COLLEGE OF AGRICULTURE PROJECT REPORT

TITLE: Behavioral-based control methods for ambrosia beetle management in ornamental nurseries

PROJECT START DATE: 10/1/2015

PERCENT ASSIGNMENT: 75%

ROLE: PI

REPORTING PERIOD JANUARY 1- APRIL 30 MAY 1- SEPTEMBER 30 **X** OCTOBER 1- DECEMBER 31

PROJECT DIRECTOR: Karla Addesso

NON-TECHNICAL SUMMARY:

Nursery and greenhouse crops account for $16 billion of the United States economy. The nursery industry is complex due to the large number of plant species grown, which makes nursery pest management research challenging. Pests that have large economic impacts, attack multiple, high production genera and are quarantine restricted are key targets for research. One major problem impacting the nursery industry today is ambrosia beetles. These beetles feed and reproduce within living or dead trees. The beetles are difficult to control with conventional pesticides, and in the nursery industry, even cosmetic damage from the beetles can result in trees that are unsalable. The overall goal of this project is to investigate new tools for the integrated management of ambrosia beetles in nursery crops. The three areas of inquiry include (1) the identification of new attractants and repellents, (2) applications of the plant defensive hormones methyl salicylate or methyl jasmonate as nursery tree protective treatments, and (3) the recruitment of predators into nursery stands as a biological control option. These objectives will be accomplished through field and laboratory assays conducted at Tennessee State University's Nursery Research Center, located at the center of Tennessee's nursery production industry. The availability of additional management approaches based on any combination of attractants, repellents, plant hormone treatments and natural enemy augmentation will move the nursery industry toward an integrated approach to ambrosia beetle management and away from sole reliance on conventional pesticides.

MAJOR GOALS OF THE PROJECT

The overall goal of this research program is to increase understanding of the behavior and chemical ecology of important ambrosia beetle species, their host plants and predators. This goal will be achieved by investigating three objectives.

1. Identification of attractive and repellent compounds for use in ambrosia beetle management.
2. Effect of plant defensive hormone treatments on ambrosia beetle attacks and plant health.
3. Recruitment of ambrosia beetle predators into nursery stands.

WHAT WAS ACCOMPLISHED UNDER THESE GOALS?

1. Identification of attractive and repellent compounds for use in ambrosia beetle management. Three oils were tested in combination with ethanol standard in the field using white trifold panel traps for a second year in both Tennessee and Connecticut for four weeks, with 8 replicates per treatment. Beetles from Tennessee have been identified for both 2014 and 2015. Connecticut samples are currently being processed and will be identified to family focusing on Scolytidae. Ambrosia beetles will be identified to species where possible with a focus on the four most common ambrosia beetles nursery pests: granulate ambrosia beetle, black stem borer, fruit-tree pinhole borer and camphor shot borer. In the current year in Tennessee we captured a total of 3,273 beetles. The most populous species were *Xylosandrus crassisusculus* (1,599), *X. germanus* (482), *Xyloborinus saxeseni* (356),

Cnestus mutilaus (297), *Euwallaceae validus* (140), *Xyleborus intrusus* (94) and *Xyleborus xylographus* (49).
All other species were caught with 20 or fewer specimens. *X. crassiusculus* showed the strongest preference for conopthorin+EtOH (362 EtOH vs 611 EtOH+conopthorin captures). *Xylosandrus germanus*, *Xyloborus xylographus* and *Xyloborinus saxeseni* also had more trap captured in the conopthorin traps. *Cnestus mutilatus* showed the opposite trend (132 EtOH vs. 33 EtOH+conopthorin). Only *Xyleborus intrusus* appeared to prefer the juniperberry oil (10 EtOH vs 65 EtOH+juniperberry).
Repellency tests were also re-run this year in Tennessee. 2014 trap captures were extremely low and did not provide much information on preferences. 2015 data is currently being processed.
2. Effect of plant defensive hormone treatments on ambrosia beetle attacks and plant health.
This year there were no statistical differences in the number of hits between trees pre-treated with MeJA and controls (25.6 control vs 33 MeJA mean hits), (13.4 vs. 16.4 galleries established). Nor were there any differences in chlorophyll reading via SPAD on Day 0 or Day 14 post stress treatment.
3. Recruitment of ambrosia beetle predators into nursery stands. The data from the clerid beetle attraction test has been fully processed. A number of different bark beetle species were collected using the 4 lures. Very few bark beetle predators were collected. In ten weeks of collecting we identified 6 specimens of *Thanasimus dubius*, our clerid of interest and 5 specimens of *Enoclerus nigripes*.

