FLORIDA DEPARTMENT OF AGRICULTURE & CONSUMER SERVICES (FDACS)

Final Performance Report
2009 SPECIALTY CROP BLOCK GRANT PROGRAM
FLORIDA DEPARTMENT OF AGRICULTURE & CONSUMER SERVICES
USDA AMS AGREEMENT NUMBER: 12-25-B-0916
TOTAL GRANT FUNDS AWARDED - $4,100,603.76

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PROJECT (1): FLORIDA AGRICULTURE IN THE CLASSROOM - GARDENING FOR GRADES

FDACS Grant Contract #15562
Total Funding - $50,000.00
End Date: 3/31/2012

PROJECT SUMMARY

Florida Agriculture in the Classroom has found that teachers and students may not relate to agriculture, but they relate to gardens.

Florida Agriculture in the Classroom is a non-profit, 50l(c)(3) organization based in Gainesville with a mission of expanding youth awareness and understanding of Florida agriculture and natural resources.

To reach more of Florida's teachers and students, Florida Agriculture in the Classroom spent 2009, 2010 and early 2011 developing a *Gardening for Grades* school garden curriculum. It educates teachers and students in kindergarten through 12th grade about Florida specialty crop fruits and vegetables by showing them how to cultivate these commodities in the classroom and schoolyard and gives teachers lessons to help them use the garden to teach science, math, language arts, social studies and other core subject areas.

Florida Agriculture in the Classroom had developed the content for the 142-page *Gardening for Grades* curriculum. It used money from the 2009 Specialty Crop Grant, and funds from the Florida Department of Education's Food & Nutrition Management and Coordinated Health Partnership to help publish and distribute it.

Based on the numbers of requests it received from teachers for gardening information and the success it has had with mailings targeted to teachers in the past, Florida Agriculture in the Classroom estimated *Gardening for Grades* would reach as many as 10,000 teachers and 250,000 students statewide.

Gardening for Grades is helping teachers engage students in reading, writing, math, science and social studies lessons because it provides real-life applications for why these lessons are important. And they're learning the importance of Florida agriculture at the same time.

PROJECT APPROACH

Florida Agriculture in the Classroom, in partnership with the Florida Department of Education's Food & Nutrition Management Office and Coordinated School Health Partnership, printed more than 11,000 copies of the *Gardening for Grades* curriculum in the spring of 2011. It also made the curriculum downloadable on its website.

The expense of printing the curriculum with a hard cover and an o-ring binder forced Florida Agriculture in the Classroom to seek a partner to help defray the cost of printing it. With matching funds FDOE's Food & Nutrition Management Office and Coordinated Healthy Partnership, Florida Agriculture in the Classroom printed more books for less than the $40,000 it budgeted for printing the book in the grant.

In the year the book has been available, more than 2,000 copies of it have been distributed to teachers, University of Florida extension agents and master gardeners and other infonnal educators who attended workshops, received school garden mini grants and ordered the book from Florida Agriculture in the Classroom's website. Florida Agriculture in the Classroom and FDOE's school nutrition agencies held 15 *Gardening for Grades* teacher workshops around the state in 2011 and early 2012 to distribute the book and train teachers on how to use it. The workshops have been very well received with about 500 teachers going through the trainings so far.

In fact, the workshops have been so popular that Florida Agriculture in the Classroom trained a dozen of its key facilitators Feb.3-4, 2012 on how to organize and execute *Gardening/or Grades* workshops in their areas to help meet growing demand. *Gardening for Grades* facilitators Doty Wenzel and Janice Easton who had been conducting the trainings for Florida Agriculture in the Classroom in 2011 trained the other facilitators. More *Gardening for Grades* workshops are scheduled in the summer and fall 2012.

GOALS AND OUTCOMES ACHIEVED

In the year *Gardening for Grades* has been available, it has been distributed to more than 2,000 teachers, University of Florida/IF AS extension agents, master gardeners and other informal educators who are interested in using school gardens as teaching tools. In addition to the *Gardening for Grades* workshops Florida Agriculture in the Classroom and the FDOE have scheduled, the book is being distributed and featured at teacher conferences such as the Florida Association of Science Teachers (FAST).

Florida Agriculture in the Classroom Executive Director Lisa Gaskalla has been visiting curriculum coordinators in school districts around the state to introduce them to the new school garden curriculum and has received numerous requests for workshops. As a result, she held a facilitator training Feb. 3-4, 2012 to train a dozen of her key facilitators on how to conduct *Gardening for Grades* teacher workshops to help cover requests for more workshops around the state.

The teachers who have ordered books from workshops and the website have been asked to administer a pre/post test assessment from lessons in the book to gauge what students are learning from it. In total, of an estimated 175,800 students who participated in the program, approximately 5,860 took the pre and post-tests. The results were as follows:

- Students' understanding of photosynthesis in the "We're the Producers" lesson grew from 53 percent on the pre test to 92 percent on the post test.
- Students' ability to identify the parts of the plant of certain fruits and vegetables in the lesson "What Are We Eating?" increased from 49 percent on the pre test to 85 percent on the post test.
- Students' knowledge of the classification of fruits and vegetables and the different varieties within a group in the lesson "Lettuce Be Different" rose from 60 percent on the pre test to 94 percent on the post test.
- Students' understanding of the composition of soil in the lesson "It All Begins with Soil" rose from 3 8 percent on the pre test to 92 percent on the post test.
- Students' grasp of the different inputs needed for plants to grow in the lesson "Yo Seeds, Wake Up!" increased from 51 percent on the pre test to 87 percent on the post test.

The book is 142 pages long, and includes 13 interdisciplinary lessons for students in kindergarten through eighth grade. In addition, it provides pointers to teachers on how to organize a school garden project, where to find grant funding to pay for it and how to determine what type of garden to plant depending on the part of the state they're in.

Florida Agriculture in the Classroom received trademark protection from the U.S. Patent and Trademark Office in 2011 for the *Gardening for Grades* name and logo.

BENEFICIARIES

Teachers and informal educators are the obvious beneficiaries because they receive a great resource that was developed by teachers free of charge. The workshops are also free of charge. In addition, teachers receive professional development points when they attend these workshops.

The Florida agriculture industry, and the agriculture industry in other states, for that matter, benefit because teachers and students have the same pest and disease and weather issues in their school gardens that farmers have in their operations. These teachers and students learn firsthand how difficult it is to grow food, and develop an appreciation for the challenges farmers face every day.

LESSONS LEARNED

Florida Agriculture in the Classroom received an extension on the project to give us more time to distribute the book to teachers. Thanks to the partnership Florida Agriculture in the Classroom had with the FDOE's Food & Nutrition Management Office and Coordinated School Health partnership, Florida Agriculture in

the Classroom saved $2,165 on printing costs. As a result, it was given permission to add $2,165 to the $4,215 it spent to distribute the book through workshops and shipping of online orders of the book.

The biggest lesson Florida Agriculture in the Classroom learned is there are a number of partners willing to participate in a popular project like this if you just look. It's also very important to pay attention to trends in education. When the popularity of school gardens took off in recent years, Florida Agriculture in the Classroom decided it wanted to be on the forefront of that trend here. It succeeded.

Florida Agriculture in the Classroom will continue to notify teachers of the availability of the book through advertising in teacher publications and at teacher conferences.

Also, Florida Agriculture in the Classroom has been promoting the book as it distributes its school garden mini grants it received as part of a 20 I 0 Specialty Crop Grant. It funded 222 $500 school garden grants to complement the *Gardening for Grades* book during the 2011-12 school year.

In addition, Florida Agriculture in the Classroom will publish a second edition of *Gardening for Grades*, which it will call *Gardening for Nutrition.* It has received a 2011 Specialty Crop grant to develop *Gardening for Nutrition*, which will feature similar gardening and grant tips, but will include nutrition lessons.

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ADDITIONAL INFORMATION

A digital download of Gardening for Grades is available by going to Florida Agriculture in the Classroom's website at http://www.flagintheclassroom.com/gardening.html.

PROJECT (2): 2009 ASSOCIATION OF FLORIDA NATIVE NURSERIES - PLANT REAL FLORIDA: OUTREACH AD PROMOTION CAMPAIGN

FDACS Grant Contract #15559
Total Funding - $133,500.00
End Date: 12/31/2011

PROJECT SUMMARY

Increased pressure to conserve water, biodiversity, and energy are creating critically important demands that can be met by using more native plants, more effectively, in urban and suburban landscapes. Local, state and national green development initiatives promote the use of native plants. But availability of plants and expertise in using them continue to be obstacles to success and growing the market.

Florida's native plant industry began in the 1970s and has grown slowly, with most research, development and marketing provided by its own small and generally resource-limited businesses and allied nonprofit organizations. As a result, knowledge and expertise in using native plants for sustainable landscaping has remained generally limited to environmental professionals, habitat gardening enthusiasts, a small number of specialty growers, and an even smaller number of landscape professionals. At the same time, due largely to concerns about water conservation and habitat loss, more industry professionals and home gardeners have become interested in the benefits of using native plants, and are looking for the plants and information on how to use them.

Plant Real Florida is the first statewide mass media campaign to enhance awareness of the availability of Florida native landscape plants and how they can be used in sustainable landscaping. This Specialty Crop Block Grant funded the first two components of this campaign: websites (one for industry professionals and another for home gardeners) and a televised public service announcement (PSA). Without this grant funding, neither of these components could have been accomplished. The websites provide the native plant industry with a more effective online presence and the technology infrastructure needed to more widely distribute plant usage information and availability. Website users are able to make more informed selections and are better able to find plants. The PSA broadcast has resulted in new web traffic and demand for native plant information. Video and still images collected during PSA development can be used in future education and promotion efforts. With these and other resources, FANN hopes to continue and expand the Plant Real Florida campaign in coming years.

PROJECT APPROACH

This Specialty Crop Block Grant program included two main components: Online Native Plant Locator (websites) and Statewide Media Campaign (televised PSA).

Online Native Plant Locator – This component resulted in development of two websites, FloridaNativeNurseries.org for industry professionals and PlantRealFlorida.org for home gardeners. Both sites provide tools for identifying, selecting and finding suitable native plants for specific areas, conditions and functions. To help guide plant selection, the websites use an ecosystem-based framework developed and published by FANN (then AFNN) in a 1991 book entitled *Xeric Guide to Landscaping with Florida Native Plants* book. This framework uses Florida's native plant communities and a design palette of plants for each community to guide

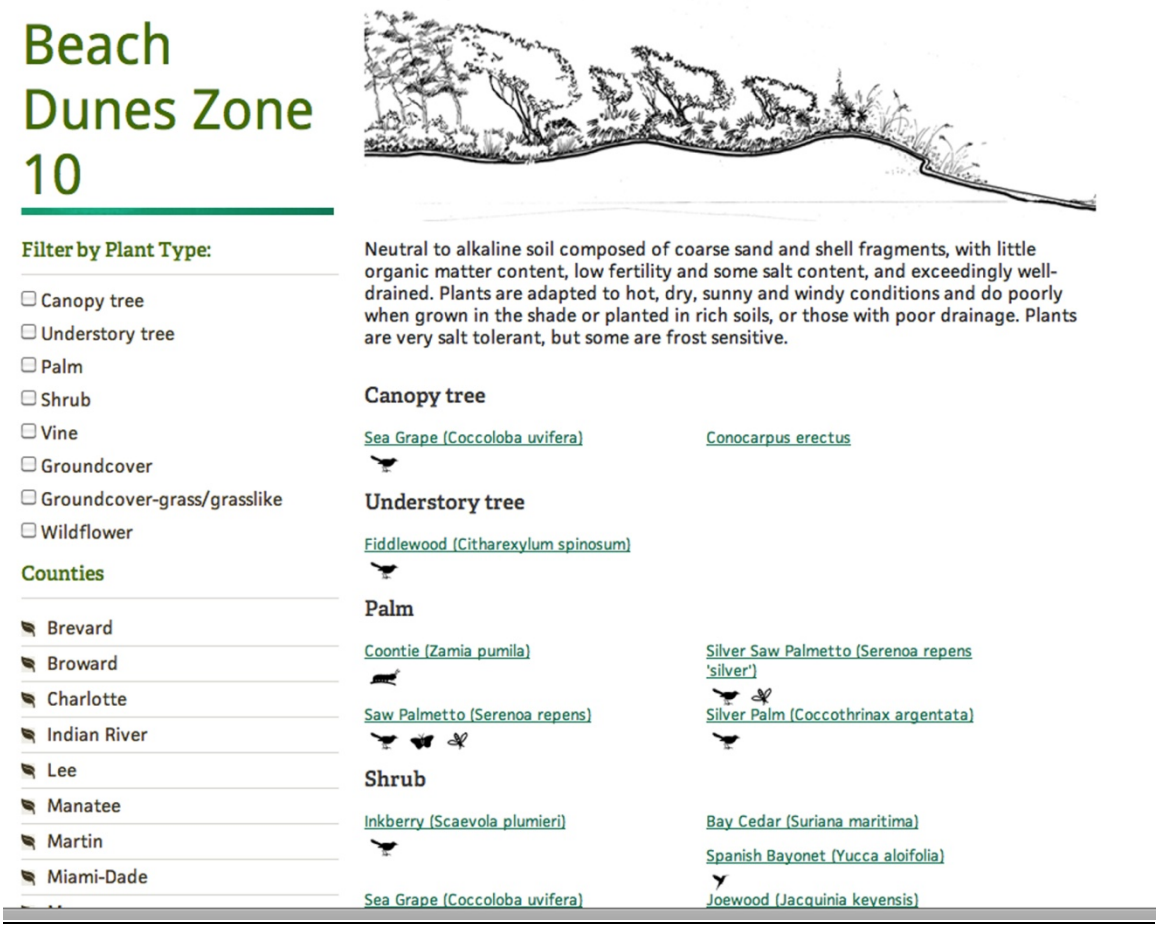
plant selection based on the historical natural landscape and site soils, drainage and exposure. Each site provides multiple ways to find native plants, growers and environmental and landscape services, as well as institutional resources (e.g., academic and nonprofit groups). Both sites interface to the University of South Florida Plant Atlas for additional botanical information.

FANN used a formal Request for Information (RFI) and Request for Proposal (RFP) process to select a website development contractor. FANN interviewed potential users, including growers, landscape designers and installers, retail garden centers and native plant enthusiasts. Using their input, and as part of the RFP, we developed a fairly detailed technical specification including user descriptions, scenarios, functional requirements and preliminary wireframes. An RFI was sent to 24 firms, from which we received 10 responses. From the ten responses, our review team selected 5 firms to receive RFPs. Three of the 5 responded and after much deliberation, FANN selected Big Sea Design & Development of St. Petersburg, Florida. A kick-off meeting was held in September 2010 and development completed in November 2011.

The "Online Native Plant Locator" grew significantly in concept and capability from what was originally envisioned in FANN's SCBG 2009 proposal, and also turned out to be more complex to implement than we imagined. Significant additional uncompensated development time was provided by both FANN's Executive Director and Big Sea Design & Development. In talking with users and suppliers, we determined that we needed two separate websites targeting two different audiences: industry professionals and retail consumers. Our approach was to provide similar functionality and navigation with different colors and imagery, running off the same underlying databases. We also discovered that the UF/IFAS vegetation map, our key graphic, really needs to be redrawn for 21st century use, a task outside the scope of this project.

Our work has also contributed to a related but separate development by a private landscape designer, Michael Miller, who is developing a site (perfectenvirons.us) that native landscape experts can use to refine ecologically correct site-specific plant palettes. FANN expects to continue collaboration with Miller's project and incorporate the results.

Above: Screen shot of PlantRealFlorida.org home page



Above: Example native plant community page. When user clicks on plant name, plant specific information including current availability is displayed. Elevation drawing at top rotates to show photos of typical beach dune communities within the USDA plant hardiness Zone 10 counties.

Statewide Media Campaign – This component was implemented as a 30-second public service announcement (PSA) aired statewide on cable television. The PSA promotes the benefits of using native plants in residential landscaping and directs viewers to the home gardener website (PlantRealFlorida.org), where they find plants, information and other resources. This spot has provided unprecedented marketing exposure for retail garden centers providing native plants and has also benefitted growers who supply the garden centers, professionals who provide native landscape expertise, and allied nonprofit organizations that provide educational outreach.

FANN partnered with the Florida Department of Agriculture (FDACS) Division of Marketing to collect video and still imagery from several different residential native landscapes and produce the spot. FDACS videographers provided filming and editing services and obtained professional audio assistance. FANN contracted with Accord Productions to produce a close caption format and DVDs for distribution to local stations. A FANN nursery uploaded the video to YouTube and we linked to that from our PlantRealFlorida.org site. FANN contracted with Florida Cable Telecommunications Association (FCTA) to run the spot for one year, from March 15, 2011 to March 15, 2012, for an expected 10,553 runs statewide.

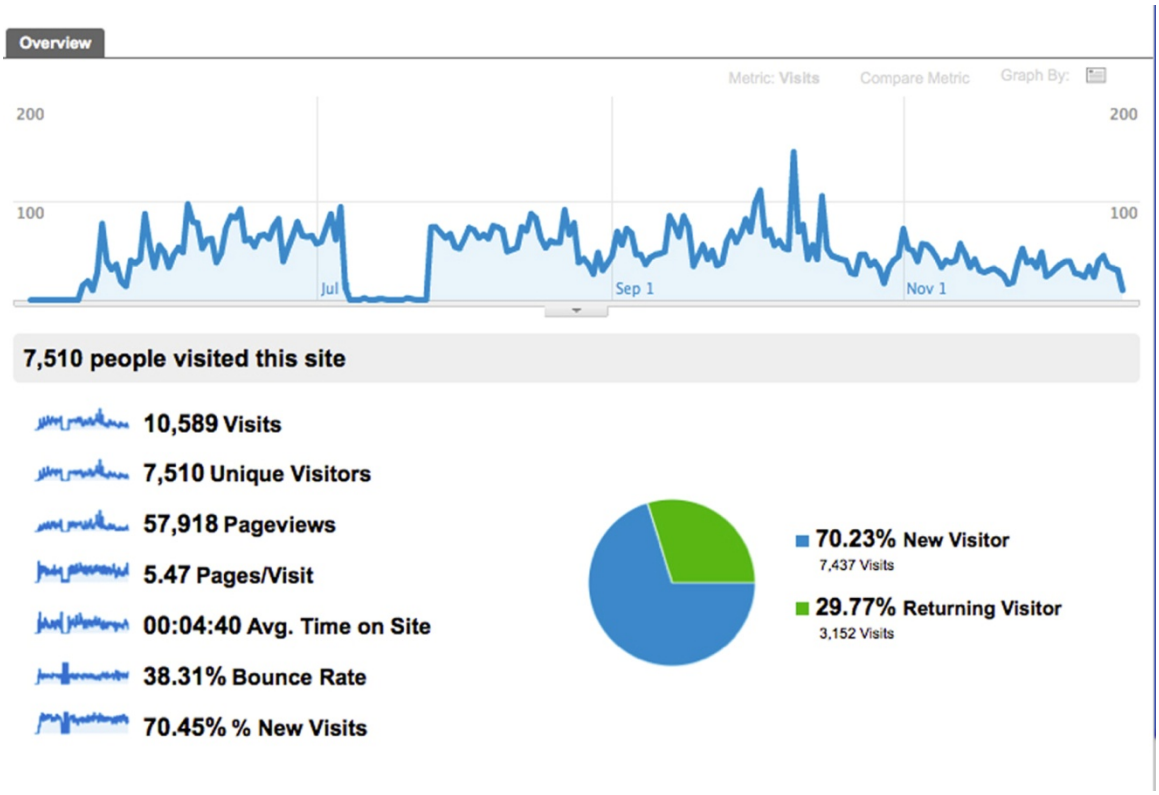
In addition, over five hours of high definition video and several DVDs of still imagery were developed for use in future visual promotions.

GOALS AND OUTCOMES ACHIEVED

Websites: With the website, our overall goal was to make it possible for any user, professional or amateur, to identify and find native plants suitable for their project based on location and site conditions, using the framework of Florida's native plant communities. We also wanted to make it possible for growers to easily change their online availability at any time. Both goals have been achieved. In our proposal, we specified the following target outcomes:

- ☐ 2000 visits per month
- ☐ 3 pages viewed per visit

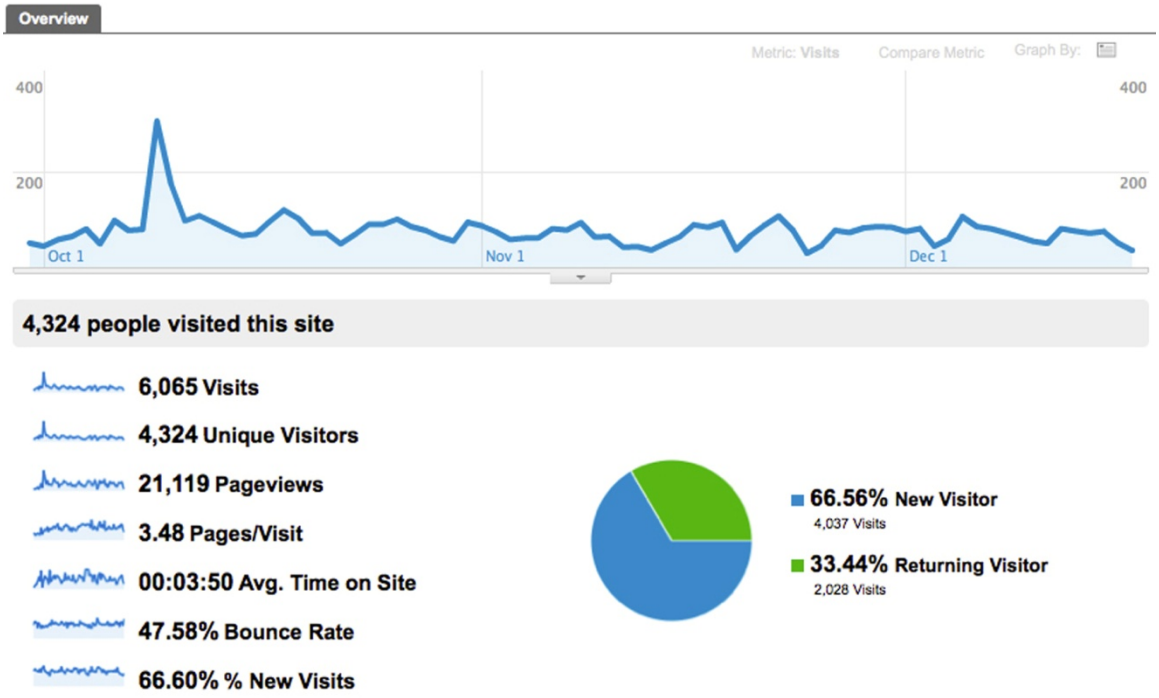
These outcomes were specified assuming one website, and we now have two, each serving very different audiences. We have Google Analytics installed on each site. If we combine average visits per month reported for both sites, the total is 3533 visits per month. There is bound to be some overlap in visitors, but even so, we think it's safe to say that we've reached 2000 visits per month or more. And we have exceeded 3 pages per visit for each site. Details are explained in the following graphics and text.



Above: PlantRealFlorida.org Google Analytics report

PlantRealFlorida.org has had 10,589 visits in seven months, an average of 1512 visits per month, with a low point in July and a spike in October. The quality of engagement is great – 70% of visitors are new, they are viewing 5.47 pages on average per visit, and they spend an average of 4 minutes, 40 seconds on the site. The site, which is the first site to target consumer availability of native plants, has had 7510 unique visitors since it launched seven

months ago. We've had many positive comments on Twitter, where we launched a @PlantRealFla feed, and from the Facebook pages of our industry partners, Florida Native Plant Society and Florida Wildflower Foundation.



Above: FloridaNativeNurseries.org Google Analytics report

FloridaNativeNurseries.org has had 6065 visits in three months, an average of 2021 visits per month. We think the site had higher results than PlantRealFlorida.org because of promotion from our industry partners, Florida Chapter American Society of Landscape Architects (FLASLA) and Florida Nurseries, Growers & Landscape Association (FNGLA). FloridaNativeNurseries.org is an industry website where we have information on continuing education for professionals and both ASLA and FNGLA used their newsletters to promote the site and the continuing education opportunities the were available after site launch. This site has had 4324 unique visitors so far.

Compared with PlantRealFlorida.org, FloridaNative Nurseries.org has a lower number of pages per visit, 3.48, and the average user spends less time, 3 minutes, 50 seconds, on the site. FloridaNativeNurseries.org replaced our original industry site, the typical use of which was to locate specific plants for specific jobs. Landscape professionals are just becoming aware of the ability and utility of using the plant community pages to put together plant selections. We think that over time, with greater education, the pages viewed and time on site will increase.

Our own members have been very impressed with both sites and are now beginning to use the FloridaNativeNurseries.org site to update their plant availability.

Statewide Media Campaign: The primary goal specified in our proposal was production of a televised 30-second public service announcement to be broadcast throughout the state. Our specific outcome specified that the spot be aired in nine major Florida cable TV markets, covering all 67 counties, for 9-12 months, resulting in an estimated 135,000,000 consumer impressions.

In addition, we planned to develop multiple messages and ideas for future promotion, which we have done in concert with our native plant industry partners, the Florida Native Plant Society, Florida Wildflower Foundation and Wildflower Seed Co-op (collectively, the Florida Native Plant Partnership (FNPP)). FNPP is now in the process of contracting for marketing plan to further promotion of native plants in 2013 and beyond. FANN collected small donations from each of our members to fund this marketing plant development.

To achieve the greatest possible mass reach with our PSA, FANN used FDACS' partnership with the Florida Cable Telecommunications Association (FCTA) which has a special program for PSAs. This program essentially provides in-kind matching benefit by broadcasting 4 times the number of runs purchased. Our $100,000 purchase would, at regular advertising rates, purchase approximately 2638 runs in all markets. FCTA offered us 10,553 runs for the same investment, running from March 15, 2011 through March 14, 2012. This achieved 9 months of broadcast time within the SCBG program timeframe plus 3 additional months.

FDACS Division of Marketing, which has used the FCTA program for years to promote Florida agriculture, advised FANN that this was our "best bang for the buck," and that in their experience, the number of "bonus runs" that occur (due to unsold ad space) is significant and that PSAs often continue for years, particularly when they carry an environmental message like ours. According to affidavits provided by FCTA, as of November 22, 2011, our PSA had already run 30,420 times, including 881 times on FSN Florida and Sun Sports Networks which are viewed all over the state. This is nearly three times what we contracted for, does not include run data from one cable market (ADI-3) not available at the time of this report, and almost 4 months of official broadcast still remains. The regular price for this number of runs would be almost $2 million. The spot also appeared on FCTA's public affairs website CapitalDatelineOnline.com, viewed by state politicians, their staff and citizens who keenly follow politics (estimated total 88,000 hits). This is a bonus audience for us that we greatly value.

