Conference Proceedings

New Orleans, LA
April 6-8, 2015

Hosted by

Louisiana State University Agricultural Center
Baton Rouge, LA

Proceedings of the
2015 Imported Fire Ant and Invasive Pest Ant Conference

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Louisiana State University Agricultural Center, Baton Rouge, LA

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Proceedings Disclaimers

These proceedings were compiled from author submissions of their presentations at the 2015 Imported Fire Ant and Invasive Pest Ant Conference, held on April 6-8 2015 at the historic Maison Dupuy Hotel, New Orleans, LA. The 2015 annual conference was organized by the Louisiana State University Agricultural Center. The opinions, conclusions, and recommendations are those of the participants and are advisory only. Mention of trade names or commercial products in this publication is solely for the purpose of providing specific information and does not imply recommendation or endorsement by the LSU AgCenter. The papers and abstracts published herein have been included as submitted and have not been peer reviewed. They have been collated and duplicated solely for the purpose to promote information exchange and may contain preliminary data not fully analyzed. For this reason, the authors should be consulted before referencing any of the information printed herein. This proceedings issue does not constitute a formal peer review publication. However, ideas expressed in these proceedings are the sole property of the author(s) and set precedence in that the author(s) must be given due credit for their ideas. A copy of the 2015 Imported Fire Ant and Invasive Pest Ant Conference Proceedings is available on the eXtension website in .pdf format. To access the 1984-2015 Proceedings, use the following link: http://www.extension.org/pages/19000/proceedings-of-the-imported-fire-antconference#.UkB7txbD_EZ.

Table of Contents

Remarks from the Conference Chair

I wish to thank all the participants for attending the 2015 Imported Fire Ant and Invasive Pest Ant Conference held at the historic Maison Dupuy Hotel in New Orleans, LA. I trust that everyone had a great time and that the conference provided valuable information. Of course, how could you not enjoy the attractions of the historic French Quarter? The final meeting attendance was 66.

The conference opened with a Monday evening reception. The conference began Tuesday morning with a welcome from the Louisiana Commissioner of Agriculture and Forestry, Dr. Mike Strain. Dr. Strain's welcome was followed by a virtual tour of the Audubon Insectarium by Mr. Zach Lehmann, Animal and Visitor Programs Manager for the Insectarium. Attendees were offered a special tour that took place Wednesday afternoon. Attendees also were treated to a traditional Cajun crawfish boil Wednesday evening.

Following the opening Welcome Session, Anne-Marie Callcott (USDA-APHIS), and Awinash Bhatkar (Texas Department of Agriculture) presented current federal and state regulatory activities and policies. This session was followed by 26 oral papers and posters on topics pertaining to invasive ants, ecology, genetics, behavior and physiology, management, biological control, fire ant identification, morphology, and extension. The conference included an eXtension Imported Fire Ant Community of Practice workshop held Tuesday afternoon.

The 2015 conference was made possible by the dedication and hard work of our conference committee: Ms. Karen Cooper, Ms. Kathleen Kramer, Ms. Elizabeth Neely, Ms. Penny Ringe and Dr. Dennis Ring. I am especially appreciative to Kathleen, who created this year's logo, and to Elizabeth and Penny, who assisted with registration, program printing, name tags, gift bags, and t-shirts. Ms. Barbara Giroir from the New Orleans Convention and Visitors Bureau assisted with on-site registration.

Please watch for information on the 2016 Imported Fire Ant and Invasive Pest Ant Conference to be held in conjunction with the National Conference on Urban Entomology in Albuquerque, NM.

Timothy D. Schowalter, Chair, 2015 Imported Fire Ant and Invasive Pest Ant Conference

Acknowledgments

The organizers of the 2015 Imported Fire Ant and Invasive Pest Ant Conference and participants would like to express their appreciation and gratitude to the sponsors for their generous support. Sponsor support was vital in making the conference a success and financially feasible. We are very grateful for their continued generosity. Sponsor ads can be found on page 63 of the proceedings.

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We would also like to thank Ms. Cindy Kass of the Maison Dupuy and her staff for the excellent accommodations and service in meeting the needs of the conference participants and organizers. We also thank Dr. Claudia Riegel, Director of the New Orleans Mosquito and Termite Control Board, for assistance with hotel selection, negotiations with hotel and meeting vendors, and for her invaluable advice on meeting planning. Thanks also to former conference organizers and members, Kathy Flanders Roberta Dieckmann, Pete Schultz and Paul Nester for their helpful advice.

Index to Submitted Presentation Abstracts / Manuscripts

NOTE: NS denotes Not Submitted. Speaker name in bold.

38 Toxicity profiles and colony effects of liquid baits on tawny crazy ants. **David H. Oi**, USDA-ARS-CMAVE, Gainesville, FL

39 Strategies for tawny crazy ant (*Nylanderia fulva*) management in urban settings. **Robert T. Puckett** and Roger E. Gold, Texas A&M University, College Station, TX

40 Area wide strategy for managing the tawny crazy ant. **Paul R. Nester**, Texas A&M Agrilife, Houston, TX

Biology and Ecology

41 The reproductive flight phenology of *Nylanderia fulva* (Hymenoptera: Formicidae). **Danny L. McDonald** and Jerry L. Cook, Sam Houston State University, Huntsville, TX

NS Negative interactions between ants and *Heraclides* species in Biscayne National Park, Florida. **Jaeson Clayborn** and Suzanne Koptur, Florida International University, Miami, FL

42 Biology and host specificity of *Pseudacteon bifidus* a decapitating fly of the tropical fire ant, *Solenopsis geminata*. **Sanford D. Porter** and Robert M. Plowes, USDA-ARS-CMAVE, Gainesville, FL

NS Beneficial and consequential effects of saline water on *Solenopsis invicta*. **Yadira Reynaldo**, Jaeson Clayborn and Dr. Deby L. Cassill, Florida International University, Miami, FL

43 Fire ant sting: pathophysiology and natural remedy. **Kevin Ng** and Gina Ng, University of Miami (retired), Miami, FL

48 Biochemical evidence for cryptic *Solenopsis* species that are morphologically *S. invicta*. **Robert K. Vander Meer** and Sanford D. Porter, USDA-ARS-CMAVE, Gainesville, FL

49 Mechanism of oil intake and distribution of radioactive linolenic and linoleic acids in fire ant. **Matthew J. Landry**, R.M. Strecker, L.M. Bui, Louisiana State University, Baton Rouge, LA

50 The new ecological invasive forest ant, *Dolichoderus thoracicus*, in Lienhuachih Forest Dynamics Plot of Taiwan. **Feng-Chuan Hsu**, Chung-Chi Lin, National Changhua University of Education, Changhua, Taiwan

51 Feasibility and compatibility of native ant species as biocontrol agent in integrated management framework for invasive fire ant in Taiwan. **Chin-Cheng (Scotty) Yang**, Hung-Wei Hsu, Rong-Nan Huang, Wen-Jer Wu, National Taiwan University, Taipei, Taiwan

52 Unmanned aerial vehicle applications for red imported fire ants (*Solenopsis invicta*) control in Taiwan. **Wei-Feng Hung**, Hui-Min Lin, Yang-Yuan Chen and Chung-Chi Lin, National Changhua University of Education, Changhua, Taiwan

Index to Submitted Poster Abstracts / Manuscripts

NOTE: NS denotes Not Submitted. Speaker name in bold.

Submitted Presentation Abstracts/Manuscripts

Update on USDA-APHIS Imported Fire Ant Activities:
Policy, Science, and Field Operations

Anne-Marie Callcott, Ron Weeks and Charles Brown
USDA, APHIS, Plant Protection and Quarantine

USDA-APHIS-Plant Protection and Quarantine (PPQ) is currently organized into three core functional areas: Policy Management, Field Operation, and Science and Technology. The Imported Fire Ant (IFA) Core Functional Area representatives and their functions are:

- Policy Management (PM): Charles Brown (Riverdale, MD)
    - Guide regulatory decisions of Federal PPQ IFA program
    - Guide regulatory changes/decisions through federal processes into Federal Register and/or PPQ Treatment Manual
- Field Operations (FO): Ron Weeks (Raleigh, NC)
    - Manage implementation of Federal IFA quarantine by states
- Science and Technology (S&T): Anne-Marie Callcott (Biloxi, MS)
    - Support PPQ IFA regulatory decisions and operations through methods development work, scientific investigation, and technology

The APHIS-PPQ IFA Program conducts activities primarily in support of the Federal Imported Fire Ant Quarantine, but also supports IFA management activities. Some activities are conducted by PPQ staff and other activities are conducted by outside entities funded by PPQ.

- Quarantine
    - APHIS-PPQ:
        - Regulatory support (PM): EAs, rulemaking, guide regulatory decisions based on federal regs, etc.
        - Development of quarantine treatments
            - Funded thru S&T to universities and ARS
        - Transfer of information to states/outreach
        - Enforcement (IES): investigations and fines associated with violations
    - States (funded thru FO):
        - Inspecting nurseries
        - Issuing compliance agreements
        - Conducting blitzes w/ USDA
        - Survey
- Management
    - APHIS-PPQ:
        - Development of biological control
            - Funded thru S&T and FO to ARS

Federal Imported Fire Ant Quarantine – The goal of the Federal IFA Quarantine is to prevent the artificial spread of Imported Fire Ants (*S. invicta*, *S. richteri*, and their hybrid) from where they are to where they aren't – but could colonize. This is accomplished through the establishment of a quarantine area, and the regulation of known pathways for IFA movement (nursery stock, hay, soil, bee equipment, and anything else that can move fire ants). The Federal quarantine is behind some states' quarantines; however, we hope to have the federal regulatory lines catch up with the state regulatory lines soon.

There have been several recent changes to PPQ Treatment Manual – Imported Fire Ant section. The PPQ Treatment Manual contains all PPQ approved treatments for both import and domestic programs and is located at:
http://www.aphis.usda.gov/import_export/plants/manuals/online_manuals.shtml

- Go to "Complete list of manuals in alphabetically order"
- Scroll to bottom of page to find Treatment Manual
    - Link will open a pdf
- Go to Domestic Treatments
- Then Imported Fire Ant (D301-81-10)

Changes to the PPQ Treatment Manual include:

- Immersion or Dip Treatments for Balled-and-Burlapped (B&B) Plants
    - Bifenthrin high rate added March 2013
    - Lower bifenthrin rates added August 2013

Pesticide	Formulation	Dose Rate: lb ai/ 100 gal H_2O	Certification Period
Chlorpryrifos*	EC	0.125 lb ai	30 days
Bifenthrin*	EC or F	0.115 lb ai	180 days
		0.05 lb ai	120 days
		0.025 lb ai	60 days

- Grass Sod Treatments
    - Bifenthrin added March 2013

Pesticide	Formulation	lb ai/acre per application	Total no. applications 1 week apart	Total lb ai/acre	Exposure Period	Certification Period
Bifenthrin	EC	0.2	2	0.4	28 days	16 wks
Chlorpyrifos	EC, WP	8	1	8	2 days	6 wks
Fipronil	G	0.0125	2	0.025	30 days	20 wks

- Additional Baits Added to List of IFA Approved Chemicals
    - Abamectin and metaflumizone added December 2014

- Modification of Application Technique for Drench Treatment of Balled-and-Burlapped Nursery Stock – amended December 2014

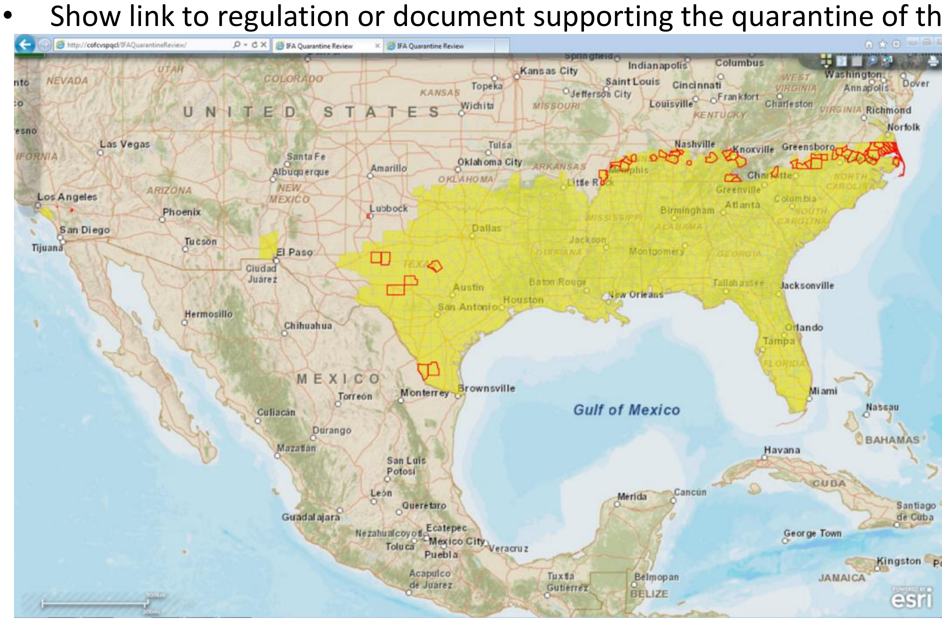
- Change from drench twice a day for 3 days to drench twice in one day and rotate or flip the root ball between drench applications
- This will not decrease the total amount of insecticide applied, but change the application technique, shortening the treatment regime from 3 days to 1 day
- Total rate of application and certification period will not change
- New language reads:
    - ➢ Do not remove burlap wrap or baskets from plants prior to treatment. The total volume of the treating solution must be 20 percent (1/5) the volume of the root ball. Treat plants singly or in groups with the chlorpyrifos solution twice in one day. Apply one-half the total drench solution, wait at least 30 minutes, then rotate the root ball and apply the second one-half drench solution. Rotating or flipping the root ball between drench applications is required to insure all sides of the root ball are sufficiently treated.

APHIS-PPQ maintains an Imported Fire Ant Web page for its stakeholders and the general public. This page primarily targets those impacted by the Federal IFA Quarantine. We have recently updated the page and it contains information on pest identification, regulations, quarantine information, program support documents and other resources such as university and extension sites. It is located at:
http://www.aphis.usda.gov/planthealth/pests_and_diseases

- ➢ Click on Imported Fire Ant

Changes coming to the APHIS-PPQ IFA web page include:

- ➢ Updated Program Aid in pdf format with recent changes to quarantine treatments
- ➢ Addition of an interactive quarantine area map
    - Ability to drill down to street level and see where quarantine is or is not
    - Show link to regulation or document supporting the quarantine of that area



Imported fire ant regulatory activities of the Texas Department of Agriculture

Awinash P. Bhatkar

Texas Department of Agriculture, Austin, Texas

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; 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 IFA regulations. Nursery-floral plant shipments require phytosanitary inspection, certification and treatment. Under the Texas General Quarantine Provisions nursery-floral articles entering the Texas must be certified pest free by the origination state department of agriculture. Recent changes in federal regulations require annual compliance inspection of field and container-grown nursery stock, greenhouse plants, blueberry and nut trees, sod farms, soil moving equipment, and hay for the shipment of these articles to IFA-free areas. In 2009, 29 counties were added to IFA quarantine, expanding the quarantine to 74% of 254 of Texas counties, so as to facilitate the interstate and international trade of quarantined articles. Regulations to exclude, contain and control IFA affect every aspect of agricultural production and commerce and have been effective in slowing the spread of IFA.

Expansion of the Range of the Red Imported Fire Ant in Coachella Valley

Jennifer A. Henke
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Red imported fire ants (*Solenopsis invicta*) were discovered California in 1998. A shipment of plants to Las Vegas from a nursery in Orange County was found to contain red imported fire ants (CDFA 2009). Nevada alerted the California Department of Food and Agriculture (CDFA), which then conducted a survey of southern California to determine the extent of the infestation. A quarantine area of nursery materials was put into effect by CDFA for all of Orange County, and then portions of Los Angeles and Riverside Counties. In 2005, the Coachella Valley Mosquito and Vector Control District began conducting surveillance and control activities for the red imported fire ant.

In 2010, the District began using a computerized system to record the technicians' chemical treatments. Most of the treatments begin with a request from a member of the public. Technicians examine whether the ants are *S. invicta*. Technicians enter information at the site of the treatment about the number of sampled locations where ants are found and record treatment information including the type and amount of chemical used. The number of treatments made has increased rapidly between 2010 and 2014 (Figure 1).

