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DEPARTMENTS

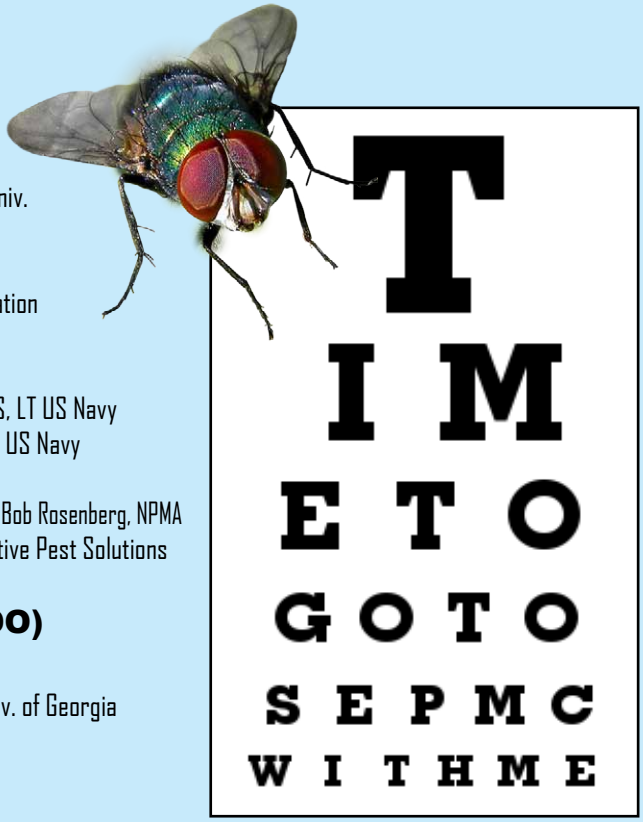
ON THE COVER
Pictured: Sixteen of the speakers scheduled to appear at the 20th annual Southeast Pest Management Conference. Many of this year's "pest pros" are graduates of the UF Urban Entomology program.

Photo illustration by Jane Medley, UF/IFAS

20/20 Perfect Vision

20th Annual Southeast Pest Management Conference

May 3—6, 2015, University of Florida, Gainesville, Florida



May 4, 2015: General Household Pests (GHP)

7:00 AM – 8:30 AM		Registration
8:30 AM – 9:20 AM	GHP	Ants and Ant Control — Karen Vail, PhD, Univ. of Tennessee
9:20 AM – 9:40 AM		Break
9:40 AM – 10:30 AM	GHP	Bed Bugs in the United States — Dini Miller, PhD, Virginia Tech Univ.
10:30 AM – 10:50 AM		Break
10:50 AM – 11:40 AM	GHP	Delusory Parasitosis — Nancy Hinkle, PhD, Univ. of Georgia
11:40 AM – 12:00 PM		SEPMC, Urban Entomology Lab, and FPMA: Partners in PCO Education
12:00 PM – 1:15 PM		Lunch
1:15 PM – 1:40 PM	GHP	Occasional Invaders — Marie Knox, MS, Control Solutions
1:45 PM – 2:10 PM		Ticks: Know the Big Five and Their Management — Jeff Hertz, MS, LT US Navy
2:10 PM – 3:00 PM	GHP	Pest Control in Politically Unstable Areas — Joe DiClaro, PhD, LT US Navy
3:00 PM – 3:20 PM		Break
3:20 PM – 4:10 PM	CORE	2-HOUR CORE: Past, Present and Future of the Pest Control Industry — Bob Rosenberg, NPMA
4:10 PM – 5:00 PM		IPM for Pest Control Companies — Richard Kramer, PhD, Innovative Pest Solutions

May 5, 2015: Wood-Destroying Organisms (WDO)

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9:20 AM – 9:40 AM		Break
9:40 AM – 10:30 AM	WDO	Methods of Termite Testing — Clay Scherer, PhD, Syngenta
10:30 AM – 10:50 AM		Break
10:50 AM – 11:40 AM	WDO	Wood-Boring Beetles — Bennett Jordan, PhD, NPMA
11:40 AM – 1:15 PM		Lunch
1:15 PM – 2:05 PM	WDO	Wood Treatment for New Construction — Dina Richman, PhD, FMC
2:05 PM – 2:55 PM	WDO	Termiticide Injection System — Bob Hickman, BS, BASF
2:55 PM – 3:15 PM		Break
3:15 PM – 4:05 PM	CORE	2-HOUR CORE: Specializing Business for Company Growth — Jonathan Simkins, BS, Insect IQ
4:05 PM – 4:55 PM		History of the Florida Pest Management Industry (Dempsey Sapp) — D.R. Sapp, Fla. Pest Control and Chemical Co.

May 6, 2015: Lawn & Ornamentals (L&O)

7:00 AM – 8:30 AM		Registration
8:30 AM – 9:20 AM	L&O	Current and Expected Trends in Disease — Carrie Harmon, PhD, UF/IFAS Plant Pathology, Gainesville
9:20 AM – 9:40 AM		Break
9:40 AM – 10:30 AM	L&O	Selecting Nitrogen Sources for Turf — Laurie Trenholm, PhD, UF/IFAS Environmental Horticulture, Gainesville
10:30 AM – 10:50 AM		Break
10:50 AM – 11:40 AM	L&O	Interpreting Soil Tests for Landscape Results — George Hochmuth, PhD, UF/IFAS, Gainesville
11:40 AM – 1:15 PM		Lunch
1:15 PM – 2:05 PM	L&O	Landscape Plant Scene Investigation (PSI) — Jim Davis, MS, UF/IFAS Sumter County Extension
2:05 PM – 2:55 PM	L&O	Managing Specialty Turf — Jason Kruse, PhD, UF/IFAS Environmental Horticulture, Gainesville
2:55 PM – 3:10 PM		Break
3:10 PM – 4:00 PM	CORE	Working Safely With Pesticides: Interactive Skillathon — Sheila Dunning, MS, UF/IFAS, Okaloosa Cty. Ext.
4:00 PM – 4:50 PM	CORE	Identification of Pest Droppings and Burrows — William H. Kern, Jr., PhD, UF/IFAS Ft. Lauderdale REC

http://entnemdept.ifas.ufl.edu/sepmc/Main_Page.html
https://www.eventbrite.com/e/southeast-pest-management-conference-registration-15048162459

SE Pest Management

Conference Celebrates a Significant Milestone

THIS YEAR we are proud to celebrate the 20th anniversary of the SE Pest Management Conference. The cover for this issue of *PestPro* shows graduates of my urban entomology program along with D.R. Sapp and Bob Rosenberg, good friends of urban entomology at the University of Florida. All of them are going to be presenting at the SE Pest Management Conference in May. These folks are all well known superstars in urban entomology because of their accomplishments over the years.

Twenty years ago

Dr. Roberto Pereira and Dr. Phil Koehler of the University of Florida Urban Entomology Lab are leaders of the Southeast Pest Management Conference.

- **Jon Simkins** is owner of Insect IQ in Tampa and is well known for his work with bees and bee removal.
- **Dr. Dina Richman** is charged with developing new products in the pest control industry for FMC.
- **Dr. Bill Kern** is an associate professor at the University of Florida in Ft. Lauderdale and is an encyclopedia of knowledge on vertebrate biology as well as invertebrates.
- **D.R. Sapp** heads up one of the largest family-operated pest control companies in the country and is a long-time friend and benefactor of our urban entomology program.
- **Dr. Nancy Hinkle** is a professor of entomology at the University of Georgia and has a tremendous program for delusory parasitosis, flies and fleas.
- **Dr. Clay Scherer** is technical service for Syngenta and is always willing to share his expertise on how experiments are designed to demonstrate effectiveness of new products.
- **Dr. Karen Vail** is a professor of entomology at the University of Tennessee and has been on the forefront of helping the pest control industry control ant infestations.
- **Dr. Joe Diclaro**, a U.S. Navy entomologist now stationed in Ghana, is familiar with controlling insects in politically unstable parts of the world. He has been active in Afghanistan, Egypt, and Ghana, dealing with horrendous infestations of flies and mosquitoes.
- **Bob Rosenberg** is the Executive Director of NPMA, a graduate of the University of Florida, and will share his vision for the future of the pest management industry.
- **Dr. Dini Miller** is a professor of entomology at Virginia Tech and is considered the world's leading expert on bed bug management.
- **Jeff Hertz** is a military entomologist who is working on his Ph.D. researching ticks and the diseases they transmit.
- **Dr. Dan Suiter** is an associate professor of entomology at the University of Georgia who has been on the forefront of training the pest control industry with hands-on as well as distance education.
- **Bob Hickman** is technical service for BASF and freely shares his knowledge of new application devices for termite control.
- **Dr. Richard Kramer** is owner of Innovative Pest Management in Maryland and is a leader in the practical implementation of IPM in the industry.
- **Dr. Bennett Jordan** is at NPMA's technical department and is providing information to the industry worldwide on wood-boring beetles.
- **Marie Knox**, director of product development with Control Solutions, helps develop and test innovative application methods for treating invading pests of structures.

