

THE PROCEEDINGS OF THE 2016
**NATIONAL CONFERENCE ON URBAN ENTOMOLOGY
AND INVASIVE FIRE ANT CONFERENCE**

MAY 22-25

ALBUQUERQUE, NEW MEXICO



EDITED BY

DR. WAHEED I. BAJWA

NEW YORK CITY HEALTH DEPARTMENT

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Preface

This publication reports the proceedings of the National Conference on Urban Entomology and Invasive Fire Ant Conference held in Albuquerque, New Mexico from May 22 to May 25, 2016. The conference included more than 100 scientific presentations and 228 participants, many of whom were students resulting in the productive interactions of the leaders in urban pest control and ultimately a very successful meeting.

An important component of the conference is the stimulation of conversation among urban and medical entomologists, pest control specialists, and the industry in order to share information on mutual tasks and to search for ways to effectively and safely control myriad pests that threaten people's homes and health. The participants included researchers, professors, administrators, stakeholders, and industry representatives. Included among the speakers were several young scientists, namely, postdocs and students, who bring new perspectives and insights to the field.

The next NCUE will take place in Cary, North Carolina in 2018. Given the rapid pace of scientific advancement in all of the areas covered by NCUE, we expect the future conference to be as stimulating as its predecessors.

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**Distinguished
Achievement Award**



The Arnold Mallis Memorial Award Lecture

Trailing with the ants

John Klotz

CE Specialist, Emeritus, Department of Entomology, University of California, Riverside

Thank you for the invitation and the award of Distinguished Achievement in Urban Entomology. It is both an honor and a privilege to speak here today. I look at the list of past recipients, and I think you gave me a mulligan, because compared to these individuals and their accomplishments, there is no comparison, but I'm not proud, so I'll take it.

Thanks to many of you here today I have accomplished my goals. In this presentation, I will attempt to give credit to those who have inspired and helped me along the way.

First, I will share "My Big Adventure" where I had a sudden-death cardiac arrest while swimming at Riverside and CPR on lane lines by swim buddies. I was in a coma for eight days and had chemical pneumonia and anoxia. At this time, I did some astral traveling to the Galapagos Islands and participated in the Iditarod in Alaska. After the coma, I had to learn to walk, talk, read, and write all over again. I appreciate the support of so many at this time including visits by Mike Rust, Les Greenburg, and Dong-Hwan Choe who inspired me with his bagpipes. I entered the flatworm stage at Loma Linda Brain Institute and Casa Colina Rehabilitation Center. During this time, my heroes were Dr. Earl Oatman, my physician, and Cory Remsberg, a recovering veteran. Finally, my wife Jenny, who has been by my side through this entire ordeal; never wavering, protecting me from unnecessary procedures, and was there to comfort me when I realized what had happened to me. She made the ultimate sacrifice to hasten my recovery.

My entomology career started at the University of Kansas. There I took courses with Coby Schal and Les Greenberg. But unlike Coby and Les, I didn't get published in the prestigious journal *Science* while still in graduate school. I was a graduate student under Rudolf Jander who was a student under Karl von Frisch. My PhD committee had the world-famous bee expert, Charles Michener. Both of these mentors were critical for my development. Jander started me off in his backyard investigating home range orientation in carpenter ants, and Michener's course on social insects was a real classic.

I left KU and Kansas with my PhD and struck out for the West Coast where I had been in boot camp in the 60's. Instead of re-upping in the Navy I was inducted into Lloyd Pest Control and worked under "Capt." Herb Field, thanks to Don Reiersen who rescued me out of the X-mas store but that is another story. At Lloyd's I was in charge of training technicians on pest control and driver safety. As to driver safety, I never told Herb about it, but I was driving on I-5 in the company mouse car my first week and got pulled over by the CHP. I begged him not to give me a ticket, because I'd lose my job. If he had given me a ticket, I might not be here today. Herb Field was an extraordinary mentor and became a good friend.

Gary Bennett took a chance on me and hired me as a post-doc at Purdue University. It was another lucky break to be working with one of the top urban entomologist. Gary allowed me to pursue my interest with carpenter ants. And with Byron Reid we did some great research on ant orientation and baits. Byron took me under his wing and showed me how to do field trials on a large scale. I met Bobby Corrigan at Purdue. Even as a student Bobby was an accomplished speaker, who became one of the most sought-after speakers and researchers in the pest control industry. Both are highly talented scientists and I appreciate my time with them. I met Mike Scharf in a toxicology class at Purdue. His exam scores were so high above the curve it was uncanny. Later I wasn't surprised when Purdue hired him to join their faculty.

From Purdue, I went to Dick Patterson and Dave Williams' group in Gainesville, Florida. Karen Vail and David Oi allowed me to plug into their already vast fieldwork research program, and with their expertise on experimental design they guided me through the statistical analyses. Karen and David were always helpful and encouraging, and very generous people. I also worked with Lloyd Davis and with his ant expertise we conducted a state-wide survey of household pest ants in FL. While there I audited Phil Koehler's very fine urban entomology course, and became aware of the challenges to the pest control industry. I met Dan Suiter there and his lovely wife, who was a student, and who later hosted my ant workshop in Griffin, GA where he was on the faculty.

From Gainesville, I went to my ultimate destination, the Urban Entomology program at UCR where I worked with the dynamic duo of Mike Rust and Don Reiersen. The scope of their research and extension program was awe-inspiring, and set the standard for excellence. No words can convey their impact on me. It would be a shame if Mike and Don don't write a book so we won't lose all of their knowledge on household pests, and preserve it for posterity, maybe one modeled on Walter Ebeling's classic Urban Entomology text. I invited Les Greenberg to join me and together we accomplished research on ant baits, and their delivery systems in urban and agricultural settings. Les's statistical, and computer expertise was invaluable. I met Nancy Hinkle there and closely watched her to see what makes a great extension speaker. Later she collaborated with my brother on solving a problem in a hospital, with an infestation of flies and dead mice, resulting in myiasis in comatose patients, which ended up on 60 minutes with

Diane Sawyer. Good thing it didn't happen at Riverside Community Hospital, while I was in a coma.

My research achievements include:

- Investigating guideline orientation and its implications for pest control.
- Investigating low-toxic liquid baits and their delivery systems.
- Investigating the role of anaphylaxis in ant stings and kissing bug bites.
- Investigating ant orientation in carpenter ants.
- Working with Bob Krieger and Jim Moss on boric acid ant baits.
- Working with my brother Steve, an M.D; Jack Pinnas, M.D.; and Mark Mosbacher, DVM, a past student who I had taught in high school; and Justin Schmidt on anaphylactic reactions to ant stings and kissing bug bites.
- Working with Laurel Hansen and the other authors on our ant books. Laurel invited me to work on her carpenter ant book, and from there we authored two other books with Mike Rust, David Oi, Herb Field and Reiner Popischil.

Some of my other memorable highlights include:

- Coordinating the Urban Conference at UCR with invitations to expert urban pest management researchers and extension personnel speaking on their specialties. These included industry spokesmen, such as Stoy Hedges and Bobby Corrigan.
- Meeting Walter Ebeling on a bus trip to Gulfport termite lab, and discussing oxidative phosphorylation with him, and his telling me how many ATP's were produced. How he remembered these details at his age is beyond me.
- Eating BBQ spareribs with EO Wilson, and his asking me questions about ant taxonomy. It was a short dinner. His book, *The Insect Societies* is one of my favorites.
- Eating at Gary Bennet's house, and not knowing what I was eating, maybe possum, maybe 'chupacabra.'
- Spending two weeks with Roger Akre and joining him on his field research with carpenter ants, constantly being called 'Klutz', and eating my gluten-free lunch and suffering the verbal abuse for being so diet conscious.
- Getting a get a giant get-well card from Austin Frishman signed by all my urban pest management colleagues.
- Stoy Hedges and his wife, Les Greenberg, and Mike Rust and his wife visiting us in Sedona once I was able to return home.
- Laurel Hansen's visit to our home in Tucson and Sedona, where we visited Montezuma Castle, a Pueblo ruins, and met 'Teddy Roosevelt' and the "Rough Riders."

Thank you for all your help in my journey 'trailing with the ants', and giving me this much appreciated and prestigious award. I have been very lucky to know all of you.

Thank you!

Student Award

Papers



Masters Degree Award

Identification of botanically-derived repellents for Turkestan cockroaches using a video tracking system

Sudip Gaire¹, Alvaro Romero¹, Mary O'Connell² and F. Omar Holguin²

¹Department of Entomology, Plant Pathology and Weed Science, ²Department of Plant and Environmental Sciences, New Mexico State University, Las Cruces, NM

The Turkestan cockroach is a peridomestic pest that has become an important invasive species throughout the Southwestern United States and is found mostly in animal facilities and occasionally in human dwellings. Our study aims to evaluate ecofriendly management strategies that help manage this pest. We evaluated the repellency of six botanical-derived components against late instar nymphs of Turkestan cockroaches. Essential oils were chosen for further studies based on the presence of effective compounds in those oils. Test arena floors were divided into halves; one half sprayed with the test material at 1% and the other half was sprayed with control solvent. Nymphal responses to dry residues were recorded for 20 minutes with an EthoVision video-tracking setup. Repellency was calculated as the ratio of time spent by nymphs in the treated half vs control half of the test arenas. Nymphs spent significantly less time (35.8%) in zones treated with thymol; the other five compounds (geraniol, eugenol, trans-cinnamaldehyde, methyl eugenol and p-cymene) did not have a detectable effect on nymph behavior. Gas chromatography-mass spectrometry analysis demonstrated the primary components were 8.02% thymol in red thyme oil, 2.26% geraniol in java citronella oil and 10.60% eugenol in clove bud oil. Behavioral assays confirmed that all these oils have repellency effects against nymphs. In conclusion, plant essential oils which contains thymol is promising candidate for Turkestan cockroach's management. However, other essential oils are also repellent and this effect is possibly due to synergistic effects of different compounds present in those oils.



Doctoral Degree Award

Orientation of Bed Bugs to Thermal Cues

Zachary Devries, Russell Mick and Coby Schal

North Carolina State University

Host location in bed bugs is poorly understood. Of the primary host-associated cues known to attract bed bugs – CO₂, odors, heat – heat has received little attention as an independent stimulus. We evaluated the effects of target temperatures (representing a host) ranging from 23-48°C at an ambient temperature of 25°C. Activation and orientation responses were assessed using a heated target located in a circular arena. The distance bed bugs could orient towards heat was measured using a 2-choice T-maze assay. Feeding responses were assessed using an artificial feeding system. All target temperatures above ambient activated bed bugs (initiated movement) and elicited oriented movement toward the target. Correct orientation as measured in the T-maze was limited to distances < 3 cm. Bed bug feeding responses increased with feeder temperature up to 38°C, remained constant at 43°C, and dropped precipitously at 48°C, with bed bugs responding to the relative difference between ambient and feeder temperatures when feeding. These results provide the first comprehensive analysis of bed bug activation, orientation, and feeding in response to different host temperatures, estimate the operational distance at which bed bugs can orient to warm objects, and should assist in improving interventions to eliminate bed bug populations.



Student Paper Competition



Short-range responses of the kissing bug *Triatoma rubida* (Hemiptera: Reduviidae) to heat, moisture, and carbon dioxide

Andres Indacocha and Alvaro Romero

Department of Entomology, Plant Pathology, and Weed Science, New Mexico State University

Abstract

The haematophagous bug *Triatoma rubida* is a species of kissing bug that has been marked as a potential vector for transmission of Chagas disease mainly in the Southern U.S. and Northern Mexico. These insects use host-derived cues to locate and take a blood meal. Our study aims to characterize the short-term response of late-instar nymphs of *T. rubida* to various temperatures (25, 32, 36, 40, 45, and 55°C) humidities (5, 30, 60, and 90% RH), and concentrations of CO₂ (0, 800, 1600, and 3200 ppm) using a modern infrared video tracking system. To test for responses to heat, we constructed an arena with a ceramic resistor mounted in the center and concentric zones for analysis were set at various distances from the source. For humidity and CO₂, we used a four-choice olfactometer and behavior near the ports was analyzed. When compared to the control (25°C), bugs were about twice as likely to visit the source at 40 and 45°C and spent about twice as much time within 4.5 cm from the source at 36, 40, and 45°C, an effect that was lost at 55°C. Bugs spent the most time near the 30% RH treatment and chose it the most. No bugs chose the 90% RH treatment. Bugs also chose 1600 ppm of CO₂ the most often. This data supports our hypothesis that *T. rubida* nymphs orient preferentially to certain temperatures, humidities, and concentrations of CO₂.



Colony structure of *Reticulitermes* (Isoptera: Rhinotermitidae) in northwest Arkansas

Mark A. Janowiecki¹, Amber D. Tripodi², Allen L. Szalanski³, Edward L. Vargo¹

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Abstract

Termites, as social insects, have a complicated life cycle that is difficult to study with traditional research methods. A termite colony can consist of a simple family (one male and one female), an extended family (multiple males and/or multiple females) or a mixed family (unrelated reproductives). While this is nearly impossible to determine from collecting and censusing colonies in the field, microsatellite DNA genotyping methods have been previously developed and applied to termites along the east coast. In this study, we apply these methods to three species of *Reticulitermes* from three forested sites in northwest Arkansas. Our preliminary sampling found 22% of *Reticulitermes* in northwest Arkansas were simple families, 72% were mixed families and 6% were mixed families. Further sampling will strengthen these observations into general trends for family structure of *Reticulitermes* in northwest Arkansas.



Variation in Chlorfenapyr and Bifenthrin Susceptibility of Bed bug field populations (*Cimex lectularius* L.)

Aaron R. Ashbrook, Mike E. Scharf, Gary W. Bennett, and Ameya D. Gondhalekar
Purdue University, West Lafayette, IN

Abstract

Insecticide resistance is an impediment for effective bed bug control. Our goal was to develop a diagnostic concentration-based bioassay for assessing chlorfenapyr and bifenthrin susceptibility levels in bed bug field strains. Glass vial and filter paper bioassay methods were statistically compared, which revealed that the glass vial assays are more accurate for susceptibility discrimination. Using the vial assay and LC₉₉ diagnostic concentrations for each insecticide, 10 field isolates and the Harlan lab-susceptible strain were screened for chlorfenapyr and bifenthrin susceptibility. 3–5 strains had reduced susceptibility to chlorfenapyr and bifenthrin. Resistance monitoring efforts should continue to detect chlorfenapyr and bifenthrin susceptibility shifts and it is recommended that bed bug infestations are managed using an integrated chemical and non-chemical approach.

**Toxicity of essential oils on the Turkestan cockroach, *Blatta lateralis*
(Blattodea: Blattidae)**

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¹Department of Entomology, Plant Pathology and Weed Science; ²Department of Plant and Environmental Sciences; New Mexico State University, Las Cruces, NM

Abstract

The Turkestan cockroach is a peridomestic pest that has become an important invasive species throughout the Southwestern United States. Our study aims to evaluate ecofriendly management strategies for this pest. We evaluated the toxicity of six botanical-derived components against nymphs of Turkestan cockroaches. Effective essential oil components were initially identified in topical and fumigant assays. Plant essential oils with high content of these components were further evaluated. In topical assays, thymol was the most toxic compound to cockroaches with a LD₅₀ of 0.34 mg/cockroach followed by trans-cinnamaldehyde, eugenol, geraniol, methyl eugenol and p-cymene with LD₅₀ values of 1.01, 1.56, 2.48, 3.10 and 9.85 mg/cockroach, respectively. Vapors of thymol had the highest toxic effect with a LC₅₀ of 27.6 mg/L air followed by trans-cinnamaldehyde, eugenol, p-cymene, methyl eugenol and geraniol with LC₅₀ values of 150.76, 251.20, 441.84, > 1000 and >1000 mg/L air, respectively. GC-MS analysis demonstrated that the primary components were 8.02% thymol in red thyme oil, 2.26% geraniol in java citronella oil and 10.60% eugenol in clove bud oil. The topical application with oils confirmed that red thyme oil (LD₅₀: 1.60 mg/cockroach) and clove bud oil (LD₅₀: 1.65 mg/cockroach) were more toxic than java citronella oil (LD₅₀: 7.87 mg/cockroach). The red thyme oil has a higher fumigant effect with a LC₅₀ value of 160.55 mg/L air than clove bud oil (LC₅₀: 318.55 mg/L air) and java citronella oil (LC₅₀: 746.74 mg/L air). Our results showed that essential oils are promising alternatives for the management of Turkestan cockroaches.



**Sublethal effects of a combination product on bed bug (*Cimex lectularius*)
behavior and implications for management**

Sydney E. Crawley, Knowles, K.A., Gordon, J.R., Potter, M.F., and K.F. Haynes

University of Kentucky Department of Entomology

The sublethal exposure of an insect to an insecticide can result in behavioral changes. These changes at the individual level often have population-level consequences. For urban pest management, these changes may impact control strategies. Thus, in this study, we investigated the sublethal effects of Temprid® SC on various bed bug (*Cimex lectularius*) behaviors. We found that exposure to a population's LT₁₀ resulted in a reduction of feeding efficacy. Fecundity of bed bugs was also impacted by exposure, as treated insects laid fewer eggs during a six-week period. Additionally, we saw a reduction in the proportion of time treated insects spent moving. We found no difference in the ability of treated bugs to respond to bed bug aggregation pheromone. These results were consistent among three populations of bed bugs with varying levels of insecticide susceptibility. Implications of these behavioral changes for the control of populations of bed bugs will be discussed.



**Impact of the Tawny Crazy Ant (*Nylanderia fulva*) on the ant community at the
Port of Savannah, Georgia**

Ben Gochmour & Dan Suiter

Department of Entomology, University of Georgia, Griffin, Georgia

Invasive species are an economic and ecological threat. Port cities play a particularly important role concerning the introduction of exotic species into and out of North America. Recently, the Tawny Crazy ant (*Nylanderia fulva*) was found on the Port of Savannah. The ant was determined to be restricted to several wooded areas on the Port of Savannah, Georgia property. Intensive sampling of the ant communities within and beyond the invaded areas was carried out during June and July of 2015. A total of 43 species across 18 genera were found on the port. Of the 43 species, 12 were exotic across 9 genera. In the wooded areas on the port, the Tawny Crazy Ant reduces ant species richness and homogenizes the ant community. Its effect appeared to be non-random, with larger, ground foraging species being most susceptible to extirpation by the Tawny Crazy Ant. Very small, cavity dwelling species and arboreal nesting species showed the most resistance in invaded areas. The Red Imported Fire Ant (*Solenopsis invicta*) was readily eliminated from both wooded areas and roadsides following an invasion by the Tawny Crazy Ant.

Submitted Papers

Ants



Distribution, Identification, Impact, and Management of the Dark Rover Ant, *Brachymyrmex patagonicus* Mayr (Hymenoptera: Formicidae)

Robert Davis¹, Chris Keefer², Janis Reed², Phillip Schults², Edward L. Vargo²

¹BASF Professional & Specialty Solutions and ²Texas A&M University

Introduction

Brachymyrmex patagonicus is an invasive ant species believed to have originated in Argentina and Paraguay. It was first identified in the United States in 1976 in Louisiana and Florida (Wheeler 1978); however, it was miss-identified as *B. musculus* Forel (MacGown et al. 2007). It was, again, identified in Mississippi in 1977. Ants of the genus “*Brachymyrmex*” are commonly referred to as ‘rover ants’, and the common name ‘dark rover ant’ has been used for *B. patagonicus*. This ant has expanded its range since the mid 1970’s and is now well established in Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, Texas, and urban centers in the southwest US, including Nevada and Arizona. It appears as if its range continues to enlarge. It is now established in Houston, Dallas and San Antonio, TX (Wild 2008), and has been recorded in South Carolina (MacGown et al. 2010) and Southern California (Martinez 2010) (Figure 1). The potential range for *B. patagonicus* may reach as far north as Tennessee (MacGown et al. 2010).

Dark rover ant workers are monomorphic, of minute size (mesosomal length 0.43 to 0.51 mm) and dark brown in color (Tamayo 2014). They have 9 segmented antennae, have relatively large eyes (ca. 1/3 head length) and 3 minute ocelli. They exhibit between 3 and 9 stout, erect hairs on the promesonotal dorsum, while the gaster has little pubescence. Males are similar in size to workers. They are bicolored with a black head and tan body with reduced pubescence on the body, appearing shiny. Queens are much larger (mesosomal length 1.24 to 1.42 mm) and concolorous reddish-brown with abundant pubescence on the entire body (MacGown 2011).

Dark rover ants are common in natural and urban areas. Colonies can be found in soil, at tree bases, in leaf litter, in wood piles and in rubbish heaps. In landscaped areas they are commonly found in mulch. Nests are also formed within man-made structures (MacGown et al. 2007). In southern California workers have been found in urban areas foraging on pavement adjacent to turf (Martinez 2010). They have a preference for high moisture and a tendency to invade

bathrooms and kitchens (MacGown et al. 2007). In the arid southwest they are likely to occur in irrigated landscapes where adequate moisture is present (Miguelena and Baker 2010). They will visit extrafloral nectaries for nectar (Robbins and Miller 2009; Wild 2008). Dark rover ants have been found on *Opuntia* cactus extra floral nectaries in Florida. They can interact with hemipterans for honeydew, which may contribute to a major portion of their diet.



Figure 1: Distribution of *B. patagonicus* Mayr in the United States as of 2008 (adpted with 2010 findings (from Tamayo UF/IFAS 12/2014)

Dark rover ants have become a problematic pest ant for Pest Management Professionals (PMP's). PMP's continually experience control issues which lead to non-satisfied accounts and additional re-services. Indoor infestations can be hard to find and treat. This can lead to issues, especially in sensitive accounts such as hospitals, clinics, nursing homes, etc. As a consequence, this study was initiated to evaluate the efficacy of BASF's newer control agents, Alpine® WSG Insecticide, Fendona™ CS Insecticide & PT® Phantom® II Pressurized Insecticide and an industry standard, Talstar One® Multi-Insecticide (FMC Professional Products).

Table 1. Treatments used in Trial (Replications = 4)

Treatments	Concentration
Alpine WSG	0.10%
PT Phantom II	0.5%
Fendona CS	0.025%
Talstar One	0.02%
Untreated Control	Water Only

Materials and Methods

Five treatments (Table 1) were tested. Each treatment was applied either directly to *B. patagonicus* or onto three common outdoor surfaces. For direct treatment, fifty ants were placed in 15 cm Petri dishes and treated topically with a test insecticide. For all other trials, pesticides were applied to ensure complete coverage of the surface and in accordance with the label. Surfaces included in these trials were vinyl, painted plywood and brick. Substrates were allowed to dry and age as the trial dictated. To start each trial, 50 *B. patagonicus* were inverted onto the treated, aged surface and exposed for a period of 30 minutes. After 30 minutes, ants were reinverted and placed back into the Petri dish. Fluker's® Cricket Quencher was added as a moisture source after ants were reinverted back in to the Petri dish. It was replenished as necessary throughout the trial. Contact efficacy was evaluated at 15 & 30 MAT, 1, 2, 3, & 4 HAT, & daily thru 7 DAT. Residual efficacy (1 HAT; 15, 30, 60 and 90 DAT) evaluated at 1, 2, 3, & 4 HAE, and daily thru 7 DAE (or 100% mortality) determined LT50 and corrected using Abbott's formula. Efficacy data aged through 60 days is presented in these proceedings.

Results and Discussion

Directed topical treatments provided faster control than residual exposure treatments. The two pyrethroid products (Fendona CS and Talstar One) provided faster ant mortality. The non repellent product treatments (Alpine WSG and PT Phantom II) exhibited a slower response on the dark rover ants, but did provide 98-100% mortality within 1-3 HAT. All treatments provided 100% mortality by 4 HAT. A slower response by the non repellents may be critical as it can allow the dark rover ants time to transfer the non repellent active ingredients from donor ant to recipient ant prior to donor ant mortality. This can enhance control of incipient ant populations.

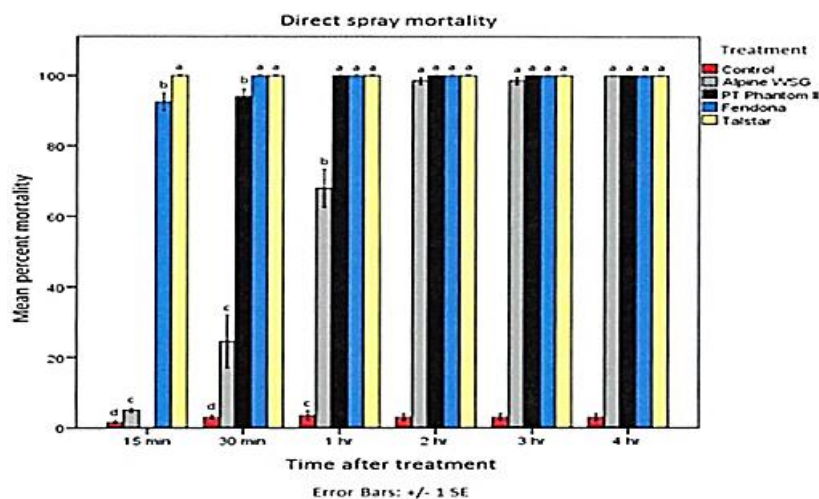


Figure 2. Efficacy of Alpine WSG, Fendona CS, PT Phantom II and Talstar One on *B. patagonicus* after direct spray treatments (n=50, rep = 4). Each observation time is considered individually for statistical purposes.

Residual aged treatments did not provide dark rover ant mortality as quickly when compared with direct topical ant treatments. Faster mortality was commonly seen with brick vs. vinyl vs. painted wood surfaces across the majority of evaluations (Figure 3). However, all the products tested did provide efficacy on all surfaces tested at all observations. The two pyrethroid products (Fendona CS and Talstar One) provided faster mortality. However, it is important to note that this is not a behavioral repellency study. Dark rover ants in a choice situation (as in the field habitats) may be repelled from treated surfaces which could impact time to mortality. See efficacy through 60 DAT (Figures 3-5). The non repellent products (Alpine WSG & PT Phantom II) exhibited a slower mortality response but did provide 100% mortality in time. PT Phantom II provided generally faster mortality than Alpine WSG. However, these slower acting non repellents may provide better overall control with enhanced Transfer of active from ant to ant. Non repellency may provide opportunities for ants to have increased exposure times to treatment. Alpine WSG may also enhance dark rover control by impacting honeydew producers. It is critical for PMP's to maximize thoroughness of treatments at site to receive enhanced mortality and control results!

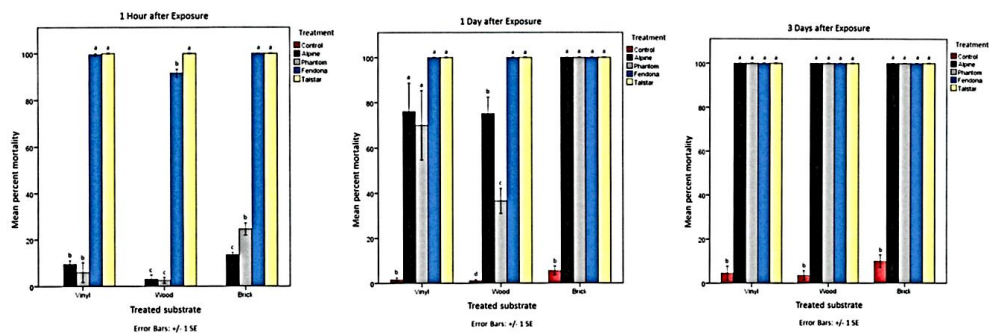


Figure 3. Efficacy of Alpine WSG, Fendona CS, PT Phantom II and Talstar One on *B. patagonicus* after 30 min exposure to 1 hour aged treated surfaces (brick, vinyl, painted wood) treatments at 1 HAE, 1 & 3 DAE (n=50, rep = 4). Substrates are considered individually for statistical purposes.

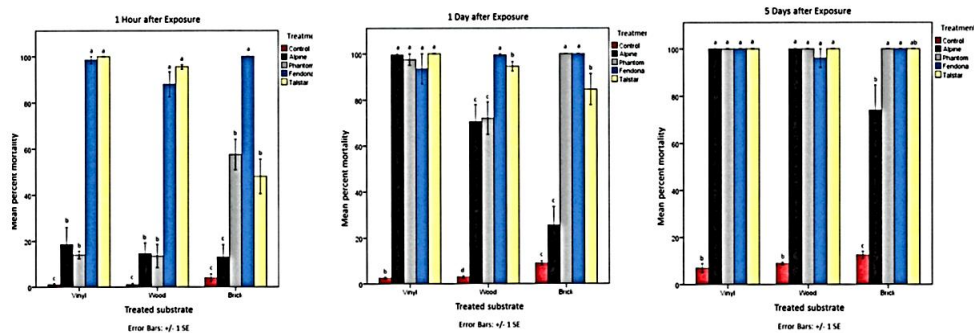


Figure 4. Efficacy of Alpine WSG, Fendona CS, PT Phantom II and Talstar One on *B. patagonicus* after 30 min exposure to 30 day aged treated surfaces (brick, vinyl, painted wood) treatments at 1 HAE, 3 & 5 DAE (n=50, rep = 4). Substrates are considered individually for statistical purposes.

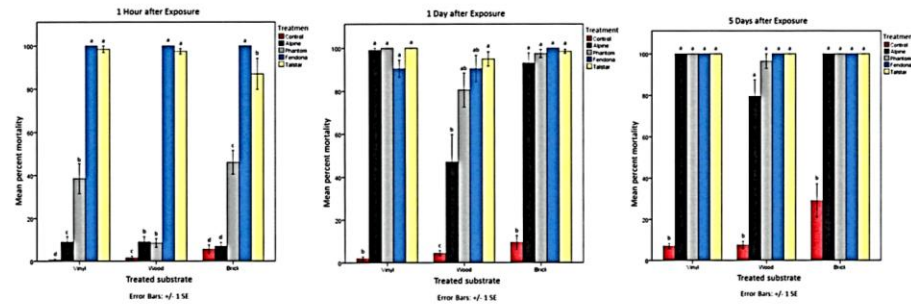


Figure 5. Efficacy of Alpine WSG, Fendona CS, PT Phantom II and Talstar One on *B. patagonicus* after 30 min exposure to 60 day aged treated surfaces (brick, vinyl, painted wood) treatments at 1 HAE, 1 & 5 DAE (n=50, rep = 4). Substrates are considered individually for statistical purposes.

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Survey of ants with emphasis on exotic ant species in the Pacific Northwest

Laurel D Hansen

Spokane Falls Community College

In 2015, an inventory was funded to survey for exotic ants in the Pacific Northwest with specific emphasis for the following: European fire ants (*Myrmica rubra*), Argentine ants (*Linepithema humile*), Velvety tree ants (*Liometopum* spp.), and Odorous house ants (*Tapinoma sessile*). Although the latter two ants are native, they possess traits common to tramp ants and are major pest problems where they occur. These four species had been announced around the state but not formally submitted for identification.

Five pest control companies were selected to participate and were supplied with vials, envelopes, and mailers. These companies collected ants from treatment sites and sent them for identification. Tentative identifications were made when the samples were submitted throughout the summer and final identifications were made in the fall and sent to all companies participating.

During the 2015 summer, 641 samples were received, identified, and stored. *Myrmica* species were sent to ant taxonomist, Robert Higgins of Thompson Rivers University (TRU) in Kamloops, British Columbia for positive identification. As ants were collected from all sites, many did not fall into the original categories.

Results of the survey revealed that the three most common ants submitted were *Tapinoma sessile* (36%), *Camponotus* spp. (19%), and *Tetramorium caespitum* (18%). The *Camponotus* species included *C. modoc* (12%), *C. herculeanus* (2%), *C. essigi* (2%), and 1% of each of *C. laevigatus*, *C. vicinus*, and *C. semitestaceus*.

Formica spp. were submitted in 14% of the samples and *Lasius* spp. were submitted in 8%. Ants in these large genera have not been identified to species at this time.

Of the four ants that were emphasized for this survey Odorous house ants were the most commonly sampled and velvety tree ants were found in 1% of the samples. Argentine ants were found in one sample at a Seattle zoo, two additional samples were submitted to Extension services, and a large infestation was observed in Victoria, British Columbia that had been observed for more than five years. *Myrmica rubra*, native to Europe, was first identified in 2006 at the Seattle zoo and has expanded its distribution throughout the arboretum. Additional sites for this ant were observed in Victoria and Vancouver, British Columbia, where it has infested community gardens and several residential blocks in urban areas of both cities.

An unexpected tramp ant, *Myrmica speciosus* (Impressive fire ant), also native to Europe, was identified with the assistance of R. Higgins, TRU. This ant was collected in four samples from

PMPs in the Seattle/Tacoma area in the survey. R. Higgins reports that this ant has caused serious problems at the Vancouver International Airport and the Arbutus Corridor of the Canadian Pacific Railway in Vancouver.

An additional exotic ant, *Tapinoma melanocephalum*, was also collected in two samples from Seattle and Portland and was observed in Canada at two additional locations.

Other ants identified in the survey at 1% or less included *Monomorium pharaonis*, *Prenolepis imparis*, *Technomyrmex difficilis*, *Hypoponera punctatissima*, *Pheidole* sp., *Manica hunteri*, *Solenopsis molesta*, *Temnothorax* sp.

The survey will be continued through 2016 with additional pest management companies cooperating in the project.

The survey was funded by the Norm Ehmann funds at Washington State University and the Washington State Commission on Pesticide Registration.



You Shall Not Pass!: How We Protect New Zealand's borders from invasive ants

Paul Craddock, Viv Van Dyk, and Brett Rawnsley

FBA Consulting

Abstract

New Zealand is a small island nation with a population of around 4.5 million people located in the South Pacific Ocean, just to the east of Australia. The geographic isolation of New Zealand means many of the common invasive ant species found around the globe are not present there. This isolation also means New Zealand features a range of unique and sensitive natural environments as well as horticultural and agricultural industries that would be severely threatened by the arrival of new invasive ants like red imported fire ant (*Solenopsis invicta*) and little fire ant (*Wasmannia auropunctata*)

Government and non-government agencies in New Zealand work hard together to keep novel invasive ant species out of New Zealand and to better manage the pest ant species (e.g., Argentine ant; *Linepithema humile*) that have arrived on our shores. We also work with our Pacific neighbors to help them keep their districts free of the many problem ant species threatening to spread around the region.

This presentation outlined how invasive ants are managed in New Zealand, including the various prevention, surveillance and treatment methodologies used both within New Zealand and by our Pacific partners. Lessons learnt for other invasive ant management programs were offered.



Status of Tawny Crazy Ants in Alabama

L. C. 'Fudd' Graham¹ and Jeremy Pickens²

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Tawny crazy ants, *Nylanderia fulva*, (Mayr), were first found in Alabama in the spring of 2014 near Theodore in Mobile County, Alabama. The site was an approximately eight acre homeowner site that remained unsold in the middle of a commercial port facility. Ants were also found on the neighboring port facilities. The ants had been on the sites for several years before they were identified.

A demonstration project was initiated in October of 2014 using Arilon® Insecticide, Syngenta Professional Pest Management. The product was diluted to deliver the recommended rate of 0.66 dry ounces product per 1000 sq. ft. in a sprayer calibrated to deliver 60 gallons per acre. The site was treated on October 21 after pre-treatment data were collected. Three data collection sites were set up in the treatment area and one was established in a non-treated area. Numbers of ants were assessed using Bar-S® hot dog slices placed on laminated cards as bait stations. Data collection sites were 1) a circle in the center of the property of five bait stations, 2) a circle around the home of five bait stations, 3) ten bait stations placed around the perimeter of the treated area and 4) five bait stations placed in the untreated control area. Ant numbers were assessed on a rating system of: 0 – 25 = 1, 26 – 50 = 2, 51 – 75 = 3, 76 – 100 = 4 and >100 = 5. Data were collected bi-weekly until ant numbers in the control sites began to decline in December. Data were collected monthly until numbers in the control sites began to increase in April of 2015.

Ant numbers decreased in all treated areas to less than 25 ants per bait in all treated areas, and remained below 50 ants per bait until ant numbers declined in the untreated areas (Figure 1). In 2015, we treated the same area on June 29 after collecting pre-treatment data. Data collection and site location were the same as in 2014. Arilon® was diluted to deliver the recommended rate of 0.66 dry ounces product per 1000 sq. ft. in a sprayer calibrated to deliver 100 gallons per acre, as per the large volume exterior application directions on the label. The ant numbers declined in the treated areas initially, but numbers rebounded after week two in the perimeter and center sites. Numbers around the home were suppressed for three weeks, but were low initially. A second application was applied to the site on July 27. The product was diluted to deliver the recommended rate of 0.66 dry ounces product per 1000 sq. ft. in a sprayer calibrated to deliver 400 gallons per acre, as per the large volume exterior application directions on the label. The larger spray volume was used in an attempt

to better penetrate the dense vegetation at the site. Similar to the first 2015 treatment, ant numbers declined slightly one week after treatment, but rebounded by the second week post-treatment (Fig 2).

