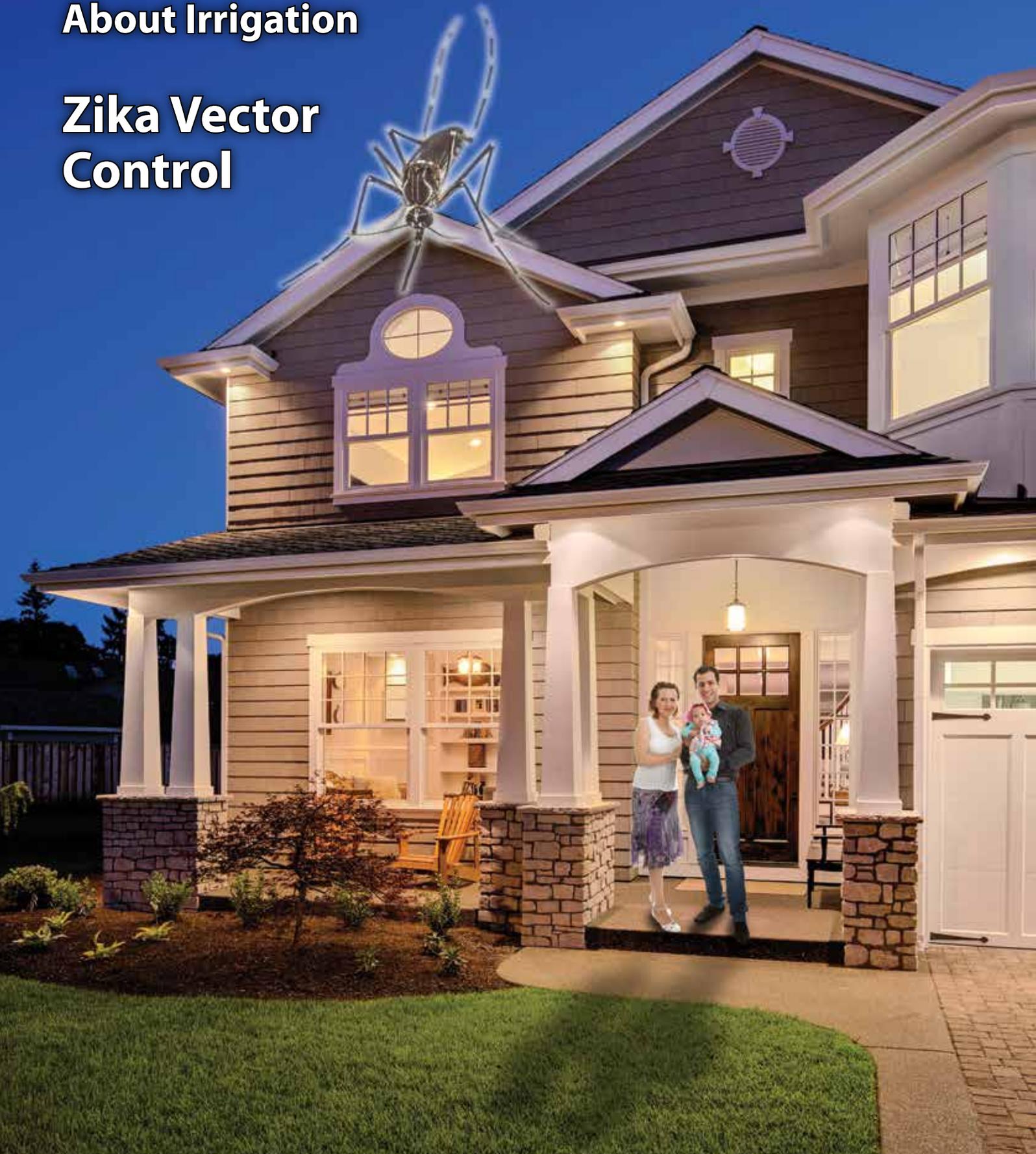


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**What to Tell
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**Zika Vector
Control**





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ON THE COVER

Zika virus is the latest in a long line of diseases spread by *Aedes* species mosquitoes. Professionals in the pest management industry will play a vital role in the fight to stop the virus. The battle takes place where your customers live.

Photo illustration: Jane Medley, UF/IFAS



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Enroll in *Landscape IPM: Ornamentals and Turf*, and take your first steps toward getting a UF Pest Management Certificate or becoming LMA Certified. Classes begin June 27.

The three-credit, six-week course will be offered starting June 2016 at the University of Florida (UF). This course will be offered for UF credit, 100 percent online. You must have a computer and Internet access to take this class. This course is for UF juniors and seniors as well as landscape and pest management supervisors and owners.

This course will be used as a measure for LMA Certification. The LMA will offer students who pass this class with an A or a B the opportunity to become LMA Certified without additional testing, since students will be tested as part of the course. This course will also count toward a UF Certificate in Landscape Pest Management.

Learn more about the UF distance program, including costs and how to register, at <http://tinyurl.com/go-learn-online>

To register for this course, please complete a Nondegree Registration Request at the following website: <http://tinyurl.com/IPM4254>

Advance Registration

March 21 to May 3, then May 5 to June 23. Fee payments due July 8!

You will need to fill out some personal information on the form and submit the following course information:

- * *Select Year and Term of Registration:* 2016 Summer (May)
- * *College:* THE COLLEGE OF AGRICULTURAL AND LIFE SCIENCES – Entomology Undergrad Distance Courses
- * *Course Information:* Prefix – IPM. Number – 4254.

If you have trouble filling out the form and registering for the course, please contact Ms. Ruth Brumbaugh, Entomology and Nematology Department Student Services Coordinator. Phone: (352) 273-3912, email: brumbaugh@ufl.edu. Please let Ms. Brumbaugh know you are attempting to register for the course as a nondegree-seeking student so she knows how to help you.

If you would like more information about the course, please contact the course instructor, Dr. Jennifer L. Gillett-Kaufman. Phone: (352) 273-3950, email: gillett@ufl.edu. She cannot help you with registration and will forward all registration requests to Ms. Brumbaugh.

Zika Vector Control

And the Pest Management Industry

ZIKA vector control has the ability to change the pest management industry almost overnight. Of course, Zika vectors are the container-breeding mosquitoes living in people's back yards, and they also are the mosquitoes capable of transmitting dengue and Chikungunya virus. These mosquitoes are daytime fliers, weak fliers, and usually don't fly more than a few hundred yards in their entire lives. That means Zika vector control is centered in the back yards of your customers. Your job is to help the state of Florida, your customers, and all the people who are likely to have their lives irreversibly changed if Zika virus becomes established.

That all translates into CHANGE for the pest management industry — in other words, this could be painful. Change to control Zika vectors will challenge even the best pest management company. However, the writing is on the wall. Your customers need mosquito control, and you need to change and provide them that service. Change is painful, but in this case, not changing is FATAL.

FLORIDA MOSQUITO CONCERNS: PAST, PRESENT AND FUTURE

Historically, Florida would be uninhabitable without mosquito control. In fact, during the 1950s to the 1980s, the numbers tell the truth. As the mosquito populations decreased in Florida, the number of residents and tourists increased. In 1947, malaria was eliminated from Florida. Yellow fever is gone.

In 2016, the threat of Zika virus being transmitted in Florida by mosquitoes could have a tremendous economic impact. I talked with a woman a couple of weeks ago. She told me that her daughter, who was pregnant, had cancelled her trip to visit her in Florida because of the large number of travel-related Zika cases in the state. Imagine the economic impact this year because of the threat of a Zika epidemic.

Most of the mosquito districts in Florida are set up to handle disease vectors like *Culex*, which transmits west Nile virus, or *Anopheles*, which transmits malaria. We have 61 mosquito districts in the state. However,



The CDC and WHO both confirmed in April 2016 that the mosquito-borne Zika virus causes microcephaly in newborns.

there are some areas of Florida that do not have mosquito districts to help control Zika vectors. A lot of mosquito efforts are to control the vast hordes of mosquitoes that invade communities from salt marshes and the Everglades. Control of those mosquitoes that migrate up to 25 miles from their breeding site takes a community-wide effort and completely different strategies than needed for the Zika vectors.

Many districts do not have the resources to provide individual mosquito control in each private property. For instance, one of the largest mosquito districts in Florida has about 65 employees. The pest control industry can provide greater resources for individual customers. Florida's industry has more than 20 percent of the pest control companies in the United States, 7,000 certified operators, and more than 20,000 technicians. One pest control company has 1,800 employees operating out of more than 100 service locations. It makes sense to recruit good pest management companies to help provide Zika vector control.

KNOW THE ENEMY

The Zika vectors are the yellow fever mosquito, *Aedes aegypti*, and Asian tiger mosquito, *Aedes albopictus*. Although it is considered a potential vector, the Asian tiger mosquito has not been proven to be a vector of the disease.

Both *Aedes* species are container-breeding mosquitoes. They are very difficult to control. They breed in small, water-holding situations like containers, tires, tree holes, and storm drains. They do not fly very far from their breeding sites.

Besides being weak fliers, *Aedes* species also are considered daytime biters. That daytime mosquito activity makes it very challenging to control them with nighttime sprays. Of course, the space sprays used to kill flying mosquitoes do not work as well when mosquitoes are not flying. Furthermore, these space sprays cannot be applied during the day because the aerosol cloud goes straight up in the air when ground temperatures are higher than the air temperatures.

PREPARE FOR BATTLE

So we are asking all pest control companies to help with the Zika vector control program. The program needs to be an integrated program that starts with education. Make sure all your employees are educated about Zika and mosquitoes. Have them pass out educational materials to homeowners. Your customers need to know that your company cares.

The Centers for Disease Control has many fact sheets and posters for you to use or adapt, available on their website at <http://www.cdc.gov/zika/fs-posters/>. Teach your customers about source reduction. They should empty all water-holding containers in their yards at least weekly. They can scrub containers that cannot be inverted to remove mosquito eggs.

Your company needs to acquire the equipment to do the job correctly. The chemical management approach can utilize space sprays to kill flying mosquitoes, residual sprays to provide control of mosquitoes resting on vegetation and buildings, and larvicides to kill mosquitoes in containers that cannot be emptied.

We need your company to help protect Floridians and our economy from Zika vectors. It is time to change and expand your service to meet the needs of your customers. Companies that provide L&O, GHP, or public health pest control can all provide this new service.