Both this magazine and our conference are valued parts of our efforts to provide the pest control industry with the best technical and up-to-date information available. New research and information are not good for the industry if the knowledge of all these specialists is placed on a bookshelf and not used. Our SE Pest Management Conference and *PestPro* magazine are good examples of how we have not only trained but have gotten the best-known urban entomologists to share their expertise with the industry.

The first issue of the new *PestPro* was so popular many pest management professionals in all parts of the country want to subscribe. Our readership is about 12,000 people. You can help our educational efforts either by advertising in *PestPro* magazine or by investing in the education of future leaders in the industry by supporting our conferences and our students.

PestPro magazine could not have been reborn without the support of our Founding Partners of *PestPro*, a group of elite companies. These companies guaranteed the future of *PestPro* by providing their entire first year's advertising dollars now for either a half- or full-page ad. These Founding Partners help us provide *PestPro* magazine at no cost for the pest management industry in Florida. Take a look at the list on page 6, and give special consideration to the products and services of our Founding Partners. PP

— Dr. Philip Koehler, Managing Director

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Ben Scratching The Surface

Photograph by Tyler Jones, UF/IFAS

Rough or smooth: Which texture would a bed bug choose? *Ben knows.*

CDC

BEN HOTTEL will graduate on April 30, 2015, with a PhD in entomology from the University of Florida. We asked Ben about how he got into entomology, his experience as a graduate student of Dr. Phil Koehler, and his research on bed bugs.

Ben, how did you first get into entomology?

I have been interested in entomology ever since I was a kid. My mother is a technical director for a pest control company in Illinois, and she would take me around to entomology meetings and conventions around the country. I received a bug net early on as a child and loved the challenge of catching dragonflies and stinging insects. While I did love biology because of all these experiences, I ended up majoring in agricultural economics at the University of Illinois for my bachelor's degree. I took a variety of business courses in marketing, management, accounting, finance, and economics. However, I was still interested in biology and took various classes such as *Insects and People* with May Berenbaum, department head of entomology at the University of Illinois. After a business internship in wheat merchandising, I decided the economics field wasn't for me and looked into opportunities to get into biology. I had enough biology classes to apply for a master's degree position at the University of Illinois. I was accepted and worked on dark eyed fruit fly monitoring.

Why did you come to UF?

Bed bugs were becoming a hot topic, and I wanted to get in on the action. Dr. Koehler had a position available for a bed bug PhD student, so I jumped on the chance to get started.

What was it like at first working with bed bugs?

They were a lot different than working with dark eyed fruit flies. Other than the obvious difference that bed bugs can't fly, I now had to worry about bringing my work home with me. I didn't care about bringing bed bugs back to the house so much as worry about how much my roommates would freak out if I accidently infested the house with bed bugs. Fortunately, it never happened.

Was Dr. Koehler's lab what you thought it would be like?

It was not like I expected. I was originally in a lab with only a few people, and Dr. Koehler's lab had over 15 people working in it at the time I arrived. Also, there is a fun atmosphere at the lab. It is never a boring day.

Does Dr. Koehler really dislike cats?

He has cat statues in front of his office. I don't know if these are to ward off cats or if they represent some sort of cat shrine.

Was there anything you disliked about your experience at UF?

Not everyone may know this, but bed bugs are actually a pest of poultry, and we actually use chickens to raise bed bugs. I can't say I enjoyed cleaning up chicken poop.

Is it hard coming up with research ideas?

Yes, it can be difficult. A few of my research ideas were inspired from other research studies, but others were made from casual observations of bed bug behavior. I would recommend any researcher to play around with their study insect and observe its behaviors before designing experiments.

What research did you work on?

Bed bugs cross a wide range of surfaces when they travel from their hidden harborages to their human victims. Because bed bugs can't

Koehler cat shrine, or cat repellent? *Ben does not know.*

Photographs on pages 8 and 9 by Jane Medley, UF/IFAS

jump like fleas or fly like mosquitoes, they entirely rely on crawling around. As you can imagine, surfaces can have a huge effect on insects that rely solely on crawling to move about. I examined the effects of some of these surface characteristics on bed bug behavior.

Hey Ben, can you share any of your research findings?

My first project at the Urban Entomology Lab examined the ability of bed bugs to grip different surfaces. Bed bug performed equally well at griping smooth surfaces such as glass and plastics used in bed bug interceptor traps. When baby powder was added to these traps, however, we observed a huge reduction in the ability of bed bugs to grip these surfaces. Interestingly, we also found that a special surface created by a lab in the Materials Sciences and Engineering Department was almost as difficult for bed bugs to grip as the talc-covered surfaces.

Another experiment I worked on tested the effects of surface roughness and pyrethroid formulation applications on bed bug harborage preference. Bed bugs were found to rest on rougher surfaces regardless of the materials used in the experiments. Pyrethroids themselves were found not to have an effect on rough surface harborage preference, but some formulations had additives that caused repellency.

I also performed a project that focused on the behavior of bed bugs moving in areas that had surfaces of different roughness. A machine called an optical profilometer quantified the roughness of these surfaces. Bed bugs showed an aversion behavior to smoother surfaces. Since cockroach sticky traps haven't been shown to work well with bed bugs, we looked into the surface characteristics of cockroach sticky traps. As surface roughness decreased around the adhesive of the trap, bed bugs were more likely to get caught in the adhesive. Bed bugs couldn't get a good enough grip on these smooth surfaces to pull themselves out of the adhesive.

You mentioned a "special surface" created by the Materials Sciences and Engineering Department. What is this special surface?

It is a nano fiber plastron surface that repels water. The surface looks hairy under high magnfication.

Sounds interesting, but do these experiments have any applications in the real world?

After seeing how well talcum powder reduces the traction bed bugs generate on smooth surfaces, I would always recommend talc applications to any pitfall trap. The plastron surface created by the Materials Sciences and Engineering Departments was patented and could be used in pitfall traps, so talcum powder would no longer be needed.

The rough-surface harborage preference can give us a better idea of areas where bed bugs may hide in the environment. When inspecting for bed bugs or making insecticide applications, you would want to focus in areas where bed bugs would hide, such as in rough-surface areas on furniture. For example, rough, nonvarnished locations on a night stand are much more likely to have bed bugs harboring on them than smooth, varnished locations.

Bed bugs' aversion to smooth surfaces may not seem important, but it became very important in modifying the cockroach sticky trap to work on bed bugs. Surfaces with low roughness values were found to catch more bed bugs in the cockroach sticky adhesive, but fewer bed bugs would come near the adhesive if the surrounding surface was too smooth. Therefore, you need a surface around the trap that is rough enough that bed bugs will come onto the trap but not so rough that bed bugs will be able to pull themselves out of the adhesive when they contact it. This idea was the basis of my first patent on a modified sticky trap used to trap bed bugs.

Ben at the Urban Entomology Lab

Do you have any other patents?

I have a few other patents I received while collaborating with a lab in the Materials Sciences and Engineering Department. One of my other patents includes the plastron surface I discussed earlier, and another one involves creating an artificial spiderweblike structure to entrap bed bugs.

What are your plans after graduation?

I am looking for research positions post-graduation, but I may go on a trip to Spain with a club from the University of Florida if I have time. PP

Cockroaches ARE BACK:

Why Your Treatments May Not Work

Philip Koehler and Roberto Pereira

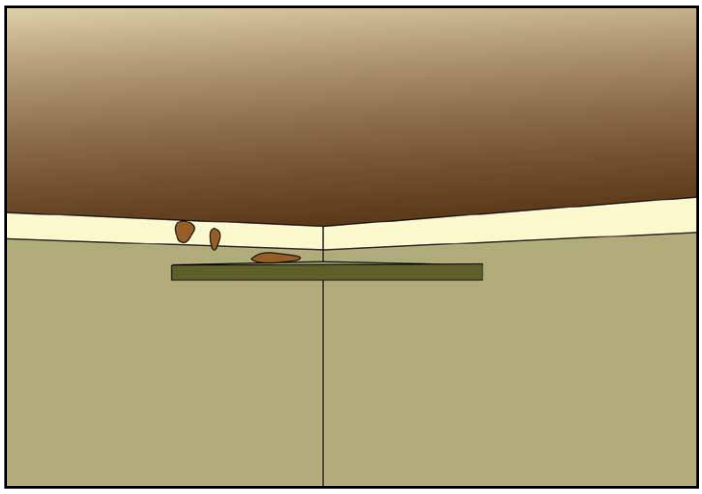
WE REMEMBER back in 1988, German cockroaches ran rampant throughout food service facilities and affordable housing, where many of the food workers lived.