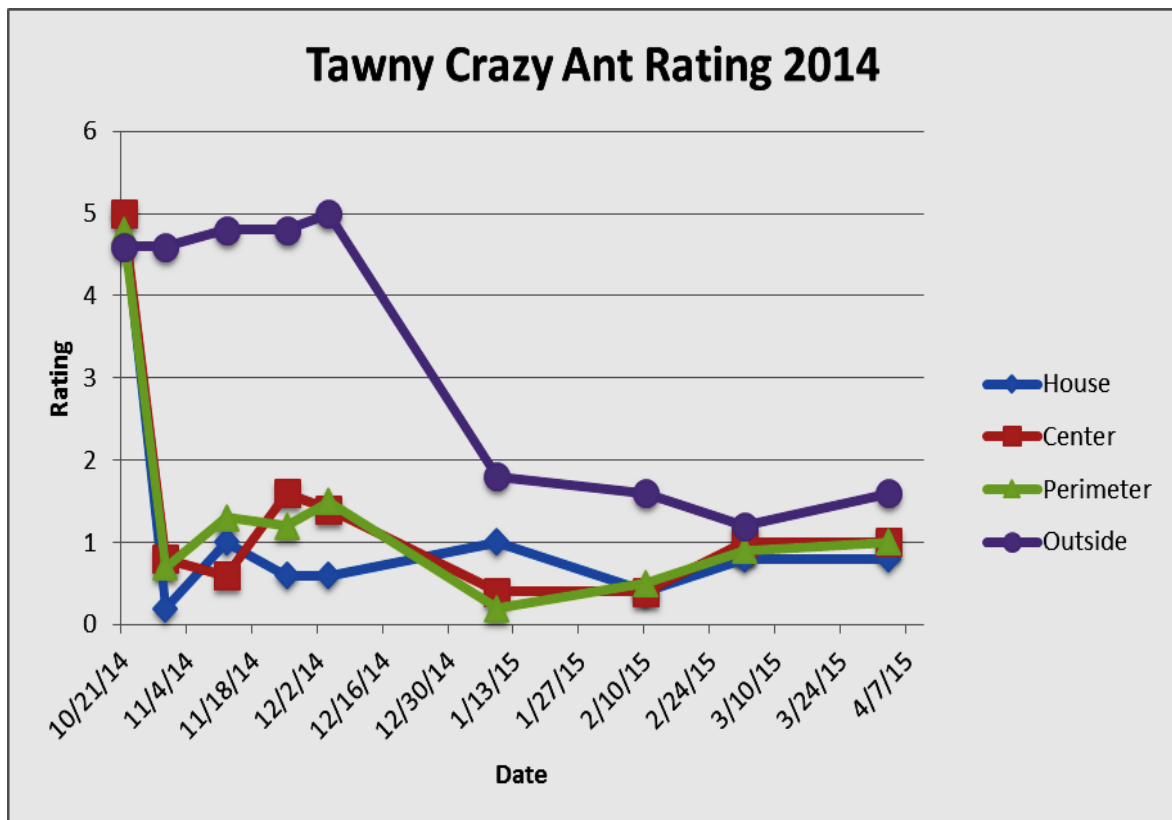


Figure 1. Mean rating value of tawny crazy ants at baits: 0 – 25 ants= 1, 26 –50 ants = 2, 51 – 75 ants = 3, 76 – 100 ants = 4 and >100 ants = 5

Tawny crazy ants have been collected over a mile from the port facility. One of the largest horticultural nurseries in Alabama is less than three miles from the site. A second study has been established to evaluate Talstar® Nursery Granular Insecticide efficacy in preventing infestation of TCA in containerized nursery stock. The rates used in our study are the rates utilized by area nurseries to comply with Federal Imported Fire Ant Quarantine. Results will be presented next year.

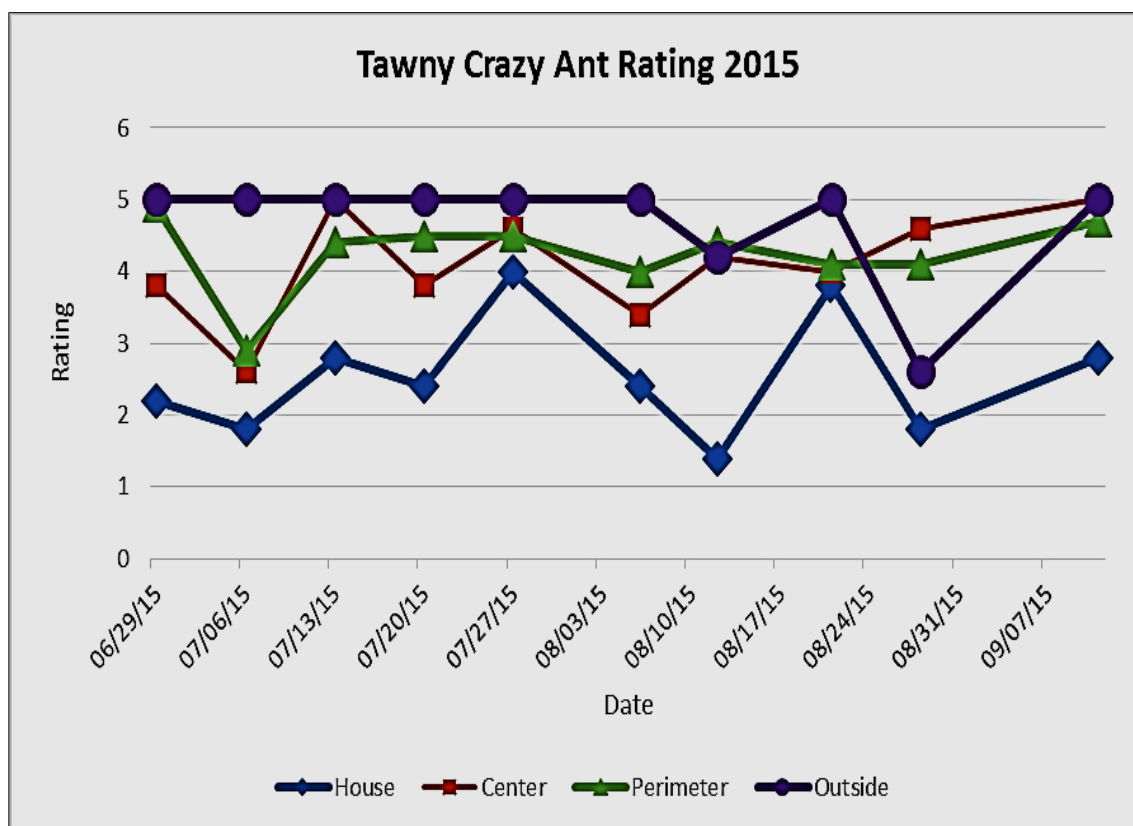


Figure 2. Mean rating value of tawny crazy ants at baits: 0 – 25 ants= 1, 26 – 50 ants = 2, 51 – 75 ants = 3, 76 – 100 ants = 4 and >100 ants = 5



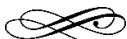
**Updates on the Venom Chemical Composition in the Little Black Ants,
Monomorium minimum (Hymenoptera: Formicidae)**

Jian Chen¹, Charles L. Cantrell², David Oi³, Michael J. Grodowitz¹

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Abstract

Venom in workers and queens of the little black ant, *Monomorium minimum* (Buckley), was analyzed using gas chromatography mass spectrometry (GC-MS). In addition to compounds that have been previously reported, this study revealed the presence of seven additional compounds in the venom of this ant species, including 9-decenyl-1-amine, N-methylenedecan-1-amine, N-methylenedodecan-1-amine, 2-(1-non-8-enyl)-5-(1-hex-5-enyl)-1-pyrroline, N-methyl-2-(hex-5-enyl)-5-nonanyl-1-pyrrolidine, β -springene ((E,E)-7,11,15-Trimethyl-3-methylene-1,6,10,14-hexadecatetraene) and neocembrene ((E,E,E)-1-isopropenyl-4,8,12-trimethylcyclotetradeca-3,7,11-triene). β -springene and neocembrene were found only in the venom of queens. All amines and alkaloids were from poison gland and β -springene and neocembrene were from Dufour's gland.



Updates to the Federal Imported Fire Ant Quarantine

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Abstract

Imported fire ants (IFA) are among the most invasive of ant species. Since their introduction into the U.S. they have continued to expand in range and now can be found in 14 states and Puerto Rico. The purpose of the federal quarantine is to restrict the human-assisted movement of IFA to new areas. The limits of the federal quarantine are described in the Code of Federal Regulations (CFR) and applicable Federal Orders. These documents are continually revised to expand the federal quarantine as new records are provided by the states.

Submitted Paper

Imported fire ants (IFA) (*Solenopsis invicta*, *S. richteri* and their hybrids) are among the most invasive of ant species. Since their introduction into the U.S. in the 1920's and 1930's through the port of Mobile, AL, they have spread to at least 13 other states. During this time, much of the spread has been due to human activities (Lofgren, Banks, Glancey 1975). In order to contain and/or slow the spread, federal quarantine guidelines were established. Federal quarantine regulations are provided in Section 7, Code of Federal Regulations, Chapter 301.81 (7 CFR 301.81) which specifies federal quarantine boundaries and regulated articles. Regulated articles are restricted from movement from within the quarantine area to areas outside of the quarantine due to the risk of moving IFA. Federal Orders are emergency measures that are used to modify quarantine boundaries and other aspects of the CFR until the CFR can be updated, which can be a lengthy process. The ever-expanding range of IFA can be attributed to natural movement of winged reproductive and natural environmental factors, as well as human-assisted movement (e.g., colony movement through infested nursery stock, infested hay bales etc.) which is usually unintentional. In order to monitor the geographic range of the ants, the Animal and Plant Health Inspection Service (APHIS) provides limited funding to state departments of agriculture to conduct surveys to track the continuing spread along the boundary. Information from state surveys leads to modification of state interior quarantines and subsequent modification of the federal quarantine boundary. The modification of the federal boundary is initially enacted through the publication of a Federal Order. A Federal Order, issued in March 2016, expanded or refined the federal quarantine in 5 states. This expansion includes five counties in Arkansas, 21 counties and 10 partial counties in North Carolina, 12 counties and 8 partial counties in Tennessee, and 1 county in Texas. In California, the quarantine boundary was further refined. This Federal Order and previous are being

incorporated into an Interim Final Rule. After the Interim Final Rule is published in the Federal Register, there will be a public comment period. Barring any substantive negative comments, the Final Rule will be published and the Code of Federal Regulations will be updated with the new quarantine boundaries in 7CFR301.81-3. The APHIS IFA website (www.aphis.usda.gov/ppq/fireant) provides the most current Federal Orders as well as maps of the quarantine area (Figure 1). IFA in the United States have not reached their full potential range and with climate change, and we are concerned with expanding the potential range (Figure 2). Microclimates in urban and suburban areas could possibly support IFA populations that would not survive the adverse environmental conditions of greater geographic locations.

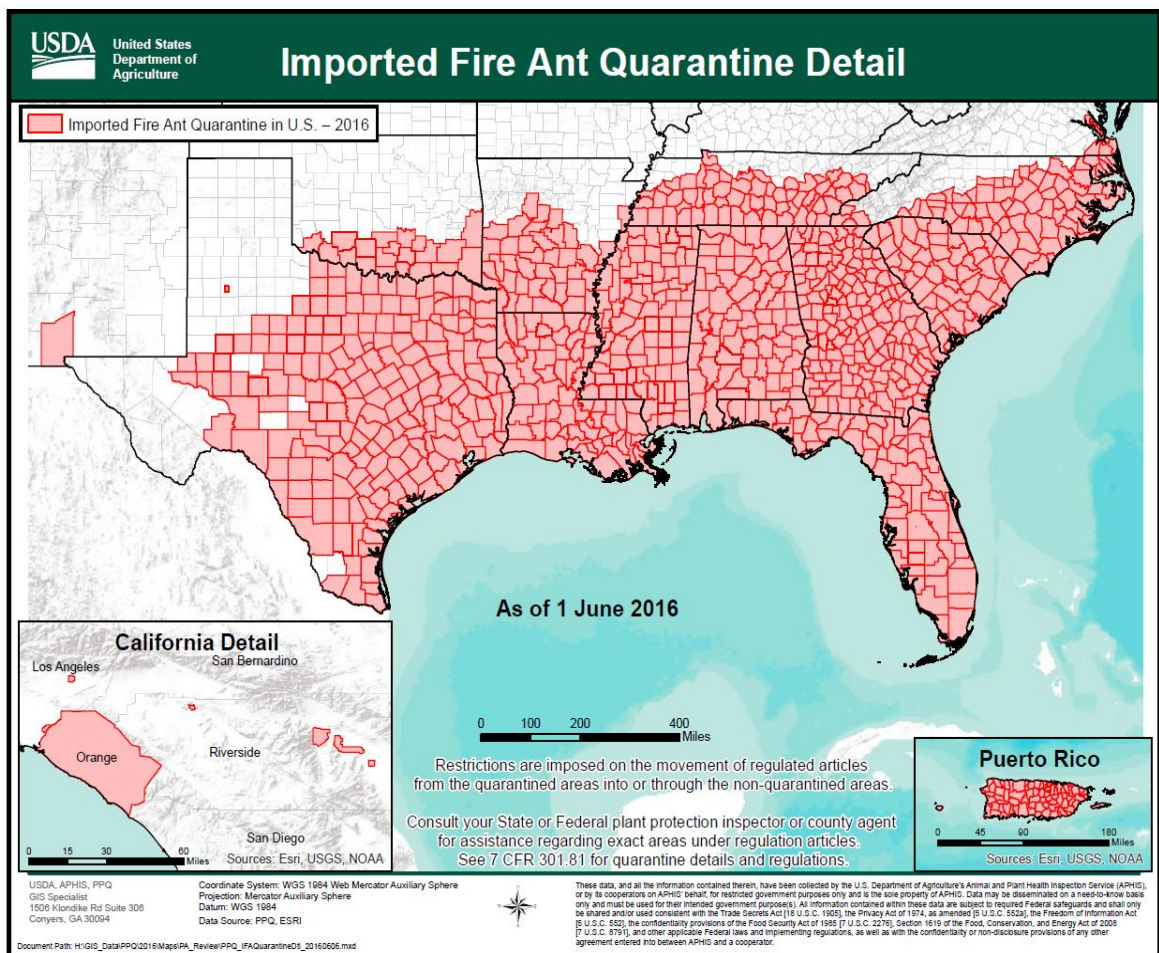


Figure 1. The current limits of the federal quarantine for imported fire ants in the United States (as of 1 June 2016).

The federal IFA Program was selected for review in Fiscal Year 2016 by the Plant Protection and Quarantine-National Plant Board (PPQ-NPB) Strategic Alliance Work Group on program evaluations. As part of the review, PPQ is conducting stakeholder consultations to assess the effectiveness of the programs and concerns for the future pathways. A separate economic

analysis of the program is being conducted by PPQ Pest Epidemiology and Risk Analysis Laboratory. The economic analysis, stakeholder concerns and review of literature will be used to provide recommendations for consideration to the PPQ-NPB Work Group and for advising the APHIS leadership of possible pathways for the program.

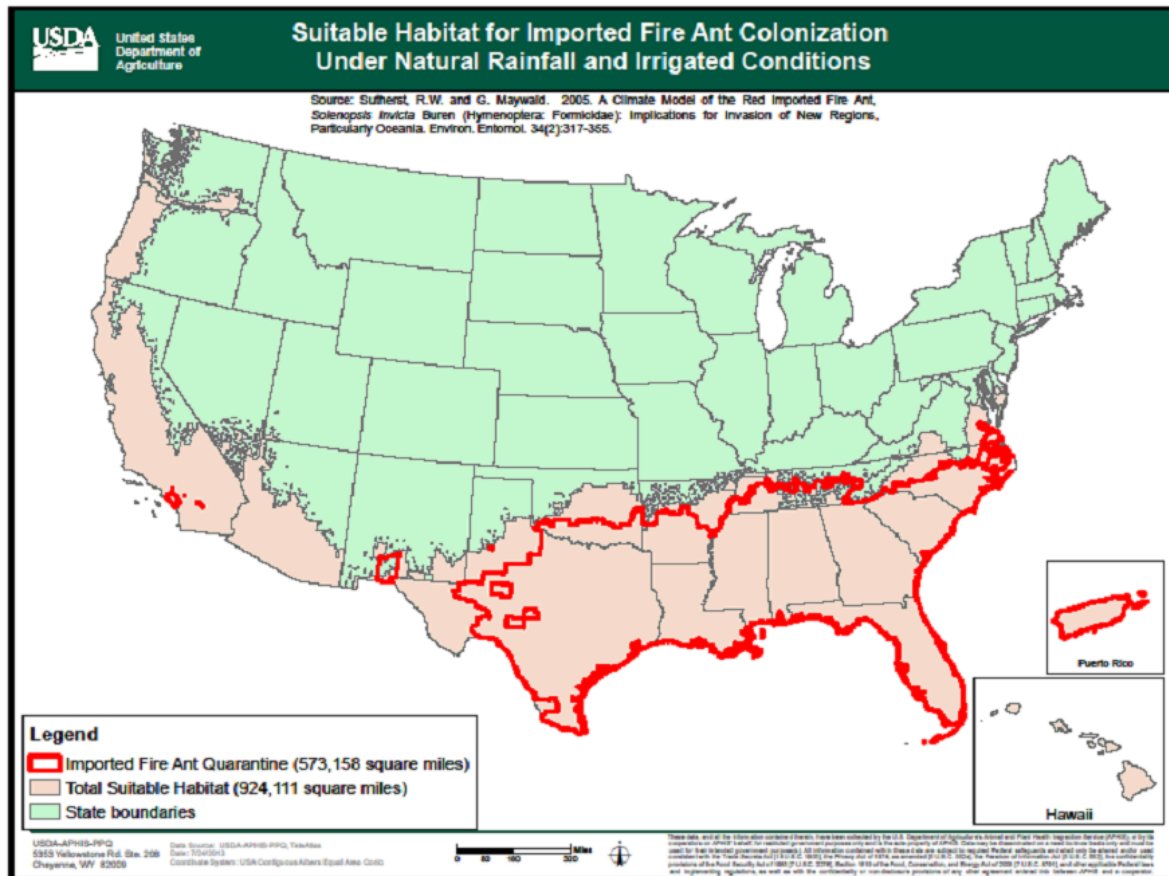


Figure 2. Projected range of imported fire ants in the United States under natural rainfall and irrigated conditions (adapted from Sutherst and Maywald 2005).

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Potential IFA Quarantine Treatments for Harvested Balled-and-Burlapped Nursery Stock

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Introduction

The goal of the Federal Imported Fire Ant Quarantine is to prevent the artificial spread of imported fire ants (*Solenopsis invicta*, *S. richteri*, and their hybrid). To accomplish this, the quarantine establishes a quarantine area and regulates known pathways for imported fire ant (IFA) movement (nursery stock, hay, soil, bee equipment, and anything else that can move fire ants). To move outside the quarantined area, regulated items must be treated in a prescribed manner or inspected and certified as free of IFA. The program also supports best management practices for IFA where they are established.

For field-grown and balled-and-burlapped (B&B) nursery stock approved quarantine treatments include:

- Pre-harvest in-field treatment
 - Broadcast bait + broadcast contact insecticide – many bait options and chlorpyrifos
- Post-harvest B&B treatments
 - Immersion/dip – bifenthrin and chlorpyrifos
 - Drench – chlorpyrifos (applied twice in one day with a rotation of the rootball between drench applications)

While rootball dips are the most effective treatment option against IFA, they are impractical with both environmental and human safety concerns. A rootball drench, when rootballs are in the holding area, prior to shipment is the preferred method of treatment. Thus numerous trials have been initiated to investigate efficacy of various insecticides and application options.

Materials and Methods

Drench treatments: Rootballs, 12-18” in diameter, were harvested by the grower and brought to the laboratory site. The total drench volume was approximately 1/5 volume of rootball. Each application consisted of ½ the drench applied to one side of rootball, rotate the rootball, then apply the other ½ drench. Applications were generally made with a garden sprinkler can or a garden type spray nozzle attached to a pump.

Dip/Immersion treatments: Rootballs, 12-18” in diameter, were harvested by the grower and brought to the laboratory site. Each rootball was submerged in the dip solution for ca 2 minutes (until bubbling cease). Most trials used a large plastic trash can to contain the dip solution.

Drench plus Injection treatments: Plants in the field with IFA colonies within the projected harvest zone were flagged and then harvested by the grower ensuring that each rootball contained a field collected IFA colony. The total treatment volume was approximately 1/5 volume of rootball. Application was as follows:

- ½ solution applied as drench
 - ½ drench on 1 side, flip, and ½ drench on other side
- ½ solution applied through injection
 - 1 injection to center of rootball OR
 - 4 injections evenly spaced around rootball

A B&G 430 Versagun Termite rod applicator equipped with the 40" x 5/8" rod and 360° tip was used to inject the rootballs and a garden spray nozzle attached to pump and spray tank was used to drench.

Bioassays Conducted

- Alate female bioassays: to determine efficacy against newly mated queen initiating colony (drench and dip)
 - Soil core samples collected at specified time intervals
 - Root ball rotated between collection times
 - 4-5 reps/treatment
 - 10 alate females exposed/confined to treated soil
 - Mortality at 7 and 14 days after exposure
- Exclusion of IFA colonies (drench only)
 - Drenched rootball, aged under irrigation, placed at one end of 2'x4' arena with 6" tall sides (sides powdered with talcum powder to prevent escape)
 - 3 reps/treatment
 - Field collected IFA colony placed at other end of arena and allowed to dry out thus forcing movement
 - Observations daily, rootballs destructively sampled on day 7
- Elimination of existing IFA colonies (drench and drench plus injection)
 - Harvested rootballs with existing IFA colonies
 - Brought to lab and treated; aged under irrigation
 - Drench: Visual and destructive sampling for presence/absence of ants over 7-14 day period
 - Drench plus injection: destructive sampling for presence/absence of ants at 1, 2 and 7 days

Results

Results for all bioassays conducted to date are shown in Table 1. The red box indicates rates currently approved for use in the IFA quarantine.

Bifenthrin is currently approved as a dip treatment with tiered rates and certification periods as shown in the table. It is effective at 0.2 lb ai rate for 6 mth as dip or drench against alate

females and IFA colony exclusion (4 mth), but not at eliminating an existing colony as a drench at that rate. However, it is effective at the 0.2 lb ai rate between 3-7 days as drench + 4 injection application against an existing colony. Future trials will include testing the 0.1 lb ai rate as drench + 4 injection against an existing colony and determining the minimum number of days to eliminate an existing colony at various rates of application.

Table 1. Efficacy of Balled-and-Burlapped Rootball Dip, Drench and Drench+Injection Treatments against Imported Fire Ants. Red box indicates current dip treatment for use in Federal IFA Quarantine. Blank boxes indicate no data to date.

Chemical(s)	Rate of Application lb ai/100 gal water	Residual Activity against IFA <u>alate</u> females		IFA colony Mort at 14d PT	IFA Colony Exclusi on	Drench+Injection IFA colony mortality at 7d PT	
		Dip	Drench	Drench	Drench	Drench+ 1 Inject	Drench+ 4 Inject
Bifenthrin	0.025	2 mth	<2 wk	-	-	-	-
	0.05	4 mth	<2 wk	-	-	-	-
	0.1	6 mth	6 mth	-	-	-	-
	0.2	6 mth	6 mth	50%	4 mth	99.99% (1 ant)	100%
Lambda- cyhalothrin	0.017	1-2 mth	-	-	-	-	-
	0.034	6 mth	2 wk	50%	1 mth	-	100%
	0.069	-	4 mth	-	-	-	-
	0.136	-	6 mth	-	-	-	-
Bifenthrin+ Imidacloprid	0.025+0.03125	1 mth	-	-	-	-	-
	0.05+0.0625	4 mth	2 wk	-	-	-	-
	0.1+0.125	6 mth	6 mth	-	-	-	-
Bifenthrin+ Trichlorfon	0.006+0.125	4 mth	-	-	-	-	-
	0.0125+0.25	4 mth	<2 wk	-	-	-	-
	0.0125+0.5	4 mth	-	-	-	-	-
	0.05+0.5	-	3 wk	-	-	-	-
Bifenthrin+ Carbaryl	0.006+0.125	4 mth	-	-	-	-	-
	0.0125+0.25	4 mth	2 wk	-	-	-	-
	0.0125+0.5	4 mth	-	-	-	-	-
Thiamethoxam	0.065	1 mth	-	-	-	-	-
	0.13	3 mth	-	-	-	-	-
Imidacloprid+ Cyfluthrin	0.1875+0.045	2 wk	-	-	-	-	-
	0.25+0.06	2 mth	-	-	-	-	-
	0.5+0.12	4 mth	-	-	-	-	-

Several insecticides were combined with bifenthrin to investigate any enhanced or synergistic activity. The addition of imidacloprid to bifenthrin does not appear to enhance activity. The addition of either trichlorfon or carbaryl to bifenthrin appears to increase efficacy against IFA in dip treatments. Both insecticides increased residual activity against IFA alates from 1 mth to 4 mths at 0.0125 lb ai bifenthrin with 0.25 lb ai of either trichlorfon or carbaryl. Both of these insecticides alone were ineffective at these rates. Both of these combinations may have possible use as a short-term drench treatment. Thus, future trials will determine effective drench rates against alates and efficacy against an existing colony.

Lambda-cyhalothrin was effective at 0.034 lb ai rate for 6 mth as a dip and 2 wk as a drench against alate females, for 1 mth for colony exclusion, but not effective at eliminating an existing colony as a drench. At 0.136 lb ai rate, which is above single application labeled rates, lambda-cyhalothrin was effective for 6 mth as a drench against alate females. However, the 0.034 lb ai rate was effective between 3-7 days as drench + 4 injection application against an existing colony. Future trials will include continued testing of the drench + 4 injection against an existing colony and determining the minimum number of days to eliminate an existing colony at various rates of application. Lambda-cyhalothrin may have possible use as short term drench and trials will continue to investigate this use as well.

Thiamethoxam rates tested as dips only gave 3 mth residual activity against alate females. However, this product may have possible use as a short-term drench or dip. The same was found for imidacloprid+cyfluthrin: rates tested as dips only gave 3 mth residual activity against alate females, and thus possible uses may be as a short-term drench or dip.

Overall, dip treatments are effective at lower rates of application against colony initiation by simulated newly mated queens (alate females) than drench treatments. Dips are more consistent in efficacy over time than drenches (data not shown here). Drench treatments at rates effective against alate females are not effective at eliminating an existing IFA colony using bifenthrin or lambda-cyhalothrin. Drench treatments are effective at excluding an IFA colony over a period of time similar to the time frame they are effective against alate females (limited data). Drench + injection is effective in eliminating an existing IFA colony however it requires between 3-7 days (ants still present at 2 d). Visual examination of rootballs is not a good indicator of presence or absence of ants if any treatment has been applied to the root ball. Growers need both long term B&B treatments for overwinter storage purposes and short term 'treat and ship' types of treatments.



Evaluation of Imported Fire Ant Quarantine Treatments in Commercial Grass Sod: Arkansas 2013 and 2015

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Introduction

Imported fire ants (IFA) originated from South America and were accidentally introduced into the United States in the early to mid-1990s. IFAs are now widespread across the Southeastern United States. Movements of this pest are regulated through a system of Federal and State quarantines. Products regulated by the IFA quarantine include, but are not limited to, hay, nursery plants, and other landscape materials including grass sod.

When treating sod in compliance with Federal and State quarantine regulations, sod producer's options are limited (USDA-APHIS 2006). One option was treatment using the active ingredient chlorpyrifos at a rate of eight pounds of active ingredient per acre. Currently, there are no chlorpyrifos products registered for IFA in sod at this required rate. Another option is to use two separate applications of fipronil at 0.0125 pounds per acre about one week apart. Fipronil can be too expensive to apply and the longer required exposure period can be a logistical problem for sod producers. One newly approved quarantine option is two applications of 0.2 lb. ai/acre bifenthrin, one week apart, for a total of 0.4 lb. ai/acre. This option is less costly and has a shorter exposure period than fipronil.

Because of limited or costly options available to sod producers, field studies were conducted (2013 and 2015) to evaluate the efficacy of other insecticides for use in the IFA quarantine. Using fire ant bait as the first application, followed by 0.2 lb. ai/acre of bifenthrin has shown much promise as a quarantine treatment. Work was conducted in 2013 and 2015 to add to the data supporting this type of treatment for quarantine use. In 2013, fire ant bait followed by bifenthrin alone and bifenthrin combination formulations (bifenthrin + zeta cypermethrin and bifenthrin + clothianidin) were evaluated. In 2015, both a bifenthrin + carbaryl combination formulation and a tank mix were evaluated alone and preceded by a fire ant bait treatment. All of these options, if effective, will allow a treatment with lower costs to the grower than the current fipronil treatment or the proposed bifenthrin 0.4 lb. treatment rate (two applications of 0.2 lb. ai/acre, applied 1 week apart).

Materials and Methods

Both studies were conducted on an irrigated sod farm in Fulton, AR (Hempstead Co.). The first began in June 2013 and ended in August 2013 and the second study began in late July

2015 and ended in late September 2015. Plots were square, measured ½ acre in area, and treatments (four treatments and an untreated control) were arranged in a Randomized Complete Block Design (RCBD) with three replications. In 2013, plots used in the study had a range of 16-28 active fire ant mounds per acre when the study began. In 2015, at the beginning of the study, study plots had a range of 16-84 active fire ant mounds per acre. An active fire ant mound was defined as a mound with 25 or more ants in the colony. Application of treatment materials within the same plot were separated by one week.

2013: Spray applications were made using a towed boom sprayer applying at 20 gal/A (15 ft. boom with ten 8003FF nozzles on an 18" spacing at 20 psi and 5.2 MPH). Granular bait applications were made using an Earthway 2750 hand operated seeder and were calibrated to apply 1.5 pounds per acre. Granular bifenthrin applications were made using an Earthway 2759 hand operated seeder and were calibrated to apply 100 pounds per acre. Treatment numbers, insecticide rates and the total amount of active ingredients applied per acre are provided in Table 1.

Table 1. 2013 Insecticide applications, rates and total amount of active ingredients

Treatment Number	Insecticide Application (fb=followed by)	Total active ingredients/acre
1	None – Untreated Control	None
2	Advion® bait (1.5 lb./A) fb OnyxPro® EC (13.9 oz./A) 8 days after bait	0.000675 lb. ai/A indoxacarb 0.2 lb. ai/A bifenthrin
3	Advion® bait (1.5 lb./A) fb Talstar Xtra Granular Insecticide (100 lbs./acre) 8 days after bait	0.000675 lb. ai/A indoxacarb 0.20 lb. ai/A bifenthrin 0.05 ai/A zeta-cypermethrin
4	Advion® bait (1.5 lb./A) fb Aloft GS SC (3.32 SC) (14.4 oz./A) 8 days after bait	0.000675 lb. ai/A indoxacarb 0.12 lb. ai/A bifenthrin 0.24 lb. ai/A clothianidin
5	Advion® bait (1.5 lb./A) fb Aloft GS SC (3.32 SC) (20.0 oz./A) 8 days after bait	0.000675 lb. ai/A indoxacarb 0.17 lb. ai/A bifenthrin 0.35 lb. ai/A clothianidin

2015: Spray applications were made using a towed boom sprayer applying at 20 gal/A (15 ft. boom with ten 8003FF nozzles on an 18" spacing at 20 psi and 5.2 MPH). Granular bait

applications were made using a Herd fire ant spreader attached to a Kawasaki Mule ATV and were calibrated to apply 1.5 pounds per acre. Granular bifenthrin/carbaryl (Duocide™) applications were made using a tow-type granular applicator (Agri-Fab) towed by a Yamaha ATV and were calibrated to apply 348 pounds per acre. Treatment numbers, insecticide rates and the total amount of active ingredients applied per acre are provided in Table 2.

Table 2. 2015 Insecticide application rates and total amount of active ingredients

Treatment Number	Insecticide Application (fb=followed by)	Total active ingredients/acre
1	None – Untreated Control	None
2	Siesta® 0.063% bait (1.5 lb./A) fb Duocide™ 2.358% G 348lb/acre 6 days after bait	0.000945 lb. ai/A metaflumizone 0.2 lb. ai/A bifenthrin 8.0 lb. ai/A carbaryl
3	Duocide™ 2.358% G 348lb/acre 6 days after bait	0.20 lb. ai/A bifenthrin 8.0 lb. ai/A carbaryl
4	Siesta® 0.063% bait (1.5 lb./A) fb Onyx Pro at 13.9 oz./A + Sevin SL at 128 fl. oz./A (tank mix) 6 days after bait	0.000945 lb. ai/A metaflumizone 0.2 lb. ai/A bifenthrin 4.0 lb. ai/A carbaryl
5	Onyx Pro at 13.9 oz./A + Sevin SL at 128 fl. oz./A (tank mix) 6 days after bait	0.2 lb. ai/A bifenthrin 4.0 lb. ai/A carbaryl

In both studies, the number of active mounds per plot was determined by counting the mounds in a circle at the center of the plot. This circle had a diameter of 58.9 ft., which corresponds to a circle with an area of 0.25 acre. Mounds were counted by anchoring one end of a 58.9 ft. rope at the center of the plot and moving the free end along the circumference of the circle. Each mound encountered along the length of the rope was disturbed by probing with a small rod and estimating the number of imported fire ants exiting the mound within 20 seconds (Jones et al 1998).

The number of active mounds in each plot was determined before any treatments were applied and then at seven days after the last application (DALA) then weekly up to 28 DALA, at which time evaluations were made every 14 days until the study ended.

All data were analyzed using Gylling's Agriculture Research Manager Software (ARM 7.0.3. 2003). An analysis of variance was performed and Least Significant Difference ($p=0.05$) was used to separate means only when AOV Treatment P(F) was significant at the 5% level (ARM 2003).

Results

2013: The data are summarized in Table 3 and Figure 2. Before applying treatments, there were no significant differences in the number of active mounds in any of the plots to be used in the study. Throughout the remainder of the study, all insecticide treated plots had significantly ($p<0.05$) fewer active IFA colonies compared to the untreated control. At 7 DALA through 28 DALA, all insecticide treated plots had zero active mounds per acre except for the Advion/Talstar Xtra treatment (a single colony in one plot remained active throughout the study). At 42 DALA an active mound was detected in one of the Advion/Onyx Pro treated plots. By 56 DALA, all insecticide treated areas had at least one plot that contained an active fire ant colony. The results for the 70 DALA evaluations were basically identical, therefore the study was discontinued. Untreated controls maintained reasonable activity all summer, probably due to routine irrigation of the test area.

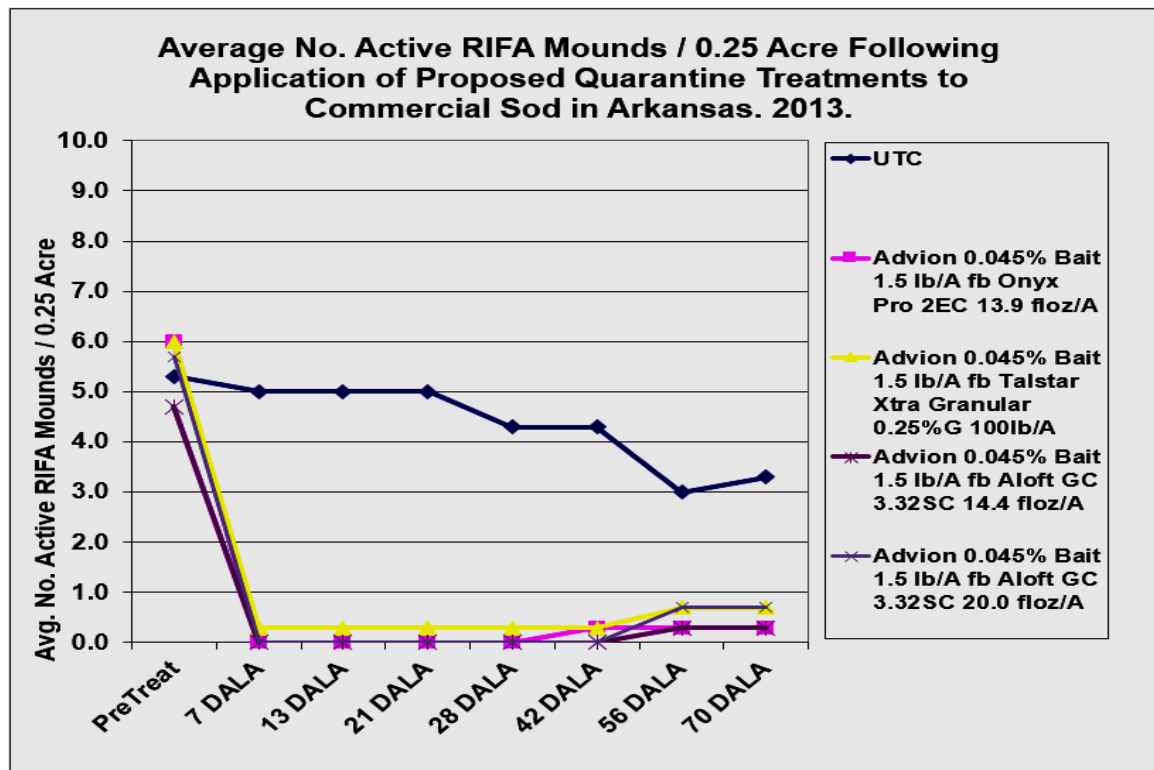


Figure 1. 2013 Average Number of Active Mounds/0.25 Acres for each treatment

All insecticide treatments significantly reduced the number of IFA colonies in treated plots and for a period of time are acceptable for quarantine uses. However, the Advion/Talstar Xtra treatment never achieved 100% control. Most treatments were also very quick to eliminate IFA within 7 days after last application, another criterion very important to sod growers. In terms of duration of “100%” control (necessary for a quarantine treatment option), both rates of the Advion/Aloft GC treatments outperformed the other treatments by at least 2 weeks (through 42 DALA). This study demonstrates that an Advion bait treatment followed by a bifenthrin or bifenthrin / clothianidin regime eliminates IFA quickly and for an acceptable time period. The results of this study were comparable to the results of a trial, performed in 2012.