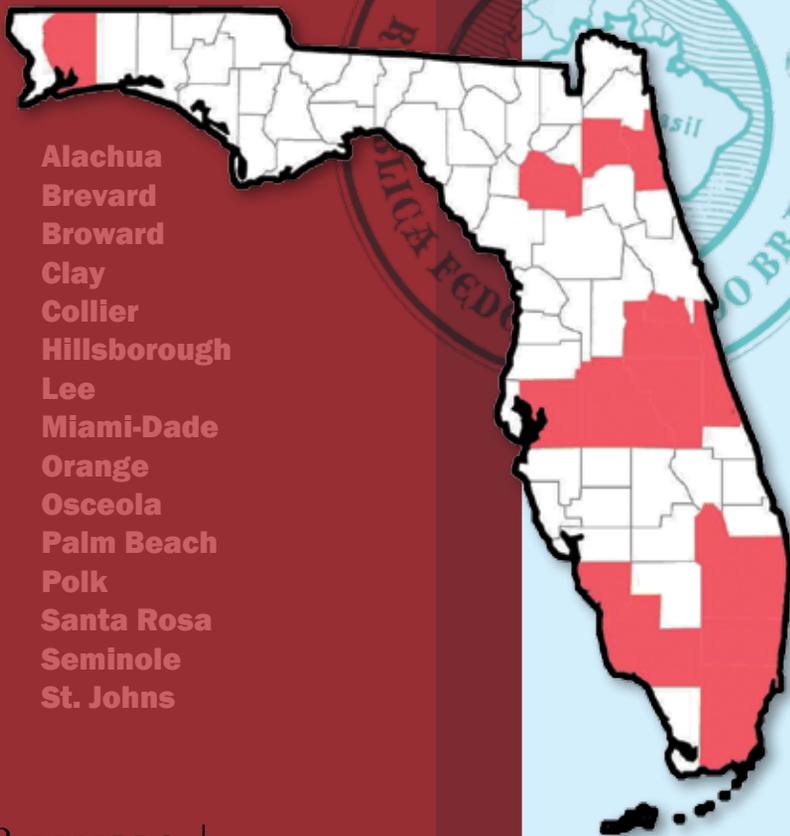
Remember: Change is painful, but not changing is FATAL. **PP**

— Dr. Philip Koehler,
Managing Director



STOP ZIKA VIRUS

Counties With Travel-Associated Zika Cases



AS OF LATE APRIL, no cases of Zika virus were reported that were spread by mosquitoes in any of the United States. **Florida is one state preparing for the possibility** of mosquito-transmitted Zika virus. **PestPro** keeps you and your customers informed with the latest research-based ZIKV information and recommendations.

Zika Virus

Incidence and Distribution

ZIKA is a mosquito-transmitted virus that has recently spread to the Americas. Zika virus (ZIKV) was discovered in 1947 in Africa, where it was isolated from a Rhesus monkey in the Zika forest of Uganda. Until recently, ZIKV occurred in a very narrow range in Africa and parts of Asia.

In 2007, a disease outbreak occurred on the Yap Islands in Micronesia and in 2013, an outbreak occurred in French Polynesia. In 2015, a large outbreak occurred in Brazil and has since spread through the Americas. According to the World Health Organization (WHO), 44 countries have reported local transmission of ZIKV and many have reported travel-associated cases of the virus. According to the Centers for Disease Control and Prevention (CDC), from January to April 13, 2016, there were 358 travel-associated cases from 40 states in the United States and 471 locally acquired cases in US territories.

There have also been seven cases of sexual transmission of Zika within the United States. As of April 15, 2016, 15 counties in Florida had reported travel-associated Zika cases. **ZIKV is expected to continue to spread, but the extent of the impact to specific geographical areas is difficult to predict.**

Zika Vector Control

For the Urban Pest Management Industry

Casey N. Parker, C. Roxanne Connelly, Dale W. Dubberly, Roberto M. Pereira, and Philip G. Koehler

Transmission and Symptoms

The primary mode of transmission for ZIKV is through the bites of female *Aedes* species mosquitoes, particularly yellow fever mosquito (*Aedes aegypti*) and possibly Asian tiger mosquito (*Aedes albopictus*) in the Americas. For a female mosquito to become infected, she must first feed on an infected human. The virus from the human blood the female mosquito ingests begins to increase in number and moves throughout the mosquito body. This process, known as the incubation period, takes two to three weeks. If the virus makes it to the mosquito salivary glands, she may transmit the virus to future hosts through her bite. It is estimated that humans are infectious for the first seven to 14 days of the illness.

Other modes of transmission include from pregnant mother to child, sexual transmission, and blood transfusion. For more information on these modes of transmission, consult your local health department or the CDC website¹.

The illness caused by ZIKV is very similar to dengue², but is milder in most cases. Symptoms of ZIKV infection include fever, rash, joint pain, red eyes, and can be accompanied by a muscle aches and headaches. However, approximately 80% of infected individuals are asymptomatic. Although hospitalizations or fatalities are highly uncommon for this disease, there is potentially a link between Zika and microcephaly and a possible association between Zika and Guillain-Barré syndrome, a rare disorder where the body's immune system attacks nerves causing paralysis. Infections of ZIKV can be hard to diagnosis due to the similarity in symptoms with two other mosquito-borne diseases, dengue and chikungunya. There are also few laboratories that have the appropriate molecular tests for the virus. As of April 2016, there was no vaccine available to prevent ZIKV infection in humans and

treatment includes rest, pain relievers, and fever reducers. Aspirin is not recommended until dengue infection has been ruled out, due to the increased risk of bleeding. Any person who has previously been infected with the ZIKV is likely immune to future infections.

Biology and ID of the Mosquito Vectors

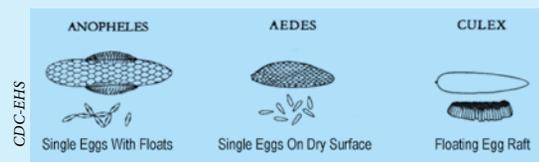
Outside of Africa, the likely primary vector of Zika is *Aedes aegypti*. *Aedes albopictus* has not been confirmed as a vector, but it has been implicated as the Zika vector in Gabon. Both *Aedes aegypti* and *Aedes albopictus* are established in the United States, and *Aedes albopictus* is considered highly invasive and is continuing to expand its range. These species most often feed on human hosts and live in close proximity to humans. Adult females lay their eggs primarily in containers that can hold water. Examples include flower pots, corrugated pipes, clogged rain gutters, or tires, but natural containers such as tree holes and bromeliad plants are often utilized. The biology of these mosquito species make them a major concern for Zika transmission.

It is important to be able to identify the vectors and their eggs. *Aedes aegypti* and *Aedes albopictus* are dark brown or black with white scaling on different parts of their body. The pale white scaling on the thorax of *Aedes aegypti* is lyre-shaped with two lines between the sides of the lyre shape. *Aedes albopictus* has a single white-scaled line down its thorax. *Aedes aegypti* and *Aedes albopictus* both have bands of white scales on their legs.

The eggs of *Aedes aegypti* and *Aedes albopictus* can be distinguished from other genera's eggs by where and how they are laid. The eggs of *Aedes aegypti* and *Aedes albopictus* are laid singly on dry surfaces such as the edges of containers. These containers will eventually flood, submerging the eggs and allowing them to hatch. *Anopheles* eggs are



Aedes aegypti (left) and *Aedes albopictus*.



From left: The eggs of *Anopheles*, *Aedes*, and *Culex* mosquitoes. Individual eggs are approximately the size of a grain of pepper.

also laid singly, but they have “floats” on either side, unlike the eggs of *Aedes*. *Culex* eggs are different from both *Aedes* and *Anopheles* because the eggs are laid in rafts on the surface of the water instead of being laid singly.

The vectors of ZIKV are day-biting mosquitoes, which is unlike many of the Florida mosquito species that bite at night. After bloodfeeding, the females will rest in a shaded area until they are ready to lay their eggs in a container. Their daytime feeding behavior, fondness for feeding on humans, and exploitation of water-holding containers around a home make these mosquitoes excellent disease vectors and very difficult to control.

However, they generally do not travel distances greater than 500 meters. *Continued*

¹ <http://www.cdc.gov/zika/transmission/index.html>

² <http://edis.ifas.ufl.edu/in699>

Casey N. Parker is Graduate Research Assistant and C. Roxanne Connelly is Professor at UF/IFAS Entomology and Nematology Department, Dale W. Dubberly is Bureau Chief, Division of Agricultural Environmental Services, Florida Department of Agriculture and Consumer Services, Roberto M. Pereira is Research Scientist and Philip G. Koehler is Endowed Professor at UF/IFAS Entomology Department.

Active ingredient	Chemical type
Bti	Microbial
Bsph	Microbial
Spinosyn	Microbial
Methoprene	Insect Growth Regulator
Pyriproxyfen	Insect Growth Regulator
Novaluron	Insect Growth Regulator
Tempfos	Organophosphate

Table 1. EPA registered mosquito larvicides

Active ingredient	Chemical type
Alpha-cypermethrin	Pyrethroid
Bifenthrin	Pyrethroid
Lambda-cyhalothrin	Pyrethroid
Tau-fluvalinate	Pyrethroid
Deltamethrin	Pyrethroid
Imidacloprid/ beta-cyfluthrin	Neonicitoid/ Pyrethroid

Table 2. EPA registered residual adulticides

Active ingredient	Chemical Type
Etofenprox	Pyrethroid
Permethrin	Pyrethroid
d-Phenothrin (Sumethrin)	Pyrethroid
Pyrethrins/Pyrethrum	Pyrethroid
Deltamethrin	Pyrethroid
Chlorpyrifos	Organophosphate
Malathion	Organophosphate
Naled	Organophosphate

Table 3. EPA registered space sprays

Integrated Vector Management for Residential Control

Inspection

Before any treatments are made, operators/ technicians should do a thorough inspection of the property to identify larval habitats, as well as adult resting locations. All water-holding containers should be identified and noted, including those that are not easily accessible such as rain gutters or corrugated pipes. When identifying larval habitats, it is important to note that mosquito larvae can develop in containers as small as a bottle cap. Any water-holding containers should be emptied or discarded, if possible. Adult mosquitoes often rest in shaded locations such as overgrown vegetation, the open space beneath a stilt house, or in crawl spaces. Overgrown vegetation can be trimmed back to reduce the resting locations of the adults.

Resident Cooperation

In addition to any pesticide treatments that are done by pest control companies or local mosquito control, residents should practice preventative measures to protect themselves and to aid in the mosquito control process. The CDC recommends wearing long-sleeved shirts and long pants, staying in air-conditioned or screened places, and wearing

EPA registered insect repellents. To prevent mosquitoes from developing around the home, residents should empty any containers holding water at least once per week, dispose of discarded tires, clean rain gutters, chlorinate pools, and stock ornamental ponds with fish. Bird baths and other permanent water-holding containers should be scrubbed along the inner walls to remove mosquito eggs. To reduce resting habitats for the adults, overgrown vegetation near the residence should be trimmed.

Pest control companies can also provide their customers with informational flyers or brochures like those produced by the CDC³ or the Florida Department of Health⁴. These flyers cover a wide array of topics, but *Help Control Mosquitoes that Spread Dengue, Chikungunya, and Zika Viruses* and *Mosquito Bite Prevention* would be very useful to homeowners. These will provide information on the effective use of insect repellents, how to mosquito-proof their home, and how to prevent mosquitoes from developing around their home.

