V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

Global Food Security and Hunger - Reducing plant pest problems using environmentally sound methods.

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
133	Pollution Prevention and Mitigation				5%
211	Insects, Mites, and Other Arthropods Affecting Plants				50%
212	Pathogens and Nematodes Affecting Plants				15%
215	Biological Control of Pests Affecting Plants				30%
	Total				100%

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	0.0	14.4
Actual	0.0	0.0	0.0	16.7

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	0	366799
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	0	348312
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	486538

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research experiments with approved and experimental insecticide compounds will be conducted that
will lead to new or improved fire ant and Japanese beetle quarantine treatments for field nursery plants. The research will expand grower options in the Federal Imported Fire Ant Quarantine and the U.S. Domestic Japanese Beetle Harmonization Plan. The TSU Entomology Program will partner with USDA/ARS and USDA-APHIS collaborators to achieve these outcomes. This program will also perform research to identify powdery mildew resistance, resistance to cercospora leafspot/blight, and to identify and catalog soil-borne pathogens prevalent in the Tennessee nursery industry.
Additionally, new biopesticide compounds that can manage soil-borne pathogen and insect problems in container nurseries will be developed. The research will be used to expand grower options and offer alternatives that are safer for farm labor and the environment. In addition to finding and developing alternative pest management options, we intend to demonstrate that a significant reduction in offsite environmental contamination can be accomplished by grower adoption of biopesticide pest management options.

2. Brief description of the target audience

Nursery producers. Policy makers for regulatory pests like fire ants (e.g., regulatory entities involved with decision making on quarantine treatment approval). Pesticide and chemical manufacturers, agricultural research community, Extension agents, parks, schools.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	0	0	0	0
Actual	0	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2010
Plan: 0
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Plan	0	3	
Actual	0	5	5

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Scientific publications pertaining to reducing plant pest problems in the green industry using environmentally sound methods.

Year	Target	Actual
2010	3	5

Output #2

Output Measure

- New techniques for control of Japanese beetle and imported fire ant.

Year	Target	Actual
2010	0	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increase in number of growers with increased awareness of program issues.
2	Percentage of nurseries adopting fire ant control strategies using newly discovered chemicals.
3	Number of educational trade articles to increase grower awareness.
4	Development of an improved treatment method for Japanese beetle and imported fire ant.
5	Approval of new insecticides or lower rates of existing insecticides in Fire Ant and Japanese Beetle quarantines.
6	Increase in number of growers aware of newly identified disease resistant cultivars
7	Increase in number of growers aware of causes of disease and pathogen survival
8	Increase in number of growers aware of soil-borne disease prevention methods
9	Increase in number of Tennessee growers aware of disease resistant hydrangea cultivars
10	Number of new biopesticde treatments developed
11	Percent reduction in pesticide movement offsite of research facility

Outcome #1

1. Outcome Measures

Increase in number of growers with increased awareness of program issues.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	150	200

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Control of imported fire ant is important for the agricultural industries of Tennessee and for public well-being.
Species-specific imported fire ant attractants/repellents will target fire ant without adversely impacting native ant species and beneficial insects.

What has been done
Presentations concerning fire ant and other invasive insect introductions and control strategies were made at field days, open houses and stakeholder conference.

Results
Nursery producers in the region are much more aware of the problems associated with inadvertent movement of invasive insects.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #2

1. Outcome Measures

Percentage of nurseries adopting fire ant control strategies using newly discovered chemicals.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	5	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Control of imported fire ant is important for the agricultural industries of Tennessee and for public well-being.
Species-specific imported fire ant attractants/repellents will target fire ant without adversely impacting native ant species and beneficial insects.

What has been done
Laboratory-based analysis of a number of essential oils and other plant extracts have been completed. Field testing has been constrained by an overall decrease in available test sites due to colder-than-average winter.

Results
Alternative treatments have not been introduced due to lack of field-level data to present for approval by regulatory agencies.

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #3

1. Outcome Measures

Number of educational trade articles to increase grower awareness.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	1	8

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Imported fire ants and Japanese beetles can cause significant economic impacts when introduced into new areas, as well as imposing time consuming and expensive quarantine regulations on nursery growers.

What has been done
Efforts have been made to increase grower awareness through presentations at grower meetings and publication of trade journal articles.

Results
Presentations/Publications:

Hale, F., B. Klingeman, A. Windham, G. Haun, S. Powell, J. Oliver, A. Self, M. Windham, J. Grant, and E. Long. 2010. Pests in the spotlight - walnut twig beetle and thousand cankers disease of black walnut. Tennessee Greentimes. 11 (4): 10-14.