2015: The data are summarized in Table 4 and Figure 2. Before applying treatments, there were no significant differences in the number of active mounds in any of the plots used in the study. Throughout the remainder of the study, all insecticide treated plots had significantly ($p < 0.05$) fewer active IFA colonies compared to the untreated control.

Table 3. 2013 Average Number of Active Mounds/0.25 acres for each treatment

Treatment	Average number of active colonies per 0.25 acre							
	PreTrt	7 DALA	13 DALA	21 DALA	28 DALA	42 DALA	56 DALA	70 DALA
UTC	5.3a	5.0a	5.0a	5.0a	4.3a	4.3a	3.0a	3.3a
Advion Bait 1.5 lb./A fb by Onyx Pro 0.2lb ai/A	6.0a	0.0b	0.0b	0.0b	0.0b	0.3b	0.3b	0.3b
Advion 0.045% 1.5 lb./A fb Talstar Xtra Granular 0.25 lb. ai/A	6.0a	0.3b	0.3b	0.3b	0.3b	0.3b	0.7b	0.7b
Advion 0.045% 1.5 lb./A fb Aloft GS 0.36 lb. ai/A	4.7a	0.0b	0.0b	0.0b	0.0b	0.0b	0.3b	0.3b
Advion 0.045% 1.5 lb./A fb Aloft GS 0.52 lb. ai/A	5.7a	0.0b	0.0b	0.0b	0.0b	0.0b	0.7b	0.7b

Means followed by same letter do not significantly differ ($P = 0.05$, LSD)

At 7 through 21 DALA, the Siesta bait plus bifenthrin/carbaryl tank mix treated plots had zero active mounds per acre. The Duocide-only treated plots had no active mounds at 7 DALA, however by 14 DALA, an active mound was detected in one of the plots. Other treatments achieved zero colonies per acre later on in the study (14 and 21 DALA). Three treatments that achieved zero colonies per acre for three consecutive weeks were the Siesta bait plus the

bifenthrin/carbaryl liquid tank mix, the bifenthrin/carbaryl only liquid tank mix, and the Duocide only treatments. Untreated controls maintained reasonable fire ant activity all summer, probably due to routine irrigation of the test area.

All insecticide treatments significantly reduced the number IFA colonies in treated plots. However, the duration of control (zero colonies per acre) was less than desired for quarantine treatment of commercial grass sod. Any of these options would likely be suitable for control in home lawns, parks or recreational areas but did not perform as well as some of the previously tested bait plus contact insecticides mixes e.g. bifenthrin/clothianidin mixture.

Table 4. 2015 Average Number of Active Mounds/0.25 acres for each treatment

Treatment	Average number of active colonies per 0.25 acre						
	PreTrt	7 DALA	14 DALA	21 DALA	28 DALA	42 DALA	56 DALA
UTC	11.7a	10.7a	6.0a	10.7a	7.0a	8.0a	10.7a
Siesta® 0.063% bait (1.5 lb./A) followed by Duocide™ 2.358% G 348lb/acre	8.7a	1.3b	0.7b	0.0b	0.3b	0.0b	0.3b
Duocide™ 2.358% G 348lb /acre	7.7a	0.3b	0.3b	0.0b	0.0b	0.0b	0.3b
Siesta® 0.063% bait (1.5 lb./A) followed by tank mix - Onyx Pro at 13.9 oz./A and Sevin SL at 128 fl. oz./A	9.7a	0.0b	0.0b	0.0b	0.3b	0.3b	0.0b
tank mix - Onyx Pro at 13.9 oz./A and Sevin SL at 128 fl. oz./A	5.3a	1.0b	0.0b	0.0b	0.0b	0.3b	0.7b

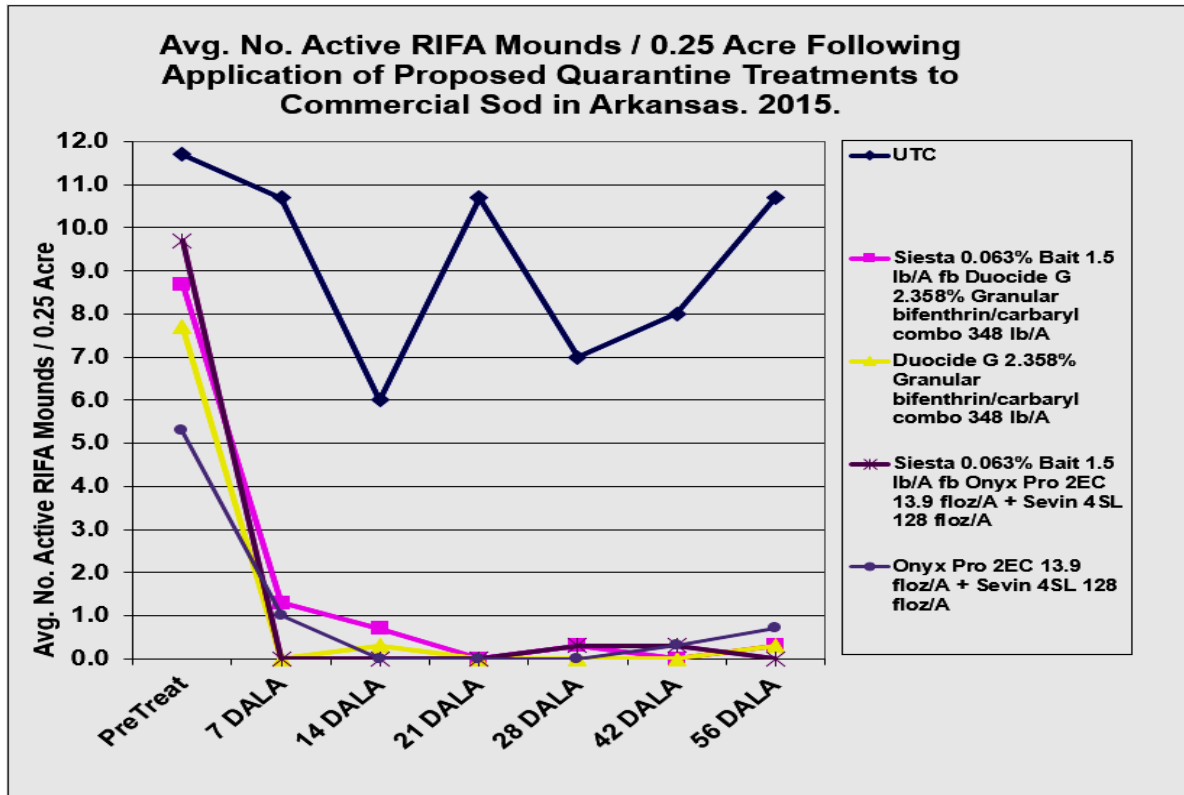


Figure 2. 2015 Average Number of Active Mounds/0.25 Acres for each treatment

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Imported fire ants in the plant industry

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Abstract

Texas Department of Agriculture (TDA) plays a central role in preventing the artificial spread of IFA into IFA-free areas through regulatory and quarantine actions. The impact of IFA is notable during the import and export of regulatory articles such as, nursery, floral and landscape plants. The regulated articles may include soil, sod, growing media, hay, straw, honey beehives, grain, fiber, nuts, firewood, lumber, building materials, landscape, industrial and military equipment, and animals and processed animal products. Of these nursery-floral plants, hay, straw, soil, and honey bee equipment are addressed by the state regulations. Nursery-floral plant shipments require phytosanitary inspection, certification and treatment. Over 74% of 254 Texas counties are quarantined for IFA. Nearly 300 plant shippers or 2% registered nurseries are brought under compliance each year under the federal guidelines. The articles to be exported to IFA-free area are treated using USDA approved treatments. Nurseries as well as articles are inspected for compliance at the critical entry points to facilitate interstate commerce. The counties along the leading edge of IFA distribution are surveyed annually. Outreach, compliance inspection, treatment success and IFA surveys have been the major components to exclude, contain and control IFA that affects every aspect of agricultural production and commerce, and they seem to be effective in slowing its spread.



Evaluation of various insecticide combinations as fire ant quarantine treatments on commercial grass sod

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Abstract

Two bifenthrin/carbaryl treatments (Duocide G - 0.058% bifenthrin + 2.3% carbaryl; or an Onyx Pro 2EC (23.4% bifenthrin) and Sevin 4SL (43.0% carbaryl) liquid tank mix) were evaluated with and without a prior application of Siesta (0.063% metaflumizone) fire ant bait. The number of active colonies were significantly reduced for all insecticide combinations seven days after the last insecticide application. This trend continued through the last

evaluation (56 days after the last application). Although all treatment combinations exhibited a high level of control throughout the study, some of the treatment plots still had at least one active colony.



Incorporating other pest ants into fire ant eXtension

Kathy L. Flanders¹, Paul R. Nester² and Robert P. Puckett³

¹Auburn University, AL; ²Texas A&M AgriLife Extension Service, Houston, TX; ³Texas A&M AgriLife Extension Service, College Station, TX

Abstract

The Imported Fire Ant eXtension Community of Practice has curated web and social media content since 2005 (e.g., *articles.extension.org/fire_ants* and *fireantinfo* on Facebook). Imported fire ants are not the only ant pests in the U.S. Therefore, the community has decided to expand the scope of the web page and social media outlets to include other pest ants, including tawny crazy ant, Asian needle ant, little fire ant, European red ant, Argentine ant, etc. Leaders of the new Ant Pests Community of Practice are Kathy Flanders, Paul Nester, and Robert Puckett. Content curators for each ant pest are being identified. The goal is to provide new content on these other ants by Fall 2016 at http://articles.extension.org/ant_pests. Please contact Kathy Flanders at flandkl@auburn.edu if you are interested in joining the new Ant Pests Community.



Red Imported Fire Ant management efforts in Corpus Christi Independent School District – avoiding tragedy

Paul R. Nester¹, Janet A. Hurely², Brett Bostian³, Hector Hernandez³, and Walter “Buster” Terry³

¹Texas A&M AgriLife Extension Service, Houston, TX; ²Texas A&M AgriLife Extension Service, Dallas, TX; ³Facilities and Operations Department, Corpus Christi Independent School District, Corpus Christi, TX

Abstract

This report discusses the 1) September 2013 death of a Corpus Christi Independent School District (CCISD) middle school student from numerous red imported fire ant (RIFA) stings during a junior high football game in Corpus Christi, TX, 2) the attempts of the CCISD Administration to address improvements to their existing RIFA management program, 3) the efforts of the Texas A&M AgriLife Extension Service to assist and monitor the fire ant management efforts and 4) the successes and challenges of maintaining an effective fire ant management program within the CCISD public school system.



Effect of Cattle Feed-Through Horn Fly Control Mineral Containing (S)-methoprene on IFA in Pastures

Henry Dorough¹, Fudd Graham² and Landon Marks¹

¹ALABAMA COOPERATIVE EXTENSION SYSTEM, ²AUBURN UNIVERSITY

Anecdotal reports from farmers using (S)-Methoprene feed-through horn fly control measures in cattle pastures include references to incredible control of imported fire ants as a side benefit. This story has been repeated by several Alabama farmers using Altosid® protein and mineral products fed free-choice to cattle with some reporting “eradication” of fire ants from their pastures. To test this claim a trial was designed in which an Altosid® feed-through mineral was provided to five groups of cattle on five separate farms in Calhoun County, Alabama for the period of two consecutive horn fly seasons. Two additional groups of cattle on two separate farms were fed free choice mineral that did not contain (S)-Methoprene as a control measurement. Live mound counts were recorded in three ¼-acre circles +randomly selected in each of the seven pastures. One month following the initial introduction of(S)-Methoprene treated mineral there appeared to be an uncharacteristic and significant drop in live mounds with control being 25.96% vs 0.67% for the treated and control pastures, respectively. However, this difference did not occur on all remaining data collections as live mound counts

and percent control remained similar for both treated and untreated pastures over the entire two-year study period.



Control of Red Imported Fire Ants in Alabama

Lucy Edwards¹, James D. Jones¹, Fudd Graham², and Reafield Vester¹

¹Alabama Cooperative Extension System, ²Auburn University

Since their introduction in Mobile, AL in the early 1900's, imported fire ants have become a problem in every county of Alabama. In addition to affecting households, fire ants have become a nuisance to entities such as agriculture, commercial businesses, airports, golf courses, schools, utilities, camps, and fair grounds. Proper fire ant management has become critical in many of these locations. For the past ten years, demonstration and evaluation of formulated fire ant bait products has been conducted in various ecosystems in Alabama including pastures, farms, and recreational lands. Since 2007, the Alabama Cooperative Extension System has evaluated the management of fire ants at the National Peanut Festival fair grounds in Dothan, AL. From this, the Extension System has been able to train Master Gardeners in fire ant management. Today, Master Gardeners and Extension personnel host a "Fire Ant Booth" during the National Peanut Festival reaching 4,000 to 6,000 individuals annually. This exhibit has provided the opportunity to explain basic fire ant biology to children as well as offer best management strategies to adults.

In 2006, the Alabama Fire Ant Management Program began educating the Master Gardeners on the biological control of fire ants. Prior to each year's Peanut Festival, the Master Gardeners receive continuing education on the status of fire ant control. Training also includes demonstration for releasing phorid flies into a container of fire ants to be displayed during the festival.

The Fire Ant Booth includes informational posters, the cast of a fire ant tunnel system, fire ant bait, hand spreader, eXtension bookmarks, live fire ants and phorid flies. Fire ant activity books and Alabama Cooperative Extension publications on managing fire ants are distributed. A live display of ants and their biological control (phorid flies) attracts many individuals. Attendees are fascinated by the phorid flies in action. Overall, the exhibit gives opportunity to teach children about the biology of fire ants, and the basics of biology and control management to the parents.



The impact of Red Imported fire Ants *Solenopsis invicta* Buren on upland Arthropods in eastern India

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Solenopsis invicta Buren. is an important invader on upland arthropod of eastern India. The ant populations were sampled before and during appearance of hibernating larva and pupa of rice yellow stem borer inside the rice plant. Species richness and diversity of other ant species was also assessed from YSB protected field with insecticide and the crop grown under Natural Biological Control. The maximum value of Barger- Parker index ($d=0.245$) indicated that RIAF constituted 24.55% of the total population. Beside this in natural as in agricultural ecosystems, interference between RIFA and mealybug aphids were also recorded.



Red Imported Fire Ant survey yields eight new Texas county records

Danny McDonald & Jerry Cook

Sam Houston State University

As the red imported fire ant (RIFA), *Solenopsis invicta*, continues to infiltrate more arid parts of the United States it is important to periodically assess the distribution of this invasive species. Although *S. invicta* have reached the outer limits of their predicted distribution limits, they are still being found beyond that predicted range where irrigation and human traffic are heavy. New counties will need to be added to the quarantine list in order to attempt to mitigate the spread of this tramp species within and between counties. In 2013 our survey efforts resulted in three new Texas county records for *S. invicta* (Menard, Sterling, and Sutton Counties). In 2014, we also found *S. invicta* in Jim Hogg, Knox, and Stonewall Counties. In 2015 our survey efforts resulted in two additional counties, Hardeman and Lubbock.



Update on the Alabama Herd Seeder Program

Kathy Flanders, Henry Dorough, and Fudd Graham

Alabama Cooperative Extension System and Auburn University

The Alabama Cooperative Extension System Herd Seeder Program was established in 1999. The purpose was to allow stakeholders to borrow the seeders to apply fire ant bait. The ultimate goal was to convince stakeholders to buy their own Herd seeder. Currently the program has 48 seeders. Of this number 30% are not used, 13% are used once a year, 33% used 2-3 times a year, and 19% are used 4-8 times a year. Seeders were used to treat an average of 44 acres per year. Seeders were used primarily on pastures and hay land (53% of acreage) and recreational land (26%). 17% of the caretakers said that their clients purchased a Herd seeder of their own after seeing how well they worked. We plan to move underutilized seeders to counties where they are more likely to be used.



An overview of residential neighborhood treatments of Red Imported Fire Ants in Orange County, CA

Cynthia Ros

Orange County Mosquito and Vector Control District

The Orange County Mosquito and Vector Control District has been managing Red Imported Fire Ants in Orange County since 2004. The goal has been to Fire Ant populations under control to protect the citizens of Orange County from this aggressive stinging insect. In 2010 the District instituted a ‘new’ treatment method in the form of Neighborhood Treatments. This is a systemized way of selecting and treating entire neighborhood blocks as one entity. This treatment method has unique complications and challenges which I will review over a period of 5 years.



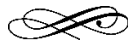
Watching ants: How insect behavior impacts protocols

Roberta Dieckmann, Gabriela Perezchica-Harvey, and Jennifer Henke

Coachella Valley Mosquito and Vector Control District

Know your pest is the first rule of any treatment. At the Coachella Valley Mosquito and Vector Control District, we reexamined the activity of red imported fire ants (*Solenopsis invicta*) from

May until November 2015. The goal was to determine the most effective time to conduct surveillance and to make treatments to control the ants, and determine if air temperature or shade impact foraging behavior. Thirty-two mounds were surveyed every two weeks during the time of day when technicians were working (May 1 – September 30: 6:00 am to 11:00 am; October 1 – November 30: 8:00 am – 1:00 pm). A hot dog slice was placed 1 m (3 ft.) from the mound. After 60 minutes, the number of ants was estimated, the hot dog slice was removed, and a new hot dog slice was placed 90° from the previous in a cardinal direction (for instance, if the first slice was north of the mound, the next slice was east of the mound). Temperature and relative humidity were measured, and temperature was found to be a good predictor of ant activity. The District is using this study to revise its Standard Operating Procedures to make effective and efficient treatments.



Symposium
Advances in Invasive Ant
Management



When Imported Fire Ants are Found Outside the Quarantine Area

Anne-Marie Callcott¹, Richard Johnson², Ronald Weeks³

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The goal of the Federal Imported Fire Ant Quarantine is to prevent the artificial spread of imported fire ants (*Solenopsis invicta*, *S. richteri*, and their hybrid) from where they are to where they are not – but could establish. To accomplish this, the quarantine establishes a quarantine area and regulates known pathways for imported fire ant (IFA) movement (nursery stock, hay, soil, bee equipment, and anything else that can move fire ants). To move outside the quarantined area, regulated items must be treated in a prescribed manner or inspected and certified as free of IFA. The program also supports best management practices for IFA where they are established.

Suspicious Ants on Nursery Stock: If suspicious ants are found on nursery stock outside the quarantine area such as in a plant nursery, at a retailer or from a direct purchase, contact the State plant inspector or extension office. They in turn will ID ants and if it is IFA, the State will contact the PPQ State Plant Health Director. PPQ will confirm identification and then PPQ and the State will then work with the nursery/vendor to determine disposition of plants.

- Hold shipment
- Return infested articles to their origin
- Remove and destroy infested shipment
- Treat infested shipment

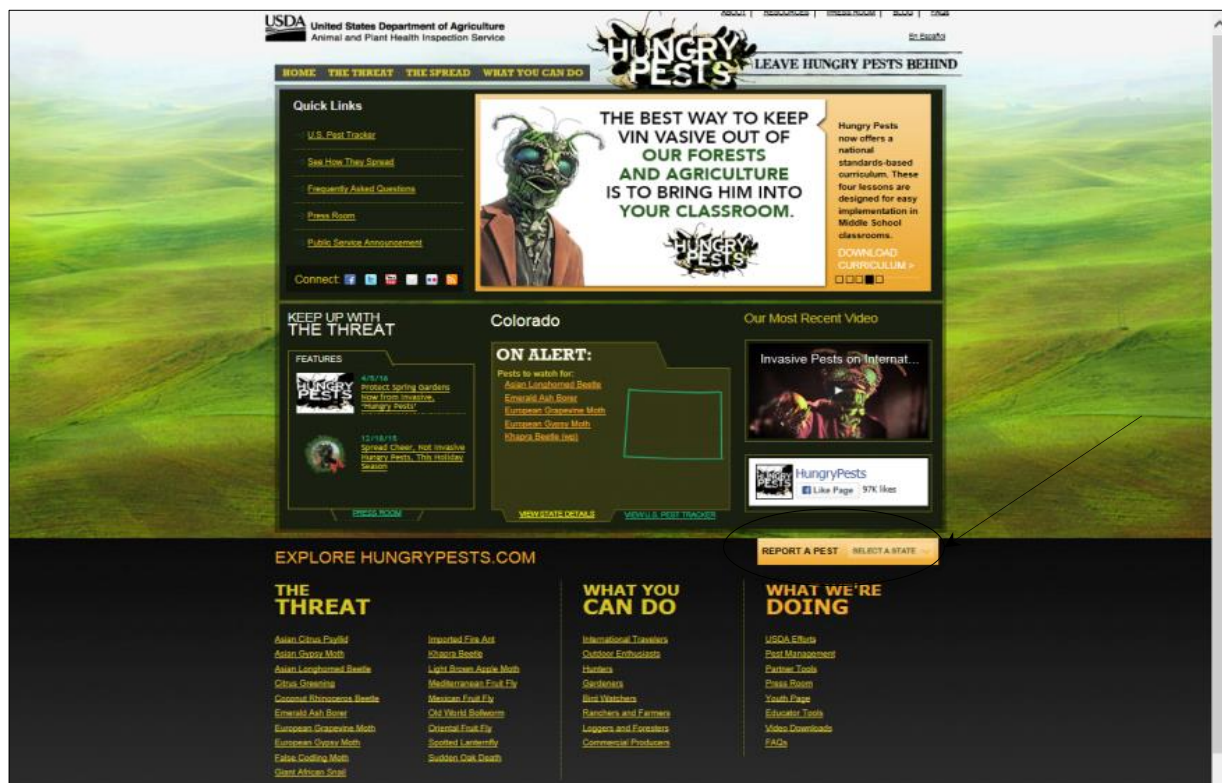
An investigation will ensue to determine whether a violation of the quarantine occurred. When regulated material is suspected to have been moved out of the regulated area in violation of the quarantine, regulatory personnel will conduct initial preliminary investigations to determine if a violation of the quarantine has occurred and safeguard any regulated material. These investigations will also attempt to identify and to trace the source and destination of any other related shipments of regulated materials that have occurred. Preliminary investigations by regulatory personnel will allow management to determine whether the situation warrants additional formal investigation by USDA-APHIS-Investigation and Enforcement Services (IES) personnel. If a violation of the quarantine has occurred fines are possible.

The State will follow up over a period of time on an IFA nursery violation. They will conduct surveys in and around the nursery, educate retailers on the IFA quarantine and the need to buy from growers with proper certification, etc. and assist with environs treatment recommendations. Funds for treating nursery stock or environs generally are not available from State or Federal governments.

Suspicious Ants in the Environment: If suspicious ants are found in the environment, contact your local extension office. They will ID ants and if it is IFA or another exotic ant, extension will contact the State Regulatory agency who will in turn contact the PPQ State Plant Health Director if necessary (if IFA). State and/or extension service may treat the ants if appropriate or make treatment recommendations. There is no federal funding to assist with treating IFA. In public areas, State or extension will assist in survey and monitoring for spread or efficacy of the treatment. Action depends on state funding and risk of IFA becoming established. In private areas, State and/or extension will provide treatment and application recommendations but generally will not treat for you.

If you find any pests (plant or animal) you are not sure about, please go to the USDA HungryPests.com website and report the pest. The website also has information on many invasive pest species.

www.hungrypests.com

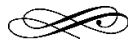


Red Imported Fire Ant eradication efforts in Taiwan

Rong-Nan Huang^{1,3}, Nancy Huei-Ying Lee², Chin-Cheng Yang³, Cheng-Jen Shih¹, Wen-Jer Wu^{1,3}

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The red imported fire ant (RIFA), *Solenopsis invicta*, an exotic species first invaded Taiwan in 2003 from United State of America. A program was immediately launched in 2004 responsible for the control of RIFA. Though the RIFA in Northern part of Taiwan did not eradicate until now, those in Southern part of Taiwan and I-Lan county (Northeastern of Taiwan) were almost completely eradicate. In particular, this is the 2 nd invasion of RIFA in I-Lan county and was effectively eradicated within one year. According to mtDNA analysis, the RIFA population in I-Lan county belong to two variants which all derived from Northern part of Taiwan and indicate multiple invasion of RIFA. The successful eradication of RIFA in I-Lan can attribute to (1) the donation of fipronil by Chung-Hsi chemical plant, (2) the team work of local government and central government, (3) the immediately launch movement control. Recently, we also evaluate the efficacy of cypermethrin powder for the control of RIFA mound. The results showed that cypermethrin treatment could efficiently reduce the mound number of RIFA in a short period. The powder treatment was easier as compared to traditional treatment (drench or injection) and fit the habitual behavior of general people and RIFA, therefore, we would suggest the cypermethrin powder treatment as an alternative for future control of RIFA mound in Taiwan.



Australia's battle with fire ants – we can't afford to lose

Sarah Corcoran

Biosecurity Queensland Control Centre, Department of Agriculture and Fisheries, Queensland
Australia

The Department of Agriculture and Fisheries has been delivering the National Red Imported Fire Ant Eradication Program (the Program), Australia's largest eradication program, on behalf of the Australian Government and all State and Territory governments since 2001.

Red Imported Fire Ants (RIFA) (*Solenopsis invicta*) are recognized as a pest of national significance, based on the massive negative impacts they would have on Australia's economy, environment, public health and lifestyle. They inflict a terribly painful sting and have potential to greatly impact the agricultural sector in terms of loss of livestock and crop production costs (cereal grains, fruit and vegetables and nuts).

Without a fire ant eradication program in Australia, more than fifty crops, as well as turf and nursery stock, will be affected by fire ants - reducing yield, killing plants, damaging equipment and infrastructure, creating medical expenses, increased labour costs, and limiting market access. Fire ants would increase annual crop production costs by at least AUD \$50 per hectare. With 26 million hectares sown to crops in Australia, the cost to industry could be in the billions.

Worth \$8.5 billion per year and already facing significant productivity losses to other pests and diseases, fire ants could also cost the Australian cattle industry over \$373 million Australia-wide per annum, double the amount already incurred to cattle tick.

The Program has been successful in keeping the level of infestation in south east Queensland very low, compared to the extremely high densities that are found in the United States. The Program is working to prevent Australia from having the same problems as the United States, where an estimated \$US7 billion is spent annually managing the impacts of fire ants.

RIFA are known to have entered Australia at least sixteen times. Of these entries, they were not immediately detected on six occasions resulting in establishment at the Port of Brisbane (2001), the south-western suburbs of Brisbane (2001), Yarwun (2006 and 2013), Port Botany (2014) and the Brisbane Airport (2015).

Genetic studies show that the main source of infestations found in Australia are arriving from the southern United States, closely followed by China and South America. This information is critical to profiling risk of entry and intercepting fire ants at the border.

It has been through continued investment in a RIFA eradication program that has allowed Australia to be successful in developing new technologies and world class eradication techniques, making it a center of excellence for tramp ant eradication. Through extensive

scientific investigations sophisticated modelling techniques have been developed that predict fire ant behavior. There has also been significant investment in developing techniques to improve the ability to find and destroy the ants. Techniques developed include remote sensing, fire ant odor detection dogs, fire ant specific insect growth regulator bait and genetic tracing.

The Program's successful use of odor detection dogs to eradicate fire ants is a world first innovation. These highly trained animals play a key role in fire ant surveillance. They can detect fire ant pheromones from 30 meters away, as well as identify fire ant nests long before they become visible to the human eye. The dogs are extremely accurate – they have almost 100 percent success rate in detecting if fire ants are present on a site.

The Program has used odor detection dogs in Brisbane, Gladstone and Port Botany in Sydney, New South Wales, to eradicate fire ants. Detector dogs are also used in north Queensland for eradicating electric ants (*Wasmannia auropunctata*).

With proven success in sniffing out fire ants in Queensland and New South Wales, odor detection dogs from the program have also been trained to detect browsing ants (*Lepisiota frauenfeldi*), an invasive ant species that is under eradication in Darwin (Northern Territory). These dogs have also been used to verify eradication of browsing ants from Perth (Western Australia).

Australia is closer to eradicating RIFA than any other country in the world that has become infested. Fire ants have been eradicated at the Port of Brisbane and Yarwun, Gladstone (Queensland) (Wiley *et al.*, 2016) and a second incursion in Gladstone is on track for complete eradication in 2016

All Australians are stakeholders and primary beneficiaries in eradicating fire ants. Failure to continue the eradication program would see widespread impacts across a range of sectors and the impacts would surpass the combined effects of many of the pests we currently regard as Australia's worst invasives (rabbits, cane toads, foxes, camels, wild dogs and feral cats—which cost Australia an estimated \$964.36M each year).

With adequate, continuous funding the eradication of fire ants from Australia remains highly feasible due to the development of effective tools and skills to achieve it. The significant progress made in these eradication technologies have also successfully been extended and applied to other eradication programs through transfer of technologies creating a significant net benefit to the Australian economy. Success will be realized when these tools can be applied in a timely way and with sufficient intensity to remove the last colonies.

Acknowledgements

The author would like to thank the ongoing support of the national cost share partners, staff of the National Red Imported Fire Ant Eradication Program, the Tramp Ant Consultative Committee, Biosecurity Queensland, and the Queensland Department of Agriculture and Fisheries.

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Bait Development for Tawny Crazy Ants

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The tawny crazy ant, *Nylanderia fulva*, is an invasive ant from South America that is spreading in the southern USA. As of December 2015, *N. fulva* was reported from at least 85 counties or parishes primarily among all the gulf coast states. In addition this ant is found on St Croix in the U.S Virgin Islands. Control of *N. fulva* is challenging and effective baits and bait application methods are needed. Preliminary laboratory tests and field applications of dinotefuran bait formulations have shown efficacy against *N. fulva* as well as another invasive, the yellow crazy ant, *Anapolepis gracilipes* (Meyers & Gold 2007; Oi 2012, 2015). To further characterize the efficacy of dinotefuran bait on *N. fulva*, delayed toxicity profiles and efficacy against colonies were determined for a range of concentrations.

To generate delayed toxicity profiles, 12 replicates of 50 *N. fulva* workers were given access to liquid bait formulations of 25% sucrose solution (w/v) with dinotefuran concentrations of 0.25%, 0.05%, 0.005%, 0.0005%, 0.00025%, 0.00005%, or 0% (control). Percent cumulative mortality was determined at 1, 2, 4, 6, 8, 12, 24, 48, 72 hours and on days: 6, 8, 10, 13, and 14. Exposure to the highest and lowest concentrations of dinotefuran (0.25% & 0.00005%) had less than 90% cumulative mortality by the end of the study. The remaining concentrations had mortalities of 90 to 95%. However, none of the baits met the standard criteria for effective ant bait active ingredients for fire ants: <15% mortality after 24 hours and ≥90% mortality within 14 days (Stringer *et al.* 1964). All of the concentrations had >50% mortality at 24 hours.

Nylanderia fulva colony efficacy (n=4) was evaluated for a 1000-fold range of dinotefuran concentrations (0.25%, 0.05%, 0.005%, 0.0005%, & 0.00025%) in 25% (w/v) sucrose solution. Colonies were starved for 24 hours, then provided bait access for 24 more hours. All

bait formulations caused significant reductions in live workers (>90%) relative to the control. Brood volume was also significantly lower than the controls in all but the lowest dinotefuran concentration (0.00025%). In the three highest concentrations, all queens (10 queens/colony) died; while 1-4 queens per colony survived in the two lower concentrations (0.0005%, & 0.00025%).

While the Stringer *et al.* (1964) bait criteria for delayed toxicity was not met, the dinotefuran formulation was effective against laboratory colonies over a broad dose range of at least 100-fold.

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Tawny Crazy Ant (*Nylanderia fulva* Mayr) IPM in Urban Environments

Robert T. Puckett

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Since its discovery in Texas in 2002, tawny crazy ants (formerly, Raspberry crazy ants), *Nylanderia fulva* Mayr, have expanded their range to include 28 Texas counties, as well as parishes and counties in Louisiana, Mississippi, Alabama, Florida, and Georgia (Fig. 1). This rapid range expansion has presumably been assisted by the movement of infested materials. These ants invade new areas very rapidly and population densities have been observed to reach extraordinary levels. In urban habitats, tawny crazy ants become an extreme nuisance as they forage around, on, and inside structures. Additionally, they have been implicated in the damage and destruction of a wide variety of electrical components and equipment. Tawny crazy ants are known to be capable of decreasing arthropod diversity in the systems they invade, and they are becoming a serious pest of agricultural systems as well through infestation of hay bales, direct impacts on commercial honeybee colonies, and by influencing increases in population densities of insects that feed on plants (including ornamental and agriculturally important plant species).

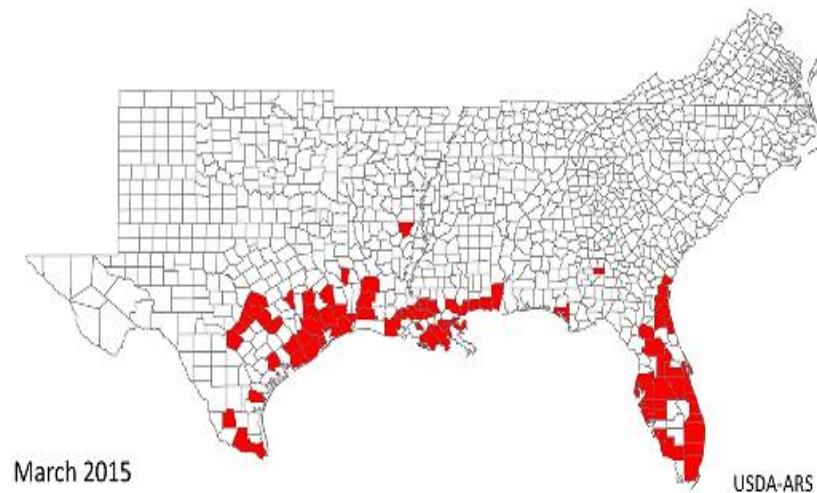


Fig. 1. Known United States distribution of *Nylanderia fulva*. Red counties and parishes indicate the presence of at least one discrete population of *N. fulva*. Map provided by Dr. David Oi, USDA-ARS.

The Rollins Urban and Structural Entomology Facility (formerly, Center for Urban and Structural Entomology) in the Department of Entomology at Texas A&M University has been involved in research focused on developing integrated pest management strategies for *N. fulva*

since its discovery in Texas. During this time, we have screened a wide variety of insecticides and formulations (granular/liquid/gel baits, and residual contact insecticides) in the laboratory and field. Based on the results of this work, the most effective strategy for managing populations of these ants in urban systems appears to be the application of residual insecticides to structures and surrounding landscapes. Specifically, our work has shown applications of fipronil (perimeter structure treatment) and dinotefuran (lawn and landscape treatment) to reduce ant activity on and in structures for up to three months. All of the granular and liquid/gel baits trialed thus far have resulted in a decrease in *N. fulva* densities; however, the effect is short-lived and not sufficient to satisfy homeowners or pest management professionals.

State and Federal funding sources for research on these ants are beginning to materialize and we were fortunate to be awarded two competitive grants to; 1) characterize (genetically and behaviorally) the colony and population structure of these ants, and 2) sequence and annotate the *N. fulva* genome. Studies such as these are fundamental to understanding the biology, ecology, and behavior of this invasive species, and will hopefully reveal aspects of *N. fulva* that can be exploited to enhance our ability to manage them.

Finally, we have formalized a community of Texas A&M University Research and Extension faculty, staff, and students who are involved in *N. fulva* research. The ‘Tawny Crazy Ant Working Group’ meets monthly at the Rollins Urban and Structural Entomology Facility to discuss current *N. fulva* related research.