Larviciding

Larvicidal treatments are specifically applied to water where mosquitoes are able to lay their eggs and larvae are able to develop. A couple of active ingredients used for larvicidal treatments are

³ <http://www.cdc.gov/zika/fs-posters/>

⁴ <http://www.floridahealth.gov/diseases-and-conditions/zika-virus/index.html>



Dr. Chelsea Smartt

UF/IFAS researchers head to Brazil seeking Zika answers

Chelsea Smartt, who conducts research at the Florida Medical Entomology Lab in Vero Beach, will use a \$10,000 UF/IFAS Mid-Career International Travel Award to take her research team back to Brazil.

GAINESVILLE, Fla. — A University of Florida Institute of Food and Agricultural Sciences researcher will return to Brazil to study the ability of two mosquito species to transmit the Zika virus.

The yellow fever mosquito, *Aedes aegypti*, and the Asian tiger mosquito, *Aedes albopictus*, are considered the main culprits behind the transmission of Chikungunya, dengue and Zika viruses.

Among other outcomes, this work will provide real-time information about the involvement of the Asian tiger mosquito in the outbreak, as most scientists are focusing on involvement of the yellow fever mosquito, said Chelsea Smartt, UF/IFAS associate professor at the Florida Medical Entomology Laboratory in Vero Beach, Florida.

Information gathered by Smartt and her colleagues would improve the ability of mosquito control officials to respond to these viruses ahead of human cases.

“This would aid disease control efforts by being able to detect the virus ahead of human cases,” she said.

Last year, there was a simultaneous outbreak of dengue, chikungunya and Zika viruses in Salvador, Brazil. Some Brazilians reported being infected with up to three viruses – one right after the other, Smartt said. That’s when Smartt initially went to Brazil and started her Zika investigation.

When they return to Brazil, Smartt and her colleagues will collect mosquitoes of both species in houses where people have contracted Zika, Chikungunya and dengue

viruses. They want to see which mosquitoes are infected with any of those viruses.

Then, they’ll find viruses on cards upon which the mosquitoes have fed that provide a safe way to store RNA at room temperature.

“We will work out detection of the virus on the cards that can be used as a proxy measure of the ability of a mosquito to transmit the virus to man,” Smartt said. “We hope to find which mosquito species — *Aedes aegypti* or *Aedes albopictus* — is actually involved in the circulation of these viruses. We also hope to determine if the cards are useful in measuring transmission of these three viruses in the absence of a sentinel animal.”

— Brad Buck, UF/IFAS

Bacillus thuringiensis israelensis (Bti) and spinosyn. Bti is a naturally occurring soil bacterium and spinosyn is derived through fermentation from naturally occurring soil organisms. Both of these larvicides act as stomach or internal toxins once they have been ingested by the mosquito larvae. Residents should see dead larvae in containers approximately one to two days after treatment.

Another form of immature mosquito control is through the use of insect growth regulators (IGRs) such as novaluron, methoprene, pyriproxyfen and novaluron. IGRs kill insects by disrupting or preventing their development. IGR formulations include those that affect mosquito larvae when ingested and those that work by contact. For IGRs, residents may not see results in the larval stage, but will likely see the most mortality during the pupal stage. Some adults may attempt to emerge, but they will likely have lethal deformations.

A list of some active ingredients available for immature control can be found in Table 1. Reductions in the adult population due to larviciding and the use of IGRs will take about two weeks or more because the current adult mosquito population is not being controlled with these methods. These treatments are preventing the next generation of mosquitoes from occurring. Product labels should be read thoroughly for specific treatment instructions before any application is done.

Adulticiding

Aedes aegypti and *Aedes albopictus* are difficult to control because they are host-seeking at a different time (during the day) than the majority of other mosquito species. For this reason, it can be hard for mosquito control districts to control these day-biting mosquitoes. Additionally, mosquito control districts may be constrained financially and may not be equipped to treat all individual residences thoroughly. Also, some counties in Florida do not have an organized mosquito control district. Pest control companies can aid in mosquito control by offering treatments to residential and commercial areas.

Adulticiding: Residual Sprays

Residual treatments, also known as barrier or surface treatments, are a long-term type of application. These treatments are most easily and thoroughly applied using a mist blower so that the insecticide forms a deposit on the surface. Mosquitoes resting on these residual treatments are in contact with a lethal dose of pesticide. Flying adults can also be affected by residual sprays if they come into contact with the insecticide while a surface is being treated.

Residual applications should be applied to areas where adult mosquitoes rest such as the vegetation near a home. Areas over impervious surfaces cannot be treated with pyrethroid insecticides due to label restrictions. Residual sprays should not be applied to the air. Time of day will not have a significant effect on residual pesticide applications because the operator is targeting adult resting sites instead of flying adults. A list of some residual adulticide active ingredients is presented in Table 2.

It is important to note that the equipment required for doing a residual treatment for mosquitoes is different from the equipment used by many pest control operators on a day-to-day basis. Compressed-air sprayers are not appropriate for mosquito treatment due to run-off, and poor treatment coverage and particle deposition on vegetation. Power spraying is also not recommended for mosquito treatments because it is not targeted, puts out a great deal of pesticide, and could contribute to further pyrethroid resistance in an area.

Adulticiding: Space Sprays

In locations where residual treatments cannot be completed due to little or no vegetation, space spray applications can be used. Space sprays (Table 3) target mosquitoes that are flying and possibly host-seeking and are sprayed into open air, the space underneath stilt houses, or the shaded regions with no vegetation. Space sprays contribute to immediate knockdown of mosquito populations, but do not provide long-term control and should not be applied to surfaces. Due to the short-term nature of space sprays, they should be reapplied as needed. Space sprays use equipment such as ultra-low-volume (ULV) sprayers or foggers. Space spray applications have no residual activity, but provide immediate-knockdown of flying mosquitoes. The timing of ULV and fogging applications is heavily dependent on when the mosquitoes are flying and host-seeking.

Pyrethroid Resistance

Various counties throughout the state of Florida have reported pyrethroid resistance in container-mosquitoes. The extent of resistance in the state is currently under investigation. To delay and prevent further insecticide resistance, it is important to practice an integrated approach that includes, in order of priority: source reduction, larviciding, and adulticiding. Monitoring the mosquito population and resistance status should be a part of all mosquito control activities. Rotation of chemicals can also be useful in delaying insecticide resistance. However, pyrethroids and a pyrethroid/neonicotinoid mixture are the only chemical classes available for residual sprays making rotation difficult. For space sprays, both organophosphates and pyrethroids are available for vector control. Major differences between residual sprays and space sprays are presented in Table 4.

Monitoring

Effectiveness of treatment for container mosquitoes can be monitored through the use of a standard ovitrap. Standard ovitraps consist of a dark plastic cup (about 500 ml) with two holes on either side of the cup for water drainage. Two tongue depressors are secured on the interior of the cup using two binder clips, and the cup is filled with water up to the water drainage holes. These ovitraps should be put in a shaded area around the home near vegetation. Cups can be secured with small tent

Continued on Page 26

Residual Spray	Space Spray
Equipment: Backpack Mister	Equipment: ULV, Fogger
Applied to mosquito resting site	Applied to open air where mosquitoes are flying
Long-term control	Short-term control, immediate knockdown
Timing of application is not significant	Treatment when mosquitoes are flying

UF/IFAS FMEEL

Table 4. Differences between residual sprays and space sprays.



Casey Parker, UF/IFAS

Standard ovitrap used for monitoring *Aedes aegypti* and *Aedes albopictus*.



Casey Parker, UF/IFAS

Tongue depressors from a standard ovitrap, showing black mosquito eggs. Collected eggs indicate the need to retreat, if allowed by the pesticide label.

How to Control Roof Rats



THE ROOF RAT, also known as citrus rat, fruit rat, black rat, or gray rat, is an introduced species of rat native to southern Asia. It was brought to America on the first ships to reach the New World and has spread around the world. This rat is the same species that carried the bubonic plague around the world and is also the reservoir host for murine typhus. Roof rats are a severe rodent pest and are very abundant. The Norway rat, which is familiar to most people, is usually less common.

Roof rats consume and destroy stored animal and human food, attack fruit crops, and take up residence in attics, soffits, hollow walls, and out-buildings. When they invade buildings they chew through wires, potentially starting fires, gnaw through plastic and lead water pipes, make holes in walls, and cause other structural damage.

The secretive, nocturnal nature of rats means that they often go unnoticed in a neighborhood until dooryard citrus and other fruit starts to ripen. They then make their presence known with a vengeance. In citrus, papaya, cantaloupe and watermelon, the characteristic damage is a circular hole about the size of a quarter or half dollar, and the whole fruit hollowed out. Hollowed-out fruit is the most common evidence of roof rats.

In apples, peaches, tomatoes, carambolas, bananas, pineapples and mangos, large sections of fruit are eaten away. They remove whole fruits from blueberries, figs, grapes, strawberries, lichees, Surinam cherry, loquat and dates, so the damage is less noticeable, or birds are blamed for the missing fruit. Roof rats — along with native cotton rats — destroy or damage a great deal of sugar cane every year.

Description

Adult roof rats are 12 to 14 inches long and weigh 5 to 10 ounces. The tail of a roof rat is longer than the head and body length and is hairless, scaly and black. The body is sleek and graceful with prominent ears and eyes. There are three color phases: black back with a slate gray belly, gray back with lighter gray belly, and brownish gray above with a white or cream-colored belly.

Did you know?

Roof rats are the No. 1 rodent pest in Florida. Fruit trees attract roof rats to our yards and homes, and damage often ensues.

Learn to fight these rodents where they live and breed.

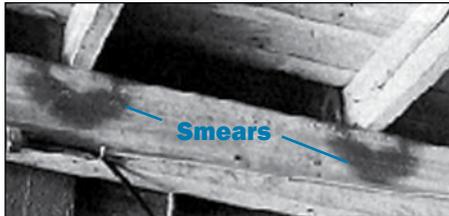


Citrus fruit damaged and hollowed out by roof rats



in Fruit Trees

William H. Kern, Jr.



Droppings

IN ADDITION to the damage done to fruit, evidence includes black, banana-shaped droppings about $\frac{1}{4}$ to $\frac{1}{2}$ inch long, and dark smears or rub marks seen along the rat's travel routes, as shown above.

Range and Habitat

The roof rat occurs along the southern Atlantic and Gulf coastal states from Virginia to Texas and throughout Florida. They also occur along the Pacific coast of California, Washington state, and Oregon.

Roof rats are arboreal (tree-living) by nature. They are similar to squirrels in their ability to move through trees and along vines and wires. They often use utility lines and tree branches to reach food and water and to enter buildings. They prefer nesting above the ground in attics, soffits, piles of debris, hollow trees, skirts of old fronds on palm trees, and in Quaker parrot nests, but will nest in burrows in canal banks and under sidewalks or stacks of materials stored on the ground.