WE DID A SURVEY of affordable housing apartments to determine the numbers of German cockroaches living there. We used sticky traps to assess population levels. Some traps came back with heavy catches, holding 225 German cockroaches only 24 hours after placement. When we treated, the floors would be covered with dead and dying cockroaches so the kitchen floor looked like it was made of roach-motif flooring. Most German cockroach infestations were usually found in kitchen areas, but great infestations extended into the bathroom and bedrooms. We even found infestations in the bed, where the cockroaches would crawl onto sleeping people to feed around their eyes, nose and mouth.

After the development and extensive use of gel baits, German cockroaches were difficult to find. In fact for the past 20 years, most cockroach researchers have either retired or moved on to studying other urban pests. Our lab is one of the few left working with cockroaches.

Cockroaches have returned but the researchers have not. Recently, inspectors found cockroach infestations in Florida's theme parks. Last year 14 of 18 restaurant

Under a counter inside a roach-infested cabinet, bait is hard to place.



Under a counter, old bait is difficult to remove.

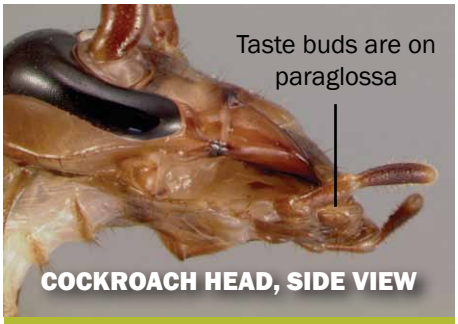
closures in the Tampa Bay area were due to "roach activity." Cockroach infestations have been found in USDA-inspected food processing plants, and their operations have been suspended. Cockroaches have been found in airline food, and even chocolate allergies have been linked to cockroach parts in the candy. In 2012, apartments in Jacksonville were found to be "unfit for human habitation" because of infestations of cockroaches, bats, and dangerous wiring. The residents were forced to vacate the premises with very short notice and were angry that management did not do more to keep the place habitable.

So cockroaches are back and thriving. Some of the gel baits that we have evaluated for cockroach control are MaxForce Magnum, MaxForce Select, and Advion cockroach gel. Magnum is advertised as being the most powerful cockroach gel. Cockroaches eat, touch, and share it with other cockroaches. MaxForce Select kills roaches by ingestion and contact. Advion is advertised as killing all pest species of cockroaches and provides speed and spectrum, all in a single product.

We tested the three baits on the larger cockroach species — American, smokybrown, Oriental, and brownbanded cockroaches — to see how fast these gel baits killed a variety of cockroach species. For all three baits and for all four cockroach species, the gel baits kill them in about seven days with greater than 90 percent mortality. These species are larger, weigh more than German cockroaches, and as a result take longer to die. But all these baits were successful for a variety of cockroach species.

To Kill and Kill Again

Most successful cockroach baits work better if they are slow acting. The reason for a slow-acting bait is to allow secondary kill. In other words, cockroaches that do not feed directly on the bait can be killed. There are four mechanisms of secondary kill for insects.



COCKROACH HEAD, SIDE VIEW

COCKROACHES HAVE RETURNED BUT THE RESEARCHERS HAVE NOT.

First, there is trophallaxis, which is when bait is passed mouth to mouth. This is important for control of ants, but not for cockroaches. The ants feed on the bait and regurgitate it for other ants.

The second mechanism of secondary kill for cockroaches is coprophagy. Coprophagy is the consumption of feces and is probably the most important mechanism of secondary kill for cockroach control. Cockroaches eat the bait and it passes through their gut in eight to 12 hours. The active ingredient is about 80 to 90 percent of its initial concentration in their feces. Newly emerged first-stage cockroach nymphs eat feces almost exclusively and die as a result of eating bait-contaminated feces.

Cannibalism, or necrophagy, is the third mechanism of secondary kill. This is where hungry cockroaches eat other cockroaches that are either harboring or dying near them. They usually rip open the abdomen and consume the crop, where bait that has been recently ingested is waiting to be digested. Cockroaches slowed or killed by the action of insecticides in the bait are the most preferred for cannibalism.

The last mechanism of secondary kill is emitophagy. Emitophagy is basically the consumption of cockroach vomit. Cockroaches affected by the insecticides in baits will often regurgitate. This regurgitated bait is something other cockroaches want to eat. They will gather around a vomiting cockroach and rapidly consume the nutrients and the insecticide from the bait.

Fresh bait, at left, and bait after 24 hours.

Resistance — Not Always Futile

Even though the gel baits have been extremely effective for German cockroach control for more than 20 years, we are now seeing failures of baits. We have colonies of German cockroaches collected from various locations. All the cockroaches have some level of resistance to the pyrethroid insecticides. Some of these German cockroaches are bait aversive. These colonies we maintain in the laboratory and try to keep their resistance levels high. One strain we treat every other month with gel bait, and the other month we treat with pyrethoid insecticide. We have done this for about 10 years with this cockroach strain. The insecticides have virtually no effect on the colony. That colony is extreme, and most German cockroaches found in the pest control industry are not as difficult to kill. However, there are increasing reports of gel-bait failures.

What causes gel baits to fail? There are three main factors that can cause gel baits to fail. The first is technician error. Technician error can be improper placement of bait, which is usually a technician who is resistant to work. Proper placement of bait is usually where cockroaches harbor. Cockroaches are lazy and will eat the food that is closest to where they live. If the harborage is under a kitchen counter, the placement should be in the supports under the counter. That requires the technican to take the time and effort for proper placement. Another type of technician error is allowing old bait to build up. The old bait is not palatable and only enhances bait aversion by a cockroach population.

The second cause of bait failure is insecticide resistance. Insecticide resistance is when cockroaches eat the bait but the insecticide is broken down by enzymes into nontoxic metabolites. Insecticide resistance in baits has not been reported for many of the bait insecticides. However, one of our colonies used to refuse to eat the bait, but over time it now consumes all the bait but does not die. That colony definitely has insecticide resistance to the bait and would be impossible to control in an account with that particular active ingredient.

The third cause of bait failure is bait aversion. This is where the cockroach senses a component in the bait that is unpalatable. The component could be the active ingredient, the gelling agents, or the sugars used to sweeten the bait for a cockroach snack. The sugar aversion has been the best studied and the most frequently encountered type of bait aversion in German cockroaches. The cockroach has taste buds on the paraglossae, which are mouthparts on the side of the mouth. These taste buds detect glucose sweeteners and cause normal cockroaches to eat the bait. However, in bait-averse cockroaches, the sensors interpret the taste as both sweet and bitter. Because of the bitter taste, the cockroaches refuse to eat it.

Of course, the solution to bait aversion is to change the formulation so glucose aversion is avoided. We have found that the sweeteners for bait in bait stations can be completely different than the ones in gel baits. Also, granular baits can be used because they also use different sweeteners. These baits can overcome bait aversion. Rather than scattering granular baits in a residence, we recommend attaching them to sticky traps and placing the baited sticky traps near cockroach harborages. We have seen cockroaches completely consume the bait off these cards and die in large numbers. Not all granular baits are registered for indoor use, so read and follow the directions on the granular bait labels.

Vary Your Approach

To solve the resurgence of cockroaches, the pest management industry needs to adopt an integrated cockroach management program using baits, sprays and dusts. Baits can overcome the pyrethroid resistance problem with most of the registered sprays for indoor use. Through our work at the UF Urban Entomology Lab, we have been able to take out large populations of cockroaches using just baits. However, we put out as much as 1.5 pounds of gel bait in a single mobile home. Sprays can be very useful to provide a residual on surfaces and in areas where there are large quantities of competing food due to poor sanitation. Dusts are useful in treating voids and cracks where cockroaches harbor. Dusts can also move cockroaches from very hard-to-treat areas to areas where they are easily controlled.