Oliver, J.B., N. Youssef, J. Basham, K. Copley, M. Halcomb, F. Hale, and W. Haun. 2010. The camphor shot borer - Tennessee's new invasive ambrosia beetle. Tennessee Greentimes. 11(3): 8-11.

Oliver, J.B., N. Youssef, C. Ranger, M. Reding, and P. Schultz. 2010. Promising biopesticides for protecting trees from ambrosia beetles. Factsheet prepared for educational session "Using biopesticides to control diseases and insect pests in ornamental plants" at the Tennessee State University School of Agriculture & Consumer Sciences, Poinsettia Open House, 17 Dec. 2010, Nashville, TN.

Mmbaga, M.T. and J. Oliver. 2010. Biopesticide tests on roses to prevent Japanese beetle

damage. Factsheet prepared for educational session "Using biopesticides to control diseases and insect pests in ornamental plants" at the Tennessee State University School of Agriculture & Consumer Sciences, Poinsettia Open House, 17 Dec. 2010, Nashville, TN.

Ranger, C.M., M. Reding, J. Oliver, J. Moyseenko, and N. Youssef. 2010. Toxicity of biopesticides to different white grub species. Factsheet prepared for educational session "Using biopesticides to control diseases and insect pests in ornamental plants" at the Tennessee State University School of Agriculture & Consumer Sciences, Poinsettia Open House, 17 Dec. 2010, Nashville, TN.

Vail, K. and J. Oliver. 2010. Managing fire ants in and around Tennessee's schools. The University of Tennessee Institute of Agriculture Extension and Tennessee State University School of Agriculture and Consumer Sciences. Department of Agricultural Sciences. Publication No. PB1788-5M-5/10 R12-4610-233-044-10.

Halcomb, M., F. Hale, D. Fare, and J. Oliver. 2010. Borer control in nursery grown dogwood, ash, maple and oak trees. The University of Tennessee Institute of Agriculture Extension and Tennessee State University School of Agriculture and Consumer Sciences, Department of Agricultural Sciences. April 2010.

Rinehart, T., and J.B. Oliver. 2011. Usefulness of fire ant genetics in insecticide efficacy trials. In S. Ludwig (ed.), Proc. Southern Nursery Assoc. Res. Conf. Mobile, AL.

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #4

1. Outcome Measures

Development of an improved treatment method for Japanese beetle and imported fire ant.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Current post- and pre-harvest treatment methods for imported fire ant and Japanese beetle management in field-grown nursery stock are expensive, hazardous, impractical or require shipping delays. Some treatment methods like the current fire ant post-harvest drench protocol, which requires a twice daily for three consecutive days drench in chlorpyrifos, has multiple problematic issues (i.e., hazardous, expensive, and shipping delays). Unfortunately, many commercial nursery producers continue to use impractical treatment methods like post-harvest drenches and dips because there are no better alternatives at the present time.

What has been done
Root ball drench treatments in combination with ball rotation were again investigated during this reporting period to confirm results from the last reporting period and develop support data for new fire ant and Japanese beetle treatments that are more practical for growers (i.e., fewer total drenches). Tree Ring pre-harvest irrigation treatments were again investigated during this evaluation period, plus 5-gallon buckets were also evaluated for the first time as a possible method to apply pre-harvest insecticides for fire ant and Japanese beetle grub control. Five-gallon buckets are used most frequently by nursery growers to irrigate nursery stock due to a lower cost than Tree Rings. Tractor applied pre-harvest pyrethroid band sprays against fire ants were repeated at a field-grown nursery in combination with mound injection treatments in an effort to eliminate larger, more difficult to control fire ant mounds.

Results
Root ball rotation again improved control of both Japanese beetle and fire ants. Two or four total drenches were effective with rotation for most insecticides evaluated, which is a reduction in total drench number for growers who must currently apply 6 drenches to comply with federal fire ant regulations. Drenches are not approved for treatment of field-grown nursery stock in Japanese beetle regulations, but data from these tests support drench effectiveness with rotation. Root balls in these studies were 30 cm diameter, so larger 60 cm diameter root balls commonly used by the nursery industry need to be evaluated with effective insecticides. Five-gallon bucket treatments were very effective for treating soil, which was subsequently toxic to fire ants in laboratory bioassays. Tree Ring and bucket tests with Japanese beetle have not been completed at this time, but will be evaluated spring 2011. As in the last reporting period, tractor applied pyrethroid bands in combination with injections targeting large-sized mounds were very effective at eliminating fire ants from nursery sites (presently 100% control at 13 weeks after treatment). Evaluations of the tractor-applied pyrethroid/individual mound test are still on-going through spring 2011. All of these tests are indicating promising results for possible new methods to apply fire ant and Japanese beetle treatments.