Food

Roof rats are omnivores — which means they eat plants and animals — but are very fond of fruit. They feed on most cultivated fruits and eat many native fruits and nuts. They also feed on livestock feed, pet food, bird seed in feeders, and garbage. They contaminate and damage much more than they actually eat. They will chew through lead and plastic pipes to reach water. They will travel 150 yards from their den to reach food or water.

Reproduction

Roof rats reach sexual maturity at three to four months of age. They breed year-round, with peak breeding activity in spring and fall. The litter of five to eight pups are born after a gestation period of 21 to 23 days. A female roof rat can have four or five litters per year.

Control

Control of roof rats is not easy. Integrated pest management is needed to control these pests. The tools of IPM include inspection, cultural control (prevention and habitat management), physical control (trapping and exclusion), biological control (predators), and — if needed — chemical control (rodenticides and repellents).

Prevention

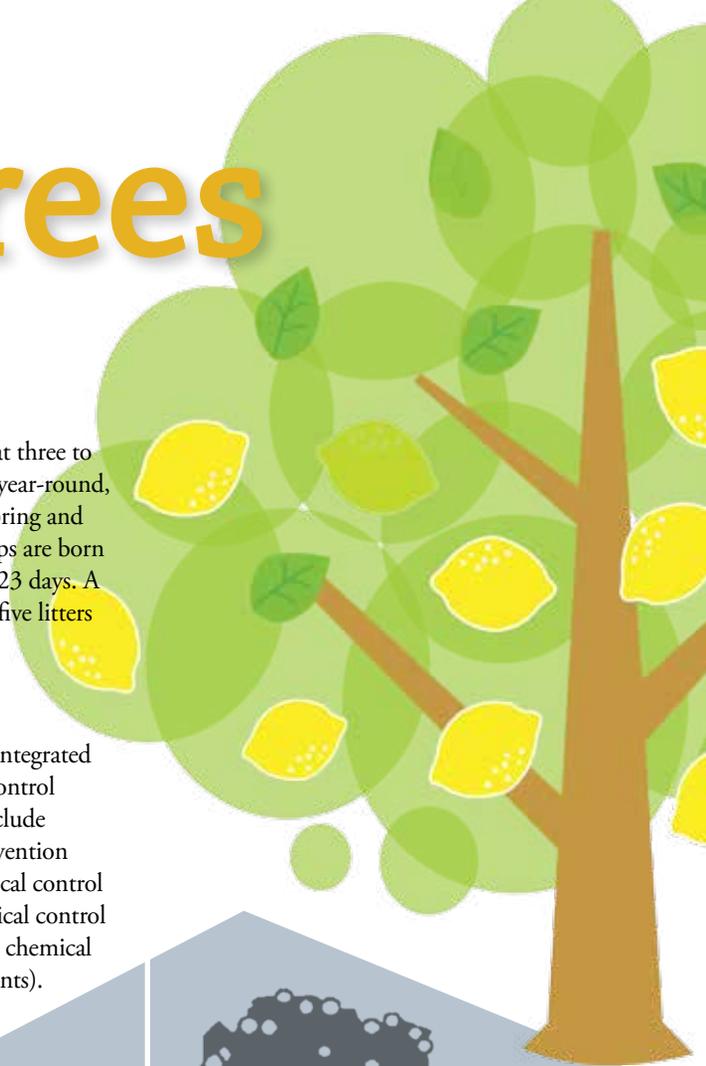
Because roof rats are such good climbers and swimmers it is hard to completely exclude them from your yard, grove, or orchard. Here are some cultural techniques to help you reduce damage.

Properly Space and Prune

Fruit Trees. Your fruit trees should be isolated, not touching fences, overhead wires, or the branches of other trees. Roof rats run along fence stringer boards or support poles, phone and cable TV wires, and tree branches to reach your fruit tree. Lower branches of the tree should not touch the ground. A low-hanging skirt of drooping branches gives the rats additional access routes and provides them with protective cover while feeding. Prune trees so that the ground under them is open and visible. This lack of cover makes the rats uncomfortable and more susceptible to predators.

Sanitation. Sanitation is also important. Use or remove all fallen fruit. If you have more fruit than you can use, contact your local food banks or become involved with community fruit-salvage operations.

Continued next page



Exclusion

Rat guards on the trunks will keep the rats out of trees. Rat guards can be as simple as a piece of sheet metal 18 to 24 inches wide and as long as the circumference of the tree plus 2 inches. Use a piece of wire bent like a giant staple to secure the ends of the sheet metal without penetrating the tree. Put the back of the wire against the tree's trunk, and insert the two ends of the wire through holes in the sheet metal. Then bend the wire outward to hold the ends of the rat guard together.



Trapping

Trapping rats has many advantages over the use of rodenticides. It greatly reduces the risk of a poisoned rat finding its way into your home or buildings, dying, and causing an odor problem.

The tree can also be protected by tying several rat traps around the trunk of the tree with the triggers pointing down. Use expanded-trigger rat traps on trees and fences. Be sure to tie the traps securely to the trunk before trying to set the traps. The next time a rat tries to climb the tree it will get caught and killed or at least given a good scare. Set rat traps only from dusk to dawn to avoid accidentally killing nontarget species like squirrels and protected birds such as wrens, woodpeckers and chickadees. These animals are diurnal, or active during the day, while rats are nocturnal — active during the night.

Since rats prefer to stay off the ground, they like to run along the stringer boards of fences and the horizontal support poles of chain link fences. Traps can be nailed directly to the horizontal stringer board of wooden fences. Place a protective board above the trap to discourage birds from accidentally getting in the trap (Figure 1).

To secure rat traps to horizontal poles of chain link fences, put an eye screw on each side of the trap and use several heavy rubber bands to hold the trap to the pole (Figure 2). As stated before, traps should be set only from dusk until dawn to avoid killing nontarget animals active during the day. Use of live traps will also prevent the accidental killing of birds and squirrels.

Roof rats are nervous and cautious of new objects in their environment, so leave traps in the same location for at least a week before moving them.

Use of Rodenticides

If rodenticide baits are used outdoors, they must be placed in a tamper-resistant bait station. All rodenticide labels state that it is illegal to place any rodenticide baits where they are accessible to children, pets, livestock, or wildlife, unless the bait is contained in a secured, tamper-resistant bait station. These stations can be secured to the trunk or branches of trees (Figure 3).

The practice of wiring rodenticide bait blocks to branches of trees is illegal and has caused thousands of cases of accidental poisoning of dogs and wildlife each year. A newer style of bait station that is very appropriate for roof rat control is the inverted T station (below). These stations can easily be secured to fences, rafters, conduit, pipes, and tree branches. In climates with high humidity, parafinized bait blocks or pellets should be used in any outdoor bait stations.

There are no repellents registered specifically for roof rats. Since most wildlife repellents cannot be used on human food plants, their usefulness in rat control on fruit trees is extremely limited.



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Yellow rat snake

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CASAVA HORNWORM

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In integrated pest management, we often rely on biological control agents as a cost-effective way of controlling pests. We have many allies in our war on rats.

Snakes. Many species of snakes help control roof rats. Yellow rat snakes, gray rat snakes, corn or red rat snakes, black racers, king snakes, coachwhips, and indigo snakes all prey on roof rats. Even our venomous rattlesnakes and cottonmouths eat lots of rats.

A cautionary tale. The importance of snakes in rat control was made clear in the following report: A dog kennel worker took it upon himself to eliminate all of the snakes at his place of work. Once the rat snakes had been killed, the roof rat population exploded.

It took two years, hundreds of people-hours, and thousands of dollars to get control of the rats and repair the structural damage the rats had caused. This does not include the hundreds of pounds of dog food the rats ate and contaminated. The economic cost of removing the rats' natural predators was obvious.

Raptors. Hawks and owls, especially barn owls, are very effective at killing roof rats. Keeping the area around fruit trees open makes hunting easier for birds of prey.

Cats and Dogs. Many people believe that cats and dogs will keep rats out of their yards and fruit trees. But, because roof rats are so arboreal, they are usually able to get into attics and fruit trees without ever coming to the ground. Rats quickly learn safe travel routes through yards to avoid terrestrial predators. Cats will kill dispersing juvenile rats, but are rarely able to handle an adult roof rat within its own territory.

Ultrasonic and Electromagnetic Devices. Many claims are made about ultrasonic and electromagnetic devices repelling rodents from buildings and yards. There is no evidence that these devices will or can drive rodents from their home range. There is evidence that ultrasonic devices can cause hearing loss in pets, especially dogs. **PP**



BRACONID WASP COCOONS



BRACONID WASP COCOONS ON TOBACCO HORNWORM

Photo credits, clockwise from upper left: JoAnn Frock, Deborah Levulis, Lyle Buss, and Deborah Levulis

Hornworms

Lyle J. Buss

IF YOU raise tomatoes in your garden, then you are probably familiar with hornworms. Even though hornworms may be several inches long, their color often works so well as camouflage that gardeners often don't notice them until their plants are suddenly missing half their leaves.

Hornworms get their name from the hornlike projection at the end of their abdomen. They are the caterpillar stage of large moths called sphinx moths. Sometimes the moths are called hummingbird moths because they hover at flowers.

Recently some folks at Slug-A-Bug in Melbourne, Florida, sent us some pictures of a different kind of hornworm that one of their customers was finding, seen in the photo at upper left. An interesting feature of these caterpillars was the fake eyespot on their thorax. This is the papaya hornworm, *Erinnyis alope*. It is common in the southern half of Florida, and feeds mainly on the leaves of papaya. Its close relative, the cassava hornworm, *Erinnyis ello*, is in the photo at upper right. Cassava hornworm has a similar range in Florida and also feeds on papaya. It also feeds on a variety of other plants such as poinsettia, guava and satinleaf.

The color pattern of these two hornworms is quite variable, with brown and green color forms occurring in both species. One difference can be seen in the full-grown caterpillars. The papaya hornworm has a short, broad horn, while the cassava hornworm is missing the horn in the last instar.

Homeowners that have papaya trees in their yards often send me pictures of a white, fluffy mass that they find on their trees, as seen in the photo at lower left. This is actually a collection of hundreds of tiny wasp cocoons. The wasp larvae are parasitic, developing inside the body of large caterpillars like hornworms, leaving them dead. When the wasp larvae are fully developed, they emerge through the integument of the caterpillar and spin their cocoons next to each other in a large mass. Adult wasps emerge a couple weeks later and seek out new hornworms to parasitize.

By the way, the hornworm that feeds on tomato in Florida is officially called the tobacco hornworm, *Manduca sexta*, seen parasitized in the photo at lower right. Tobacco hornworm eats both tobacco and tomato. It gets parasitized by a different species of braconid wasp. Be sure to leave these parasitized ones in your garden to help kill other hornworms that may be hiding on your tomatoes! **PP**

William H. Kern, Jr. is Associate Professor of Entomology at UF/IFAS Ft. Lauderdale Research and Education Center.