Environmental modifications around a Tennessee home unintentionally reduce odorous house ant populations

Karen M. Vail

Entomology & Plant Pathology, University of Tennessee

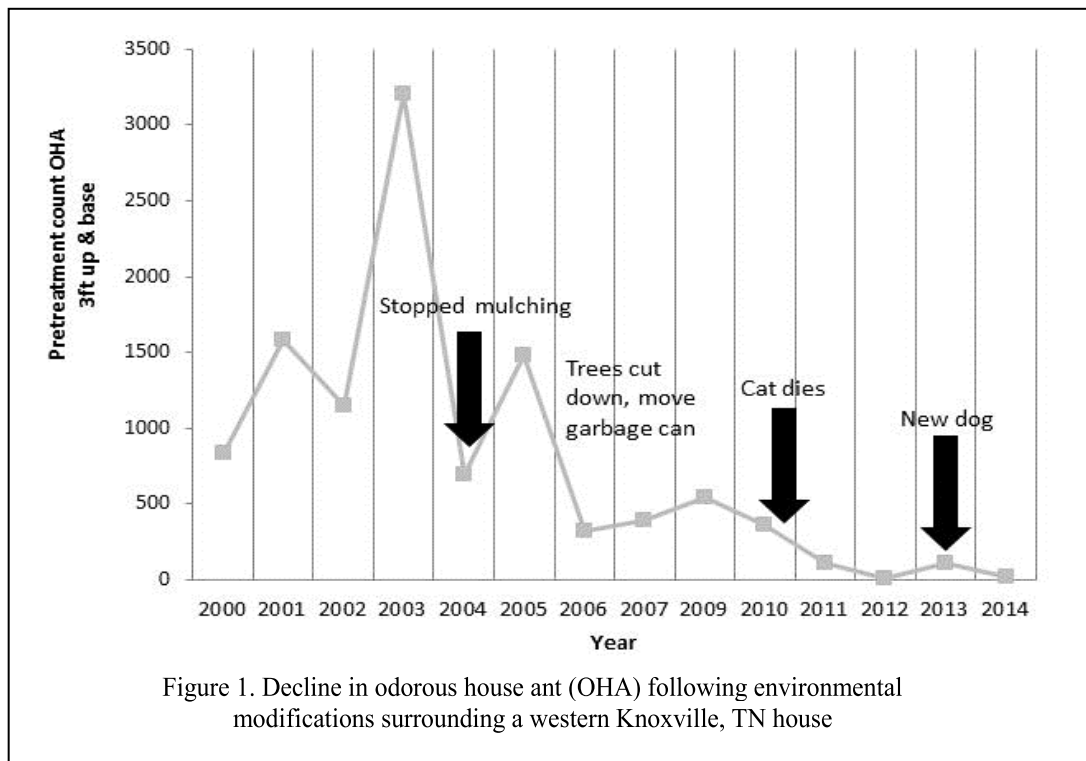
The steps for managing odorous house ants include correctly identifying the ant; correcting conducive conditions; monitoring, inspecting and locating nests; baiting areas of activity; treating nests; treating perimeters, entry ways and areas of activity; and the combination of the above. However, often more effort is expended on identification and choice of pesticide rather than correcting conducive conditions. Here I describe a case study in which modifications of the environment around a home provided long-term, unintentional reduction in odorous house ant populations.

The home is situated in a subdivision of western Knoxville, TN. In 2000, odorous house ants were found nesting in the mulch, in curled dried leaves, at the base of the iris rhizomes, and under scrap roofing/siding/stucco laying on the ground, in the firewood and under the outside garbage can. Some ants overwintered in the garage, in cracks around the door frame near the garbage can. Ants were seen foraging along physical guidelines such as the foundation base, edges of concrete sidewalks, porch and patios, along ridges in the textured stucco shaded by a rhododendron, into the dog food bowl on the patio, to carrion (skinks, rodents, snakes, birds, rabbits, etc.) left by the cat and into the silver maples, pine, azaleas and rhododendrons. Ants were observed feeding on dead insects, rhododendron nectar and carrion. Ants were also found nesting/ foraging in the top boards of the bee hives.

Each year since 2000, this house was used as a control for odorous house ant insecticide evaluations. Pretreatment counts were taken by placing a honey-smeared card every 10 – 20 ft. around the house at 3 ft. above the base, at the base of the foundation wall on the ground, and 7 – 8 ft. on the ground in the landscape. Cards were left in place for 40 minutes, the ants counted and tapped off the card (Vail and Bailey 2002). Pretreatment counts presented in Figure 1 are a sum of the ants on the cards at 3 ft. up and the base for pretreatment counts from 2000 – 2014. Pretreatment odorous house ant counts trended towards an increased number until 2003 when it peaked at 3209.

In 2004, the first in a series of environmental modifications occurred and the pretreatment count began a steady decline. An ecological ant study (Toennisson *et al.* 2011) was being performed around this and other Knoxville houses and participants were asked to refrain from modifying their landscape for the duration of the study. This was the first year in which cypress mulch was not applied to the front yard's landscaping. Between 2004 and 2010, several trees and shrubs were removed. The rhododendron on the back of the house was removed and thus no longer shaded the ant trail into the house nor provided a nectar source. The pine and azalea

in the mailbox bed were removed as were the two silver maples – ants had been foraging into all of these. Landscape timbers, an OHA nest site, surrounding the patio were replaced with formed block. Ants were never seen nesting under the block. A shade plant garden was created off this patio and stretched down to an oak about 50 ft. away. Mulch was added periodically and pine needles and dried leaves provided nesting sites away from the structure. The bees died thus removing a food source and nest site for the ants. The 14-yr old cat died in 2010 and thus the constant supply of carrion was lost. The aging dog refused to eat outside - it was too hot in the summer and too cold in the winter. Thus another food source was lost to the ants. The dog bowl was moved to the interior side of the wall in the same location, but the ants never discovered it. The garbage can, which served as a nesting site and food source, was moved away from the side door nest site and spigot water source to the less conducive south side of the house where it was surrounded by stucco walls, concrete pads and asphalt.



After 2013 pretreatment populations were at insufficient levels to be included in research studies as a control site. Once the decline in ant populations was seen as permanent and not just yearly fluctuations, the owners started adding mulch to the front flower beds again. In the winter of 2013 a new dog joined the family. He readily ate outdoors, so the old dog followed suit, but the younger dog enthusiastically removed any food crumbs from both food bowls. Liquid ant bait stations were filled with sugar-water. But so far, little increase to the ant populations have been observed.

Integrated pest management is mentioned when discussing ant control, but how many professionals emphasize correcting conducive conditions or provide these services themselves? Surely, if conducive conditions were corrected all at once, rather than over an 8 year period, a permanent reduction in ant numbers would have occurred more quickly.

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Pheromone-assisted techniques to improve Argentine ant management in urban settings

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In California or other parts in USA, outdoor residual sprays are among the most common methods to control pestiferous ants in urban pest management programs. If impervious surfaces such as concrete are treated with these insecticides, the active ingredients can be washed from the surface by rain or irrigation. In fact, some of the active ingredients used as outdoor residual sprays in urban residential settings are found in urban waterways and aquatic sediments. Given the amount of insecticides applied to urban settings for ant control and their possible impact on urban waterways, the development of alternative strategies is critical to decrease the overall amounts of insecticides applied, while still achieving effective management of target ant species. In this presentation, we report a “pheromone-assisted technique” as an economically viable approach to maximize the efficacy of conventional sprays targeting the Argentine ant. By applying insecticide sprays supplemented with an attractive pheromone compound, (Z)-9-hexadecenal, Argentine ants were diverted from nearby trails and nest entrances and subsequently exposed to insecticide residues. Laboratory and field experiments indicated that the overall efficacy of the insecticide sprays on Argentine ants was significantly improved by incorporating (Z)-9-hexadecenal in the sprays. This technique, once it is successfully implemented in practical pest management programs, has the potential to achieve a maximum control efficacy with reduced amount of insecticides applied in the environment. The similar idea can be also adopted in developing a better baiting strategy, maximizing the consumption of the bait by target ant species before any detrimental changes of the bait matrix or active ingredient(s) occurs.



**Comparative genetic and ecological studies of the Asian needle ant,
Brachyponera chinensis, in native and introduced ranges**

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The Asian needle ant *or Brachyponera* (= *Pachycondyla*) *chinensis*, native to East Asia, was first reported in the southeastern U.S. in 1934 (Smith 1934) and has since emerged as a serious pest of urban and natural areas in the southeastern U.S. In natural areas it displaces native ants and impacts native arthropod communities (Guénard & Dunn 2010), and in urban areas it inflicts a painful sting (Nelder *et al.* 2006). In this study, our objectives were twofold. First, we conducted genetic and ecological studies of this species in the native range in Japan and in the introduced range in North Carolina to obtain a better understanding of the colony genetic structure and spatial expanse of colonies. Second, we investigated the diet in native and introduced populations to determine if its invasion success may be related to a dietary shift in its introduced range.

To determine colony genetic structure and spatial expanse of colonies, we collected samples along 1-km transects in three sites in North Carolina. Using microsatellite markers developed by Takahashi *et al.* (2005), we genotyped workers at 5 loci. We found that samples collected at 100-m intervals were genetically distinct indicating they belonged to different colonies. We followed up this study with a more fine-scale study and determined that colonies had foraging areas that ranged from a few up to 40 linear meters. Our study of colonies in Japan indicated that in the native range colonies had smaller foraging ranges of only a few meters, confirming earlier conclusions by Gotoh and Itoh (2008).

Regarding the colony genetic structure for two populations in North Carolina and one population in Japan, the average number of microsatellite alleles per colony was about 2, whereas another population in Japan had 6 alleles per colony. In all cases the number of alleles per colony was less than half the total number of alleles per population, indicating colonies had a limited subset of the entire allelic composition of their resident populations. The degree of relatedness among workers within colonies was close to 0.5. Colonies of this species are known to be polygyne and undergo seasonal cycles of queen production and queen death (Gotoh & Ito 2008) and we have seen multiple queens frequently within the same nest. Our results suggest that colonies are founded by a single queen and become secondarily polygyne by adding queens that stay within the natal nest and that the seasonal changes associated with queen number involve queens produced within the natal nest.

Within the native range, *B. chinensis* is considered a termite specialist, nesting in decaying wood often associated with termites (Matsuura 2002). In the introduced range, it is also closely associated with subterranean termites. To get a better idea of its trophic level in native and introduced populations, we measured stable isotope ratios ($\delta^{15}\text{N}/\delta^{13}\text{C}$). There was no significant difference between native and introduced individuals. Similarly, the subterranean termites of the genus *Reticulitermes* from the native and introduced ranges did not differ significantly from each other, although they had a much lower $\delta^{15}\text{N}/\delta^{13}\text{C}$ ratio than *B. chinensis*. These results confirm the trophic position of *B. chinensis* as predators in both the native and introduced ranges.

To determine whether ants in the native and introduced ranges were eating termites to the same extent, we aged the diet of prey using radioactive carbon-14 levels. Carbon-14 levels rose in the atmosphere during the height of nuclear weapons testing in the 1950s and 1960s. We aged the diet of both ants and their termite prey using the equation: diet age = sample collection year – year (t), where year (t) = $2074 - 16.71\ln(\Delta 14\text{C})$ based on Hua and Barbetti (2004). Our results show the diet age of *B. chinensis* in the introduced range is less than half that in the native range (10 years versus 25 years), whereas the diet age of termites in the two regions do not differ significantly (~ 30 y). Thus, termites in both areas are eating wood of similar ages, but *B. chinensis* in the introduced range is consuming fewer termites suggesting that ants in the introduced range have a wider diet breadth than ants in the native range.

In conclusion, colonies of *B. chinensis* undergo secondary polygyny, adding new queens produced within the colony. Colonies in the introduced range appear to be more expansive than those in the native range, although they do not approach anything like the super colony status of other invasive ants such as the Argentine ant. *B. chinensis* seems to consume a wider breadth of arthropods in the introduced range which may help account for the larger colonies in the invasive range. Additional work on the genetics, ecology and foraging habits of this species should shed further light on its invasion success in the U.S.

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National Electric Ant Eradication Program – Is this the end?

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The Department of Agriculture and Fisheries has been running the National Electric Ant Eradication Program (the Program) on behalf of the Australian Government and all State and Territory governments since 2006.

The electric ant (*Wasmannia auropunctata*) was first detected in Smithfield, a northern suburb in Far North Queensland, on May 11, 2016. The detection was the first established incursion of the species in Australia's history and given its international recognition as being highly invasive, the Australian Government acted swiftly to implement an eradication program. Of particular concern was the proximity of the infestation to World Heritage listed rainforests and the potential impacts that the electric ant could have on the Australian economy, which has been estimated at \$79 million over 30 years.

Over the past 10 years, there has been continued investment in the eradication of this invasive ant species. This has allowed Australia to have success in developing new technology and world class eradication techniques. Electric ants are small and do not move very quickly or travel long distances unless they are assisted by humans, either in green waste or potted plants. Early on in the eradication program, plant swapping was identified as the primary human assisted cause of spread and, as a result, weekend markets, gardening groups, shopping center displays, nurseries, and removal companies were targeted to raise awareness.

Through extensive scientific investigations, the Program has been extremely successful in detecting and eradicating electric ants. This has included training the world's first electric ant odor detection dogs. The Program has also designed specific electric ant traps for application in particular situations, including canopy traps (for use in trees), gutter traps (for use in roof gutters), and in-house traps. These bait stations and lures were developed especially for the Cairns environment and terrain.

The Program also has a national and international reputation as a center of excellence for tramp ant response, having relationships with electric ant experts in New Caledonia, Hawaii and Vanuatu. Specifically, collaboration with the Program's New Caledonian counterparts has resulted in the establishment of a trial eradication program based on Australian protocols in southern New Caledonia. The Program staff's expertise is also demonstrated through collaboration with the University of Hawaii, which is exploring the possibility of using detector dogs on islands where electric ants are not endemic.

Eradication activities for electric ants in the Cairns region were due to be completed by June 30, 2016 under national cost share arrangements. However, recent detections have meant that eradication activities have been extended until December 31, 2016, whilst decision is made at the national level on how to fund eradication into the future.

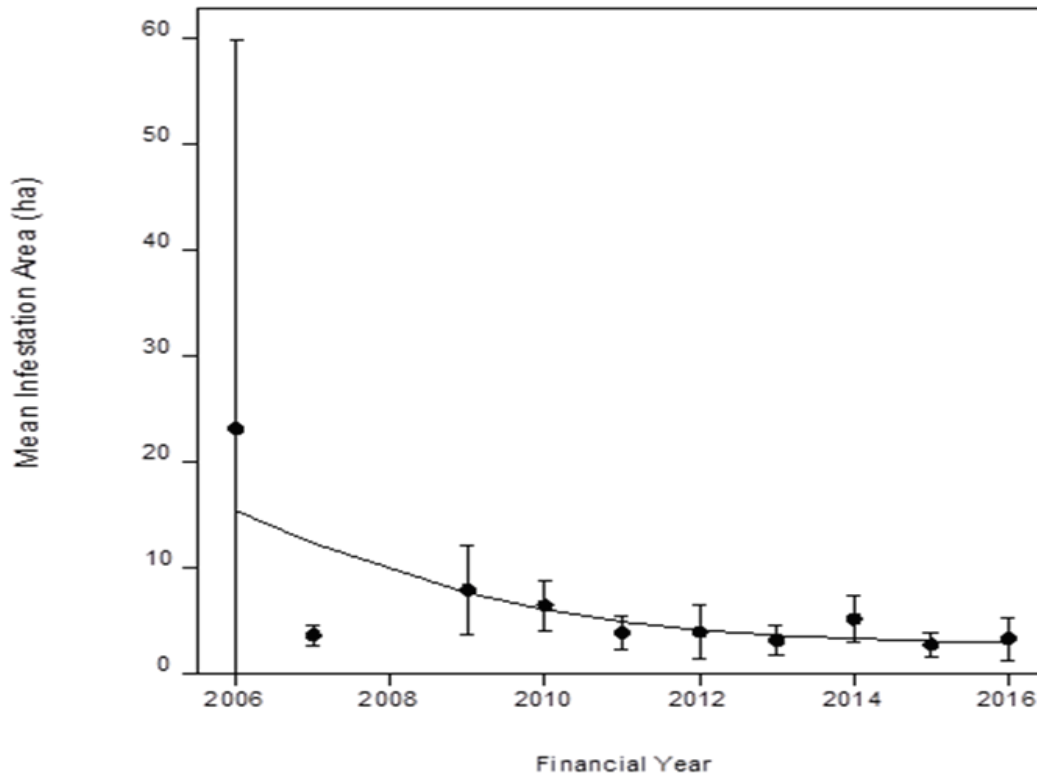


Figure 1: Reduction in Electric Ant population through persistent eradication effort in North Queensland

In the meantime, the Program continues to make progress by developing a gel bait for use in complex environments to ensure the eradication of electric ants. The Australian Pesticides and Veterinary Management Authority, who register chemicals for use, has been contacted for advice on implementing the gel for eradication purposes. The prospect of obtaining a permit for the gel bait quickly is looking favorable.

Despite recent detections, the infestation of electric ants remain sparse and in a small area, predominantly in Cairns, totaling just over 163 hectares, with infestations to the west in Kuranda.

Statistically there has been a slow but steady reduction in the mean infestation area, showing a clear plateauing in the general trend of infestation over the last two years.

This 'tail' is not unexpected during the latter stages of an eradication program, as finding the last one percent of a pest is as difficult as finding the other ninety-nine percent.

In the meantime, the Program will continue with:

- A comprehensive surveillance program
- Maintaining movement controls
- Continuing with high risk treatment program
- Continuing community engagement strategy
- Preparing for proof of freedom

By the end of the June 2016, the investment of national cost-share funding for the eradication of electric ants over the past 10 years is expected to be \$12.88 million. This is a significant investment that has placed Australia in a good position to achieve eradication of electric ants.



Symposium Pest Prevention

What We've Learned Over the Past Decade to Make Buildings Safer?



The Scientific Coalition of Pest Exclusion (SCOPE 2020) – what it is and how it can help you when you work with building administrators

Jody Gangloff-Kaufmann

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Abstract

Solid structural IPM plans for residential, municipal and commercial buildings should rely upon pest exclusion as a prerequisite to sustainable pest control and prevention. Unfortunately, this critical tenet of IPM is often ignored, overlooked or considered too costly, especially in aging structures. The Scientific Coalition of Pest Exclusion (SCOPE) was created to evaluate the current body of research about pest exclusion efficacy, to evaluate methods of pest exclusion and to promote the use of exclusion within the pest management and building maintenance fields. SCOPE consists of two USDA IPM Centers-funded working groups with overlapping membership. One group is focused on the science and promotion of residential pest exclusion and the other on commercial pest exclusion. Both working groups have membership from academia, extension and industry. These groups are evaluating best practices and pest exclusion materials. They will develop methods to verify impacts of pest exclusion, focusing primarily on mice. A literature review is underway to document what is known about pest ecology, movement, building construction and exclusion techniques that work, as well as gaps in our understanding and barriers to adoption that should be addressed. A dictionary of pest exclusion terminology, including images and possibly videos, will be developed to help formalize pest exclusion as a primary management technique for the pest control industry.



**Excluding the diabolically clever Norway rat, *Rattus norvegicus*, from buildings:
lessons learned from the Big Apple**

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Abstract

The Norway rat is known far and wide for its incredible cunning, gymnastics and gnawing capabilities that enable it to gain entry into human structures of all kinds. With typical everyday doors and sheetrock walls for example, pest proofing must go above and beyond ordinary maintenance repairs. Pest Proofing materials suitable for mice are completely vulnerable to city rats. Infrastructural damage (e.g., exterior retaining walls and city sidewalks) are often grossly under-repaired relative to the determined rat and are thus subject to further and very expensive deterioration. This paper examines the detail inspections, repairs and design precision necessary to exclude *Rattus* species. New technology combating rat entries to urban buildings is discussed.



Pest Exclusion Using Physical Barriers: A Sustainable Future for New and Existing Structures

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Introduction

Advances in the use of physical barriers to effectively exclude subterranean termites have made it possible to add new dimensions to integrated pest management strategies for both pre-construction and post-construction implementations. Particulate barrier systems have applications on the exterior of structures, and in and around interior plumbing penetrations. Sealants, membranes, and wire meshes can be used as effective barriers to invading insect populations at the soil, concrete slab, veneer interfaces, as well as soffit and roof areas. Advances in the development and installation of elastomeric membranes will provide opportunities for pest management professionals to effectively solve problems with cracked slabs, cold joints, and other construction abnormalities, which in the past have resulted in the incursion of pest populations.

Particle Barrier Systems

Particulate termite barriers have been widely and successfully used in other parts of the world since the 1980s. However, they have never been commercially available in the mainland United States. The principle behind particle barriers has been well researched by Ebeling and Pence (1957), Su et al. (1991), Su and Scheffrahn (1992), Yates et al. (2003), and Keefer et al. (2013). Research with particle barriers was initiated at Texas A&M University in 2003 at the request of Bryan Springer, a Texas pest control professional. Glass tube bioassays were prepared to test the product previously referred to as Dual Guard™, which was composed of granite particles, sized 8-16 mesh. Initial laboratory tests showed that the specifically-sized particle was efficacious in preventing tunneling of both *Reticulitermes flavipes* and *Coptotermes formosanus*. As a result, the product was reduced to practice in 15 Texas homes in 2005 (Table 1). Homes included in this initial field trial were infested with termites and inspected annually for 5 years. For the duration of the field test, none of the homes experienced re-infestation. Further refinements were made to the initial particle barrier materials in 2005 through both laboratory (Keefer et al. 2013) and field trials. The new product was called Polyguard TERM Particle Barrier. Various particle characteristics were evaluated, including size, angularity, and interstitial space between particles. Results showed that a particle blend of 8, 10 and 12, as well as a mean angularity of 3200+ and 40% interstitial space, was most effective against tunneling termites. The TERM particle barrier was deployed in a proof of concept study in six Texas homes in 2015. Each structure was initially infested with termites, but have been free of termites since installation of particle barrier and spot treatments of

termiticides. All structures are located in areas around Galveston and Houston, Texas, where both *R. flavipes* and *C. formosanus* termites are a serious problem. To date, none have shown evidence that termites have breached the particle barrier.

Elastomeric Membrane Barriers

A field study was initiated in 2003 to evaluate the effectiveness of Polyguard's elastomeric sealant barrier to protect wood against termite damage. Aged Southern Yellow Pine (SYP) boards were cut into billets (12.70 X 0.63 X 5.08 cm). The treatment billets were completely covered and sealed with TERM Membrane Sealant Barrier, which is self-adhering, while the untreated control billets were not covered with treatment materials. Sets of treated and untreated control billets were buried together in five different Texas locations with demonstrated active subterranean termite colony.

Table 1. Summary of TERM particle barrier test site installations. LTA = live termite activity. NTA= no termite activity.

TERM Particle Barrier: Galveston/Houston Area Test Sites Summary of Text Installations											
Site	Location	Approx. Age of Structure (years)	Construction	Installation Date		Start	Inspection (on or about anniversary)				
				Month	Year		Year 1 2006	Year 2 2007	Year 3 2008	Year 4 2009	Year 5 2010
1	Texas City	45	brick masonry	January	2005	LTA	NTA	NTA	NTA	NTA	NTA
2	Santa Fe	25	brick masonry	March	2005	LTA	NTA	NTA	NTA	NTA	NTA
3	Santa Fe	25	brick masonry	March	2005	LTA	NTA	NTA	NTA	NTA	NTA
4	Houston	50	brick masonry	April	2005	LTA	NTA	NTA	NTA	NTA	NTA
5	Texas City	50	cinder block	April	2005	LTA	NTA	NTA	NTA	NTA	NTA
6	Santa Fe	25	brick masonry	May	2005	LTA	NTA	NTA	NTA	NTA	NTA
7	Bacliff	20	brick masonry	June	2005	LTA	NTA	NTA	NTA	NTA	NTA
8	Texas City	50	wood frame	June	2005	LTA	NTA	NTA	NTA	NTA	NTA
9	Texas City	50	wood frame	June	2005	LTA	NTA	NTA	NTA	NTA	NTA
10	Texas City	30	brick masonry	July	2005	LTA	NTA	NTA	NTA	NTA	NTA
11	Galveston	30	wood frame	July	2005	LTA	NTA	NTA	NTA	NTA	NTA
12	Texas City	50	wood frame	August	2005	LTA	NTA	NTA	NTA	NTA	NTA
13	Texas City	5	wood frame	August	2005	LTA	NTA	NTA	NTA	NTA	NTA
14	Santa Fe	30	brick masonry	November	2005	LTA	NTA	NTA	NTA	NTA	NTA
15	Santa Fe	30	brick masonry	November	2005	LTA	NTA	NTA	NTA	NTA	NTA

A total of 10 billets, 5 treated and 5 untreated controls were buried on the same date and location. The protocol called for exhuming and removing one each of the treated and untreated billets, from each site on or about the annual anniversary date. The test units were to be taken back to the laboratory, carefully washed to remove soil and termite mud tubes, air dry, and then to estimate the amount of damage done to them by termites or other factors. Each of the extracted billets was visually inspected and the damage was rated using the ASTM scales (D3345-08), in which a rating of 10.0 meant "no damage" was observed, while a rating of 0.0

indicates the wood sample was “destroyed”. The billets covered with TERM Membrane Sealant Barrier, were likewise cleaned and examined for any tears, termite feeding scars, or penetrations. Each of the billets was photographed at the time of extraction from the soil. The “proof of concept” tests were done at a single residence (Site 1) located in College Station, Texas. This site had an active infestation of *R. flavipes* subterranean termites feeding on the house, which the owner agreed to leave in place. The billets were buried on February 1, 2003 at 2.5 cm below the level of the soil, immediately adjacent to a large subterranean tube leading from the soil into a plumbing penetration on the exterior of the house. Termite active was easily monitored on the exterior of the house by breaking open a portion of the tubes, or from the interior of the house by opening the bath trap access cover, to observe termite activity. Based on what was learned from the “proof of concept” installation at Site 1, changes were made in future installations to potentially make it easier to recover the billets through time. Starting in 2005, we utilized field sites in which we had established subterranean termite bucket traps made from a 3.7 L plastic bucket with the bottom removed, and filled with SYP slats. These traps were buried up to the top of the container, where a plastic snap lid protected the contents. The test billets were placed in pairs within 0.9 m of the traps, and buried to at least 2.5 cm beneath the surface of the soil. A 20 mm metal washer was added to each of the treated and untreated control billets using a nylon cable tie, which was threaded through a hole drilled in the end flap of the TERM Membrane Sealant Barrier and directly through the end of the SYP billet for the untreated controls. This allowed the use a metal detector to more quickly locate the billets through time. The “proof of concept” units (Site 1) were buried in 2003, while the replicated studies (Sites 2-5) were initiated in 2005.

Table 2. American Society of Testing Materials (ASTM) ratings of buried wood samples treated with Polyguard’s TERM membrane sealant and untreated control samples. A rating of 10.0 indicates no damage, while a rating of 0.0 indicates the sample is destroyed.

American Society of Testing Materials (ASTM) Ratings of Buried Wood Samples								
Site	Termite Species	Initiation	Year 1		Year 2		Year 5	
			Treatment	Control	Treatment	Control	Treatment	Control
1	<i>Reticulitermes flavipes</i>	2/1/2003	10.0	9.0	10.0	0.0	m.d.*	m.d.*
2	<i>Reticulitermes flavipes</i>	10/13/2005	10.0	9.0	10.0	0.0	10.0	0.0
3	<i>Reticulitermes flavipes</i>	10/13/2005	10.0	4.0	10.0	0.0	10.0	0.0
4	<i>Coptotermes formosanus</i>	10/25/2005	m.d.*	m.d.*	10.0	0.0	10.0	0.0
5	<i>Coptotermes formosanus</i>	10/25/2005	10.0	9.0	10.0	9.0	10.0	0.0

*m.d. indicates missing data

Site 1 was lost due to change in ownership.

Site 4 missing data due to flooding from Hurricane Ike.

Results of this study are displayed in Table 2. At site 1, the treated and untreated control billets were recovered in year 1, and the treatment was rated as 10.0 on the and the untreated control had only trace damage and was rated as 9.0 (Table 2). There was clear evidence that the termites had found and explored the treated and untreated billets, based on the mud tubing on

both. The TERM Membrane Sealant Barrier had no impact on the termite populations as termites were still active both in the house and on the structure. Recovery of the billets was successful in year 2, with the treatment billets rated at 10.0, with no damage to the TERM Membrane Sealant Barrier; however, only small pieces of the control billet were recovered resulting in a ASTM rating of 0.0 (Table 2). The subterranean termites were still active at this site. In year 3, we were not able to get access to the site, on the anniversary date, but finally on October 6, 2006 we regained access (45 months after initiation), and found the treatments, which were undamaged, but only remnants of the control billets were recognizable. The ASTM ratings were 10.0 for the treatments and 0.0 (Table 2) for the untreated. In being conservative with these results, we list only the year 2 data in Table 2, although the TERM Membrane Sealant Barrier treatments were still in excellent condition at 45 months post-initiation. Because of landscaping changes, we had to abandon Site 1 after October 2, 2006. At site 2 in year 1, the TERM Membrane Sealant Barrier was in excellent condition and were rated 10.0, while the control billets showed trace damage and were rated on the ASTM scale as 9.0 (Table 2). By year 2, the untreated controls had been completely consumed, while the treatments remained in excellent condition with no evidence of access by the termites, which continued to be active in the bucket trap at this site. In year 5, there was no evidence of the control billets, and only the washers remained in the soil (ASTM 0.0); however, the treated billets were in excellent condition and were rated as 10.0 (Table 2). The termites were still active in the bucket trap at this site in the year 5. At site 3 in year 1, the TERM Membrane Sealant Barrier was in excellent condition (ASTM 10.0), while the untreated control billets showed heavy damage and were rated on the ASTM scale as 4.0 (Table 2). By year 2, the untreated controls had been completely consumed, with only the washers remaining, while the treatments remained in excellent condition (ASTM 10.0) with no evidence of access by the termites, which continued to be active at this site. In year 5, there was no evidence of the control billets, and only the washers remained in the soil (ASTM 0.0). The TERM Membrane Sealant Barrier was in excellent condition with no indication of a breach or any damage. The ASTM ratings at year 5 were treatment 10.0 and untreated control at 0.0, respectively (Table 2). The colony was still active in the bucket trap at five years. Site 4 billets for both the controls and treatments were buried on October 25, 2005; however, on the first anniversary date, October 24, 2006, the study site was still flooded due to a tropical storm. The technician went to the site on schedule, but with the conditions as they were, he recovered a single washer which had been attached to one of the control billets, but no wood was found with the washer, indicating that it had been completely consumed by termites (ASTM 0.0). It was months before the site was dried and we had access, but on the second anniversary date, the technicians located three treatments and three washers that had been attached to untreated controls. We extracted the year 2 treatment billet, and the untreated control unit washer to confirm our findings. The remaining treatments were left in place for future evaluation. The year 2 ratings were 0.0 and 10.0 for the untreated controls and treatment, respectively (Table 2). In year 5, there was an active Formosan termite

population in the bucket trap, and the treatment billets were still without damage. The ratings for year 5 were 0.0 and 10.0 for the untreated control and treatment, respectively (Table 2). Site 5 was infested with Formosan subterranean termites as evidenced by termites in the bucket trap. We were able to recover the research units on or about the anniversary dates through 5 years post-initiation. In years 1 and 2, the control billets had only trace damage and were rated at 9.0, but that indicated that termites had found and fed upon the untreated wood. The treatment billets had no damage to either the TERM Membrane Sealant or the billet. In year 5, the treatments were recovered, but only the metal washer was found from the untreated control. The ASTM ratings were 0.0 for the untreated controls and 10.0 for the treated billets (Table 2). The Formosan termites were still active in the bucket trap at this site in year 5.

Integrated pest management (IPM) is a practice that is encouraged and utilized to control against target organisms. The use of termite barriers, manufactured without the use of pesticides, can contribute to termite IPM methods that are in need of supplementation. Particle barriers have shown to prevent termite infestation by blocking termite tunneling behavior. While commonly used in Australia and Hawaii, aggregate barriers are just beginning to aid in termite control in the continental United States. Membranes and sealants have proven efficacious in protecting wood from foraging subterranean termites. In the study described, there was no negative effect on termite foraging in the immediate area of the treatments, showing that the membrane sealant is an exclusionary device, and not a chemical treatment. Physical barriers can be included throughout structures, and when combined with chemical control, can protect from termite infestations for extended periods of time.

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Issues affecting pest exclusion practices in industrial and commercial urban pest management

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Pest exclusion is a topic that is often discussed among academics, government officials, and pest management providers. As a topic in Integrated Pest Management (IPM) training, exclusion has a prominent place in sound pest management strategy. However, in practice, exclusion is seldom considered a prerequisite for an IPM program. Similar to pesticide applications, pest exclusion is often thought of as a control response to a pest issue, rather than a means of restricting and eventually stopping pest movement, especially in situations of chronic infestation. Exclusion is rarely practiced as a preventative step, with the exception of very high-value circumstances (such as in the pharmaceutical industry), or in cases where the exclusion breach is obvious, such as an open exterior door in a restaurant or food manufacturing facility.

Having stated that exclusion is used as a reactive--rather than preventative--control measure, the authors are not implying that there is a lack of desire in the pest management industry or their customer base to see a change for increased preventative exclusion practices. The Scientific Coalition On Pest Exclusion (SCOPE) was formed to study ways exclusion practices could be better incorporated into pest management programs, thereby decreasing chronic pest activity through prevention techniques. The first task of the SCOPE groups (Industrial and Commercial (IC SCOPE); Multifamily Housing (MF SCOPE) was to discuss perceptions of benefits from improved pest exclusion practices, and more importantly, possible impediments to adopting exclusion practices for prerequisite or preventative IPM programs.

A number of impediments to exclusion were discussed and, of all issues found, there were five key themes identified from the SCOPE working groups as impeding use of preventative exclusion practices: 1) prevailing business models for most pest control operations; 2) "SOX" Compliance (Sarbanes-Oxley Act of 2002); 3) extent of exclusion practices to be used around a given facility; 4) materials selection for reliable use in exclusion practices; and, 5) contending with building degradation and further maintenance. It should be noted that, particularly in the first theme, discussion of these themes were part of uncovering larger systemic issues that should be explored, and not a criticism of specific companies. It is the hope of the authors that ongoing discussions of these issues will lead to appropriate generation of questions and hypotheses for research into improving the use of exclusion as a prerequisite program for urban IPM.



Symposium
IPM Outreach in Urban
Settings



Cockroaches, Bed Bugs & Mice, Oh My!
Lessons from Urban IPM

Dion Lerman

Pennsylvania Integrated Pest Management Program, Penn State University

The Pennsylvania Integrated Pest Management Program (PA IPM) is an autonomous grant-funded program housed at Penn State University. Originally focused on agriculture, the adoption of state School IPM laws in 2002 added an urban perspective to our program. In 2002, PA IPM opened an office in Philadelphia, the largest city in the Pennsylvania, fifth largest in the country, and poorest large city in the country. Initial needs assessments included immersion in the network of community organizations in Philadelphia, and a pilot study of pest conditions in row-homes (the characteristic style of housing in Philadelphia, mostly built before 1940). This was followed up by a larger survey of 100 low income households, in Philadelphia and neighboring Camden, NJ. The study was done in cooperation with Rutgers University. These surveys expressed extreme needs in the community for integrated pest management. In the Row House Survey, for example, 26% of residents surveyed employed pest control technicians, but only 17% used licensed Pest Management Professionals.

Over the last fourteen years, the Philadelphia Schools and Community IPM Partnership (PSCIP), which is the Philadelphia-based urban IPM partnership of PA IPM, has grown to almost 200 organizations and agencies. Partners include: the Community Asthma Prevention Project (CAPP), Philadelphia Housing Authority, Philadelphia Department of Public Health, Energy Conservation Agency, Rebuilding Together Philadelphia, the US Environmental Protection Agency, and Department of Housing and Urban Development, and others.

Today, the primary activities include work around asthma, healthy homes, childcare, schools, bedbugs, and Latino outreach, specifically:

- Promoting healthy environments for all people
- Focusing on health issues due to pests and pesticide use
- Providing outreach education and training, including Healthy Homes training
- Bridging community involvement in solving problems
- Working in partnerships

Mice and cockroaches are considered the primary triggers of asthma in urban environments, and asthma is the single biggest cause of lost school days. (Centers for Disease Control and Prevention, 2013) One study found the asthma rate in Philadelphia's public schools to be 23.6%, (Yuen, EJ; Magione, S; Cleary, 2004) almost three times the national rate of 8.3%. We have worked with the School District of Philadelphia to help reduce pests and remove indoor environmental triggers of asthma that school staff, students, and parents are often unaware of. The EPA's *Tools for Schools* Indoor Air Quality (IAQ) program, which includes IPM as one of its components, has been a valuable framework (US EPA, 2012). Walkthroughs have revealed the ubiquitous presence of mice and the need for better rodent control protocols.

Childcare has also been a prime constituency for IPM. Childcare providers are dedicated to ensuring children's health while they are in the childcare facility, but they have had little exposure to environmental health. The Eco-Healthy Child Care® (EHCC) training program, which is recognized by the state childcare training accreditation agency, the Pennsylvania Quality Assurance System (PQAS), has been well attended. (CHEN, 2016). IPM training and consultation have also been important to childcare because of the need to frequently feed young children in their classrooms and the ubiquity of mice. Early Head Start programs, that provide weekly home visits to families with young children, have proven to be valuable and engaged partners. Case workers carry the messages directly to clients with whom they have built a long-term trusting relationship. Case workers report high acceptance and significant changes in their clients.