The location of the treatments was compared with the location of the CDFA Quarantine zone (CDFA 1999). The Quarantine zone was drawn into Google Earth (Google Earth 2015) using the directions outlined in the Plant Quarantine Manual (CDFA 1999). The treatments were classified by year and by product used (Figure 2).

Several reasons are plausible for the change in the number of treatments and in the apparent increase in treatments being made outside of the Quarantine zone. For example, the District has increased its public outreach, leading to an increased awareness of its services by residents. This may have led to an increase in requests. Alternatively, the red imported fire ants may be spreading. Nurseries within the Quarantine zone have mandated inspections of landscape materials prior to movement. However residential properties and movement of green wastes is not regulated. The common practice to collect green waste material is to leave it on the ground and then to collect it later in the same day. It is conceivable that infested red imported fire ant green waste is moved from residences and properties within the Quarantine zone to composting facilities outside of the zone. The life history of the fire ants may also be influenced by the environment of the Coachella Valley. The frequent irrigation of residences and golf courses within the valley may lead to an increased number of reproductive flights. Daily winds may help to move the fire ants, allowing them to spread to areas outside the Quarantine zone.

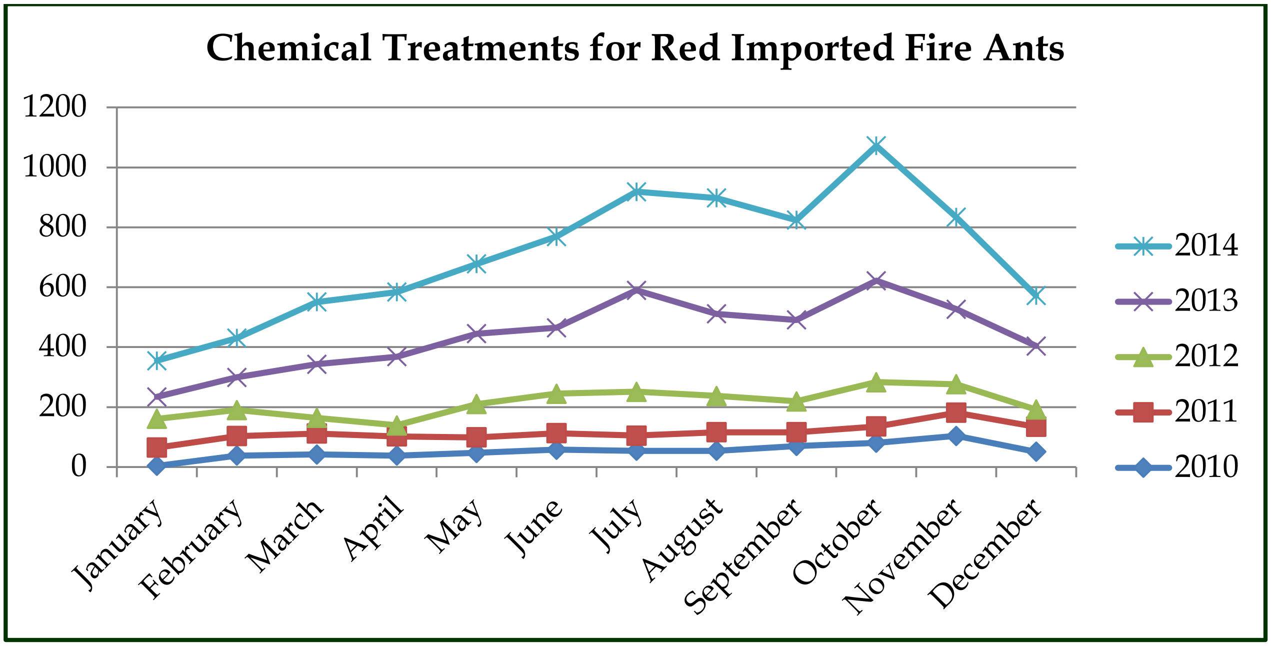

Figure 1. The number of treatments made for red imported fire ants each month from January 2010 to December 2014. Treatments were usually with Advion (individual residences) or Extinguish Plus (parks, schools, homeowners' associations, and golf courses).

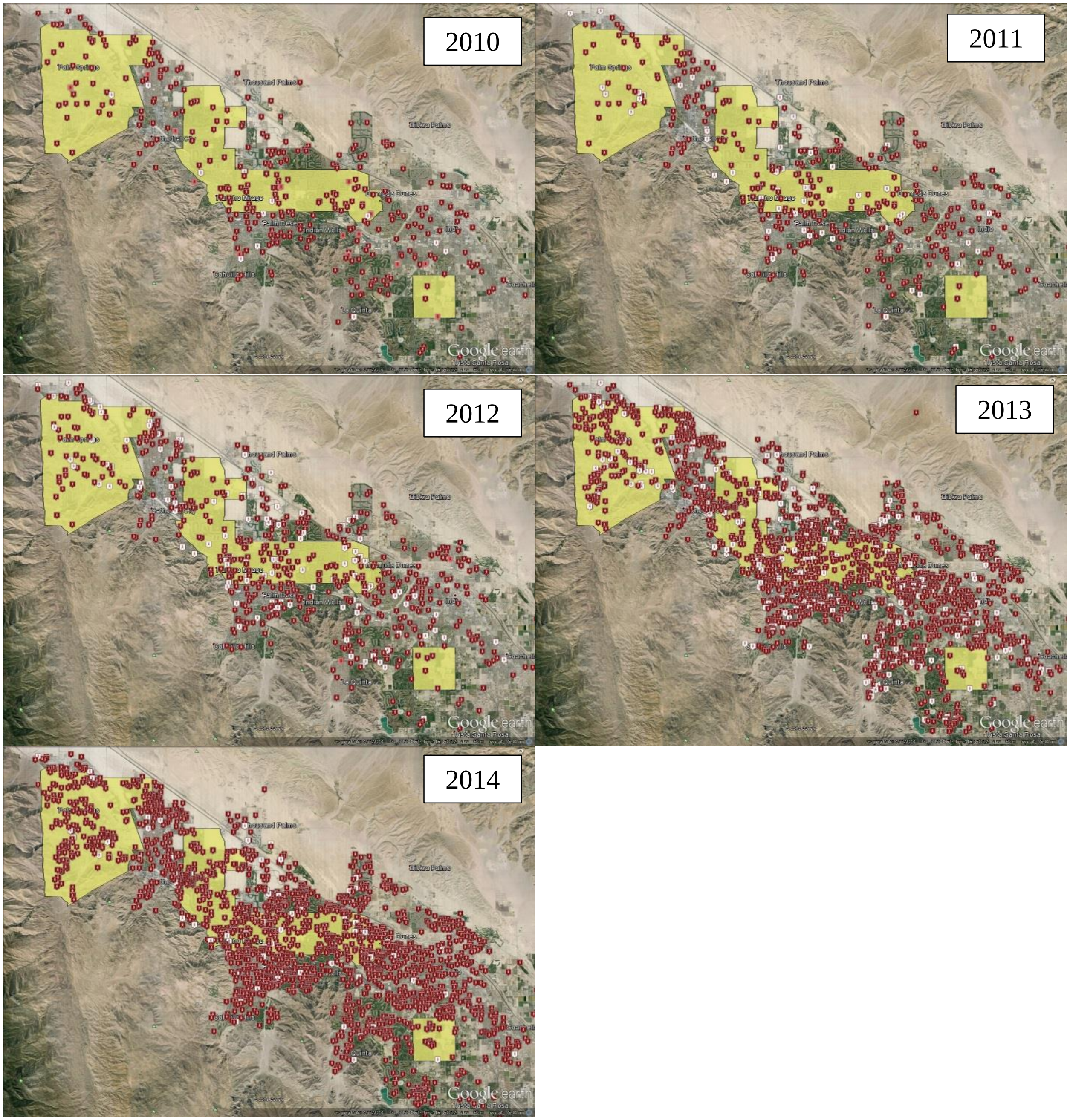

Figure 2. Maps showing the change in location of the treatments for red imported fire ants within the Coachella Valley between 2010 and 2014. Maps were created in Google Earth. Treatments were made with Advion (red), Extinguish Plus (white), or rarely Distance (pink). The CDFA Quarantine zone is in yellow. Marker for treatments from Maps Icons Collection.

References Cited

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Google Earth. 2015. Map data.
Maps Icons Collection http://mapicons.mapsmarker.com.

Tackling Fire Ants, After a Student Death, a Case Study for School IPM in Texas

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Abstract

In September 2013, a middle school student died after numerous fire ant stings during a junior high football game in Corpus Christi, TX. Allergic reactions to fire ant stings are rare, but require quick thinking and proactive first aid work. Shortly after this, Texas A&M AgriLife Extension School Integrated Pest Management (IPM) Program team was contacted to assist in reviewing the districts' IPM program, but also review the fire ant management program and make recommendations. The review came in two phases, one to assess the actual school IPM program under the Texas Department of Agriculture's school IPM rules, and the second phases was to review the fire ant management protocols and develop a new treatment protocol for the entire district. Corpus Christi Independent School District (CCISD) is located on the gulf coast of Texas in a semi-urban area. The district boasts it covers 63 square miles and has 37 elementary schools, 11 middle schools, 7 high schools, and 3 special campuses, with a total student enrollment of 39,414. To manage this, the district has one IPM Coordinator and two pesticide applicators and was using coaches to help with reporting fire ant mounds. After several meetings and revisions to the fire ant management plan for CCISD, the district implemented an improved fire ant management program in spring 2014. The result was they spent less money per unit area for fire ant management, have had fewer calls and complaints about fire ants and the coaching staff is now using more land than the 1.5 acres they were using for games.

Stinging incident: as reported by ABC News Reports

1. September 2013, a 13 year old middle school student died after numerous fire ant stings during a junior high football game in Corpus Christi, TX.
2. Student had been huddled with fellow football players during halftime of a football game when he began to scream, "Ants! Ants! "
3. A coach ran over and attempted to squirt the ants off the student's legs using a water bottle.
4. Shortly after the 13-year-old lost consciousness and collapsed on the field.
5. The student died after spending several days in an induced coma because of swelling in his brain.

Note: Due to Texas State restrictions, an epinephrine auto-injector was not readily available.

Fire ant management conducted by CCISD before incident:

1. CCISD scheduled monthly inspections, supplemented with inspections by coaches/teachers.
2. Generally, coaches called by telephone to report fire ants on a football field.

3. This would generate a WO (work order) either before or after treatment and be entered on the technicians daily log.
4. In general the CCISD followed IPM threshold suggestions and treated reported mounds utilizing mound drenches and a limited baiting area technique.
5. Unless threshold was met, fire ants were not treated in many instances.

Fire ant management after incident before baiting program:

1. Personnel from CCISD facilities department and athletic department walked each field every day:
   a. Identify active mounds
   b. Treat active mounds
2. Coaches walked fields again during PE classes and reported active mounds.
3. Took several weeks to get fire ant mound densities low.
4. All middle school games moved to high school field complex, which was treated with Top Choice©.

Response by Texas A&M AgriLife Extension Service:

1. CCISD asked for assistance in developing a more effective fire ant management strategy September 13, 2013.
2. On October 1, 2013, Janet. Hurley, Extension Program Specialist – School IPM conducted a site audit of CCISD's IPM program and reviewed their fire ant management protocols. This site audit was done in conjunction with a private firm who reviewed the District's emergency response protocol as well.
3. Ms. Hurley, responded with sending Texas A&M AgriLife Extension publications on fire ant management and a letter to CCISD addressing the audit results:
   a. Education of CCISD employees about IPM program
   b. Parent notification about IPM efforts
   c. Distribute IPM program information district wide
   d. Proper posting to visibly display efforts
   e. Effective monitoring
   f. Pest sighting logs can be good monitoring
   g. Critiqued the present fire ant management effort
   h. Recommended proactive fire ant management strategy
4. After Ms. Hurley's site visit, Dr. Paul Nester, Extension Program Specialist IPM and resident fire ant specialist was asked to work with CCISD to review the district's current practices and make recommendations for future efforts.

Critique of CCISD fire ant control efforts:

1. The IPM Thresholds to trigger control (reactive approach) were inadequate for the CCISD situation.
   a. Could only identify visible active fire ant mounds
   b. Focused on single mound applications
      i. Once mounds were seen would react
      ii. Limited baiting area (~58 acres)

        iii. Did not treat adjacent turf areas
2. Recommendations for CCISD fire ant control effort (proactive approach)
    a. Use of proper application equipment
    b. Treatment of all the grounds with fire ant bait or fipronil granule.
    c. Proper timing of fire ant bait applications for maximum effectiveness.
    d. Further discuss fire ant management strategies with the Texas A&M AgriLife IPM Extension Program Specialist.

Involvement of Texas A&M AgriLife Extension Program Specialist, Dr. Paul R Nester

1. Conducted phone conference with representatives from CCISD administration and Facilities and Maintenance Department addressing:
    i. Fire ant biology (life cycle, mounding, periods of activity, etc.)
    ii. Fire ant control products
        1. Baits and application timing based on life cycle
        2. Long residual versus short residual products
2. Stressed that CCISD needed:
    i. a proactive plan not reactive plan
    ii. a baiting strategy (broadcast versus single mound treatments)
    iii. provision of using some long residual granule products with fipronil
    iv. use of properly calibrated application equipment

New fire ant management strategy adopted by CCISD:

1. Implemented a District wide fire ant baiting program for all campuses (~541 acres)
2. The baiting program utilized:
    i. Spring – Broadcast fire ant bait application (Extinguish Plus© chosen)
    ii. Summer – Broadcast fire ant bait application (Advion© chosen)
    iii. Fall – Broadcast fire ant bait application (Extinguish Plus© chosen)
    iv. Single mound treatments if needed for hard to control mounds
3. Most applications are made to campuses after hours, or on weekends with the products identified in spreadsheet. Spreadsheet developed by Brett Bostian lists each campus, net total acres, athletic acres (fields) and campus acres. Products and costs are listed in the spreadsheet as well.
4. Long residual fipronil granule (Top Choice© chosen), spread in February, is only utilized at the main competition sports complex, Cabaniss Field 6.9 acres.
5. All facilities are posted as required by Texas Department of Agriculture under the school IPM rules.

Impact—Results of new fire ant management program:

The result since treating the entire campus:

1. CCISD found the baiting approach to be extremely effective in reducing fire ants, and was pleased with the fire ant baiting program.
2. CCISD spent less money per unit area of land for better fire ant management.
3. After subsequent treatments with Extinguish Plus© and Advion©, calls and complaints about fire ants in the district have become very limited.

4. The need for volunteers to check for fire ant mounds has disappeared since there was a significant decrease in visible and active ant mounds after the 1st application.
5. The CCISD coaching staff is now using more land than the 1.5 acres they were using for games.
6. CCISD Facilities and Maintenance Department has seen a greater than a 50% decrease in work orders for ants with many of the work orders being for ants other than fire ants.
   i. 316 work orders for fire ants from July 2012 – September 2013 (21/month)
   ii. 285 work orders for ants September 2013 – February 2015 (< 15/month, 50% of which were on other ants not fire ants)

Additional consequences as a result of this stinging incident:

1. Several Texas school districts changed their fire ant management practices—choosing to use baits on all campus property, not just athletic fields.
2. Several Texas school districts added education for staff on fire ants, fire ant stings and first aid response.
3. 84th Regular Session of Texas Legislature (2015)
   a. Four (4) Bills were introduced—relating to the use of epinephrine auto-injectors on public and open-enrollment charter school campuses and at off-campus school-sanctioned events.
   b. Excerpt from bills: "may maintain at each campus a supply of anaphylaxis medicine, including an epinephrine auto-injector that may be administered to a person on campus or at an off-campus school event experiencing an anaphylactic reaction, regardless of whether the medicine or auto-injector was prescribed for that person. For anaphylaxis medicine to satisfy this subsection, the medicine may not have an expiration date that has passed."

Reducing the Impact of the Red Imported Fire Ant in Waverly Acres Airpark, New Waverly, TX, 2013-2014

Paul R. Nester[1] and Reggie Lepley[2]
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Introduction

The red imported fire ant, *Solenopsis invicta* Buren (Hymenoptera: Formicidae) has become an important economic problem in urban Texas, according to a 1998 study conducted by the Department of Agricultural Economics, Texas A&M University. Fire ant related costs in Dallas, Fort Worth, Austin, San Antonio, and Houston, fire ants have serious economic effects for these metro areas of Texas (Lard, Hall, and Salin 2000). Households experienced the largest costs among sectors examined with an average of $151 per household spent annually. These costs include repairs to property and equipment, first-aid, pesticides, baits, and professional services. A full damage assessment for Texas must include additional sectors, and the estimated costs of $581 million per year for the selected sectors underscore the impact of this pest. Treatment costs accounted for over 50% of the total cost. In Houston, the average medical treatment cost per household was $25.46. The duration of injury for children and adults was 6.6 days and 5.6 days, respectively. The fire ant limits outdoor activities and homeowners and agricultural producers incur added costs in managing fire ants.