Lyle J. Buss, scientific photographer, manages the Insect Identification Lab at the UF/IFAS Department of Entomology and Nematology.

WESTERN DRYWOOD TERMITE

Brian J. Cabrera and Rudolf H. Scheffrahn



Alate



Soldier head



Queen

King



\$250 million in damage and treatment yearly

IT IS the most common structure-infesting drywood termite in the Southwest United States. California and Arizona see a \$250 million economic impact yearly.

Originally described as *Kaloterмес minor*, *Incisiterмес minor* was reclassified into the genus *Incisiterмес*. In California, *Incisiterмес minor* infestations are still sometimes referred to by some pest control operators as “Kalos” and designated with a “K” on termite inspection reports. In 1988 this termite — the western drywood termite — was found in Florida.

They Get Around

Incisiterмес minor is found in the coastal and lower mountain regions of southern California. Its range extends to the coast to northern California and onward in a discontinuous distribution along the coasts of Oregon and Washington. It is also found extensively in the central valley of California up to Sacramento and in isolated pockets in the high desert where trees are present. Toward the east, *I. minor*'s range extends to central Arizona and southward it extends into Baja California and Sonora, Mexico. The relative ease of intracontinental travel and commerce coupled with the fact that infested wood can be easily transported has resulted in isolated occurrences of *I. minor* infestations throughout

the United States, including Florida. Infestations have been found in China, and it is well established in Japan.

Infestations have also been found in Arkansas, Iowa, Maryland, New Jersey, New York, Oklahoma, Ohio and Texas. A heavily infested structure was reported in Toronto, Canada. Recently, *I. minor* has been found in Georgia, South Carolina and Louisiana. The latter is significant to Florida because *I. minor* was taken from a park tree in New Orleans, indicating that it can survive outdoors in a non-Mediterranean, subtropical climate. This apparently was the case with three boat infestations in Florida, where termites and damage were found in wood located outside the cabins. In southern California and Florida, yachts, sailboats and small pleasure craft harboring mature colonies may serve as floating sources of introduction outside *I. minor*'s native range as they set sail for global ports of call.

How to Recognize the Western Drywood Termite

The western drywood termite is not a “typical” *Incisiterмес*, in that several characteristics such as color, wings, ocellus, arolium and soldier eye are distinct from most other species of *Incisiterмес*.

Alate, or swarmer

Alates are winged male and female termites and are the only caste that, during dispersal flights, leaves the colony. If successful in mating, some will become royal pairs — the kings and queens of new colonies. The western drywood termite alate has an orange-brown head and pronotum, and a dark brown abdomen. The wings are dark with a somewhat smoky tint to them. Alates are 11 to 12.5 mm long, including the wings.

Brian J. Cabrera is County Entomologist for the Santa Barbara County Ag Commissioner's Office (California), and Rudolf H. Scheffrahn is Professor, UF/IFAS Fort Lauderdale Research and Education Center

Soldier

The soldiers have large, reddish-brown head capsules that are heavily sclerotized. The mandibles are large and black with two prominent teeth visible on the inner margin of the left mandible. Western drywood termite soldiers are recognized by the enlarged, clublike third antennal segment that is as long or longer than the fourth through sixth antennal segments combined. Soldiers of mature, older colonies are large, ranging from 8 mm to more than 12 mm long.

Worker

Drywood termites lack true workers, a terminal caste which is reproductively sterile and found only in the Termitidae. Instead, drywood termite workers are called “pseudergates” (literally, false workers) if they lack wing pads, or “nymphs” if wing pads are present. The workers develop from earlier instars that are often referred to as larvae, even though termites go through simple metamorphosis. Pseudergates are not sterile or a terminal caste. Therefore, they maintain the capability of molting into a soldier, a supplementary reproductive (neotenic), or an alate.

Comparison with the West Indian powderpost drywood termite, *Cryptotermes brevis*

Incisitermes minor is much bigger and has larger colonies than *C. brevis*, the most common structure-infesting drywood termite in Florida. The enlarged third antennal segment of *I. minor* and the phragmotic head of *C. brevis* easily separate the soldiers of these two species. The orange-brown head and smoky tinge to the wings of *I. minor* also distinguishes the alates from those of *C. brevis*. Western drywood termites infest both natural and structural wood, while *C. brevis* is found only in structural wood. Both species produce characteristic hexagonal fecal pellets but those of *I. minor* (right) are larger than those of *C. brevis* (left), in the photo below.



The Life of the Western Drywood Termite

The life cycle is typical for that of other drywood termites. Western drywood termite alates fly during the day and in southern California swarm from late September through November. In desert areas, where average daytime temperatures are warmer, they may swarm much earlier in the year. For instance, in Palm Springs, California, swarming flights have been observed as early as May. Swarming has been seen in April from warm indoor locations such as water heater closets and in laboratory colonies.

Swarming usually occurs on bright, sunny days with temperatures between about 80 to 100°F. Alates emerge from exit holes in the wood and are attracted to light, which is called positive phototaxis. Upon reaching the outside, the swarmer take off in all directions. They are relatively poor fliers, neither particularly fast nor agile, and can easily be caught by hand.

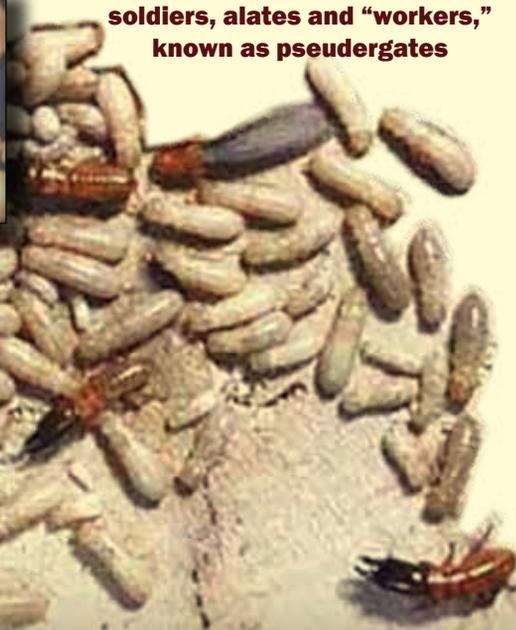
Upon landing, *I. minor* alates drop their wings by bracing their wing tips against the substrate and then twisting and turning so that the wings break off at the base. These dealates crawl about in search of a mate and, if one is found, the pair engages in courtship activity. This includes tandem running in which the female scurries about with the male in tow.

A colony is born

Once the female accepts a male, the pair — now referred to as the king and queen — remain mates for life. Their first task as a royal pair is to find a crack, crevice or hole in a piece of wood where they can start excavating a royal cell. This usually takes three to four days and when completed, they seal the entrance with a plug of gut contents.

Following a period of inactivity that may last up to approximately nine months, the queen begins laying eggs. Larvae hatch from the eggs and are fed by the king and queen until they are large enough to feed and excavate galleries in the host wood.

Western drywood termite soldiers, alates and “workers,” known as pseudergates



AFTER TWO YEARS, the colony is still quite small, consisting of the king, queen, a soldier, and perhaps a dozen or so nymphs. Over time, the size of the queen’s ovaries increases and the abdomen swells — a condition known as physogastry. The physogastric abdomen appears striped because the swelling stretches the abdominal intersegmental membranes so that each individual abdominal sclerite becomes visible.

The queen lays most of her eggs from late spring into late fall. The queen will lay approximately two to five eggs during the first year and approximately eight to 15 eggs during her second year. Her fecundity increases with each successive year until a plateau is reached after 10 to 12 years. It may take five to seven years before an incipient colony produces visible feeding damage or is found infesting wood.

A five-year-old colony consists of the primary king and queen, 20 soldiers and 500 nymphs. At 10 years, one or more supplementary reproductives may be present in addition to the primaries, plus 70 soldiers and 1,600 nymphs. At 15 years, there may be one or more supplementaries plus the primaries, 120 soldiers and 2,600 nymphs. These estimates are subject to considerable variation as the population size and growth is influenced by numerous environmental factors such as temperature, and the amount and nutritional quality of the host wood.

Life in the colony

Incisitermes minor has at least seven instars, and it probably takes more than a year for a nymph to develop from the egg to an alate or soldier. Western drywood termite nymphs have relatively large amounts of fat body, and the larger nymphs are very robust.

The galleries of *I. minor* are typical of other drywood termite species, albeit a bit larger and more cavernous. They consist of irregular excavations that extend throughout the sapwood, across both spring and summerwood, and sometimes into the heartwood. Some galleries are spacious enough to accommodate large aggregations of termites while others are so narrow that termites can only pass through in single file.

Another characteristic feeding behavior is that *I. minor* will excavate toward the outer surface of the wood without actually breaking through it, thus leaving a paper thin, outer protective layer. Infested wood sometimes appears sound, but upon close inspection and mechanical probing this outer shell can be easily broken, revealing the underlying galleries and large amounts of frass, or fecal pellets.

Incisitermes minor is well adapted to living in arid habitats. Its natural geographic range includes many areas of low precipitation and high summer temperatures. Furthermore, sound wood under extremely dry conditions, such as those found in inland Southern California on hot summer afternoons, contains only about 6 to 7% water. Western drywood termites obtain water either directly from the wood on which they feed or they produce it themselves through oxidative metabolism.

Continued



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Fecal pellets under a door



**Kickout hole
Size: 1 mm**

The presence of pellets, sometimes found in piles, is a very characteristic sign of infestation. Homeowners often mistake this for sawdust. Drywood termites expel their fecal pellets from the gallery through “kickout” holes. These holes are extremely small and usually are sealed with a plug of wet feces and pellets when not in use. Kickout holes can sometimes be found by carefully searching wood surfaces directly above where fecal pellets accumulate.

Where it Lives in Florida

Incisitermes minor has a spotty distribution from the Panhandle south to Miami, where it was probably first introduced into Florida. It has been found on both coasts of the peninsula. Two incidences of infestation were reported in 1988, and since then there have been 22 more confirmed records. Of all records, three occurred on boats — two of these from Southern California — that were subsequently fumigated. Three other infestations were associated with furniture that was traced to the Pacific Coast. So far, all the Florida infestations have only been found in structural lumber, not in natural wood.

In one case study conducted in the laboratory at the University of Florida Fort Lauderdale Research and Education Center, *I. minor* workers in structural lumber initiated a large infestation.

In April 1990, western drywood termite-infested wood was cut into sections and placed on a laminate-covered plywood bench top not previously exposed to *I. minor*. A few days later, workers were observed trailing from the exposed wood galleries to the juncture between the bench top and wall. Over the years, fecal pellets were observed falling from the bench top. In 2000, the entire 24-foot length of the bench top had pellets falling from it. Known flights from the bench top occurred in September 1999 and July 2001.