Community Health Workers (CHW), in general, have proven to be excellent multipliers for our messages. CHW are lay (non-clinically trained) staff who are drawn from the same population as their clients. They provide patient education, and for many programs, often provide home visits. This is especially true for programs addressing children's asthma, lead poisoning prevention, maternal and infant care, and early childhood development. CHW's have become strong advocates for IPM, and has become important to their clients.

Training is a central activity in IPM. In addition to the EHCC program described above, IPM trainings are customized for different constituencies (residents, building managers, child care providers, foodservice, etc.). The Healthy Homes (HH) program provides a broader environmental health context for IPM for the housing and public health communities. (Healthy Housing Solutions, 2016).

The issue with the most salience has been Bed bugs (*Cimex lectularius*). In the past ten years bed bugs have exploded from being virtually unknown to universal. We provide information and training to individuals, social services, housing providers, libraries, refugee communities and others. Bed bugs are the number one entomological problem we currently address. In addition to outreach and training, we helped facilitate a task force, though it is still awaiting

implementation, commissioned by Philadelphia City Council, to make policy recommendations to the City of Philadelphia (PBBTF, 2016).

The Latino community is expanding rapidly in the Philadelphia region, growing 58% in the first decade of this century (Greater Philadelphia Chamber of Commerce, 2016). When we had a native Spanish-speaking staff member, she made extensive contacts with Latino organizations and service providers, who enthusiastically welcomed the information and skills. Unfortunately, funding was discontinued and those contacts have been difficult to maintain.

Other projects have included Pesticide Applicators License training for ex-offenders from Philadelphia prisons, provided in partnership with the social service agency Resources for Human Development. We trained four cohorts, of about 15 each, in IPM methods as well as the state standards. Up to 64% passed the state exam on the first taking and several are still employed in the industry 5 years later, including at least two who started their own pest control businesses. Although labor intensive, this was a very valuable program and was most successful when applicants were well screened for literacy and motivation.

The PA IPM Program has been engaged in community-based outreach, education, and technical assistance in the Philadelphia region for over fourteen years. We have worked with hundreds of organizations, ranging from block groups to the Philadelphia Housing Authority (the nation's sixth largest), and the School District of Philadelphia, which consists of 218 schools serving over 134,000 students and over 35,000 staff. We have helped ex-offenders start their own businesses, and improved indoor environmental health throughout childcare providers in Philadelphia. What we have not done is maintain an evaluation program. My primary recommendation to programs that want to do community work is to maintain rigorous records and evaluations to ensure that metrics are available to explain and justify the programming. That said, the relationships we have developed with our partners is ongoing and reciprocal. We learn from them as we seek to meet their needs. Community based urban IPM has proven to be effective and sometimes transformative and we hope that other programs will explore this work.

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Hire us, then help us: Challenges and successes for IPM services offered by pest control companies

Allison A. Taisey

National Pest Management Association, Fairfax, VA

Any description of Integrated Pest Management (IPM) mentions that IPM is a team effort. Property-wide pest control with the goal of minimizing both pests and pesticide use cannot happen without the participation of the people who use the space. Their role is to maintain the area in a way that denies pest access to food, water, shelter, and the inside of any the buildings. The role of the pest management professional (PMP) on the team is to educate the client, make detailed recommendations on what should be done to achieve pest reduction and prevention, and to utilize both chemical and non-chemical strategies in response to pest presence detected by monitors and/or inspection. If the goal of the IPM program is to reduce both pests and pesticide use, then the client must act on the PMPs recommendations.

IPM Team participation requires good communication with the PMP from the start of the relationship. Especially with commercial properties (including schools, offices, and multifamily housing), the relationship may include people who never take part in the actual pest management. Without their knowledge of the importance of the team, the requirement for, and thus the implementation of the team approach may not exist. Procurement professionals including the sales staff at pest management firms need to understand the team approach and include provisions for it in the request for proposals, bids, and final service agreements for IPM services.

The most effective way for complete IPM programs to operate may be through certified service. With certification, a pest management firm's service must meet certain provisions as determined by a 3rd party. The procurement professional can require certified service of any potential vendor and know that the service is IPM without having to have a complete understanding of what it entails. The latest version of the QualityPro Certification Program's GreenPro certification includes requirements that help ensure the team approach to pest management is implemented. It requires companies to submit both the service protocol (what the PMP uses to understand the service), the service agreement (what the client uses to understand the service), and any forms that are used for communication and documentation throughout the service.

Before earning GreenPro certification for its service and to ensure that the IPM team is in place and functioning, a company must submit proof that their service includes the following components of IPM:

- The service includes pest-specific inspection and monitoring strategies that can detect low-level infestations of the pests listed in the scope of service
- The service includes routine client communication about pest infestations, conducive conditions, and ways to prevent pests.
- The service includes follow-up.
- The submission includes procedures and expectations for situations in which the customer does not or is not able to implement recommendations.
- The submission includes a “scope of service” documenting and outlining the responsibilities of all parties.
- The submission includes a quality assurance plan that specifies what the technician should do differently if problem has not improved or resolved at the follow-up.

Although there are many ways that the IPM team can break down, spelling out the roles and clarifying expectations as early as the first interaction between the salesperson and the procurement professional can help ensure the IPM service begins strong and is set up for success. PMPs and those working to increase the use of IPM should include the procurement and sales professionals in their target audiences and use certification as a way of standardizing expectations of what an IPM service entails.



Symposium Internal Biomes



Fungus among us: The diversity of microbes in homes

Rachel Adams

Plant & Microbial Biology, University of California, Berkeley

Abstract

While we spend about 90% of our time indoors, we spend nearly 70% of our time in a residence specifically, and knowing our exposures in homes is an important part of cataloguing our overall environmental exposures. Homes are rich in microorganisms (including bacteria and fungi), and recent advancements in technology have allowed us to characterize the breadth of microbial organisms and their products indoors. This talk will present diverse perspectives on microorganisms found in homes – both as contaminants and companions. The evolutionary potential of microorganisms in indoor environments will also be discussed.



The California Experience: limiting water quality impacts linked to management of structural pests of the indoor biome

Dave Tamayo

California Structural Pest Control Board, Sacramento, California

Abstract

Since the mid-1990s, California urban water bodies have been recognized as impaired by urban-use insecticides. The primary source of these insecticides is applications on the outside of structures to control Argentine ants and other arthropods that commonly invade the indoor biome. Local agencies are subject to compliance liability under the federal Clean Water Act, and have supported a number of strategies to reduce the water quality impacts, including public outreach, pest management research, state regulations to limit applications and require IPM continuing education, and changes in pesticide regulatory processes. The current status of this issue will be discussed.



Systematically altering pest habitat in the built environment: Application of the Pest Prevention By Design guidelines to low-income housing rehabilitation

Chris Geiger

San Francisco Department of the Environment City & County of San Francisco, California

Abstract

The emphasis of urban pest management is shifting toward prevention. Building design and maintenance measures are available that can both prevent pest infestations and reduce pesticide use, primarily by reducing food, water, harborage, and entry opportunities. The *Pest Prevention By Design* Guidelines were developed by an interdisciplinary team to review and collate these measures. San Francisco has been testing the Guidelines in its rehabilitation of 3,450 low-income housing units, under the HUD-sponsored Rental Assistance Demonstration (RAD) program. The early results of these efforts will be discussed, as well as the obstacles and opportunities encountered.



Arthropods of our Homes

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¹California Academy of Sciences, San Francisco CA; ²North Carolina State University, Raleigh NC

Abstract

For as long as humans have lived in fixed habitations there have been other arthropods that dwell alongside us. Here we investigated the complete arthropod community of the indoor biome in 50 houses (located in and around Raleigh, North Carolina, USA). We discovered high diversity, with a conservative estimate range of 32 to 211 morphospecies, and 24 to 128 distinct arthropod families per house. We found arthropods within homes are both diverse and prevalent, and are a mix of closely synanthropic species and a great diversity of species that wander indoors very rarely. Despite being found in the majority of homes, several arthropod groups such as gall midges (Cecidomyiidae) and book lice (Liposcelididae) remain unfamiliar to the general public. The majority of this indoor diversity (73%) was made up of true flies (Diptera), spiders (Araneae), beetles (Coleoptera), and wasps and kin (Hymenoptera, especially ants: Formicidae). The diversity of arthropods was non-random with respect to location within the house; we tended to collect a higher diversity of insects from common rooms, lower levels of the house, carpeted rooms, and rooms with more windows and doors leading outside. On a larger scale, houses located in higher income neighborhoods and with more diverse local vegetation had higher arthropod richness. These findings present a new

understanding of the diversity, prevalence, and distribution of the arthropods in our daily lives.



Gut bacteria mediate aggregation in the German cockroach

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The German cockroach is a highly specialized commensal of human-built structures and populations are not known elsewhere in nature. A large body of literature details the impacts of cockroaches on health, concentrating on their etiological role in allergic disease and asthma and their potential to carry and vector microbial pathogens to humans. Nothing is known; however, on the role of the cockroach microbiome in shaping the home microbial community: What are the impacts of the massive organic excrements, shed cuticles and dead bodies that cockroaches leave behind on the density and diversity of the home microbiome? This presentation will highlight major gaps in our understanding of the interactions between us and cockroaches. It will also discuss the role of the cockroach gut microbial community in the production of aggregation pheromones.

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Symposium Gaps & Challenges

R&D, Academia, and Field Application of Control Strategies



Challenges in the field: The practical implications of implementing new protocols

Pat Copps

Technical Services Manager, Orkin Pest Control

Abstract

Successful Urban Pest Management Programs require the implementation of protocols based on key information and data. Today's Professional Pest Management Providers must have the ability to recognize trends in pest activity, understand expectations and implement preventive and corrective actions all within the structure of a specific protocol or auditing scheme. Recent changes in IPM practices, new and emerging insect pests, the development of green structures and high-tech facilities and the detailed and strict requirements for food processing plants require those in the field to receive additional training in advanced pest management concepts. To be successful, it's imperative that pest management service providers understand and are capable of implementing the required protocols in highly complex urban environments. This presentation will discuss the practicalities involved with the implementation of protocols that are designed to meet the challenges of today.



The conundrum of action thresholds (AT's) in urban entomology.

Brian T. Forschler

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Abstract

The concept of an action threshold is deeply rooted in the philosophy of agricultural IPM and has been largely ignored by urban entomologist. There is a dearth of data supporting use of pest detection/monitoring tools relative to the corresponding health, safety, legal or economic AT determinants for typical urban insect pests. In addition, pest tolerance, which can be extraordinary personal, drives most pest management in urban areas. The low number of

insects traditionally considered for urban insect AT's will result in rote decision-making rather than the search for innovative site-specific remedies that make IPM a compelling approach to pest management.



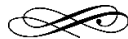
The Pest Management Foundation grant proposal review process and determining the “applicability” of proposed research

Jim Fredericks,

National Pest Management Association and The Pest Management Foundation

Abstract

The Pest Management Foundation is an independent 501(C) (3) organization affiliated with the National Pest Management Association whose mission and purpose is to advance the pest management industry through education, research and training. Toward these goals, the Foundation regularly solicits urban entomologists to submit research proposals for funding. Successful applicants most commonly propose projects that identify a particular pest challenge facing the industry and seek out effective solutions to these challenges as a practical application of the project's conclusions. The structural pest management industry is characterized by its hands-on approach to solving problems. When considering funding requests, the Pest Management Foundation's science review committee has been instructed by its Board of Trustees to carefully consider the applicability and specific benefits that the proposed research will have to the pest management industry. The Foundation has made a concerted effort to overhaul the proposal review process to make it more objective and transparent, with the end goal of selecting and funding high-quality, impactful research projects that will advance the industry and help pest management professionals servicing structures in the field.



Reduced Risk Pest Management Challenges: Handcuffed By Hazard Tiers?

Timothy J. Husen

Technical Services, Rollins Inc.

Abstract

This talk will focus on a few of the many challenges facing PMPs when implementing a reduced risk pest management program. Leadership in Energy and Environmental Design (**LEED**) is one of the most popular green building certification programs used worldwide. One aspect of building LEED certification is the incorporation of indoor and outdoor IPM plans with the goal of reducing pest populations while protecting the environment. These IPM plans mandate the use of physical, mechanical, and cultural control tactics prior to chemical control. If chemicals are necessary, then a reduced risk pesticide should be the first option (based on the City of San Francisco/Pesticide Research Institute Approved Pesticide Product List/Hazard Tier Ranking). PMP challenges with LEED reduced risk pest management programs include:

- Society's variable definition of "green pest control"
- Getting customer buy-in to "their" certification pest management program
- Protecting public health and implementing certification mandates
- Desired property certification level and achieving necessary credits
- Approved pesticide product list and hazard tiers limiting available control options



Bed Bugs Demonstration Project - From the lab to the bedroom: translating research-based bed bug management strategies to low-income apartment buildings

Andrew M. Sutherland

SF Bay Area IPM Advisor; UCCE Alameda County

Abstract

Management of the common bed bug, *Cimex lectularius*, in multi-unit housing situations is challenging due to ease of pest dispersal, widespread use of secondhand furniture and personal belongings, structural disrepair, high resident density, high turnover, communication barriers, and budgetary constraints. Results from recent surveys in the western United States indicated that bed bug management in these environments is typically reactive in nature (initiated by tenant complaints) and reliant upon liquid insecticide applications. Proactive management

programs involving tenant education and regular monitoring have the potential to detect infestations before dense multi-unit populations develop, but such programs are often viewed as prohibitively expensive by housing managers. We demonstrated proactive bed bug management programs at three large multi-unit housing sites in California with the help of three collaborating pest control operators over the course of one year, comparing these programs to the typical, reactive programs in terms of efficacy (# infested units, bed bug density, tenant complaints), cost (# pest control visits, # effort-hours expended, # treatments made, total cost of services rendered), and tenant satisfaction. All demonstrated programs included tenant education methods, regular monitoring, nonchemical tactics, and targeted insecticide applications. Initial inspections revealed much higher bed bug incidence than realized, and management costs were initially much higher than for typical complaint-based programs. Monthly costs decreased over time at all sites, however. After one year, bed bug incidence and density were significantly decreased at all sites when compared to initial findings, and tenants reported higher satisfaction than with complaint-based, insecticide-reliant programs.



From the lab to the bedroom: translating research-based bed bug management strategies to low-income apartment buildings

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Management of the common bed bug, *Cimex lectularius*, in multi-unit housing (MUH) situations is challenging due to ease of pest dispersal, widespread use of secondhand furniture and personal belongings, structural disrepair, high resident density, high turnover, communication barriers, and budgetary constraints. Furthermore, existing national and state habitability laws as well as recent municipal enhancements (City and County of San Francisco, 2012; Drlik, 2012) dictate landlord obligation to provide vermin-free housing, a difficult charge dependent upon open and regular communication amongst MUH stakeholders. Results from recent surveys in the western United States indicated that bed bug management in these environments is typically reactive in nature (initiated by tenant complaints) and reliant upon liquid insecticide applications (Campbell et al, 2016; Sutherland et al, 2015). Proactive management programs involving tenant education and regular monitoring have the potential to detect infestations before dense multi-unit populations develop, but such programs are often viewed as prohibitively expensive by housing managers.

We demonstrated proactive bed bug management programs at three large MUH sites in California with the help of three collaborating pest control operators (PCOs) over the course of one year, comparing these programs to the typical, reactive programs in terms of efficacy (# infested units, bed bug density, tenant complaints), cost (# pest control visits, # effort-hours expended, # treatments made, total cost of services rendered), and tenant satisfaction. These data for reactive programs were approximated from previous pest control contracts held at the demonstration sites. All demonstrated programs included tenant education methods, regular monitoring, nonchemical tactics, and targeted insecticide applications. Changes in bed bug incidence and density were measured using interceptor monitors (LightsOut BedBug Detector, Protect-A-Bed; Wheeling, IL) before and after the one-year demonstration. Two interceptors were placed in each bedroom and living room, in contact with the wall, bed frame, sleeping surface, upholstered furniture, and / or other furniture items. Interceptors were not placed under bed frame legs since not all bedrooms contained bed frames. Interceptors were left in place for one week, at which time they were retrieved and examined for bed bug specimens within the laboratory.

Tenant education was delivered via bilingual (Spanish/English) in-person programs consisting of slide shows, specimen viewing, and handouts on bed bug identification, prevention, and management. Monitoring tactics during the program varied by PCO and included triannual property-wide canine detection services and either biannual or quarterly property-wide visual inspections coupled with interceptor deployment (Table 1). Once bed bugs were detected, management tactics varied by PCO but included vacuuming, laundering, volumetric heating, silica gel desiccant application to voids, chlorfenapyr aerosol application to wall joints, dinotefuran/ prallethrin/ pyriproxyfen aerosol application to carpets, and imidacloprid / cyfluthrin spray applications to bedroom furniture items (Table 1). Tenant satisfaction was measured using surveys employing Likert scales and comparisons to previous bed bug management programs.

Table 1. Site characteristics and methods used at three different multi-unit housing complexes during a one-year demonstration of proactive bed bug management programs.

Site (#)	Location, size, building type	Ownership, income categories	Pest control operator	Monitoring tactics employed	Control tactics employed
Site A	Bay Point, CA; 120 units; vertical shared access blocks	Private, 10% supportive housing, mixed-income	Large multinational company	Triannual canine detection	Volumetric heat, desiccant, aerosol
Site B	Concord, CA; 64 units; vertical shared access blocks	Private, low-income	Small regional company	Biannual visual inspections and interceptors	Volumetric heat, desiccant
Site C	San Diego, CA; 190 units; horizontal shared access towers	Public housing, transient and low-income	Small regional company	Quarterly visual inspections and interceptors	Vacuum, laundering, desiccant, aerosols, liquid spray

Initial inspections revealed much higher bed bug incidence than realized, and management costs were substantially higher than for the complaint-based programs in place at these sites previously (Table 2). Monthly costs decreased over time at all sites, however. Bed bug incidence and density were significantly decreased at all sites when compared to initial findings (Table 2), and tenants reported higher satisfaction than with complaint-based, insecticide-reliant programs. Interestingly, interceptor monitors detected bed bugs several times when canine detection or visual inspection did not.

All three different IPM programs for bed bugs in MUH environments demonstrated in this study were effective in reducing bed bug incidence and density as compared to those

experienced under reactive management programs. Additionally, all three programs led to increased tenant involvement and satisfaction with bed bug management. Costs of these programs, however, were many times more than those of reactive, complaint-based programs. It is probable that management costs within such programs will decrease over time, considering most costs were associated with initial ‘clean-up’ of very high bed bug incidence, perhaps the direct consequence of years of inadequate bed bug management programs reliant upon tenant complaints. In light of increasing landlord obligation under habitability laws, litigation related to bed bug infestations and ineffective management programs, and bed bug resistance to insecticides, such proactive programs, based on tenant education, prevention, regular monitoring, and combination of nonchemical tactics and insecticides will be more and more desirable within MUH environments.

Table 2. Bed bug incidence before and after demonstration of one-year proactive bed bug IPM programs at three different multi-unit housing sites, approximate costs relative to those of reactive complaint-based programs, and associated levels of reported tenant satisfaction (when comparing IPM program to previous reactive program) after one-year demonstrations.

Site (#)	Initial incidence	Final incidence	§Relative costs IPM: reactive	‡Tenant satisfaction
Site A	10.8% (13/120 units)	1.7% (2/120 units)	2 : 1	67%
*Site B	50.0% (32/64 units)	6.3% (4/64 units)	5 : 1	75%
†Site C	22.1% (42/190 units)	15.8% (30/190 units)	1.5 : 1	63%

* Data associated with Site B were collected at six months after the beginning of the demonstration program. One-year data are being collected now. Trends observed at six months continue to be observed at the one year mark. † Site C was demolished after nine months and all residents relocated to another building. Data reported were therefore collected nine months after the beginning of the demonstration project. § Approximate costs of the one-year IPM demonstration, based on values of contracts and services rendered, as compared to approximate annual costs of reactive bed bug management programs in place at the same sites before demonstration, based on historical records of contracts and calculated values of services rendered. ‡ Proportion of surveyed tenants answering ‘it’s better’ when asked ‘How does the current bed bug management program compare to those in place during previous years?’

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**Customer Expectations: From designing an IPM program to resolving pest issue
with the available tools and technology**

Zia Siddiqi

Director of Quality Systems, Rollins, Inc., Atlanta, GA

Abstract

The principles, strategies and implementation of an IPM program can be discussed and planned during the customer and PMP in contract negotiations, however, the actual implementation and data requirement is ever evolving in real life situation. Real life examples of different types of clients ranging from food service to food retail to food warehouse will be presented to understand the challenges faced by a PMP. While the customers acknowledge the PMP as the expert, key customers still dictate what strategies are selected and implemented.



Symposium Urban Rodent Control



An integrated approach to commensal rodent management in New Orleans, Louisiana

Claudia Riegel

City of New Orleans Mosquito and Termite Control Board, New Orleans, LA

Abstract

The historic, port city of New Orleans has had a long history with commensal rodents. The city of New Orleans has a dedicated rodent abatement division that implements the principles of Integrated Pest Management (IPM) for the management of these animals. Hurricane Katrina has left more than 30,000 blighted properties with abandoned houses or lots with high grass. The city's rodent abatement division has survived in this environment by leveraging local, state, federal, university, and private industry resources in order to expand and provide services to the public and municipal buildings. The division conducts surveillance of commensal rodent populations, zoonotic diseases, and rodent-borne ectoparasites in coordination with other agencies. Information obtained will better target control strategies.



Managing pocket gophers under the Healthy Schools Act of California

Ashley Freeman

California Environmental Protection Agency, Department of Pesticide Regulation

Abstract

The Healthy Schools Act of California mandates that the Department of Pesticide Regulation (DPR) promote Integrated Pest Management (IPM) practices in most licensed child care centers and all K-12 public schools in California. IPM promotes using a variety of control and prevention practices based on the biology of the targeted pests and environmental factors. Managing pocket gophers on school sites is a difficult task under California conditions. These pests are prolific in public schools and cause serious structural and landscape damage as well as problems for children's health including sports injuries from damaged turf. Preventing them or discouraging entry into a school site is the first line of defense, but often populations become

troublesome for school site managers to control. Fumitoxin, or aluminum phosphide, is commonly used to cheaply manage these rodents and is thought to be safe to use around children due to the methods of application. Fumitoxin applications in the spring take advantage of breeding season when females and their young stay close to their burrows and moisture levels in the soil keep gases from escaping. Trapping is a safe and effective alternative to control isolated and emerging populations of pocket gophers during drier times of the year. DPR uses school site pesticide use data to tailor continuing education and outreach activities where and when it is needed to complete their goal of encouraging IPM practices at child care centers and public schools.



Field Evaluation of Two Second-Generation Anticoagulant Rodenticides (SGARs) Against the House Mouse (*Mus musculus domesticus*) in a Confined Swine Facility

ElRay M. Roper¹, Steve Sanborn¹, Grzegorz Buczkowski²

¹Syngenta Lawn and Garden, ²Purdue University

Three rodenticide bait blocks were compared for consumption, speed of control, and effectiveness of reduction of a house mouse infestation (*Mus musculus*) in a confined swine facility. The test was conducted at the Swine Unit of the Animal Sciences Research and Education Center (ASREC), a commercial swine farm operated by the Department of Animal Sciences at Purdue University in West Lafayette, Indiana. Three separate buildings were used. Each building received one of three treatments.

The three treatments were Talon® Ultrablok (0.005% brodifacoum bait block), Contrac® Blox (0.005% bromadiolone bait block), and Final® Blox (0.005% brodifacoum bait block). Baits were placed in the buildings in the areas of highest mouse activity determined by visual inspection. Baits were placed in tamper resistant mouse bait stations (Bell Protecta mouse station). Tracking pads were placed at both entrances to the bait stations. Tracking pads were 6 inch by 6 inch PVC tiles coated with blue construction chalk.

The study consisted of 3 phases. Phase I was pre-baiting with non-toxic bait blocks (Detex® Block, Bell Labs) and monitoring with tracking pads. Each building was continuously baited for 8 days and bait was replaced every 48 hours as needed. Bait consumption and tracking activity were measured in each building.

During phase II each building was baited with one of the three treatments and tracking was monitored with tracking pads. Phase II began 3 days after the completion of phase I. Each building was baited continuously for 15 days and bait was replenished every 48 hours as needed. Bait consumption and tracking activity were measured.

Phase III began 3 days after the end of phase II. Phase III was baiting with non-toxic bait blocks and monitoring with tracking pads. Each building was continuously baited for 8 days and bait was replaced every 48 hours as needed. Bait consumption and tracking activity were measured in each building. At the end of the 8 days of baiting live catch traps (JT Eaton 420CL Repeater™ Multiple Catch Mouse Trap) were placed throughout each building to determine if any mice remained active in the buildings.

To check for the presence of anti-coagulant rodenticide resistance, a one inch section from the tails of 12 mice that were captured at the end of the study were submitted to the Rodent

Research Lab at Reading University (Reading UK) and a genetic analysis was conducted to look for the presence of the two anti-coagulant resistant mutations, Y139C and L128S.

Results

Consumption of non-toxic bait for all treatments during phase I averaged 96.3% of bait applied $\pm 1.5\%$. Mean percent tracking during phase I for all treatments during phase I was $87\% \pm 1.7\%$. There was no significant statistical difference in mouse activity between treatments.

Bait consumption during phase II was; 2,454 grams of Talon Ultrablok, 1,094 grams of Final Blox, and 7,136 grams of Contrac Blox. There was no statistical difference in the consumption of Talon and Final bait. Consumption of Contrac was significantly greater than consumption of Talon and Final. No Final blox were consumed after the 2nd day of baiting.

Consumption of non-toxic bait during phase III was 1% for the Talon treatment, 38% for the Final treatment, and 91% for the Contrac treatment. Tracking activity for the Talon treatment was 1%, 27% for the Final treatment, and 78% for the Contrac treatment. Consumption and tracking for the Talon treatment were significantly less than for the Talon and Contrac treatments.

At the conclusion of the test, 6 mice were trapped in the Talon treatment, 44 mice were trapped in the Final treatment, and 57 mice were trapped in the Contrac treatment.

DNA analysis showed that 67% of the mice analyzed were homozygous and 33% were homozygous for the Y139C mutation for anti-coagulant resistance. In addition, another 33% of the mice were homozygous for the L128S mutation for anti-coagulant resistance.

Conclusions

The high rate of consumption of Contrac bait with a low level of control is indicative of physiological resistance to the anti-coagulant active ingredient bromadiolone. The results of the DNA analysis confirm the presence of the mutation for anti-coagulant resistance in this mouse population. As this mouse population is fairly isolated, this is not indicative that bromadiolone resistance is wide spread in the region where the test was conducted.

The low consumption of Final bait with moderate control and no feeding after the 2nd day of baiting indicates bait aversion in the mouse population. Because a very similar formulation of bait to Final has been used for years at the facility the selection for aversion is highly probable.

The moderate consumption of Talon bait with a very high level of control indicates that there is as yet no physiological resistance to brodifacoum in this mouse population. The attractiveness of a novel bait formulation resulted in strong consumption and a high level of control.

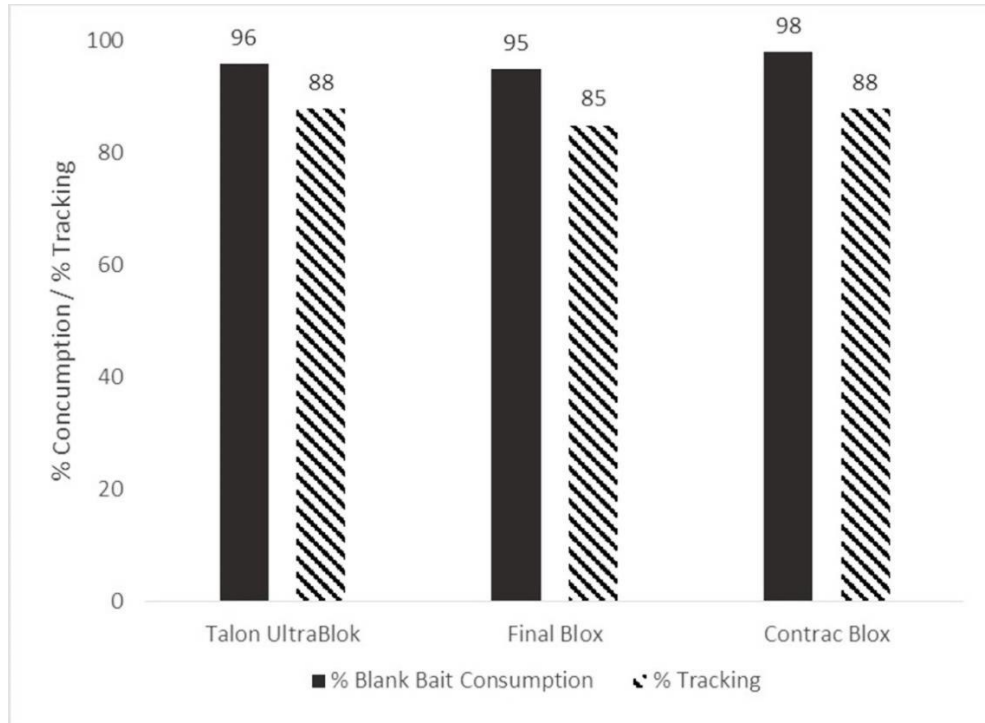


Figure 1. Phase I. Percent Consumption of non-toxic (blank) bait and Percent Tracking by Treatment.

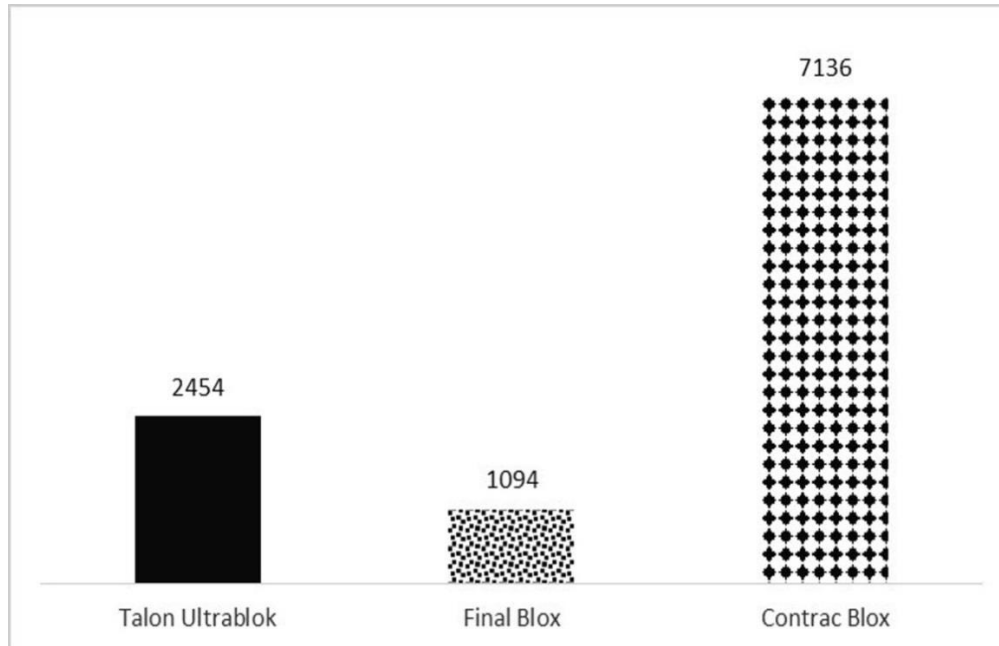


Figure 2. Phase II Total grams of bait consumed for each treatment during 15 days of continuous baiting. No Final Blox were consumed after the 2nd day of baiting.

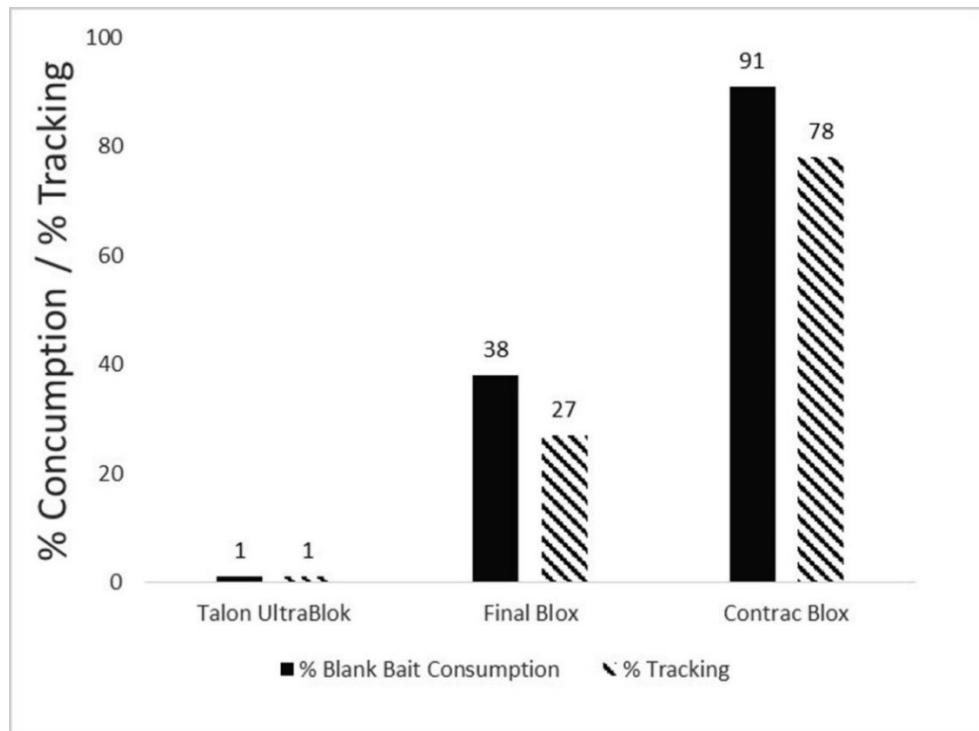


Figure 3. Phase III Percent Consumption of non-toxic (blank) bait and Percent Tracking by Treatment.



Field efficacy of a new global rodenticide bait formulation

Kyle K. Jordan, Sharon Hughes, Euan Bates, Thorsten Storck

BASF Professional & Specialty Solutions

Abstract

BASF has been in the rodent bait market for more than 30 years and currently features five global product lines. Formulation specialists have developed the most recent line using cholecalciferol, an active that has historically been plagued by its lack of palatability. This new formulation seems to overcome that issue and has shown excellent control in the field – in both urban and rural infestations. Because of the stop-feeding effect this bait induces, it may actually decrease the active baiting period normally required when using anticoagulant rodent baits by up to two thirds.



Symposium

Future of Urban Entomology



Future Challenges and Opportunities in Urban Entomology

Shripat T. Kamble

Department of Entomology, University of Nebraska, Lincoln, NE 68583-0816

Urban Entomology is experiencing overwhelming challenges. Some entomology departments are merging with other departments with major emphasis on crop pest management. The grant opportunities in United States Department of Agriculture's (USDA) National Institute of Food and Agriculture (NIFA) and Agriculture and Food Research Initiative (AFRI) programs are principally geared towards crops, organic farming, and invasive crop pests. Recently, USDA has included few livestock programs. Right now, Urban Entomology is completely excluded from NIFA and AFRI grants in spite of the major public health issues. Furthermore, the basic manufacturers are merging with new emphasis on big revenue generating markets such as field and vegetable crops, seed production and turf-grass industry.

The commercial urban pest control industry is flourishing and many pest control companies are generating sizable revenues. However, this industry does not invest in research, undergraduate and graduate student training. Everyone is depending on university researchers as the unbiased source of information. These researchers are expected to conduct basic and applied research to generate data for use by the industry and government agencies. They also assume responsibility to train future urban entomologists. It is uncertain at this time if urban entomology can uphold the high-quality programs with such sparse resources.

Therefore, it is prudent for urban entomology leaders to create a unified "Think Tank" and open dialogues with USDA leaders. This symposium has been a stepping stone for urban entomologists to offer constructive suggestions to strengthen the case. The six speakers have presented following topics:

1. "Introductory Comments" by Shripat T. Kamble, Department of Entomology, University of Nebraska, Lincoln, NE;
2. "Past, Present and Future of Urban Entomology" by Roger E. Gold, Department of Entomology, Texas A&M University, College Station, TX;
3. "Impact of Department Mergers and University Downsizing on Urban Entomology" by Patricia Zungoli and Eric Benson, The Clemson University, Clemson, SC;
4. "Funding Resources–Urban Entomology" by Coby Schal, Department of Entomology, North Carolina State University, Raleigh, NC;

5. “Molecular Research in Urban Entomology” by Edward Vargo, Department of Entomology, Texas A&M University, College Station, TX; and
6. “Industry Perspectives on Future of Urban Entomology” by Joseph Schuh and Robert Davis, BASF Professional and Specialty Solutions, Morrisville, NC.