Management of the fire ant on large mixed use land tracts using insecticide products is economically feasible when the economic impact of high fire ant population levels equals or exceeds the cost of control (Flanders and Drees 2004). Mixed use land tracts may include parks, camp grounds, convention centers, animal-care facilities, or sod based runways and taxi-ways for small aircraft. The use of these areas can expose the unaware to fire ants and the problems they bring if no control measures are undertaken.

The Waverly Acres Airpark is a 185 acre community in Walker County, consisting of 46 lots ranging from 2-14 acres, with a 4000 foot Bermuda grass sod runway for light aircraft. This community has 18 developed lots, 14 of which are inhabited, three are under construction. In November 2012, Morris Postlewate, resident of Waverly Acres Airpark, contacted The Texas A&M AgriLife Extension Service via email stating, “There are hundreds of fire ant mounds on the runway and we are seeking a viable solution to the problem. They seem to have gotten worse since we installed an irrigation system and have steady water going to the grass. Could you provide us some possible treatments we could use to get rid of them?”

After contacting Reggie Lepley, CEA-AG/NR in Walker County, we decided this would be a great chance to introduce the Texas A&M AgriLife Extension Texas Two-Step program and the Community-Wide concept for managing the Red Imported Fire Ant in landscaped property to a different audience with similar issues which is reducing fire ant populations over a large area to minimize its effect on their chosen manner of living. (Nester et al. 2003, 2004, 2007, 2012, 2013)

Materials and Methods

Morris Postlewate and the Home Owners Association (HOA) President, Alan Dominy, invited representatives of the Texas A&M AgriLife Extension Service to visit their community to discuss fire ant management and offer suggestions on fire ant baiting within their community especially on their aircraft runway. They mentioned that besides the general nuisance of the fire ants during everyday life routines, the presence of the fire ant mounds on the runway caused extremely rough take-off and landing experiences for the pilots of the various aircraft utilizing the runway. The constant emergence of the fire ant mounds through the sand base and Bermuda sod (exacerbated by constant irrigation to minimize cracking by the clay bed) created hard obstacles and depressions on the runway surface that could not be avoided by an aircraft.

The Two-Step program promoted by the Texas A&M AgriLife Extension Service which utilizes broadcast applications of fire ant bait products in the spring and fall followed by individual mound treatments if needed (as outlined in the AgriLife Bookstore publication Fire Ant Control: The Two-Step Method and Other Approaches (EL-5496), http://www.agrilifebookstore.org/product-p/el-5496.htm was discussed with Waverly Acres Airpark representatives. This fire ant management program encourages owners of large tracts of property to schedule spring and fall application of a fire ant bait product to keep fire ant populations on the property at low levels.

It was decided that Waverly Acres Airpark would evaluate a community-wide fire ant baiting project, and besides advice through the Texas A&M AgriLife Extension Service on management techniques we would be allowed to survey the community in 2013 and 2014 to evaluate overall effectiveness and resident satisfaction with the fire ant management effort, and train community volunteers to continue future fire ant baiting events.

1) The Community would plan baiting events in June 2013, in late September 2013, and in June 2014 the possibility of additional baiting events in 2014 and 2015.
2) Community volunteers would be trained in proper techniques for broadcasting fire ant bait products.
3) The fire ant bait product containing hydramethylnon plus s-methoprene, Extinguish® Plus Fire Ant Bait (donated by Central Life Sciences, Dallas, TX) will be broadcast in early summer and late fall at a rate of 1.5 pound product/acre via a vehicle mounted Herd GT-77 Broadcast Seeder (Kasco Manufacturing Company, Shelbyville, IN, http://www.kascomfg.com) over the runway and taxiways and all property bordering the runway and taxiways, and those inhabited properties not adjacent to the runway (~110 total acres).
4) Pre and post fire ant mound activity evaluations, **Table 1**, will be made by taking the number of Active fire ant mounds within 0.25 acre circles on the runway (4 GPS'ed locations) and in uninhabited properties (4 GPS'ed locations) bordering the runway and taxiways. **Figure 1**.
5) A web-based survey will be provided to residents of the inhabited properties before and after the baiting events to gauge their satisfaction with the fire ant management project.

6) As the project progresses other instructional items may be utilized/developed to educate the community on fire ant management.

Figure 1: Locations of 0.25 acre circles assessed for active fire ant mounds, Waverly Acres Airpark, New Waverly, TX, Walker County 2013.

Preparing for a successful fire ant management project:

A meeting and location visit was planned with Morris Postlewate and Alan Dominy May 2, 2013 to view Waverly Acres Airpark Community to determine their fire ant management needs and begin initial plans for the Waverly Acres Airpark Fire Ant Project. An initial educational meeting was held on May 8, 2013 with Waverly Acres Airpark Community volunteers, Morris Postlewate, Alan Dominy and Joe Leggett when general fire ant biology, integrated pest management, ant management, use of fire ant bait products and the equipment needed to efficiently spread the fire ant bait product was discussed. The community decided to buy a Herd Broadcast Seeder to use for spreading fire ant bait products. On June 13, 2013, all three community volunteers were instructed on how to properly mount a Herd Broadcast Seeder using a vehicle trailer hitch receiver mount, an ATV mount, and a three point hitch mount (all of which they will be using), **Figures 2, 3** and **4**, and to calibrate the units (**Figures 4 and 5**) using the "fire ant bait product" kit (various bottom plates) provided with the Herd Broadcast Seeder. They were visually evaluated for their proficiency in mounting and calibrated the Herd Broadcast seeder, and when asked they all agreed that they were confident they could operate the equipment as instructed.

Figure 2: Properly mounted Herd Broadcast Seeders to utility vehicles

Figure 3: Properly mounted Herd Seeder via receiver hitch mount to trucks.

Figure 4: Properly mounted Herd Seeder via three point hitch mount to utility tractor then calibrating   the speed of the tractor.

Figure 5: Calibrating speed on utility vehicles

In the summer of 2013 an answer to one of the questions (**Figure 6**) on a survey prompted the decision to increase the awareness of the property owners in Waverly Acres Airpark on fire ant management and native ant species so they would know if the fire ant bait was working.

Figure 6: Waverly Acres Airpark survey response.

10. How informed do you feel about fire ants and fire ant management?

#	Answer		Response	%
1	Very informed		1	10%
2	Somewhat informed		7	70%
3	Not informed at all		2	20%
	Total		10	100%

An email was sent out to all the residents of Waverly Acres Airpark that included the fire ant control publication, ENTO-034 (Fire Ant Control: The Two-Step Method and Other Approaches), the most recent version of the "The Latest Broadcast on Fire Ant Control Products" information sheet and a copy of the preliminary report of the Waverly Acres Fire Ant Project. Videos were also created so the residents could see what was being done in their community. Additional questions asked the community in 2014 (**Figures 7 and 8**) indicates they are now more aware of native ants and believe that the fire ant baiting effort was successful.

Figure 7: Response to 2014 survey question, "Do you know how to identify fire ants visually verses the other native ants commonly found on your land?"

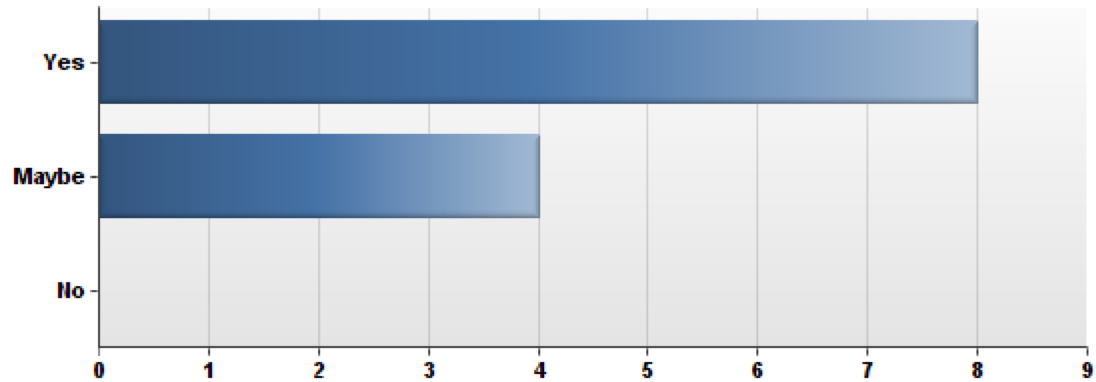
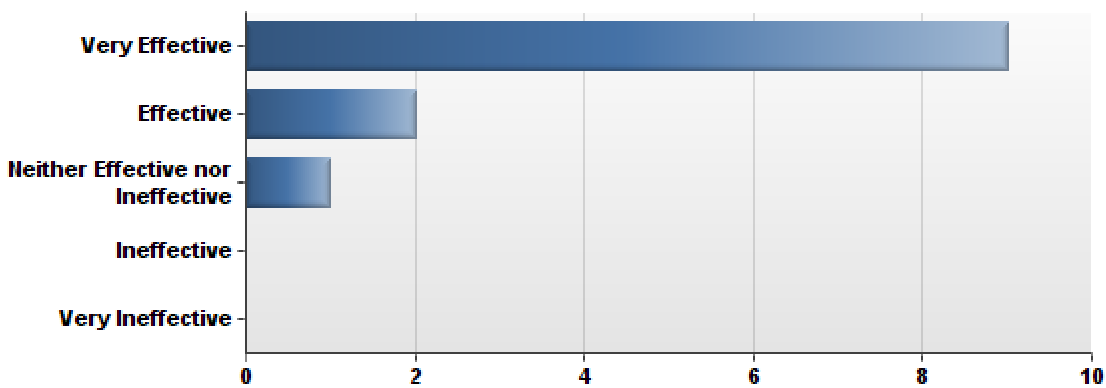


Figure 8: Response to 2014 survey question, "Do you think the broadcasting of a fire ant bait product is effective in the management of fire ants?"



Results and Discussion

The baiting program was a success, **Tables 1 & 2**. Eight weeks after broadcasting the fire ant bait in early summer (6/14/13) greater than 90% reduction in observable fire ant mounds was recorded and 6 months (8/8/13) after treatment greater than 80% reduction was still observed. Twelve weeks (12/18/13) after the fall fire ant bait application (9/27/13), greater than a 95% reduction in fire ant mound activity was observed. 2014 Evaluations conducted in June (6/4/14) noted 88% reduction and August (8/15/14) 98% reduction of active mounds. Fire ant mound activity is remaining at a low level. Residents were completely satisfied with the effort as reflected in the fall survey where 100% of the residents replied that the fire ant management effort promoted by the Texas A&M AgriLife Extension Service had a positive impact on the community.

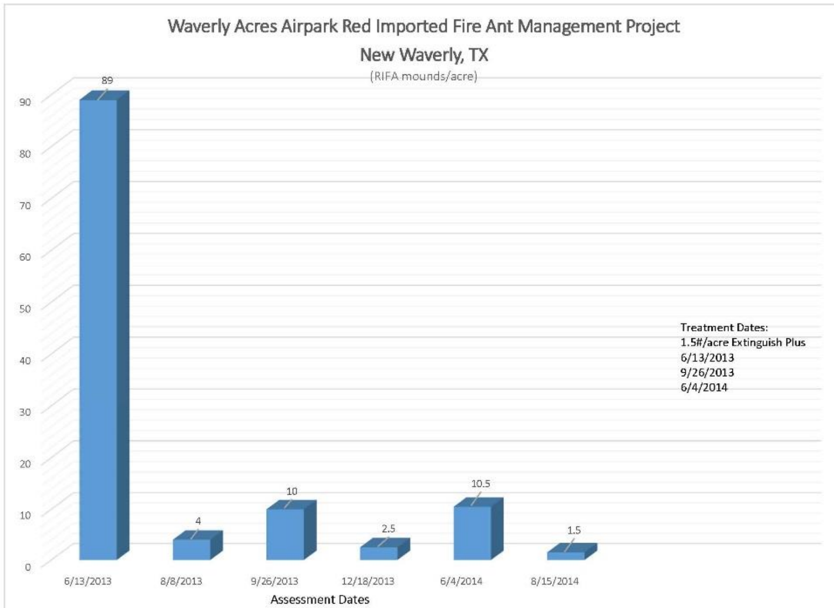


Table 1: The average number of visible active fire ant mounds per acre (determined by counting active fire ant mounds within 0.25 acre circles at eight locations) and the percent reduction in mound activity based on initial activity assessments within the Waverly Acres Airpark Community, Walker County, New Waverly, TX, 2013 & 2014.

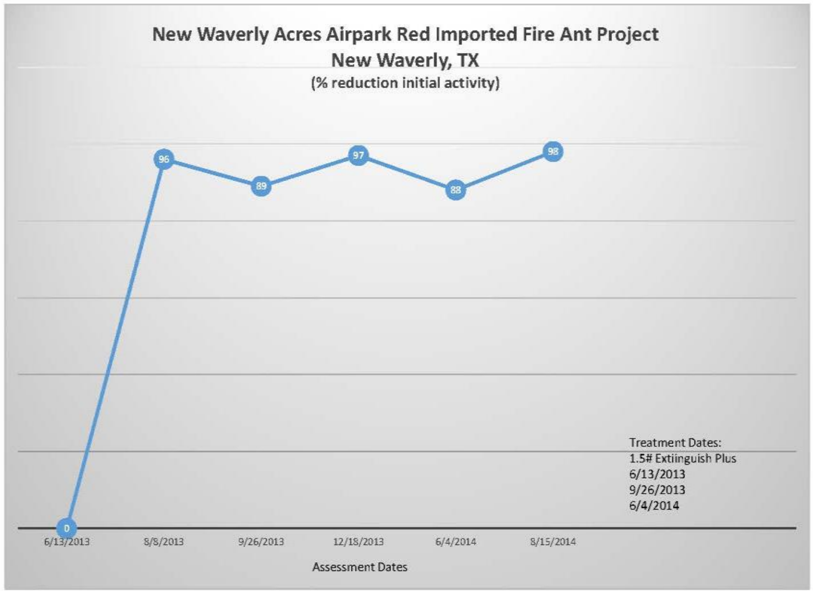


Table 2: The % reduction of active fire ant mounds per acre (determined by counting active fire ant mounds within 0.25 acre circles at eight locations) and the percent reduction in mound activity based on initial activity assessments within the Waverly Acres Airpark Community, Walker County, New Waverly, TX, 2013 & 2014.

Economic Results:

The residents stated in the pre-treatment survey that they had from 5-20 active fire ant mounds on their property, 100% of them had been stung. As a whole, 100% of the residents thought there was a moderate to severe problem in the Waverly Acres Community, with 40% of the resident stating the problem was severe. Before the fire ant baiting event, all the residents were treating their property at some time during the year for fire ants, with 60% of the residents treating their fire ants once a month or more. After the event less than 45% were treating once a month or more, while 21% did not treat and 36% only treated every other month. Before the fire ant baiting event the residents approximated they were spending an average of $66.50 (six of the residents stated they spent over $75.00), while after the baiting event this cost was dropped to $26.50 (~$15.00/acre). Based on the initial estimate of $66.50, and assuming the cost of fire ant bait is $10.00 per acre, $20.00 for 2 acres, $30.00 for 3 acres, etc., all residents would save from $20.00 to $40.00/year (or more since some did not treat) in fire ant related costs. Also when broadcasting a fire ant bait product all of the area is treated which will reduce fire ant populations for subsequent treatments, essentially reducing costs further.

From the fall (post treatment) survey, stinging incidences had been reduced by two thirds (71 % reported no stinging incidences), 70% of the residents consider the fire ant problem now to be minor (only 1% said severe versus 40% said it was severe in pre-treatment survey), and all residents (100%) would want to continue with the fire ant baiting effort, realizing that fire ant management is not free. Residents gave the fire ant management effort an overall satisfaction rating of 95% after the first baiting event.

The property owners association purchased a Herd Broadcast Seeder specifically for spreading fire ant bait and is considering purchasing an all-terrain vehicle. Community volunteers plan to spread fire ant bait products purchased by the property owners association over the runway and properties twice a year. This indicates a change in attitude toward the management of fire ants, realizing the need to promote a community-wide program approach and follow through with bi-annual fire ant bait treatments.