Management Strategies

There are a variety of treatments for controlling drywood termite infestations. The type used depends on several factors including severity, location, economics, tolerance level, and attitudes toward pesticide use.

Fumigation of a structure, usually with sulfuryl fluoride, is recommended for severe or widespread infestations, or when they are in inaccessible areas. This treatment is the most effective in ensuring the whole structure is treated and all termites within are killed. On the minus side, it is expensive, highly disruptive (usually one night must be spent away from home), and it does not provide residual protection.

Continued on Page 20

Western Drywood Termite Infestation Sites 1986 – 2001



Introducing Adam Dale

Assistant Professor of
Turfgrass and Ornamental
Entomology at UF/IFAS
in Gainesville



I hope to help
the landscape
industry
stay ahead
of challenges
in pest
management.

Adam

GAINESVILLE, Fla. — Dr. Adam Dale was recently hired as the Assistant Professor of Turfgrass and Ornamental Entomology at the University of Florida in Gainesville. Adam moved to Gainesville from North Carolina State University in Raleigh, where he worked for several years studying insect pests of ornamental plants in greenhouses, nurseries and landscapes.

Dale's PhD work focused on the ecology and management of insect pests of trees in urban landscapes. His research identified ways in which urbanization increases pest fitness and abundance on landscape trees and reduces the services trees provide. This research led to the development of tree-planting strategies and recommendations that reduce the severity of pest infestations on urban trees.

In North Carolina, Dale was actively involved with the Cooperative Extension Service and landscape industry, leading landscape pest management field days and writing articles for trade magazines. "I'm looking forward to working with the Florida landscape industry to help

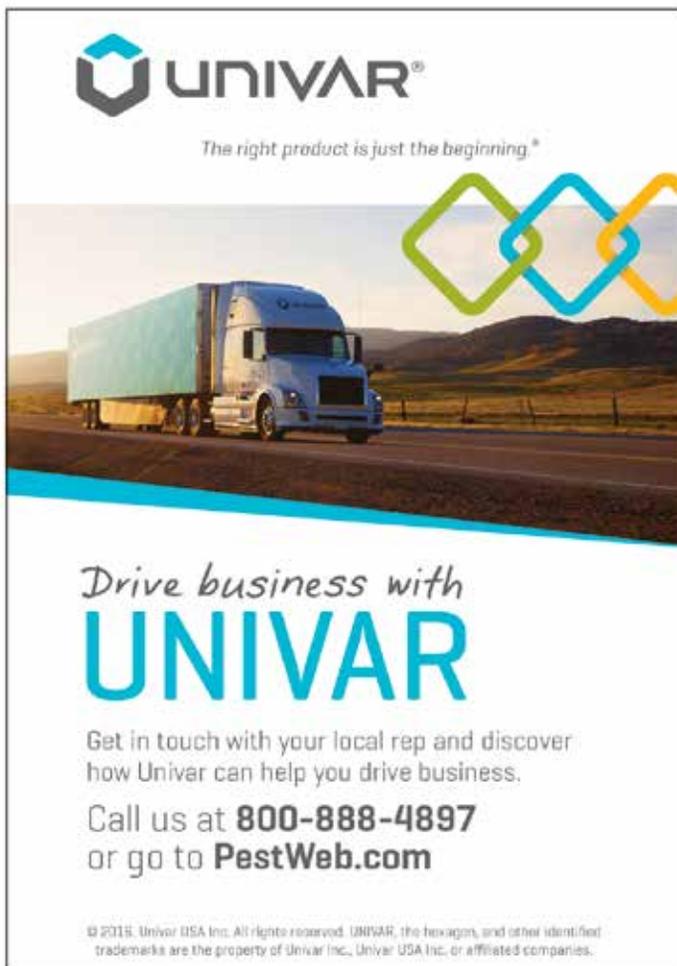
them address challenges they are facing," Dale said.

Dale's research is broadly focused on biological control, plant-insect interactions, and the relationship between insects and their environment. He has placed emphasis on studying multiple factors as they affect pests and their host plants in landscapes, with the ultimate goal of developing more sustainable pest management strategies.

Now in Florida, Dale will expand his previous work and build an Extension and research program to address the needs of the Florida landscape industry. "I'm excited about the size of the Florida landscape industry and the diversity of insect pests it is faced with," he said.

As the turfgrass and ornamental Extension specialist, Dale plans to use multiple outlets to reach as many extension faculty and landscape professionals as possible throughout the state. He said, "I hope to help the landscape industry adapt to and stay ahead of challenges in arthropod pest management." **PP**

Adam Dale photo by Alex Catalano, UF/IFAS



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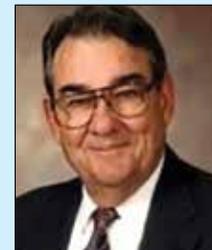
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Pest Management Industry Loses Two Pioneers

Robert Earl Dixon, Sr.

ROBERT EARL DIXON, SR., of Welaka, Florida, died March 16, 2016. He was 89.

He was born March 11, 1927, in Bronson, Florida. He was a U.S. Army veteran. Earl was a graduate and staff member of the University of Florida Department of Entomology when he was hired by Otto Orkin to begin his career in the pest control industry.



He and his wife, Louise, founded Peninsular Pest Control Service in 1954 from their home in Arlington, and it grew into one of Northeast Florida's largest independent pest control businesses. He was elected to the Florida House of Representatives from Duval County in 1968 and later served as Chairman of Appropriations. Earl was reelected four times until he decided not to seek reelection in 1978. The same year he was appointed to the State Ethics Commission.

He held many professional, service and civic affiliations, including State Pest Control Commission, Past President of the Florida Pest Control Association (Pioneer Award), Past Vice President of the National Pest Control Association, Phi Sigma Honorary Biological Society, Pi Chi Omega, and Honorary Entomological Society.

In addition to his wife of 67 years, Louise, he is survived by daughter Carolyn Richardson and a large extended family. He was predeceased by son Robert Earl Dixon, Jr. **PP**

Adapted from Florida Times-Union obituary, Mar. 18, 2016

Dempsey Robert Sapp, Sr.

DEMPSEY ROBERT SAPP SR., of New River, Florida, passed away March 25, 2016. He was 94.

He was born in New River. On September 5, 1949, he opened the doors of Florida Pest Control & Chemical Co. in Gainesville, Florida. Florida Pest is still family owned and one of the largest pest control companies in the nation. He was Chairman Emeritus until his death.



This pioneer of the pest control industry was appointed to the State Pest Control Commission for a three-year term by Governor Leroy Collins in 1959 and appointed to another three-year term by Governor C. Farris Bryant in 1964.

Mr. Sapp was a very benevolent person. He gave generously to the University of Florida and established the Distinguished Endowed Professorship in Structural Pest Control and Urban Entomology. He was a member of the Entomological Society of America, the Florida Entomological Society, and the Newell Entomological Society. A devoted Gator fan, he attended Gator football games for 50 years.

Mr. Sapp is survived by his loving wife of 72 years, Margie Beckham Sapp, daughters Wanda Kay Frowick and Angelia Dickey, and son D.R. Sapp, Jr., as well as a large extended family. He was predeceased by daughter Deborah Wise. **PP**

Adapted from Gainesville Sun obituary, Mar. 27-30, 2016

Drywood Termite, continued from Page 18

When infestations are limited, easy to find, and in easy-to-reach areas, they can be given a localized treatment. These spot treatments consist of drilling holes into the infested wood or opening kickout holes and injecting a termiticide into the galleries. Control is sometimes as simple as removing and discarding infested wood. This can be done for wood members that can be easily removed from a structure and when infestations are limited to only one or a few pieces of wood such as a door, fence post, or dead branch on a tree, for example.

Public wariness over the use of pesticides and toxic chemicals in urban environments and the phase-out of methyl bromide — at one time a widely used fumigant — has spurred the development of alternative or nontraditional treatments for drywood termites. Heat treatment involves enclosing an infested structure or isolated parts of it with tarpaulins and blowing heated air inside to produce high lethal temperatures inside the wood. Cold treatment consists of filling wall voids or areas enclosed within a thermally insulated cover with liquid nitrogen to freeze termites in the wood.

Microwave devices produce thermal energy that is directed toward infested wood and literally cooks the termites within their galleries. The electrogun is a device that delivers high voltage, low current electricity to infested wood and electrocutes drywood termites inside their galleries. All four of these treatments can be effective if done properly, but each has its own set of limitations. Operator expertise and precisely locating the infested areas are especially important for the latter two and can have a tremendous impact on the treatment's effectiveness. **PP**

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Why You Should Seriously Consider Selling Your Company NOW, Part I

John P. Corrigan, Esq., Dan Gordon, CPA, and Norman Cooper

DESPITE the very scary first quarter of 2016, which thankfully shook off a 10.5 percent financial downturn before the first quarter's finale, our pest control industry has celebrated all-time highs in selling valuations. With unprecedented interest rates expected from the Fed through late 2016, what can we expect beyond that period, with critical elections, international upheavals, bureaucratic rules, and Mother Nature's unpredictability? Many believe that a market correction is imminent after a seven-year bull market.

If you have ever even considered the possibility of selling your company in the not very distant future, prepare sooner rather than later. Pest management owners should be totally aware of the true value of their companies NOW. Value is not primarily based upon annual revenue. For example, recently a pest control company grossed less than \$800,000 per year and was paid more than \$1,000,000. Almost \$14 million was offered to another pest control company grossing \$9 million dollars annually.

ADVICE FOR SELLERS

The above examples may not always be obtainable, but our intention is to guide you, at this critical time, with the best advice in order to achieve the best possible outcome for you. This can best be done by:

- ◆ Ensuring that confidentiality takes precedence. You don't want your employees or key customers to find out before you're ready for them to know.
- ◆ Selecting advisors who are focused exclusively on pest control and landscape companies and have a vast industry—contact database and deep relationships.
- ◆ Making sure that you are contacting the most qualified potential buyers and creating a competitive bid process.
- ◆ Packaging your company in the best possible light.

- ◆ Recognizing that the process doesn't end when you receive the offer. Deal structure terms, i.e., amount in cash and guaranteed vs. over time or on an earn-out, and contract details, i.e., reps and warranties, can alter the outcome considerably.
- ◆ Making sure that your employees are taken care of.
- ◆ Seeking expert tax and legal advice to avoid legal and tax issues and maximize the after-tax proceeds from your sale.

The best pest management advisory firms have superior reputations and provide potential sellers with the information needed to prosper in today's competitive business environment. The highest price does not necessarily yield the most money. It's the surety of getting paid and the effectiveness of tax minimization strategies that yield the most money for sellers.