The spot specifically refers viewers to our PlantRealFlorida.org website at the end, to find out how they can bring native plants and the beauty of Real Florida to their home. FANN has been thrilled to get 443 new subscribers to our free *Guide for Real Florida Gardeners* as a result of these visits. We know that these subscribers are coming primarily as a result of seeing our TV spot based on their addresses and comments. Each subscriber gives us their name, email address, mailing address, phone number (home and mobile) and optional comments. In just 8 months, we have received 1/3 again as many subscriptions as we have received in the previous 3 years.

A downside of using the FCTA PSA program is that no official Nielsen-type data is available as there would be for a specific spot buy. This makes it impossible to certify that we've had 135,000,000 consumer impressions. However, FANN is confident that with the combination of statewide networks and runs in each market across a variety of cable channels, we have achieved our desired saturation. Here's why: Florida has 11,300,000 viewers of cable services statewide. To reach 135,000,000 consumer impressions, our spot would need to be seen only about 12 times across the cable viewing audience.

Total # PSA runs through Nov. 22, 2011	Viewing Market	Regular advertising rate
3691	ADI-1 (Florida Panhandle)	$103,348
398	ADI-2 (Tallahassee region)	$8756
197	ADI-4 (Gainesville/NC region)	$5122
299	ADI-5 (Orange County to East Central Region)	$8273
7791	ADI-6 (Greater Tampa Bay region)	$337,350
702	ADI-7 (Naples/Fort Myers region)	$19,066
6702	ADI-8 (Greater Palm Beach region)	$394,145
9759	ADI-9 (Broward, Miami-Dade & Keys region)	$414,855
1	FSN Florida & Sun Sports (12am-6am) statewide	$400
321	FSN Florida & Sun Sports (6am-12pm) statewide	$160,500
386	FSN Florida & Sun Sports (12pm-6pm) statewide	$289,500
173	FSN Florida & Sun Sports (6pm-12am) statewide	$129,750

Above: table illustrating how many runs occurred in various Florida cable TV markets and their regular advertising cost. FANN paid $100,000 total for 30,420 runs, using SCBG funds.

BENEFICIARIES

Beneficiaries of this SCBG program include:

- Florida's native plant industry, as represented by FANN members including 80 growers, 45 retail outlets and 20 environmental consultants and landscape professionals, representing about 5-10% of the Florida's horticulture/landscape industry. These small businesses have received unprecedented marketing exposure through this program and will continue to benefit in years to come.
- Florida's broader horticulture/landscape industry, a multi-billion industry, including landscape architects, landscape designers and installers, wholesale growers and retail garden centers, who now have a superior online tool for finding native plants and selecting them with an understanding of historical heritage, aesthetics and site conditions.
- Florida's gardening public, millions of households, seeking environmentally sustainable solutions for their home landscapes, now have an easy-to-use tool for finding the best native plant selections for their area. This will improve as the native plant industry grows and spreads throughout Florida's 67 counties.

Dozens of Florida's municipalities and public agencies seeking to encourage the use of Florida-friendly native plants for water and energy conservation now have an online reference for their constituents. Our new websites have already led to increased sponsorship from municipalities and nonprofit organizations.

LESSONS LEARNED

We met and really exceeded our goals and outcomes, but we did face some challenges. Our website development was far more complex and took much more time than we anticipated, and much work remains to be done in the integration of visual and horticultural information. A major practical marketing challenge in the native plant industry is availability of fresh, affordable, vetted and ornamental quality still imagery for our plants. It took a lot of time to acquire what we did and it remains a fraction of what we need. On the video side, because we were relying on availability of FDACS videography staff (an in-kind contribution by FDACS) and needed peak bloom time for our plants, we had narrow windows of opportunity during which to film. This resulted in our filming only in Central Florida, rather than our original plan of filming in North, Central, and South Florida. However, we remain challenged to find the professional editing resources to use the video we did collect.

Despite these challenges, our new websites offer a much greater opportunity to share and repurpose information than we anticipated, and we have obtained resources that we did not have to market and promote increased consumption of Florida native plants.

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Project (3) Florida Blueberry Association – $123,656

PROJECT TITLE
Developing Integrated Pest Management Strategies for Controlling Key Pests in Florida Blueberries

FINAL PERFORMANCE REPORT

Project Summary

Southern highbush blueberries (*Vaccinium corymbosum* L. x *V. darrowi* camp) are an important crop in Florida. In 2008, 9.8 million lbs were harvested from 3000 acres at an average of $5.30 per lb. Rabbiteye blueberries (*Vaccinium ashei*) are better suited for u-pick operations and local sales. The purpose of this project was to develop integrated pest management strategies for four major blueberry pests in Florida: flower thrips (*Frankliniella* spp.), Chilli thrips (*Scirtothrips dorsalis* Hood), blueberry gall midge (aka cranberry tipworm *Dasineura oxycoccana* Johnson), and flea beetles.

Flower thrips, *Frankliniella* spp. is the key insect pest in southern highbush and Rabbiteye blueberries. They feed on floral parts reducing blueberry yields. In addition, when larvae emerge from the flower they cause fruit scarring on ripening berries reducing its marketability. The purpose of this project component was to improve the integrated pest management of flower thrips in southern highbush blueberries to increase grower's profit.

Chilli thrips, *Scirtothrips dorsalis* Hood is generally smaller than flower thrips. They feed mainly on young blueberry foliage. Chilli thrips was first recorded in blueberries in the summer of 2008. Due to its potential to cause significant damage in blueberry plantings its population needs to be monitored throughout the season. The purpose of this project component is to assess the impact of Chilli thrips in some of the major blueberry growing counties in Florida.

Blueberry gall midge, *Dasineura oxycoccana* (Johnson) is a key pest of southern blueberries which produces dramatic yield losses. Adult females deposit eggs in blueberry flower and leaf buds and when hatch the larvae feed on the bud tissues significantly reducing plant vigor. The purpose of this project component is to determine the population density of blueberry gall midge and its parasitoids over a two year period in Florida.

Flea beetles are an emerging post harvest pest for southern blueberry growers. Adults feed on the leaves boring shot holes and reduce the leaf capabilities to carry out photosynthesis, which result in a significant reduction in yield the following year. The purpose of this project component is to investigate the relationship between each species in the flea beetle species complex and their blueberry host plants.

Project Approach

Component 1: Flower thrips

The 2010 replicates of the two experiments, one to determine an EIL for flower thrips in southern highbush blueberries and the other to examine the effects of weed control on flower thrips populations, of this project component have been completed. The first year of the EIL study was conducted on the farm in Inverness. The two varieties sampled from were Emerald and Premadonna. The first set of traps was placed in the field on Feb. 4, 2010. The last samples were taken on March 24.

Processing of flower samples was completed by mid-May. Both thrips adults and larvae per flower remained low until the last two weeks of the flowering season. Ninety-eight and 99% respectively of the adult thrips collected from the Emerald and Premadonna flowers were *Franklineilla bispinosa* (Morgan). The remaining 2 % of the Emerald adults were two *Franklinothrips* sp. and a single *Neohydatothrips variabilis* (Beach). The remaining 1 % of the Premadonna adults included a single *Thrips hawaiiensis* (Morgan) and a single *N. variabilis*.

Fruit injury evaluation was done on April 7. In the Emerald variety, an average of 31% of the fruit was injured, but only 4% was unmarketable. In the Premadonna variety, 24% was injured and only 3% was unmarketable.

There was no relationship between thrips per flower and fruit injury in either the Emerald (adj R^2 = -0.09, P_{slope} = 0.74) or Premadonna (adj R^2 = -0.01, P_{slope} = 0.38) varieties (Fig. 1). Because of this, we were unable to calculate an EIL.

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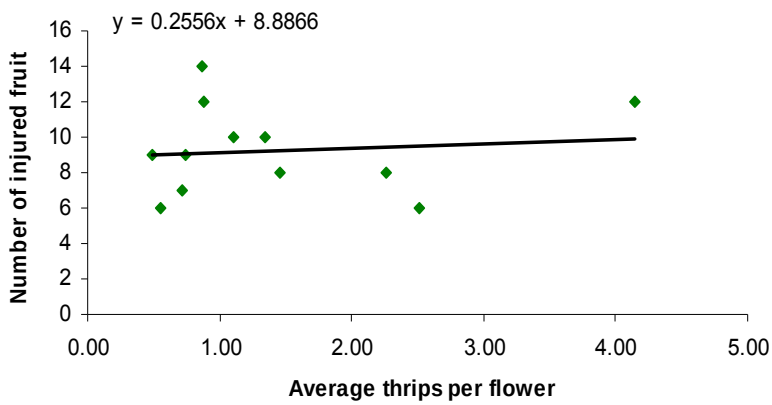

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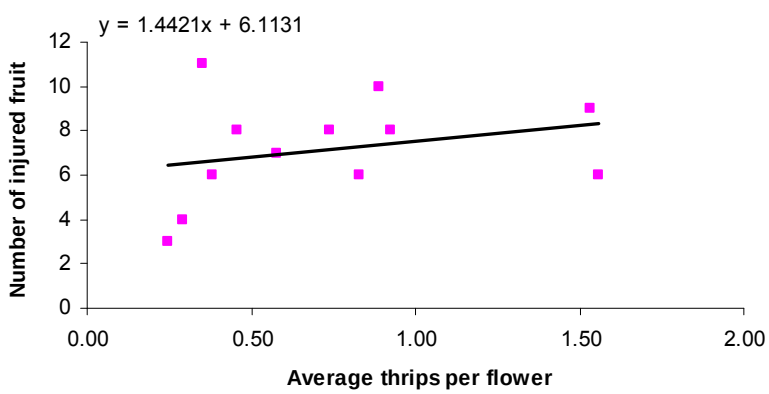


Fig. 1. Average thrips per flower vs. total injured fruit in the a) Emerald and b) Premadonna varieties.

The first year of the weed control study was conducted at the Citra PSREU. The two weeded plots were weeded on Feb. 3. The first set of traps was placed in the field on Feb. 10. The last set of samples was collected on March 16. Processing of sticky traps was completed on April 1. The sticky trap data is shown in figure 2. There were significantly more thrips per trap in the

unweeded plots compared to the weeded plots on Feb. 23 (t = 2.00, df = 38, P = 0.05) and March 16 (t = 3.27, df = 38, P = 0.0023).

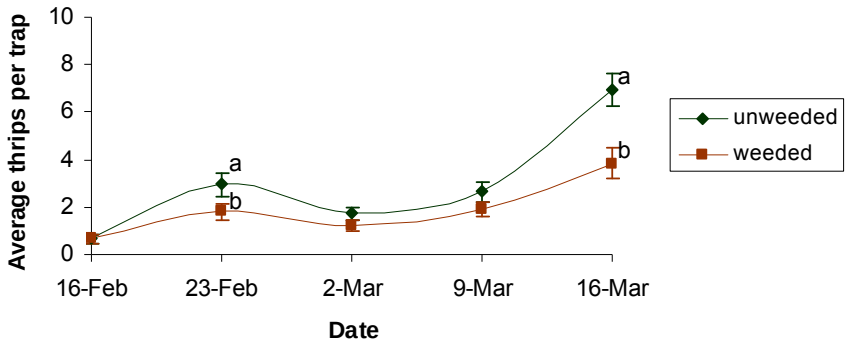
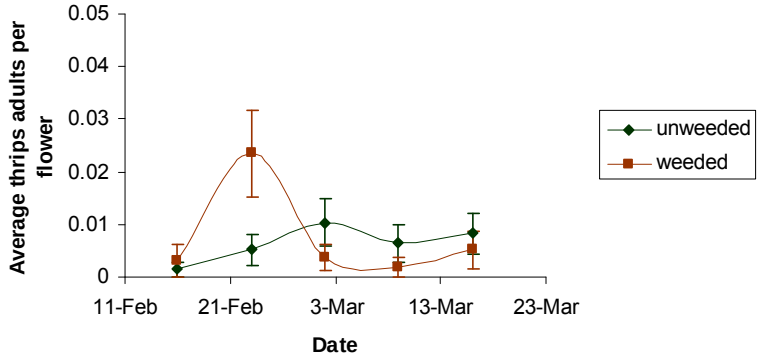
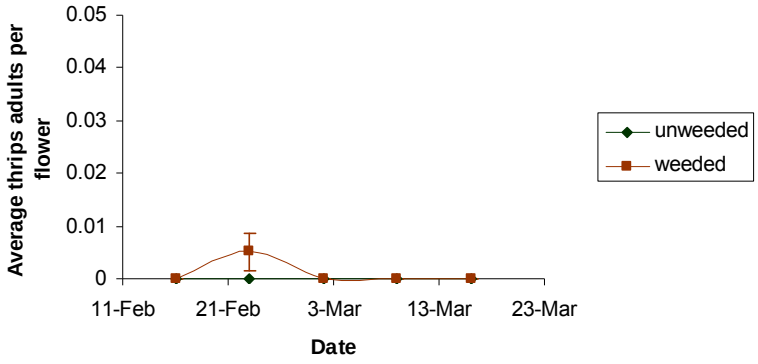


Fig. 2. Average thrips per trap sampled from the weeded and unweeded plots during each sampling week. Error bars represent standard error of the mean.

Processing of flower samples was completed by mid June. There were no significant differences in thrips adults per flower (all P > 0.09) between the treatments on any date (Fig. 3a). The thrips per flower data could not be analyzed because only a single thrips larva was found during the season on Feb. 23 in the weeded plots (Fig. 3b). Out of the 18 adults collected from the unweeded plots, 11 were *F. bispinosa*, three were *Pseudothrips inaequalis* (Beach), and the remaining four included a single specimen each of *Franklinothrips* sp., *Heterothrips azaleae* Hood, *T. hawaiiensis*, and *T. pini* (Uzel). The weeded plots were less diverse, with 10 out of 16 adults identified as *F. bispinosa*, five as *T. hawaiiensis*, and one as *Franklinothrips* sp.



a



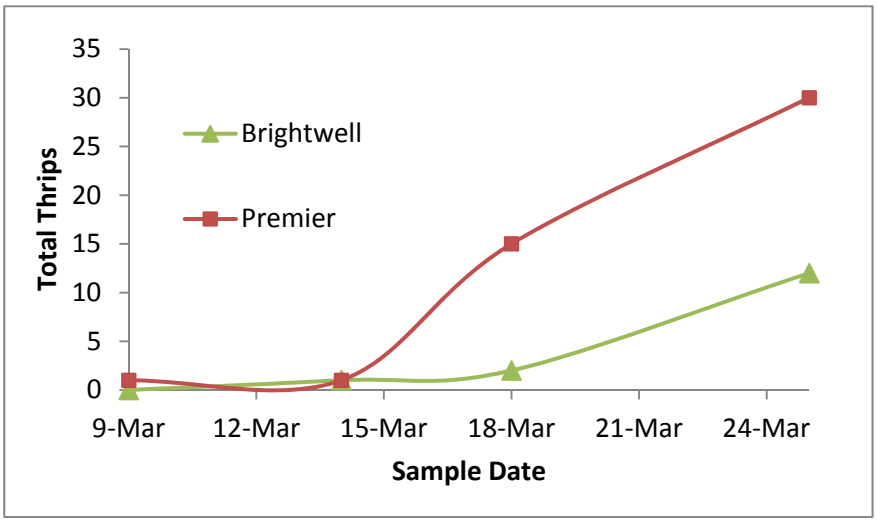
b

Fig. 3. Average thrips a) adults and b) larvae per flower from the weeded and unweeded plots during each sampling week.

Data on marketable yield was collected twice a week from May 3 to May 27. There was no significant difference in average total yield between the two treatments (t = -1.68, df = 38, P = 0.10, Fig. 6). There were an average of 2.5 ± 0.2 kg and 3.3 ± 0.4 kg in the unweeded and weeded plots, respectively.

During the spring of 2011 flower thrips samples were collected from two 0.3 acre plots of 7 year old rabbiteye blueberry plants at the University of Florida Plant Science Research and Education Unit in Citra, FL. These plots consisted of four Rabbiteye varieties: 'Climax', 'Brightwell', 'Premier', and 'Powderblue'; However, samples were only collected from 'Brightwell' and 'Premier'. All plants were approximately 1.5 to 2.0 m (5 to 6.6 ft) tall. We did not collect any samples from southern highbush varieties because they flower much earlier (February) in Gainesville and thrips population at that time of the year in 2011 was extremely low.
Flower samples consisted of three flower clusters taken from plants that had not been treated with insecticides. Sampling commenced at full bloom. Only flowers with fully expanded and open corollas were collected. Flower clusters were placed in vials containing a dilute alcohol solution and taken to the Small Fruit and Vegetable IPM Laboratory at the University of Florida, Gainesville, FL for processing. Nymphs and adults were removed from the flower clusters using the shake-and-rinse method. Both nymphs and adults stages were pooled for the analysis. White sticky traps were also used to catch thrips moving through the blueberry canopy. Traps were hung from blueberry branches in the middle part of the canopy at a height of approximately 1.2 m (4 ft). Four traps were used for each sample period (beginning March 11 and 22) and were left in the field for seven days. The total number of adult thrips on each trap was counted. Traps were not saturated so sub-sampling was not required.

More than 90% of the thrips collected were, *Frankliniella bispinosa* (Morgan), the key species attacking southern highbush and Rabbiteye blueberries in Florida. Thrips population at the sampling sites started low in early March but increased rapidly later in the season (Fig. 4. A & B). There was a 15-fold increase in the number of thrips collected in flower clusters between 14 and 25 March, 2011. The Rabbiteye blueberry variety 'Premier' had 5 times as many flower thrips as 'Brightwell' in late March (Fig 4. A & B). The reason for the difference in thrips population between these two varieties is unknown but could be related to a more uniform flowering habit that is expressed by 'Premier', as well as its longer flowering period. More research has to be done before any definite conclusions can be drawn.



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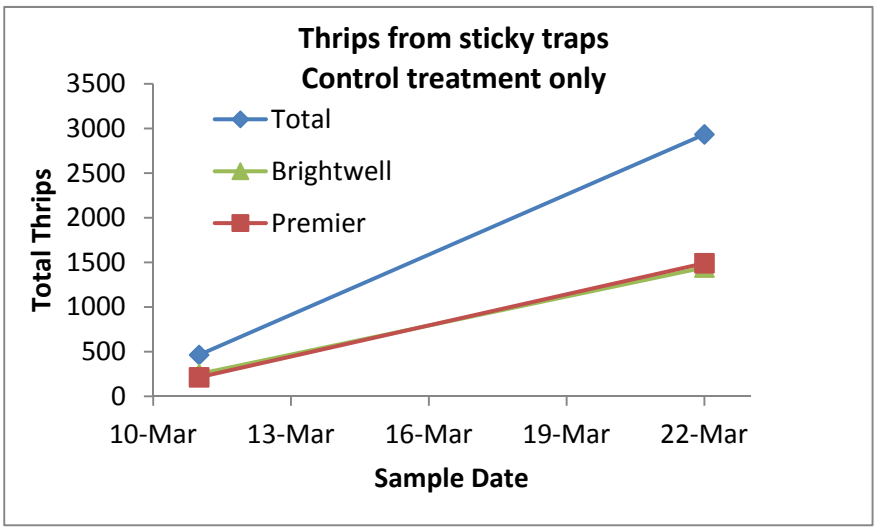

B

Fig. 4. A) Flower thrips from flower samples by variety, B) flower thrips samples from sticky traps

Component 2: Chilli thrips

During 2010 and 2011, blueberry plantings were monitored in 6 counties, including Alachua, Bradford, Gilchrist, Marion, Sumter, and Lake for Chilli thrips. Monitoring was done bi-weekly using white sticky traps. A minimum of two traps were deployed per acre. These traps were replaced every two weeks. Some traps were sent to the Small Fruit and Vegetable IPM laboratory at the University of Florida for thrips identification and confirmation. Diminutive populations of Chilli thrips were recorded in Lake, Marion, Sumter counties in 2010 and 2011. However, none of these populations were large enough to cause significant damage.

Component 3: Blueberry gall midge

In 2010, yellow sticky traps were used to capture natural enemies flying in the blueberry canopy. These were placed on plants at an organic blueberry farm with a large blueberry gall midge population. Blueberry flower buds and leaf buds were collected and taken to the Small Fruit and

Vegetable IPM Laboratory at the University of Florida, Gainesville, FL for dissection. Midge larvae were removed from the buds, counted, and the examined to determine if they had been parasitized.
Many parasitic Hymenoptera were collected, but no potential predators. Of the parasitoids collected, the Platygastridae were most abundant. Some species of Platygastridae have been documented as primary parasitoids of blueberry gall midge. These wasps tended to be most abundant early in the blueberry flowering period (Fig. 5).
All parasitized larvae removed from flower buds were parasitized by a species of *Platygaster* (Platygastridae). Percent parasitism in flower buds was approximately 10%. In leaf buds, however, a species of *Aprostocetus* (Eulophidae) was dominant. Percent parasitism in leaf buds was much higher at 40%.

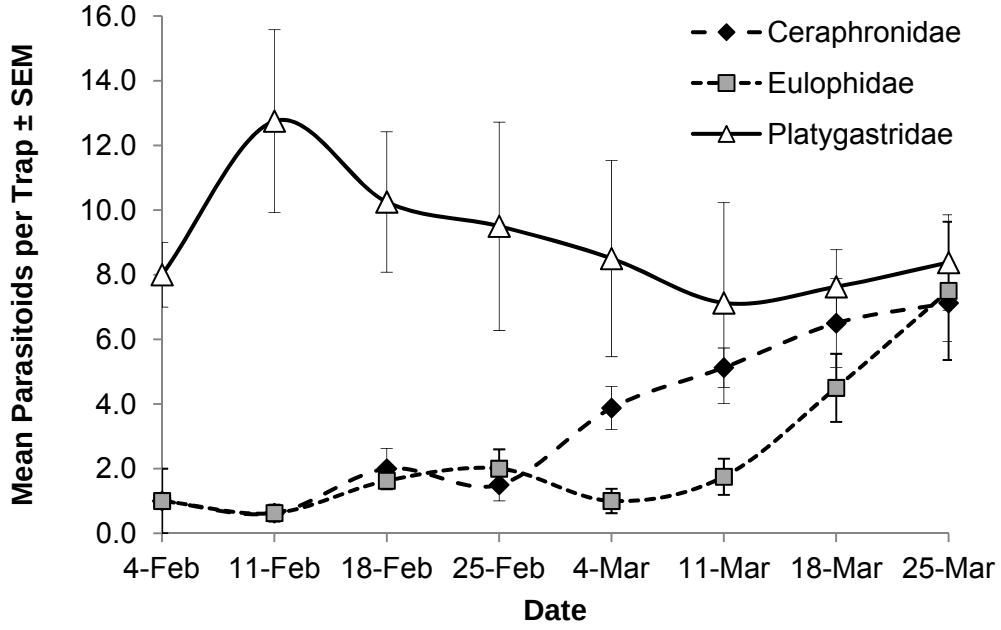

Fig. 5. Seasonal abundance of three parasitoid families (Hymenoptera) known to parasitized blueberry gall midge.

Two blueberry gall midge projects were pursued during the 2011 field-season running from February through April. In the first project we investigated the response of males, *D. oxycoccana* to chemical cues released by females in a Y-tube olfactometer. Our objective was to provide behavioral evidence that blueberry gall midge mating is mediated by a female-produced sex pheromone. Each replication consisted of releasing a single male downwind and giving him time to move upwind and choose either the treatment arm (containing one unmated adult female) or control arm (filtered air only). Gall midge adults used in this experiment were reared from larvae collected in the field.
The second project dealt with the incidence of parasitism of blueberry gall midge infesting blueberries. This was a continuation of a previous year's research. Our objectives were to identify the primary parasitoids attacking blueberry gall midge and determine the stage(s) at which the midge is most vulnerable to parasitoids. Midge larvae were collected from infested blueberry plants and examined in the laboratory to determine their stage of development and whether or not they contained parasitoid eggs. A census of adult parasitoids was also conducted by using yellow sticky traps hung in blueberry plants. From this we will determine the seasonal patterns of the major parasitoid groups that occur in north-central Florida blueberry farms.

Our preliminary results indicated that more than 70% of *D. oxycoccana* males flew up-wind in a Y-tube olfactometer in response to females displaying pheromone plumes. This provided preliminary evidence that males responds female pheromone plumes.

We recorded 11 families of hymenoptera parasitoids (Table 1). The highest number of parasitoids was recorded from the family Platygastridae in Rabbiteye and southern highbush blueberry bushes. Platygastrids were abundant from February when sampling started to April 7th when the population crashed (Fig. 6). Other common parasitoids include those in the families; Scelionidae, Ceraphronidae and Eulophidae. These parasitoids began to increase in early march and peaked around the first week of April.

Table 1. Show the percentages of various hymenoptera parasitoid families found on two farms in Florida

Family	Farm 1 (RE)	Farm 2 (SHB)
Aphelinidae	4.6	10.2
Braconidae	3.0	5.8
Ceraphronidae	8.8	9.0
Encyrtidae	7.0	10.7
Eulophidae	10.4	8.1
Eupelmidae	6.8	7.8
Ichneumonidae	2.9	3.6
Mymaridae	5.5	6.6
Platygastridae	29.6	18.4
Pteromalidae	5.9	1.0
Scelionidae	10.2	13.9
	n = 1380	n = 620

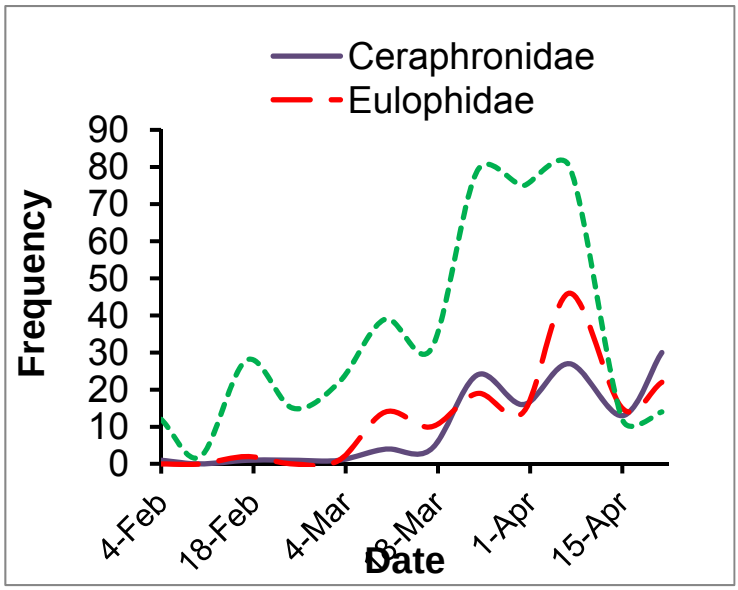

Fig. 6. Population of hymenoptera parasitoids in a Rabbiteye planting in Alachua county Florida

Component 4: Flea beetles

During the summer of 2010, adult flea beetles were sampled in two 5-acre blocks of southern highbush blueberries at a commercial blueberry farm. Sampling was conducted by visually observing every third bush per row. Twenty specimens of each species were collected and brought to the Small Fruit and Vegetable IPM Laboratory at the University of Florida, Gainesville, FL for identification.