The cockroaches are back. They are major problems in restaurants, apartments, food manufacturing and processing plants, and residences. They are back because of technician error in some cases, insecticide resistance, and bait aversion. Make sure your company is adjusting its management plan to take care of these "super" cockroaches. PP

Philip Koehler is Endowed Professor and Roberto Pereira is Associate Scientist at UF/IFAS Entomology and Nematology Department.

Adult weevil and larva photos by Lyle Buss, UF/IFAS

Palm Weevil

Lynn Griffith

Several species of weevil are known to attack palms. In Florida the palm weevil, *Rhynchophorus cruentatus,* is native and exists throughout the state. It may have coevolved with *Sabal palmetto,* our state tree. Adult palm weevils are just over an inch long, with a varying pattern of red and black on their bodies. The distinctive characteristic is the pronounced snout, which is about a quarter of an inch long.

In the wild, the palm weevil's primary host is probably saw palmetto, *Serenoa repens,* though they are known to attack *Phoenix canariensis, Washingtonia* and *Bismarckia* species, along with sabal palm and others.

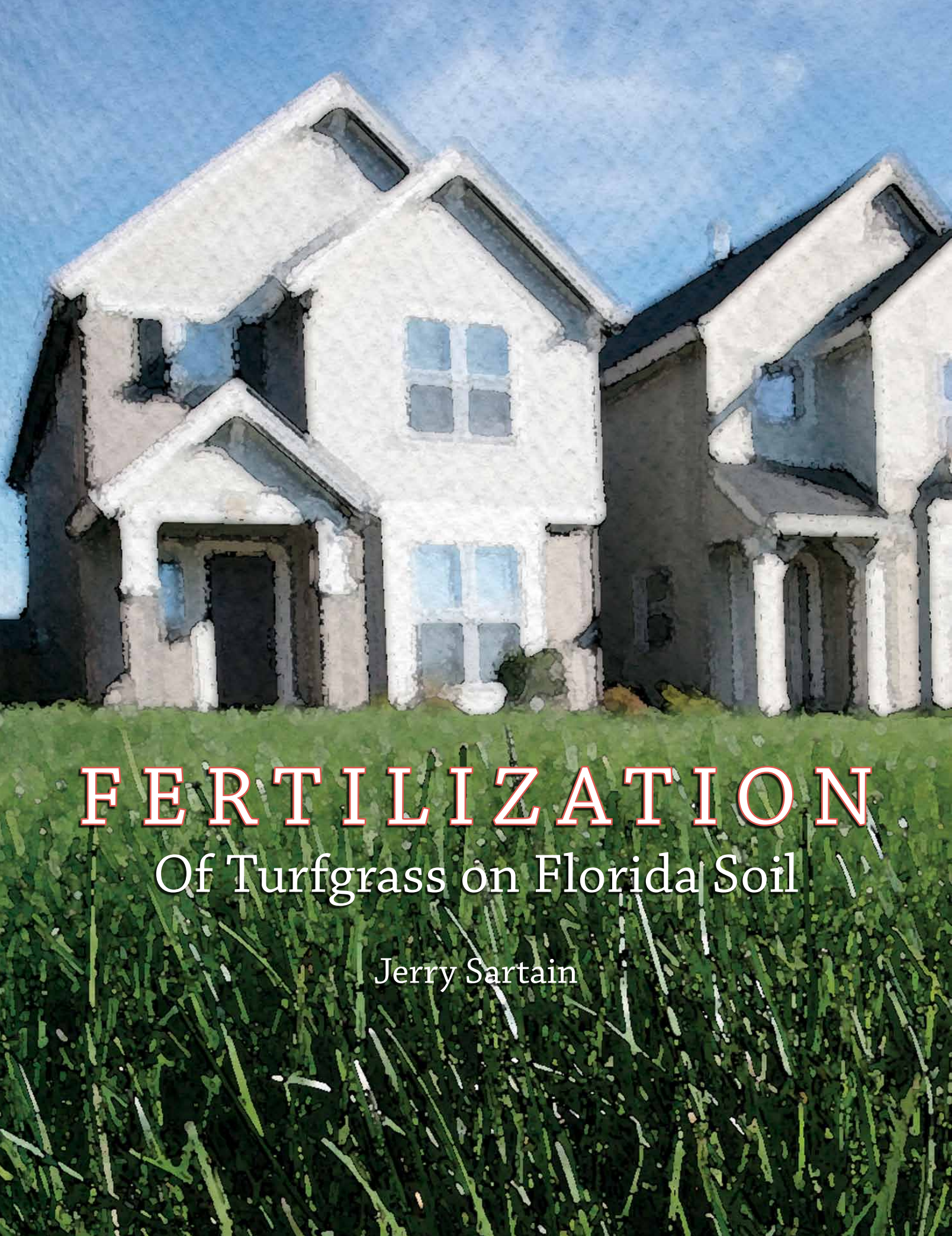
Palm weevils generally attack palms that are stressed by either transplanting or pruning, responding to chemical stress signals from the palm. Male palm weevils respond to these palm esters, and they in turn generate pheromones that attract additional weevils. Female weevils lay eggs in the palm bud region. Weevil larvae can be the size of your thumb, and they quickly devour the heart tissue, destroying the palm.

External symptoms can be difficult to spot on larger palms without closely observing the bud tissue by using a ladder or lift. Sometimes you can hear larvae feeding by placing a stethoscope on the palm trunk. Occasionally you may see large holes in bud tissue or leaf sheaths. Damaged bud tissue often causes the spear leaves to either fall over or collapse altogether. Newly pruned *Phoenix* palms seem to be especially susceptible. While stress is said to attract the weevils, I have seen severe infestations on *Bismarckia* palms in tree farms with no apparent signs of plant stress.

Control options are sketchy. In the old days, lindane and Dursban were thought to be somewhat effective. Drenching or injecting imidacloprid may be somewhat helpful for palms that have been recently transplanted or pruned. One enterprising landscaper I know hangs bars of perfumed soap in susceptible trees in order to mask or disguise odors emanating from stressed palms.

When dealing with palm problems on your accounts, keep palm weevil in mind as a possible cause, especially in palms that are stressed. PP

Lynn Griffith is a tropical plant and soil expert, A&L Southern Agricultural Lab



FERTILIZATION

Of Turfgrass on Florida Soil

Jerry Sartain

In many neighborhoods, people envy the individual with the most beautiful lawn, and they want to hire a company that will grow a lawn of equal quality.

A well-maintained lawn only requires some knowledge about fertilization, watering, pest control, and mowing. This article provides basic information about fertilization. By far, the best approach to a proper fertilization program is to start with a soil test, but if a soil test is not available, these guidelines can be used for a general turfgrass fertilization program.

Essential Elements

All plants require certain chemical elements for proper growth and appearance. Of these nutrients, at least 16 are known to be essential elements. All essential elements except carbon, hydrogen, and oxygen are obtained from the soil and absorbed by plant roots.

If inadequate nutrients are available in the soil, turfgrass growth and quality may be limited. However, essential elements can be added to a soil through fertilizer applications.

Turfgrasses require the macronutrients nitrogen (N), phosphorus (P), and potassium (K) in greatest quantities. Calcium (Ca), magnesium (Mg), and sulfur (S) are required in smaller quantities. The micronutrients iron (Fe), manganese (Mn), zinc (Zn), copper (Cu), chlorine (Cl), molybdenum (Mo), and boron (B) are required in very minute quantities. Micronutrients are as essential as the macronutrients, but are required in much smaller amounts.

Types of Fertilizers

Fertilizers are identified by analysis and/or brand name. Many common commercial fertilizers are known by their grade, such as 16-4-8, 10-10-10, or 6-6-6. A complete fertilizer contains N, P, and K. The numbers indicate the percentage of each of these nutrients. These three constituents, N, P, and K, are called the primary plant foods; if all three are present, the fertilizer is referred to as a complete fertilizer. Besides the primary elements (N, P, and K), the fertilizer may contain secondary plant foods. The secondaries may include Ca, Mg, S, Mn, Zn, Cu, Fe and Mo.

Both primary and secondary elements, if present, are listed on the fertilizer label. The label also tells the materials from which the fertilizer has been made. This information appears below the "derived from" statement.