TIMING

The "best time" for you to sell might be driven by your particular health situation, family circumstances, financial needs, or numerous other reasons. Be aware, however, that it is always better to sell a day too early than a day too late. Buyers are apt to offer far more for pest control companies that have proven growth and profitability, especially within the past three years, than for a company that has started to decline. Selling before you have to can give you a once-in-a-lifetime opportunity to relax, travel, engage in civic and charitable endeavors, check off your bucket-list goals, and spend more time with family — or less, in the case of a family business.

Waiting for the end of warm weather, when pests are more active, has often encouraged pest control owners to sell after Labor Day. You should realize that purchasers of pest management firms have calendars and compute the seller's value based upon a 12-month basis.

WHAT TO LOOK FOR IN ACCOUNTANTS, ATTORNEYS AND BROKERS

Accountants certainly deliver significant financial and tax strategy advice. However, even these savvy, financial "generalists," despite knowing the specific financials of their clients, usually don't know the reputations of those pest control companies that want to merge with other companies and that are financially able to do so.

Your current business lawyer delivers important advice to your company regarding vital lawsuits or preventing same, employment matters, insurance, and more. Your lawyer may have also excelled in advising you regarding personal situations and accidents over a period of time. Despite their general legal knowledge, they too may have not negotiated multiple pest control deals and may not know the nuances of negotiating a favorable deal structure and contract terms for a pest control company.

There are all types of brokers as well. Too many generalist business brokers focus on getting a deal done at any price vs. maximizing the value of the deal to sellers. Make sure you have a broker who has experience selling pest control companies and whose interests are aligned with yours.

The difference between closing a "maximum deal" vs. leaving money on the table greatly depends on advisors who represent your interests.

Part II of this column on why you should seriously consider selling your company now will appear in a future *Executive Suite*. **PP**

The authors are the managing directors of PCO M&A and Succession Specialists, LLC. If you would like a free copy of our fact-filled brochure, call Dan Gordon at 973-300-0028 x 201.

What You Need to Tell Your Techs About IRRIGATION

Erin Harlow and
Luke Harlow

IRRIGATION is one of those technical sciences that seems like it should be really easy, when in fact it requires a very technical, exact skill set and can impact many different aspects of the pest control industry that might not be easily recognized. This article will explore how irrigation may impact you as a pest management professional and what you need to tell your technicians about irrigation, whether they are treating for termites, household pests or lawns.

Irrigation and Termite Treatments

Does irrigation promote termite activity? Wood-decaying fungi?

Some termite species, especially dampwood termites, *Neotermes* spp., need a certain percentage of free moisture to survive. Irrigation that is hitting rotting wood or logs and even live wood such as on trees can be enough to support a termite colony, resulting in a technician occasionally finding termites in the landscape in living plants. Irrigation that constantly hits buildings also promotes termite habitat and can support wood-decaying fungi. It is a good idea to train termite technicians to be mindful of irrigation in the landscape and remember that it might be the cause of conducive conditions.

I was just installing a bait station — what do you mean I drilled through an irrigation pipe?

If you install bait stations such as a Sentricon® System in landscapes for termite treatments then there is a chance you may have drilled through an irrigation waterline at some point, possibly receiving a bath if it was a pressurized line. Most sprinkler system waterlines run parallel to the home within a distance of 3 to 5 feet away from the exterior walls, which coincides with the distance that many companies install termite bait stations.

While it is impossible for a termite technician to know the exact location of waterlines buried in the ground, several practices should be followed to prevent the headache that will ensue from a drilled through irrigation line. When using a power drill and auger bit to core into the soil during installation, do not apply downward pressure to the drill. Let the auger core down to the appropriate depth. If the bit stops moving down prematurely, there may be a chance you have encountered a pipeline. Stop drilling and choose a new space to drill for the bait station that is 6 inches diagonally forward or backward from your original drill site. Another practice is to be aware of other irrigation components near the bait station site. If there are valve boxes or a backflow near that location, there is an increased chance of finding pipelines in that location. If possible, it would be beneficial to partner with a licensed irrigation contractor who can work with your team to fix these problems.

Irrigation in GHP

What's hiding in the valve box?

Irrigation valve boxes are notorious for being a perfect location for some less-favorable insects and animals you might find in the landscape. For instance, Africanized honey bees love to make valve boxes their homes. The small opening and large cavity make an ideal location for a nest. Other animals such as snakes, frogs, spiders and ants find valve boxes to be a perfect home or hunting spot.

Does irrigation promote insect activity?

Leaky irrigation can provide a water source for insects and rodents. Rodents will chew through drip tubing in a landscape to access the water. It can also promote insect activity if the water is hitting a wall or landscape material.



Perimeter Treatments

Irrigation sprinklers, when not aligned properly, can literally wash away a great technician's work within minutes. Sprinklers that are constantly hitting the home instead of spraying shrubs or turf may quickly make a pest treatment completely ineffective. It is a good practice for technicians to do a quick perimeter walk of the property to make sure all sprinklers near the exterior walls of the home are directed away from the house and that no broken sprinkler heads are present.

Irrigation in Lawns and Ornamentals

What is the proper irrigation schedule for establishing turfgrass?

While installing sod may not be part of your business, caring for it is, and new sod is installed on accounts for a variety of reasons. Chances are that the homeowners were given lots of advice on how it should be cared for by the installers, landscapers, friends, neighbors and Internet searches.



Irrigation control panel



Broken or leaky pipe

Make sure your technicians are giving out the correct advice for the best possible establishment. The best way to establish new sod is to apply irrigation for two to three times throughout the day for five to ten minutes. This should be done for the first seven to ten days. After that the frequency of irrigation can be reduced to around once a day and the length of time increased to approximately twenty minutes. After another week or so, begin to reduce the frequency to every other day or every two days and increase the length of time to apply ½" at each application. By the third week, the roots should have begun to "peg." This means the roots have begun to grow into the soil. This method of irrigation greatly reduces the stress on the turf, does not waste water, and decreases the chance of pythium root rot.

Watering in treatments?

If the irrigation uniformity and distribution is not efficient or provides good coverage then it can really be a problem for lawn applications. On most occasions, if you ask a homeowner how their irrigation system is operating, they will tell you it works great because they can see that it has run. However, they may not realize that there might be areas getting too much or too little water and causing problems. If a technician has completed an application, but proper water is not applied according to the label, the potential for phytotoxicity or damage to the turf is much greater. This can also lead to gaps in coverage from the product resulting in insects, weeds and diseases.

Insects and Irrigation

The most familiar insects associated with irrigation issues are chinch bugs. Chinch bugs are most active during the hot, dry part of the day. Areas with poor coverage, such as the middle of a large lawn, are susceptible to damage because they are already stressed. The best way to show clients that they are

not receiving enough water in an area is to put a small tuna or cat food can in the area and run the system. By comparing the amount of water in the cans from across the lawn, it becomes evident which areas may be receiving too much or too little irrigation.

Weeds and Irrigation

If herbicide applications have been done and the technician is continually being called back to a site for weeds such as dollarweed or nutsedges, then irrigation may be a factor. The technician should look for weeds that are damaged, then determine how much new growth has occurred since the previous application. If it seems excessive, then the irrigation schedule should be checked. If it seems isolated in one area, then consider a broken or leaking pipe underground. The source of the problem will need to be fixed to gain control of the weeds.

Diseases and Irrigation

Some clients tend to over-love their lawns or have the misconception that to have a beautiful lawn they have to constantly water. If the system provides approximately ½" at each application and has good distribution, then twice a week during the summer is all that should be needed for a healthy turf. Disease issues, most notably pythium root rot, *Pythium* spp., can be magnified by overwatering. Take-all root rot can also be related to overwatering, but it is affected by the turf being stressed from many factors, including temperatures, soil pH and mowing height. Technicians should be aware that pythium may cause the turf to look wilted like drought stress — chinch bugs will also do this. It usually occurs in a random pattern, making the turf look unthrifty. A helpful field method for identification is to pull root samples and run your finger down the root. If the outer sheath comes off or is broken, then that is likely pythium root rot and may require treatment.

Treating Lawns With No In-Ground System

If you have been in the business for any length of time then you realize that sometimes there are some accounts that present greater challenges than others. Accounts with no in-ground irrigation system that rely on the client dragging a hose around the yard for supplemental water may just be one of these accounts. Without an in-ground irrigation system, it is nearly impossible to provide uniform coverage and treatments run the risk of being ineffective because they were improperly watered either too much or too little.

Because irrigation is such an important part of the landscape and is integral to many aspects of the pest management industry, it is important to keep technicians up-to-date and provide some basic training on irrigation systems and how they impact their accounts. **PP**

Erin Harlow is a Commercial Horticulture Agent, UF/IFAS Extension – Duval County. Luke Harlow is an Agriculture and Natural Resources Agent, UF/IFAS Extension – Nassau County, and a licensed irrigation contractor in several counties in northeast Florida.

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Featured Creatures Update

Jeepers Creepers, Look at All the Cool New Creatures From UF/IFAS *Featured Creatures*!

Jennifer Gillett-Kaufman

IT IS THAT time of year when it seems everywhere you look is an insect you have never seen before. To keep you in the know, we have pulled together some of the newest L&O and GHP creatures from the University of Florida Institute of Food and Agricultural Sciences *Featured Creatures* website. These articles were developed by UF scientists, students and collaborators, and the excerpts below are from the actual article. If you do not see anything new here, visit the website and look around for information on a few creatures to add to your mental toolbox.



L&O: Oblong-Winged Katydid (Suggested Common Name)

Shari Linn and Jennifer L. Gillett-Kaufman, Entomology and Nematology Department, University of Florida

http://entnemdept.ufl.edu/creatures/misc/amblycorypha_oblongifolia.htm

The oblong-winged katydid, *Amblycorypha oblongifolia* (De Geer, 1773), is a false katydid in the subfamily Phaneropterinae. It is very similar in appearance to *Amblycorypha floridana*, the Florida false katydid; however, the two species can be differentiated by their calling songs and distribution.

The false katydid adults are distinguishable from the adults of the true katydids (subfamily Pseudophyllinae) by their hind wings that extend beyond their leathery forewings, or tegmina (Kramer 1944). True katydids have relatively shorter forewings, and, compared to those of the false katydids, the wings bulge out at the sides (Capinera et al. 2004).

This species of katydid is typically green, but can be pink, orange, tan, brown, or yellow, though it is rare to find these in the wild.



L&O: Broadtipped Conehead Katydid (Suggested Common Name)

Shari Linn and Jennifer L. Gillett-Kaufman, Entomology and Nematology Department, University of Florida

http://entnemdept.ufl.edu/creatures/misc/Neoconocephalus_triops.htm

The broad-tipped conehead katydid, *Neoconocephalus triops* (Linnaeus, 1758), is a coneheaded katydid in the subfamily Conocephalinae. Within this subfamily, four genera consisting of 22 species total, exist in America (SINA 2014a). Like all other coneheads, they possess a cone (called a fastigium), a projection (sometimes sharply pointed, depending on the species) from the head that stretches beyond the basal antennal segments.