The two species found were *Colaspsis pseudofavosa* and *Systena frontalis*. *C. pseudofavosa* was more abundant (68% of total) than *S. frontalis* (32%). *Altica sylvia* was not encountered in this sampling.

Our 2011 flea beetle summer experiments were designed to evaluate cultivar preferences and feeding behaviors between southern highbush and Rabbiteye blueberry varieties. Two experiments were conducted between June and July 2011. For experiment 1, choice tests were conducted with 5 blueberry cultivars consisting of 3 southern highbush varieties, Jewel, Millenia and Star, and two Rabbiteye varieties, Brightwell and Climax. The experimental arena consisted of 3 cm (~1 inch) diam. leaf discs taken from the 5 cultivars being evaluated. Leaf discs (5) were placed into each Petri dish containing two adult beetles, *Colaspis pseudofavosa* (n = 50). Beetles were allowed to feed for 48 h then leaf discs were scanned and area consumed were measured from digital images (Scion Image Corp, Fredick, MD). There were no differences in leaf area consumed among the southern highbush varieties Millennia, Star and Jewel. However, significantly more southern highbush leaf disc area was consumed compared with Rabbiteye. The average leaf area consumed for southern highbush was approximately 25% versus 12% for Rabbiteye cultivars.

Experiment 2 was similar to experiment 1; however, no-choice tests were used to evaluate two blueberry cultivars, one southern highbush (Jewel) and one Rabbiteye variety (Climax). Only 1 beetle was used per Petri dish and each leaf disc was replaced every 24 h for 4 days. The experimental arena and measurements of leaf area consumed were evaluated using the same

methodology as in experiment 1. Significantly more southern highbush (Jewel) was consumed compared with Rabbiteye (Climax) (fig. 7).

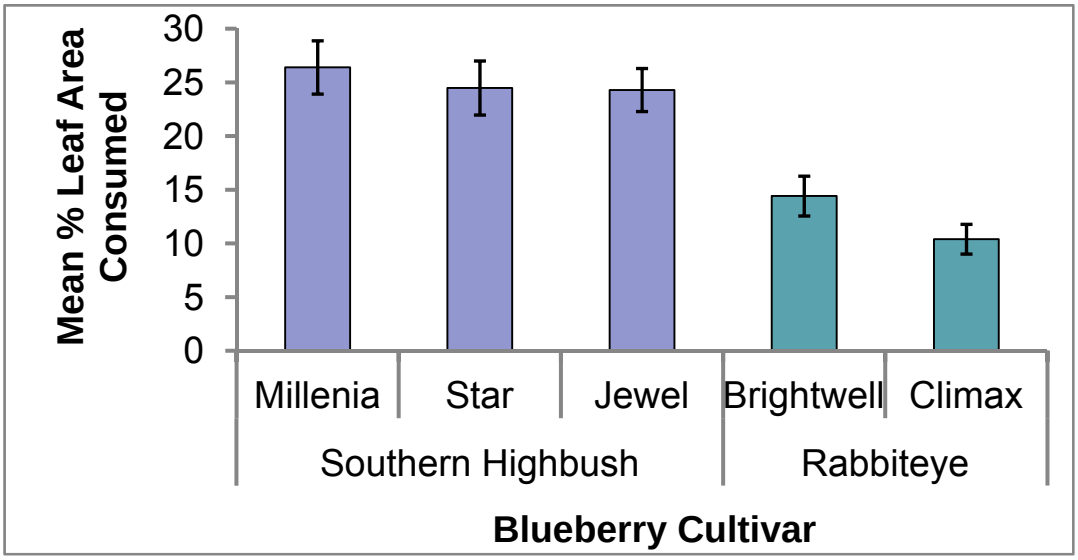

Fig. 7. Cultivar preferences of *Colaspis pseudofavosa* in highbush blueberries, Alachua, Co.

Goals and Outcomes achieved

Component 1: Flower thrips

We made significant progress towards the goal of determining the feasibility of mowing fields of flowering plants adjacent to blueberry plantings to reduce thrips populations. Our results from the spring of 2010 indicate that weed control may be a feasible tactic.

Unfortunately, we were unable to calculate an EIL for flower thrips in southern highbush blueberries due to the low population of thrips that was present in 2010.

Component 2: Chili thrips

The goal of this project component was completed. As expected, we determined the extent of Chilli thrips infestation in six counties in north Florida. Chilli thrips were recorded at low levels in Lake, Marion, and Sumter Counties in both years.

Component 3: Blueberry gall midge

We successfully completed the goals of this project component, also. We identified several blueberry gall midge parasitoids and were able to determine when the most common parasitoids were abundant. Platygastrids were abundant from February to early April, which coincides with the presence of flower buds. Parasitoids in the families Scelionidae, Ceraphronidae and Eulophidae began to increase in early march and peaked around the first week of April, which is when leaf buds are abundant.

Component 4: Flea beetles

We accomplished both goals of this project component. There are two flea beetle species in southern blueberries, *Colaspsis pseudofavosa* and *Systena frontalis*. *Colaspsis pseudofavosa* is the more abundant of the two species. Because it was twice as abundant as *S. frontalis*, we focused our varietal preference tests on *C. pseudofavosa*. This species prefers southern highbush blueberries compared with rabbiteye blueberries.

Meetings. We participated in the spring and fall blueberry meetings that were held in Plant City, Florida on March 3rd and November 1st, 2011. Over 150 blueberry growers, crop consultants, and marketing representatives attended the meetings. A research update on thrips, gall midge and flea beetles was presented to growers to allow them to track our progress.

Workshops. On February 1st 2011 we had an in-service training workshop in Bartow Florida where we trained extension agents working with blueberry growers on pest identification (thrips, gall midge and flea beetles), and management practices. This workshop was a success and approximately 25 extension agents attended, representing all 67 counties in the state.

The information gained from each component has been disseminated to more than 250 blueberry growers. In fact at my last presentation at the blueberry growers' fall meeting, there were more than 300 people registered at the meeting. In addition, more than 100 blueberry growers attended several other meetings and on-farm demonstrations that took place throughout the duration of the project.

Our research is periodically published in the Florida Blueberry Growers Association newsletter. In addition the research and final report is published on the University of Florida, Fruit and Vegetable IPM website at http://entnemdept.ufl.edu/liburd/fruitnvegipm/ . We have already published (as discussed in the final report) several research papers and we will also be publishing several EDIS publications over the next two years. Finally, presentations given at the Florida Blueberry Growers Association meetings are listed on their website.

The Florida Blueberry Growers Association extends information to over 90% of the blueberry growers and all of the extension agents in Florida. Therefore, our information is well disseminated to all of the blueberry growers and potential blueberry growers in Florida as well as neighboring states.

Beneficiaries

Southern blueberry growers, crop consultants and extension agents will benefit from the information we have gathered. The flower thrips data are preliminary, but interested growers could implement the mowing of open fields on their farms based on our data if it is of low cost to them. Southern blueberry growers are aware of the potential of chilli thrips to cause problems and which counties they are present in so far. Knowledge of the peaks in blueberry gall midge parasitoid activity will allow growers to time sprays minimize impacts on these natural enemy populations. The information we gathered about flea beetle ecology will lead to better management tactics for growers in the future.

Extension agents have also benefitted from our research. They can aid growers in the identification of pest species and provide guidance on management tactics.

Future researchers can build on our findings to further improve the management of pests in southern blueberries.

Lessons Learned

We were able to make significant advances in blueberry pest management in terms of understanding thrips population dynamics, identifying key parasitoids that were common in blueberry plantings with potential to regulate blueberry gall midge populations. In addition, we were able to understand the feeding preferences of a key flea beetle that is common in southern blueberries. Overall, the research outlined here will help us to develop better management practices for key pests in southern blueberries.

The one goal we did not achieve was to develop an EIL for flower thrips in southern highbush blueberries. The flower thrips population in 2010 was too low. A colony of flower thrips *F. bispinosa* (Morgan) would have to be established to avoid relying on unpredictable wild populations.

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Additional Information

Publications

Rhodes E. M. and O. E. Liburd. 2011. Flower thrips (Thysanoptera: Thripidae) dispersal from alternate hosts into southern highbush blueberry (Ericales: Ericaceae) plantings. Florida Entomologist. 94: 311-320.

Rhodes E. M., O. E. Liburd and S. Grunwald. 2011. Examining the spatial distribution of flower thrips in southern highbush blueberries by utilizing geostatistical methods. Environ. Entomol. 40: 893-903.

Roubos, C. R. and O. E. Liburd. 2010. Pupation and emergence of blueberry gall midge, *Dasineura oxycoccana* (Diptera: Cecidomyiidae), under varying temperature conditions. 93: 283-290.

Liburd, O.E., and C.R. Roubos. 2010. Blueberry gall midge: A key pest of southern highbush and rabbiteye blueberries. Refereed section. Proceedings of the Florida State Horticulture Society. 123: 23-25.

PROJECT (4): GULF CITRUS GROWERS, INC.: COMPOUNDS THAT PROMOTE SYSTEMIC ACQUIRED RESISTANCE (SAR) IN CITRUS

FDACS Grant Contract #15558
Total Funding - $274,908.00
End Date: 6/30/2012

PROJECT SUMMARY

The purpose of this proposal was to screen compounds that are reputed to promote Systemic Acquired Resistance (SAR) to greening and canker, the two most important bacterial diseases affecting commercial citrus crops in Florida. Pathogens are able to disrupt the basal defense mechanism of plants and cause disease. In response, plants produce compounds that travel systemically throughout the plant eliciting defense-related genes that increase resistance to secondary infection by the pathogen. There has been a lot of interest by the citrus industry in finding compounds that will boost the natural defense mechanism of citrus trees as aids to decreasing the severity of symptoms by these two bacteria in commercial groves. Furthermore, chemical companies are peddling compounds they claim will induce SAR in citrus, but growers do not always have results from an independent laboratory to verify the claims. To date there are no comprehensive research programs in Florida screening SAR compounds. This project was designed to aid decisions by growers concerning compounds to spray in their commercial groves to mitigate these diseases and is expected to help the industry throughout Florida.

The citrus industry in Florida is one of the most important contributors to the state's economy. In recent years, two major bacterial pathogens, Huanglongbing (HLB), also known as "Greening", and "Bacterial Canker" or "Canker" have devastated the industry and continue to drive up production costs to keep them under control. Effective management of these diseases will require a multipronged approach, one of which is to stimulate the natural defense mechanism of citrus trees using commercially available compounds. This information is important for developing approaches to mitigating these diseases at lower cost than current practices. This was a new project and not previously funded by SCBGP or SCBGP-FB.

PROJECT APPROACH

Our principle goal was to develop a program to screen commercial products for their efficacy against greening and canker. In accomplishing our goal, we identified biochemical markers within the plant that we could use as indicators of success in product performance and then tested compounds that are reputed to promote systemic acquired resistance.

For canker we had to conduct a series of experiments that included comparing response of susceptible citrus, such as sweet orange and grapefruit, to citrus resistant to canker such as kumquat and calamondin. These studies yielded several papers and a book chapter. From this work we've identified potential approaches for genetically modifying citrus to enhance its response to canker, which we recommend for future studies. We then tested commercial products for stimulating levels of hydrogen peroxide in the plant and reducing canker symptoms. Salicylic acid enhanced hydrogen peroxide levels in citrus and therefore enhanced disease resistance, but not sufficiently to reduce disease symptoms. Phosphite, fertilizers, beneficial bacteria, and humic acid alone did

not improve disease resistance when applied alone. Two products gave us encouraging results (Fortress plus Safeguard II and NAI-5750, which is sold under the trade name Tiadinil in Japan). We then tested these products in a commercial grove heavily infected with canker and had encouraging results similar to our tests from the greenhouse. Although NAI-5750 is not currently labeled for citrus, representatives from the parent company, Nichino, Inc. indicated that they would be interested in pursuing a label efficacy was demonstrated on field grown citrus. We propose that Nichino, Inc. be encouraged to pursue a label for this product for citrus against canker. The reason for success of Fortress plus Safeguard II is unclear, however, the combination of chemicals in this product (salicyclic acid, fertilizers, and phosphite) may be required to applied together for efficacy. This product also contains nickel, which is an essential nutrient of plants, but may inhibit canker similar to copper. Research needs to continue to determine which aspects of this product are promoting disease resistance in citrus against canker.

Before testing products on citrus plants infected with greening, we first tested the hypothesis that Liberibacter, the bacterium that presumably causing greening, cannot move into new growth flushes in trees where the Asian psyllid is not present. We found in our initial studies that it did move into the new growth flushes, but the plants were also heavily infected with phytophthera root rot which we believe may create routes for the bacteria to move into the new growth flush. This result was surprising and has led us to initiate a follow-up study that includes fungicides, beneficial bacteria, and enhanced fertilization to suppress phytophthera root rot and encourage growth. This study is currently ongoing. Demonstrating that the bacteria can be prevented from moving into new growth flushes is considered essential before testing of commercial compounds can progress since the presence of another pathogen, in this case phytophthera, can compromise the plants sufficiently that it would alter results of testing products that promote SARs.

Dr. Ebel served as the PI on the research aspects of the project. Ron Hamel served as a liaison with the board of directors of the Gulf Citrus Growers Association (GCGA). The GCGA was involved in the initial planning of the project and commented on progress during the course of the research when results were presented.

Goals and Outcomes Achieved

1. Developed a screening program for determining efficacy of promoting SARs by commercial products against greening and canker.
2. Identified markers for canker (hydrogen peroxide) and HLB (Ct values using RT-PCR) for impact of SARs products on reducing disease.
3. Screened commercial products that were reported to promote SARs in citrus against canker. These products were categorized as containing one or more of the following components: essential nutrients, salicylic acid, phosphite, fungicides, beneficial bacteria, and humic acid. Of the products tested, one product (salicylic acid) demonstrated enhanced disease resistance although did not reduce symptoms when applied alone, and two products (Fortress plus Safeguard II and NAI-5750) showed increase in defense response (enhanced H_2O_2) and reduced disease.
4. Measurable outcomes of this work include: a. Book Chapter (1)
    a. Robert C. Ebel and Naveen Kumar (2012). Interference of Oxidative Metabolism in Citrus by *Xanthomonas citri* pv. *citri*, Oxidative Stress - Environmental Induction and Dietary Antioxidants, Volodymyr I. Lushchak (Ed.), chapter 8. ISBN: 978-953-51-0553-4. (http://www.intechopen.com/books/statistics/oxidative-stress-environmentalinduction-and-dietary-antioxidants/interference-of-oxidative-metabolism-incitrus- by-xanthomas-citri-pv-citri-the-causal-agent-of-citr) Total downloads: 664 from 85 different countries

b. Refereed publications (5):

Kumar, N., Ebel, R. C. and Roberts, P. (2011). Antioxidant metabolism of grapefruit infected with *Xanthomonas axonopodis* pv*. citri.* Environmental and Experimental Botany. 71: 41-49.

Kumar, N., Ebel, R. C. and Roberts, P. D. (2011). Antioxidant isozyme variability in different genotypes of citrus and kumquat. Journal of crop improvement. 25: 86-100.

Kumar, N., Ebel, R. C. and Roberts, P. (2011). SOD activity in *Xanthomonas axonopodis* pv*. citri* infected leaves of kumquat. Journal of Horticultural Science and Biotechnology. 86: 62-68. UK.

Kumar, N., Ebel, R. C. and Roberts, P. D. (2011). H_2O_2 metabolism during sweet orange (*Citrus sinensis* L. Osb.) Hamlin *Xanthomonas axonopodis* pv. *citri*. Scientia Horticulturae. 128: 465-472.

Kumar, N., Ebel, R. C. and Roberts, P. D. (2011). H_2O_2 degradation is suppressed in kumquat leaves infected with *Xanthomonas axonopodis* pv.*citri.* Scientia Horticulturae. 130: 241-247.

c. Conference proceedings (5)

Kumar, N., Ebel, R. C. and Roberts, P. D. (2009). Evaluation of antioxidant metabolism in commercially grown citrus cultivars in Florida. Proc. Fla. State Hort. Soc. 122: 166-168.

Kumar, N., Ebel, R. C. and Roberts, P. D. (2010). Effect of salicylic acid on oxidative metabolism during *Xac* infection of grapefruit. Proc. Fla. State Hort. Soc. 123: 87-91.

Kumar, N., Ebel, R. C. and Roberts, P. D. (2012). Effect of high temperature on different genotypes of citrus. Proc. Fla. State Hort. Soc., in press.

Kumar, N., Ebel, R. C. and Roberts, P. D. (2012). Responses of *Citrus medica* var. *sarcodactylis* during *Xanthomonas citri* pv. *citri* infection. Proc. Fla. State Hort. Soc. , in press.

Handique, U., R.C. Ebel, and K.T. Morgan. (2012). Influence of soil-applied fertilizer on greening development in new growth flushes of sweet orange. Proc. Fla. State Hort. Soc. , in press.

d. Presentations at scientific meetings (4)

Kumar, N., Ebel, R. C. and Roberts, P. (2009). Evaluation of antioxidant metabolism in commercially grown citrus cultivars in Florida. Florida State Horticulture Society.

Kumar, N., Ebel, R. C. and Roberts, P. (2010). Effect of Salicylic Acid on Oxidative Metabolism During Xac Infection of Grapefruit. Florida State Horticulture Society.

Kumar, N., Ebel, R. C. and Roberts, P. D. (2012). Responses of *Citrus medica* var. *sarcodactylis* during *Xanthomonas citri* pv. *citri* infection. Fla.State Hort. Soc. (June 2012)

Handique, U., R.C. Ebel, and K.T. Morgan. (2012). Influence of soil-applied fertilizer on greening development in new growth flushes of sweet orange. Proc. Fla. State Hort. Soc. , in press.

e. Popular press articles (2)

N Kumar and R C Ebel (2012). The role of salicylic acid in controlling citrus canker. Citrus Industry, June, 12-13.

R.C. Ebel and Naveen Kumar. (2012). Stimulating Citrus' Natural Defense Mechanism Against Canker. Fruit and Vegetable, in press.

f. Reports to the Gulf Citrus Growers Association (5)

Results of this research were presented at 5 meetings of the Gulf Citrus Growers' Association, each of which was attended by 15-20 producers.

The table below shows the originals goals from the grant and the accomplishments that were achieved for each.

Year	Task	Original Goal	Accomplishments
1	1	Established citrus trees infected with greening or canker in a greenhouse at SWFREC/IFAS. Spray infected potted trees with test compounds and track symptom development, bacterial population, and defense-related markers in the Citrus Physiology Laboratory at SWFREC/IFAS.	Accomplished
	2	Identify commercial groves with extensive greening or canker symptoms via the Board of Directors of the Gulf Citrus Growers Association	Accomplished for canker, but was too preliminary for greening.
2	1	Spray trees with test compounds not tested in year 1 or combinations of compounds tested in year 1 that are believed to restore the complete defense mechanism and track symptom development, bacterial population, and defense-related markers in the Citrus Physiology Laboratory at SWFREC/IFAS.	This was accomplished for canker. Due to the length of time it took to establish plants with greening and the complication of phytophthera, further work needs to be conducted to control this fungal pathogen before SARs products can be tested.
	2	Spray target compounds in commercial groves and track symptom development, bacterial population and, where appropriate, defense-related markers.	Accomplished for canker with two products demonstrating sufficient efficacy to warrant further study.
3	1	Spray target compounds in commercial groves and track symptom development, bacterial population and, where	Same as above.

		appropriate, defense-related markers.	
	2	Publish research results from potted studies in scientific journals.	Some research from this work has been published (See above) with several more publications in preparation.
	3	Present results to the entire citrus industry via trade magazines, EDIS documents, and presentations at industry meetings.	Two trade magazine articles have been published. Trade magazine articles and EDIS documents will be developed upon successful publication of research results in scientific publications.

BENEFICIARIES

The citrus growers benefit by having products tested by an independent lab that shows which products can promote SARs and disease control in citrus against canker.

The chemical companies benefit by knowing whether their products can promote SARs and reduce disease symptoms.

The economic impact of this project is difficult to project since no economic analysis was conducted. Furthermore, the information is still somewhat preliminary in that recommendations from the studies conducted here are being transmitted to the industry, but it is unknown how much the recommendations will be adopted. We do anticipate that the information provided here will aid decision making by growers in their programs to promote citrus tree health.

LESSONS LEARNED

We believe we have fulfilled most of the objectives of this study. We also went beyond in our understanding of the defense response of citrus against canker to where there are strategies that could be tested for genetically modifying citrus to make them more resistant to canker. We are optimistic that the products that have been shown to stimulate the defense mechanism can be alternative treatments than copper sprays, but more work needs to be done to verify their best use, especially how combined with other chemicals efficacy can be optimized. We encourage the industry to pursue labeling NAI-5750 with Nichino, Inc. Although we did not progress as far with greening as we had hoped, the long time required to develop plants with greening (6 months) and the long time required to conduct individual studies (10 months) makes studying SARs products on this disease more challenging than canker. We plan to continue the research study we currently have underway, which is required before we can study SARs chemicals in citrus against this disease.

The only major unexpected outcome was the development of phytophthera root rot in the greening experiments. What is interesting is that we conducted canker studies in the same greenhouse and did not see any phytopthera root rot on those plants. We must find a method to control phyophthera root rot before we can undertake screening of SARs products since this disease may interfere with our results.

The biggest challenge we faced was the length of time it takes to develop plants with greening and to actually conduct the experiments. Our project goals, in retrospect, were too ambitious for the time of the grant.

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PROJECT (5): UNIVERSITY OF FLORIDA, INSTITUTE OF FOOD AND AGRICULTURE SCIENCE: GROWER MANAGEMENT STRATEGIES FOR GREENING (HLB) INFECTED GROVES

FDACS Grant Contract #15638
Total Funding - $606,996.00
End Date: 6/30/2012

PROJECT SUMMARY

This project was begun in 2009 to provide field-based solutions for management of citrus greening or huanglongbing (HLB). Understanding that citrus is a perennial commodity and several years of continued treatment would be needed to obtain results, the project was considered an important first step to establishing treatments. Future treatments and data collection will be necessary to make decisions on best treatments and combinations.

At the time the project was begun, the best management practice of removing trees was being replaced by good horticultural practices (foliar fertilization and other foliar applications designed to improve health). The goal of the project was to identify management practices that could be used soley or combined with other practices to sustain productivity in endemic HLB situations.

This project had not previously been funded by the SCBGP or SCBGP-FB.

PROJECT APPROACH

Objective 1: Determine profitability of aggressive HLB-infected tree removal versus enhanced grove care to sustain production.

Plots were set up in Jan 2010 in a 38-acre block of 20-yr old Valencia on mixed rootstocks. At this time, scouting the block indicated that the basal HLB infection rate was approximately 15%. Initially designed to compare HLB-infected tree removal vs no tree removal, it was apparent from emerging HLB management concepts developed in Brazil that plot sizes were too small to make accurate comparisons. The experiment was redesigned to compare tree performance with high foliar nutrition and standard foliar nutrition. The basal management in this block was 15-gph daily automated irrigation by microsprinklers, 180-200 lbs granular N/acre/yr + Ca(NO3)2 + B applied in 4X equal fertilizer splits/yr, herbicide as needed, mowing, hedging and topping. Pesticides were applied annually as follows: Jan Dimethoate, Feb Danitol, Apr Lorsban, May Mustang, June oil Movento Delegate, July oil Imidan, Sep oil Actara, Oct Danitol. The standard foliar nutrition treatment (24 plots of 84 trees each) in 2010 consisted of 1-2 annual applications coinciding with flushes of Mn, Fe, and Zn at 2 gal/acre (Growers Fertilizer Corporation liquid 1.6% Mn, 2% Fe and 2% Zn. In 2011, 10-02-13 granular fertilizer was used + 11.3% Ca, 1.7% Mg, 3.5% S, 0.03% Fe, and 0.03% B. Supplementary fertigation was applied during the the early spring and summer to reps in the western half of the block. Comprehensive hydroponics nutrient solution at 0.5 lb N/acre was injected in the daily irrigation, adding approximately 20 lb additional N/acre/yr. The high foliar nutrition treatment (24 plots of 84 trees each) included major, secondary and micronutrients applied with every pesticide spray as described in table 2 of the March 2012 Field Day document. The plant nutrient elements used were N, P, K, Ca, Mg, S, Mn, Zn, Mo, B and Fe. Non-nutrient active ingredients were K-phosphite, K salicylate, and *Bacillus subtilis* biofungicide. Unfortunately, treatment effects on yield could

not be determined due to severe freezes during the winters of 2009-10 and 2010-11. Additional treatment years will be needed in order to ascertain a treatment effect on yield. Spring flush
leaves were analyzed in July of each year to assess the nutritional status and determine treatment responses. Of the nutrients tested, only P and Fe were significantly greater in leaf tissue of the high foliar nutrition treatment when compared with the standard foliar treatment. By March 2011, there were no significant treatment effects on HLB incidence (34.7% and 35.6%).

Objectives 2 and 4: Evaluate performance of psyllid repellent on psyllid population and HLB incidence, and determine the effect of psyllid spray 'Priority' timing on psyllid population, yield, HLB incidence and production cost.

SPLAT-ACP Repel was applied in April and May 2010 as the label directs to determine the effects on ACP populations. Applications were made to 3-4 acre replicated blocks, and
identical adjacent blocks were used as controls. ACP populations were monitored, but population effects were inconclusive due to very low psyllid populations. Because of the critical nature of controlling ACP populations for effective HLB management, the use of the repellent was abandoned. Instead, ACP populations were monitored as affected by our basal pesticide applications described above. When ACP populations were monitored after 6 months in areas where basal pesticide treatments + SPLATACP Repel were applied, ACP populations were reduced to 0.25 ACP/10 traps. At these low populations, the cost of SPLAT-ACP Repel may not warrant its use. Nevertheless, advanced SPLAT-ACP Repel formulations were tested. Two of the four formulations produced very good results, suppressing ACP populations better than previous formulations. In order to continue formulation trials, tests should be conducted in groves harboring high ACP populations. Because of the critical nature of controlling ACP populations for effective HLB management, the use of the repellent was abandoned. Instead, ACP populations were monitored as affected by our basal pesticide applications described above. We joined the 17/27 Highlands County CHMA and
participated in area-wide control of ACP. Under these conditions and with basal insecticide applications, very few ACP were found, confirming the value of CHMA participation to control ACP populations. A demonstration was set up in 2010 to showcase the use and efficacy of the mating disruption pheromone for citrus leafminer, SPLAT CLM Mating disruption was effective for periods up to 8 weeks. The material appeared to have a mitigating effect on the spread of citrus canker. Application of SPLAT CLM was achieved manually in 2010 at a cost of $200/acre, but in 2011
significant changes in scale up occurred, and application was done for $40/acre with a specialized application machine.