In addition to complete fertilizers, some materials are used almost exclusively to supply N to turfgrasses for rapid growth and dark green color. These materials include soluble forms of N; ammonium nitrate (34% N), ammonium sulfate (21% N), urea (46% N), calcium nitrate (15.5% N), potassium nitrate (13% N & 44% K_2O) and slow-release N sources; Ureaformaldehyde (38% N), Isobutylidene diurea (31% N), Sulfur-coated urea (36-39% N), Nutralene (40% N), and Polyon (40%–43% N). Turfgrasses commonly require higher rates and more frequent applications of N source fertilizers than other nutrient sources. In most cases, slow-release N sources can be used to reduce the potential for leaching losses of applied N. In order to obtain the desired growth and color response in most cases, a mixture of soluble and slow-release N sources is recommended for use on turfgrasses. It should be pointed out that turfgrasses are one of the most N-absorbing efficient ground covers that one can use. When fertilized at the recommended rate and frequency, N leaches very sparingly, if at all, from the turfgrass system. Poor quality, slow-growing and improperly fertilized turfgrasses actually leach much more N than turfgrasses growing at optimum levels. A quality turfgrass furnishes a complete and uniform cover of the soil surface. The highest quality turfgrass is not necessarily the darkest green or most rapidly growing turfgrass, but the turfgrass that has acceptable color and density without excessive growth. Excess N application can lead to a dark green turfgrass that is growing at excessive rates, requiring more frequent mowing and possibly resulting in contamination of the groundwater with nitrate nitrogen. *Continued next page*

This article is excerpted from *General Recommendations for Fertilization of Turfgrass on Florida Soil,* Publication SL21, UF/IFAS Soil and Water Science Department.

For Florida turfgrasses, the best yearly fertilization program usually includes a combination of one or two applications of multiple nutrient fertilizations and several supplemental applications of an N fertilizer. Nitrogen fertilization is often based on the desired growth rate and type of turfgrass being grown.

Due to past fertilization and the inherent nature of some Florida soils, P fertilization is not always required. One should depend on a recent soil test to determine if P is required for optimum turfgrass growth. If your soil test indicates an adequate level of extractable soil P, choose a fertilizer blend that does not contain P as one of the supplied nutrients. Excess P application can result in enrichment of the P status of run-off or leachate waters, and in the eutrophication of adjacent water bodies.

Second only to N in total fertilization requirement is K. Potassium influences root growth and water and stress tolerance relationships in turfgrasses and should be maintained at adequate levels for optimum growth. In most turfgrass growth systems, the potassium fertilization program should be based on a recent soil test.

Fertilizer Application

Most fertilizers are applied at a rate determined by the type and amount of nitrogen present in the material. Nitrogen is the nutrient most used by a turfgrass and often the material that burns the turfgrass if applied at excessive rates.

The pounds of actual N in every fertilizer can be determined by dividing the percent N listed on the label into 100. For example, if applying soluble N from ammonium sulfate, divide 21% (the N content of ammonium sulfate) into 100 to find the number of pounds of ammonium sulfate that will supply 1 pound of N. Since 100 divided by 21 equals approximately five, 5 pounds of ammonium sulfate would supply 1 pound of N.

Inorganic Nitrogen Sources	
Advantages	**Disadvantages**
Readily available N	Leach readily
Low cost per pound of N	Danger of fertilizer burn
Easily controlled N Levels	High salinity potential
Little problem of residual N	Must be applied frequently at low rates

Table 1. Advantages and disadvantages of inorganic nitrogen fertilizer sources.

Organic Nitrogen Sources	
Advantages	**Disadvantages**
Slow release of N	May be very expensive per pound of N
Less subject to leaching loss	Not released at adequate rate during cool season
Small danger of turfgrass burn	Application response may be slow
May be applied infrequently at high rates	May contain weed seeds that contaminate turfgrass

Table 2. Advantages and disadvantages of organic nitrogen fertilizer sources.

Organic vs. Inorganic Fertilizers

There is much confusion over whether to use organic or inorganic fertilizers on turfgrasses. Both types have advantages and disadvantages. However, the type of fertilizer makes no difference to the turfgrass. Grasses absorb N as nitrate- or ammoniacal-N. Organic N is not used directly by the plant but must first be converted to one of the above chemical forms by soil microorganisms before being taken up by the plant.

The advantages and disadvantages of organic or chemical fertilizers relate to the consumer, not the turfgrass. Inorganic N fertilizers have advantages and disadvantages as listed in Table 1.

Organic N fertilizers also have advantages and disadvantages as listed in Table 2. Select an N source after considering the pros and cons of the various forms. A mixture of the two will most likely result in the best response.

Supplemental Iron Application

Many times turfgrasses such as centipedegrass, bahiagrass, and St. Augustinegrass turn yellow during the summer due to lack of N fertilizer. However, fertilization with N in the summer is not always desirable, since this often encourages disease and insect problems. Many times the addition of iron (Fe) to these grasses provides the desirable dark green color, but does not stimulate the excessive grass growth that follows N fertilization. Usually, iron sulfate (2 ounces per 3–5 gallons of water per 1,000 square feet) or a chelated iron source are used to provide this greening effect. The effect from supplemental iron application is only two to four weeks. Therefore, repeat applications are necessary for summer-long color.

Preventing Fertilizer Injury To Plants

All soluble fertilizers may burn the turfgrass if improperly applied. To avoid burn, never apply fertilizer at greater than the recommended rate. If only slow-release N materials are used, up to 2 pounds of N can be applied in a single application. Apply P and K only when required based on a recent soil test, and do not exceed the recommended rate of application, especially for P.

Always apply fertilizers when the turfgrass leaves are dry, and water thoroughly after application. Apply enough water to dissolve the fertilizer and move it below the surface. This is generally accomplished by applying between ¼ and ½ inch of water through the irrigation system, which you can do by running a typical turfgrass irrigation system for 15 to 20 minutes. Excess irrigation may leach the soluble N below the root zone, so great care should be taken not to water too little or too much. PP

Jerry Sartain is Professor Emeritus at UF/IFAS Soil and Water Science Department

Millipedes EVERYWHERE

Catharine Mannion

What is that insectlike creature with lots of legs? Is it a centipede or a millipede?

Catharine Mannion, UF/IFAS

Centipedes are usually brownish, elongated, flattened arthropods with numerous legs, ranging from 10 to 100 legs depending on the species. Centipedes have one pair of legs per body segment and can be 1 to 6 inches long. Centipedes are predators and will feed on other arthropods, including insects. They are usually found in damp, dark places. Centipedes can bite and do carry venom, which can cause temporary localized pain.

Millipedes are more wormlike than centipedes and cylindrical or flattened with many body segments, each with two pairs of legs, giving the appearance of thousands of legs. Millipedes feed on decaying matter and are often found under stones or debris and can sometimes be a minor garden pest.

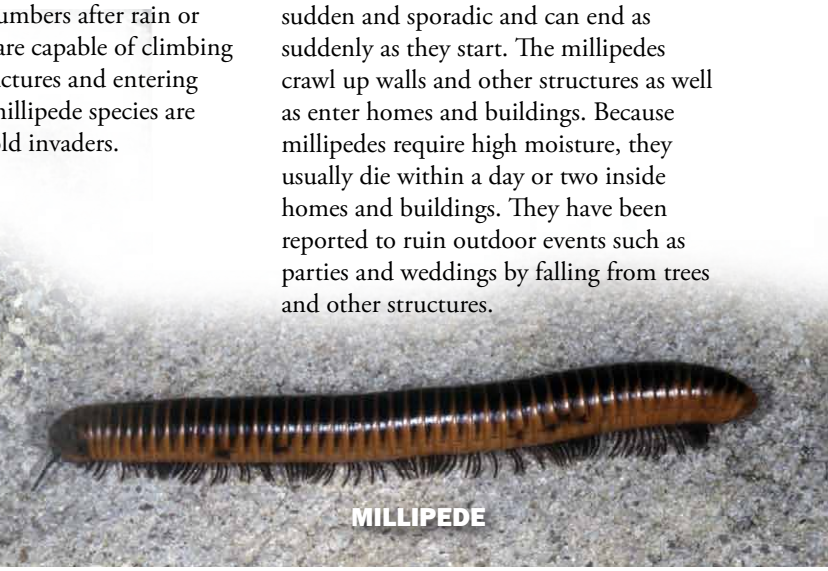
There are more than more than 51 species of millipedes in Florida, with several that are common in the Florida landscape. Millipedes can vary in body shape and size and are often black or brown. Most millipedes are detritivores and feed on decomposing vegetation, feces, or organic matter mixed with soil. They can play an important role in the breakdown and decomposition of leaf litter. There are a few species that feed on living plants, fungi, or other organisms such as insects, earthworms and snails. Millipedes tend to move slowly and do not bite or sting. When disturbed they often curl into a tight coil. Some species can emit a foul-smelling liquid as a defense mechanism. Some of these substances have been shown to be an irritant to insects and other organisms. Monkeys have been observed intentionally rubbing millipedes on themselves, potentially providing protection from mosquitoes or other pests. In folklore and traditional medicine around the world, millipedes have been used in rituals to treat fever, convulsions, wounds, earaches and even hemorrhoids.