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The authors would like to thank the residents of Waverly Acres Airpark Community especially, Morris Postlewate, Alan Dominy and Joe Leggett for their participation in this effort, and thanks to Doug Van Gundy, Central Life Sciences, Dallas, TX, for the generous donation of the Extinguish® Plus Fire Ant Bait product for this demonstration study.

Lure, Switch and Bait; A Novel Concept for Fire Ant Management around Endangered Species

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Camp Bullis is a military installation in San Antonio, Texas that contains karst caves and features that are inhabited by endangered arthropods. It is required by law that fire ants, a potential threat of the endangered species, must be managed, however, current methods are not successful or cost effective. This project utilized a lure, switch, and bait method for managing fire ants in order to pose minimal effects on non-target species with maximum effects on reducing and managing fire ant populations.

Status and Management of Tawny Crazy Ants (*Nylanderia fulva*) in Alabama

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Introduction

Tawny crazy ants, *Nylanderia fulva*, were discovered in Mobile County in south Alabama in the spring of 2014. Ants were identified by Charles Ray of Auburn University's Department of Entomology and Plant Pathology. The site is located near Theodore, AL along a commercial shipping channel. The property is a home site with an approximately 3.5 ha narrow rectangle of forested property located in the middle of a commercial shipyard on the bank of the shipping channel. There is an approximately 0.5 ha grassy area surrounding the house that is located near the water. We assume that the tawny crazy ants arrived via the port since the homeowner could not remember visiting any areas where the ants are currently known to be located. This property is an ideal habitat with plenty of vegetation and food resources in the wooded areas and home site. The ants are located in the surrounding shipyards that are relatively barren of vegetation, but not in the numbers we found on the homeowners property. The homeowner reported that the ants had been on her property for several years and she had been trying to manage the population with insecticide sprays with little to no success. In an effort to give her some relief, a demonstration project was conducted in an attempt to manage the population.

Materials and Methods

Prior to any treatment, the homeowner was given time to clear mulch, limbs, pool equipment, etc. that could possibly hold moisture underneath to remove as many nesting sites as possible for the ants. After much of the material was removed from the area, Arilon® (Syngenta Professional Products) was applied in a 0.1% solution at a rate of 227 liters per 0.4 ha in the lawn areas and five feet up the side of the structures. Pre-treatment data to determine relative ant numbers were taken on October 21, 2014 and the property was treated immediately following data collection. Data were collected using hot dog baits placed on a laminated card. Baits were placed in four locations; 1) in the center of the property (5), 2) around the house (5), 3) around the treated perimeter (10) and 4) in the untreated area (5). Ant numbers were estimated using a rating system with 1 ≤ 20, 2 ≤ 40, 3 ≤ 60, 4 ≤ 80 and 5 = 100+ ants. Data were collected on 30 Oct, 12 & 25 Nov, 4 Dec, 9 Jan, 10 Feb, 3 Mar, and 3 Apr.

Results and Discussion

Tawny crazy ant numbers were approximately equal pre-treatment (see graph). One week post-treatment, numbers were reduced in all of the treated area to less than 20 ants per bait. On all data collection dates, except Nov 25 and Dec 4, ant numbers on all baits in the treated area were estimated at less than 20. On Nov 25 and Dec 4, ant numbers in the center circle and on the perimeter were between 20 and 40 ants per bait. Ant numbers in the untreated areas remained high (> 90 per bait) until mid-Dec and then decreased to below 40 ants per bait as mean daily temperatures decreased. This reduction in numbers was expected and has been seen in similar tests conducted in Florida and Texas.

This population is located less than 10 miles from one of the largest ornamental nurseries in Alabama. A second test to determine the efficacy of pot treatments approved for the imported fire ant quarantine was also set up in the untreated area of the property. Due to 'vandalism' by animals, the test was aborted.

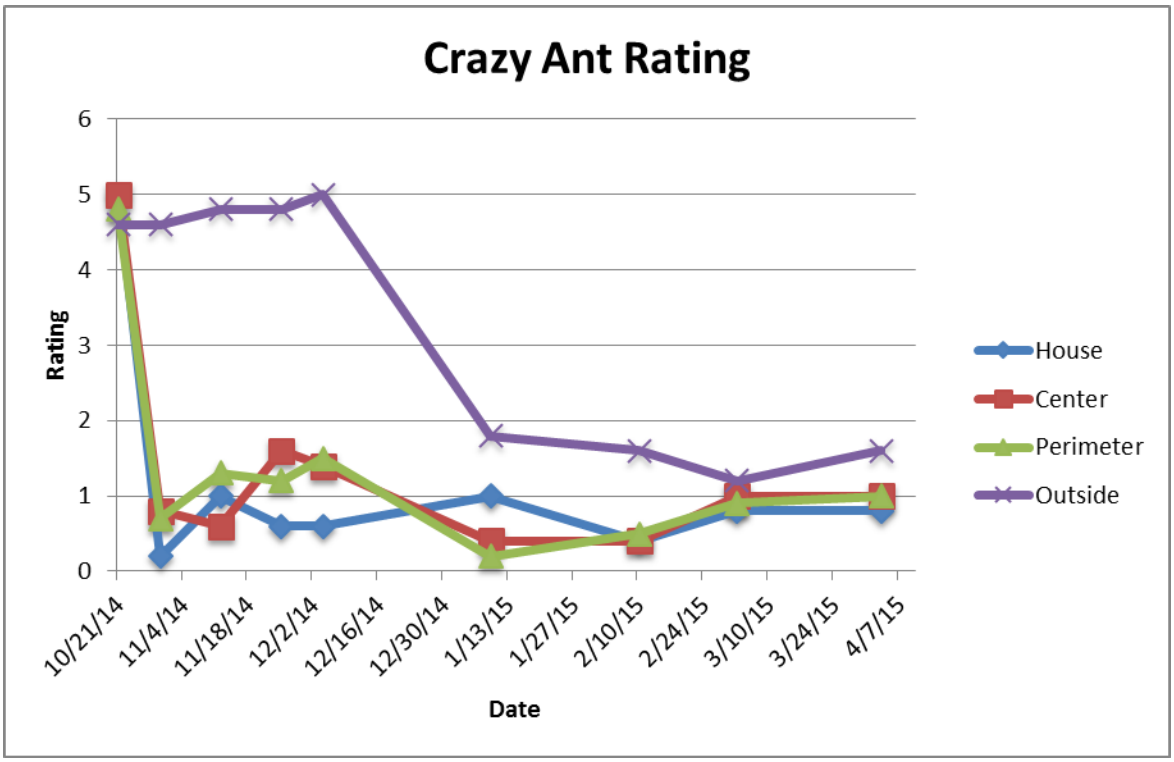

Figure 1. Mean rating of tawny crazy ant numbers inside the treated area of the yard, around the house, on the perimeter of the treated area and outside of the treated area.

Acknowledgements

The authors would like to thank Ms. Grace Talbert for the access to her property and Clay Scherer, Technical Services – Southeast U.S., Syngenta Crop Protection for providing the Arilon® for the test and for his technical assistance.

Experiences with Tawny Crazy Ant, *Nylanderia fulva*, Control in Mississippi

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Mississippi State University Extension Service

Tawny crazy ants (TCA), *Nylanderia fulva*, were first detected in Mississippi in fall of 2009 in an isolated area of Hancock County, though the identification/taxonomy of this ant was unclear at this time. Infestations were documented in Jackson Co. in 2010 and in Harrison Co. in fall of 2012. As of fall of 2014, TCA in Mississippi continued to be restricted to portions of these three coastal counties. Within infested areas, TCAs build to astonishingly high populations, especially from mid-summer through fall, and owners of infested properties find TCAs objectionable for several reasons. Although TCAs do not sting, they are a severe nuisance simply due to their high numbers, and property owners are often unable to enjoy their lawns and outdoor living areas because of these ants. Also, owners of infested properties routinely report experiencing multiple malfunctions of various types of electrical equipment due to invasion by TCAs.

In 2012 we conducted a trial to investigate the utility of two granular baits, Advance Granular Carpenter Ant Bait and Advance 375A Select Granular Ant Bait, for control of TCAs. Both baits contain 0.011% abamectin. In 2014 we conducted a trial to determine the effectiveness of Termidor SC (fipronil, 9.1%) when applied as an exterior perimeter spray three feet up exterior walls and to soil and turf areas up to ten feet away from exterior walls. Results of these trials are presented, along with a discussion of homeowner experiences with TCA control and current control recommendations.

Toxicity Profiles and Colony Effects of Liquid Baits on Tawny Crazy Ants (plus an update on their U.S. distribution)

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Tawny crazy ants, *Nylanderia fulva*, is an invasive ant that are known to readily forage on the liquid, carbohydrate rich honeydew produced by hemipterans such as aphids and scales. There is interest in developing liquid ant baits that can eliminate tawny crazy ant colonies. Preliminary and anecdotal reports have indicated that liquid ant bait formulations containing active ingredients of dinotefuran, imidacloprid, or disodium octaborate tetrahydrate (DOT) can kill tawny crazy ant workers (Meyers & Gold 2007 J. Agric. Urban Entomol. 24: 125-136; Oi, unpubl. data). Delayed toxicity profiles of liquid bait formulations consisting of sucrose solution and the aforementioned active ingredients were generated for tawny crazy ants. None of the baits met the standard criteria for effective ant bait active ingredients of <15% mortality after 24 hours and $\geq$90% mortality within 14 days (Stringer et al. 1964 J. Econ. Entomol. 57: 941-5). However the dinotefuran and imidacloprid formulations did have > 90% mortality unlike the DOT. Liquid bait formulations containing imidacloprid and dinotefuran caused significant reductions in brood levels of laboratory colonies of tawny crazy ants. Dinotefuran treatments also had significantly fewer numbers of live workers in these colonies as well as death for a majority of the 10 queens per colony (n=5 colonies per treatment). DOT baits were not tested against colonies.

The tawny crazy ant is spreading in the southern United States. As of March 2015, 81 counties or parishes had reports of tawny crazy ant infestations. New infestations since April 2014 were reported in 1 county each in Texas and Florida, 2 counties in Georgia 14 parishes in Louisiana, and the initial report of an infestation in Alabama. The number of counties or parishes, per state, with tawny crazy ant infestations are as follows: Texas-28, Louisiana-19, Mississippi-3, Alabama-1, Georgia-3, and Florida -27 (Fig. 1).

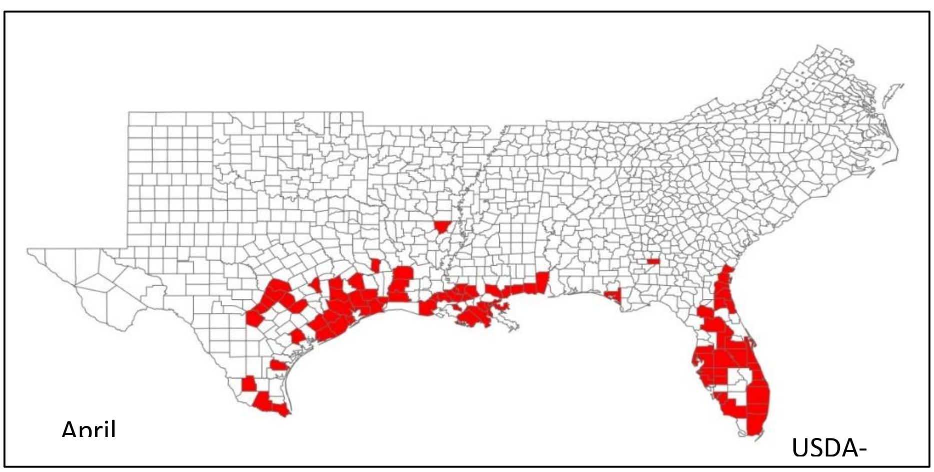

Fig. 1. Distribution of tawny crazy ant infestations in the southern U.S. by county.

Strategies for Tawny Crazy Ant (*Nylanderia fulva*) Management in Urban Settings

Robert T. Puckett and Roger E. Gold

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Since discovery in Texas in 2002, tawny crazy ants (*Nylanderia fulva* Mayr) have expanded their range to include 27 Texas counties. Until recently, techniques for management of these ants in urban and agricultural systems have proven to be inadequate. In 2013 and 2014 we assessed the effectiveness of three treatment strategies involving the application of contact insecticides for the prevention of *N. fulva* activity on homes in Texas City, TX. In both 2013 and 2014, *N. fulva* activity associated with treated structures was observed to be significantly less than that of untreated controls, and some of the treatment strategies were effective for up to 12 weeks post-treatment. These results are encouraging, and suggest that these ants can be effectively managed in urban systems. Additionally, the results of laboratory trials designed to observe competitive interactions between *N. fulva* and red imported fire ants (*Solenopsis invicta* Buren) will be presented.

Area Wide Strategy for Managing the Tawny Crazy Ant

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In 2013 a demonstration was initiated to evaluate the concept of treating several adjacent properties in the management of the tawny crazy ant (*Nylanderia fulva*). Five adjacent properties found to be infested with a moderate to high population of the tawny crazy ant in the Walden Community located in Montgomery, TX, were chosen for this study. In early August 3013 the initial treatment utilizing Termidor® SC and Alpine® WSG was applied. Termidor® SC, 1.2 ozs product/1.5 gallons/1000 sq. ft., was applied around each of the structures on the properties according to the Sec. 18 Quarantine Exemption to use Termidor® SC for control of the Tawny (Rasberry) Crazy Ant species in the state of Texas. Alpine® WSG was applied as a 10% solution, 1 gallons/1000 sq. ft., to all other areas. This initial treatment kept the tawny crazy ant away from each of the structures for over 12 weeks. An additional treatment of Alpine® WSG (10%) was applied in early October 2014. Tawny crazy populations did not recover throughout the summer and early fall of 2014. Treating of multiple properties should be considered when attempting to manage populations of this pest.

The reproductive flight phenology of *Nylanderia fulva* (Hymenoptera: Formicidae) in Southeast Texas

Danny L. McDonald and Jerry L. Cook

Sam Houston State University, Huntsville, TX

Nylanderia fulva (the tawny crazy ant) is an invasive ant species affecting the Gulf Coast states, yet little is known about their reproductive ecology. We investigated their reproductive flight phenology in three counties near Houston, TX for two years using black light and malaise traps. Males were be found flying year round at night and densities peak in late August with 504 males caught per day in black light traps. Two alate queens were found in malaise traps and five alate queens were found in black light traps. We believe that the dispersal strategy used by *N. fulva* is the female calling syndrome where females gather near their parent colony, use pheromones to attract males, mate, and start reproduction as an extension of the parent colony. Mating flights could not be predicted by any environmental stimuli. Bycatch provided reproductive flight phenology data for many other species and 34 new county records.

Biology and host specificity of *Pseudacteon bifidus* a decapitating fly of the tropical fire ant, *Solenopsis geminata*

Sanford D. Porter and Robert M. Plowes

USDA-ARS, CMAVE, Gainesville, FL and Brackenridge Field Laboratory, University of Texas, Austin, TX

Pseudacteon bifidus is a small decapitating fly which attacks tropical fire ants (*Solenopsis geminata*) in Texas. We have been able to rear this fly on tropical fire ants in Florida for more than 10 generations. We are currently investigating its suitability as a self-sustaining biocontrol agent for tropical fire ants in Guam, Hawaii, and the Galapagos. Recently completed host-specificity tests show that this fly is completely specific to fire ants in the genus *Solenopsis*. Food attraction tests show that this fly does not have the potential to become a nuisance pest because it is not attracted to fruits, vegetables, carrion, feces, or various prepared foods.

Fire Ant Stings: Pathophysiology and Natural Remedy.

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Introduction

My interest in fire ant venom came as a result of my discovery of the angiotensin converting enzyme (ACE) in the lungs (Ng and Vane, 1967, Ng and Vane 1968) and the discovery of an inhibitor (ACE inhibitor) in the venom of a Brazilian snake *B. jararaca* (Ng and Vane,1970). This led to the synthesis of captopril (Capoten history, http://en.wikipedia.org/wiki/Captopril) and more than a dozen ACE inhibitors currently used in the treatment of hypertension, congestive heart failure and diabetic kidney disease.

Statistics

According to the American College of Asthma, Allergy and Immunology, 500,000 people go the Emergency Room for insect stings each year. More than 40 die from sting anaphylaxis or whole body reactions annually. Fire ant may be the number one agent of insect sting. Fire ant stings costs the United States of America about $6 billion a year.