Molecular research in urban entomology

Edward L. Vargo

Department of Entomology, Texas A&M University, College Station, TX 77845

Abstract

Molecular biology is a branch of biology that deals with the structure, function and manipulation of nucleic acids (DNA and RNA) and proteins. The tools of molecular biology are used extensively by many areas of biology to study genes and gene expression, including genetics, physiology, development, ecology and evolutionary biology. Understanding biological processes at the molecular level is revolutionizing medicine and agriculture. While urban entomology has been slower to adopt molecular approaches, this is beginning to change due to the successful application of molecular techniques in medicine and agriculture and thanks to the increasing number of urban pests whose genomes have been sequenced. The application of molecular tools has already led to a number of important advances in urban entomology, especially in the areas of organismal biology and toxicology, social insect biology and management, population and invasion biology, taxonomy and insect-microbe interactions. Embracing molecular approaches more fully is expected to ensure the vitality of our discipline and lead to important breakthroughs in urban pest management.



Symposium Additional Topics



Clemson Extension Commercial Pesticide Applicator Licensing Prep Course

Vicky Bertagnolli & Tim Davis

Clemson University Cooperative Extension

Abstract

The S.C. Pesticide Applicator Training Program is mandated by the Federal Environmental Pesticide Control Act of 1972 and the South Carolina Pesticide Control Act of 1975, as amended in 1978. Individuals are required to be trained and certified in the safe and responsible use of pesticides in order to purchase and apply pesticides in accordance with Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the South Carolina Pesticide Control Act of 1975. Many of the people taking the pesticide applicator licensing exam are knowledgeable but have difficulty taking tests. Dr. Tim Davis and Vicky Bertagnolli, developed a curriculum to help pest managers study for and pass the Commercial Pesticide Applicator exams in Core, Category 3 (Turf and Ornamental), Category 7A (Structural Pest Control), and Category 8 (Public Health). This Prep Course also provides the needed research-based continuing education to obtain required recertification credits allowing applicators to maintain proficiency and certification.



The Confusing Case of Chlorfenapyr: The Challenges of Testing Phantom

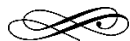
Meyers, J., Austin, J., Davis, B., Furman, B., Hickman, B., Jordan, K., Medina, F.

BASF Professional & Specialty Solutions

Abstract

Why do results with Phantom products vary greatly amongst laboratory tests? When investigating chlorfenapyr, protocol designs often necessitate a deeper understanding of its environmental and physiological interactions. Herein, we offer a review of various chlorfenapyr-based research demonstrating the complex effects of laboratory environments and protocol designs on results of chlorfenapyr testing. With the rapid increase in pyrethroid resistance in bed bugs, mosquitoes, cockroaches and others, it becomes imperative to invest in non-pyrethroid active ingredients. Chlorfenapyr has exhibited no cross-resistance amongst

insecticide classes utilized for structural pest control. Resultantly, chlorfenapyr can be an ideal tool for Pest Management Professionals.



Cross resistance between Hydramethylnon and Indoxacarb in German cockroaches (*Blatella germanica*)

Alex Ko, Coby Schal, & Jules Silverman

North Carolina State University

Abstract

Cross resistance is a phenomenon that can be expected if two or more active ingredients have similar modes of action. However, the insecticides hydramethylnon and indoxacarb are two bait formulation active ingredients that have distinctly different modes of action. We present data from various field collected strains demonstrating how laboratory selection with one of these active ingredients increases resistance to the other. These results illustrate the importance of artificial selection studies in predicting future insecticide resistance problems.



Subterranean Populations of *Culex pipiens molestus* in New York City

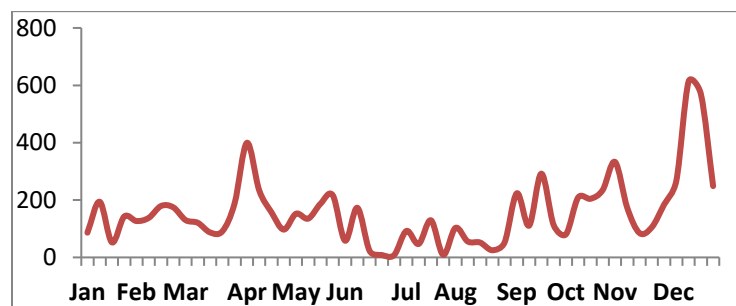
Waheed I. Bajwa and John Zuzworsky

New York City Department of Health and Mental Hygiene

Scientific Note

In New York City, *Culex pipiens molestus* reproduces in subterranean habitats such as sewers and standing water in cellars predominantly located in Manhattan (Upper West Side, Upper East Side, Tribeca, Financial District) and some areas in north central Queens (College Point and Flushing neighborhoods). Although fecund in London's underground railway network, the species has been elusive in the New York City subway train system. This subspecies reproduces throughout the year, feeds on sewer rats and invade private premises to feed on humans in the colder months (November - February). We believe these mosquitoes enter buildings via doors, holes in window screens, crevices; from voids around drain pipes, mainly in old buildings; and basement doors when left open. They also sit on the main doors of the buildings and wait for the opportune moment to enter through an unclosed door. In spring, summer and early fall, this subspecies prefers to feed primarily on mammals and occasionally on birds in the open areas. We maintained autogenous colonies of this subspecies for several years, without supplying the vertebrate blood meals. CDC light traps are regularly installed in the manholes of the affected areas to survey the *Cx. p. molestus* populations. Figure 1 shows the population dynamics of this species in the sewers in 2003 and 2004. We analyzed (for disease infection) mosquito pools of more than 5,000 *Cx. p. molestus* females since 2003; no specimens were tested positive for West Nile virus or any other mosquito-borne pathogens (including dengue virus and chikungunya virus). We have been managing *Cx. p. molestus* populations by weekly flushing large quantities of water into the sewer system of Upper East Side and a combination of larviciding (with *Bacillus sphaericus* and/or *Bacillus thuringiensis israelensis* products) and occasional water flushing in the Upper West Side. Overall, both techniques produced good results in the respective areas. Weekly flushing of sewers with large quantities of water, however, produced significantly better results in Upper East Side.

Figure 1: Average trap-catch per day of *Culex pipiens molestus* on CDC light traps installed inside sewers in the affected areas of Manhattan (2003 and 2004)



Mosquitoes of New York City

Waheed I. Bajwa, Nareeza Sakur, Zahir Shah, Liyang Zhou, Maddie Perlman-Gabel,
Ana Fonseca, and Tonuza Bazli

The importance of mosquitoes as vectors of human diseases highlights the need to document their diversity in New York City and other areas at risk of introduction of invasive mosquito species from the neighboring areas and abroad. As a result of international trade and immigration, New York City has a history of susceptibility to arbovirus (arthropod borne viruses) outbreaks. From 1794 to 1805, New York City, like other major cities in the Northeast United States, was plagued with multiple outbreaks of Yellow Fever (Heaton, 1946). The epidemic was precipitated by *Aedes aegypti*, a mosquito species that is incapable of overwintering in temperate climates, but was reintroduced every summer by trade ships. Upon the turn of the twentieth century, an abundance of natural and unnatural mosquito breeding habitats, ill maintained construction sites, and an influx of immigrants from disease-stricken nations instigated an epidemic of malaria (Patterson 2009). Starting from the twentieth century, numerous guides, including ones by Howard (1901) (1912), Felt (1904), Mitchell (1907), and Matheson (1944) extensively documented the presence of mosquitoes in New York State, but with limited references to New York City. In this paper, we provide a unique overview of mosquitos found in New York City based on our collection between 2000 and 2015.

Over the past 16 years, NYC Health Department has collected and identified 1.9 million adult mosquitoes across all five of the city's boroughs. Each survey site had a CO₂-baited CDC light trap, a gravid trap and occasionally a BG Sentinel[®] trap. In addition, several hundred larval mosquitoes were collected, reared to adult stage and identified to species. This large collection is comprised of 51 mosquito species belonging to 10 genera including: *Aedes* (3), *Anopheles* (7), *Coquillettidia* (1), *Culex* (5), *Culiseta* (4), *Ochlerotatus* (23), *Orthopodomyia* (1), *Psorophora* (4), *Toxorhynchites* (2) and *Uranotaenia* (1). Overall, *Cx. pipiens* (19.2%) was the most prevalent and most frequently encountered mosquito species citywide. Other common species such as *Cx. salinarius* (18.7%), *Och. sollicitans* (10%), *Cx. restuans* (6.8%), *Och. taeniorhynchus* (6.7%) and *Cq. perturbans* (5%), were trapped as large catches (per trap-day) from certain habitats/localities. During the 1930s, 1950s and 1960s, similar studies by NYC health officials revealed nine genera with 27 species in 1937 and 37 species in 1950 and 1969. With time, more diversity has appeared among genus *Ochlerotatus* - 10 species in 1936 to 23 species in the recent surveys (2000 – 2015). Specialty maps that correlate spatial and temporal distributions were created using ArcGIS and its various extensions to precisely characterize mosquito habitats and were utilized for integrated mosquito management in the City.

It is important to note that the population distribution and spatial equivalences are all dependent on temporal variables that lie within the constraints of locality. Utilizing data analysis tools

such as ArcGIS and mathematical modeling; we were able to simulate the population based on previous aggregated data (Figure 1).

Although the general weighted averages fluctuate, from 2006 to 2008, there was a large increase in both population densities and catch per trap-day (24-hour catch). Figures 2 & 3 provide a more detailed look at spatial and temporal distributions of key mosquitoes in New York City.

As temperatures increase during prime summer months, the average twenty-four hour catch per trap-day increases proportionally until the vernal equinox (Figure 2). It is contingent upon the overall rainfall along with other environmental variables.

Figure 3 shows the spatial distribution of *Aedes albopictus* over the course of four years. The relative density can be determined by the shaded areas that surround the established 52 permanent sites. There is an alarming increase in catch per trap-day during these years (2009-2013) particularly in Staten Island. This could be due to the abundance of befitting habitats for *Ae. albopictus* such as open containers and standing water.

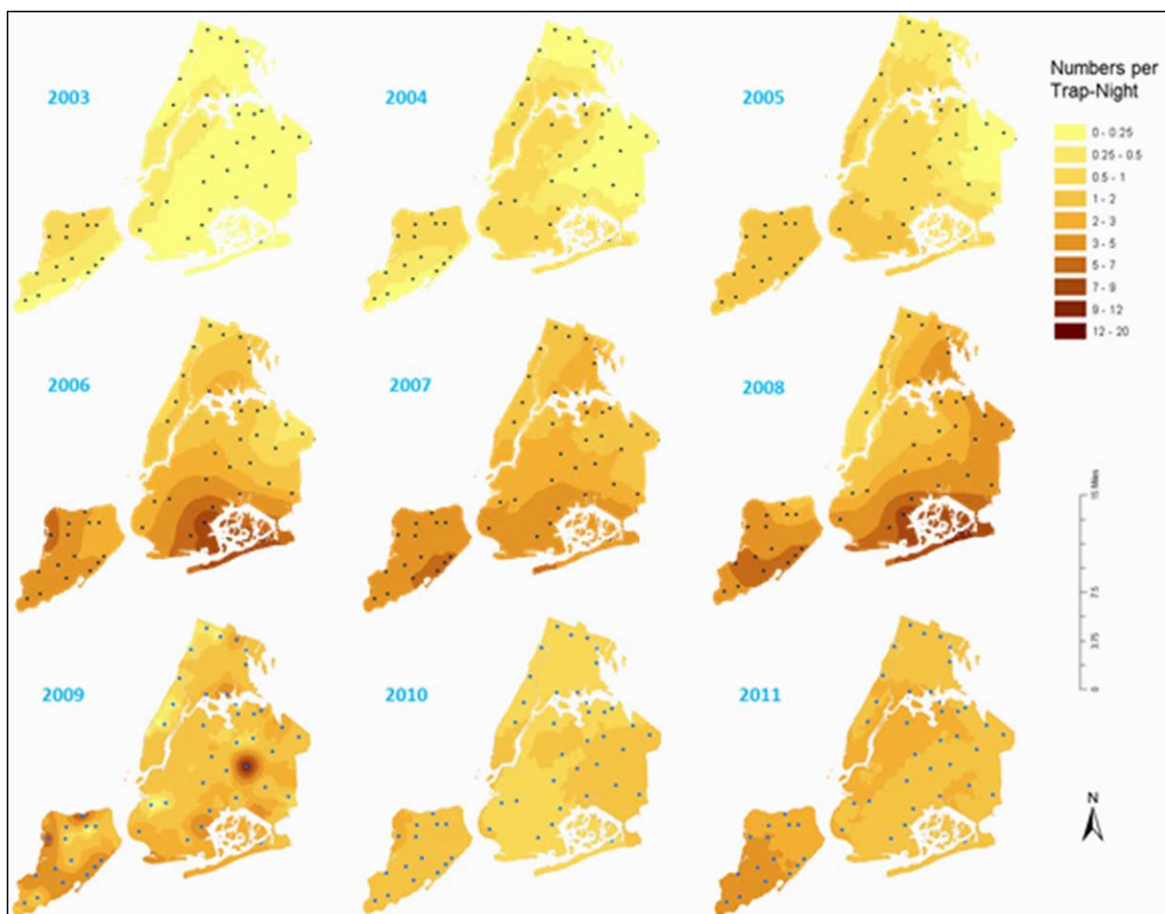


Figure 1. Spatial distribution of *Aedes albopictus* in NYC from 2003-2011

Figure 4 depicts the overall spatial distribution of *Culex salinarius* from 2009 to 2013. The areas known to provide environments conducive to breeding salt water mosquitoes are heavily shaded, which may correlate to exorbitant temperatures

Figure 5 shows the overall abundance of the most commonly trapped mosquitoes in New York City. The predominant species caught in light and gravid traps, on average, were *Cx. pipiens* at 20.8%, followed by *Cx. salinarius* at 20.2% and *Ae. vexans vexans* at 11.6%. It is important to understand that these mosquitoes are the most adaptable of all species and reach their greatest abundance in coastal areas near freshwater impoundments.

Figure 6 shows the abundance of the less commonly trapped mosquitoes. *Ps. ferox* is the most recurring mosquito (31.47%) followed by *An. quadrimaculatus* (22.31%). These mosquitoes in particular are significant pests of man and livestock, and thrive in areas where intermittent flooding and rainfall are frequent. It is also interesting to note that the species that are highly adaptable to urban landscapes have consistently doubled and tripled in population throughout areas that offer suitable habitats.

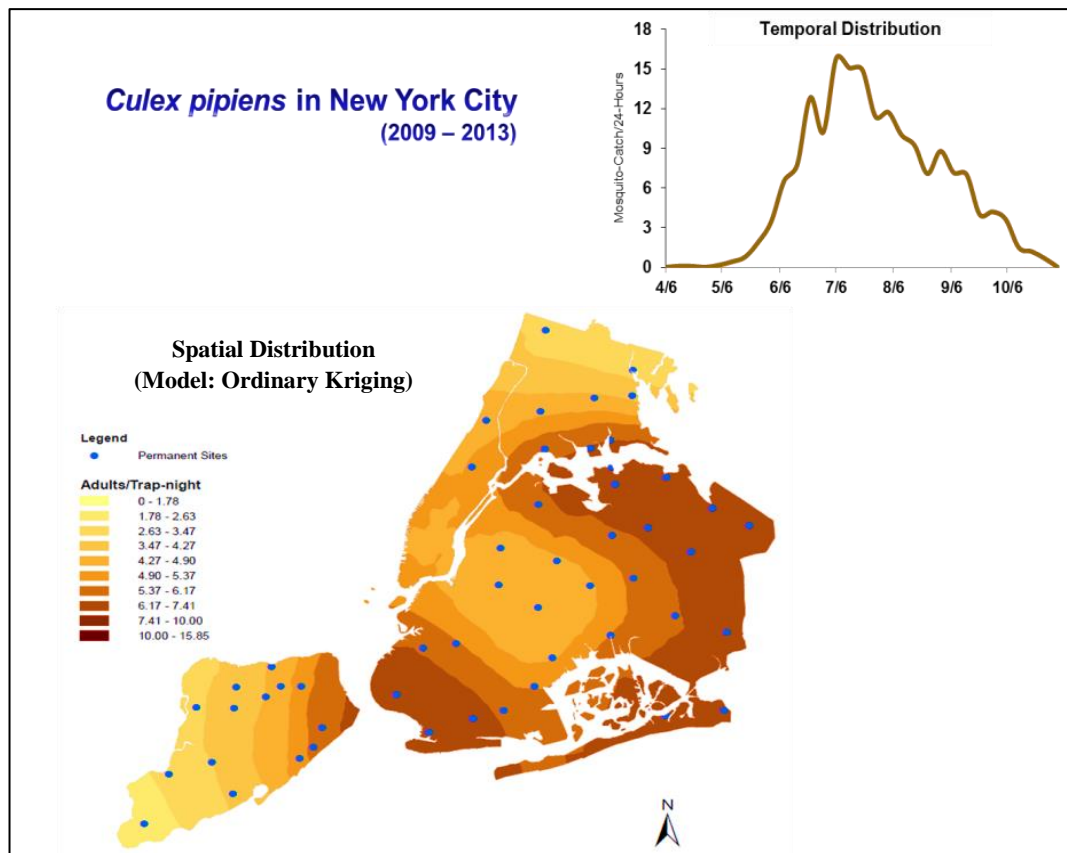


Figure 2. Spatial and temporal distribution of *Culex pipiens* between 2009 and 2013

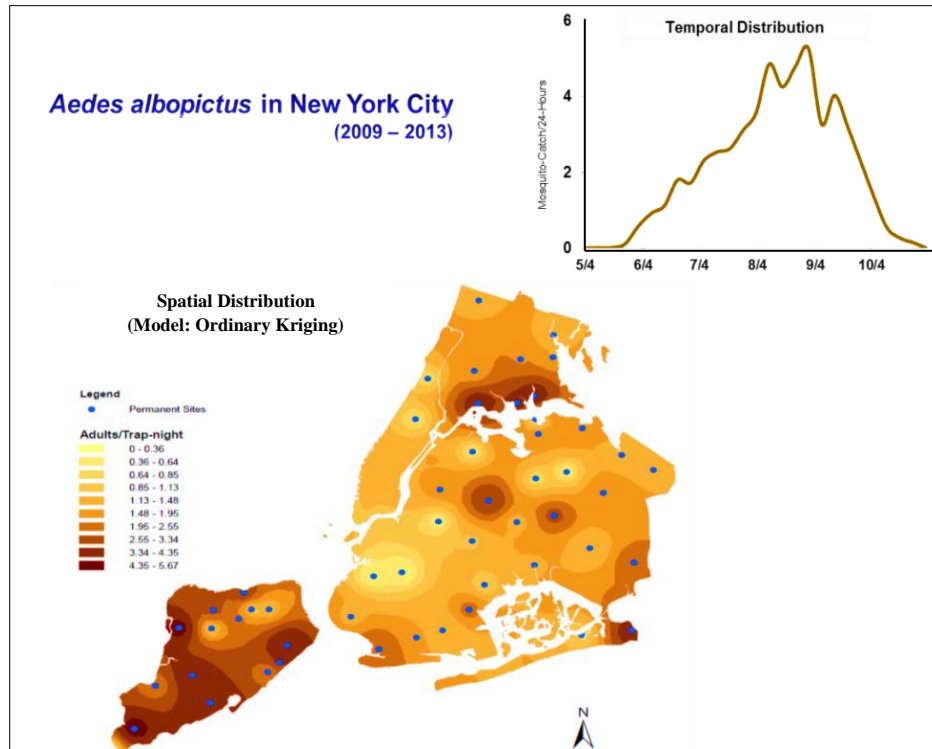


Figure 3. Temporal and spatial distribution of *Aedes albopictus* in NYC

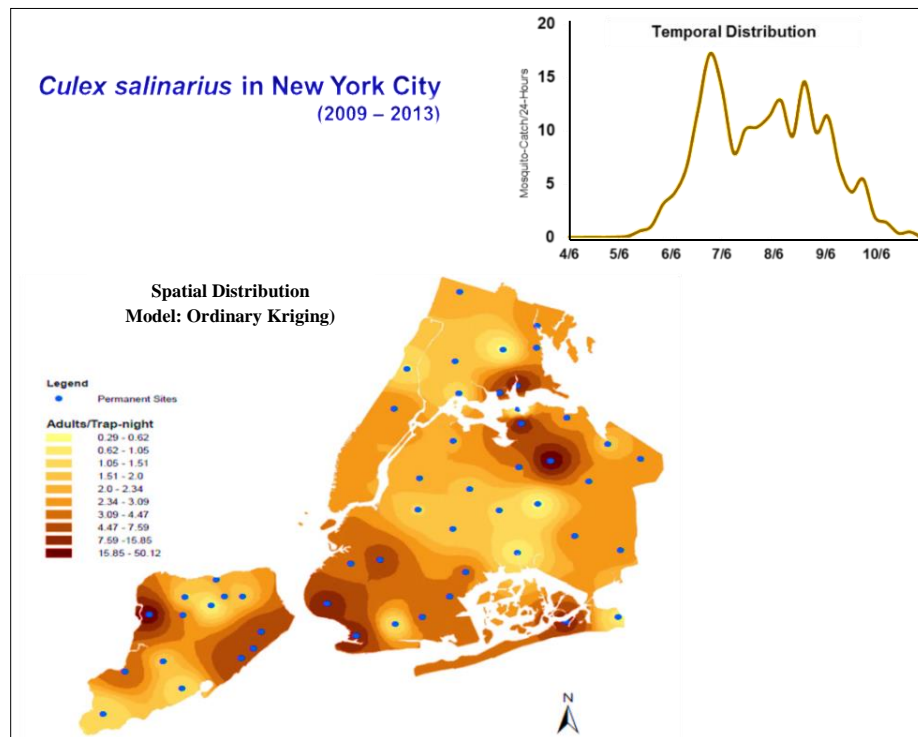


Figure 4. Temporal and spatial distribution of *Culex salinarius* in NYC

Figures 7 and 8 show the overall rank abundance of least commonly trapped mosquitoes in New York City. *Ps. howardii* (62.73%) and *Ps. ciliata* (44.76%) are both top contenders in areas that are prone to flooding and are voracious biters during daylight hours.

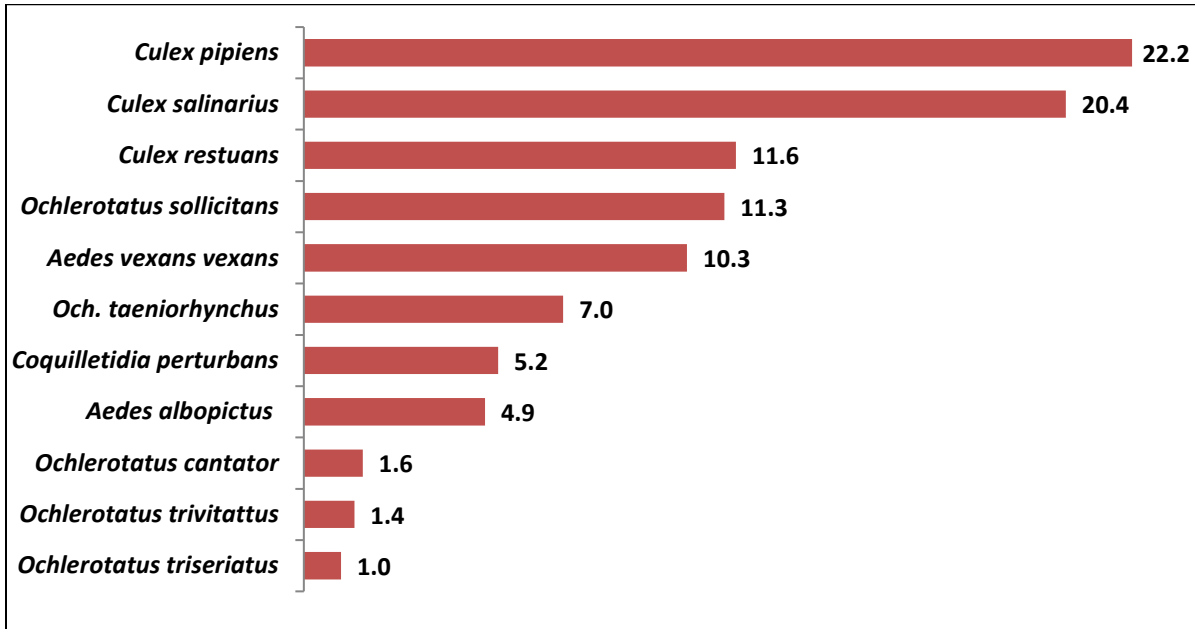


Figure 5. Abundance (%) of most common mosquito species in NYC

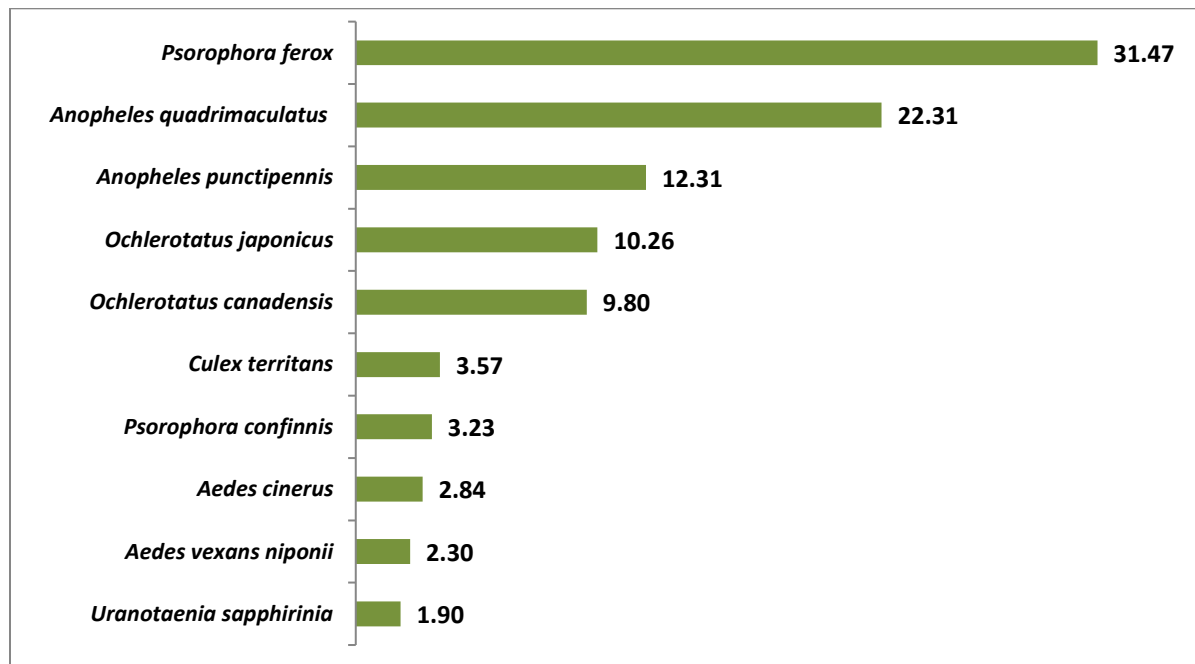


Figure 6. Abundance (%) of less common mosquito species in NYC

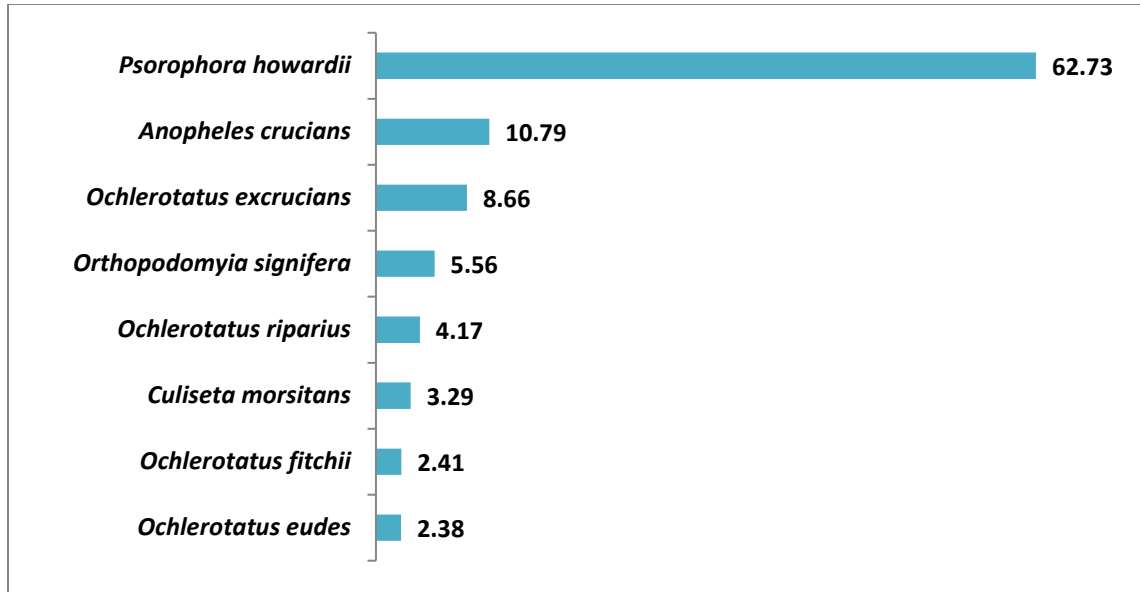


Figure 7. Abundance (%) of least common mosquito species in NYC

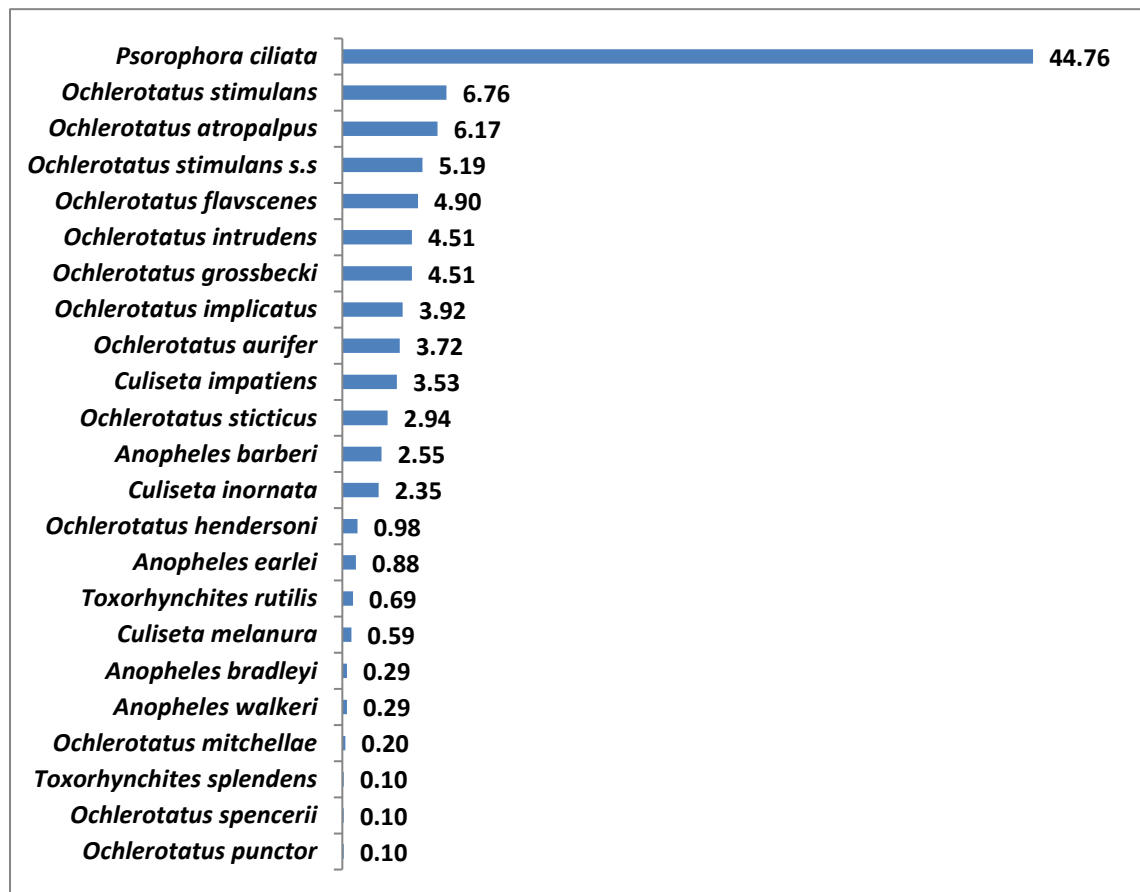


Figure 8. Abundance of sporadic mosquito species in NYC

Given the trends in mosquito population and densities per trap-day, it is evident that population averages are highly dependent on external variables such as weather patterns, habitat types, and available resources for mosquito breeding.

Among *Culex pipiens* complex, New York City has abundant populations of aboveground *Cx. pipiens pipiens* and belowground *Culex pipiens molestus*. The *Cx. p. molestus* females have yellow-brownish appearance, much lighter in color than *Cx. p. pipiens* females. *Cx. p. molestus* reproduces throughout the year and enters buildings to readily feed on human hosts in the cold winter months (November/December – February). In spring, summer and early fall, they feed mainly on mammals and occasionally on birds in the open areas such as streets, back/front yards in the residential areas, parks and other natural areas.

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Symposium
Barrier Applications for
Mosquito Management in
Residential Settings



Backyard verses Community Wide Mosquito Service

Ron Harrison

Orkin Technical Services

Abstract

Mosquito service for many years was the responsibility of local communities. Current community based mosquito control will be discussed. The concern of wide spread aerial pesticide applications led to a reduction in community based mosquito control. Home and commercial owners and managers needed mosquito control services to reduce the opportunity of disease transmission and increase outdoor yard enjoyment. Currently the concern of disease transmission from mosquitoes has heightened the concerns of residential and commercial customers. Pest control companies have been providing back yard mosquito control for over 15 years. This presentation will discuss challenges for pest control companies in servicing diverse customers wanting mosquito control. Particularly helping the customers understand the difference between population reduction verses prevention of disease transmission from mosquitoes will be presented. The presentation will discuss the need for involving customers in successful mosquito service. Though most regional and national companies generate less than 5 percent of their revenue from mosquito service it is often the most requested repeated seasonal service. The future of back yard mosquito service will be discussed



The Use of Backyard Treatments by Mosquito Control Districts for Routine and Targeted Mosquito Control

C. Riegel¹, E.R. Cloherty¹, B.H. Carter¹, S.R. Michaels¹ and C. W. Scherer²

¹ City of New Orleans Mosquito & Termite Control Board: ² Syngenta Crop Protection, Inc.

Abstract

Mosquito control districts (MCDs) utilize multiple strategies to control mosquitoes including educational campaigns, source reduction, and ground & aerial adulticiding and larviciding. Treatments of individual properties may also be utilized if manpower and resources allow. Residential yards can be treated using ultralow volume equipment or with mist blowers that produce larger droplets. Treatments may also have residual insecticide activity, depending on the method of application and active ingredient. Treatments may reduce the number of adult mosquitoes experienced in individual yards and can be conducted in areas at risk of arbovirus transmission. With the threat of mosquito-borne diseases, the use of backyard treatments may be a viable tool to reduce adult vector mosquito populations including *Aedes* spp. and *Culex* spp. The presentation will discuss case studies from New Orleans where the majority of vector species rest outdoors in an urban environment and commonly breed in containers.



Comparing Public Vector Management and Private Mosquito Control Service: Is this a competition?

Joe Barile

Technical Service Lead, PPM/Vector, Bayer

Abstract

The recent media hysteria regarding the Zika virus outbreak has raised public awareness regarding mosquito-borne disease threats in the United States. Many communities have established Mosquito Abatement/Control agencies. These agencies support public health protection with ongoing Integrated Mosquito Management programs. Mosquito control has become a significant growth opportunity for the structural pest management industry. Are these two approaches contradictory or complementary? We will discuss mosquito management from both sides, non-profit and for-profit, and address the strengths and shortcomings of both approaches.

Evaluation of Barrier Applications of Demand® CS and Archer® IGR for Control of Container Mosquitoes in Indian River County, FL

C. Roxanne Connelly, Carol Thomas, Wayne Thomas, Tim Hope, and Gregg Ross

University of Florida, IFAS, Florida Medical Entomology Laboratory, Vero Beach, FL

Demand CS and Archer IGR were applied to vegetation around 40 homes in two neighborhoods in Vero Beach, FL, and evaluated for reducing adults and eggs of container mosquitoes *Aedes aegypti* and *Aedes albopictus*. Mixed results were seen from island and mainland locations. When comparing adult mosquito reduction to egg reduction, the yards receiving barrier treatments exhibited a more noticeable reduction in the adult mosquitoes than eggs.



New Developments in Backyard Mosquito Control and their Relation to Mosquito-Borne Disease.

Grayson C. Brown, A. Glenn Skiles, Kyndall C. Dye.

Public Health Entomology Laboratory, Department of Entomology, University of Kentucky

Abstract

Recent outbreaks of mosquito borne disease have increased homeowner awareness of this threat. Fortunately, new advancements in perimeter/barrier treatments for suppression of anthropophagic mosquitoes in the spatial scale of a typical suburban backyard show good promise in providing meaningful reduction in disease risk for subscribing homeowners and their families. This presentation will examine those advancements and their implications to public health in the suburban environment.



Mosquito Work Doesn't Bite!