Although millipedes are generally not considered pests, they can definitely become an annoyance or nuisance. For example, millipedes may migrate into buildings in high numbers after rain or cold periods. They are capable of climbing walls and other structures and entering dwellings. Several millipede species are considered household invaders.

INVASION OF THE PARTY CRASHERS

In South Florida, two introduced species of millipedes have become frequent unwanted guests within homes, buildings and at many outdoor events. The yellow-banded or bumblebee millipede, *Anadenobolus monilicornis*, was first found in Monroe County in 2001. This millipede is brown with narrow yellow bands and red legs. It may grow to 4 inches long. Like other millipedes it lives in leaf litter or other organic areas. In 2005, another millipede observed in South Florida was determined to be *Trigoniulus corallinus*, sometimes called the rusty millipede. This millipede now sometimes rivals the yellow-banded in being a nuisance. This millipede is about the same size and shape as the yellow-banded millipede but has red bands, giving it an overall red color. It also has a more gray color form.

One of the biggest complaints about these two millipedes is that all of a sudden they are everywhere in extremely high numbers. These migrations are often sudden and sporadic and can end as suddenly as they start. The millipedes crawl up walls and other structures as well as enter homes and buildings. Because millipedes require high moisture, they usually die within a day or two inside homes and buildings. They have been reported to ruin outdoor events such as parties and weddings by falling from trees and other structures.



Centipede and millipede photos by Lyle Buss, UF/IFAS

Aditya Madhurawada, Wikimedia Commons

Why we see these large migrations is not completely understood. They are often observed during the rainy season but have also been seen under very dry or drought conditions. They prefer moist conditions, so too wet or too dry may drive them to find better locations. Or, as seen in several insect groups, migration may be related to breeding — they might move from a feeding area to a breeding area, or move to increase contact among individuals. Or, similar to earthworms, it is speculated that rains give them an opportunity to move greater distances across surfaces than they could do through soil and also to mate above ground. The biology and behavior of these millipedes is not well known, and we can only speculate on this migration behavior.

PREVENT MASS ATTACKS

What can be done about these mass numbers of millipedes that suddenly show up in and around houses and buildings? There are no easy answers. If possible, remove debris, leaf litter, and other favorable habitats around building foundations. Divert water away from buildings, and avoid overwatering landscapes. Focus on the shady, moist areas where the millipedes are more likely to reside. Seal cracks or openings into homes and buildings with weather stripping and caulking when possible.

If the problem remains persistent and severe, insecticides may help reduce indoor invasions. Pyrethroid insecticides (i.e., bifenthrin, cyfluthrin, lambda-cyhalothrin, and permethrin) are recommended for this use. Usually only shaded sides of the home need to be treated. Treating entire yards is unnecessary and not recommended. These products can be used as chemical barriers around a structure. Millipedes inside homes can be swept or vacuumed. However, vacuuming may cause the millipedes to discharge an objectionable odor. Physical barriers and traps have been suggested but may not always be feasible or successful in reducing the invasion.

A barrier that has a sticky surface may be able to trap millipedes but would need frequent replacement due to other debris covering the sticky surface. Barriers with a smooth, slick surface may prevent millipedes from climbing, or a barrier at the base of a house that turns back on itself so the millipedes cannot successfully get around it to the wall, may prevent indoor invasion. If the area they are migrating from can be identified, then a combination of factors such as insecticides, barriers and traps may be the most useful in reducing the "stampede." PP

Catharine Mannion is a Research and Extension Specialist, UF/IFAS Tropical Research and Education Center, cmannion@ufl.edu

Closing More Sales
Through Relationship Selling

HARVEY F. GOLDGLANTZ

If you or your sales team is still selling the same old traditional way, then your lead-to-close ratio is most definitely not where it could be.

The Traditional Sales Model

Traditional sales techniques involve detailing features, "hawking" service, presenting and defending price, submitting the proposal and, hopefully, closing the sale.

The salesperson usually maintains control of the conversation from beginning to end, asking questions and making assumptions as to what the client wants or needs.

Salespeople who engage in excessive small talk, demean their competition, or simply "pitch" their offering with scores of features per minute all exhibit traditional traits that will drive away today's highly demanding prospects.

The Relationship Sales Model

The key to successful selling today is through building relationships and problem-solving. Relationship selling should be considered as the preferable sales technique.

Relationship selling is defined as personal selling in which the salesperson becomes a trusted advisor to the customer and plays the role of a consultant.

This type of selling strategy requires sales professionals to focus every ounce of attention on first identifying, then satisfying, the needs and wants of their customers.

Salespeople can no longer "pitch" their product. Instead, they must ask questions, listen to answers, and provide sound recommendations and advice.

This technique focuses on building relationships, creating an atmosphere of trust, and selling the way your customer wants to buy — not the way you like to sell. The hard close is thus replaced by the strong opening.

The traditional salesperson is the talker; the Relationship salesperson is the listener.

Nine Characteristics Of the Successful Relationship Salesperson

1) Outstanding listening skills, 2) Takes the time to build the relationship, 3) Understands the client's unique problem, 4) Offers solutions for the desired result, 5) Identifies and caters to the client's unique personality style, 6) Finds common ground for initiating the conversation, 7) Gets the client to a place where they can feel comfortable knowing they are making the right choice. In other words, the client can say, "I trust you," 8) Never interrupts the client, 9) Never finishes the client's thoughts.

Customer Satisfaction: The Ultimate Goal

Customer satisfaction is the ultimate goal of the Relationship salesperson throughout the selling process. He/she establishes a firm foundation for a productive relationship with the client, including the use of an icebreaker to warm up the client before discussing any service information.

A Relationship salesperson is a solutions provider that utilizes a "we can" approach. He/she becomes an ally for the customer's business and builds trust, probes and asks questions, listens, discusses benefits, reassures, then finally and unobtrusively closes.

Relationship selling frequently works hand-in-hand with value-added selling, in which a salesperson presents customer-specific benefits related to his or her product or service. The Relationship approach, when properly executed, yields a quantity of information about the prospect's wants and needs, which makes it easy for the salesperson to take the next step and present the perfect benefits for those wants and needs.