Fire ant sting

When a worker fire ant stings, it gives rise to a sensation of fire followed by a blister surrounded by a pinkish ring within one hour. The discomfort of itch follows rapidly. The blister is then filled with pus surrounded by a dark red circle within 36-48 hours. The itch intensifies until the the pustule ruptures leaving an open wound on the skin. If it is not not infected due to scratching, the lesion heals within 2 to 4 weeks.

The reactions to fire ant stings are classified into local and whole body or systemic responses. It is estimated that 99% of the victims suffer from local reactions. Only 1% of victims suffered from anaphylaxis or whole body severe reactions which require emergency treatment with Epipen (epinephrine) and perhaps hospitalization.

Skin

The skin acts as a barrier to external pathogens and injury. The thickness of the skin varies between 0.1 to 2.5 mm. and it is made up of 3 layers: epidermis, dermis and hypodermis. In the dermis, there is network of arteries, veins, lymphatics and nerves. Interspersed in the matrix are mast cells, immune cells and fibroblasts. The mast cells are in close proximity to the blood vessels. The transient inflammatory cells include neutrophils, T and B lymphocytes, eosinophils and monocytes.

Worker Fire Ant

The worker fire ant varies between 2 to 6 mm in size. The venom injected into the skin weighs about 1 microgram (ug) or 1/1000 milligram (mg) but its toxic effect is monumental.
When fire ant venom is injected into the skin, the reaction is called Inflammation. It is characterized by pain, swelling redness and heat. These are the cardinal signs of inflammation first described by Celsus (30BC-38AD) more than two thousand years ago.

Venom (Pinto et al, 2012))

95% of the venom is a water insoluble alkaloid known as solenopsin A. 5% of the venom is allergenic proteins which recently has been fractionated into 46 components. Both solenopsin A and allergenic proteins are toxic to cellular structures such as blood vessels, white blood cells, muscles and nerves. They are also potent releasers of mediators of inflammation and itch. However, solenopsin A has a unique property of inhibiting the growth of blood vessels. This biological action has been used to design new drugs for the treatment of cancer. The enzyme phospholipase A2 from the protein fraction is an enzyme which disrupts the cell membrane leading to the release of arachidonic acid which in turn is converted by the enzyme cyclo-oxygenase and lipoxygenase to lipd mediators (prostaglandins, prostacyclin, thromboxane and leukotrienes).

Mechanism of Inflammation.

When venom comes into contact with the skin, the surrounding cells are either injured or killed. This initiates the process of acute inflammation:

(1) Vasoldilation: The mast cells are degranulated releasing histamine, serotin, cytokines, (TNF, iL1 and iL6) chemokines and newly synthesized prostaglandins(PGE_2), prostacyclin, thromboxane, leukotrienes(LD_4) and platelete activating factor. Vasodilation gives rise to redness, swelling and heat.

(2) Exudation: The blood vessels dilate and open the tight joints between the endothelial cells. This allows plasma to exudate and to activate the kallikrein-bradykinin system. Together with histamine and other inflammatory mediators, bradykinin stimulates the sensory nereve fibres causing pain and itch.

(3) Diapedesis: Migration of neutrophils and macrophages to site of injury where they produce more cytokines (TNF, iL6), chemokines, prostaglandins, thromboxane and nitric oxide.

(4) Phagocytosis:This refers to the removal of debris and dead tissues by macrophages. The end result is the formation of pus.

(5) Resolution : This is the stage of tissue repair by fibroblasts under the influence of anti-inflammatory cytokines and lipoxins.

Whole body (systemic) response to fire ant stings: anaphylaxis.

The systemic response to fire ant stings is also known as anaphylaxis which means without protection. It is characterized by generalized pruritus, angioedema, bronchoconstriction, hypotension, seizure, multi organ failure and death.

This phenomenon is due to an abnormal reactive response to the fire ant venom which results in an explosive release of inflammatory mediators into the circulation. It is a medical emergency which requires immediate treatment with epinephrine followed by evaluation at the Emergency Department.

Treatment:

There has not been much advances in the treatment of fire ant stings for the last few decades. Home remedies make use of ice, vinegar, ammonia, sodium bicarbonate, meat tenderizer, aloe vera gel and tea tree oil. Over-the-counter topical products include sprays, lotions, cream, and balm using corticosteroids, antihistamine, analgesics and menthol as active ingredients. The responses to these products are slow and minimal as they are water based, their concentration is low and they are not well absorbed through the skin. Furthermore, they target only two out of more than twelve mediators of inflammation caused by fire ant stings.

Phytochemicals

Since the original chemical of aspirin is derived from the bark of white willow tree, it is reasonable to suspect that other active ingredients may be available to suppress the inflammatory process. My mentor Sir John Vane (Vane 1982) in the late 60s found that aspirin blocks the release of prostaglandins by inhibiting the enzyme cyclo-oxygenase. Since then, no effective pharmaceutical inhibitor is available for the topical treatment of fire ant stings.

Several pharmaceutical cytokine inhibitors (Enbrel, Humira, Stalara, Cimza etc.) for Tissue Necrosis Factor (TNF) are available for the treatment of Rheumatoid arthritis, Psoriasis, Crohns disease and other auto-immune disease. However, their use leads to many side effects. Furthermore, they are cost prohibitive and therefore not appropriate for topical use.

An enzyme inhibitor for lipoxgenase was developed for the treatment of asthma but it is toxic to the liver. It is now replaced by two leukotriene receptor blockers (Singular, Accolate). No studies had been made on their topical use.

Salicin, the original phytochemical of aspirin, was found in the bark of white willow tree. Studies in the last few decades indicate that there is an abundance of natural active ingredients known as phytochemicals which show anti-inflammatory, antioxidant, antiaging and anticancer effects. Frenkincence, one of the three gifts given to Jesus Christ contains Boswallic Acid which inhibits the enzyme lipoxygenase. Green tea, ginger, turmeric, galangal, lumpuyang, lemon grass and many others inhibit not only the arachidonic pathway, but also the Transcription Factor (NF-kB) and cytokine cascade.

By extracting and blending the active ingredients from plant sources, we have developed several lines of topical formulas for the relieve of pain, itch and other medical ailments.

Itch evaluation

The main problem with fire ant sting is the discomfort of itch. At this time, there is no objective means to measure the intensity of itch. A visual scale from 0 to 4 has been developed for clinical assessment: 0 represents comfortable with no itch, 1 represents a little itch without interference with activity, 2 represents itch with interference with activity, 3 represents a lot of itch with difficulty to sit still and 4 represents intense itch with difficulty to concentrate or sleep.

Effect of Phytochemical Extracts.

Water and alcohol extracts of plant materials did not significantly relieve the itch. The most effective extracts were those formulated with oils. Extract from one plant material was less effective than a mixture of two or more extracts. This suggests that the active ingredients act synergistically. Their actions are similar to the synergistic effects by using multipe drugs for the treatment of Hypertension, Congestive heart failure, Type 2 diabetes, Rheumatoid arthritis, Alzheimer's disease, etc.

Clinical experiments showed that the oil extracts of phytochemicals from four botanical sources relieved pain and itch almost instantly. On an itch scale from 0 to 4, it ranked 0. There was no swelling, redness, warmth or pain. No pustules were observed. No side effects developed. In contrast, 2% topical antihistamine and 1% hydrocortisone did not relieve the discomfort from itch. Nor did they prevent the formation of pus. On an itch scale of 0 to 4, it ranked between 3 to 4.

Anaphylaxis treatment

Severe reactions to insect sting is an emergency problem. About 40 people die from insect stings every year according to the American College of Asthma, Allergy and Immunology. It is characterized by generalized pruritis, angioedema of mouth and throat, bronchoconstriction, hypotension, shock, multi-organ failure and death. It is caused by an explosive release of inflammatory cytokines and other mediators into the circulation, a condition recently described as "cytokine storm".

The treatment for anaphylaxis is symptomatic including the use of corticosteroids and antihistamines. However, new treatments for cytokine storm (Cytokine storm, wikipedia) are now undergoing clinical study. These include Tissue Necrosis Factor (TNF) blockers, angiotensin converting enzyme inhibitor (ACE inhibitors), angiotensin receptor blocker (ARB), gemfibrosil, antioxidants and OX40 immunoglobulin. I am pleased to find that what I had discovered more than 40 years ago may find its way into the treatment of this deadly reaction to fire ant stings.

Conclusions:

- The advances of pathophysiology in acute inflammation have outpaced the treatment of local reactions to fire ant stings.
- The conventional local treatments need to be updated in accordance with new knowledge of biologic response to inflammation.
- The abundance of phytochemicals in nature that target multiple inflammatory mediators open new frontiers in the topical treatment of fire ant stings.
- Phytochemicals are inexpensive, safe, effective and free from side effects.

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Biochemical Evidence for Cryptic *Solenopsis* species that are Morphologically *S. invicta*

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USDA/ARS

Biochemical analyses of > 180 colonies from northern Argentina indicate the presence of three distinct chemical patterns, including that of *S. invicta* from the USA. Morphologically the three chemotypes are indistinguishable. Where these chemotypes are collected sympatrically, there is no indication of introgression. The venom alkaloids and cuticular hydrocarbons are biosynthesized by distinctly different pathways and can be considered independent chemotaxonomic characters. In addition, analyses of Dufour's glands, the source of recruitment pheromones, showed the presence of the major sesquiterpene found in USA *S. invicta* Dufour's glands from one of the Argentina *S. invicta* chemotypes, but not from the other two Argentina chemotypes. This is excellent evidence for morphologically cryptic species of *Solenopsis* in northern Argentina.

Mechanism of Oil Intake and Distribution of Radioactive Linolenic and Linoleic Acids in Fire Ant Colonies

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Red imported fire ants (RIFA), *Solenopsis invicta*, are an invasive species that brings large economic cost. The ultimate solution to the RIFA endemic is eradication, which seems unlikely any time soon. In the interim, continued entomological research may ultimately lead to population management and prevention of continued infestation. Our research purpose was to remove a twofold gap in knowledge: (1) Do solid particles act as a “sponge” for oils allowing them to carry liquid baits? (2)Where are oils preferentially distributed in a colony? Previous studies have used radioactive components that were added to liquid. This technique might not follow the nutrient but rather the radioactive molecule whereas our experiment utilizes radioactive tracers incorporated into oils, which are undetectable to the ants ensuring we are following oil as a tracer. RIFA colonies were collected from the field and flooded to remove them from the soil. Radioactive 14C linoleic acid and 14C linolenic acid was offered to the colonies to freely forage for 48h. Ten larvae and workers were removed for scintillation counting; worker exoskeletons were dissolved using nitric acid. Behavioral observations have shown that the solid, granular baits are not used by RIFA, and only act as a “sponge” for liquid baits. Additionally, we hypothesize that oils consumed from liquid baits will be preferentially distributed to larvae and primary reproductive queens. The significance of the results will be valuable in the understanding of how RIFA interact, distribute oil-based baits, and aid in the management and prevention of continued infestation of the RIFA.

The New Ecological Invasive Forest Ant, *Dolichoderus thoracicus*, in Lienhuachih Forest Dynamics Plot of Taiwan

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Invasive ants, those species that demonstrate ecological, environmental, or economic impacts, are now widely recognized as one of the primary threats to biodiversity and the functioning of ecosystems. The human activity and commerce has contributed to the dispersal of exotic ants and their introduced into new habitats. Though the arboreal ant, *Dolichoderus thoracicus*, distributing throughout Southeast Asia, was reported applying to biological control on agricultural pests, but it has been listed in invasive species by Center for Invasive Species and Ecosystem Health. This study described the arboreal ant, *D. thoracicus*, which invades the Lienhuachih Forest Dynamics Plot in Nantou County, Taiwan. We collected by circle trunk pitfall traps in 40 trees belong to 8 tree species. These traps set at 1m, 4m height and tree canopy on the main trunk, according to circumstances each tree set 1~3 traps and sampling once every two months continuing for a year to monitor the influence of this species on native arboreal ants community structure. A total of 46 species, 23 genera belong to 5 subfamilies of ants were identified. The results showed that *D. thoracicus* is the most abundant species which takes up 56% of all captured individuals and widely distributes from the shrub layer to the canopy in this forest. *D. thoracicus* extends into the primary forest by human-made facilities (pipes, wires and ropes). It has strong impacts on the native arboreal ant community structure and even influences all of the canopy ecosystem.

Feasibility and compatibility of native ant species as biocontrol agent in integrated management framework for invasive fire ant in Taiwan

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Recent studies have highlighted the importance of biocontrol agents in area-wide suppression of the red important fire ant (*Solenopsis invicta*). While microbial pathogens (ex. microsporidia) and parasitoids (ex. phorid fly) have been primary agents of interest in most of the cases; competitors, however, receive much less attention. Our earlier surveys indicated that a native ant species, gray-black spiny ant (*Polyrhachis dives*), remains abundant and active when coexisting with *S. invicta*, suggesting the potential of utilizing this species as competitive biocontrol agent in Taiwan. The present study therefore is to comprehensively evaluate the feasibility of integrating *P. dives* into current control framework of fire ant in Taiwan, and several aspects are then considered including: 1) interspecific competition between the two ant species; 2) susceptibility of *P. dives* to conventional fire ant bait and 3) potential role of *P. dives* in ‘‘vectoring’’ *Solenopsis invicta* virus 1 (SINV-1) during interspecific interaction. Virtually all experimental data indicate that *P. dives* can serve as an efficient control agent (competitor) by itself alone, but also show considerable compatibility to current control approaches against fire ant in Taiwan. The future application of *P. dives* is thus discussed in this study.

Unmanned Ariel Vehicle Applications for Red Imported Fire Ants (*Solenopsis invicta*) Control in Taiwan.

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The first concept of Unmanned Ariel Vehicle (UAV) was for war purposes from Austrian in middle 1800s, and now a day UAV was still developed and used in military. They were now also applied in unmilitary purposes like entertainment (flying fan players, and wedding design company), commercial (delivery and advertisement company), and science (observations and treatments) usages. UAV styles (sizes and shapes) were changed based on its application purposes, and multicopters were going to be popular devices in agricultural and environmental sciences because of their multi-functions when they were with different accessories. One multicopter was designed and used to spray Methoprene to control imported fire ants in this experiment in Tao-Yuan City, Taiwan. Flying spray experiments were tested in different heights and different horizontal flying speeds in the same setting of spraying speed. Sample traps were set on the ground in a matrix shape (5X5, 7X7), and the multicopter flied cross the middle line of traps. Methoprene samples in each trap were collected after each flight, and they were measured by microbalance in the laboratory. Wind direction and wind speed were measured and recorded before each flight. The closest result to 2-4 kilograms per hectare is flying at 5 meters per second horizontal speed at 3 meters height from sea level in tail wind condition. Further studies will still work on development of new standard operation procedure settings to fly and spray different materials in different environments and design more multi-functional accessories on multi-axis flying devices for different missions.

Lab Studies on Interspecific Competition among *Pseudacteon* spp.

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Pseudacteon phorid flies are parasitoids that have been released in the United States for the biological control of red imported fire ant, *Solenopsis invicta*. Interspecific competition *between Pseudacteon curvatus* and *P. obtusus* was simulated in a laboratory setting in which host size, sex ratios, species ratios, and development time were analyzed. *Pseudacteon curvatus* emerged from smaller hosts than *P. obtusus*. Although *P. curvatus* host sizes did not vary by sex, *P. obtusus* males emerged from smaller hosts than females. Sex ratios were significantly different between species, but did not significantly differ among treatments. Species ratios did not significantly differ among competition treatments. Development time varied between species, but was not affected by competition. The findings of this study indicate that *P. curvatus* and *P. obtusus* are not affected by interspecific competition.

Caste-Specific Terpenoids in Little Black Ants, *Monomorium minimum*

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Analysis of the extracts of workers and queens in *Monomorium minimum* revealed the presence of terpenoids. Neocembrene [(E,E,E)-1-isopropenyl-4,8,12-trimethylcyclotetradeca-3,7,11-triene] was found only in fertile queens. In workers, a series of other terpenoids were found. The biological function of these terpenoids is uncertain. Elucidation of their functions is the direction of our further research.