WHAT DO YOU PLAN TO DO DURING THE NEXT REPORTING PERIOD TO ACCOMPLISH THE GOALS?
1. We will be testing some additional compounds in the spring of 2016 for lures which have shown activity in the lab.
2. We will be testing a new fungicide product, which is reported to mitigate plant stress and increase growth as well as prevent fungal infections. We will test this in place of the hormone applications for use in mitigating ambrosia beetle attacks. We will also be continuing to test a 'blocker' product trialed in 2015 for blocking ethanol emission from trees as a potential management tool for ambrosia beetles.

PRODUCTS
Peter B. Schultz, Steven D. Frank, Michael E. Reding, Patrick Tobin, Jason B. Oliver, Karla Addesso. Non-native ambrosia beetles as indicators of living, but weakened trees. Christopher Ranger (presenter), P-IE Section Symposium: Exploring Complex Interactions among Non-Native Bark and Ambrosia Beetles (Coleoptera: Scolytinae), their Associated Fungi, and Naïve Hosts. Entomological Society of America Annual Meeting, Portland, OR, November 15-19th, 2014.

Karla M. Addesso and Jason B. Oliver. Woody Ornamental Pest Management: Safer Solutions for Challenging Pests in Nursery and Landscape. University of Tennessee Entomology and Plant Pathology Department Seminar Series.

Karla Addesso. Systemics, Organics and Alternative Methods for Pest Control in the Landscape. Middle Tennessee Landscape and Grounds Management Shortcourse.

Karla Addesso. Ornamental Nursery and Landscape Pests of Concern in Tennessee. Tennessee Nursery and Landscape Association and Tennessee Nursery and Green Industry Educational Field Day, TSU Nursery Research Center, June 3rd, 2014.

Chris Werle (student), Karla Addesso, Blair Sampson and John J. Adamczyk. Kaolin clay application as a deterrent for ambrosia beetle (Curculionidae: Scolytinae) attack at ornamental nurseries. Entomological Society of America Annual Meeting, Portland, OR, November 15-19th, 2014.

Alicia Bray, Karla Addesso, Jason Oliver and Paul A. O'Neal. Calling all wood-boring beetles: laboratory and in-field bioassays with potentially attractive compounds for beetle management. Entomological Society of America Annual Meeting, Portland, OR, November 15-19th, 2014.

Jason B. Oliver, Karla Addesso, Nadeer Youssef, Paul A. O'Neal, Christopher Ranger, Michael E. Reding, Peter B. Schultz, Blair Sampson, Joshua P. Basham, Joseph Lampley and Debbie Eskandarnia. Tree proximity and ethanol dose as factors in trap tree strategy for exotic ambrosia beetles. Entomological Society of America Annual Meeting, Portland, OR, November 15-19th, 2014.

Target Audience

The target audience for this reporting period included student interns and grower stakeholders. Students learned field and laboratory data collection and analysis approaches. Extension and outreach was performed for growers in the form of a talk delivered at an industry field day and a educational display at the TNLA Green Industry Field Day as well as additional presentations local and national meetings.

How Have the Results Been Disseminated to Communities of Interest?

Several presentations have been given at local landscape shortcourse, field days to growers and landscapers in Tennessee.
Scientific results have been presented at the national Entomological Society of America Meeting.

Student Count

This season three graduate students helped with this project while also working on their masters theses. This exposed the students to techniques in chemical ecology and nursery pest management. One masters student has shifted his plan of study to continue with the stress-mitigation work.

Impact

Nursery and greenhouse crops make up $16 billion of the United States economy. The nursery industry grows many different types of plant species, which makes nursery insect management research challenging. Pests that cause lots of damage to many types of popular trees and shrubs are key targets for research. One major insect attacking nursery crops is the ambrosia beetle. The beetles are difficult to control with regular pesticides.

The goal of this project is to investigate new ways to control ambrosia beetles in nursery crops. The three areas of study are: new ways to attract and repel the insect; use of natural plant hormones to protect trees; and using other insects to eat ambrosia beetles.

One compound was identified that increased the numbers of beetles that could be lured away from the trees, but it is expensive and probably not worth the expense to growers. However, some of the compounds tested showed promise for trapping other kinds of insects and will be studied further. A fungicide product was identified that when applied prior to tree stress, reduced ambrosia beetle attacks by 90%. Another compound was identified that can be mixed with a standard organic pesticide and used to block the one of the natural chemicals used by the beetle to locate trees to attack. The next step in this research will be to make this compound more resistant to weathering. As these results are perfected and incorporated into nursery production methods, this research will have lasting effects on the ability for nursery producers to grow healthier trees with fewer pesticides.