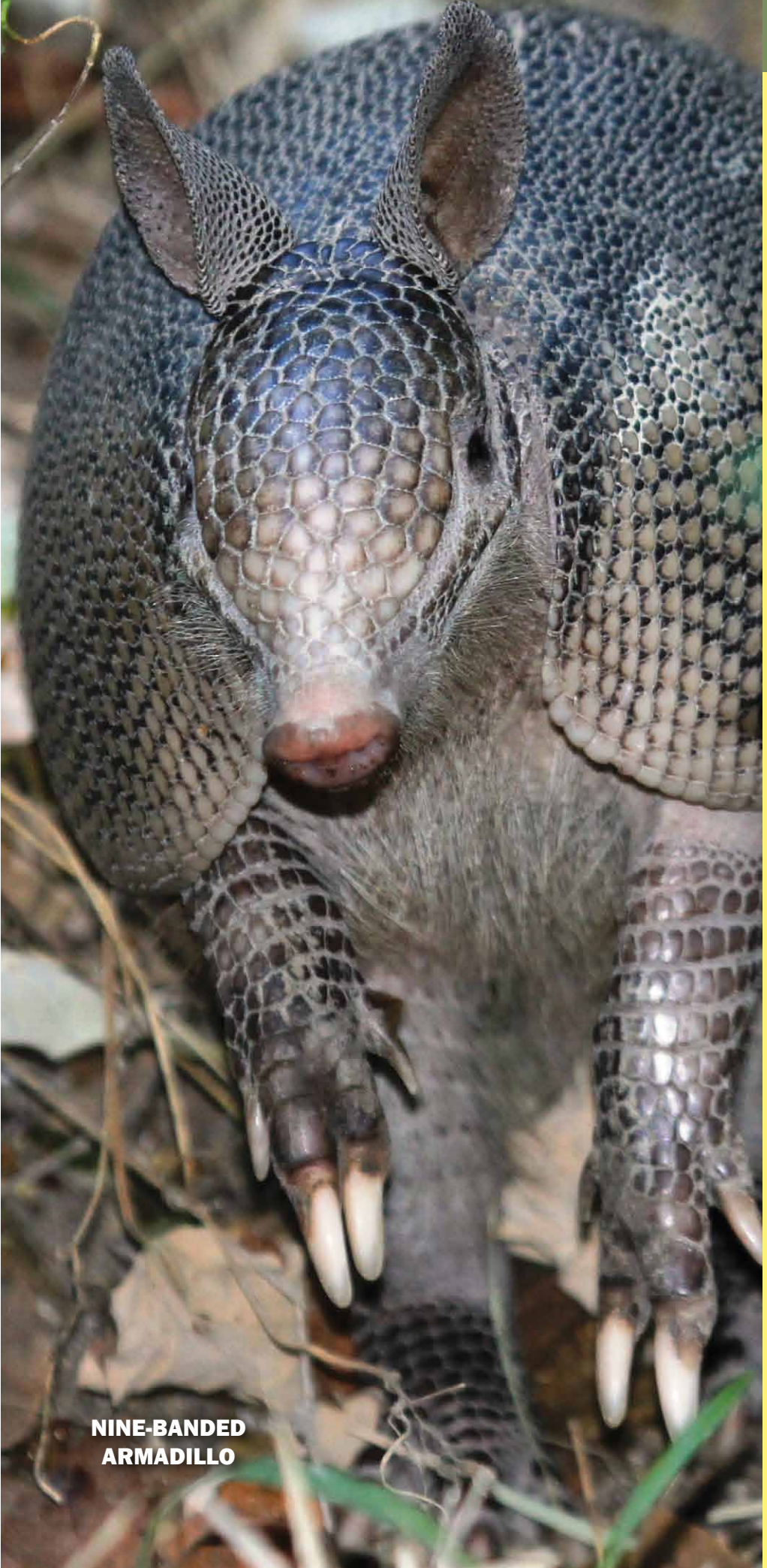
Controlling The Relationship Sales Call

Outstanding salespeople have an intimate knowledge of the structure of a Relationship sales call. They are in complete control. They know where they're going and what they want to accomplish at every point in the dialogue. They take nothing for granted. They never lose direction as they focus on probing, learning, and intimately understanding everything possible about a client's needs. They do this before discussing any product or service, so that their response to client needs is truly Relationship and adds real value.

Thoroughly qualifying prospects before setting up an appointment is critically important to a Relationship approach.

Remember, Relationship sales is not an art, it is a process! Selling has changed. Have you changed the way you sell? PP

Harvey F. Goldglantz is President of Pest Control Marketing Company, Inc., a consulting firm to the pest management industry located in Elkins Park, Pa. His clients range in size from start-up companies to those with revenues in excess of $30 million. Goldglantz has been in the pest control industry for more than 40 years. He served three terms on the National Pest Management Association Board of Directors.



Nine-banded armadillo photo by Ereneege, Wikimedia Commons

Baiting The ***Nine-Banded Armadillo***

Holly K. Ober, Lucas W. DeGroote, and Russell F. Mizell III

THE NINE-BANDED armadillo, *Dasypus novemcinctus,* is considered an invasive species in Florida. Armadillo feeding activity causes damage in a wide range of locations such as lawns, flower and vegetable gardens, golf courses, sports fields, cemeteries, nurseries, and orange groves. Armadillos have been blamed for reducing bobwhite quail and sea turtle numbers because of their fondness for quail and turtle eggs. Armadillos are also blamed for causing structural instabilities when they dig burrows around and under buildings. In sum, they are one of the most significant nuisance pests in Florida and much of the Southeast.

The most common damage complaints against armadillos are from the extensive digging they do while searching for food. Armadillos feed primarily on invertebrates that live in the upper layers of the soil. Using its long nose and forefeet, a single

Holly K. Ober, Associate Professor/Extension Specialist, Department of Wildlife Ecology and Conservation; Lucas W. DeGroote, Biological Scientist; and Russell F. Mizell III, Professor/Extension Specialist, Department of Entomology and Nematology, UF/IFAS

Steve A. Johnson

individual may dig dozens of shallow holes 2–6 cm wide and up to 15 cm deep each night. Because armadillos prefer to dig in moist soil, their activity is concentrated in well-kept lawns and gardens—exactly where people are most sensitive to such destructive activity!

Armadillos first arrived in Florida during the 1920s and 1930s. They are considered an invasive species because they were brought by people and quickly began reproducing. By the early 1950s, they had spread throughout most of the state. The growing armadillo population in Florida in recent decades has increased the frequency of contact between armadillos and humans. This contact is of medical concern because nine-banded armadillos are the only animal other than humans capable of hosting the bacteria that causes leprosy. Leprosy has been detected in armadillos from Texas, Louisiana, Mississippi, and Alabama, but has not yet been detected in armadillos residing in Florida or Georgia. The method by which leprosy is transferred among organisms and the potential for armadillos to transmit leprosy to humans is not well understood, and is not currently an issue in Florida or Georgia.

Control Methods

Most of the methods used to reduce damage caused by wildlife are not effective against armadillos. There are no repellents, toxicants, or fumigants registered for use with armadillos. Exclusion with fences is challenging because armadillos are good at both burrowing beneath and climbing over them. There are also no effective methods for baiting armadillos into traps. Although armadillos occasionally enter live traps when fencing material is used to divert them from habitual travel paths into trap entrances, capture rates are extremely low. A recent study in Georgia reported one capture for every 132 nights a trap was set open.

One of the most commonly recommended tactics for reducing armadillo damage is removing the foods armadillos are known to eat by killing invertebrates living in the soil. Because widespread application of insecticides can have negative side effects on nontarget species and the environment, this is not a sustainable solution. Clearly, there is a need to develop more effective and efficient armadillo control methods.

The Search for Bait Materials

Two types of materials have strong potential to serve as bait to lure armadillos into traps: food items and smells from other armadillos. Armadillos are generalists, meaning they consume a wide variety of foods. Approximately 75 percent of their diet by volume is insects, mostly beetles (Coleoptera). The remainder of the diet consists of other invertebrates such as worms, insects and spiders, small amphibians, reptiles, mammals, birds, eggs, fruit and other plant material, and carrion, or dead animals. This wide variety in armadillo diets makes the selection of a single item to use as a bait challenging!

Smells from other armadillos also can attract armadillos. It is believed that armadillos communicate with one another through odors they emit through their anal scent glands. Odors produced by the scent glands of one armadillo may stimulate the curiosity of another. *Continued on page 26*

The following materials were tested:

- crickets, ***Acheta domesticus***
- pond worms, ***Lumbricus terrestris***
- red worms, ***Eisenia fetida***
- wigglers, ***Pheretima hawayanus***
- meal worms, ***Tenebrio molitor***
- big red worms, ***Eisenia hortenis***
- glow worms, ***Eisenia hortenis***, dyed bright colors
- millipedes, Diplopoda
- chicken eggs
- quail eggs
- avocado
- banana
- strawberry
- peanut butter
- vanilla wafer cookies
- pads containing odors from armadillos of the same gender
- pads containing odors from armadillos of the opposite gender
- unscented pads

Featured Creatures Update

Ants to Zombie Flies: Exciting Creatures Now Online!

Jennifer Gillett-Kaufman

HERE IS a quick "snapshot" of articles produced for 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 articles.

I have selected just a few of the hundreds of publications we have available. I chose articles I think are the most relevant to pest managers and a couple, like *Zombie Fly* and *African Malarial Mosquito*, that I think you will also find interesting. You might be asking why I chose to share two moths with you. Both of these beautiful creatures are often encountered by homeowners, and I would like to broaden your insect ID skills by sharing them with you.