A Novel Design for a Mechanical Aspirator Targeting Ant-sized Insects

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Collection of some insects by mouth aspiration is often problematic considering that the operator may become sensitized to insect allergens or the insect may emit volatile compounds when agitated. Mechanical aspirators are widely available but are generally expensive and may be limited to particular applications. By modifying an inexpensive bilge blower fan, we designed and fabricated a highly mobile aspirator that is particularly well suited to the collection of medium to small ants and like-sized insects. The new configuration compared favorably to a commercially available unit for air flow and allows collections of fast moving ants in multiple types of environments. The tawny crazy ant, *Nylanderia fulva*, (Hymenoptera: Formicidae), has proven to be a particularly noxious species when mouth aspirated and served as the impetus for producing our device. This species, well established in FL, and TX, can now be found in a patchwork distribution in all the contiguous coastal states in between. Our aspirator increased the catch rate and comfort level for the author during collections of tawny crazy ants in comparison to that experienced using a mouth aspirator

Application of GPS and GIS for Survey and Control of Red Imported Fire Ant in Chaiyi, Taiwan

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Red imported fire ant (*Solenopsis invicta* Buren, RIFA) was first found in Chiayi County of Taiwan in October 2003, and a detection survey was then begun late October 2004. The coordinates of RIFA mound were obtained using Global Positioning System (GPS), and geospatial distribution of RIFA mounds were displayed on aerial photographs by a geographic information system (GIS) for planning the ranges of survey and control efforts. Initially, the coordinates of numerous known RIFA mounds were drawn on maps including 2 x2 km grids, which covers primary RIFA infestation in Chiayi, an area totaling 60 km2. After 2008, area with a radius of 100 m was designated for the infested area, a 300 m radius was designated for monitoring, and a 500 m radius was designated for control using a buffer analysis provided via the GIS. The methods utilized for survey include visual inspection and bait stations. GIS platform was also involved in lure survey program where every lure station was created on crossover point of grids of 50x50 m. With such information system, our control efforts brought the total infestation area of RIFA in Chiayi from 700 ha to 22 ha by 2013.The present case demonstrates that integrating the GPS and GIS techniques into RIFA monitoring and control can contribute to overall coordination of control efforts and promotion of control efficiency.

Efficacy of water-resistant fire ant bait against *Solenopsis invicta* (Hymenoptera:Formicidae)in the field in Taiwan

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Abstract

The aim of this study was to investigate the efficacy of water-resistant bait against *Solenopsis invicta* Buren, in the humid and rainy conditions under the field in northern Taiwan. A new bait(0.5% pyriproxyfen(wt/wt))was applied three times a year in the rainy days at the rates of 2kg/hectare in the field tests for control of red imported fire ant. Surveys using the visual technique and bait trap technique have shown that seven month after the application of water-resistant bait reduces 75.5%-98% of the active nests and worker ants. After the first one month of treatment , the number of broods, reproductive ants, and worker ants within the nests have all decreased significantly($p < 0.05$) with untreated area .In conclusion, this study shows that water-resistant bait could be an efficient tool to eliminated the ant especially in the humid areas, and also be an excellent substitute for current fire ant baits.

Key words: water-resistant bait; red imported fire ant; *Solenopsis invicta*; pyriproxyfen; Insect growth regulator

Introduction

The red imported fire ant, *Solenopsis invicta* Buren, is an invasive species from South America. They invaded the southern USA in the early twentieth century(Lofgren et al.,1975;Vinson,1997), and Australia and New Zealand in 2001 (Jennings and McCubbin,2004;Bissmire,2006).In 2003,an established infestation of the ant was identified in Taiwan(Huang et al., 2004), is still colonizing this island for more than a decade. Till the end of 2014, 64,000 hectares of Taiwan's northern region are assesses as the ants infested area. They are found in agricultural fields,plant nurseries, parks, campuses, wetlands, reservoirs, in green areas of the city and by riversides (Huang et al.,2004;Hwang, 2007, 2009;Hwang and Chen,2010). *S. invicta* have become the most common and most serious invasive species in campuses in Northern Taiwan (Hwang, 2015).It was also discovered in other parts of Asia in 2004, including mainland China and Hong Kong (Zeng et al.,2005;Oi and Oi,2006). In South China *S. invicta* has spread rapidly, and it is found in several provinces, Guangdong, Guangxi, Hunan, Fujian and Jiangxi, occupying at least 71 km^2 (Zhang et al., 2007).

The broadcasting of bait has long been the most effective, and a long-lasting method for the treatment of large areas infested with ants (Williams,1983;Lofgren and Williams,1985;Hwang, 2005).Juvenile hormones are Insect growth regulators that can deform pupae, deform adults, stop larval metamorphosis, sterilize the queen temporarily, and/or shift production away from workers toward sexual (Lofgren et al., 1975).The current baits commonly use soybean oil as the phagostimulant and corn grits as carrier (Williams,1986).Toxic bait can be an effective control measure for ants (Lofgren and Weidhaas, 1972).However, if the bait gets wet, the soybean oil separates and thus becomes unattractive to the ants. Also,if the bait exposes in sunlight, it breaks down quickly and then becomes ineffective (Banks, et al.,1988; Davis,2004; Drees, 2004).It is usually recommended to avoid bait application if rain is expected within 4-6 hours, because rain and even morning dew on the ground will degrade the corn grit carrier making the treatment ineffective. This limits the use of the current bait formulation, especially in humid tropical and sub-tropical areas. The purpose of this study, therefore, was to test the efficacy of water-resistant bait in controlling ants during rainy periods. The results could also provide a reference for fire ant population control in tropical and subtropical areas.

Materials and Methods

1. Field site

The field site is situated in the hilly areas of Northern Taiwan. A closure landfill that had been enclosed for 20 years, the area covered 18 hectares and was located at 121°20'08.75E, 24°54'04.22N.The landfill had been restored and afforested by loamy soil where no crops were planted. The plant species included perennial grass, centipede grass, morning glory and moss. Plant heights in some areas were 100~200 cm. Ant mounds were mainly distributed in open, sunny areas. Ant colonies are recognized multiple queen forms. The closure landfill had slope stability as cement ditches were cut to collect the leachate water. The weeds on the site were mowed third per year. The average monthly temperature of the field site was 16.1~29℃ and the average annual temperature was 23℃. Annual rainfall was 2,405 mm with an average number of rainy days per month of 11.7~15.5 and an annual number of 165.5 rainy days. The annual relative humidity was 76.6%.

2. Treatments

The Council of Agriculture, Executive Yuan, the National Taiwan University and Chung Hsi Chemical Plant Ltd. cooperated to develop the water-resistant bait using active ingredient (0.5% pyriproxyfen wt/wt) from the Sumitomo Chemical Co. Ltd. The bait was applied three times using spread rotary seeders, at the rates of 2 kg/hectare from August 2013 to March 2014 (i.e. August 2013, October 2013 and March 2014).The temperature on the three days of application was 29.0℃, 28.2℃ and 23.1℃, respectively; the rainfall was 2.5 mm, 0.3 mm and 1 mm. In this study, the selected natural infestation field had an area of 6 hectares. In each test, each treatment was applied to 3 plots; 3 plots were treated with water-resistant bait and 3 plots were left untreated as controls. A 1-hectare buffer area was delineated between the two sites to prevent the spread of ants. Evaluations were completed before1:00 p.m. during the summer to avoid false negative readings due to the heat. This study was performed monthly, both before and after treatment, and lasted one year. Appropriate data were then analyzed using IBM SPSS procedures with means separated using independent samples T test (IBM, 2011).

3. Evaluation of the effectiveness

(1) Minimal disturbance technique

(i) Number of mounds: using a visual technique, systematic investigations were performed in the treated and untreated sites .The number of mounds in the survey area were fixed with a GPS unit and marked with flags, after being confirmed that they were ant mounds. Mound activity was determined by using a minimal disturbance technique. Mounds were lightly disturbed with a pointed tool handle and ant reaction observed. If ants appeared at the surface, it was considered as active. The total number of mounds in the treated and untreated sites were recorded and compared to calculate the rate of decline. During this study, we observed and recorded the worker ants immediately foraging bait after its application.

(ii)Worker ant density of in individual mounds: all active mounds discovered in the treated and untreated sites were investigated. We counted the number of worker ants that crawled onto the iron bar(1 m long× 4mm diameter) in a 1-min time period. The density unite was taken as the number of ants per nest per minute (no./nest/min).The density of worker ants for the individual mounds in both the treated and the untreated sites were recorded and compared.

(2) Foraging evaluations:Bait trap technique

30~35 bait station per hectare were set using commercial potato chips as bait. A chip was taken with a pair of tweezers and place it in a 12-cm-long plastic tube (Eppenddorf, 50mL). Once the plastic tubes were placed, their locations are marked with a flag. The tubes are set up at 11am, and recollected and brought back to the laboratory 1h later, where the numbers of ants in the tubes is calculated. The percentage of positive bait traps and the number of trapped worker ants was used to assess the effectiveness of the treatment.

(3) Change of the population within a nest

We selected a random subplot in both the treated and untreated sites, for inspection. This monitoring of the treated and untreated sites were carried out monthly, both before and after treatment, to calculate the number of broods, worker ants, and reproductive ants within the nests. To perform the survey, the mound was dug open with a spade. Then, 5-mL measuring tubes were used to take random samples of the soil containing ants (including brood), 5 g each time, three times per nest, for a total of 15 g. This was placed in a bottle with 75% alcohol, and returned to the laboratory for detailed examination to determine the number of broods (eggs, larvae and pupae), reproductive ants, and worker ants of each nest(Hwang,2009).

Results

1.Minimal disturbance technique

(1) Number of mounds

The water-resistant bait was applied three times on rainy days from August 2013 to March 2014. Based on the results of the 12-month investigation, the number of mounds was reduced by 63.2% 3 months after the first application of the bait and by 94.7% after 12 months. After 3 months, there was a significant difference ($p < 0.05$) between the rate of decline of the mounds on the treated site compared to those on the untreated site. The standard deviation of the number of mounds on the treated site was greater than that for the untreated site. This indicated that the control effect differed among the plots on the treated site (Table 1).

Based on the investigation results, the number of mounds on the untreated site may be reduced in summer. As the weather condition is hot in the summer, the ants live in the deep soil and no mounds are formed. Furthermore, existing mounds may not easily be found due to collapse caused by rainfall. If the weather is suitable, however, mounds will be formed again. Since water accumulation due to rainfall and weeding occurred during the test period, colony division and movement may also have occurred in the infested area. In this study, the worker ant foraging was immediately observed after application of the bait. In fact, a large number of worker ants began to forage the bait two minutes after its application. From this, we can confirm that the water-resistant bait with the new carrier can enhance the foraging activity of workers ants.

Table 1
Effect of water-resistant pyriproxyfen on red imported fire ants in the field (visual technique)

Treatment	% reduction in mounds after number of months(Number of mounds)												
	0	1	2	3	4	5	6	7	8	9	10	11	12
Treated	0^{a} (6.3±1.5)	5.3^{a} (6.7±1.5)	15.8^{a} (5.3±3.2)	63.2^{a} (2.3±0.6)	68.4^{a} (2.0±1.7)	78.9^{a} (1.3±1.5)	78.9^{a} (1.3±2.3)	89.5^{a} (0.7±0.6)	94.7^{a} (0.3±0.6)	94.7^{a} (0.3±0.6)	94.7^{a} (0.3±0.6)	100^{a} (0±0)	94.7^{a} (0.3±0.6)
Untreated	0^{a} (5.7±1.5)	-5.8^{a} (6.0±1)	-82.4^{a} (10.3±1.2)	-205.9^{b} (17.3±2.0)	-170.6^{b} (15.3±4)	-235.3^{b} (19.0±3)	-117.6^{b} (12.3±2.1)	-152.9^{a} (14.3±4.2)	-135.3^{b} (13.3±2.1)	-170.6^{b} (15.3±3.2)	-141.2^{b} (13.7±1.2)	-82.4^{b} (10.3±2.1)	-58.8^{b} (9.0 ±2)

Means in the same column with the same letter are not significantly different by independent-sample T- test (p＜ 0.05).

(2) Worker ant density in individual mounds

Based on their density of worker ants in individual mounds were carried out using the disturbance techniques on the treated site was dramatic reduction in the first month after application of the bait. The density was 43.1±17.1/nest/min before application. It was reduced to 12.6±7.6/nest/min after one month of application and 1.3±2.3/nest/min after 12 months (Table 2). One month after application, there was a significant difference (p<0.05) between the density of worker ants on the treated and untreated sites. During the investigation, the density of the worker ants in the individual mounds ranged from 43.1±17.1/nest/min to 79.3± 9.9/nest/min in the untreated site (Table 2).This indicates that the colony dynamics may effect due to environmental condition or sexual maturity.

Table 2
Effect of water-resistant pyriproxyfen on red imported fire ants in the field (minimal disturbance technique)

Treatment	Month (No./nest/min)												
	0	1	2	3	4	5	6	7	8	9	10	11	12
Treated	43.1±17.1^{a}	12.6±7.6^{a}	11.3 ±2.4^{a}	15.1±7.0^{a}	12.2±7.9^{a}	16.9±14.9^{a}	11.3±6.5^{a}	10.7±6.1^{a}	6.3±1.0^{a}	6.7±1.0^{a}	1.0±1.7^{a}	0±0^{a}	1.3±2.3^{a}
Untreated	66.4±14.1^{a}	39.0±9.4^{b}	74.4 ±17.0^{b}	44.7±10.9^{b}	79.3±9.9^{b}	46.3±13.2^{a}	61.9±7.5^{b}	62.1±20.1^{b}	55.8±12.5^{b}	58.8±19.8^{b}	60.0±18.0^{b}	41.4 ±9.8^{b}	45.9 ±8.1^{b}

Means in the same column with the same letter are not significantly different by independent-sample T- test (p＜ 0.05).

2. Foraging evaluations

(1) Ratio of positive bait traps

The findings showed that the ratio of positive bait traps was 51.1±10.2% before application but decreased one month after application. There was a significant difference (p<0.05) between the ratio of positive bait traps on the treated site compared to the untreated site. The ratio of positive bait traps was decreased to 12.2±9.6% after 12 months of bait application (Table 3). The standard deviation in the ratio of positive bait traps in the treated site was greater than that of the untreated site, indicating that the control effect differed among the plots on the treated site. This study used the bait trap technique to evaluate the foraging ability of the ants. Based on the ratio of positive bait traps, it can be seen that the incidence rate of the ants was high within the infested area. Mounds were mainly distributed in bare ground or in places where weeds were shorter. It should be noted that the subplots were separated by cement ditches, reducing the range for foraging; this is the reason for the high incidence rate.

Table 3
Effect of water-resistant pyriproxyfen on controlling red imported fire ants (bait trap technique)

Treatment	Positive bait trap,%												
	0	1	2	3	4	5	6	7	8	9	10	11	12
Treated	51.1± 10.2 ^{a}	25.6± 7.7 ^{a}	40.0± 17.6 ^{a}	36.7 ± 3.4 ^{a}	20.0 ± 6.7 ^{a}	4.5± 3.9 ^{a}	16.7 ± 15.2 ^{a}	17.8 ± 18.4 ^{a}	7.8± 5.1 ^{a}	5.6± 3.9 ^{a}	1.1± 1.9 ^{a}	0± 0 ^{a}	12.2± 9.6 ^{a}
Untreated	56.7± 8.9 ^{a}	93.3± 3.3 ^{b}	100± 0 ^{b}	96.7 ± 5.8 ^{b}	100± 0 ^{b}	85.6 ± 6.9 ^{b}	95.6 ± 7.7 ^{b}	97.8 ± 3.9 ^{b}	98.9 ± 2.0 ^{b}	96.7 ± 5.8 ^{b}	97.8 ± 2.0 ^{b}	56.7 ± 10.0 ^{b}	47.7± 7.7 ^{b}

Means in the same column with the same letter are not significantly different by independent-sample T- test ($p < 0.05$).

(2) Number of worker ants

In this study, the number of worker ants was investigated to explore the foraging ability of ants. Based on the average number of ants trapped in the bait station each month, the number of the worker ants was 38.0±9.5 before bait was applied; that number was reduced one month after bait application.There was a significant difference ($p < 0.05$) between the number of trapped worker ants in the bait station on the treated and untreated sites after one month. After 12 months, the number was further decreased to 3.0±1.0 (Table 4). Unfortunately, high temperatures and the hot summer sun reduce ant foraging, and thus affected the ratio of positive bait traps in the untreated site. Therefore, the application of bait in the summer may also reduce worker ant foraging.