Objective 3: Evaluate an advanced production method for replanting in HLBendemic
groves.

A 5.6-acre block dedicated to planting a young block under an advanced citrus production system regime. This block was designed primarily for evaluating and demonstrating different citrus rootstocks and a rooted cutting propagation method, delivery of fertigation by microsprinkler (7.7 gph/tree) or drip (2.24 gph/tree), and use of controlled release fertilizer. In some cases, trees had drip
and microsprinkler irrigation for freeze protection. Overall, the 5.6-acre block had microsprinklers installed on 1701 trees for freeze protection. Windbreak trees (Torrelliana) were planted at 7' spacing surrounding the block to protect against canker from an adjacent grove. Vernia was planted on X639 (7 rows, 567 trees), C-35 (7 rows, 567 trees), and rough lemon (4 rows, 324 trees), and 3 rows of rooted Valencia cuttings were planted (243 trees). Significant time elapsed between ordering and receiving trees. The Vernia trees were planted in March 2011 and the Valencia rooted cuttings in

October 2011. The trees are too young to show meaningful differences but will be followed for future reporting. The Advanced Citrus Production System (ACPS) block represents a more sustainable way to culture citrus, requiring much less resources to grow a crop. Although a larger up-front investment is needed to establish an ACPS, however, previous work demonstrated that the return on investment is much faster. The March 2012 Field Day document contains more information about the equipment installed for the ACPS.

EXTENSION *Lake Placid Field day*: A field day was planned and conducted on March 7, 2012, to showcase treatments applied and outcomes of the research program supported by the Specialty Crops Block Grant with the objectives detailed below. The field day speakers were those that participated directly or indirectly in the project objectives. Over 70 growers and industry members attended the field day. Attendees were given a 24-page booklet describing the research conducted in the grove, support received from the FDACS Specialty Crop Block Grant, and the role of the Citrus Research and Education Foundation, Inc., for oversight of management at the Lake Placid location. During the period of the grant, yield increased (Figure 1) nearly 2-fold in Hamlin and 3-fold in Valencia, even though HLB infection rate increased. Important to note was the absence of a significant freeze event in 2012, which helped to stabilize yield.

Objective 1: Determine profitability of aggressive HLB-infected tree removal versus enhanced grove care to sustain production. In the blocks designated for this objective, we learned from other studies and grower trials throughout the state and the world that removing trees in a small area would not be successful. Thus, experiments were initiated to compare additional intensive fertilization methods with the conventional dry granular fertilizer program and standard supplementary micronutrient sprays in endemic HLB situations. Other horticultural practices were uniform for these blocks, including daily-automated irrigation and herbicide applications. Leaf analysis conducted in 2010 after nutrient applications indicated that imposed treatments resulted in leaf nutrient contents that were generally in range with IFAS recommendations. Attendees were taken through plots. Although nutrition field experiments are generally slow to respond to treatments, attendees saw no apparent differences at that time between standard and intensive foliar spray coupled with fertigation programs. Moreover, the attendees saw that a comprehensive granular fertilization program containing a balance of macro and microelements may sustain trees in HLB-endemic groves without the need for elaborate foliar spray programs. However, in situations where root uptake of nutrients may be compromised, foliar applications can quickly remedy more immediate nutritional needs.

Yield data for the 2011/12 harvest: There were no significant differences between the fertigated and non-fertigated experiments across all measured yield variables. The yield means are listed in Table 1 for the individual sprayed and unsprayed treatments in either fertigated and unfertigated experiments.

Table 1. Mean Valencia fruit yield (boxes/ac) across all treatments (NS)

	Std foliar spray	High intensity foliar spray
Fertigated	426	410
Non-fertigated	410	424

Other measured yield variables were pooled in Table 2 across both fertigated and unfertigated experiments due to the lack of significant fertigation response. The only significant treatment response was measured in the fruit weight, which indicated that the fruit sizes were smaller for trees receiving the intensive foliar spray program. This likely was a compensatory response to a slightly higher fruit count per tree (Table 2). Soluble solids yield per box was nearly significantly different, in favor of the more intensive foliar sprays.

Table 2. Valencia fruit yield and internal fruit quality parameters for the 2011/12 harvest.

TREATMENT	Fruit yield (boxes/ac)	Acid (%)	Brix (%)	Ratio	Soluble solids (lb/box)	Fruit weight (g)	Juice (%)	Total juice (lb/ac)	Fruit count (fruits/tree)	Soluble solids yield (lb/acre)
Std foliar spray	418	0.669	13.38	20.0	7.183	232.1	59.65	22,527	644	3019
High intensity foliar spray	417	0.686	13.66	20.1	7.379	217.3	60.01	22,539	679	3082
LSD (0.05)	53.2	0.0377	0.325	0.977	0.2192	14.36	1.166	3,099.7	97	438.3
F-probability	0.961 NS	0.368 NS	0.088 NS	0.933 NS	0.079 NS	0.044 *	0.533 NS	0.994 NS	0.461 NS	0.773 NS

Objectives 2 and 4: Evaluate performance of psyllid repellent on psyllid population and HLB incidence, and Determine the effect of psyllid spray 'priority' timing on psyllid population, yield, HLB incidence and production cost.

We began psyllid repellent experiments to determine efficacy, timing and placement dynamics. However, our psyllid spray program applied as a basal treatment throughout the grove was so effective, we had very few psyllids in the grove, making treatment differences difficult to follow. Thus, we began a program of monitoring psyllid populations and later, the grove was enrolled in a more comprehensive DPI-APHIS-USDA statewide psyllid-scouting program. The grove also became a member of the 17/27 Highlands County Citrus Health Management Area (CHMA) coordinated psyllid spray program. We also began a program of leafminer control that involved a new leafminer pheromone recently commercialized. The attendees commented on our excellent psyllid control, and psyllid counts were presented. A presentation was made that informed attendees about minimizing the development of pesticide resistance and the value of CHMAs in that regard. We also presented the latest information on application of leafminer control and discussed its success in the Lake Placid grove.

Objective 3: Evaluate an advanced production method for replanting in HLBendemic groves.

Due to the length of time required to grow and deliver nursery plants, we were unable to completely plant the 5.6-acre block at once. By the time the field day was conducted, all trees had been planted, so attendees were able to see block layout and the windbreak trees surrounding the planting. The 5.6-acre block was designed to evaluate and demonstrate different citrus rootstocks and a rooted cutting propagation method, delivery of fertigation by microsprinkler or drip, and the use of controlled release fertilizer. Delivery of water and nutrients was completely automated, and
attendees viewed the various components used to implement timed applications. Although we were not able to demonstrate treatment differences immediately, in time those differences will become apparent and reported. The field day booklet was submitted to the sponsor at the last quarterly report and should be on file. Detail of presentations and discussions are contained therein and on the IFAS Extension web site:
http://www.crec.ifas.ufl.edu/extension/extension_meetings/

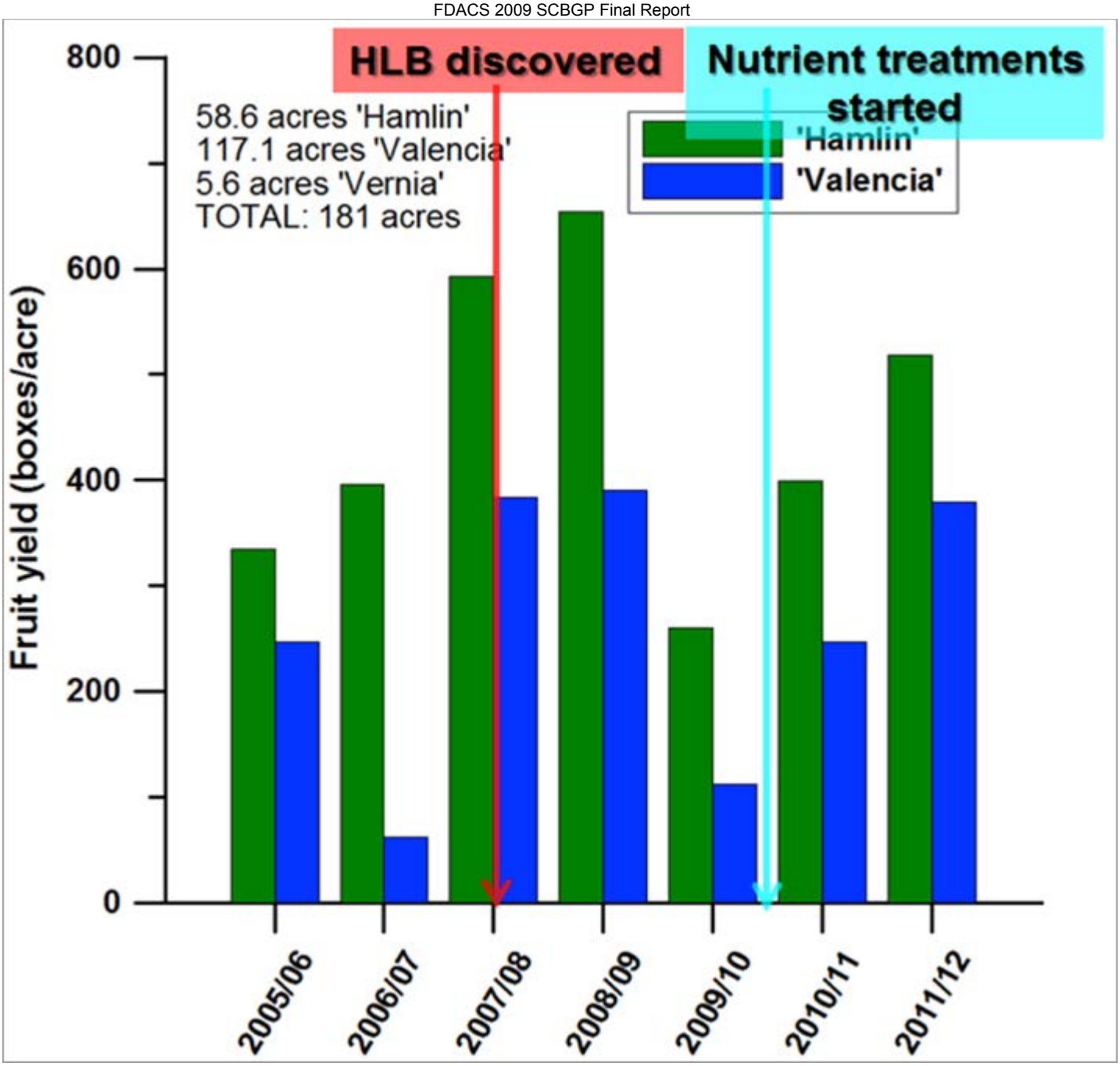

Figure 1. Average fruit yield of 'Hamlin' and 'Valencia' oranges in the CREF grove. Since the beginning of the Specialty Crop Block Grant (2009), yield has been steadily increasing in Hamlin and Valencia. We attribute this increase to a combination of layered management practices judiciously applied in 2009-2012. Yield increased even though cumulative HLB infection rose from less than 10% to more than 80% in 2.5 years.

This project provided information that growers can use to manage their groves in endemic HLB environments. Specifically it highlighted 1) the role of balanced nutrition in reducing yield losses due to HLB, 2) the use of combined ground and foliar nutritional applications (when needed) to achieve balanced nutrition of trees, 3) the importance of leaf analysis results to guide nutritional applications, 4) the value of an IPM approach (leafminer and asian citrus psyllid) to control pests in groves, 5) the value of area-wide management to reduce asian citrus psyllid populations, and 6) establishment of a high density advanced citrus production grove that reduces resources input and allows return on investment in approximately 3 years. Our project partners, the Citrus

Research and Education Foundation (CREF) Board of Directors, a group of Florida growers, oversaw the conduct of the research and grove management during the course of the project.

GOALS AND OUTCOMES ACHIEVED

Management and treatment activities outlined in the proposal were carried out. However, clear outcomes cannot be assessed due to the long-term nature of treatments and grove response time. We established treatments that are applied in a timely and measured manner that, over time, can be assessed for their efficacy in future years.

Our goal was to sustain productivity in endemic HLB environments. As the project begun, HLB infection rate was less than 10% but rose to over 80% by the end of the project. Despite this setback, yield was increased. This increase was due to several factors, including good horticultural practices, participation in an area-wide CHMA, and recovery from 2 years of freezes. The extension field day was a success, demonstrating the outcome of treatments to date, and highlighting what can be done in endemic HLB environments to maintain tree health and sustain yield. Over 70 people attended the field day at the Lake Placid grove location.

The unit of currency for growers and for this project was yield. This is best demonstrated by figure 1, where yield was consistently increased during the course of this project in mature trees. Good horticultural practices played a major role, as did the absence of debilitating freezes. Increased yield, coupled with good fruit prices, illustrated what could be achieved with management practices that included pest control, good nutrition, and adequate irrigation to sustain trees.

BENEFICIARIES

The Florida grower will be the beneficiary of the accomplishments of this project. Although yield was increased by 200 boxes/acre in Hamlin and 350 boxes/acre in Valencia, some skeptism remains about inoculum management (roguing infected trees) vs. keeping infected trees in the ground and managing their health with good horticultural practices. We have made note that even if HLB-infected trees and managed with nutritional applications as described in this report, trees are more susceptible to stress conditions such as drought and freeze damage. Yet, the majority of growers are managing their endemic HLB groves with good horticultural practices, and this project recognizes this fact and has provided clear guidance in this regard. With respect to asian citrus psyllid management, participating in a CHMA and conducting ground insecticide sprays reduced the psyllid population to near zero. However, surveys are not perfect and we suspect that many psyllids go undetected, underscoring the potential for continued spread of HLB.

LESSONS LEARNED

One objective was to plant a 5.6 acre block of new trees in an advanced citrus production system format. Yet, trees ordered in early 2009 did not arrive until late 2011/early 2012. This prevented us from making significant progress in this area. We also learned that removing trees in small areas would fail as a measure to control HLB in small plots, due to the lessons learned in Brazil and within our own Florida citrus industry. The significant contributions of our management decisions were evident, as described above.

A new pheromone control, and natural product, became available during the course of the project, and it was applied to the entire 179 acre grove site. It was remarkable in its ability to reduce citrus canker, another disease problem plaguing the industry. Insecticides were part of the basal treatments applied to the entire grove site, but this leafminer pheromone proved to be an important demonstration of efficacy. Since the first application in our site, the cos of the product has been markedly reduced, making this a viable option for the Florida citrus grower.

As described above, this was a long-term project that will require more time to achieve reliable results. We will continue these management strategies and report as information becomes available.

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Note: Jackie Burns, Arnold Schumann, Tim Spann, Lukasz Stelinski, Michael Rogers, and Megan Dewdney contributed significantly to this project. We thank Mr. Troy Gainey and Mr. Nolan Rayburn for expert technical and operational assistance at the grove site. We greatly appreciate the assistance of the CREF Board of Directors for their guidance and support of this project.

PROJECT (6): USDA HORTICULTURE RESEARCH LAB: ANTIMICROBIAL TREATMENTS TO REDUCE
GREENING (HLB) IN CITRUS

FDACS Grant Contract #15597
Total Funding - $179,724.13
End Date: 3/31/2012

Project Summary

Existing citrus groves are becoming unproductive because of *Candidatus* Liberibacter asiaticus (CLa) the causual agent of Huanglongbing (HLB). Experiments were performed to develop a strategy to save existing groves through application of a CLa control molecule (antimicrobial) combined with a mobilizing agent that will transport the antimicrobial into the phloem (location of the CLa bacterium). Ten individual natural plant-based antimicrobials (cineole, salicyclic acid, isopropyl benzyl alcohol, myrtenal, verbenone, carvone, perillaldehyde, carvacrole, menthol and thymol) were tested alone and in combination along with a penicillin–streptomycin mixture known to work through trunk injections and two other commercial antimicrobial solutions (Prontech^{tm} and PPM^{tm}). This was done to determine if they could be mobilized into the phloem and reduce the CLa titer. We tested two different mobilizing agents that could work to mobilize compounds across the bark thus allowing economical use of compounds. None of the natural products worked to reduce CLa titer in infected citrus however we did demonstrate that the penicillin-streptamycin combination did work as a trunk application using specific mobilizing agents. We also showed that a surfactant/mobilizing agent did greatly reduce the developmentof CLa in citrus placed in a grove where they were under heavy psyllid pressure. Our results suggest that trunk application is a feasible approach to get antimicrobials systemic within citrus, and that such an application can reduce CLa titer within a treated citrus tree. This opens the possibility of commercializing this method for HLB control.

Project Approach

All work was performed at the USDA, ARS, USHRL facility. Combination of two mobilization mixtures were tested as basal bark applications to containerized citrus either in the greenhouse or placed in our research citrus grove. Movement of these mobilization mixtures through the canopy were assessed by GC/MS and by an antimicrobial bioassay. Applications were applied monthly and the CLa titer within the treated trees was monitored using a polymerase chain reaction (PCR) detection method, designed to quantitatively detect the presence of CLa DNA. Furthermore, treated citrus was monitored for treatment effects on plant growth and health.

Goals and Outcomes Achieved

Goal 1: Screening of antimicrobial compounds using HLB-causing bacterium cultures.

- Result: This was never initiated because culture methods were never successfully developed for this bacterium. As a result, we selected a larger number of potential antimicrobial compounds to be tested *in planta* and we included a list of penetrants that would aid in plant uptake of the various antimicrobial compounds. The list of antimicrobial compounds and penetrants tested is given in Table 1.

Table 1. List of penetrants and antimicrobials screened in this research.

Class of tested compound	Name of compound	Description
Penetrant	Water (Control)	
Penetant	DMSO	Universal solvent
Penetrant	Pentrabark	Registered agricultural use organo-silicate pen
Penetrant/ Antimicrobial	Prontech	Commercial antimicrobial "Quat" with antimicrobial and surfactant properties
Antimicrobial	PPM (Plant Preservative Mixture)	A mixture of two isothiasolones: methylchloroisothiazolinone and methylisothiazolinone (Industrial biocides)
Antimicrobial	Cineole	Plant secondary metabolite
Antimicrobial	Thymol	Plant secondary metabolite
Antimicrobial	Carvone	Plant secondary metabolite
Antimicrobial	Carvacrol	Plant secondary metabolite
Antimicrobial	Cumic alcohol	Plant secondary metabolite
Antimicrobial	Menthol	Plant secondary metabolite
Antimicrobial	Methyl-salicylate	Plant secondary metabolite (Plant defense inducer)
Antimicrobial	Myrtenol	Plant secondary metabolite
Antimicrobial	Perilaldehyde	Plant secondary metabolite
Antimicrobial	Verbenone	Plant secondary metabolite

Goal 2: Develop GS/MS detection methods for penetrant and antimicrobials.

- ☐ Results: This was accomplished and used to detect movement of these molecules through the plant. We expanded on this further to develop biologically-based assays of antimicrobials, as we found this was a quicker procedure and provided us with actual toxicity data not just presence or absence of specific molecules. We used this to show that the antimicrobials taken up in the plant survived for less than 8 days.
  REVIEW of Results:

Gas Chromatography/ mass spectrometry detection of penetrants and antimicrobials:

Extraction and detection methods were developed using treated potted citrus in the research greenhouse. Experiments were conducted as basal bark applications to the potted trees and then leaves were collected 1, 2, 4, and 8 days after treatment and used for extraction and detection. 8 treatments with 3 reps per treatment - 1 ml of treatment applied to each tree. Treatments consisted of:

1. Control
2. DMSO 10%
3. DMSO 10%, Combination of 10 secondary metabolites (see Table 1) at 0.25% each
4. Combination of 10 secondary metabolites (see Table 1) at 0.25% each
5. DMSO 10%, PPM 10%
6. PPM 10%
7. DMSO 10%, Penicillin 45%, Streptomycin 9%
8. Penicillin 45%, Streptomycin 9%.

Resuts of Detection. Treatments highlighted in green are those in which the compound if interest was added to the treatment solution. Cases where compounds are detected when the compound was not added indicate that that compound (or an interfering compound) that cannot be distinguished from the compound of interest is naturally present in the plant tissues sampled. Note that his is presented as a +/- assay where detection is indicated by the replication (either A, B, or C) letter in which it was found. If the replication letter is bold it indicates that the sample was equal to or greater than double the amount found in the plant control.

DMSO:

Treatment	Initial	Day 1	Day 2	Day 4	Day 8
Trt 1					
Trt 2			B,C	B,C	
Trt 3		AC	A,B,C	A,B	
Trt 4					
Trt 5		A	A,B	A,B	
Trt 6					

Trt 7		A,B,C	A,B,C	A,B,C	
Trt 8					

DMSO2: (Degradation product of DMSO)

Treatment	Initial	Day 1	Day 2	Day 4	Day 8
Trt 1					
Trt 2			A,B,C	A,B,C	A,B,C
Trt 3		C	A,B,C	A,B,C	A,B,C
Trt 4					A
Trt 5		A,B,C	A,B,C	A,B,C	A,B,C
Trt 6		A,B,C	A	A	
Trt 7		A,B,C	A,B,C	A,B,C	A,B,C
Trt 8					

Secondary Metabolites:

Carvacrol:

Treatment	Initial	Day 1	Day 2	Day 4	Day 8
Trt 1	A**B**C	ABC	ABC	ABC	ABC
Trt 2	ABC	ABC	ABC	ABC	ABC
Trt 3	ABC	ABC	A*BC	ABC	ABC
Trt 4	ABC	ABC	ABC	ABC	ABC
Trt 5	ABC	ABC	ABC	ABC	ABC
Trt 6	ABC	ABC	ABC	ABC	ABC
Trt 7	ABC	ABC	ABC	ABC	ABC
Trt 8	ABC	ABC	ABC	ABC	ABC

Carvone:

Treatment	Initial	Day 1	Day 2	Day 4	Day 8
Trt 1	**B**				
Trt 2				A	
Trt 3			A		
Trt 4					
Trt 5					
Trt 6			B		
Trt 7					
Trt 8	BC		A		

Cineole:

Treatment	Initial	Day 1	Day 2	Day 4	Day 8
Trt 1	**BC**			C	A
Trt 2			B	A	
Trt 3	**B**	**A**B	A,C		A
Trt 4					
Trt 5					C
Trt 6		B,C	B,C	A	A,B
Trt 7	C				A
Trt 8	**BC**	C	A	A,B	

Cumic Alcohol:

Treatment	Initial	Day 1	Day 2	Day 4	Day 8
Trt 1	A**BC**	ABC			
Trt 2	ABC	ABC			
Trt 3	ABC	A**B**C	A		
Trt 4	ABC	ABC			
Trt 5					
Trt 6	C				
Trt 7	ABC				
Trt 8	ABC				

Menthol:

Treatment	Initial	Day 1	Day 2	Day 4	Day 8
Trt 1	BC			C	
Trt 2			B	A	
Trt 3			A,C		A
Trt 4				B	
Trt 5					C
Trt 6	C	B,C	B,C	A	A,B
Trt 7					A
Trt 8	BC	C	A	A,B	

Methyl Salicylate:

Treatment	Initial	Day 1	Day 2	Day 4	Day 8
Trt 1	**B**C			**C**	
Trt 2			B	**A***	
Trt 3	B	AB	**A***C		A
Trt 4				B	
Trt 5			B		C
Trt 6	C	**B**C	**B**C	**A**	ABC

Trt 7		A			A
Trt 8	BC		**A***	B	

Myrtenol:

Treatment	Initial	Day 1	Day 2	Day 4	Day 8
Trt 1					
Trt 2				A	
Trt 3	**B**	**BC**	A		
Trt 4		**ABC**			
Trt 5		B			
Trt 6					
Trt 7			A		
Trt 8			A		

Perilaldehyde:

Treatment	Initial	Day 1	Day 2	Day 4	Day 8
Trt 1	**BC**			BC	
Trt 2			B	**A**	
Trt 3	B	**B**	**AC**		A
Trt 4				B	
Trt 5					C
Trt 6	C	BC	BC	B	AB
Trt 7			A		A
Trt 8	BC	C	A	ABC	

Thymol:

Treatment	Initial	Day 1	Day 2	Day 4	Day 8
Trt 1	**B**C		ABC	ABC	ABC
Trt 2			ABC	ABC*	ABC
Trt 3	B	AB	A*BC	ABC	ABC
Trt 4		A	ABC	ABC	ABC
Trt 5	ABC	ABC	ABC	ABC	ABC
Trt 6	ABC	ABC	ABC	ABC	ABC
Trt 7		ABC	ABC	ABC	ABC
Trt 8	ABC	ABC	A*BC	ABC	ABC

Verbenone:

Treatment	Initial	Day 1	Day 2	Day 4	Day 8
Trt 1	**B**				
Trt 2				A	
Trt 3		B	A		
Trt 4					
Trt 5					
Trt 6			B		
Trt 7					
Trt 8			A		

Conclusions for GC/MS detection:

Penetrants:

DMSO could be readily detected exclusively in plants treated with DMSO and we validated our methods as an acceptable approach for detection and monitoring DMSO after topical applications.

Results for other penentrants are not shown because we were not able to develop Ssuitable GC?MS detection methods for these.

Antimicrobial Compounds:

Only GC/MS results for detection of plant secondary metabolites (see Table 1) are shown. We were not able to use GC/MS for detection of any of the other antimicrobial compounds tested. Unfortunately all citrus samples contained a significant amount of each of these plant secondary metabolites and therefore the background amounts detected in untreated plants (all treatments except treatments 3 and 4) was not reproducible lower than those levels detected in the treated plants. Therefore we do not appear to be elevating levels of the secondary metabolites above that which is already present in the plant tissues. Because we do not know the process by which the secondary metabolites are metabolized by the plant, we realize that antimicrobially active derivatives of the applied secondary metabolites may be present. Because of these results we developed a bioassay based on detecting antimicrobial activity in citrus leaf extracts from plants on which treatments were applied as basal bark applications. Typically this is done on small citrus seedlings (~ 0.5 m in height) and applications are painted on the trunk just above the soil surface (trunk application area: between 4 cm above the soil surface up to ~16 cm above the soil surface). Figure 1 shows the plant treatment and bioassay method developed for this study. This assay was developed with the idea that we wish to identify a combination of penetrant and antimicrobial that results in efficient systemic movement within the phloem. This bioassay is based on the requirement of system movement into the leaves from bark applications.