Tawny Crazy Ant

(Previously Known As Caribbean Crazy Ant)

Shweta Sharma, John Warner and Rudolph H. Scheffrahn, Entomology and Nematology Department, University of Florida

http://entnemdept.ufl.edu/creatures/urban/ants/tawny_crazy_ant.htm

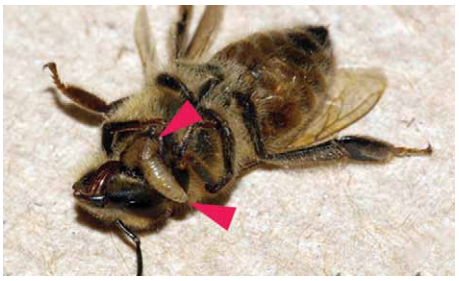
NYLANDERIA FULVA was previously confused with *Nylanderia pubens* (Synonym: *Paratrechina pubens*). *Nylanderia fulva* is native to South America, where the type locality is Brazil, whereas *Nylanderia pubens* may have originated from the St. Vincent Island and the Lesser Antilles. Samples of *Nylanderia pubens* collected in Coral Gables and Miami, Florida, date from 1953. Klotz et al. report infestations in Boca Raton, Homestead, and Miami, and state that "in 1990, hundreds of these ants were found on the second floor of a large Miami hospital." Deyrup et al. report that it "is abundant on the campus of the University of Miami, where it resembles a pale *Nylanderia bourbonica*, foraging on sidewalks and running up and down tree trunks." L. Davis, Jr. has seen these ants from Everglades National Park, Fort Lauderdale, Jacksonville, and Port St. Lucie. Specimens from Sarasota were also confirmed.

Pavement Ant

Tyler Vitone and Andrea Lucky, Entomology and Nematology Department, University of Florida

http://entnemdept.ufl.edu/creatures/misc/ants/pavement_ant.htm

THE PAVEMENT ANT, *Tetramorium caespitum* L., is one of the most commonly encountered ants in the United States. The first introduction into the United States occurred from Europe in the beginning of the 19th century. Since then, the ant has become well established and is prevalent in urban areas in the northern U.S. and parts of Canada. While the presence of pavement ants in the U.S. has been acknowledged for decades, the extent of their invasiveness and severity as a pest is not well characterized.



Zombie Fly

Nicole A. Casuso, Ashley N. Mortensen, and James D. Ellis, Entomology and Nematology Department, University of Florida

http://entnemdept.ufl.edu/creatures/misc/bees/Apocephalus_borealis.htm

APOCEPHALUS BOREALIS Brues (the zombie fly) is a member of a specialized subgenus known as Mesophora. This subgenus parasitizes insects other than ants. Their typical hosts include bumble bees and paper wasps but they are capable of parasitizing many other arthropods. *Apocephalus borealis* recently has been confirmed to parasitize European honey bees, *Apis mellifera* spp., along the West Coast of the United States as well as in South Dakota and Vermont. Recently, molecular analyses of honey bees from Belgium tested positive for *Apocephalus borealis*. These discoveries have stirred interest in both the scientific community and media due to an international interest in honey bee health.

Gulf Coast Tick

Jeffrey C. Hertz and Phillip E. Kaufman, Entomology and Nematology Department, University of Florida

http://entnemdept.ufl.edu/creatures/urban/medical/Gulf_coast_tick.htm

THE GULF COAST TICK, *Amblyomma maculatum*, was first described by Koch in 1844. Gulf Coast ticks are found in grass prairies and coastal uplands throughout much of the western hemisphere. The ticks are ectoparasites that feed on a variety of birds and mammals, and will readily bite humans. Gulf Coast ticks are of increasing concern because of their ability to transmit several pathogens of veterinary and medical importance.

Imperial Moth

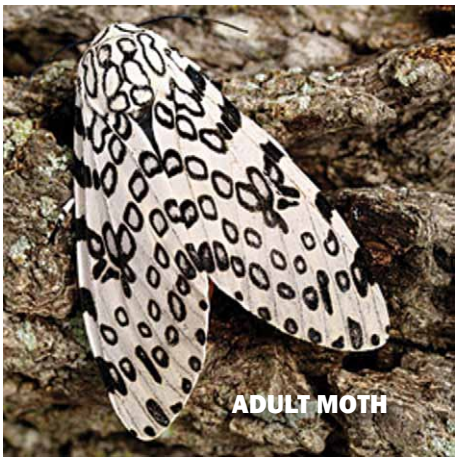
Donald W. Hall, Entomology and Nematology Department, University of Florida

http://entnemdept.ufl.edu/creatures/bfly/moth2/imperial_moth.htm

THE IMPERIAL MOTH, *Eacles imperialis imperialis*, is one of our largest and most beautiful moths. It is also the most variable in appearance and the most widely distributed of our large eastern U.S. saturniid moths. Imperial moth larvae are polyphagous, with many recorded hosts.

Continued next page

Jennifer Gillett-Kaufman is Featured Creatures Editor And Project Coordinator, University of Florida/IFAS Entomology and Nematology Department.



Giant Woolly Bear (Larva)
Giant or Great Leopard Moth (Adult)
Donald W. Hall, Entomology and Nematology Department, University of Florida
http://entnemdept.ufl.edu/creatures/misc/moths/Hypercompe_scribonia.htm

THE GIANT LEOPARD MOTH is our largest eastern tiger moth. It was formerly in the family Arctiidae, which now composes the subfamily Arctiinae in the family Erebidae. Giant leopard moths are nocturnal. Males are commonly attracted to lights at night. Sometimes dozens of males come to bright lights set out in good habitat. Females are less common around lights.

African Malaria Mosquito
Sabrina A. White and Phillip E. Kaufman, Entomology and Nematology Department, University of Florida
http://entnemdept.ufl.edu/creatures/aquatic/Anopheles_gambiae.htm

ANOPHELES GAMBIAE is the most efficient vector of human malaria in the Afrotropical Region. Thus, it is commonly called the African malaria mosquito. The *Anopheles gambiae* complex of sibling species comprises eight reproductively isolated species that are almost indistinguishable morphologically: *Anopheles amharicus* Hunt et al. 2013, *Anopheles arabiensis* Patton 1905, *Anopheles bwambae* White 1985, *Anopheles gambiae* Giles 1902, *Anopheles coluzzii* Coetzee & Wikerson 2013, *Anopheles melas* Theobald 1903, and *Anopheles merus* Dönitz 1902. None of these species occur in North America.

I hope you learned something new from reviewing the excerpts from these articles. The next *PestPro* "Featured Creatures Update" is scheduled to be published in the September/October 2015 issue. If you would like to receive periodic updates when new Featured Creatures articles become available, you can register for weekly updates from the UF/IFAS Pest Alert Blog[1], or for monthly updates from the UF/IFAS Entomology and Nematology Department Newsletter[2]. PP

[1] http://blogs.ifas.ufl.edu/pestalert/
[2] http://entomology.ifas.ufl.edu/news/

Scan code to visit http://entomology.ufl.edu/creatures/

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Baiting Armadillos, continued from page 22

To determine which materials have the greatest potential to serve as bait, University of Florida researchers set up several tests. They captured 40 wild armadillos and maintained them in outdoor enclosures. They then compared armadillo interest in a variety of items including invertebrates commercially available from bait shops and pet stores, eggs, fruits, and scents collected from armadillo anal glands.

Of the materials tested, worms and crickets performed best. These baits attracted the attention of armadillos more quickly than the other materials, armadillos visited the locations where these baits were placed more often than locations with other potential baits, and armadillos spent significantly more time where these baits were placed than at all other locations.

Interestingly, although armadillos are known to eat eggs of quail, turkeys, sea turtles, gopher tortoises, lizards, and snakes in the wild, our tests suggested that eggs from domestic bobwhite quail and chickens were less attractive than worms and crickets. Eggs from domestic birds seem to have limited potential to serve as bait for armadillos.

Tests also showed that armadillos have an extremely short perceptual distance: they do not recognize the presence of food items until they are within a few feet of the material. For this reason, it is unlikely that placing any of the preferred baits or any other naturally occurring materials in a trap will effectively lure armadillos into traps over long distances.

Conclusions

Armadillos preferred pond worms, wigglers, crickets, and red worms. Each of these materials is commercially available from bait stores and pet stores. Each is therefore readily accessible to anyone interested in baiting nuisance armadillos into traps. Crickets or worms can be placed in a bowl or a stocking and put into a live trap to attract the attention of foraging armadillos.

However, because armadillos do not seem to recognize potential prey items until they are very close, trap placement is likely more important to capture success than selection of bait materials. Traps are most effective when placed in one of two locations: near the entrances to active armadillo burrows or along barriers such as fences in areas where armadillos regularly travel.

It is wise to invest time searching for armadillo burrows and observing their travel paths, because the chances of catching the offending animal will increase greatly if the trap is properly placed. The habit of armadillos to follow barriers can be used to your advantage: Temporary garden fencing or wooden boards can be used to funnel armadillos traveling along such barriers into traps. PP

Additional suggestions on how to funnel armadillos into live traps are available at http://edis.ifas.ufl.edu/pdffiles/UW/UW08200.pdf.