Table 4
Effect of water-resistant pyriproxyfen on controlling red imported fire ants (bait trap technique)

	Ave. No. of Worker/bait trap												
	0	1	2	3	4	5	6	7	8	9	10	11	12
Treated	38.0 ±9.5 ^{a}	24.3 ±9.9 ^{a}	7.3 ±4.9 ^{a}	2.7 ±0.6 ^{a}	1.3 ±0.6 ^{a}	0.7 ±0.6 ^{a}	1.3 ±0.6 ^{a}	2.0 ±2.0 ^{a}	1.7 ±0.6 ^{a}	0.7 ±0.6 ^{a}	0.7 ±1.2 ^{a}	0 ±0 ^{a}	3.0 ±1.0 ^{a}
Untreated	35.0 ±7.2 ^{a}	88.3 ±11.0 ^{b}	103.0 ±2.6 ^{b}	99.0 ±23.4 ^{b}	59.7 ±9.1 ^{b}	78.7 ±10.7 ^{a}	62.3 ±10.4 ^{b}	70.1 ±21.9 ^{b}	114.0 ±13.7 ^{b}	112.3 ±7.8 ^{b}	101.0 ±2.0 ^{b}	33.0 ±12.1 ^{b}	33.7 ±7.5 ^{b}

Means in the same column with the same letter are not significantly different by independent-sample T- test ($p < 0.05$).

3. Change of population within nests

Active mounds in the treated and untreated sites were dug into and 15 kg of soil was collected in order to calculate the number of ants. The findings showed that, before bait application, the average number of brood in each nest was 40.3±35.3/15g soil, the number of reproductive ants was 10.8±6.0/15g soil and the number of worker ants was 61.2±20.0/15g soil. After the first one month of treatment, the number of broods, reproductive ants and worker ants in the nest was 10±4.6/15g soil, 12.8±6.8/15g soil and 33.6±18.8/15g soil, respectively. From this, we can see that the number of broods and worker ants was quickly reduced, but not the number of reproductive ants (Fig. 1). After one month, there was a significant difference ($p < 0.05$) between the number of broods, reproductive ants and worker ants in the treated and untreated sites. The number of eggs laid by the queen was reduced in the treated site after bait was applied, resulting in a dramatic reduction in the number of brood in the nest. However, new brood (eggs, larvae and pupae) could still be found even after 12 months of bait application. After six months observation and no further sightings of brood, reproductive or worker ants, the inactive nests were excavated to reveal the queen, still alive. Further study should be taken to determine whether the survival mechanisms of the queen can cause reinfestation.

Based on the number of brood and adult ants in the untreated site nests each month, the ants grow and reproduce at all seasons, nuptial flights can occur throughout the year in Northern Taiwan. Brood, reproductive and worker ants emerge each month, but their population and breeding peaks in April and September (Fig. 2). To take advantage of the controlling effect of the bait, March-June and September-November are the best periods for applying bait. If mould rains or typhoons occur within those periods, the amount of rainfall may negatively impact both the opportunities to use bait and its effect. The proposed use of water-resistant pyriproxyfen on rainy days or during the rainy season can solve this problem.

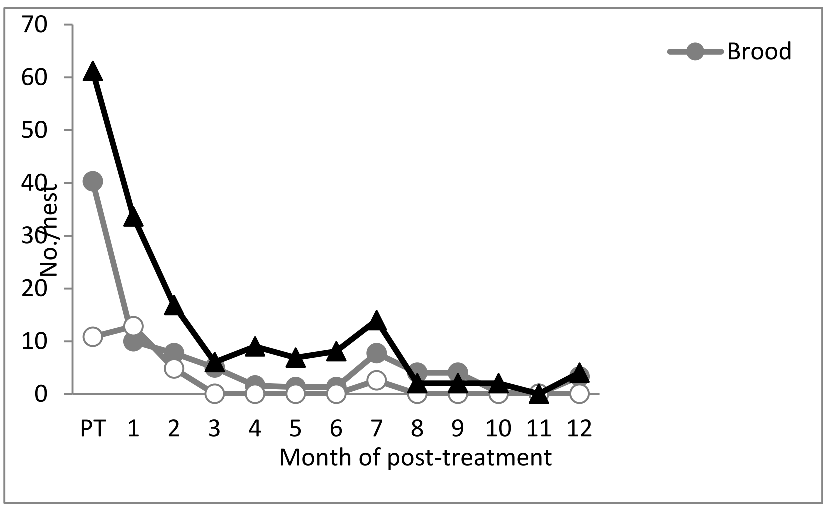

Fig.1. Change of population within nests after application of post-treatment.

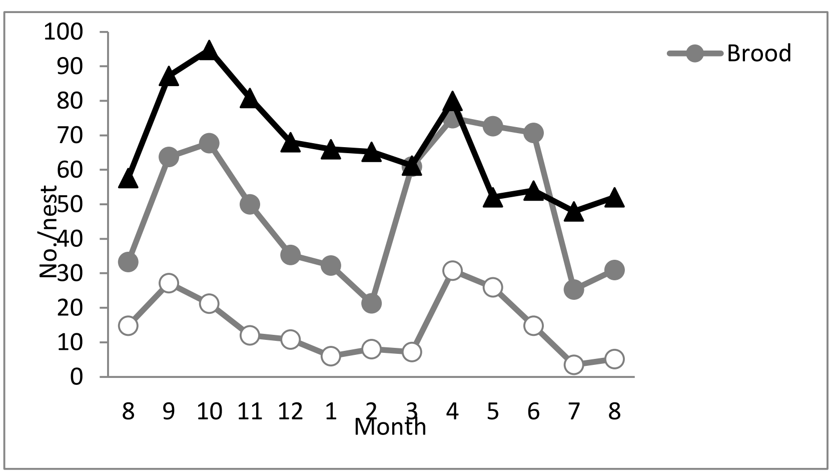

Fig.2. Number of fire ants within nest in seasonal variations during the study.

Discussion

The pypriproxyfen bait was found to be as effective against the ants(Banks and Lofgren, 1991).Hwang(2009,2015)reported the successful eradication of ants via the application of pyriproxyfen bait in reservoirs, schools and other environmentally sensitive areas. Hwang (2011) indicated that April to November is the best time to apply bait in northern Taiwan according to the temperature. Unfortunately, the annual number of rainy days is 186 days and the annual rainfall is 3,310 mm, greatly reducing the efficacy of any bait. Furthermore, the bait is easily wetted and ants cannot be trapped. The tropical and subtropical regions are humid and rainy. Due to weather instability, application delays, and/or waste of bait or human resources due to rain and wetted after application, the control effect of the bait is negatively impacted. Therefore, the development of water-resistant bait can improve the control of ants in tropical and subtropical regions. Kafle et al. (2009) reported that, although microencapsulated corn grit bait could resist water, the ants were not stimulated to feed on it. Kafle et al. (2010) indicated that, in the field, new water-resistant bait (cypermethrin 0.128%) is efficient fire ant bait, especially under moist conditions. Unlike Kafle et al.'s study, in our field tests, the bait was applied on three rainy days and the monitoring and control lasted one year.

The research of Hwang (2009), which performed field tests in Taoyuan, Taiwan with grift bait formulation of pyriproxifen, shows that in the 6 month of treatment, the decline increased at the rate of 92.3%, reaching 99.8% in the seventh month. The control effect is as good as that of water-resistant pyriproxyfen applied on rainy days. In addition, it was observed that the worker ants started to forage two minutes after its application. Therefore, water-resistant bait is made of the hydrophobic carrier and shrimp shells, which can enhance the foraging activity of worker ants. This study found that ants grow and reproduce all year round in Taiwan, and population peaks from April to May and September to October. The mould rain and typhoon had just occurred during this period and, as a result, the rainfall and overall number of rainy days had increased. The water-resistant bait increases the opportunities for control during reproduction period. The standard deviation in the number of mounds in the treated site is greater than that for the untreated site. This indicates there were differences in the control effect in repeated areas of the treated site.

The control effect of an insect growth regulator is generally evaluated using two methods: visual technique and population index (Banks et al., 1988; Lofgren and Williams, 1985). During hot, dry periods of the year, ants reside deep in the soil and may not construct mounds; in the rainy season, the mounds are not easy to discover due to collapse or some ants colonies are located in tree stumps, compost piles, or other structures, where their colony may not be easily observed or not associated with a mounds. Thus, additional methods, such as use of food lures placed alone or in some type of container to attract foraging workers ant, is a valuable addition. This study also used the bait trap technique to explore the incidence rate of ants in the infestation area. Active nests were also excavated to identify the effects of the growth regulator on broods and adult ants. The seasonal fluctuation of the ants in the untreated area can be examined to select the best time for the application of bait.

The report by Hwang et al. (2015) indicates that 23.6% of schools still had reinfestation of ants even after the application of bait and two years monitoring. As a result, ants will to recover 1~4 years after the initial eradication. Within six weeks after ant queens ingest pyriproxyfen the ovarioles became vacuolated, the tunica propria thickened, and most eggs are resorbed (Glancy, et al.,1990).The research of Banks and Lofgren(1991)points out the effects appear to be reversible, however ,if the pyriproxyfen is eliminated by metabolism or excretion. Queens collected from treated field colonies at six weeks posttreatment exhibited these effects. However, queens collected from other colonies within the same plot at 24 weeks, when effects of the pyriproxyfen were no longer apparent, had normal ovaries and a full complement of eggs within the ovarioles. The result of this study show that , even after six months observation and no active signs of brood, reproductive or worker ants, when the inactive nests were excavated, the surviving queens were exposed. These effects appear to be reversible, however, if the insect growth regulator is eliminated by metabolism or excretion. Therefore, future studies could be conducted on the survival mechanisms of queens and whether they can cause reinvasion.

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An overview of Fire Ants Impacts on Fish

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The water and deep soil around ponds/lakes/ fish farms and along rivers provide ideal habitat for fire ant colonization. Reflective surface of water is attractive to fire ant swarmers. During breeding season, thousands of winged adult ants go on mating flight. Multitude of adult ants inevitably land on water. Additionally, fire ant workers readily construct rafts to float upon water during flash flooding. In both situations, fire ants become accessible to fish.

Much has accumulated since Green and Hutching (1960) first reported red imported fire ants affecting fish. Some document fire ants a food supply for fish and some implicate fire ants a cause for fish death. This work reviews documented cases pertaining to fire ant impacts on fish during the approximately 70-y period since its introduction to the U.S. in the early 1930s, as an effort to synthesize the state of our knowledge regarding those impacts.

Cases

Green and Hutchins (1960, JEE):

A considerable number of bluegill bream (*Leponis* sp.) was fund died in farm ponds after heavy rains in South Mississippi and Alabama. Autopsy revealed distended stomach by a large ball of fire ants. Pond test and laboratory tests observed fish ate and then disgorge most of the live and dead fire ants. Fish was able to avoid live ants after the 1st encounter. Fish force-fed with 2 ml H2O blended with 0.5 g of macerated ants disgorged much but displayed signs of poisoning in 5 min and died in 1 h, indicating that fire ant was toxic to fish.

Prather (1960, P. ACSAGFC)

Bluegills and sunfish (*L. microlophus*) were force-fed gelatin capsules containing 100g ant workers twice/d, 5 days/wk for 4 wk, but none of the fish showed ill effects.

Grance (1965, The Progressive Fish-Culturist)

More than 95% of the sick or dead bluegills collected from 27 ponds contained fire ants in their stomachs. The number of partially digested fire ants ranged from 25 to 60 per fish, indicating ingestion of winged ants was fatal to bluegills and sunfishes. However fish ingested fewer ants could recover with no apparent lasting effects.

Texas Parks and Wildlife Department (1998, 1999, The Texas Journal of Science)

Dead rainbow trout contained winged ants in stomach (1961-1963). More than 22,000 stocked rainbow trout in the Guadalupe were dead after eating dead ants in 1998. Some trout contained about 500 ants, indicating they died from toxins in the dead ants rather than from stings.

Alabama observations by Waters, Catchings , Wright, Raines etc. (2000s)

Dead fish in farm ponds and lakes was reported every spring after a heavy rain or a major fire ant warming. Necropsies of dead fish always showed stomachs full of ants. A plausible explanation was overindulgence of ants by fish.

Hu, Ray and Haffner (2011)
10% trout died in Smith Lake the day after a fire ant swarming in later spring in North-Central AL. Autopsies revealed stomachs were tightly packed with winged ants, ranging from 25-60 by counting ants abdomen.

Discussion
Case review casts a doubt on fire ants as a food supply but shines some light on a combination of overindulgence and venom being the cause of fish kill. Not all the fish are susceptible to fire ants. Some fish are able to avoid feeding on fire ants after one exposure. The impacts of fire ants on fish remain unquantified. More experimental research is needed to provide a better understanding that can lead to better management of potentially affected fish species.

Formic Acid Disrupts Red Imported Fire Ant Foraging and Defense

Cai Wang and Gregg Henderson
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Formic Acid, a product of most formicine ants, was found to affect both the foraging ability and defense behavior of Red Imported Fire ants. It is suggested that formicine ants, like carpenter ants, may use formic acid to their advantage to disrupt fire ant foraging when living sympatrically.

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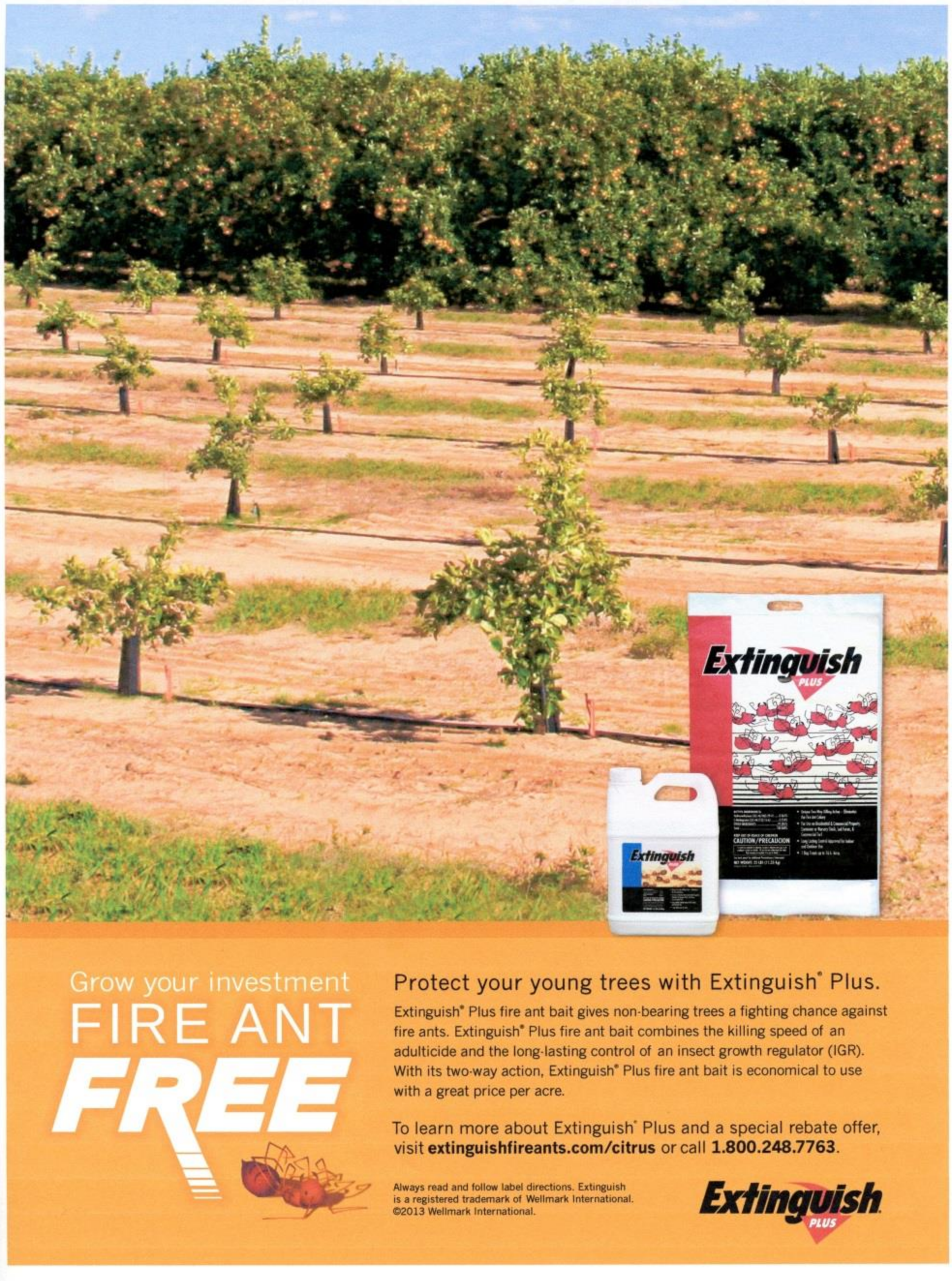