Rick Bell,
Arrow Exterminators

Abstract

Mosquito work has become an essential part of our customer offerings. We provide thorough technical training for our Service Professionals with an emphasis on pollinator protection. We outline clear application objectives and also highlight pollinator sensitivity and customer concerns regarding pollinators and their role in our environment. We will also review and discuss our revenue growth and retention through this extremely effective service.



Residual Effectiveness of Demand® CS on *Aedes albopictus* in Virginia

Nicola T.Gallagher¹, Benjamin McMillan², Jake Bova², Carlyle Brewster² and Sally L.Paulson²

¹Department of Entomology, Virginia Polytechnic Institute and State University; ²Syngenta Crop Protection, Inc.

Abstract

Aedes albopictus (Skuse) is the most invasive vector mosquito in the world and a competent vector for many viruses. Also, as an aggressive human biter, this mosquito is often the primary pest species eliciting complaints from the public in areas where it occurs. It readily utilizes artificial containers for breeding, and thus has adapted well to suburban and urban habitats. Once it has been established in a region it is very difficult to eradicate. Due to its daytime activity, standard mosquito control efforts utilizing spray trucks to administer insecticides offers little control against *Ae. albopictus*, as this method is generally directed towards crepuscular species. Because this species is a major biting pest in suburban yards and may transmit viruses such as Chikungunya, homeowners have increasingly searched for methods to control the mosquito in the U.S. A common recommendation for population control is reduction of larval development sites, but many breeding sites are cryptic. Residual pesticides applied to mosquito resting sites in vegetation have been shown to reduce pest mosquito populations. The focus of this study was to evaluate the residual toxicity under field conditions of Demand CS (lambda-cyhalothrin) to *Ae. albopictus* when applied to several species of commonly used landscaping plants by evaluation of residual efficacy on treated leaves using a laboratory bioassay.



Submitted Papers

Termites



Evaluation of Proprietary and Generic Termiticides in Laboratory Studies with *Reticulitermes flavipes* and *Coptotermes formosanus* Subterranean Termites

Roger E. Gold¹, Phillip Shults¹ and Ron Harrison²

Urban & Structural Entomology, Texas A&M University¹. Rollins Inc.²

Independent evaluation of proprietary (Termidor SC, Termidor HE, Premise 2 and Talstar P) and generic (Taurus SC, Dominion 2L and Bifen I/T) termiticides at both high and low label rates were made in laboratory tests using glass tube bioassay systems. Trials were run with field collected Eastern subterranean termites (*Reticulitermes flavipes*)(Tables 1, 3, and 5) as well as Formosan subterranean termites (*Coptotermes formosanus*)(Tables 2, 4, and 6). Data was collected on the distance tunneled through time by the test termites, and the mortality caused by the termiticides, as compared to non-treated controls. All termiticides used in these replicated evaluations (five replicates) were purchased on the same date from a national supplier. The results were compared and contrasted based on the active ingredients (fipronil, imidacloprid or bifenthrin). In addition, analysis was done on the solubility and pH of the diluted termiticides at the labeled rates (Tables 7 and 8).

Table 1. Mean distance tunneled (mm) and mean mortality through time of *Reticulitermes flavipes* in glass tube bioassays with fipronil at 3 days.

Treatment	Distance (mm)	Mortality (%)
Termidor SC 1250	3.6 (c)	100 (a)
Termidor SC 600	10.4 (b)	100 (a)
Termidor HE 1250	2.8 (c)	100 (a)
Termidor HE 600	6.2 (b)	100 (a)
Taurus SC 1250	1.0 (c)	100 (a)
Taurus SC 600	1.0 (c)	100 (a)
Control	50.0 (a)	0 (b)

Means followed by the same letter are not significantly different (p=0.05) per Tukey's HSD

Data on all variables was assessed and compared statistically with SPSS v 21 by Analysis of Variance (ANOVA), and means were separated utilizing Tukey's Honest Significant Difference (HSD) with $p \leq 0.05$. While substantial differences were determined between active ingredients and concentrations (high vs. low label rates), we failed to reject the null hypothesis that proprietary and generic formulations had the same effects on the test termite subsets, and thus met the regulations administered by the Pesticide Regulations Division of the United States Environmental Protection Agency in that generic pesticides had to be "substantially similar" to their proprietary counter parts in terms of chemical makeup, formulation and efficacy.

Table 2. Mean distance tunneled (mm) and mean mortality through time of *Coptotermes formosanus* in glass tube bioassays with fipronil at 2 days.

Treatment	Distance (mm)	Mortality (%)
Termidor SC 1250	9.4 (b)	100 (a)
Termidor SC 600	12.8 (b)	100 (a)
Termidor HE 1250	5.0 (c)	100 (a)
Termidor HE 600	9.0 (b)	100 (a)
Taurus SC 1250	1.0 (c)	100 (a)
Taurus SC 600	1.4 (c)	80 (a)
Control	50.0 (a)	0 (b)

Means followed by the same letter are not significantly different ($p=0.05$) per Tukey's HSD

Table 3. Mean distance tunneled (mm) and mean mortality through time of *Reticulitermes flavipes* in glass tube bioassays with imidacloprid at 14 days.

Treatment	Distance (mm)	Mortality (%)
Premise 2 1000	1.2 (b)	92.6 (a)
Premise 2 500	1.0 (b)	10.0 (b)
Dominion 2L 1000	1.0 (b)	95.4 (a)
Dominion 2L 500	1.0 (b)	91.0 (a)
Control	50.0 (a)	<10 (c)

Means followed by the same letter are not significantly different ($p=0.05$) per Tukey's HSD

Table 4. Mean distance tunneled (mm) and mean mortality through time of *Coptotermes formosanus* in glass tube bioassays with imidacloprid at 14 days.

Treatment	Distance (mm)	Mortality (%)
Premise 2 1000	9.0 (bc)	67.8 (b)
Premise 2 500	13.8 (b)	65.8 (b)
Dominion 2L 1000	4.2 (cd)	100.0 (a)
Dominion 2L 500	2.8 (d)	100.0 (a)
Control	50.0 (a)	<10 (c)

Means followed by the same letter are not significantly different ($p=0.05$) per Tukey's HSD

Table 5. Mean distance tunneled (mm) and mean mortality through time of *Reticulitermes flavipes* in glass tube bioassays with bifenthrin at 11 days.

Treatment	Distance (mm)	Mortality (%)
Talstar P 1200	1.0 (b)	51.4 (b)
Talstar P 600	0.8 (b)	97.0 (a)
Bifen I/T 1200	1.0 (b)	72.4 (a)
Bifen I/T 600	0.6 (b)	57.0 (b)
Control	50.0 (a)	<10 (c)

Means followed by the same letter are not significantly different ($p=0.05$) per Tukey's HSD

Table 6. Mean distance tunneled (mm) and mean mortality through time of *Coptotermes formosanus* in glass tube bioassays with bifenthrin at 11 days.

Treatment	Distance (mm)	Mortality (%)
Talstar P 1200	1.0 (b)	84.6 (a)
Talstar P 600	1.0 (b)	67.8 (a)
Bifen I/T 1200	1.0 (b)	70.6 (a)
Bifen I/T 600	0.6 (b)	76.8 (a)
Control	50.0 (a)	<10 (b)

Means followed by the same letter are not significantly different ($p=0.05$) per Tukey's HSD

Table 7. Mean pH of products at manufacturers label rates for termite treatments.

Treatment	Concentration (ppm)	pH
Termidor SC	1250	9.71 (a)
Termidor HE	1250	9.41 (b)
Taurus SC	1250	9.62 (a)
Premise 2	1000	8.07 (c)
Dominion 2L	1000	7.49 (d)
Talstar P	1200	7.90 (c)
Bifen I/T	1200	8.00 (c)

Means followed by the same letter are not significantly different ($p=0.05$) per Tukey's HSD. Standards: 4.00=4.01 pH and 7.00=7.00 pH.

Table 8. Solubility of products at manufacturers label rates for termite treatments

Treatment	Concentration (ppm)
Termidor SC	1250 (a)
Termidor HE	1250 (a)
Taurus SC	1250 (a)
Premise 2	1000 (a)
Dominion 2L	1000 (a)
Talstar P	1200 (a)
Bifen I/T	1200 (a)

Concentrations followed by the same letter are not significantly different in ability for product to pass through sieves. Note: American Society of Testing Materials sieve sizes utilized were 10, 12, 14, 20, 35, 50, and 60.



Field trials with *Coptotermes formosanus* Shiraki in New Orleans: Performance of Recruit® AG FlexPack and determination of colony foraging distance

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¹Dow AgroSciences, Fayetteville, IN, ²NOMTRCB, New Orleans, LA; ³AR Dow AgroSciences, Indianapolis, IN

Abstract

Field Trials were conducted by Dow AgroSciences and the City of New Orleans Mosquito Termite and Rodent Control Board (NOMTRCB) in 2014 – 2015 in New Orleans, Louisiana. Six properties with structures infested by the Formosan subterranean termite, *Coptotermes formosanus* Shiraki, were baited with Sentricon® System Recruit® AG FlexPack stations containing a new briquetted bait matrix formulation. Results showed the same good hit rate, bait consumption and colony eliminations as Recruit IV AG. Elimination of Formosan colonies was achieved at all structures in approximately two to four months (mean = 3 months) after initial Recruit AG FlexPack installation. A second field study of trees infested by *C. formosanus* at Fort Pike Louisiana State Historic site located just east of New Orleans was also conducted. DNA analyses showed that 3 trees with a linear distance between two of the trees equal to 340 feet were infested by the same colony. This unique finding equates to a Formosan colony with a linear foraging distance greater than a football field. The colony was subsequently eliminated by Recruit HD bait feeding.



A multi-state study to assess the efficacy of Altriset® termiticide in controlling *Reticulitermes flavipes* in infested structures

SUSAN C. JONES¹, Edward L. Vargo^{2,3}, Paul Labadie³, Chris Keefer^{2,4}, Roger E. Gold², Clay W. Scherer⁴, and Nicola T. Gallagher⁴

¹OHIO STATE UNIVERSITY; ²TEXAS A&M UNIVERSITY; ³NORTH CAROLINA STATE UNIVERSITY; ⁴SYNGENTA CROP PROTECTION, INC.

Abstract

The efficacy of Altriset® 20SC (AI, chlorantraniprole) in controlling structural infestations of the eastern subterranean termite, *Reticulitermes flavipes*, in Ohio, North Carolina, and Texas (3 to 4 homes per location). Prior to Altriset® treatment, we collected termites from the structure itself as well as from a grid of in-ground monitoring stations encircling each structure, and microsatellite markers were used to genetically fingerprint the termite colonies. The location and foraging area of infesting colonies subsequently was tracked after the termiticide

treatment. Altriset® provided effective structural protection as termite activity generally ceased within ~1 month or less and the structures continued to be free of termites for the 2-year study duration.



High precision termite control

Freder Medina¹, Kenneth S. Brown¹, Jeff D. Vannoy¹, Bob Davis¹, Bob Hickman¹, Kyle Jordan¹, Jason Meyers¹, Matt Spears¹, Judy Fersch¹, Amy Dugger-Ronyak¹, Anil Menon¹, Richard Warriner¹, Jim Cink¹, John Paddock², Joe Schuh¹

¹BASF Professional & Specialty Solutions, RTP, NC; ²DryJect, Inc, Hatboro, PA

Abstract

Innovation plays an important role at BASF and it provides Pest Management Professionals (PMPs) with the most advance termite treatment products and tools. Since Termidor® first US registration in 2000 until today, six million homes have been successfully treated with our product. However, the efficacy of current control methods relies on a methodology that involves digging trenches to establish continuous treatment zones around the foundation of the structure. With our latest innovations, Termidor® *H•P* High Precision Termiticide and Termidor® *H•P* High Precision Injection System, PMPs are able to inject the termiticide directly into the soil with unrivaled accuracy, precision, minimum disruption to landscape, and less water consumption.



Submitted Papers

Bed Bugs



Field evaluations of bed bug interceptor traps in homeless shelters

Michael Merchant¹, Elizabeth Brown², Molly Keck³, Paul Nester⁴ and Jonathan Garcia¹

¹Texas A&M AgriLife Research & Extension Center at Dallas, ²Texas A&M AgriLife Extension-Travis County, ³Texas A&M AgriLife Extension-Bexar County, ⁴Texas A&M AgriLife Extension-Harris County

Introduction

An estimated 564,000 people were homeless in Jan 2015 in the U.S., including over 23,000 in Texas (Henry et al. 2015). In Dallas County, Texas, alone, there were over 3,900 people staying on the street or in shelters in January 2016, an increase of over 20% since 2015 (Rajwani Mar 22, 2016). Homeless shelters nationwide provide housing for an estimated 69% of the homeless (Gangloff-Kaufmann and Pichler 2008, Henry et al. 2015) and bed bugs in emergency and transitional shelters are a growing problem. Bed bugs pose psychological challenges for shelter clientele and employees (HCH Clinicians Network 2005, CDC/EPA 2010), and in some cases prevent clientele from taking advantage of shelter (Hauser Jan 3, 2014).

An essential part of IPM for bed bugs in shelters is early detection and effective monitoring of areas with active infestations. Although visual inspections are an essential part of this process, such sampling is time consuming and disruptive, and may be especially difficult in situations of low level infestations.

The ClimbUp Interceptor, Verifi Detector, BlackOut Detector, Slider BDS-SLDR96, and SenSci Volcano traps are commonly sold and used by PMPs for bed bug monitoring. Over a two-year period, we evaluated these traps for economy, stability in the homeless shelter environment, and ability to catch bed bugs. In addition, we compared SenSci Volcano traps with lures to unbaited SenSci traps and ClimbUp Interceptors.

Methods and Materials

Six Texas homeless shelters were monitored monthly for bed bugs between 2012 and 2014. Shelters were located in Dallas, Houston, San Antonio and Austin. Each bed was randomly assigned either four ClimbUp Interceptors, one Verifi Detector, or four BDS-SLDR96 (sticky)

traps. Later in the survey, four BlackOut Interceptor traps replaced the BDS SLDR96 traps on beds in five of six shelters. All traps were placed under (ClimbUp, BlackOut), next to (Verifi), or on beds (BDS-SLDR96). ClimbUp and BlackOut Interceptor traps were placed under all four feet of the beds whenever possible.

In 2015, we monitored 24 beds in a Dallas homeless shelter with a chronic bed bug infestation. Under each bed we placed a SenSci Volcano trap baited, a SenSci Volcano trap unbaited, and a ClimbUp Interceptor trap. Traps were checked every 14 days and nymphal and adult bed bugs were counted. Differences in overall catches among trap types were compared using Chi-square analysis; and direct comparisons were made between the different trap counts from each bed using paired T-test.

Results

Usability of traps was measured by the percent of traps that were in good condition and that were not disturbed, moved or damaged each month. ClimbUp (80%), BlackOut (72%), and Verifi (74%) traps had the highest usability ratings; however, because there was only one Verifi station per bed, Verifi sampled beds had an overall lower rate of capturing useful data. The BDS SLDR96 trap was the most commonly lost or damaged trap from month to month in our study, with a usability rating of 62%.

Looking at average trap catch (only for usable traps) over all sites and dates, BlackOut traps caught the most bed bugs, followed by Verifi and ClimbUp traps). The BDS slider traps caught the fewest bed bugs, and were eventually dropped from five of the six shelters because of low bed bug numbers.

There was a significant difference in the ratio of nymphs to adults among the different trap types (Chi-square=49.49, df=2, $P<0.0001$) with Verifi traps catching significantly more adults (38%) compared to BlackOut and ClimbUp traps (29% and 28%, respectively).

In comparing the newer SenSci Volcano traps (with and without SenSci Active lures) to ClimbUp Interceptors, Volcano traps with SenSci Active lures caught an average of 67% more bed bugs over an 8-week period than Volcano traps without lures ($n=786$; $P(T<t)$ two-tail = 0.0002). Volcano traps with lures caught 23% more bed bugs than ClimbUp traps, though the difference was not significant ($n=900$; $P(T<t)$ two-tail = 0.190). However, the ClimbUp trap caught significantly (33%) more bed bugs than the Volcano trap without lures ($n=776$; $P(T<t)$ two-tail = 0.062). Volcano traps also caught significantly more nymphs (88%) than ClimbUp traps (82%) ($n=1148$; Chi-square = 9.27, df=1, $P=0.0023$).

When total trap catches were compared on each of the four sample dates, there was a significant departure from equal trap catch proportions for the first month of the study (Chi-square test, $P<0.01$). At week two and week four, SenSci Volcano traps with the SenSci Active lure caught significantly more bed bugs than Volcano traps with no lure. After four weeks, lure-baited

traps caught slightly more bed bugs than unbaited traps, though the difference was not statistically significant ($P>0.05$). This suggests that SenSci traps with lures should have fresh lures installed every 1-2 months.

An additional consideration when selecting traps for use in shelters is cost. The most expensive trap was the Verifi station at approximately \$30 each (Verifi has been discontinued and will only be available until existing stocks are sold). The ClimbUp Interceptor trap was the least expensive at \$2.23/unit (12-pack price, Amazon.com). The BlackOut Detector cost \$5.00 per unit (Bed Bug Central), and the SenSci Volcano and SenSci Active lure cost \$4.50 and \$5.00, respectively.

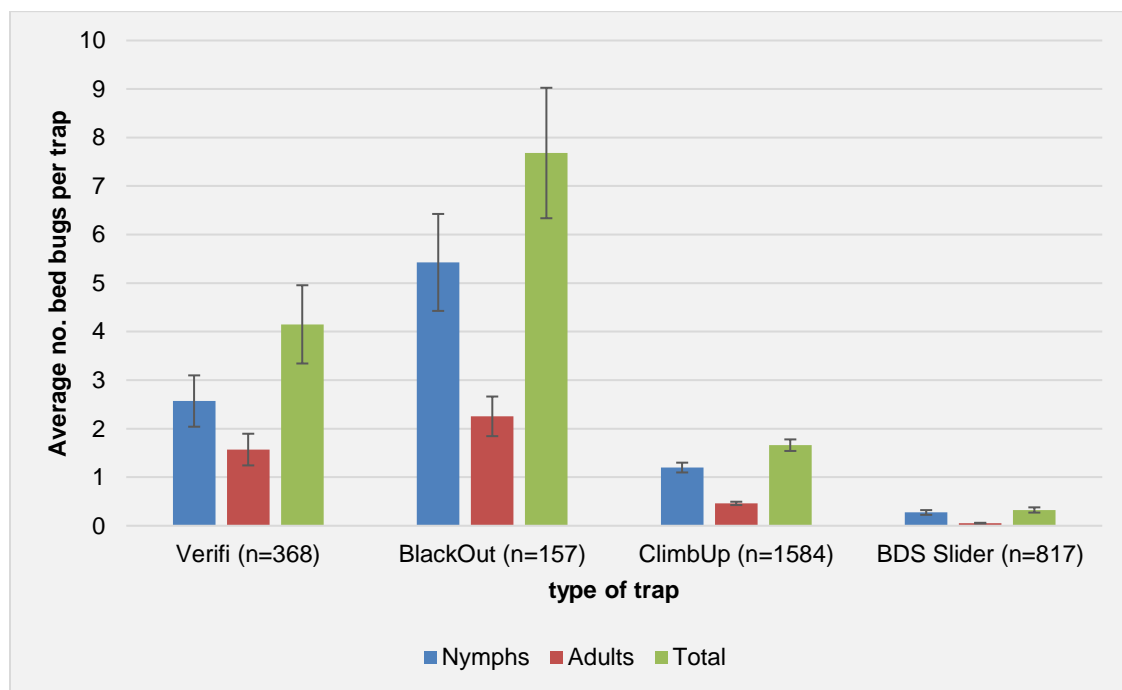


Figure 1. Average monthly numbers of bed bugs caught per trap, for four trap types in six Texas homeless shelters. 2012-2014.

Conclusions

ClimbUp Interceptor traps and BlackOut Detector traps had the highest stability in the homeless shelter environment, possibly because they could be stabilized under the feet of beds. BlackOut Detectors caught the highest numbers of bed bugs overall, followed by Verifi. The one sticky trap evaluated in our study (BDS SLDR96) did not perform well and was dropped before the end of the study.

The new Volcano trap and SenSci Activ lure provided a discrete alternative trap that caught as many bed bugs as the ClimbUp Interceptor, at least over 8 weeks of observation. Usability over a long period of use was not evaluated for the Volcano traps.

Based on unit cost, stability in the environment and not needing costly lure replacement, the ClimbUp and BlackOut traps were the most economical bed bug monitoring tools in our study.

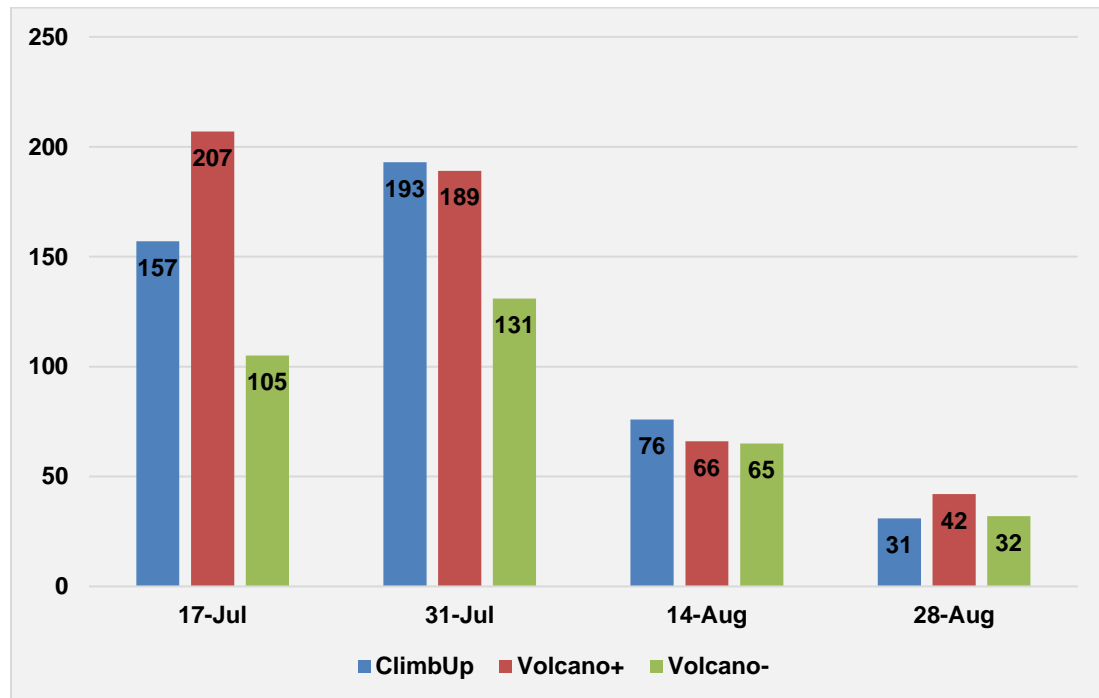


Figure 2. Total trap catches of bed bugs for three trap combinations (ClimbUp, Volcano + lure, and Volcano – lure) over eight weeks. Dallas, TX. July-Aug. 2015.

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Insecticide resistance bioassays for bed bugs: a review of methodologies

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Ever since the first report of bed bug resistance to pyrethroid in modern bed bugs, research efforts have aimed at understanding the development of resistance to bed bugs and other classes of insecticides that has been gradually introduced in the market for bed bug control. This information is crucial for monitoring and management of resistant bed bugs in field conditions.

Resistance is an evolutionary response of organisms to the presence of continued environmental changes. Resistance develops through the selective survival of a few individuals that have inherited mechanisms that withstand the action of insecticides. If populations with these individuals are continuously exposed to insecticides, susceptible individuals die while resistant ones survive, breed and pass the resistant traits to their progeny (Staunton et al. 2008). Insect populations generally develop resistance to insecticides faster when these compounds have been used before or share a mode of action with other compounds (Georghiou 1986).

A number of methodologies have been used to measure insecticide resistance in bed bugs. The methods range from evaluations with technical grade insecticides to formulated insecticide materials. A more precise measurement of insecticide resistance is achieved when evaluations are conducted with a range of concentrations of the technical insecticide which allow making dose-response curves. Elaboration of these curves with susceptible and resistant strains is the basis for the identification of discriminating doses which are used for a rapid screening of susceptibility to insecticides in bed bug field samples. In the United States, a comprehensive screening of pyrethroid resistance in bed bug populations was conducted with a discriminating dose and results indicated the deltamethrin resistance was widespread. Given the emergence of neonicotinoid resistance in some bed bug populations in the United States, the identification and use of discriminating doses will help monitor resistance and manage resistant bed bugs to these compounds under field conditions.

Recently, others rapid methods have been proposed to evaluated insecticide resistance under field conditions. In Australia, a small piece of mat (Mortein Odourless Mozzie Zapper) impregnated with the pyrethroid d-allethrin (Dang et al. 2015) has been used to detect pyrethroid resistance in bed bugs. The system is simple and within 24 h is possible to determine whether the sample is resistant or not. Monitoring of insecticide resistance in bed bug populations will require standardized methodologies that quickly diagnosis resistance with low number of specimens.

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Evaluating the efficacy of hand-held and backpack vacuums as bed bug management tools

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Abstract

The purpose of this study was to evaluate several hand-held and backpack vacuums for their efficiency and potential utility in bed bug management programs. A field evaluation determined that the vacuuming was indeed a necessary infestation management tool. The majority of vacuums tested removed all bed bugs and their eggs from mattresses and other surfaces. The vacuums were also able to remove thousands of molted bed bug "skins" that served as protective harborages for small instars, essentially shielding them from liquid insecticide applications. Finally, vacuuming was determined to be necessary for eliminating cast skins and dead bugs from the environment so that new bed bug evidence could be easily observed after treatment. Overall, vacuuming was found to be an important element in the management of bed bug infestations.



Laboratory assays to determine the efficacy of two multi-action insecticide products for bed bug control

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Bed bugs (*Cimex lectularius*) are an ever-worsening problem for pest management professionals, and chemical insecticides are still the most commonly used treatment method for bed bug infestations (Potter et al. 2015). Insecticide resistance in bed bugs has been documented as early as the mid-20th century, and resistance to multiple classes of insecticides is becoming a concern for researchers and pest management professionals alike (Busvine 1958, Gordon et al. 2014, Romero and Anderson 2016). We tested the efficacy of two multi-action insecticide products for bed bug control in fresh residue laboratory assays (Crossfire® bed bug concentrate: 4% clothianidin, 0.1% metofluthrin, 0.1% piperonyl butoxide and Tandem® insecticide: 11.6% thiamethoxam, 3.5% lambda-cyhalothrin). Bed bugs of the Harlan (susceptible) and Epic Center (resistant) strains were exposed to the products for one hour or continuously, and mortality was recorded regularly for 14 days. Both products killed 100% of the Harlan strain bed bugs by day 14, but Tandem® killed Harlan strain bed bugs significantly faster than Crossfire® bed bug concentrate. There was no significant difference in time to mortality in Epic Center strain bed bugs exposed to either product, but only Epic Center strain bed bugs exposed to Crossfire® reached 100% mortality by day 14. We found that both of these products were effective in the laboratory, but we still conclude that controlling bed bug populations in the field is near impossible using chemical methods alone. However, the products we tested remain a valuable resource and are appropriate for incorporation into an integrated pest management plan.

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Evaluating encasements: Are all created equal?

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¹Virginia Tech Bed Bug and Urban Pest Information Center, Blacksburg, VA; ²Virginia Tech Department of Entomology, Blacksburg, VA

Abstract

An important non-chemical bed bug management strategy is the installation of mattress and box spring encasements. An effective encasement will trap any bed bugs already on the mattress and prevent new bed bugs from aggregating within the box spring. Encasements are used by 86% of pest management professionals in the United States (Potter et al. 2011). While many encasements are available to consumers, not all are effective. We evaluated several encasements, including those new to the market, in order to identify their important features and potential flaws, as well as to determine if they are economical based on cost benefit.



Evaluating the factors involved with heat treatment success

Ian Sandum & Dini Miller

Virginia Tech Department of Entomology, Blacksburg, VA

Abstract



Due to growing resistance in bed bugs to insecticides, there is a greater need for other treatment methods. Heat is being increasingly used to control bed bug infestations in multi-unit apartments. However, there is not an accurate way of determining how effective a treatment will be since many factors affect the success of a heat treatment. Among these factors are size of the apartment, and amount of clutter. Unfortunately, there has not been studies that have properly characterized the effect that these factors will have. The goal of this experiment was to determine the extent of differences of treatments in apartments of different sizes and amount of clutter.




NATIONAL CONFERENCE ON URBAN ENTOMOLOGY AND INVASIVE FIRE ANT CONFERENCE PROGRAM

2016

National Conference on Urban Entomology and Invasive Fire Ant Conference

May 22-25
Albuquerque, New Mexico

ncue.tamu.edu
 [groups/ncue16](https://www.facebook.com/groups/ncue16)
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NCUE/IFA schedule at a glance
Refer to daily details for session locations.

SUNDAY, MAY 22

6:00-8:00 Welcome reception

MONDAY, MAY 23

6:30-8:00 Breakfast (included with hotel registration)

8:00-9:15 **PLENARY SESSION**

9:15-9:45 **STUDENT SCHOLARSHIP AWARD PAPERS**

9:45-10:15 BREAK

10:15-11:30 **STUDENT PAPER COMPETITION**

11:30-1:00 Lunch on your own

1:00-2:15 **SUBMITTED PAPERS ANTS I (Non-RIFA)**

2:15-2:45 BREAK

2:45-4:45 **SYMPOSIUM** Pest Prevention & Learnings
SUBMITTED PAPERS ANTS II (RIFA)

4:45 Dinner & evening on your own

TUESDAY, MAY 24

6:30-8:00 Breakfast (included with hotel registration)

8:00-10:00 Concurrent sessions:
SYMPOSIUM Invasive Ant Management I
SYMPOSIUM IPM Outreach
SYMPOSIUM Indoor Biomes

10:00-10:15 BREAK

10:15-12:15 Concurrent sessions:
SYMPOSIUM Invasive Ant Management II
SYMPOSIUM Gaps & Challenges in Urban Entomology

12:15-1:45 **AWARDS LUNCHEON**

1:45-3:30 Concurrent sessions:
SUBMITTED PAPERS Ants III (RIFA)
SYMPOSIUM Urban Rodent Control
SUBMITTED PAPERS Additional Topics
Zika Virus Panel Discussion

2:45-3:30 BREAK

3:30-3:45 Concurrent sessions:
SYMPOSIUM Mosquito Barrier Treatments
SUBMITTED PAPERS TERMITES

4:00-5:45 **Fire Ant eXtension Meeting**

6:00 Shuttles begin departing for Albuquerque Museum

6:30-8:30 **Evening at the Albuquerque Museum**

WEDNESDAY, MAY 25

6:30-8:00 Breakfast (included with hotel registration)

8:00-10:00 Concurrent sessions:
SYMPOSIUM Future of Urban Entomology
SUBMITTED PAPERS Bed Bugs

10:00-10:30 BREAK

10:30-11:30 **FINAL BUSINESS MEETING**

11:30-12:00 **EXECUTIVE COMMITTEE BUSINESS MEETING**

Registration and paper upload hours:
 Sun 2:30-5
 Mon & Tues 7:00-5:00
 Wed 7:00-10:00

*Please be courteous and upload your talk at least one session prior to when you are speaking.