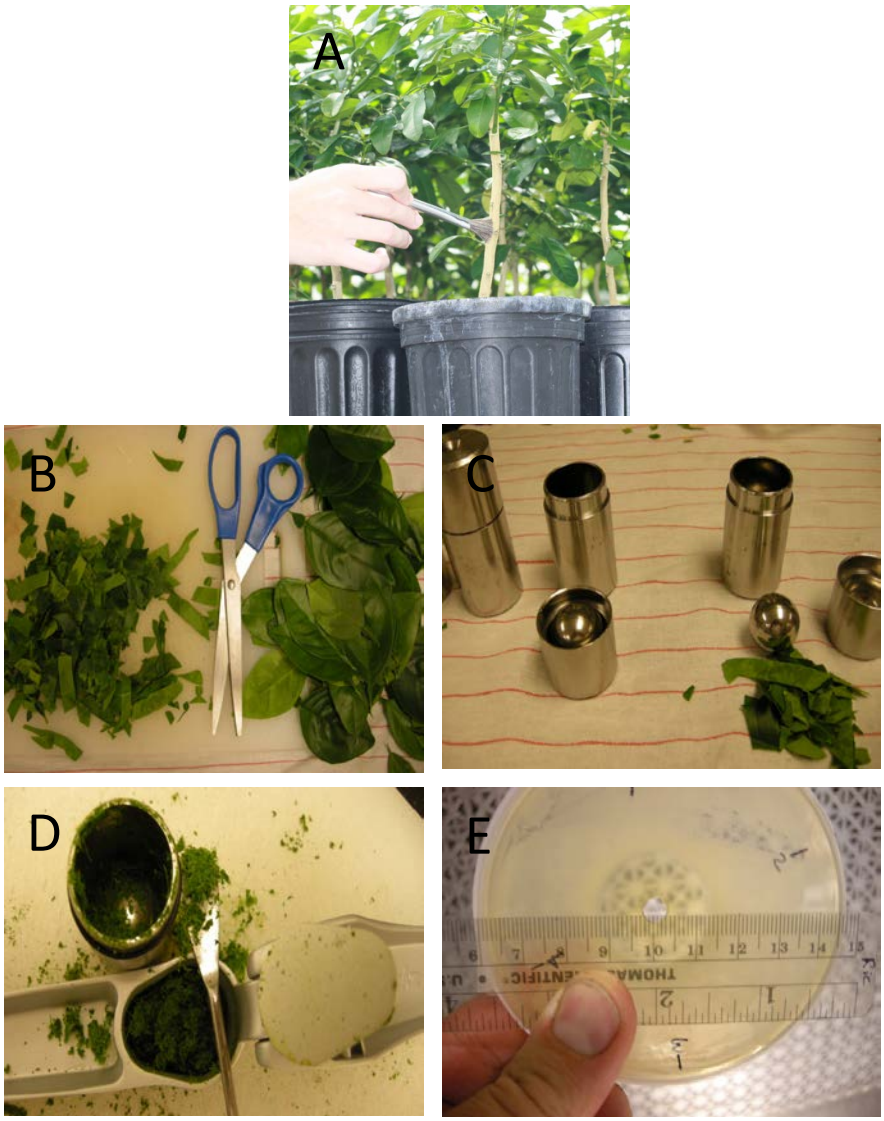


Figure 1. Demonstration of plant basal bark applications and leaf bioassay. A: Basal bark painting of teatment solution; B, C, and D: preparation of leaf extracts. Liquid is extracted from ground leaf tissue (D) using a garlic press and 100 uL of this liquid is added to a center well created in a petri dish containing an agar bacterial growth medium on which a bacterial culture was evenly spread (E). The diameter of the clearing zone created by diffusion of the extract added to the center is linearly proportionate to the amount of antibacterial solution present.

Goal 3: Conduct tests on optimal mobilizing/penetrant compounds.

- ☐ Results: This was completed and the results were used in subsequent field and greenhouse experiments.
  - We identified glycerol as a penetrant that worked in the leaves for penicillin and streptomycin foliar uptake.

Review of Results:

Foliar uptake of both penicillin and streptomycin (the two antibiotic combination that was previously shown to be effective in killing the CLas bacterium when injected into plants) was found to be enhanced by glycerol, Figure 2. Without glycerol streptomycin was not taken up when applied to foliage; however, some penicillin would enter leaf tissue that was sprayed with aqueous solutions of the antibiotic. However, glycerol allowed for greater penicillin uptake by the citrus leaves.

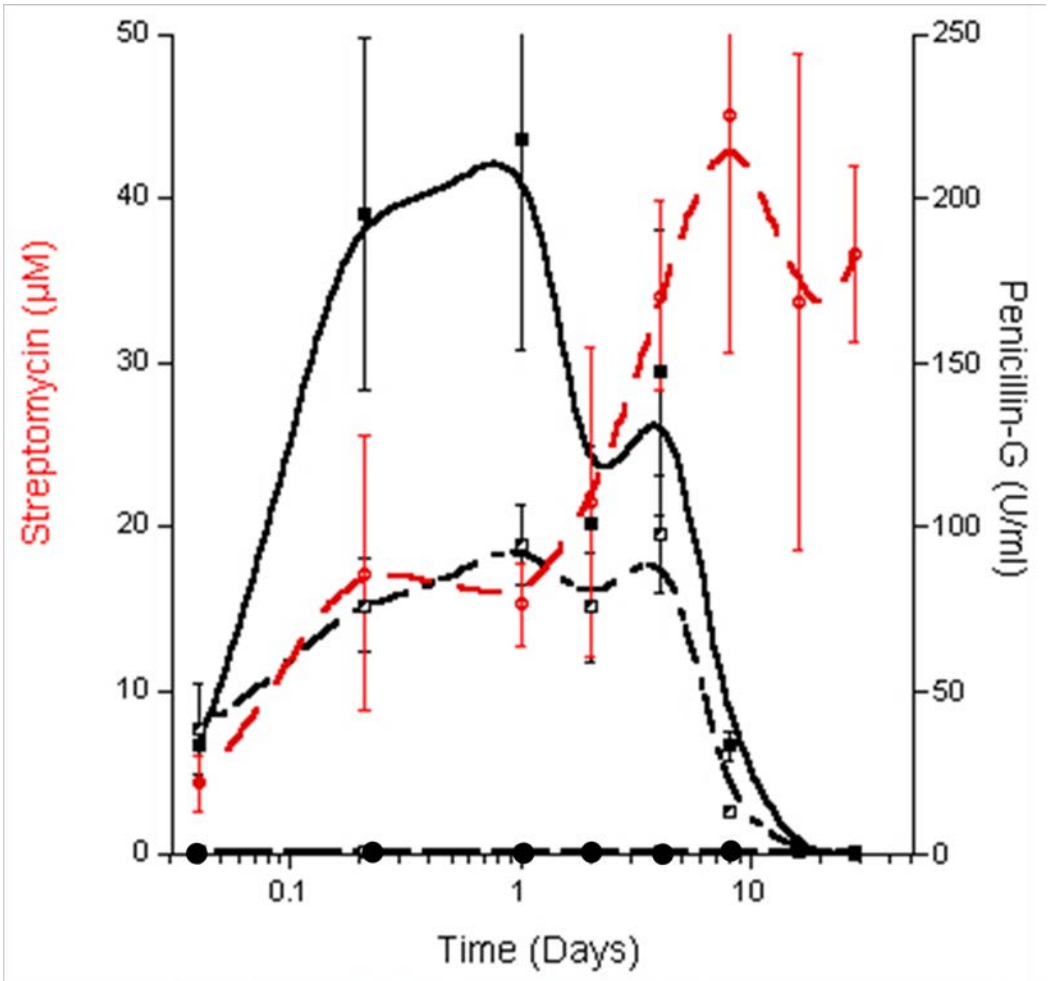


Figure 2. Leaves of potted grapefruit plants were sprayed with 0.5 g of either streptomycin or 0.5 g of penicillin in either water or 1% glycerol . Leaves were collected periodically during 12 days following application and these leaves were washed with detergent and extracted and tested for presence of antimicrobial activity using the previously described bioassay. Plots: - -□- - Penicillin in water; —■— Penicillin in 1% glycerol; - -●- - Streptomycin in water; - -o- -Streptomycin in 1% glycerol.

- We identified other penetrants that improved bark uptake of antibiotics.

Review of results:

A major goal of the conducted research was to determine if an alternative strategy to injection could be developed for administering antibiotic compounds to a tree that would work efficiently and economically in stimulating systemic uptake of the antibiotic. A basal bark treatment strategy was the focus of this research since it would minimize application cost and environmental exposure to the antibiotic compounds. Research was conducted to compare all possible penetrants to determine which ones would aid in antibiotic uptake when applied as a bask bark treatment. This work was monitored with only penicillin and results for glycerol and Atomic Grow are shown as compared to water, Figure 3.

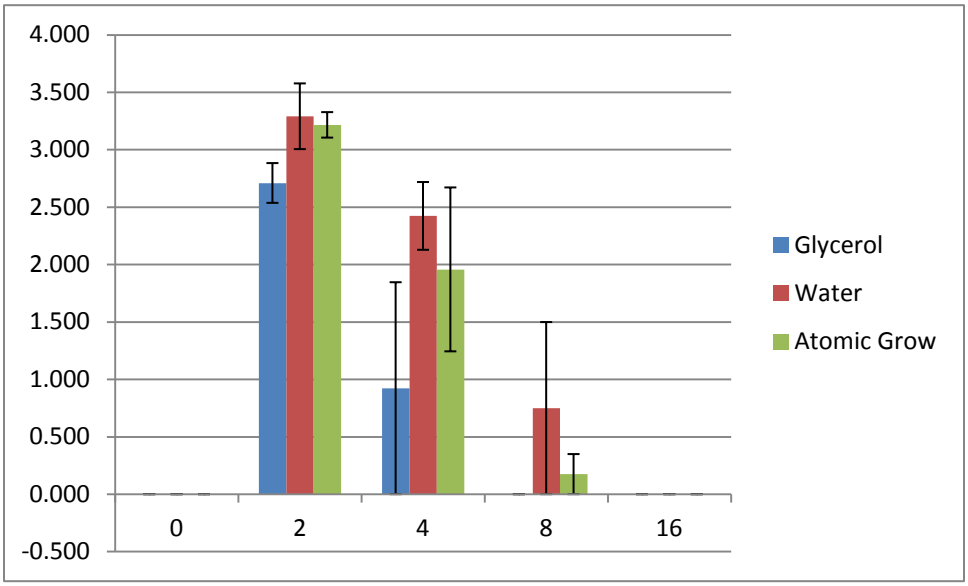


Figure 3. Penecillin was applied to 0.5 m tall potted citrus seedlings in our research greenhouse. Efficient uptake of the penicillin was monitored by determining the amount of detectable antibiotic was present in extracts from leafs removed from treated plants before treatment (day 0) and 2, 4, 8 and 16 days after treatment. Although the presence of glycerol seemed to reduce the amount of antibiotic that can be detect moving systemically as compared to water, Atomic Grow appeared to provide a trend

toward increased antibiotic uptake; however, this was not statistically different than that observed with water.

Although the Atomic Grow apparent slight improvement in antibiotic systemic uptake was not significant, we believe that when this work is scaled up to larger trees, the use of mobilizing agents different than water may become more important to allow molecules to cross the more impenetrable bark of older trees. For this reason we recommend continued screening with larger trees.

Goal 4: Conduct greenhouse tests on antimicrobial/penetrant combinations on HLB-positive citrus.

- ☐ Results: Identified that the combination of penicillin and streptomycin could be applied as a basal bark application and it was effective at reducing HLB-causing bacterial titers.

Review of Results:

Basal bark Treatment of potted greenhouse citrus trees showed that an antibiotic combination of penicillin and streptomycin was effective in reducing the titer of CLas in the citrus tree, Figure 4.

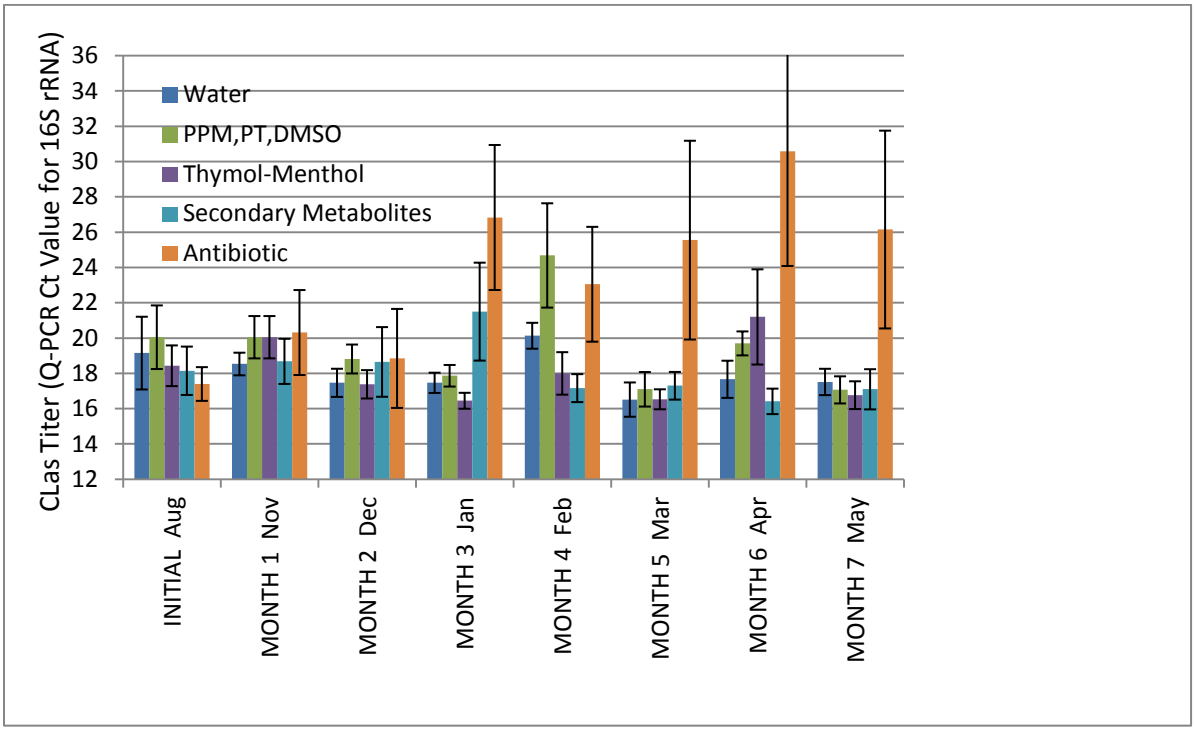


Figure 4. Effect of basal bark treatments on the titer of CLas in potted Valencia orange trees displaying HLB symptoms prior to treatment. Basal bark treatments indicated in the legend were administered monthly and leaf samples were collected prior to each treatment. Total nucleic acid was isolated from

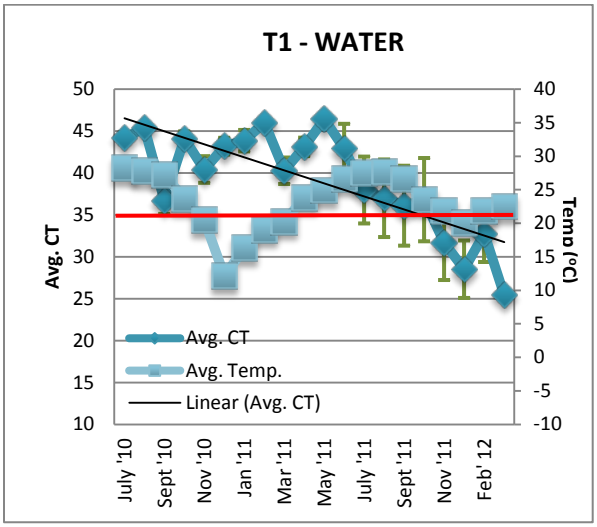
the leaf samples and used for quantitative detection of the number of CLas 16S rRNA gene copy numbers. This is represented as the Q-PCR Threshold cycle (Ct), a number that is inversely proportionate to the log of the 16S rRNA gene copy number.

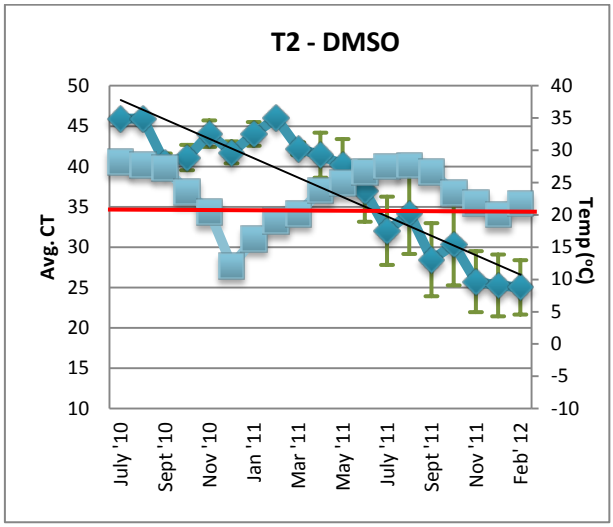
Goal 5: Conduct Field trials on the effect of basal bark applications of natural products/penetrants to test effect on establishment of HLB causing bacterium in citrus.

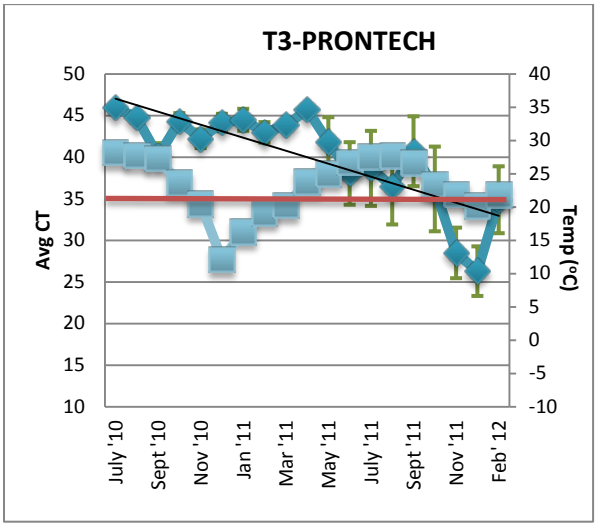
- ☐ Result: Initial study was conducted We identified a basal bark Chemical treatment that reduced the incidence of HLB-bacterial establishment in the plants by 75%.

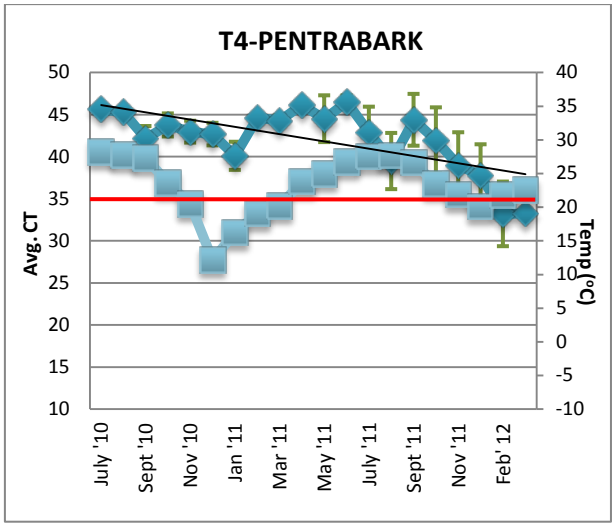
Review of Results:

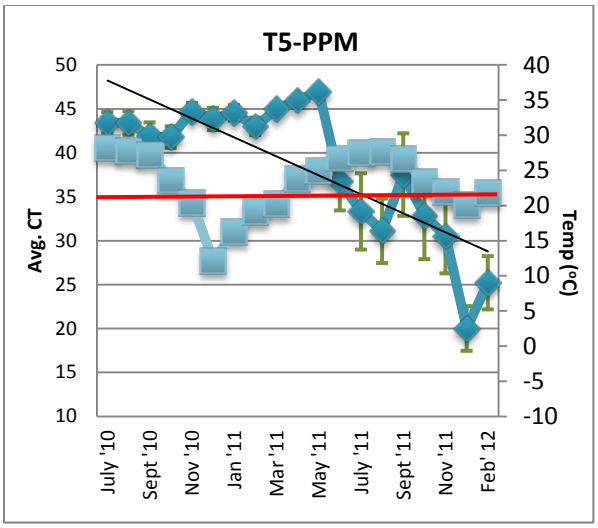
Field testing penentrant/antimicrobial combinations was conducted over a 1.5 year period at the USDA, ARS, USHRL, Fort Pierce, FL research farm using potted Valencia citrus trees placed among other citrus plots. Monthly applications of various single or combination treatments of penetrants and antimicrobials, Figure 5. The goal of this project was to determine if any treatments could either keep citrus free of CLas or extend the time the citrus would remain CLas free. We chose to use a Q-PCR Ct value of 35 for etection of the CLas 16S rRNA gene as a threshold for considering the trees essentially CLas free (more precisely, they were considered to be HLB free containing a titer of CLas that was below that expected to induce HLB symtoms). Our results showed that two treatments Treatments 4 and 11 (T4 and T11) kept the titer close to or above the Ct value of 35. There also appeared to be a CLas deterent effect of the secondary metabolite combination used (See Table 1 for list of secondary metabolites), Figure 5; however, these induced phytoxicity at the site of application and the treatments could not be extended. These results show the feasibility of basal bark applications for controlling the bacterium that causes citrus greening (HLB). However, optimization methods are still needed to determine the best antimicrobial/penetrant combination. This field study did not include the penicillin and streptomycin antibiotics because it was started before we realized that they were the only antimicrobials affecting CLas titer within the plant. Clearly, a combination of pentrabark and the antimicrobials is suggested by our results as a possible treatment to allow citrus to remain productive in the face of HLB and needs to be evaluated further.

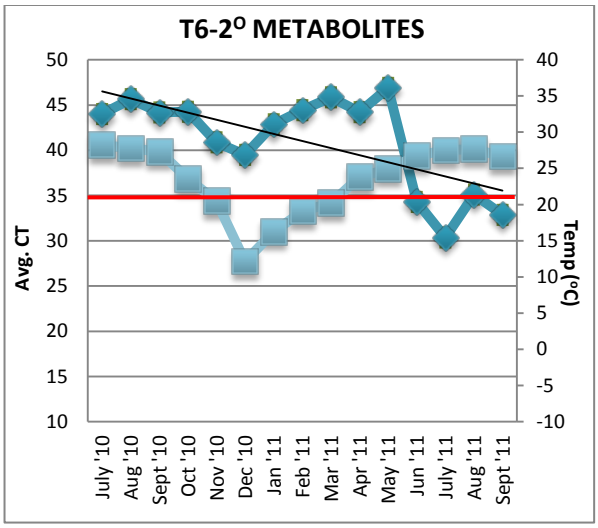

T1 - WATER
Avg. CT
Temp (°C)
Avg. CT
Avg. Temp.
Linear (Avg. CT)
July '10
Sept '10
Nov '10
Jan '11
Mar '11
May '11
July '11
Sept '11
Nov '11
Feb' 12


T2 - DMSO
Avg. CT
Temp (°C)
July '10
Sept '10
Nov '10
Jan '11
Mar '11
May '11
July '11
Sept '11
Nov '11
Feb' 12


T3-PRONTECH
Avg CT
Temp (°C)
July '10
Sept '10
Nov '10
Jan '11
Mar '11
May '11
July '11
Sept '11
Nov '11
Feb' 12


T4-PENTRABARK
Avg. CT
Temp (°C)
July '10
Sept '10
Nov '10
Jan '11
Mar '11
May '11
July '11
Sept '11
Nov '11
Feb' 12


T5-PPM
Avg. CT
Temp (°C)
50
45
40
35
30
25
20
15
10
40
35
30
25
20
15
10
5
0
-5
-10
July '10
Sept '10
Nov '10
Jan '11
Mar '11
May '11
July '11
Sept '11
Nov '11
Feb' 12


T6-2O METABOLITES
Avg. CT
Temp (°C)
50
45
40
35
30
25
20
15
10
40
35
30
25
20
15
10
5
0
-5
-10
July '10
Aug '10
Sept '10
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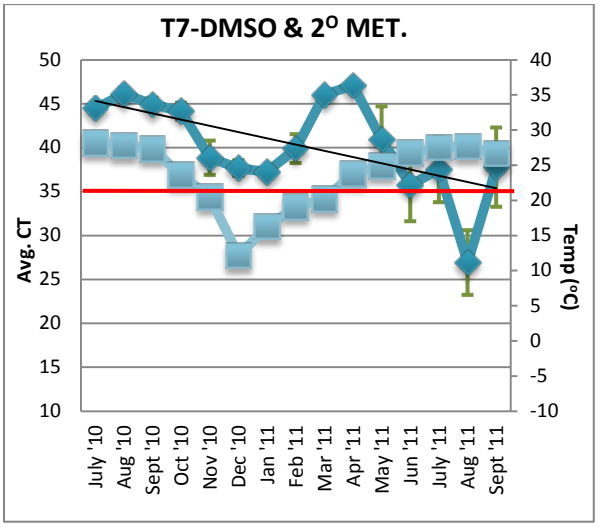
Jun '11
July '11
Aug '11
Sept '11


T7-DMSO & 2O MET.
Avg. CT
Temp (°C)
50
45
40
35
30
25
20
15
10
40
35
30
25
20
15
10
5
0
-5
-10
July '10
Aug '10
Sept '10
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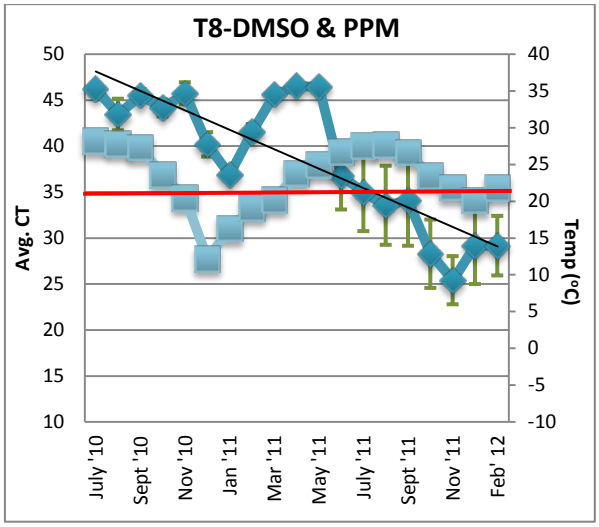
Jun '11
July '11
Aug '11
Sept '11