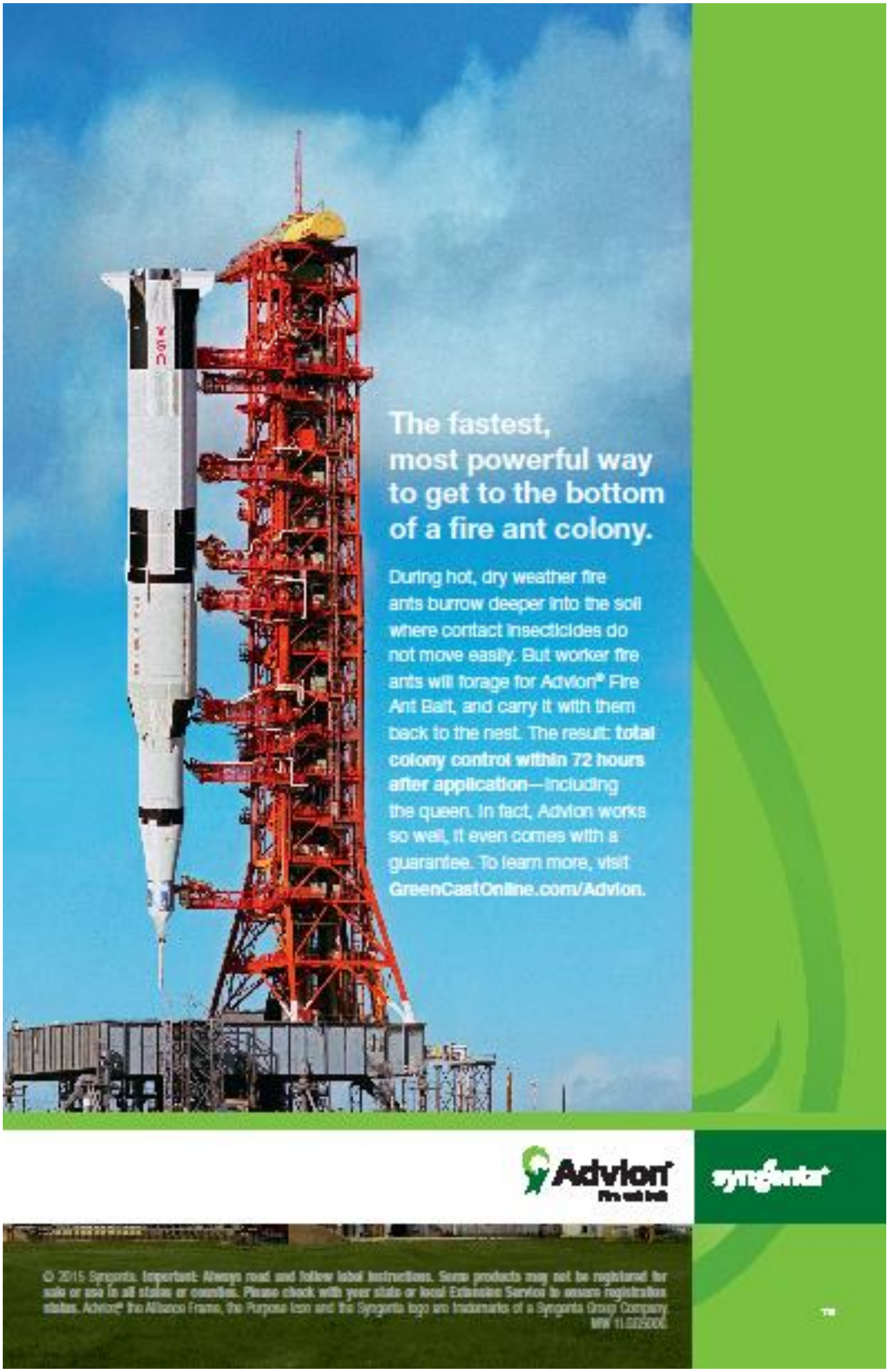
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Appendix 1: 2015 Program Agenda

2015 Imported Fire Ant and Invasive Pest Ant Conference
New Orleans, Louisiana

2015 Imported Fire Ant and Invasive Ant Conference

Maison Dupuy Hotel
1001 Rue Toulouse, New Orleans, Louisiana 70112
April 6-8, 2015

Monday, April 6

3:00 - 5:00 pm	**Registration in hotel lobby area**
5:30 - 7:30 pm	**Welcome reception (Main Courtyard/LeMertage; if inclement weather, Toulouse/Salon Renoir)**

Tuesday, April 7

7:00 - 8:30	**Continental breakfast (Main Courtyard/LeMertage)**
8:00 - 5:00	**Registration continues**

Opening Session **Dr. Tim Schowalter, Moderator (Toulouse ABC)**

8:30 - 9:00	Welcome and housekeeping
9:00-9:15	Commissioner Mike Strain, Louisiana Department of Agriculture and Forestry
9:15 - 9:30	Zack Lemann, Virtual Tour of the Audubon Insectarium

Regulatory: Moderator, Anne-Marie Callcott (Toulouse ABC)

9:30 - 9:45	Update on USDA-APHIS imported fire ant activities - policy, science and field. **Anne-Marie Callcott**, Ron Weeks and Charles Brown, USDA-APHIS-PPQ, Biloxi, MS
9:45 - 10:00	Imported fire ant regulatory activities of the Texas Department of Agriculture. **Awinash P. Bhatkar**, Texas Department of Agriculture, Austin, TX
10:00 - 10:30	**Break and poster viewing**

Fire Ant Management: Moderator, Molly Keck (Toulouse ABC)

10:30 - 10:45	Expansion of the range of the red imported fire ant in the Coachella Valley. **Jennifer A. Henke**, Coachella Valley Mosquito and Vector Control District, Indio, CA
10:45 - 11:00	Tackling fire ants, after a student death, a case study for school IPM in Texas. **Paul R. Nester**, Janet A. Hurley, Brett Bostian and Walter "Buster" Terry, Texas A&M Agrilife, Houston, TX

11:00 - 11:15 Reducing red imported fire ant populations in the Waverly Acres Airpark Community. **Paul R. Nester** and Reggie Lepley, Texas A&M Agrilife, Houston, TX

11:15 - 11:30 Lure, switch and bait: a novel concept for fire ant management around endangered species. **Molly Keck**, Bart Drees, Alejandro Calixto, Natalie Cervantes, Texas A&M University, College station, TX

11:30 - 1:00 **Lunch (on your own)**

Tawny Crazy Ant Management: Moderator, Dennis Ring (Toulouse ABC)

1:00 - 1:15 Status and management of tawny crazy ants (*Nylanderia fulva*) in Alabama. **L. C. 'Fudd' Graham**, Kelly Palmer and Jeremy Pickens, Auburn University, Auburn, AL

1:15 - 1:30 Experiences with tawny crazy ant, *Nylanderia fulva*, control in Mississippi. **M. Blake Layton**, Mississippi State University, Mississippi State, MS

1:30 - 1:45 Toxicity profiles and colony effects of liquid baits on tawny crazy ants. **David H. Oi**, USDA-ARS-CMAVE, Gainesville, FL

1:45 - 2:00 Strategies for tawny crazy ant (*Nylanderia fulva*) management in urban settings. **Robert T. Puckett** and Roger E. Gold, Texas A&M University, College Station, TX

2:00 - 2:15 Area wide strategy for managing the tawny crazy ant. **Paul R. Nester**, Texas A&M Agrilife, Houston, TX

2:15 - 3:00 **Break and Poster Viewing**

3:00 - 3:15 Fire ant eXtension celebrates its 10th anniversary. Where do we go from here? **Kathy Flanders** and Paul Nester, Auburn University, Auburn, AL

3:15 - 5:00 Extension work session, Part 1

8:00 - 5:00 **Poster Session**

1. Lab studies on interspecific competition among *Pseudacteon* spp. **Sim Barrow**, Kelly Loftin, John Hopkins and Ricky Corder, University of Arkansas, Fayetteville, AR
2. Caste-specific terpenoids in little black ants, *Monomorium minimum*. **Jian Chen**, Lei Wang, and David Oi, USDA-ARS-CMAVE, Gainesville, FL
3. A novel design for a mechanical aspirator targeting ant-sized insects. **David C. Cross** and M. A. Caprio, Mississippi State University, Starkville, MS
4. Application of GPS and GIS for survey and control of red imported fire ants in Chaiyi, Taiwan. **Li-Hsin Huang**, Jung-Chun Chu, Shen-Kuan Chen, Shou-Hong Huang, Jian-Cheng Yin, Ming-Ying Lin and Wen-Ying

Su, Taiwan Agricultural Chemicals and Toxic Substances Research Institute, Taichung, Taiwan

5. Efficacy of water-resistant fire ant bait against *Solenopsis invicta* (Hymenoptera: Formicidae) in the field in Taiwan. **Ji-Sen Hwang**, Taipei Municipal University of Education, Taiwan
6. Red Imported Fire Ants in the Dry Prairies of Central Florida: An Analysis of Habitat Suitability. **Danielle K. Romais**, Scott H. Markwith and Sanford Porter, Florida Atlantic University, Boca Raton, FL
7. Cases review of fish kill caused by fire ants. **Xing Ping Hu**, Auburn University, Auburn, AL
8. Formic Acid Disrupts Red Imported Fire Ant Foraging and Defense. C. Wang and **Gregg Henderson**, Louisiana State University, Baton Rouge, LA

Wednesday, April 8

7:00 - 8:30 **Continental Breakfast (Main Courtyard/LeMertage)**

Biology and Ecology: Moderator, Roberta Dieckmann (Toulouse ABC)

8:30 - 8:45 The reproductive flight phenology of *Nylanderia fulva* (Hymenoptera: Formicidae). **Danny L. McDonald** and Jerry L. Cook, Sam Houston State University, Huntsville, TX

8:45 - 9:00 Negative interactions between ants and *Heraclides* species in Biscayne National Park, Florida. **Jaeson Clayborn** and Suzanne Koptur, Florida International University, Miami, FL

9:00 - 9:15 Biology and host specificity of *Pseudacteon bifidus* a decapitating fly of the tropical fire ant, *Solenopsis geminata*. **Sanford D. Porter** and Robert M. Plowes, USDA-ARS-CMAVE, Gainesville, FL

9:15 - 9:30 Beneficial and consequential effects of saline water on *Solenopsis invicta*. **Yadira Reynaldo**, Jaeson Clayborn and Dr. Deby L. Cassill, Florida International University, Miami, FL

9:30 - 9:45 Fire ant sting: pathophysiology and natural remedy. **Kevin Ng** and Gina Ng, University of Miami (retired), Miami, FL

9:45-10:30 **Break**

10:30 - 11:30 State, Industry and Federal reports

11:30 - 1:00 **Lunch (on your own)**

Biology and Ecology: Moderator, Chin-Cheng (Scotty) Yang (Toulouse ABC)

1:00 - 1:15 Biochemical evidence for cryptic *Solenopsis* species that are morphologically *S. invicta*. **Robert K. Vander Meer** and Sanford D. Porter, USDA-ARS-CMAVE, Gainesville, FL

1:15 - 1:30	Mechanism of oil intake and distribution of radioactive linolenic and linoleic acids in fire ant. **Matthew J. Landry**, R.M. Strecker, L.M. Bui, Louisiana State University, Baton Rouge, LA
1:30 - 1:45	The new ecological invasive forest ant, *Dolichoderus thoracicus*, in Lienhuachih Forest Dynamics Plot of Taiwan. **Feng-Chuan Hsu**, Chung-Chi Lin, National Changhua University of Education, Changhua, Taiwan
1:45 - 2:00	Feasibility and compatibility of native ant species as biocontrol agent in integrated management framework for invasive fire ant in Taiwan. **Chin-Cheng (Scotty) Yang**, Hung-Wei Hsu, Rong-Nan Huang, Wen-Jer Wu, National Taiwan University, Taipei, Taiwan
2:00 - 2:15	Unmanned aerial vehicle applications for red imported fire ants (*Solenopsis invicta*) control in Taiwan. **Wei-Feng Hung**, Hui-Min Lin, Yang-Yuan Chen and Chung-Chi Lin, National Changhua University of Education, Changhua, Taiwan
2:15 - 2:45	Future meeting discussion
2:45 - 3:15	**Break**
3:00 - 5:00	Optional tour of the Audubon Insectarium
3:15 - 5:00	Extension Work Session, Part 2
6:00 – 9:00	**Crawfish Boil (Main Courtyard/LeMertage; if inclement weather, Toulouse/Salon Renoir)**

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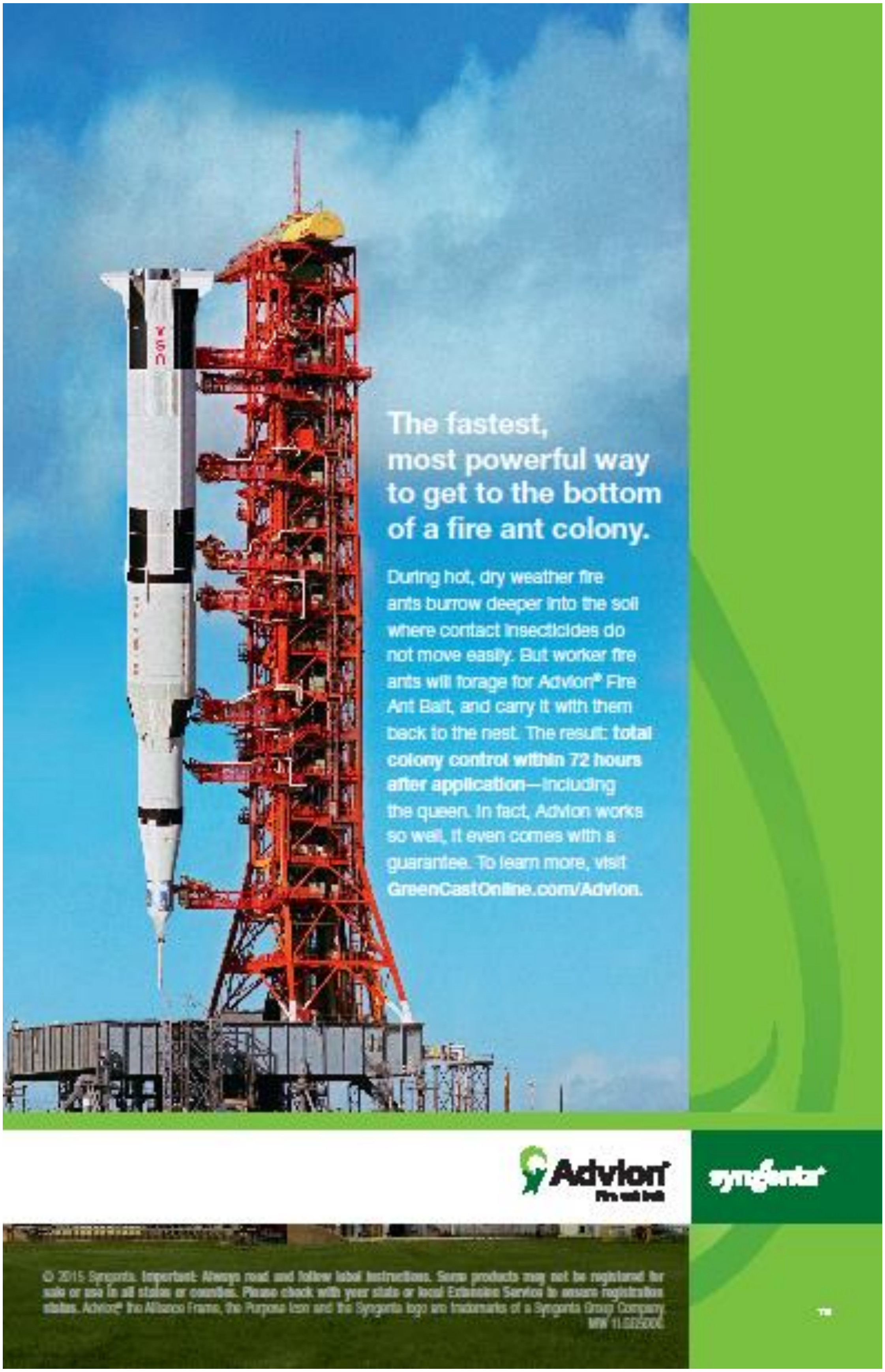
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