NCUE/IFA 2016

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<p>SUNDAY, MAY 22</p> <p>6:00-8:00 Welcome reception (free hors d'oeuvres) La Ventana (Sponsored by ORKIN)</p> <p>MONDAY, MAY 23</p> <p>6:30-7:45 Breakfast (included for hotel guests) – Waterfall Cafe</p> <p>AWARDS PRESENTATIONS – Sandia V-VIII</p> <p>8:00-8:15 Opening Remarks</p> <p>8:15-9:15 Distinguished Achievement in Urban Entomology The Arnold Mallis Memorial Award Lecture Trailing with the ants JOHN KLOTZ UC RIVERSIDE</p> <p>9:15-9:30 Masters of Science Award Identification of botanically-derived repellents for Turkestan cockroaches using a video tracking system SUDIP GAIRE, Alvaro Romero, Mary O'Connell, Omar Holguin NEW MEXICO STATE UNIVERSITY</p> <p>9:30-9:45 Doctoral Award Orientation of bed bugs to thermal cues ZACHARY DEVRIES, Russell Mick, Coby Schal NORTH CAROLINA STATE UNIVERSITY</p> <p>9:45-10:15 BREAK</p> <p>10:15-11:30 STUDENT PAPER COMPETITION Sandia V-VIII <i>Moderator: Grzesiek Buczkowski, Purdue University</i></p> <p>10:15-10:27 Short-range responses of the kissing bug <i>Triatoma</i> <i>rubida</i> (Hemiptera: Reduviidae) to heat, moisture, and carbon dioxide ANDRES INDACOCHEA, Alvaro Romero NEW MEXICO STATE UNIVERSITY</p> <p>10:27-10:39 Colony Structure of <i>Reticulitermes</i> (Isoptera: Rhinotermitidae) in northwest Arkansas MARK A. JANOWIECKI, Amber D. Tripodi, Allen L. Szalanski, Edward L. Vargo TEXAS A&M UNIVERSITY, USDA-ARS, University of Arkansas</p> <p>10:39-11:51 Variation in chlorfenapyr and bifenthrin susceptibility of bed bug (<i>Cimex lectularius</i> L.) field populations AARON R. ASHBROOK, Mike E. Scharf, Gary W. Bennett, Ameya D. Gondhalekar PURDUE UNIVERSITY</p> <p>11:51-11:03 Toxicity of essential oils on the Turkestan cockroach, <i>Blatta lateralis</i> (Blattodea: Blattidae) SUDIP GAIRE, Alvaro Romero, Mary O'Connell, F. Omar Holguin NEW MEXICO STATE UNIVERSITY</p> <p>11:03-11:15 Sublethal effects of a combination product on bed bug (<i>Cimex lectularius</i> L.) behavior and implications for management SYDNEY E. CRAWLEY, K.A. Kowles, J.R. Gordon, M.F. Potter, K.F. Haynes UNIVERSITY OF KENTUCKY</p> <p>11:15-11:27 Effects of the tawny crazy ant (<i>Nylanderia fulva</i>) on the ant community at the Port of Savannah, Georgia BEN GOCHNOUR, Dan Suiter UNIVERSITY OF GEORGIA</p> <p>NCUE/IFA 2016 3</p>	<p>11:30-1:00 Lunch on your own</p> <p>1:00-2:15 SUBMITTED PAPERS ANTS I (Non-RIFA) Sandia V-VIII <i>Moderator: Laurel Hansen, Spokane Falls Community College</i></p> <p>1:00-1:15 Distribution, identification, impact, and management of the dark rover ant, <i>Brachymyrmex patagonicus</i> (Hymenoptera: Formicidae) ROBERT DAVIS, T. Chris Keefer, Janis Reed, Phillip Schults, Edward L. Vargo BASF PROFESSIONAL & SPECIALTY SOLUTIONS, Texas A&M University</p> <p>1:15-1:30 Survey of ants with emphasis on exotic ant species in the Pacific Northwest LARUEL D. HANSEN SPOKANE FALLS COMMUNITY COLLEGE</p> <p>1:30-1:45 You shall not pass!: How we protect New Zealand's borders from invasive ants PAUL CRADDOCK, Viv Van Dyk, Brett Rawnsley FBA CONSULTING</p> <p>1:45-2:00 Status of tawny crazy ants in Alabama FUDD GRAHAM, Jeremy Pickens AUBURN UNIVERSITY</p> <p>2:00-2:15 Updates on the venom chemical composition in the little black ant, <i>Monomorium minimum</i> (Hymenoptera: Formicidae) JIAN CHEN, Charles L. Cantrell, David Oi, Michael J. Grodowitz USDA-ARS</p> <p>2:15-2:45 BREAK (sponsored by Syngenta Crop Protection)</p> <p>2:45-4:45 Concurrent sessions SYMPOSIUM Pest Prevention: What We've Learned Over the Past Decade to Make Buildings Safer Sandia IV <i>Organizer/Moderator: Janet Hurley, Texas A&M Extension</i></p> <p>2:45-3:05 The Scientific Coalition of Pest Exclusion (SCOPE 2020) – what it is and how it can help you when you work with building administrators JODY GANGLOFF-KAUFMANN NEW YORK STATE IPM PROGRAM</p> <p>3:05-3:25 Excluding the diabolically clever Norway rat, <i>Rattus</i> <i>norvegicus</i>, from buildings; Lessons learned from the Big Apple BOBBY CORRIGAN RMC PEST MANAGEMENT CONSULTING</p> <p>3:25-3:45 What you need to know about pest prevention and LEED green building certifications CHRIS GEIGER SAN FRANCISCO DEPT OF THE ENVIRONMENT</p> <p>3:45-4:05 Pest exclusion using physical barriers: A sustainable future for new and existing structures CASSIE KREJCI, Roger Gold, T. Chris Keefer POLYGUARD, Texas A&M University, Syngenta Crop Protection</p> <p>4:05-4:25 Modeling for pest risk in and around school buildings, how the IPM Calculator can help you prevent and solve tough pest problems</p> <p>NCUE/IFA 2016 4</p>
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<p>JANET HURLEY, Blake K. Bennett, Michael E. Merchant TEXAS A&M AGRILIFE EXTENSION SERVICE 4:25-4:45 Pest exclusion: What are the top strategies that work the best for most buildings STEPHEN KELLS UNIVERSITY OF MINNESOTA</p> <p>SUBMITTED PAPERS ANTS II (RIFA) Sandia V</p> <p>2:45-3:00 Moderator: Paul Nester, Texas A&M Agrilife Extension So you think you know what ant species you are working with – a fire ant case study ROBERT K. VANDER MEER, Sanford D. Porter USDA-ARS CMAVE</p> <p>3:00-3:15 Updates to the Federal Imported Fire Ant Quarantine RICHARD JOHNSON, Ron D. Weeks, Anne-Marie Callcott USDA-APHIS-PPQ-PM, -FO, -S&T</p> <p>3:15-3:30 Potential IFA quarantine treatments for field-grown/balled-and-burlapped nursery stock ANNE-MARIE CALLCOTT, Jason Oliver, David Oi, Nadeer Youssef, Karla Adesso USDA-APHIS-PPQ-S&T, Tennessee State University, USDA-ARS-CMAVE</p> <p>3:30-3:45 Imported fire ants in the plant industry AWINASH BHATKAR TEXAS DEPARTMENT OF AGRICULTURE USDA-APHIS-PPQ-PM, -FP, -S&T</p> <p>3:45-4:00 Evaluation of various insecticide combinations as fire ant quarantine treatments on commercial grass sod KELLY M. LOFTIN, John D. Hopkins, Anne-Marie Callcott UNIVERSITY OF ARKANSAS, USDA-APHIS</p> <p>4:00-4:15 Incorporating other pest ants into Fire Ant eXtension KATHY L. FLANDERS, Paul R. Nester, Robert P. Puckett AUBURN UNIVERSITY, Texas A&M Agrilife Extension Service</p> <p>4:15-4:30 Red imported fire ant management efforts in Corpus Christi Independent School District – avoiding tragedy PAUL R. NESTER, Janet A. Hurley, Brett Bostian, Hector Hernandez, Walter “Buster” Terry TEXAS A&M AGRILIFE EXTENSION SERVICE, Corpus Christi Independent School District</p> <p>4:30-4:45 Effect of cattle feed-through horn fly control mineral containing (S)-methoprene on IFA in pastures HENRY DOROUGH, Fudd Graham, Landon Marks ALABAMA COOPERATIVE EXTENSION SYSTEM, Auburn University</p> <p>Dinner & evening on your own</p> <p>NCUE/IFA 2016 5</p>	<p>TUESDAY, MAY 24</p> <p>6:30-8:00 Breakfast (included for hotel guests) – Waterfall Cafe</p> <p>8:00-10:00 Concurrent sessions</p> <p>SYMPOSIUM Advances in Invasive Ant Management I Sandia V Organizers/Moderators: David Oi & Sanford Porter, USDA-ARS</p> <p>8:00-8:15 When imported fire ants are found outside the federally quarantined area ANNE-MARIE CALLCOTT, Richard Johnson, Ron Weeks USDA, APHIS PPQ-PM, -FO</p> <p>8:15-8:30 Development of a lateral flow immunoassay for rapid field detection of the red imported fire ant, <i>Solenopsis invicta</i> STEVEN VALLES USDA-ARS CMAVE</p> <p>8:30-8:45 Fire ant biological control: <i>Pseudacteon</i> decapitating flies and other natural enemies SANFORD PORTER USDA-ARS CMAVE</p> <p>8:45-9:00 Red imported fire ant eradication efforts in Taiwan RONG-NAN HUANG, Nancy Hui-Ying Lee, Chin-Cheng Yang, Cheng-Jen Shih, Wen-Jer Wu NATIONAL TAIWAN UNIVERSITY, Chung-His Chemical Plant</p> <p>9:00-9:15 Australia's battle with fire ants – we can't afford to lose SARAH CORCORAN BIOSECURITY QUEENSLAND CONTROL CENTRE</p> <p>9:15-9:30 Bait development for tawny crazy ants DAVID OI USDA-ARS CMAVE</p> <p>9:30-9:45 Tawny crazy ant (<i>Nylanderia fulva</i> Mayr) IPM in urban environments ROBERT PUCKETT TEXAS A&M UNIVERSITY</p> <p>9:45-10:00 Strategies to manage the European fire ant ELLIE GRODEN UNIVERSITY OF MAINE</p> <p>SYMPOSIUM IPM Outreach in Urban Settings Sandia I-III Organizers/Moderators: Brittany Hanson & Kaci Buhl, Oregon State University National Pesticide Information Center</p> <p>8:00-8:20 Cockroaches, bed bugs, and mice, oh, my! Lessons from urban IPM DION LERMAN PENN STATE UNIVERSITY</p> <p>8:20-8:40 Hire us, then help us: Challenges and successes for IPM services offered by pest control companies ALLISON TAISEY NATIONAL PEST MANAGEMENT ASSOCIATION</p> <p>8:40-9:00 A toolbox of outreach methods from the National Pesticide Information Center: Wins & losses KACI BUHL OREGON STATE UNIVERSITY</p> <p>NCUE/IFA 2016 6</p>
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9:00-9:20	Promoting conservation of beneficials: Strengths & gaps in resources BRITTANY HANSON OREGON STATE UNIVERSITY
9:20-9:40	Efforts in endemic and invasive pest outreach for urban & community audiences in California KAREY WINDBIEL-ROJAS UC Statewide IPM Program
9:40-10:00	Creating a searchable toolbox for school IPM – introducing iSchoolPestManager and Stop School Pests JANET HURLEY TEXAS A&M AGRILIFE EXTENSION SERVICE
SYMPOSIUM Indoor Biomes Sandia IV <i>Organizers/Moderators: Vernard Lewis & Brian Forschler, UC Berkeley, University of Georgia</i>	
8:00-8:10	Introduction
8:10-8:30	Fungus among us: The diversity of microbes in homes RACHEL ADAMS UNIVERSITY OF CALIFORNIA, BERKELEY
8:30-8:50	Arthropods of our homes MISHA LEONG, Matt Bertone, Keith Bayless, Robert Dunn, Michelle Trautwein CALIFORNIA ACADEMY OF SCIENCES, North Carolina State University
8:50-9:10	Gut bacteria mediate aggregation in the German cockroach COBY SCHAL, Madhavi Kakumanu, Ayako Wada-Katsumata NORTH CAROLINA STATE UNIVERSITY
9:10-9:30	Systematically altering pest habitat in the built environment: Application of the Pest Prevention by Design guidelines to low-income housing rehabilitation CHRIS GEIGER SAN FRANCISCO DEPARTMENT OF THE ENVIRONMENT
9:30-9:50	The California experience: Limiting water quality impacts linked to management of pests of the indoor biome DAVE TAMAYO CALIFORNIA STRUCTURAL PEST CONTROL BOARD
10:00-10:15	BREAK
10:15-12:15	Concurrent sessions
SYMPOSIUM Advances in Invasive Ant Management II Sandia V <i>Organizers/Moderators: David Oi & Sanford Porter, USDA-ARS</i>	
10:15-10:30	Lessons learned from past and current research on odorous house ant management KAREN VAIL UNIVERSITY OF TENNESSEE
10:30-10:45	Pheromone-assisted techniques to improve Argentine ant management in urban settings DONG-HWAN CHOE UNIVERSITY OF CALIFORNIA, RIVERSIDE
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10:45-11:00	Comparative genetic and ecological studies of the Asian needle ant, <i>Brachyponera chinensis</i> , in native and introduced ranges EDWARD L. VARGO TEXAS A&M UNIVERSITY
11:00-11:15	The Trojan-horse approach for managing invasive ants: A study with Asian needle ants GRZESIEK BUCZKOWSKI PURDUE UNIVERSITY
11:15-11:30	A new challenge – control of arboreal little fire ants in Hawaii CASPER VANDERWOUDE HAWAII ANT LAB
11:30-11:45	Electric ants in Australia – is this the end? SARAH CORCORAN BIOSECURITY QUEENSLAND CONTROL CENTRE
SYMPOSIUM Gaps & Challenges: R&D, Academia, and Field Application of Control Strategies Sandia I-III <i>Organizers/Moderators: Zia Siddiqi, Pat Copps, Ron Harrison, Rollins, Inc.</i>	
10:15-10:35	Challenges in the field: The practical implications of implementing new protocols PAT COPPS ORKIN PEST CONTROL
10:35-10:55	The conundrum of meaningful action thresholds (ATs) in urban entomology BRIAN T. FORSCHLER UNIVERSITY OF GEORGIA
10:55-11:15	The Pest Management Foundation grant proposal review process and determining the 'applicability' of proposed research JIM FREDERICKS NATIONAL PEST MANAGEMENT ASSOCIATION/ PEST MANAGEMENT FOUNDATION
11:15-11:35	Reduced-risk pest management challenges: Handcuffed by hazard tiers? TIMOTHY J. HUSEN ROLLINS, INC.
11:35-11:55	Bed bugs demonstration project – From the lab to the bedroom: Translating research-based bed bug management strategies to low-income apartment buildings ANDREW SUTHERLAND UNIVERSITY OF CALIFORNIA COOPERATIVE EXTENSION/UC IPM
11:55-12:15	Customer expectations: From designing an IPM program to resolving pest issues with the available tools and technology ZIA SIDDIQI ROLLINS, INC.
12:15-1:45	AWARDS LUNCHEON (Meal sponsored by BAYER ENVIRONMENTAL SCIENCES) Embassy Suites Atrium
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1:45-3:30	Concurrent sessions SYMPOSIUM Urban Rodent Control Sandia I-III <i>Organizer/Moderator: Bobby Corrigan, RMP Pest Management Consulting</i>	ROBERTA DIECKMANN, Gabriela Perezchica-Harvey, Jennifer Henke COACHELLA VALLEY MOSQUITO AND VECTOR CONTROL DISTRICT
1:45-2:05	The state of the union on rats and American cities BOBBY CORRIGAN RMC PEST MANAGEMENT CONSULTING	SUBMITTED PAPERS ADDITIONAL TOPICS Sandia IV <i>Moderator: Barry Furman, BASF Professional & Specialty Solutions</i>
2:05-2:25	An integrated approach to commensal rodent management in New Orleans, LA CLAUDIA RIEGEL CITY OF NEW ORLEANS MOSQUITO & TERMITE CONTROL BOARD	1:45-2:00 Clemson Extension Commercial Pesticide Applicator Licensing Prep Course VICKY BERTAGNOLLI, Tim Davis CLEMSON UNIVERSITY COOPERATIVE EXTENSION
2:25-2:40	Managing pocket gophers under the Healthy Schools Act of California ASHLEY FREEMAN CALIFORNIA EPA DEPT OF PESTICIDE REGULATIONS	2:00-2:15 The confusing case of chlorfenapyr: The challenges of testing Phantom® JASON MEYERS, James Austin, Bob Davis, Barry Furman, Bob Hickman, Kyle Jordan, Freder Medina BASF PROFESSIONAL & SPECIALTY SOLUTIONS
2:40-2:55	Harboring secrets: Ectoparasites of Norway rats in New York City MATT FRYE NEW YORK STATE IPM PROGRAM	2:15-2:30 Cross resistance between hydramethylnon and indoxacarb in German cockroaches (<i>Blattella germanica</i>) ALEX KO, Coby Schal, Jules Silverman NORTH CAROLINA STATE UNIVERSITY
2:55-3:10	Field evaluation of two second-generation anticoagulant rodenticides (SGARs) against the house mouse (<i>Mus musculus domesticus</i>) in a confined swine facility ELRAY M. ROPER, Grzesiek Buczkowski, Steve Sanborn SYNGENTA, Purdue University	2:30-2:45 Mosquitoes of New York City WAHEED BAJWA, Nareeza Sakur, Zahir Shah, Liyang Zhou, Maddie Perlman-Gabel NEW YORK CITY DEPARTMENT OF HEALTH AND MENTAL HYGIENE
3:10-3:25	Field efficacy of a new global rodenticide bait formulation KYLE K. JORDAN, Sharon Hughes, Euan Bates, Thorsten Storck BASF PROFESSIONAL & SPECIALTY SOLUTIONS	2:45-3:30 Zika Virus Panel Discussion – Sandia IV James Austin, Brian Forschler, Claudia Riegel, Roxanne Connelly BASF P&SS, University of Georgia, New Orleans Mosquito & Termite Control Board, University of Florida
	SUBMITTED PAPERS ANTS III (RIFA) Sandia V <i>Moderator: Kathy Flanders, Alabama Extension</i>	3:30-3:45 BREAK
1:45-2:00	Control of red imported fire ants in Alabama LUCY EDWARDS, James D. Jones, Fudd Graham, Reafield Vester ALABAMA COOPERATIVE EXTENSION SYSTEM, Auburn University	4:00-5:45 FIRE ANT eXtension MEETING – Sandia V
2:00-2:15	The impact of red imported fire ants (<i>Solenopsis invicta</i> Buren) on upland arthropods in eastern India C.R. SATPATHI BIDHAN CHANDRA KRISHI VISWAVIDYALAYA	3:45-5:45 Concurrent sessions SYMPOSIUM Barrier Applications for Mosquito Management in Residential Settings Sandia I-III <i>Organizers/Moderators: Nicky Gallagher & Clay Scherer, Syngenta Crop Protection</i>
2:15-2:30	Red imported fire ant survey yields eight new Texas county records DANNY MCDONALD, Jerry Cook SAM HOUSTON STATE UNIVERSITY	3:45-3:55 Introduction 3:55-4:10 Backyard versus community-wide mosquito service RON HARRISON ROLLINS/ORKIN TECHNICAL SERVICES
2:30-2:45	Update on the Alabama Herd Seeder Program KATHY FLANDERS, Henry Dorough, Fudd Graham ALABAMA COOPERATIVE EXTENSION SYSTEM, Auburn University	4:10-4:25 New developments in backyard mosquito control and their relation to mosquito-borne disease GRAYSON C. BROWN, A. Glenn Skiles, Kyndall C. Dye UNIVERSITY OF KENTUCKY
2:45-3:00	An overview of residential neighborhood treatments of red imported fire ants in Orange County, CA CYNTHIA ROSS ORANGE COUNTY MOSQUITO AND VECTOR CONTROL DISTRICT	4:25-4:40 Comparing public vector management and private mosquito control service: Is this a competition? JOE BARILE BAYER ENVIRONMENTAL SCIENCE
3:00-3:15	Watching ants: How insect behavior impacts protocols	
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4:40-4:55 Evaluation of barrier applications of Demand® CS and Archer® IGR for control of container mosquitoes in Indian River County, FL
C. ROXANNE CONNELLY, Carol Thomas, Wayne Thomas, Tim Hope, Gregg Ross
UNIVERSITY OF FLORIDA

4:55-5:10 Residual effectiveness of Demand® CS on *Aedes albopictus* in Virginia
NICOLA T. GALLAGHER, Benjamin McMillan, Jake Bova, Carlyle Brewster, Sally L. Paulson
SYNGENTA CROP PROTECTION, Virginia Tech

5:10-5:25 Mosquito work doesn't bite!
RICK BELL
ARROW EXTERMINATORS

5:25-5:40 The use of backyard treatments by mosquito control districts for routine and targeted mosquito control
CLAUDIA RIEGEL, E.R. Cloherty, B.H. Carter, S.R. Michaels, C.W. Scherer
CITY OF NEW ORLEANS MOSQUITO & TERMITE CONTROL BOARD, Syngenta Crop Protection

5:40-5:45 Closing remarks & questions

SUBMITTED PAPERS TERMITES

Sandia IV

Moderator: Susan Jones, The Ohio State University

Opening remarks

3:45-3:50 Field trials with *Coptotermes formosanus* Shiraki in New Orleans: Performance of Recruit® AG FlexPack and determination of colony foraging distance
JOE DEMARK, Barry Yokum, Neil Spomer
DOW AGROSCIENCES, City of New Orleans Mosquito & Termite Control Board

4:05-4:20 Evaluation of proprietary and generic termiticides in laboratory studies with *Reticulitermes flavipes* and *Coptotermes formosanus* subterranean termites
ROGER E. GOLD, Philip Shults, Ron Harrison
TEXAS A&M UNIVERSITY, Rollins/Orkin Technical Services

4:20-4:35 Controlling termite infestations in wall voids
X.P. HU, Meng Chen, Jordon Yuan
AUBURN UNIVERSITY

4:35-4:50 A multi-state study to assess the efficacy of Altriset® termiticide in controlling *Reticulitermes flavipes* in infested structures
SUSAN C. JONES, Edward L. Vargo, Paul Labadie, T. Chris Keefer, Roger E. Gold, Clay W. Scherer, Nicola T. Gallagher
THE OHIO STATE UNIVERSITY, Texas A&M University, North Carolina State University, Syngenta Crop Protection

4:50-5:05 High Precision Termite Control
FREDER MEDINA, Kenneth S. Brown, Jeff D. Vannoy, Bob Davis, Bob Hickman, Kyle Jordan, Jason Meyers, Matt Spears, Judy Fersch, Amy Dugger-Ronyak, Anil Menon, Richard Warriner, Jim Cink, John Paddock, Joe Schuh
BASF PROFESSIONAL & SPECIALTY SOLUTIONS, DryJect Inc.

6:00 Shuttles begin departing for Albuquerque Museum

6:15-8:00 **Evening at the Albuquerque Museum** (Sponsored by **BASF Professional & Specialty Solutions**)

WEDNESDAY, MAY 25

6:30-8:00 **Breakfast** (included for hotel guests) – Waterfall Cafe

8:00-10:00 **Concurrent sessions**
SYMPOSIUM
The Future of Urban Entomology
Sandia IV
Organizer/Moderator: Shripat Kamble, University of Nebraska

8:00-8:10 Introduction
SHRIPAT KAMBLE
UNIVERSITY OF NEBRASKA

8:10-8:30 Past, present, and future of urban entomology
ROGER E. GOLD
TEXAS A&M UNIVERSITY

8:30-8:50 Impact of department mergers and university downsizing on urban entomology
PATRICIA ZUNGOLI, Eric Benson
CLEMSON UNIVERSITY

8:50-9:10 Funding resources – urban entomology
COBY SCHAL
NORTH CAROLINA STATE UNIVERSITY

9:10-9:30 Molecular research in urban entomology
EDWARD L. VARGO
TEXAS A&M UNIVERSITY

9:30-9:50 Industry perspectives on the future of urban entomology
JOSEPH SCHUH, Robert Davis
BASF PROFESSIONAL & SPECIALTY SOLUTIONS

9:50-10:00 Closing remarks and questions

SUBMITTED PAPERS BED BUGS

Sandia V

Moderator: Jason Meyers, BASF Professional & Specialty Solutions

8:00-8:15 Field evaluations of bed bug interceptor traps in homeless shelters
MICHAEL MERCHANT, Jonathan Garcia, Elizabeth Brown, Molly Keck, Paul Nester
TEXAS A&M AGRILIFE EXTENSION SERVICE

8:15-8:30 Evaluating the efficacy of hand-held and backpack vacuums as bed bug management tools
DINI M. MILLER, Molly L. Stedfast, Katlyn L. Amos
VIRGINIA TECH

8:30-8:45 Insecticide resistance bioassays for bed bugs: A review of methodologies
ALVARO ROMERO
NEW MEXICO STATE UNIVERSITY

8:45-9:00 Laboratory assays to determine the efficacy of several commercially available insecticide products for bed bug control
KATLYN L. AMOS, Dini M. Miller, Molly L. Stedfast
VIRGINIA TECH

9:00-9:15 Evaluating encasements: Are all created equal?
MOLLY L. STEDFAST, Katlyn L. Amos, Dini M. Miller
VIRGINIA TECH

10:00-10:30 **BREAK/CHECK OUT**

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10:30-11:30 **FINAL BUSINESS MEETING** - Sandia V
 11:30-12:00 **EXECUTIVE COMMITTEE BUSINESS MEETING**

NOTES/AUTOGRAPHS/STICKER COLLECTION:

**Past Recipients of the
Distinguished Achievement Award in Urban Entomology**

1986	Walter Ebeling, James Grayson
1988	John V. Osmun, Eugene Wood
1990	Francis W. Leichleitner
1992	Charles G. Wright
1994	Roger D. Akre, Harry B. Moore, Mary H. Ross
1996	Donald G. Cochran
1998	Gary H. Bennett
2000	Michael K. Rust
2004	Roger E. Gold
2006	Coby Schal
2008	Nan-Yao Su
2010	Don Reiersen
2012	Shripat Kamble
2014	Jules Silverman

Past Conference Chairs

1986	Patricia A. Zungoli
1988	William H. Robinson
1990	Michael K. Rust
1992	Gary W. Bennett
1994	Roger E. Gold, Judy K. Bertholf
1996	Donald A. Reiersen
1998	Brian T. Forschler, Shripat Kamble
2000	Shripat Kamble
2004	Daniel R. Suiter
2006	Dini Miller, Robert Kopanic
2008	Richard Houseman, Bob Cartwright
2010	Karen Vail
2012	Faith Oi
2014	Faith Oi, Grzesiek Buczkowski

2016 NCUE Planning Committee

Conference & Program Chair: KYLE K. JORDAN, BASF
Professional & Specialty Solutions

Awards Co-chair: FAITH OI, University of Florida

Awards Co-chair: GRZESIEK BUCZKOWSKI, Purdue University

Treasurer: EDWARD L. VARGO, Texas A&M University

Assistant Treasurer: LAURA NELSON, Texas A&M University

Secretary: ALLIE TAISEY, National Pest Management Association

Local Arrangements: ALAVARO ROMERO, New Mexico State University

Local Arrangements: ROBERT DAVIS, BASF

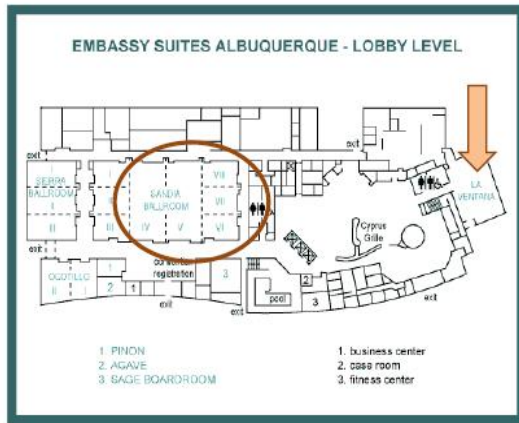
Sponsorship Chair: DANIEL R. SUITER, University of Georgia

Sponsorship Committee: DINI MILLER, Virginia Tech

SHRIPAT KAMBLE, University of Nebraska

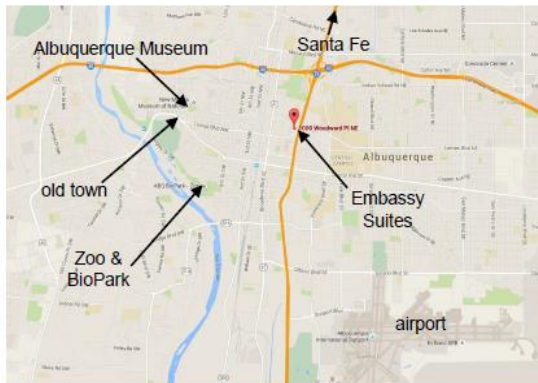
GARY BENNETT, Purdue University

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Albuquerque area map



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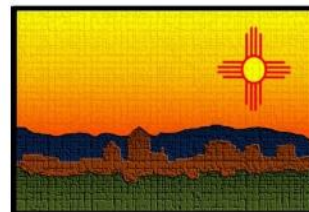
NCUE operates on a minimal budget but has been able to avoid raising registration rates for almost a decade now – a feat which would simply not be possible without the support of our sponsors. Please be sure to thank their representatives when you see them at the conference!

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2016 NATIONAL CONFERENCE ON URBAN ENTOMOLOGY

PLANNING COMMITTEE

NCUE Planning Committee
Conference & Program Chair

Kyle Jordan, BASF Professional &
Specialty Solutions

Awards Co-Chairs

Faith Oi, University of Florida
Grzesiek Buczkowski, Purdue University

Treasurer
Assistant Treasurer

Edward L. Vargo, Texas A&M University
Laura Nelson, Texas A&M University

Secretary

Allie Taisey, National Pest Management
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Local Arrangements

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Robert Davis, BASF

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Sponsorship Members

Daniel R. Suiter, University of Georgia
Dini Miller, Virginia Tech
Shripat Kamble, University of Nebraska
Gary Bennett, Purdue University

Proceedings Co-Chairs

Waheed I. Bajwa, NYC Health
Department
Kyle Jordan, BASF Professional &
Specialty Solutions

2018 NATIONAL CONFERENCE ON URBAN ENTOMOLOGY

PLANNING COMMITTEE

Conference Chair	Kyle Jordan, BASF Professional & Specialty Solutions
Program Chair	Allie Allen, National Pest Management Association
Awards Chair	Dini Miller, Virginia Tech
Treasurer	Ed Vargo, Texas A&M University Laura Nelson, Texas A&M University
Secretary	Molly Keck, Texas AgriLife Extension
Local Arrangements Co-Chairs	Barry Furman, BASF Coby Schal, North Carolina State University
Sponsorship Chair	Dan Suiter, University of Georgia
Proceedings Co-Chairs	Waheed I. Bajwa, New York City Health Department Kyle Jordan, BASF Professional & Specialty Solutions

NATIONAL CONFERENCE ON URBAN ENTOMOLOGY BYLAWS

BYLAWS

NATIONAL CONFERENCE ON URBAN

ENTOMOLOGY ARTICLE I-NAME

The name of this organization is the National Conference on Urban Entomology.

ARTICLE II-BACKGROUND

In the spring of 1985, individuals representing urban entomology and the pest control industry came together to organize a national conference to be held biennial. The mission of these conferences was to open channels of communication and information between scientists in industry, academia, and government, and to foster interest and research in the general area of urban and structural entomology.

The primary scope of the National Conference is to emphasize innovations and research on household and structural insect pests. It is the intent; however, to provide flexibility to include peripheral topics that pertain to the general discipline of urban entomology. It is anticipated that the scope of the conference could change through time, but the emphasis would be to provide an opportunity for urban entomologist to meet on a regular basis. It is not anticipated that any specific memberships would be required or expected, but that the cost associated with the conference would be met through registration fees and contributions. In the event that funds become available through donations or from the sale of conference proceedings, that these resources will be spent to meet expenses, to pay the expenses for invited speakers, and to provide scholarships to qualified students working in urban entomology. It is the intent of this organization to be non-profit, with financial resources provided to the Conference to be used entirely in support of quality programming and the support of scholarships.

ARTICLE III-OBJECTIVES

The objectives of this organization are:

1. To promote the interest of urban and structural entomology.
2. To provide a forum for the presentation of research, teaching and extension programs related to urban and structural entomology.
3. To prepare a written/electronic proceedings of all invited and accepted papers given or prepared at the biennial meeting.
4. To promote scholarship and the exchange of ideas among urban entomologists.

5. As funds are available, scholarships will be awarded to students pursuing scholastic degrees in urban entomology. Three levels of scholarships will be offered: the first level is for Bachelor students; the second level is for Masters students; and the third level is for Ph.D. candidates. These students must register for, and attend, the conference and present the paper in order to receive funding. These scholarships will be awarded based solely on the merits of the candidates, and the progress that they have made towards completion of their research and scholastic degrees. The student will receive funding only if they are currently enrolled in a university at the time that the conference is held.
6. There may also be first, second, and third place recipients of an onsite student competition for students who are currently involved in their undergraduate or graduate programs. These students can compete for scholarship funds; however, if any student has already been awarded a scholarship for the current meeting, and wishes to participate in this onsite competition, their presentation must be completely separate, and they must be properly registered in advance for this competition.

ARTICLE IV-JURISDICTION

The jurisdiction of this conference is limited to events held within the United States of America; however, we will be supportive of international urban entomology conferences as they are organized and held.

ARTICLE V-MEMBERSHIP

There are no membership requirements associated with this organization except for the payment of registration fees which go to offset the cost of holding the conference, preparation/printing of proceedings and the offering of scholarships. All persons with an interest in urban entomology are invited to attend the conferences and associated events.

ARTICLE VI-OFFICERS

Leadership for the Conference will be provided by the Chair of the Conference Committee. The Executive committee will be composed primarily of representatives from academia, industry and government. There will be seven officers of the Executive Committee and will include the following:

- Chair of the Conference Committee
- Chair of the Program Committee
- Chair of the Awards Committee
- Secretary to the Conference
- Treasurer to the Conference
- Chair of the Sponsorship Committee
- Chair of the Local Arrangements Committee

The Chair of the Conference Committee will preside at all Committee meetings, and will be the Executive Officer for the organization, and will preside at meetings. In the absence of the Chair

of the Conference Committee, the Chair of the Program Committee may preside. The voting members for executive decisions for the conference will be by a majority vote of a quorum which is here defined as at least five officers.

The duties of the officers are as follows:

Chair of the Conference Committee: To provide overall leadership for the Conference, to establish adhoc committees as needed, and to solicit nominations for new officers as needed.

Chair of the Program Committee: To coordinate the conference in terms of arranging for invited speakers and scientific presentations as well as oversee the printing of announcements, programs and proceedings.

Chair For Awards: To oversee and administer the Mallis Award, scholarships and other honors or awards as approved by the executive committee.

Secretary: To take notes and provide minutes of meetings.

Treasurer: Provide documentation of expenditures, and the collection and disbursement of funds. To act on behalf of the executive committee in making arrangements with hotels, convention centers and other facilities in which conferences are held.

Chair For Sponsorship: This committee will be involved in fund raising and in seeking sponsorship for various aspects of the conference. It will also contact contributors and potential contributors to seek donations and support for the conference and associated events. It is anticipated that the committee will be composed of at least one member representing academia, and one member representing industry.

Chair For Local Arrangements: To gather information on behalf of the executive committee for hotels, convention centers and other facilities in which the conference is to be held. To arrange for audio/visual equipment, and to oversee the general physical arrangements for the conference.

ARTICLE VII-TERMS OF OFFICE & SUCCESSION OF OFFICERS:

Officers may serve for a maximum of four conference terms (8 years); however, if no new nominations are received, the officers may continue until such time as replacements are identified and installed.

The Awards Chair is the last position to be served, and may be relieved from NCUE officer duties unless asked or willing to serve NCUE in another capacity.

The Conference Chair may serve for one conference after which time they will become the Chair of the Awards Committee.

The Program Chair may serve for one conference term after which time they will become the Conference Chair.

The Secretary may serve for one conference term, after which time they will become the Program Chair.

The Chair for Local Arrangements should change with each conference unless the meetings are held in the same location.

The Chair the Sponsorship Committee (to include both an academic and industry representative) will serve for two conferences.

The Treasurer will serve for two conference cycles, unless reappointed by the Executive Committee.

ARTICLE VIII-NOMINATION OF OFFICERS

Nominations for any of the chair positions may come from any individual, committee, or subcommittee, but must be forwarded to the Chair of the Conference before the final business meeting of each conference. It is further anticipated that individuals may be asked to have their names put into nomination by the Chair of the Conference. In the event that there are no nominations, the existing Chair may remain in office with a majority vote of the Executive Committee for the conference. It is clearly the intent of these provisions that as many new people be included as officers of this organization as is possible, and no one shall be excluded from consideration.

ARTICLE IX-MEETINGS

Conferences of the National Conference on Urban Entomology will be held every two years. Meetings of the officers of this organization will meet at least annually either in direct meetings or by conference calls in order to plan the upcoming conference, and to conduct the business of the organization.

ARTICLE X-FINANCIAL RESPONSIBILITIES

All financial resources of the Conference will be held in a bank under an account named, "National Conference on Urban Entomology", and may be subjected to annual audits. Expenditures may be made in support of the conference, for scholarships and other reasonable costs; however, funds may **not** be used to pay officers', or their staff's salaries, or for officers' travel expenses. In the event that this organization is disbanded, all remaining funds are to be donated to the Endowment Fund of the Entomological Society of America.

ARTICLE XI-FISCAL YEAR

The fiscal year will run from January 1 through December 31 of each year.

ARTICLE XII-AMENDMENTS

The bylaws for this organization may be amended by a two-thirds affirmative vote of the attendees at the business meeting, provided that the proposed amendments are available for review at least 48 hours in advance of the voting.

ARTICLE XIII-INDEMNIFICATION

The National Conference on Urban Entomology shall indemnify any person who is or was a party, or is or was threatened to be made a party to any threatened, pending or completed action, suit or proceeding, whether civil, criminal, administrative or investigative by reason of the fact that such person is or was an officer of the Committee, or a member of any subcommittee or task force, against expenses, judgments, awards, fines, penalties, and amount paid in settlement actually and reasonably incurred by such persons in connection with such action, suit or proceeding: (I) except with respect to matters as to which it is adjudged in any such suit, action or proceeding that such person is liable to the organization by reason of the fact that such person has been found guilty of the commission of a crime or of gross negligence in the performance of their duties, it being understood that termination of any action, suit or proceeding by judgment, order, settlement, conviction or upon a plea of nolo contendere or its equivalent (whether or not after trial) shall not, of itself, create a presumption or be deemed an adjudication that such person is liable to the organization by reason of the commission of a crime or gross negligence in the performance of their duties; and (II) provided that such person shall have given the organization prompt notice of the threatening or commencement (as appropriate) of any such action, suit or proceeding. Upon notice from any such indemnified person that there is threatened or has been commenced any such action, suit or proceeding, the organization: (a) shall defend such indemnified person through counsel selected by and paid for by the organization and reasonably

acceptable to such indemnified person which counsel shall assume control of the defense; and (b) shall reimburse such indemnity in advance of the final disposition of any such action, suit or proceeding, provided that the indemnified person shall agree to repay the organization all

amounts so reimbursed, if a court of competent jurisdiction finally determines that such indemnified persons liable to the organization by reason of the fact that such indemnified person has been found guilty of the commission of a crime or of gross negligence in the performance of their duties. The foregoing provision shall be in addition to any and all rights which the persons specified above may otherwise have at any time to indemnification from and/or reimbursement by the organization.

Modified: 5/19/10-passed

**LETTER CERTIFYING COMPLIANCE WITH IRS FILING
REQUIREMENTS**



THOMPSON, DERRIG & CRAIG, P.C.
Certified Public Accountants

April 18, 2016

National Conference of Urban Entomology
Board of Directors
c/o Texas A&M University
Center for Urban and Structural Entomology
2143 TAMU
College Station, TX 77843-2143

Dear Board of Directors,

The organization's average annual gross receipts for the three-year period of 2013, 2014, and 2015 is \$23,545. Therefore a Form 990 is not required. A Form 990-N (the e-Postcard) has been electronically filed with the IRS for the 2015 tax year to notify the IRS that the organization's average annual gross receipts are under the \$50,000 threshold.

Sincerely,

Dillard Leverkuhn, CPA

Woody Thompson, CPA/CFP | Ronnie Craig, CPA | Dillard Leverkuhn, CPA | Lyn Kuciemba, CPA | James Larkin, CPA
Peggy Adcock, CPA | Sandy Beavers, CPA | Ailene Briers, CPA | Priscilla Butler, CPA | Nicole Carlton, CPA | Gay Vick Craig, CPA
Kay Dobbins, CPA | Harrison Fox, CPA | Alice Monroe, CPA | A.J. Taylor, CPA | Lindsey Thomson, CPA | Marian Rose Varisco, CPA

1598 COPPERFIELD PARKWAY, COLLEGE STATION, TX 77845 979.260.9696 F: 979.260.9683 firm@tdccpa.com/www.tdccpa.com

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Form 990-N	Electronic Notice (e-Postcard) for Tax-Exempt Organization Not Required to File Form 990 or 990-EZ		2015
Electronic Filing Only— Do Not Mail			
For the 2015 calendar year, or tax year beginning 1/01, 2015, ending 12/31, 2015			
Check if applicable <input type="checkbox"/> Termination	Organization name and address NATIONAL CONFERENCE OF URBAN ENTOMOLOGY 2143 TAMU, TEXAS A&M UNIVERSITY COLLEGE STATION, TX 77843-2143		Employer identification number 57-0802364 Telephone Number (979) 845-5855
Other names the organization uses _____			
Website:> _____			
Check > <input checked="" type="checkbox"/> if the organization's gross receipts are normally not more than \$50,000 (\$5,000 for a 509(a)(3) supporting organization)			
Principal Officer Information	Name	LAURA NELSON	
	Address	2143 TAMU COLLEGE STATION, TX 77843-2143	

Form 990-N, also known as the e-Postcard, must be filed electronically with the Internal Revenue Service. There will be no paper form accepted by the Internal Revenue Service.

Do Not mail this form to the Internal Revenue Service.

04/18/2016	2015 e-file Activity Report	Page 1
12:42 PM	Thompson, Derrig & Craig, PC	

Client 60350 - National Conference of Urban E EIN: 57-0802364
 US: Even Return.....\$0

Activity

US - ACCEPTED 04/18 (Current Status)
 Submission ID: 74105320161093568353

Previous Activity

- 04/18 Sent to the IRS
- 04/18 Received at Lacerte
- 04/18 Sent to Lacerte
- 04/18 Ready To Send
- 04/18 Passed Validation

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