T8-DMSO & PPM
Avg. CT
Temp (°C)
50
45
40
35
30
25
20
15
10
40
35
30
25
20
15
10
5
0
-5
-10
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Sept '10
Nov '10
Jan '11
Mar '11
May '11
July '11
Sept '11
Nov '11
Feb' 12

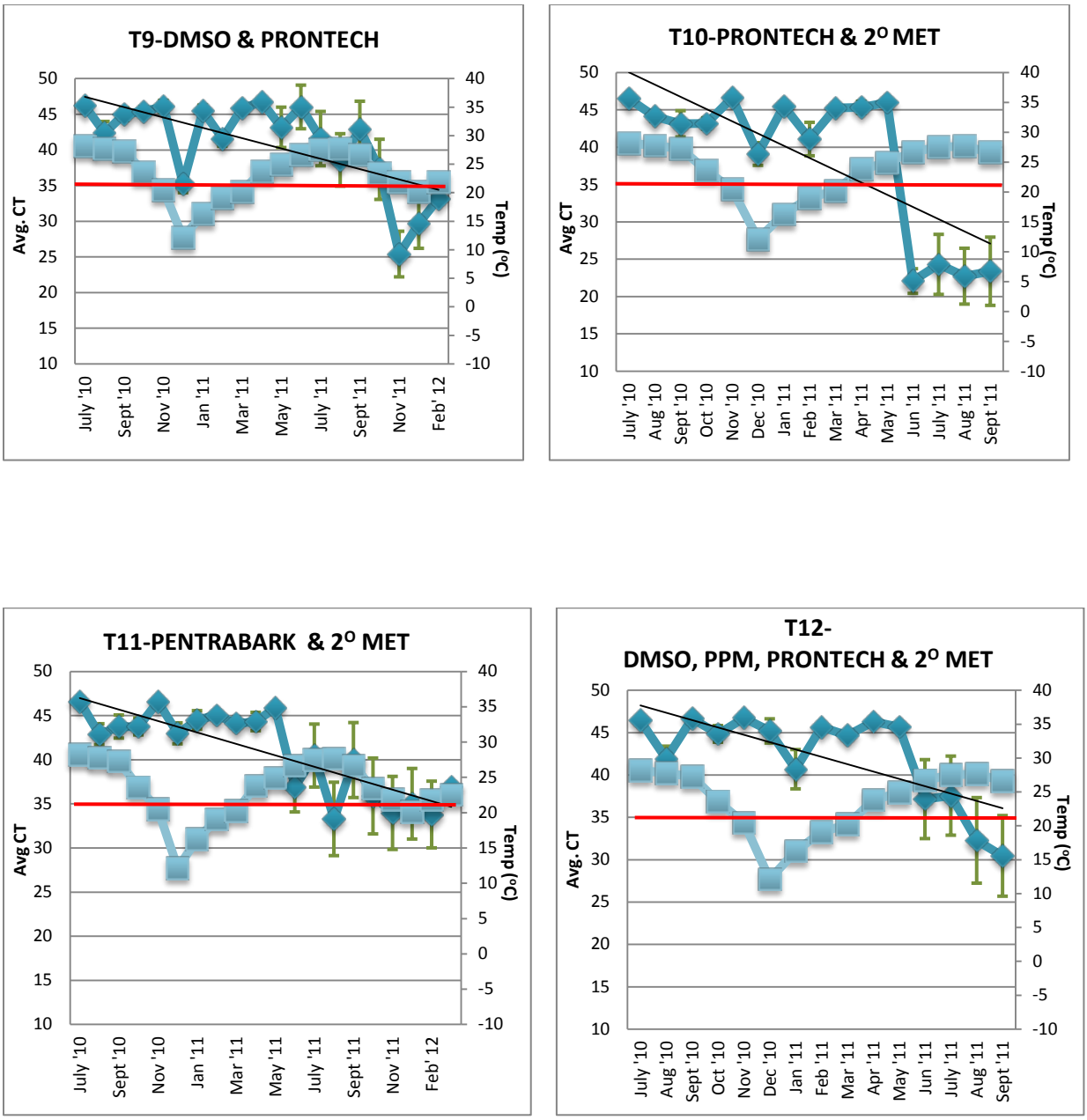

Figure 5. Twelve Field Treatment of Valencia sweet orange trees (10 trees per treatment, blocked by replication) with various penetrant and antimicrobial compounds (singly or in combination as described in Table 1) were tested. Trees were treated and sampled monthly over a 1.5 year period. Treatments were applied as basal bark applications to potted citrus plants (approx. 1 meter in height) that were placed in USDA, ARS, USHRL research farm in Fort Pierce, FL. Leaf samples were used to evaluate titer of Candidatus Liberibacter asiaticus using Q-PCR detection of CLas 16S rRNA gene. Titer is presented as Q-PCR threshold cycle (Ct), a number that is inversely proportionate to the log of the number of CLas 16S rRNA gene sequences present in the leaf sample. The Ct value (right y-axis) is plotted with average monthly temperature (left y-axis). Red line indicates the Ct value (35) above which we know no citrus greening symptoms would be present.

Beneficiaries

Our work has shown that basal bark application strategies can effect CLas titer in citrus and has now moved into a commercial feasibility study. If this method can be adapted for commercial application it will provide: 1) the first control strategy to reduce CLas in citrus; and 2) provide a more economical method of applying CLas control compounds to citrus. This work will greatly aid citrus growers throughout the U.S.

Results have been presented at the Florida Citrus Show attended by many of the Florida citrus growers and at the Citrus Health Research Forum attended by leading citrus industry representatives from throughout the U.S. citrus producing regions. These presentations have lead to special discussion groups on how to move forward with issues related to registration of use of antibioitics on citrus and has been a component of the overall research conducted within the U.S. that led to an international competition (Innocentive competition) sponsored by the Florida citrus growers conducted to identify the most effective antimicrobials that could be used to treat citrus.

Our results suggest the feasibility of basal bark application (and possibly improved efficiacy of foliar spray application) of antimicrobial, in combination with penetrants as a treatment for citrus greening disease. Commercialization will require that such applications be economically feasible for profitable citrus production. We have shown that low cost application strategies could be effective (basal bark applications would reduce volume of antibiotic that needs to be applied and use of glycerol as a penetrant for foliar applications would be economically feasible because of the low cost of glycerol). Therefore further optimization would be the impetus to obtain commercial interest. Once commercialized, such a treatment would be adapted by virtually all citrus growers in the U.S. since all growing regions in Florida are now affected by HLB and recent findings in Texas and California suggest that the disease could spread throughout those growing regions as well.

Lessons Learned

- ☐ We developed a bioassay that works much better and provides more information about the systemic movements of antibacterial agents throughout citrus.
- ☐ We showed that basal bark applications can be an economical alternative to antimicrobial applications.
- ☐ We showed that when foliar sprays are performed, glycerol functions as an excellent adjuvant, aiding the movement of the antimicrobial into the leaf.
- ☐ We found that penicillin is rapidly lost/metabolized within citrus, being undetectable eight days after application. This provides support for the use of penicillin since residue accumulation may not be a problem.

Contact Person

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Additional Information

- ☐ Manuscript on use of glycerol as foliar uptake adjuvant is in preparation
- ☐ Information on bark mobilization chemistry is currently being reviewed for intellectual property protection.

PROJECT (7): USDA HORTICULTURE RESEARCH LAB: CONTROL STRATEGIES FOR CITRUS (HLB) GREENING

FDACS Grant Contract #15579
Total Funding - $706,344.00
End Date: 3/31/2012

PROJECT SUMMARY

Citrus huanglongbing (HLB), also known as citrus greening, is one of the most destructive diseases of citrus, and is threatening the survival of Florida's $9 billion citrus industry. The disease is spreading so quickly that the future of the entire U.S. citrus industry is now in jeopardy. Occurring in most of the global citrus producing regions, HLB affects all citrus cultivars by causing rapid decline and shortening the life span of infected trees. The causal agents of the disease are believed to be three species of α-Proteobacteria in the genus of '*Candidatus* Liberibacter', namely, '*Ca*. L. asiaticus' (Las), *Ca*. L. americanus and '*Ca*. L. africanus'. These fastidious bacteria reside in the phloem of the plant hosts and are vectored by the citrus psyllids. Of the three bacterial species, Las is the most prevalent, is vectored by *Diaphorina citri*, and is the only one found in the United States.

This research project addresses the following major objectives: 1) develop standardized protocols for screening and eliminating HLB bacteria from nursery stock using highly sensitive detection technology, and effective Las-eradicant compounds; 2) verify if *Murraya paniculata* is a preferred reservoir of HLB pathogens, and test its potential as an attractant trap plant for HLB control; and 3) implement chemical control of citrus HLB by developing cost-effective chemical compounds and application technology.

PROJECT APPROACH

1. Clean planting material (budwood and seeds) to eliminate recurring disease outbreaks

In addition to optimizing the APHIS recommended standardized protocol for detection of Las in Florida, we have developed and standardized an additional supersensitive detection method that targets the nearly identical tandem repeats of two prophage genes in the Las bacteria. This method not only simplified the detection procedure, but also detected the HLB bacterium at very low titers, especially the seed-transmitted Las bacteria in seedlings. This new technology has been published in Molecular and Cellular Probes, and transferred to universities and regulatory institutions world-wide for extended applications in the detection and diagnostics of citrus HLB.

Using information in the complete Las genome, finished in our lab, we have identified different population dynamics associated with different phenotypes of the HLB disease. We are currently optimizing strain-typing protocols for detection and differentiation of Florida's Las populations with an emphasis on differentiating the seed-transmitted Las from HLB-causing Las populations.

Most seeds from HLB-affected citrus plants carry a high titer of Las, but a high percentage (up to 70%) of the resulting seedlings carry an extremely low titer of Las. Most of these seedlings did not cause typical HLB. However, up to 30 % of the seedlings grew poorly compared to seedlings from healthy seeds. These growth-retarded seedlings can be rescued by rich nutrients after thermal therapy. For budwood therapy and preservation, we have developed a new heat treatment protocol and propagation system to clean up the pathogen.

2. *Determining if the ornamental Murraya species are HLB inoculum reservoirs*

Murraya paniculata, or orange jasmine, is a common landscape plant that can be a host for both the psyllid and the bacteria. A systemic survey was conducted in which we monitored eight plantings of orange jasmine and adult psyllids that developed from nymphs on these plants for infection by Las. Extremely low rates of Las infection were found in both psyllids and orange jasmine. During the early spring (April) 0 to 7.4% of the *Murraya* samples from each site tested positive for Las. However, during the summer months (June and August), 0 to 28% of the *Murraya* samples tested positive. Despite the differences in Las prevalence in the plants, 0.8 to 1.8 % of the psyllids utilizing *Murraya* as a host were Las positive across all collections. It is possible that the low number of psyllids carrying Las is related to the extremely low titer of Las found in the plants since the titers found in *Murraya* are approximately 65,000 times lower than those in *Citrus*. Our results indicate that orange jasmine hedges may be a minor HLB inoculum source for nearby citrus groves. The manuscript entitle "Low Incidence of *Ca.* Liberibacter asiaticus in *Murraya paniculata* and associated *Diaphorina citri*" has been published in the journal Plant Disease.

We have also conducted experiments testing the efficiency of psyllid transmission of Las between *Citrus* and *Murraya* plants. We successfully transmitted Las from infected *Citrus* to *Murraya*; however, the rate of infection was extremely low as was the titer of Las. We tested *M. paniculata* and *Citrus sinensis* grown in the same field for their Las titer. We also assayed *D. citri* from colonies on Las-infected *M. paniculata* and *Citrus* sp. We found the bacterium in both plant species, but the titer was four orders of magnitude lower in *M. paniculata* than in *Citrus.* Psyllids reared on infected *M. paniculata* also carried bacterial titers four orders of magnitude lower (about 10,000 times fewer bacteria) than psyllids reared on infected *Citrus* sp. These observations question the importance of *Murraya* as a reservoir of HLB and indicate resistance to HLB in *M. paniculata*. Further work includes determining whether the *D. citri* that acquire a Las infection from *M. paniculata* are capable of transmitting Las that will cause typical HLB in *Citrus*. A manuscript entitled "Titers of '*Candidatus* Liberibacter asiaticus' in *Murraya paniculata* and *Murraya*-reared *Diaphorina citri* are much lower than in *Citrus* and *Citrus*-reared psyllids" has been submitted for publication.

3. *Application of new chemical therapies to eliminate 'Ca. Liberibacter asiaticus'*

The chemicals penicillin G and streptomycin (PS) have been evaluated as the most effective compounds for eliminating or suppressing the Las bacterium of HLB-affected citrus in greenhouse experiments. New optimized combinations of PS were injected into HLB-affected trees in field trials at the USHRL's Pico's farm. The Las bacterial titers in the PS-5 treated citrus were kept at less than 1000 cells per gram of plant tissue (Ct>36.0) for 14 months after the termination of PS treatments. Similar results were observed when PS was applied at PS-10, except that the Las bacterial titers were kept at less than 1000 cells per gram of plant tissues (Ct>36). In contrast, the Las bacterial titers from the water control treated plants remained at 2 x10^6 throughout the experiment. The results have been published in Phytopathology.

We have developed a graft-based chemotherapy method to rapidly screen potential HLB-controlling chemical compounds. In addition, we improved transmission efficiency by using the most responsive HLB-affected scion-rootstock combination, and demonstrated the HLB bacterial titer was the critical factor in transmission. The HLB-affected lemon scions had a high titer of HLB bacterium, survival rate (83.3%), and pathogen transmission rate (59.9%). Trifoliate, a widely used commercial rootstock, had the highest survival rate (>70.0%) compared to grapefruit (52.6%) and sour orange (50.4%). Using this method, we confirmed a mixture of penicillin and streptomycin was the most effective compound in eliminating the HLB bacterium from the HLB-affected scions, and in successfully rescuing severely HLB-affected citrus germplasm. In addition, we screened more than 80

chemical compounds selected from the worldwide contest. A few of them are effective and may be used for field trials. These findings have been published in Phytopathology.

4. Thermal therapies eliminate 'Ca. Liberibacter asiaticus' from infected citrus trees under controlled conditions (additional accomplishment)

We used controlled heat treatments to alleviate HLB caused by Las. In temperature-controlled growth chambers, we evaluated the time duration and temperature required to eliminate or suppress the Las bacterium in citrus, using various temperature treatments for time periods ranging from 2 days to 4 months. Results of qPCR after treatment illustrated significant decreases in the Las bacterial titer, reaching an undetectable level, combined with healthy vigorous growth on all surviving trees. Repeated surveys confirm previously infected plants show no detectable levels of Las, while untreated control plants remain highly infected. The results indicate that continuous thermal exposure at 40-42°C for at least 48 hours was sufficient to significantly reduce Las titer levels in HLB- affected citrus seedlings. These results have been submitted for publication in Phytopathology.

5. Striped mealybug (Ferrisia virgata) as a potential vector (additional accomplishment)

Issues in our HLB isolation greenhouse with striped mealybug insects on infected periwinkle plants led us to investigate the hypothesis that the phloem-feeding mealybugs could (1) be infected with HLB and (2) transmit the disease to other plants in our greenhouse. We have confirmed these striped mealybugs carried the Las bacteria after feeding on HLB-infected periwinkles and citrus. However, transmission study using Las-positive stripe mealybugs gave no evidence of HLB transmission. Further studies will focus on the differences between mealybugs and psyllids in their vectoring mechanism for Las.

GOALS AND OUTCOMES ACHIEVED

We have developed methods for sensitive detection of HLB bacterium and effective cleaning of HLB- infected budwood and seeds. The new detection method is able to detect extremely low titers of Las bacterium both in citrus seeds and plants that would be missed by the APHIS standard qPCR detection method. We also demonstrated that orange jasmine hedges may be a minor source of HLB inoculum for nearby citrus groves, question the importance of *M. paniculata* as a reservoir of HLB, and revealed resistance to HLB in *M. paniculata*. While developing a rapid screening method, we have shown anew composition of two antibiotics (streptomycin and penicillin) is effective in eliminating the Las bacterium both in the budwood and plant treatments and in both greenhouse conditions and field trials. In addition, great progress has been made on an alternative treatment method that effectively mitigates or eliminates the disease using simple thermal therapy with optimized parameters. These

technologies are being further evaluated and modified in field trials.

Results were communicated to interested stakeholders by the following ways:

- University of Florida extension publications;
- Presentation in annual Florida horticulture meeting, and other special HLB-related conferences;
- Results also will be available to growers through Florida county extension agents and Florida Citrus Production Research Advisory Council, and our ARS Websites.

Links to these publications are provided in the "Additional Information" section.

In addition to presenting our newly developed technologies and other results in different conferences/meetings, such as International Conference of Citrus Huanglongbing in Orlando, Florida and Annual Citrus Health Research Forum in Denver, Colorado, we have shared our results with number of stakeholders, such as APHIS, Department of Plant Industry, and FDACS. More importantly, we have shared or informed our results to over 200 growers and Lawmakers, Senator Bill Nelson, former Congressman Allen West, and Commissioner Adam Putnam via demonstrations and question and answer sessions during their visits at the USDA facility.

BENEFICIARIES

Beneficiaries of this project include all Florida citrus growers, representing approximately 554,000 acres of production and an estimated $1.05 billion per year in fruit sales. Elimination of HLB infection from new growth on existing citrus trees may provide growers with a more cost-effective method of control than removal of whole trees.

LESSONS LEARNED

We will treat the priority planting source material and complete the treatment of priority planting source trees in DPI collections. Experiments continue to determine if the Las bacteria in *Murraya paniculata* can be transmitted to citrus by the psyllid vector and its role in the disease development of citrus HLB. We will continue to evaluate our field trials using chemical and thermal therapy. Other priorities include expanding our field trials for the evaluation of control technology and the continued development of effective application technology to eliminate Las from infected trees. We will work with a private company to facilitate the registration of chemical applications to citrus and to develop a cost effective thermal therapy device for treating HLB-infected plants. This collaboration will include conducting economic studies for the potential application of our newly developed technologies and for the potential commercialization of these technologies.

During this research, the most important lessons we have learned are: 1) Due to limited knowledge of citrus HLB complex and politics, we could not convince related institution(s) to implement our supersensitive detection technology for detection of the HLB bacterial pathogen

in citrus germplasms with a higher standard. We hope our publications and more research findings about HLB will lead these institutions to adapt to better technologies in the future; 2) Because of low titer and transitory nature, establishment of the Las bacterial infection via psyllid Transmission and maintaining Las-infected Murraya paniculata/exotica plants were extremely difficult in lab conditions. We believe different Murraya genotypes/varieties may have different resistance to Las infection. In future research, we may need to select more susceptible genotype(s). Meanwhile, screening for resistance within Murraya genotypes may lead to the identification of the resistant genotype(s) that would meet the criteria for future Florida nurseries; 3) the factor hindering effective chemical control of citrus HLB in the fields is the system needed to deliver a chemical systemically and evenly into an entire citrus tree. Although we have screened a number of effective chemicals (including antibiotics), we have limited success with these chemicals in the field. Development of an effective delivery system becomes one of our priorities in the phase II project.

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Additional Information

Peer-reviewed Scientific Publications:

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3. Walter, A. J., Hall, D. G., and Duan, Y. P. 2012. Low incidence of '*Candidatus* Liberibacter asiaticus' in *Murraya paniculata* and associated *Diaphorina citri*. Plant Dis. 96:827-832.

4. Walter, A. J., Duan, Y. P., and Hall, D. G. 2012. Titers of '*Ca.* Liberibacter asiaticus' in *Murraya paniculata* and *Murraya*-reared *Diaphorina citri* are much lower than in *Citrus* and *Citrus*-reared psyllids. HortScience 46:1141-1147, 2012.

5. Morgan J. K. , Zhou, L., Li W., Shatters R. G., Keremane M., Duan,Y.P. 2012. Improved real-time PCR detection of '*Candidatus* Liberibacter asiaticus' from citrus and psyllid hosts by targeting the intragenic tandem-repeats of its prophage genes. Molecular and Cellular probes 26:90-98.

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1. Zhang, S.A., Walter, A. J., Hall, A. G., and Duan, Y. P., 2012. Urban Plantings of *M. paniculata* May Not Be a Major Inoculum Source of '*Candidatus* Liberibacter asiaticus', the Causal Agent of Citrus Huanglongbing. The Veg. Newsletter, Issue No.574.
2. Periwinkle offers hope against greening by Dennis O'Brien (ARS), May 10, 2010. Southeast Farm Press.
3. Researchers moving nearer solutions for greening disease by Charles Johnson. Jan.13, 2012. Southeast Farm Press.

Conference/Meeting (Annual Meeting of American Society of Phytopathology):

1. Zhang, M. Y. Duan, C. A. POWELL 2010. Bactericidal activities of antimicrobial molecules against huanglongbing-associated '*Candidatus* Liberibacter asiaticus' in the diseased periwinkle. Phytopathology 100:S145.
2. HOFFMAN, M. T., Y.P. Duan, L. Zhou, I. Stocks, D. Hall. 2011. Is the striped mealybug, *Ferrisia virgata*, a vector of huanglongbing bacterium *Candidatus* Liberibacter asiaticus? Phytopathology 101:S73

PROJECT (8): FLORIDA A&M UNIVERSITY 2009: SPECIALTY CROP MARKETING ALTERNATIVES

FDACS Grant Contract #15560
Total Funding - $97,625.85
End Date: 12/31/2011

PROJECT SUMMARY

Local farm entrepreneurs are finding business opportunities by producing quality goods for nearby markets. The current market segment locally sourced food is estimated at less than one percent of the $900 billion U.S. food industry. These local outlets range from farmers' markets to restaurants and grocery stores, as well as institutional food services such as schools, universities and hospitals. The demand for local food products greatly exceeds available supply due to the lack of efficient supply chains that link production, processing, storage and distribution. The development of localized or regionalized supply chains will allow a multitude of small-scale farm operations to profitably produce for nearby market outlets.

Multiple factors have prevented the increased procurement and distribution of locally produced foods in larger commercial and/or institutional settings. In order to deliver fresh and healthy foods to vulnerable communities, schools and other institutions and retail outlets, there needs to be a change in the traditional system for food delivery and significant effort needs to be directed towards the development of alternative food production and delivery systems.

Many small-scale producers can benefit from diversification, beyond traditional food, feed and fiber products into new agricultural products, including specialty crops. Developing specialty crop enterprises could result in increased income-generating potential for small-scale farm operations. Many small-scale operators will need immediate and specific information on methods and systems that will enable them to increase farm profitability and viability. Efforts to assist small-scale operations should be focused on:

1. Market assessment and development of market strategies for specialty crop enterprises produced by small-farm operations
2. Production technology development and application of specialty crop enterprises suitable for production by small farm operations

The Project focuses on specialty crop enterprises that will enhance farm profits and marketing success. The project allowed for the creation of new market outlets for small-scale farm operations by strengthening the links between producers and consumers for a more secure community and economically viable small-scale farms. Small-scale operations can benefit from diversification into specialty crop products, and facilitate the development of alternative farming systems and expanding marketing opportunities. Additionally, small-scale farm operations have special marketing needs because existing marketing systems are not designed to handle small volumes. The project evaluated efforts to evaluate alternative market opportunities for small-scale operations, including market availability and market development.

PROJECT APPROACH

The goal of the project is to enhance the competitiveness of specialty crop operations through improved production and alternative marketing opportunities for small-scale farmers. Project objectives included:

- Evaluate existing and emerging marketing systems that can facilitate specialty crop enterprises
- Evaluate coordinated production and distribution systems for specialty crop enterprises
- Develop appropriate educational materials for specialty crop enterprises and alternative market opportunities for small-scale producers

Activities Performed

Year One

1. **Identify alternative market outlets for demonstration/training purposes**, including:
   - Retail markets
   - Institutional markets
   - Local community outlets (direct sale to consumer opportunities) including engaging local churches in rural/suburban communities, and "rolling store" (mobile market).

   - Developed collaborative relationships with three (3) local churches for local community market development (farmers markets, farmer recruitment and training); churches served as community sites for market venues and farmer training and outreach.
   - Initiated efforts to evaluate feasibility of mobile EBT for local community market outlets.
   - Developed relationships with two (2) produce distribution companies to evaluate potential opportunities for specialty crop producers to supply products including food safety, liability and production requirements; Project staff participated in two (2) outreach activities conducted by produce providers relative to the procurement of products grown by specialty crop producers.

2. **Establish on-station production and marketing demonstration training activities**
   - Fifty-five (55) specialty crop producers participated in on-farm and on-site training demonstration projects
   - Mustard green production and marketing trial conducted, in collaboration with North Florida Research & Extension Center – Suwannee Valley, to evaluate feasibility of specialty crop alternative for production, value-added processing and marketing to retail, institution and local community markets; three varieties were preferred by panel of five farmers relative to appearance, processing/packaging suitability and taste.
   - Two (2) on-farm training demonstration sites evaluating production and marketing of collards and green beans; NNFC provided one-on-one assistance to participating farmers in crop production and post-harvest handling.
   - Three (3) on-site training sessions conducted in leafy greens and green bean production, value-added processing and alternative market development; NNFC assisted with coordinating hands-on training activities.

3. **Develop website and educational materials**
   - Conducted training sessions in Alternative Marketing Opportunities for thirty-eight (38) specialty crop producers at FAMU Farm Fest.
   - Project staff served as panelist training activities, including
     - Art of Selling workshop conducted by local extension
     - Food safety and Liability Insurance Issues conducted by Community Food Security Coalition
   - Two specialty crop producers attended training at Farm to Cafeteria Conference in Detroit, MI
   - Aggregated existing educational materials and modified publications for specialty crop operations (marketing, farm business management)
   - Disseminated over 100 promotional/outreach materials for specialty crop producers (exhibits at Florida Small Farm Conference and FAMU Grape Harvest Festival).

- Initiated design plans for internet-based resource for small-scale specialty crop producers; web-based resources will be housed at Florida A&M University Cooperative Extension Program website and linked to UF-IFAS Small Farm/Alternative Enterprises website. The website may be viewed at http://www.famu.edu/cesta/main/index.cfm/cooperative-extension-program/agriculture/marketing/specialty-crop-project/#my-menu.