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #5

1. Outcome Measures

Approval of new insecticides or lower rates of existing insecticides in Fire Ant and Japanese Beetle quarantines.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Treatment options for field grown nursery stock to meet imported fire ant and Japanese beetle quarantines are expensive, time consuming, and limited. Before this project, there were only three options to satisfy imported fire ant quarantines for field grown nursery, including a post harvest root ball dip in chlorpyrifos, a post harvest twice daily for three consecutive days drench in chlorpyrifos, or a fire ant bait + granular chlorpyrifos pre harvest treatment.
The only practical method for growers among the three approved fire ant treatments was the bait + granular chlorpyrifos option, but producers could not afford this treatment option due to the cost of the granular chlorpyrifos formulation labeled for nursery crops (about $215 per treated acre). In addition, the granular fire ant treatment must be applied every 84 days and the dip or drench treatments every 30 days, which is a time interval too short for the typical field grown nursery harvesting cycle (generally September to April). For Japanese beetle, there were only two quarantine treatment options for field grown nurseries before this project, including a post harvest root ball dip in chlorpyrifos or a pre harvest band treatment of imidacloprid between May and July. As with fire ants, the dip treatment is not practical for Japanese beetle and the imidacloprid treatment must be applied before fall / winter harvesting begins, which is a cost risk if plant sales demand subsequently declines during the fall and winter.

What has been done
No new insecticides have been submitted for regulatory approval at this time. Tests were performed with two pre-harvest generic imidacloprid-based products (Quali-Pro Imidacloprid 2F and Mallet 2F) and one clothianidin (Arena 50WDG) product. These products were compared against currently approved U.S. Domestic Japanese Beetle Harmonization (DJHP) standards (i.e., Discus and Marathon 60WP).

Results

Test results support the inclusion of Quali-Pro Imidacloprid 2F, Mallet 2F, and Arena 50WDG in the DJHP, based on Japanese beetle grub control efficacy equivalent to approved imidacloprid standards (Discus and Marathon 60WP). It is felt Quali-Pro Imidacloprid and Mallet imidacloprid generics can be added to the DJHP without further testing based on the proven efficacy of imidacloprid. Generic imidacloprid products are lower cost than trade products, reducing grower costs once formerly approved. Clothianidin has provided consistent grub control results three years in a row, including this one, and can now be recommended for addition into the DJHP.

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #6

1. Outcome Measures

Increase in number of growers aware of newly identified disease resistant cultivars

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	75	75

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Information will reduce fungicide use in the nursery industry, thus reducing the amount of pesticides entering the environment. This information will also reduce production costs for nursery producers, resulting in a net increase in income.

What has been done
Confirmation of Hydrangea resistance to powdery mildew. Presentation of information at grower conference.

Results
Research results have been submitted for journal publication. Conference attendees have now increased knowledge of resistant hydrangea cultivars.

4. Associated Knowledge Areas

KA Code	Knowledge Area
212	Pathogens and Nematodes Affecting Plants

Outcome #7

1. Outcome Measures

Increase in number of growers aware of causes of disease and pathogen survival

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	75	75

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Information will reduce fungicide use in the nursery industry, thus reducing the amount of pesticides entering the environment. This information will also reduce production costs for nursery producers, resulting in a net increase in income.

What has been done
Information was communicated to producers at the Southern Nursery Association Research Conference and Trade Show via a poster presentation.

Results
Growers are aware that effective disease management requires early intervention during petal fall when new leaves form.

4. Associated Knowledge Areas

KA Code	Knowledge Area
212	Pathogens and Nematodes Affecting Plants

Outcome #8

1. Outcome Measures

Increase in number of growers aware of soil-borne disease prevention methods

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	75	75

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Growers need to know diseases causing plant death or declining plant health.

What has been done
Areas that are at risk for potential disease outbreaks were identified based upon environmental parameters.

Results
Disease severity models were developed based on various environmental parameters and availability of leaves.

4. Associated Knowledge Areas

KA Code	Knowledge Area
212	Pathogens and Nematodes Affecting Plants

Outcome #9

1. Outcome Measures

Increase in number of Tennessee growers aware of disease resistant hydrangea cultivars

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	50	50

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Commercial nurseries that produce Hydrangea will use these cultivars to decrease pesticide needs and improve profits.

What has been done
Resistance to leaf spot diseases were confirmed and cultivars that have moderate disease resistance were identified.

Results
Research results have been communicated to journal for publication. Cultivars resistant to powdery mildew and other foliar diseases were identified; information communicated to producers.