L&O: Pillbug, Roly-poly, Woodlouse

Julie A. Franklin, Morgan A. Byron, and Jennifer Gillett-Kaufman, Entomology and Nematology Department, University of Florida

http://entnemdept.ufl.edu/creatures/misc/Armadillidium_vulgare.htm

The pillbug, *Armadillidium vulgare* (Latreille), is an isopod, a type of non-insect arthropod also known as a terrestrial crustacean. It is sometimes called a roly-poly due to its ability to roll into ball when disturbed. This defensive behavior

also makes it look like a pill, which is why it is sometimes known as a pillbug. The name woodlouse is used for both pillbugs and sowbugs in Europe and refers to where these arthropods are found, such as under logs. Pillbugs are nocturnal, though they may be found during the day in the soil or under debris. They are mainly beneficial in the garden or landscape, but can become occasional pests if they wander indoors.

The pillbug is often mistakenly referred to as a sowbug, which is the common name used for other species of woodlice in the genera *Oniscus* and *Porcellio*. Sowbugs and pillbugs are both isopods, but they differ in that a pillbug can roll into a ball and a sowbug cannot.



L&O: Florida Flower Thrips (Suggested Common Name)

Steven P. Arthurs, Moh Leng Kok-Yokomi, and Hugh Smith, Entomology and Nematology Department, University of Florida

http://entnemdept.ufl.edu/creatures/veg/thrips/Frankliniella_bispinosa.htm

Frankliniella bispinosa Morgan is a common flower thrips species native to Florida and southern Georgia. Often found in association with other flower thrips, Florida flower thrips is considered to be of secondary importance relative to the more invasive western flower thrips, *Frankliniella occidentalis*. Nonetheless, Florida flower thrips can attain large populations quickly following flowering of susceptible crops, especially before predator populations build up. This species causes significant economic damage to a range of crops, including citrus, blueberries, strawberries, and field pepper. Field identification of different flower thrips species is difficult without expert help.

Continued on page 27

Jennifer Gillett-Kaufman is *Featured Creatures* Editor and Project Coordinator, University of Florida/IFAS Entomology and Nematology Department. Register for weekly *Featured Creatures* updates at <http://blogs.ifas.ufl.edu/pestalert/>, or monthly updates at <http://entomology.ifas.ufl.edu/news/>.

stakes so that they are not knocked over by wind or animals. Standard ovitraps should be checked weekly for the presence of eggs and replaced with new tongue depressors. If eggs are present, a retreatment of the house should be done unless the label prohibits the use of the pesticide within a certain time frame. If possible, count the number of eggs on the tongue depressors weekly with the aid of a microscope to detect any reductions in the population over time.

Many mosquito control districts throughout the state routinely perform adult surveillance of mosquitoes and may be able to provide historical

or current data on *Aedes aegypti* or *Aedes albopictus* populations in an area.

Application Equipment, Personnel, and Personal Protective Equipment

Mist blowers are a type of low volume sprayer used to control both larval and adult populations of mosquitoes. Mist blowers are characterized by relatively low fluid pressures, with flow rates of several ounces per minute. Dispersal of liquid insecticides is done using high air velocity. Typically, the product is run through hoses to a metering device, which may or may not be connected to

a conventional nozzle. Mist blowers dispense mists of pesticide though a nozzle mounted within an open cylinder. The cylinder can be aimed, permitting precise treatment of mosquito resting areas.

Backpack-sized units can be used to treat areas up to several acres quickly and efficiently. The main advantage over power sprayers is the lower volume of formulated product needed for treatment. Mist blowers are particularly useful in mosquito control for applying a thorough residual application for adult control to individual properties. Backpack-type power mist blowers are highly portable and allow rapid treatment of up to several acres by individual vector-control technicians. Although mist blowers are best suited for liquid applications, some manufacturers offer the option of equipping them with hoppers for use with larvicidal pellets or granules.

Space sprays use equipment such as ultra-low-volume (ULV) sprayers or foggers that deliver small particle droplets (< ~30 microns) that can impinge on the mosquito cuticle and deliver a lethal dose of pesticide. These types of applications have no residual activity, but provide immediate knockdown of flying mosquitoes. Both ULV sprayers and foggers can be handheld machines or mounted on a truck. ULV sprayers can also be used in aerial applications for wide-area control.

Personnel and PPE

Any person conducting insecticide treatments for container mosquitoes should wear long sleeves and long pants in addition to using mosquito repellents. The CDC recommends DEET, IR3535, oil of lemon eucalyptus (OLE), and Picaridin for long-lasting protection from mosquitoes. DEET is a commonly used repellent and is highly effective. Repellents should be provided to operators/technicians doing mosquito work. Repellents should be applied to exposed skin and clothing, but not worn underneath clothing. Repellents should not be applied over irritated skin such as cuts or wounds. They should also be removed after completing treatments and returning indoors.

When doing mosquito pesticide applications, operators should wear eye protection and gloves in addition to their pants and long sleeves. Face masks, dust masks, or respirators can be worn as an added precaution. Some insecticide labels recommend the use of a respirator when products are being applied. Refer to insecticide label instructions for required PPE for different products. **PP**

NOTE: For information about Zika virus and potential occupational concerns, see the OSHA fact sheet *Interim Guidance for Protecting Workers from Occupational Exposure to Zika Virus*, available online at <http://tinyurl.com/zika-fact-sheet>



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Mosquito Spraying Regulations

FLORIDA has some very confusing laws and regulations governing mosquito control. With the threat of a Zika epidemic in Florida, it is important that licensed pest control companies adhere to the standards for mosquito control. Mosquito control can be regulated by either the Structural Pest Control Act (FS Chapter 482) or the Mosquito Control Act (FS Chapter 388).

Pest control companies licensed in the categories of General Household Pest (GHP) or Lawn and Ornamental (L&O) may perform pest control, including mosquito control in, on or under a structure, lawn or ornamental (Florida Statutes Section 482.071). This law refers to spraying residential and commercial properties as a part of normal business practices. However, if a company is doing community-wide mosquito control using handheld, truck mounted, or aerial large-scale methods throughout neighborhoods, agricultural areas, other public areas, or in a contract agreement with a local mosquito control district, then the company must have a public health (PH) license or be operating under the direct supervision of an individual holding a public health pest control license.

The public health (PH) license is substantially different from GHP or L&O license of the Structural Pest Control Act. The rules implemented by FDACS for the PH license are listed in the box at right.

Enforcement of the laws and rules may change due to declared states of emergency regarding the presence of Zika virus. On February 3, 2016, Governor Rick

Scott issued a state of public health emergency for four Florida counties due to the presence of travel-related Zika virus. Since then the number of counties has expanded considerably. The state of public health emergency for Zika triggers preparations for mosquito control operations, but not the application of emergency treatments. That would require a state of emergency for mosquitoes to be declared by the commissioner of agriculture.

As of this writing, the commissioner of agriculture has not declared a state of emergency for mosquitoes. If a state of emergency for mosquitoes is declared, there will be emergency changes to the requirements for licensing to do mosquito control that will only be in effect for the emergency locations and during the mosquito emergency. Contact FDACS for more information on the licensing and certification requirements under Chapters 482 or 388, Florida Statute. **PP**

Contact: Tamara James
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Division of Agricultural Environmental Services
Florida Department of Agriculture and Consumer Services
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Tamara.James@FreshFromFlorida.com

Report by Dale W. Dubberly, Bureau Chief, Division of Agricultural Environmental Services, Florida Department of Agriculture and Consumer Services

Florida Statutes

- 5E-13.021 (21) "Public health pest control" — a category or classification of licensure that includes private applicators, federal, state, or other governmental employees using or supervising the use of general or restricted-use pesticides in public health programs for the management and control of pests having medical and public health and nuisance importance.
- 5E-13.039 (2) Applicators licensed in public health pest control may directly supervise no more than 10 unlicensed employees
- 5E-13.040 (1) It is a violation of these rules for a person to apply a pesticide intended to control arthropods on property other than his own individual residential or agricultural property unless he is licensed to do so or is working under the direct supervision of a licensed applicator, as allowed under subsection 5E-13.039(2), F.A.C.
- 5E-13.021 (28) "Direct supervision" — supervision by licensed applicators, who are responsible for the pesticide use activities and actions of unlicensed individuals. The licensed direct supervisor must be in immediate contact, either directly or by electronic means, including, but not limited to, cell phones, radios and computers.

Featured Creatures Update, continued from Page 25



GHP: The Brown-Banded Cockroach
 Shiyao Jiang and Phillip E. Kaufman, Entomology and Nematology Department, University of Florida
http://entnemdept.ufl.edu/creatures/URBAN/roaches/brown-banded_cockroach.htm

The brown-banded cockroach, *Supella longipalpa* (Fabricius), is a small domestic (cockroaches that live their entire life indoors) cockroach species. This species derives its name from two prominent bands present on nymphs and adults. The brown-banded cockroach resembles the German cockroach, *Blattella germanica*, with its small size and body shape, but it can be distinguished by the absence of two dark pronotal stripes.



GHP: The Paper Wasp, Red Wasp (Suggested Common Names)
 Lizzie Paulus and Andrea Lucky, Entomology and Nematology Department, University of Florida
http://entnemdept.ufl.edu/creatures/misc/wasps/Polistes_carolina.htm

The genus *Polistes* belongs to the subfamily Polistinae, whose members are known as the paper wasps because of the papery nests the queens build and colonies live in. These wasps are primitively eusocial, characterized by morphologically similar reproductive queens and non-reproductive workers, moderate colony sizes (yielding hundreds of offspring in the most successful nests), and independent founding queens.



GHP: The Brown Widow Spider
 Donald W. Hall, Entomology and Nematology Department, University of Florida
http://entnemdept.ufl.edu/creatures/URBAN/spiders/brown_widow_spider.htm

The brown widow spider, *Latrodectus geometricus* Koch, belongs to the family Theridiidae (Foelix 2011, Howell and Jenkins 2004). Theridiids are known as comb-footed spiders because of the comb-like rows of stout, curved bristles on the tarsi (feet) of the hind pair of legs. They are also known as cobweb spiders because of their irregular webs. The brown widow is believed to be native to southern Africa but was originally described from South America (Vetter 2013). Its distribution is now pantropical and also includes many subtropical areas around the world. **PP**



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Broward	GHP L&O	Pending	Gross \$150,000.00

Contact: John Brogan

for a confidential conversation.

Office: 772-220-4455 • Cell: 772-284-4127

E-mail: john@acquisitionexperts.net

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YES, I HAVE THOUGHT ABOUT SELLING, BUT:

I am not sure about the selling price.

I don't know what I would do for a job.

I don't want to jeopardize employee's job(s).

If You have additional questions you would like answered.

Call, text, or email. No Obligation.

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