Year Two

1. **Identify alternative market outlets for demonstration/training purposes**

   Retail and institutional markets

   - Evaluated market opportunities supplying independent grocery stores in FL, AL and GA.
     - Conducted visits and phone calls with produce managers, store managers and store owners to discuss product selections, pricing, delivery logistics and conflict resolution.
     - Five (5) specialty crop producers participated in hands-on training in market development in which they identified independent retail outlets for potential markets. The training was conducted in collaboration with NNFC as marketing consultant. These producers were trained in:
       - Presenting high quality products
       - Product promotion (using samples) to develop retail and institutional markets.
       - Negotiation of delivery times
       - Pricing of products
       - Conflict resolution regarding product shelf-life
       - Distribution logistics and dealing with store personnel

   - Established relationship with commodity purchasing representative for schools in Alabama; discussed opportunities for FL farmers to supply specialty crop products for AL schools.
     - Conducted visits and phone calls for planning with AL School Commodity purchasing representative for implementing pilot marketing project for FL farmers to supply specialty crop products for AL schools in Fall 2011; products being considered are turnips and sweet potatoes.
     - Women in AG training group initiated plans to produce raw product for retail and institutional markets through networking with other farmer groups; 1.5 to 2 acres of turnips were planted to supply retail and school outlets.
     - Over 50 specialty crop producers participated in hands-on training in production, value-added processing and distribution for AL pilot activity.

   - Established relationship with school districts in GA & AL; discussed opportunities for participating specialty crop producers to supply produce for school meal programs.
     - School districts included GA - Seminole County, Lowndes, Dougherty; AL - Houston County, Dothan City
     - Conducted meetings with two (2) school produce providers in GA to discuss quality and delivery requirements for products distributed to schools.
     - Five (5) participating farmers were trained in delivery to produce providers and direct school delivery of produce, including invoicing, proper storage and placement of produce in school kitchens and interacting with school cafeteria personnel.

   Other Retail/School-Related Activities

   - Conducted informational meeting with Dexter Farms in GA to discuss potential purchasing and distributing products from specialty crop producers in FL to retail and institutional markets.
   - Conducted meeting with local farmer to discuss institutional market development for satsumas and tangerines.
   - Eleven (11) specialty crop producers were trained in developing a production and marketing plan for select retail and institutional market outlets (determining production requirements based on market volume).
   - St. Mary's Beginning Farmer training group developed and implemented production and marketing plan for pilot training activity with 17 grocery stores and 2 restaurants beginning in September, 2011

- Participating farmers coordinated product purchases, processing and distribution to stores and restaurants
- Three (3) stores in FL, eleven (11) stores in AL, three (3) stores in GA, two (2) restaurants in FL.
- Average volume of product sold ranged from 1,000 -1200 bags each week.

Local community outlets, including direct sale to consumer opportunities - farmers' markets, engaging local churches in rural/suburban communities, "rolling store".

- Project staff continued efforts for local community market development training through engaging local churches and incorporating EBT technology.
- Established collaborative relationships with three (3) local churches for local community market development (farmers markets, farmer recruitment and training).
- Began establishment of on-site demonstration for spring and summer training activities in specialty crop production, management and market development.
- Five (5) participants were trained in product promotion (preparing samples) to develop local community markets.

2. Establish on-station production and marketing demonstration training activities

- On-site demonstration site was established training activities in specialty crop production, management and market development. Approximately five (5) acres was utilized for training in plasticulture and traditional seedbed production of selected specialty crop products, including leafy greens and green beans. Market development efforts included retail, schools and local community outlets.

- Conducted on-site demonstration training activities; training involved crop production and management practices, plasticulture, irrigation, harvesting, post-harvest handling, value-added processing and packaging, market development & distribution to retail grocery stores and local community.
  - SUMMER: Two training groups participated in 11 training sessions; total of 108 attendees in training sessions
  - St. Mary's Beginning Farmer training group developed production and marketing plan for a nine-week pilot training activity with 15 grocery stores and 2 restaurants beginning in September, 2011
    - Nine (9) hands-on training activities were conducted in value-added processing and distribution for retail outlets; total of 117 participants.
    - Participating farmers coordinated product purchases, processing and distribution to stores and restaurants
    - Average volume of product sold ranged from 1,000 -1200 bags each week.

- SUMMER: Training groups planted two training plots of collards (establishment of one plot was not successful due to weather) and one plot of turnips

- FALL: Established two (2) on-farm hands-on training demonstration sites, approximately 1.5 acre sites each, for leafy green production (collards, turnips)

- Conducted half-day training/outreach activity with 4-H Summer Enrichment Camp participants
  - 20 youth attended, ages 6-14
  - Demonstrated agricultural production and value-added processing with emphasis on opportunities in agricultural entrepreneurship

3. Develop website and educational materials

- Develop educational materials for specialty crop enterprises and market opportunities
  - Factsheets and other resource materials uploaded to Extension Program website.

- http://www.famu.edu/cesta/main/index.cfm/cooperative-extension-program/agriculture/marketing/specialty-crop-project/
- Search: *famu specialty crop project*

- Development of web-based resource for small-scale specialty crop producers
  - Webpage developed for Specialty Crop Project
  - Factsheets uploaded on webpage.

- Promotional display exhibited and outreach materials disseminated at the following farmer-related events:
  - 2011 Florida Small Farm Conference in July, 2011
  - FAMU Grape Harvest Festival in August, 2011
  - FAMU Farm Fest in November, 2011
  - FAMU Cooperative Extension Listening Session for Socially Disadvantaged Farmers in October, 2011
  - FAMU IPM Field day in October, 2011 (marketing presentation and display)
  - FAMU Cooperative Extension Listening Session for Socially Disadvantaged Farmers in December, 2011.

- Project staff participated in SoGreen Summit in Tallahassee in February, 2011; provided training session on developing opportunities with institutions (schools) as alternative market for specialty crop producers; approximately 50 attendees; 50 training materials distributed.

Present the significant contributions and role of project partners in the project.

- The project continues collaboration with New North Florida Cooperative (NNFC) to provide "real-world", hands-on training to participating specialty crop producers.
- NNFC also leveraged demonstration site, production inputs, equipment, processing and classroom facilities and vehicles to enhance effectiveness of training activities.
- St. Mary's Missionary Baptist Church provided assistance in recruiting participating producers for participation, as well as allowed use of facilities for training/outreach meetings and small plot of land for production/marketing demonstration training activities.
- North Florida Research & Extension Center – Suwannee Valley assisted with mustard green production and marketing trial to evaluate feasibility of specialty crop alternative for production, value-added processing and marketing to retail, institution and local community markets.
- Florida A&M University Cooperative Extension Program (4-H/Youth Development, Family & Consumer Science) and Center of Viticulture and Small Fruits provided opportunities for outreach and training meetings for specialty crop producers and youth.

GOALS AND OUTCOMES ACHIEVED

The project sought to enhance the competitiveness of specialty crops through improved production and alternative marketing opportunities for small-scale farmers. The project is intended to increase consumption and innovation, as well as improve efficiency and reduce costs of distribution systems for specialty crop enterprises. The objectives of the project are to: 1) evaluate existing and emerging marketing systems that can facilitate specialty crop enterprises; 2) evaluate coordinated production and distribution systems for specialty crop

enterprises, and; 3) develop appropriate educational materials for specialty crop enterprises and alternative market opportunities for small-scale producers. The activities that were completed in order to achieve the performance goals and measurable outcomes for the project include:

1. **Identify alternative market outlets for demonstration/training**
2. **Establish on-station production and marketing demonstration training activities**
3. **Develop website and educational materials**

EXPECTED MEASURABLE OUTCOMES		ACTUAL OUTCOMES
1. FAMU WILL CONDUCT FIVE (5) WORKSHOP SESSIONS OVER THE PROJECT PERIOD IN CROP PRODUCTION AND MARKETING FOR SPECIALTY CROP PRODUCERS.		**1.** CONDUCTED 28 TRAINING SESSIONS WITH SPECIALTY CROP PRODUCERS **2.** CONDUCTED 1 HALF DAY TRAINING/OUTREACH ACTIVITY WITH YOUTH
2. FAMU WILL CONDUCT TWO (2) ON-STATION AND TWO (2) ON-FARM TRAINING DEMONSTRATIONS PER YEAR (SPRING AND FALL CROPS) TO EVALUATE PRODUCTION AND MARKETING CAPABILITIES FOR SPECIALTY CROP PRODUCERS.		**1.** ESTABLISHED FIVE ON-SITE PRODUCTION TRAINING DEMONSTRATIONS **2.** ESTABLISHED FOUR (4) ON-FARM TRAINING DEMONSTRATION SITES. **3.** CONDUCTED TEST MARKETING DEMONSTRATION OF LOCAL COMMUNITY DEMAND. **4.** CONDUCTED HANDS-ON TRAINING ACTIVITIES WITH SPECIALTY CROP PRODUCERS IN RETAIL MARKET DEVELOPMENT AND DISTRIBUTION.
3. FAMU WILL DEVELOP WEB-BASED AND EXPORTABLE EDUCATIONAL MATERIALS IN CROP PRODUCTION, HARVESTING, POST-HARVEST HANDLING, VALUE-ADDED PROCESSING AND MARKETING FOR USE BY SPECIALTY CROP PRODUCERS.		1. Aggregated existing educational materials and modified publications for specialty crop operations (marketing, farm business management) **2.** EXPORTABLE EDUCATIONAL MATERIALS DISSEMINATED AT FARMER-RELATED EVENTS **3.** EDUCATIONAL MATERIALS UPLOADED ON EXTENSION PROGRAM WEBSITE.

Increase knowledge and skills of specialty crop producers in crop production and marketing opportunities:

1. Women in AG training group initiated plans to produce raw product for retail and institutional markets through networking with other farmers.

2. St. Mary's Beginning Farmer training group developed and implemented production and marketing plan for pilot training activity with 17 grocery stores and 2 restaurants; average volume of product sold ranged from 1,000 -1200 bags each week.

3. Five (5) participating farmers were trained in delivery to produce providers and direct school delivery of produce, including invoicing, proper storage and placement of produce in school kitchens and interacting with school cafeteria personnel.

BENEFICIARIES

- Fifty-five (55) specialty crop producers participated in on-farm and on-site training demonstration projects
  - Two (2) on-farm training demonstration sites were established to evaluate production and marketing of collards and green beans.
  - Three (3) on-site training sessions conducted in leafy greens and green bean production, value-added processing and alternative market development; NNFC assisted with coordinating hands-on training activities.

- Five (5) specialty crop producers participated in hands-on training in market development in which they identified independent retail outlets for potential markets. These producers were trained in:
  - Presenting high quality products
  - Product promotion (using samples) to develop retail and institutional markets.
  - Negotiation of delivery times
  - Pricing of products
  - Conflict resolution regarding product shelf-life
  - Distribution logistics and dealing with store personnel

- Over 50 specialty crop producers participated in hands-on training in production, value-added processing and distribution for AL school pilot activity.
- Eleven (11) specialty crop producers were trained in developing a production and marketing plan for select retail and institutional market outlets (determining production requirements based on market volume).
- Established collaborative relationships with three (3) local churches for local community market development (farmers markets, farmer recruitment and training).
- Five (5) participants were trained in product promotion (preparing samples) to develop local community markets.

LESSONS LEARNED

Small-scale farm operators participating in project activities concentrated only on a few crop enterprises, and were trained in strategies to address changes in production policies, markets, prices and farming conditions. Participating specialty crop producers benefitted from diversification into specialty crops and utilization of alternative market opportunities. The economic and social attributes obtained through the project included: 1) alternative employment and/or income earning opportunities for farmers and rural communities; 2) new markets for specialty crop products; 3) new sources of products for consumers; 4) methods to minimize the environmental effects of traditional agricultural production, and; 5) development of value-added products. Additionally to reach specific, underserved groups of farmers, particularly African-American producers, outreach and training efforts

should be varied and provide hands-on experiences. Engaging non-traditional collaborative partners, such as local churches and other community-based organizations, have demonstrated to be tremendously successful for effective program delivery.

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PROJECT (9): 2009 FDACS, UF-IFAS LEON COUNTY EXTENSION AND FAMU

FDACS Grant Contract #15578
Total Funding - $29,000.00
End Date: 6/30/2012

PROJECT SUMMARY

Florida's small farmers serve niche and specialty markets statewide. Most are limited income farmers who are the sole operator and they sell through a variety of non-traditional and limited exposure venues. Time and resource demands on these producers make it difficult to stay current with the increasingly complex production methodologies. Most have off farm jobs to fulfill their income needs. Many have had no training relating to production beyond a family member's shared experience or trial and error. It is critically important to educate these small farmers to improve their economic prospects and to lessen their environmental impacts.

PROJECT APPROACH

The University of Florida- Institute of Food and Agriculture Science (UF-IFAS) Leon County Extension Office partnered with the Florida Department of Agriculture and Consumer Services (FDACS) and Florida A & M University (F AMU) to educate a combined 250 small, limited resource and minority producers and community market vendors in the following counties during the sessions:

- Escambia County Extension Office
- Jackson County Extension Office
- Leon County Extension Office
- Calhoun County Extension Office
- Washington County Extension Office

Activities Completed: The University of Florida- Institute of Food and Agriculture Science (IFAS) Leon County Extension Office, the Florida Department of Agriculture and Consumer Services and Florida A & M University's goal was to educate a 250 small, limited resource and minority producers on the following:

- Soil testing and nutrient analysis
- Fertilizer- Proper application and the right amount
- Soil ph and how to maximize yields
- Assessing a crop's water needs and water quality issues
- Crop diseases and their causes
- Insect pest and their control
- Plant viruses, molds and fungus

Three Florida County Extension Offices offered the four Small Farm Outreach classes to area residents in the spring of 2012. Those counties offering spring classes were: Calhoun, Escambia, and Wakulla. The subject areas covered during the four two-hour class sessions were: Your Soil – How to get the Most From it; Garden Problems and their Solutions; Fertilizer – Getting the most Yield for the Least Input; and Bugs and Water. There were 74 participants in these classes. Additionally, Wakulla County held training for growers interested in producing shiitake and oyster

mushrooms with 28 in attendance. Participants were taught the techniques and protocols required to produce a mushroom crop.

As part of the educational program, all three counties had demonstration gardens which were used as learning tools for students, all of which were maintained by Extension Service personnel. All the gardens had a conventional production component, but the Wakulla County Garden had an organic component also. This feature proved to be an added benefit as part of the applied teaching of production techniques.

GOALS AND OUTCOMES ACHIEVED

Goal 1: A minimum of 250 participants will receive training on the aforementioned topics

A goal of 250 participants was set for program participation. In 2010 there were 108 farmer\students who chose to attend the classes. In 2011 an additional 62 small farms and specialty crop producers participated. In the first quarter on 2012 there have been 102 participants bring the total program participation up to 272 people who have received training. Based on class survey data, 99 percent indicated they had learned new and applicable small farming techniques during the sessions and 97 percent stated an intention to apply their new knowledge to their production of specialty crops. The goal for skills and knowledge imparted was 70 percent of the participants. The students were asked to rate the materials and instruction on a one (1) to five (5) scale with one being the worst and five the best. The materials and instruction were rated a 4.74 for usefulness and comprehension.

Goal 2: The participants will achieve at least a 70% retention score on the post-training test.

- ☐ In 2012 the following results were recorded:
  - 99% (24/25) of the Small Farms Outreach Program improved their knowledge of proper soil sampling.
  - 96% (24/25) of the Small Farms Outreach Program improved their knowledge of fertilizer selection.
  - 92% (23/25) improved their understanding of how legumes work as green manure.
  - 82% (19/23) improved their knowledge of regional insects and how to reference information to tell the harmless from the harmful.
  - 85% (18/24) of the Small Farms Outreach Program improved their knowledge of how to read and understand a soil sample.
  - 88% (22/25) of the Small Farms Outreach Program improved their knowledge of proper watering techniques

  The baseline score goal was set at 70 percent.

BENEFICIARIES

The group which benefitted most from this project was small, minority and limited resource specialty crop farmers. For most, their limited training lessens their economic prospects, compounds their potential for negative environmental effects. These shortcomings have the potential to be expensive for the specialty crop grower when losses occur or the wrong inputs are used. Small producers operate on a narrow margin of financial returns, and any product loss or other expense has major implications.

LESSONS LEARNED

Based on participation in the previous Small Farms Outreach Program; small, minority and limited resource specialty crop farmers have demonstrated a willingness to commit time to educate themselves in areas where there is potential to improve their knowledge and skill sets with the objective of improving their economic position.

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PROJECT (10): FLORIDA LETTUCE ADVISORY COMMITTEE: OPTIMIZATION OF LEAFY GREEN PRODUCTION

FDACS Grant Contract #15596
Total Funding - $395,650.00
End Date: 12/31/2011

PROJECT SUMMARY

Leafy greens production in the Everglades Agricultural Area (EAA) of south Florida comprises approximately 10,000 acres and is valued at $60,000,000 annually. In addition, hundreds of jobs are created with production, processing, and marketing throughout Florida. However, recent challenges are compromising the efficiency of leafy green production, including escalating input costs such as fuel, labor and fertilizers, and new pathogen and insect pests. In light of concerns regarding food safety and sanitation, management of birds and other wildlife is likewise gaining in importance. This proposal focuses on the major issues affecting leafy greens production as indicated by Florida growers. The culmination of several commodity group meetings resulted in growers unanimously selecting the priority areas addressed in this proposal. The four issues include 1) optimizing fertilizer use efficiency, 2) management of plant pathogens and weeds, 3) insect pest management, and 4) control of wildlife in fields. All of these problems result in high input costs for growers while reducing yields. By addressing these issues, we can decrease input costs, increase production, and enhance the safety of leafy greens, resulting in greater acreage and profitability, and potentially expanded markets for Florida leafy greens. Florida leafy greens production is poised for expansion and a greater capture of the national market due to increased transportation costs from traditional production areas in the western United States, potential water supply issues and food safety concerns with contaminated leafy greens in those areas, and a national trend toward better nutrition and consumption of vegetables.

Greater than 90% of all the crops used in the making of leafy greens salad mixes are produced in the western United States, with products being shipped throughout North America. With the historically low cost of transportation versus high crop value, growing these crops in the western United States under ideal climatic growing conditions made economic sense. However, the steady increases in fuel and transportation costs, and recent microbial contamination of crops from concentrated production areas, have made diversification of growing salad mix crops in the eastern United States more attractive and sustainable. Development of a geographically robust and diverse leafy greens production industry in the eastern United States can lead to economic sustainability for growers, fresher products due to reduced transit time from east coast farms to east coast cities, reduced costs to consumers, and wider product availability to the public.

PROJECT APPROACH

Numerous field demonstration projects were conducted in 2010 and 2011 related to fertilizer management, wildlife infestation, and evaluation of fungicides, insecticides, and herbicides for leafy greens production. These experiments were conducted in grower fields under commercial production practices as well as at the Everglades Research & Education Center. These projects were designed and conducted in close collaboration with leafy greens growers, the industry groups (Lettuce Advisory Committee and Palm Beach County Vegetable Crops Advisory Committee), and with private industries (herbicide, fungicide, and insecticide companies).

Meetings of the Lettuce Advisory Committee were held two times per year and all leafy greens demonstration projects and field trials were discussed with the committee. The committee then made recommendations to be incorporated into future demonstration projects. The Vegetable Advisory Committee also met twice annually and discussion of leafy greens projects occurred as well, with recommendations made by the committee. These meetings of growers, industry representatives, and University of Florida scientists and extension agents provided a means of thorough discussion of the objectives of the leafy greens project, and aided the participants in planning their field trials and surveys.

Approximately 25 field days were conducted to relay information to clientele, and additional training sessions were delivered to growers who gained CEUs. Growers gained better knowledge of leafy greens management practices, including methods for improvement of phosphorus use efficiency by lettuce, and better chemical mixes for disease control. Alternate strategies to decrease phosphorus fertilizer use, such as use of soil pH amendments, were demonstrated. Wildlife control strategies were demonstrated to improve leafy greens production and eliminate potential health hazards. Immediate changes in grower practices included adoption of a lettuce seed testing program for a bacterial pathogen, and a new weed management strategy to reduce its alternate hosts. Grower knowledge and acceptance of these practices were gauged by pre- and post-grant surveys.

GOALS AND OUTCOMES ACHIEVED

The leafy greens project was planned with the following specific goals to be addressed.

- Maximize fertilizer use efficiency and decrease input costs incurred by growers by updating fertilizer recommendations for leafy greens grown on muck soils
- Reduce incidences of bird/animal intrusions into fields by identifying potential management practices that decrease their infestation, and training of growers for adoption of these practices
- Evaluation of effectiveness of new fungicide and insecticide chemistries and application methods for control of plant pathogens and insects to increase yields and minimize pesticide costs
- Optimize control of weeds by refining crop management strategies, including herbicides, rotation, and timing, for proper control of pests resulting in an increase in yields
- Develop training documents combining elements of fertilizer use, crop chemicals, and pest control to improve leafy greens production for growers in Florida.

We have made considerable strides in identifying best management practices for fertilizer use. Field trials have identified phosphorus fertilization rates that produced the optimal lettuce yield, and our data support changing the current recommendations. Alternatives to phosphorus fertilizer, such as the use of soil pH amendments, were evaluated to reduce fertilizer costs to growers. Various phosphorus rates ranging from one- half to 4 times the recommended rate were tested for romaine and iceberg lettuce. The marketable yield increased with increasing applications rates about the recommended rate, with optimal yield occurring at approximately 2.5 times the recommended rate. Combinations of these various phosphorus rate experiments across seasons, years, and soil types will be used to update the phosphorus fertilizer recommendations for romaine and iceberg lettuce. Growers will benefit by the knowledge of matching the phosphorus fertilizer rate with the response of lettuce yield. Furthermore, adherence to official recommendations will ease their regulatory burden regarding phosphorus discharges from agricultural fields, and improve the adherence to mandatory Best Management Practices (BMPs) required of leafy greens growers.

Additional studies were undertaken to determine the role of pH amendments in influencing nutrient availability and lettuce yield. Grower interest in using elemental sulfur for pH management has been increasing. This sulfur transforms

phosphorus contained in soil rather than adding external phosphorus to the system, thus potentially decreasing the external load from the EAA. Amendments are applied to reduce soil pH and increase nutrient availability. All amendments were effective at increasing lettuce yield. Optimal amendment rates were about 500 lb/ac, but no amendment was better than the other. Banded application of amendments was better than broadcast at low rates, but broadcast was better at the higher application rates. Banded application at high rates had harmful effects on lettuce growth –some burn that limited growth resulting in lower yield compared to broadcasting. Potentially, these pH amendments, when used in concert with reduced P application, could reduce the total phosphorus fertilizer needed for lettuce production by making more of the soil phosphorus available to crops. As an ancillary benefit, the lower phosphorus load (via fertilizers) into the EAA leafy greens production area would likely contribute to lower phosphorus in runoff as well.

For wildlife control, we completed 2 years of quarterly surveys in leafy greens, vegetable, sugarcane, and rice fields and natural marshes. Land use in the Everglades Agricultural Area is mostly devoted to sugarcane, with other acreage in leafy greens, vegetables, rice, and some wetland marshes. Thus, many different land uses are present in close proximity or adjacent to land cropped to leafy greens. When growers produce crops such as sugarcane and rice in rotation with leafy greens, or grow rice and sugarcane in the vicinity of leafy greens crops, it is critical to know if their proximity is causing a buildup in amphibian populations that will remain in the area when leafy greens are planted and cause an increased pest pressure. Information derived from these amphibian surveys greatly assisted the growers in planning crop rotations and providing fencing and other control measures where needed for their leafy greens fields, thus optimizing efficiency and cost-effectiveness of their control measures as well as reducing damage and potential contamination.

We surveyed 875 points in lettuce, sugarcane, rice, and flooded habitats throughout the year and including rotation crops with lettuce and vegetables. We identified all individuals and choruses to species and documented size of chorus and observation locations. Amphibians were present in all agricultural fields in the EAA. There are more species in sugarcane and rice than in vegetables, including leafy greens. However, the major lesson is that fields adjacent to leafy greens fields, especially canals and sugarcane fields, were a major source of amphibians and other wildlife in leafy greens fields. Through wildlife surveys, we were able to recommend that net fencing or exclosures surrounding leafy greens fields was effective in isolating amphibians in the peripheral canals and keeping them out of the leafy greens fields. Lettuce varieties were evaluated for their resistance to insect pests and pathogens. This research led to identification of lettuce cultivars which were most resistant to insect pests and plant pathogens. Banded cucumber beetle (BCB) (*Diabrotica balteata*), Serpentine leafminer (SL) (*Liriomyza trifolii*), and aphids (Homoptera: Aphididae) are among the major insect pests that cause significant economic damage to lettuce (*Lactuca sativa*) in southern Florida. Cultivar 70096 had the lowest percent (3.7%) of BCB feeding damage among the romaine cultivars. Romaine cultivar Manatee also had significantly lower BCB feeding damage (12.1%) than the susceptible cultivars Okeechobee (19.8%) and Terrapin (19.1%). The lowest level of infestation of aphids was observed on 'Manatee', followed by '70096', whereas 'Okeechobee' and 'Terrapin' had severe infestation of aphids. The cultivars identified as resistant to insects can play an important role in integrated pest management, which may decrease pesticide applications, reduce production costs, and protect the environment. Future breeding goals are to incorporate those lines exhibiting resistance into an expanded lettuce breeding program.

Several pathogen issues emerged this year, including a bacterial leaf spot infestation that damaged much of the commercial lettuce crop in Spring 2010 and resulted in significant yield loss. Through interaction with growers, we decided to include more research on understanding how this pathogen (*Xanthomonas campestris p.v. vitians*) infects lettuce and its potential control. We responded to this threat by establishing variety trials and attempted to identify various cultivars that show natural resistance to this pathogen. No such cultivars were identified however. Then, we conducted a survey of weeds which may serve as hosts for this pathogen in the Summer, when the fields are normally fallow. We were able to identify weeds that could serve as hosts and recommended a weed control program for summer fallow to reduce the probability of a recurrence of this infestation. Growers adopted this recommendation.

Resistance to plant pathogens was evaluated for different lettuce varieties. We screened lettuce varieties and germplasm for resistance to bacterial leaf spot caused by *Xanthomonas campestris* subsp. *vitians*. There were

no lines that demonstrated complete resistance but some lines displayed less disease than others, indicating that there are at least some prospects for incorporating genetic resistance to this important disease. We also investigated potential inoculation of lettuce with plant pathogens, namely *X. campestris*. The bacterial pathogen had apparently been transported in the runoff and because of the wounding caused by the hard rain, been capable of causing total destruction. A planting containing the same variety, Belle Glade, planted only 100' away but not exposed to runoff from the infected planting remained uninfected. These observations may be crucial to a management practice that involves isolating infected fields with appropriately designed drainage, should an outbreak occur and rain be forecast in sufficient time to allow for prevention. Thus, through this observation, we were able to make recommendations to leafy greens growers about isolation of fields infected with this pathogen, which would significantly aid in limiting the dissemination of this pathogen across the EAA in the future. Numerous field trials were conducted for the purpose of evaluating different chemical control measures of leafy greens diseases, particularly downy mildew. Collaboration with chemical companies was essential. We were able to identify better compounds, mixes of compounds, and timing of applications to control many diseases. For example, disease suppression and lettuce yields were significantly enhanced with applications of phosphite compounds, which are classified as reduced-risk pesticides.