4. Associated Knowledge Areas

KA Code	Knowledge Area
212	Pathogens and Nematodes Affecting Plants

Outcome #10

1. Outcome Measures

Number of new biopesticde treatments developed

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	1	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The nursery and greenhouse industries are important sectors of U.S. Agriculture providing about 2 million jobs according to recent economic estimates. Biopesticides offer an environmentally friendly and worker friendly alternative to conventional pesticides for the treatment of pests and pathogens in containerized nurseries. According to the U.S. Environmental Protection Agency, biopesticides have multiple advantages over conventional pesticides, including: 1) inherently less toxic, 2) often affect only the target pest, 3) often effective in small quantities, 4) decompose quickly, and 5) can reduce reliance on conventional insecticides. In addition, many biopesticides are exempt from pesticide registration requirements, which can reduce the development cost to chemical manufacturers and potentially lower the costs to nursery stakeholders.

What has been done
All biopesticides tested with container plants during fall 2009 were retested in spring 2010 and trials are underway for fall 2010 and spring 2011. Biopesticides have been tested alone and with low rates of carbaryl (Sevin SL 0.0625 lb AI / 100 gal), bifenthrin (Onyx Pro; 0.0125 lb AI / 100 gal), and trichlorfon (Dylox 420SL; 0.0625 lb AI / 100 gal). In addition, a new biopesticide called Dazitol (capsaicin and related capsaicinoids [0.42%] and allyl isothiocyanate [3.7%])) was tested for the first time in spring 2010 and is being tested now in fall 2010 tests. Armorex (rosemary oil [1%], garlic oil [2%], clove oil [2%], white pepper [0.5%], and sesame oil [84.5%]) and Veggie Pharm (organic coconut oil soap [63.8%], soil oil [19.2%], garlic oil [11%], peppermint oil [0.8%], rosemary oil [0.8%], sodium bicarbonate [2.2%], and potassium chloride [2.2%]) were evaluated for the first time with and without permethrin as trunk sprays against ambrosia beetles.

Results
In spring 2010, all biopesticides provided 100% Japanese beetle grub control when applied to container media in combination with Onyx Pro and Dylox 420SL. The biopesticides Armorex, EcoTrol, and Triact 70 also provided 100% grub control when combined with Sevin SL, but Azatin XL and Cinnacure did not. Dazitol was 100% efficacious against Japanese beetle grubs in containers at rates of 14.2 and 37.9 ml product / gal. Results are not available at this time for fall 2010 or spring 2011 tests. For ambrosia beetles, Armorex, Veggie Pharm, permethrin, and combinations of biopesticides with permethrin provided significantly greater protection of trees from ambrosia beetles than trees that were not protected with the insecticides. Trees were artificially stressed with ethanol injections to induce mass ambrosia beetle attacks, so results indicate potential for biopesticide / insecticide combinations to protect stressed trees from ambrosia beetles.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
215	Biological Control of Pests Affecting Plants

Outcome #11

1. Outcome Measures

Percent reduction in pesticide movement offsite of research facility

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Offsite movement of pesticides from nurseries is a major issue for regulatory agencies. Movement of pesticides into surrounding water systems has numerous potential impacts on both human health and natural systems. Consequently, as regulatory actions increase on nurseries, it could have adverse impacts on the continued operation of nursery businesses. Biopesticides have the potential to mitigate or reduce offsite pesticide movement because many degrade faster and have lower acute toxicity to non-target organisms.

What has been done
Multiple commercial biopesticides (Armorex, Azatin XL, Cinnacure, EcoTrol EC, Triact 70) were combined with reduced rates conventional synthetic insecticides (bifenthrin, carbaryl, trichlorfon) and evaluated against third instar Japanese beetle grubs in a container substrate consisting of 80% pine bark 20% peat. Conventional insecticide rates were 18× (bifenthrin) and 128× (carbaryl, trichlorfon) lower than labeled rates.

Results
Neither biopesticides or conventional insecticides have consistently managed Japanese beetle grubs at rates evaluated when tested individually. However, the combination of biopesticides with reduced rates of conventional insecticides provided 100% grub control for most combinations tested. The effectiveness of conventional insecticides at reduced rates when combined with the low residual / environmentally friendly biopesticides, means lower potential for environmental contamination and off-site movement of pesticides.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Government Regulations

Brief Explanation

As is the case in much applied agricultural research, weather continues to be a factor that influences the completion of the research. A winter with longer-than-average periods of sub-freezing temperatures reduced fire ant populations significantly. This circumstance made it difficult to find enough experimental units for some of the fire ant research. Populations are expected to rebuild in one to two years.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Before-After (before and after program)
- During (during program)
- Comparisons between program participants (individuals, group, organizations) and non-participants
- Comparisons between different groups of individuals or program participants experiencing different levels of progra intensity.

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}