We evaluated 31 basil varieties for resistance to downy mildew. Although all sweet basil varieties appeared susceptible, a number of other basil types (i.e. lemon, blue) displayed some level of resistance. This information was forwarded to breeders for inclusion in their breeding programs for host-plant resistance in sweet basil.

We evaluated different herbicides, and timing of herbicide applications, on weed control in romaine and iceberg lettuce, and other leafy greens. Timing of herbicide application was very important, as prolonging the first application beyond 3 weeks after planting resulted in enhanced weed competition and reduced lettuce yields. We thus recommended to growers a diligent herbicide management program for early weed control. Herbicide trials often indicated mixed results, but we determined that for spinach, Dual applied pre-emergence at 4 and 8 fl oz/ac rates provided good weed control with little or no phytotoxicity. For parsley, Caparol at 1.0 pint/acre provided satisfactory weed control without compromising parsley vigor. All other chemicals and their various combinations had various leaf burns, were deemed unsatisfactory for parsley.

Twenty five field days were conducted during the 2-year course of this project, with each field trial supporting a field day attended by growers, industry representatives, and scientists. CEUs were commonly offered at these functions. Furthermore, additional CEU training sessions were conducted in which scientists presented updates on field trials and revised leafy greens management recommendations. Additionally, 8 meetings were held of the Lettuce Advisory Committee and the Palm Beach County Vegetable Crops Advisory Committee to discuss current and future research needs, for exchange of ideas, and for development of recommendations for improving leafy greens management.

Surveys of leafy greens growers were conducted in early 2010 and in late 2011 to gauge their knowledge of management practices. Through the meetings and field days, we have concluded that improvements in grower knowledge have been made regarding fertilizer and pest management practices, including identification of best management strategies to limit plant pathogen infestation of fields, control of amphibian populations, identification and timing of pesticide applications, and knowledge of proper phosphorus fertilizer use. Growers have adopted some new strategies that were recommended by scientists, including use of new pesticides, and strategies for controlling *X. campestris* infestation.

Numerous extension and training documents have been produced, including 2 EDIS documents, 4 articles in the statewide Vegetable Production Guide, and numerous articles in trade newsletters. Furthermore, handouts and fact sheets were distributed to all growers at field days and advisory committee meetings. Peer-reviewed manuscripts have been published relating to leafy greens production, and presentations at state and national conferences demonstrated Florida leafy greens management practices to a wider audience.

Notes on Goals and Outcomes Achieved:

25 field days covering the field demonstration projects were held over the 2-year duration of the project, with total attendance being 575 persons representing the leafy greens growers, industry representatives, scientists, and extension agents.

Four meetings of the Lettuce Advisory Committee were attended by 155 growers, scientists, and private industry representatives, and the 4 meetings of the Palm Beach County Vegetable Crops Advisory Committee were attended by 60 scientists, growers, and private industry representatives.

Surveys were sent to growers in early 2010 at the start of the project, and again near the end of the project in October 2011. Surveys were sent to one representative for each of the 4 leafy greens growers. The final survey results indicated that 100% of the leafy green growers showed an increase in knowledge gained of fertilizer and nutrient management, plant pathogen management, weed control, insect pest management, and wildlife control. No increase in leafy greens acreage was documented. Changes in leafy greens grower behavior and adoption of new management practices were documented for fertilizer management, plant pathogen, insect, and weed control, and for wildlife control. Descriptions of these changes are described in greater detail below.

The surveys sent to each of the leafy greens growers were as follows:

Initial Survey of Leafy Greens Growers in the Everglades Agricultural Area

David D. Sui, Alan L. Wright, Gregg S. Nuessly, Richard N. Raid, Elise Pearlstine

As part of a USDA specialty crops grant awarded to the Florida Lettuce Advisory Committee, the Everglades Research & Education Center, and Palm Beach County Extension for 2010 - 2011, research and extension activities specifically for leafy greens production within the Everglades Agricultural Area (EAA) will be conducted. Leafy greens are defined as such including all types of lettuces, endives, escaroles and spinach. This survey is designed to gauge the status of leafy greens production, identify the issues and problems facing the industry, and determine ways that the University of Florida Institute of Food and Agricultural Sciences (IFAS) extension agents and specialists can work with growers to address these problems. Also, there is a need to predict future issues that may affect the industry. It is important to document the current state of the leafy greens industry and again after project completion so that we can assess the effectiveness of research and extension projects in meeting the needs of growers. Please record your responses to questions and offer comments to questions.

Leafy Greens Industry Status

What is the acreage of your farm and acreage devoted to leafy greens?

What types of leafy greens are grown and their acreage?

What are the major issues facing the industry today?

How can the University of Florida-IFAS help you in addressing these issues, and what specific research or extension projects are most necessary to address?

Has your farm been visited by extension agents or specialists, and would you like to have more site visits? How will site visits help your farm business?

Those involved in agriculture, like many other industries, must employ environmental management practices. What educational programs might UF-IFAS conduct over the next five years to help farmers understand and implement new leafy greens management practices?

Specific Issues Addressed by Leafy Greens Project

Nutrient and fertilizer management

Do you feel that current IFAS fertilizer recommendations are suitable for leafy greens grown on muck soils? If not, what changes are needed to the recommendations?

Describe issues related to nutrient management for leafy greens that you want to see addressed with the USDA block grant?

Weed management

List the major weed problems for leafy greens production, and what research areas you want EREC to focus on.

Plant Pathogen management

What are the major plant pathogen problems for leafy greens, and describe limitations to their control?

What should be the focus of research and extension efforts?

Insect management

What are the major insect problems for leafy greens, and describe limitations to their control?

What research and extension activities would you like to see IFAS conduct in regards to insects problems in leafy greens?

Vertebrate pest management

What kinds of vertebrate pests do you have in the leafy greens fields, and what measures do you take to keep vertebrate pests out of fields?

What specific problems have you observed caused by vertebrate pests? Body parts, contamination through feces, damage to crops, etc?

Are vertebrate pests a greater problem in any particular leafy green type, and is there a time or season when the problem is more severe?

What research and extension activities would you like to see IFAS conduct in regards to vertebrate pests in leafy greens?

Conclusion Survey of Leafy Greens Growers

David D. Sui, Alan L. Wright, Richard N. Raid, Gregg S. Nuessly,

and Elise Pearlstine

October 2011

As part of a USDA Specialty Crops Block Grant awarded to the Florida Lettuce Advisory Committee, the Everglades Research & Education Center, and Palm Beach County Extension for 2010 - 2011, research and extension activities was conducted specifically for leafy greens production in south Florida. This survey is designed to assess research-extension impact from this grant on addressing grower issues as well as assessing remaining issues that need to be addressed in the future. Your responses are important in assisting us and the grant agency to gauge the grant's effectiveness and future needs. Please record your responses to questions and offer comments.

Specific Issues Addressed by Leafy Greens Project

Research-Extension	Did the research-extension program address issues related to management for leafy greens production (please circle one under each	How has your farm benefitted from this research and extension

Area	category)	program
Nutrient and Fertilizer Management	Yes No	
Plant Pathogen Management	Yes No	
Weed Management	Yes No	
Insect Management	Yes No	
Plant Breeding & Varieties	Yes No	
Nuisance Animals	Yes No	

General Area of Concerns

1. How many total acres of leafy greens did you plant at your farm?

2. What research and extension activities would you like to see IFAS continue to conduct in regards to leafy greens production?

Expected Measurable Outcomes:

- An increase in leafy green production, which can be assessed through increased acreage, increased yields, or increased throughput of processing facilities
- Decreased grower input costs, such as fertilizers and pesticides, and reduced disease, insect and weed management problems. These can be documented by grower surveys of practices using University of Florida Extension Agents. Grower surveys will be performed pre-project, then annually until completion of the project.

Increases in total leafy greens production did not occur for this 2-year project, although long-term effects of grower knowledge gained may take longer to be noted with respect to increasing acreage. In addition, other market factors, such as increased profitability in recent years of alternate row crops, such as sugarcane, decreased

the amount of land that was able to be leased to leafy greens growers. In fact, one leafy greens grower experienced lost leafy greens acreage because that land was converted to sugarcane production because of high sugar prices. So in the short time frame of this project, we were not able to document increases in leafy greens acreage.

We were, however, able to document gains in grower knowledge and more importantly changes in grower management practices. We documented increased leafy greens yields and reduced input costs through better control of diseases and pests, which resulted from the research and extension program supported by this grant. Specifically, elimination of lettuce yield losses caused by a plant pathogen pest resulted in higher yields and an increase in acreage that was harvestable. Also, utilization of higher phosphorus fertilization rates as demonstrated for this project increased romaine and crisphead lettuce yields by 20%, and thus increased throughput for leafy greens processing facilities.

BENEFICIARIES

This research was conducted in close collaboration with the Florida Lettuce Advisory Committee, which consists of all growers of leafy greens in the EAA. These meetings are held twice annually and are attended by scientists, growers, and private industry. Likewise, the Palm Beach County Vegetable Advisory Committee consists of scientists, county extension agents, leafy greens and vegetable growers, and private industry. The function of these groups is to aid dissemination of research through extension to commercial growers, and to guide research and extension efforts into leafy greens in Florida.

The beneficiaries of this research include the leafy greens growers, private industry, including makers of herbicides, insecticides, etc., and other vegetable growers as well. The leafy greens growers directly benefit through their adoption of the management practices that were developed during this project. We have improved their understanding of how to control plant pathogens, insects, weeds, and wildlife, and how to minimize phosphorus fertilizer inputs. For example, banding of phosphorus fertilizer in narrow bands reduced the total phosphorus needed by approximately 20% compared to broadcasted application, resulting in potential savings in input costs to growers. Likewise, use of soil pH amendments, such as elemental sulfur, reduced the need for phosphorus fertilizer by approximately 25%. Banded sulfur application showed promise for increasing P availability and increasing lettuce yield. Plant-available phosphorus increased with the sulfur application rate corresponding to yield increase, and showed a significant increase at 400 lb S/ac, about a 25% increase over no S. Elemental sulfur banded at 200 lb S/ac showed an approximate 20% increase in romaine lettuce yield compared to unamended soil. Adoption of this soil amendment by lettuce growers would have the same effect on soil phosphorus availability as 200 lb/ac of phosphorus fertilizer. Since there are government-imposed limits on phosphorus discharges in runoff from EAA fields but not for sulfur discharge, the use of soil pH amendments aids leafy greens growers by enhancing potential for their compliance with water quality regulations, as well as
reducing input costs. Likewise, any potential eutrophication of wetlands receiving agricultural phosphorus runoff from the EAA would be minimized through adoption of soil pH amendments, resulting in considerable environmental benefits.

Demonstration of proper use of pesticides for control of weeds, pathogens, and insects allowed for identification of new methods and chemicals for their control and management, and for update of best management practices. The use of the revised management practices, such as new chemical products, results in better disease and pathogen control, and higher crop yields. Furthermore, recommendations made concerning

seed treatment and its adoption by all growers aims to eliminate a troublesome bacterial pathogen on lettuce. Our research results from this project are being used to breed more disease-resistant varieties of leafy greens, which will serve the leafy greens industry well into the future. Lettuce and basil varieties were evaluated for host-plant resistance to pests. For lettuce, 10 lines were evaluated for resistance to bacterial leaf spot, with some promising lines showing some resistance. The three romaine lettuce varieties, Okeechobee, King Henry, and Manatee, exhibited the highest levels of resistance to bacterial leaf spot, with Okeechobee being significantly more resistant than the others. With regards to downy mildew, two varieties, Manatee and 10283, exhibited immunity, and King Henry and Okeechobee exhibited only moderate resistance. All other tested varieties displayed a high susceptibility to downy mildew in this particular trial. These promising lines are now being used by Everglades REC scientists in a lettuce breeding program to develop new and better lettuce cultivars. Basil cultivars have also been identified as showing resistance to downy mildew, and this information was forwarded to breeders to assist their development of more resistance cultivars.

All of our field days and Lettuce Advisory Committee meetings were attended by representatives of all four leafy greens growers in the Everglades Agricultural Area. Thus, 100% of leafy greens growers participated in this project and directly gained knowledge of new leafy greens management practices, and all growers were able to implement the new ideas generated from this project. An example of grower knowledge gained and changes in grower management practices caused by this research grant follows.

Growers lost approximately 1000 acres of leafy greens harvest due to the infestation of a bacterial plant pathogen during this project. The lettuce was damaged resulting in lower yields or even a total loss of the product, resulting in reduced or no profits for infested fields. Through research into the problem, we were able to identify the causative factor, a bacterial pathogen, and devise a corrective plan to deal with it. The result was a determination that seed-borne pathogens were causing the outbreaks in the fields, a we devised a program to test all seeds for the pathogen being planting. No further infestations occurred since seed testing began. Thus, this program resulted in a decrease in infected acreage and eliminated the yield loss from pathogens, resulting in greater profitability for the leafy greens growers. All of the leafy greens growers adopted this management practice.

Another example is the demonstration of better phosphorus fertilization application rates. The growers learned that if the phosphorus application rate increased by a factor of 2.5, yields would increase approximately 20%. Growers now have improved knowledge to figure out if the extra cost of phosphorus fertilizer will be worth the benefit of higher yields and higher gross product sales. All of the lettuce growers currently use phosphorus fertilizer application rates that were recommended by this project.

Various chemicals and chemical combinations were evaluated for effectiveness in controlling insect and plant pathogens for a wide variety of leafy greens. All leafy greens growers have changed their herbicide, insecticide, and fungicide applications to account for the new research generated by this project.

Through wildlife surveys, we were able to recommend that net fencing or exclosures surrounding leafy greens fields was effective in isolating amphibians in the peripheral canals and keeping them out of the leafy greens fields. We documented a 25% increase in grower adoption and usage of netting for exclusion of amphibians from leafy greens fields.

Many fungicide treatments provided for significant reductions in downy mildew severity in lettuce. Of the few conventional fungicides currently registered for use on basil, the various phosphites have consistently provided good downy mildew control. Revus generally provided control superior to other fungicides, followed by Ranman and then Presidio and Quadris,. Results indicate that the fungicides being considered for registration through IR-4 program (Revus, Ranman, and Presidio), each with a different mode of action, should provide for improved control of downy mildew on basil, while also serving to slow or prevent fungicide resistance. Luna Sensation, Rovral, Cabrio, and Quadris provided for the most efficacious control of *Alternaria* leaf spot on parsley. For chives, we evaluated pre-emergence herbicides to gather data to support an IR-4 registration for Prowl. Results showed excellent weed control with Prowl at both the 2 and 4 pint/ac rates, while Buctril provided some control but not enough to be commercially viable.

We were able to demonstrate leafy greens management practices not only to area growers and industry, but to growers from other regions of Florida, and nationally as well. A tour of lettuce production areas was made to a group of vegetable growers from Finland, and other tours were made to the North Neck Virginia Vegetable Growers Association. Tours of demonstration trials and fields by area schools, civic leaders, and governmental and civic organizations were conducted to share the importance of the leafy greens industry in Florida and to explain new management strategies.

LESSONS LEARNED

Through the demonstration projects and field trials, we have gained considerable knowledge about how to improve leafy greens production in Florida. We learned about and were able to recommend to growers new chemical products and application methods for disease and pest control, better management practices to control wildlife in fields, and new fertilizer management strategies that reduce total fertilizer use.

We had to be somewhat flexible in designing field trials, as some problems and issues developed during the course of the project. Our primary objective was to improve leafy greens production, so any emerging issue that was identified by the growers was to be addressed by the scientists. For example, an unexpected major infestation of bacterial leaf spot occurred which devastated many lettuce fields and rendered them unmarketable, resulting in major economic losses to growers. We reacted quickly and began diverting resources to investigate this problem. We were able to identify the pathogen, and then conducted laboratory, greenhouse, and field trials to identify mechanisms for its control. We determined that the pathogen may persist on weeds near canal banks proximal to lettuce fields, so we then recommended better weed control for canals. Growers responded by using better weed control both during the growing seasons and during fallow periods to prevent carryover to the next growing season, which subsequently turned out to be free of the disease. Also, we were able to ascertain that the causative factor for the disease was likely untested contaminated lettuce seeds. Subsequently, we were able to recommend to growers to have all seed tested for the pathogen *X. campestris*. Growers responded by having lettuce seeds planted in the EAA tested for this pathogen, resulting in less likelihood of a recurrence of this disease caused by untested seeds. Thus, this unexpected issue was dealt with quickly, and helped growers to minimize and hopefully eliminate this disease from the EAA.

Growers in the EAA are required to follow certain well-define best management practices, one of which is adherence to University of Florida fertilizer recommendations. The recommendation for phosphorus fertilizer use for lettuce is about 25 years old, and considered outdated. Our goal was to use this project to support changing the phosphorus fertilizer recommendations for lettuce. Subsequently, through numerous field trials, we were able to demonstrate that indeed, through changes in lettuce varieties and soil conditions through the years, that the current phosphorus fertilizer recommendation was underestimating the rate needed to support maximum lettuce

yield. We were able to demonstrate that a rate approximately twice that currently recommended produced the optimal lettuce yield. This information will now be used to update the official fertilizer recommendations for lettuce.

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- **Project Title:** Florida Nursery, Growers and Landscape *Research, Education and Marketing Programs to Sustain Florida's Nursery and Landscape Industry*
    - Component #1 - Consumer Marketing & Outreach
    - Component #2 – Research
    - Component #3 – Certification
    - Component #4 – Education

- **Contract Number:** FDACS CONTRACT #015561
- **Specialty Crop Block Grant Funding Year:** 2009
- **Reporting Period:** Final Report

The 2009 grant proposal, submitted and executed by the Florida Nursery, Growers and Landscape Association (FNGLA), was centered around providing the proper tools and expertise to safeguard and sustain against the enormous financial risk being placed on the industry due to the downturn in the market. In 2005, total sales by Florida nursery, landscape service firms and retailers were $15.2 billion. During the housing boom, sales skyrocketed in comparison to sales in 2000, growing by 54%. A dramatically different picture was revealed during the request of the grant.

As one of the largest agricultural commodities in the state, the nursery and landscape industry has certainly been one of the hardest hit economically and will be one of the last to come out of a recessionary environment. Regrettably, many still view Florida's nursery products and landscape services as luxuries, not life necessities.

The project was divided into four components. Through research, education, certification and marketing, FNGLA utilized its vibrant network of professionals to help reshape the future of Florida's nursery and landscape industry and sustain the industry's business success.

Component (1) Consumer Marketing & Outreach

Project Summary:

To engage and educate Florida's gardening consumers on the benefits of Florida landscapes, FNGLA developed a comprehensive three-pronged consumer relations campaign. www.floridagardening.org was revamped to position Florida landscapes and plants as key elements of a sustainable lifestyle leading consumers to smart purchase decisions for their home landscapes and outdoor living areas. Through FNGLA-generated consumer content (such as the core elements of the *Florida Plants of the Year* selections, hiring FNGLA-certified professionals and inclusion of a statewide calendar of consumer gardening events), the web site serves as a conduit for other industry-related sites, such as botanical gardens and the University of Florida/IFAS statewide extension offices. This message was furthered through brochure development with a series of key

messages targeting: (1) general consumers; (2) youth; and, (3) garden-interested end-users. Combined with the physical outreach also planned, These pieces increased consumer recognition of the plants, products and services of Florida's nursery and landscape industry and substantiated Florida plants both as a local commodity and a "Fresh From Florida" element. The overall purpose of the consumer relations campaign was to build public awareness of Florida's nursery and landscape industry, its potential impact on residents' lives and to lessen the information gap with Florida's homeowners and gardening consumers. The project linked the public with information about the industry related to their yards and homes spurring consumers to build gardening knowledge.

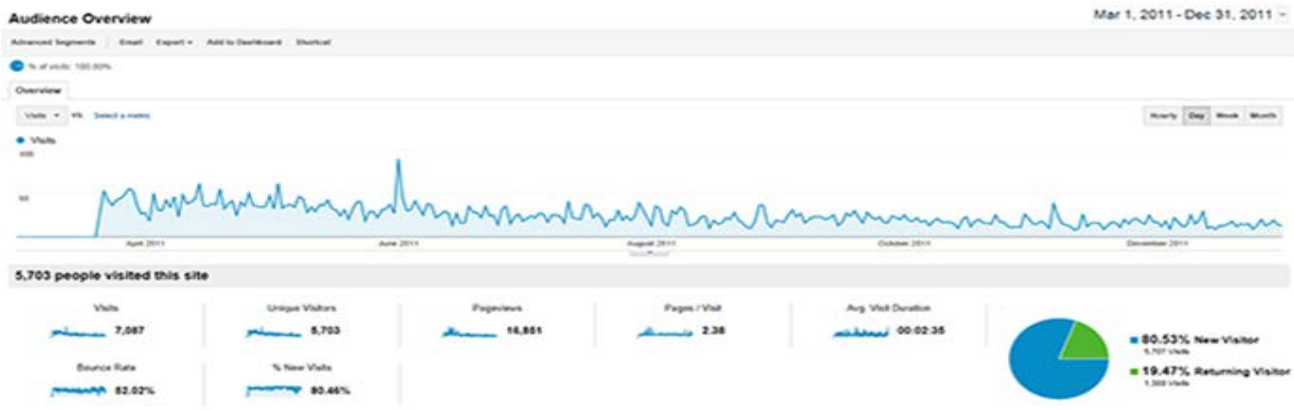
Project Approach:
In order to maximize effectiveness with a diverse audience group, a multi-pronged approach was utilized. It included traditional printed information, digital information, as well as targeted distinct consumer groups and groups who have direct contact with Florida's gardening/potential gardening audience.

This effort partnered FNGLA with the University of Florida- IFAS; University of Florida's School Gardening Competition, Florida Cable Telecommunications Association, and, the Florida Agriculture in the Classroom (FAITC).

Goals & Outcomes Achieved:
Website development - www.floridagardening.org
The site was conceptualized and developed throughout 2010 and launched in March 2011 with the onset of spring. Initial feedback from users showed the most preferred area was the Gardening A to Z section followed by the Florida Garden Select area. User statistics concurred with the opinion poll. While initially very pleased with the site's aesthetics, towards the end of the year, the FNGLA Marketing Committee made slight alterations such as the removal of images that did not test well (with focus group participants) and continued to tweak the site's look and feel. We are very pleased with the calendar area as Florida lacked a consolidated area for all gardening events and the site is a primary vehicle for communicating with consumers the value of the Florida Garden Select plants and program.

Staff turnover with the subcontractor created more delays than expected and a change in hosting added to technological difficulties.

Site usage throughout 2011 showed an increased usage at launch which coincided with the spring season. Google Analytics shows 80.5% of visitors were "new users" and 5,703 were "unique users." This high usage correlated to both the defunct nature of the site's URL prior to the relaunch and the immense promotions as part of FNGLA's garden at the 2011 Epcot International Flower & Garden Festival. Average Site duration (time spent on the site) was 02:35. The most heavily referenced areas were the "Gardening A to Z" tab and the "Florida Garden Select" areas.



While the usage survey was not able to be conducted, FNGLA did extract opinions through six focus group sessions and adjusted the site's design, flow and content based upon this feedback.

See full report on the focus group sessions:
http://www.fngla.org/news/archive/2011/downloads/FGS_CenterPIEReport.pdf

Printed Materials & Youth Promotions

Recognizing the value of packaging messages to extend reach, the "Benefits of Plants" piece and the youth-targeted promotions were combined to maximize effectiveness. The final product married both intents into one cohesive message touting the benefits of plants as well as showcasing career options for today's youth. The final "piece" was the Florida Garden Select" promotional piece, which was actually two pieces: one targeting industry and the other Florida's end consumers. Having cut design expenses by designing the piece in-house. FNGLA was able to increase printed quantities and pay expenses for the small-version piece, which were minimized as it was printed on excess paper which would have been discarded. The materials promoting the state's nursery industry were and continue to be used at an array of industry events and consumer happenings throughout the state and beyond.

Printed Materials & Youth Education: Grouping the "Benefits" and youth education pieces took considerably more planning, yet the end product was exactly on task with the messaging and futuristic approach ideal for youth interactions.

The "Benefits of Plants" folder piece targets higher education agriculture students and those looking to change career paths towards "green" careers, such as nursery, landscape, ag sciences and the full range of careers feeding into nursery and landscape. 7,500 pieces were printed and distributed at these events as noted. The balance (around 1400) is still being used by FNGLA at events and efforts in a similar fashion:

- 1,600: Tropical Plant industry Exhibition (TPIE) on the show floor and at the Career Event for Youth (January)
- 200: University of Florida CALS Expo (February)
- 500: American institute of Floral Designers Conference (July)
- 630: Southeast Builders Conference (July)
- 215: Garden Writers National Conference, Region Meeting (August)
- 160: America in Bloom Symposium (September)
- 2,800: The Landscape Show (September)

The "Benefits of Plants" 8 ½ X 11 Flyers targeted higher education agriculture students and those looking to change career paths towards "green" careers, such as nursery, landscape, ag sciences and the full range of careers feeding into nursery and landscape and FNGLA Certified Horticulture Professionals (for use by the pros with those seeking to hire a FNGLA Certified Hort Pro . 15,000 pieces were printed and distributed at these events as noted and through the FNGLA Certified Horticulture Pros. We were surprised by the piece's popularity within the nursery grower group and received many requests for these pieces for use at regional "home shows" attended by various nursery businesses. The balance (around 4,500) is still being used by FNGLA and efforts in a similar fashion:

- 1,600: Tropical Plant industry Exhibition (TPIE) on the show floor and at the Career Event for Youth (January)
- 200: University of Florida CALS Expo (February)
- 500: American institute of Floral Designers Conference (July)
- 630: Southeast Builders Conference (July)
- 215: Garden Writers National Conference, Region Meeting (August)
- 160: America in Bloom Symposium (September)
- 2,800: The Landscape Show (September)
- 4,500: FNGLA Certified Horticulture Professionals & via FNGLA member requests (Continuously)

The 2011 Florida Garden Select promotional pieces promote the program and the year's selections into the program. Targets include Florida's gardening

consumers and we target this audience via 80 University of Florida extension agents, their county offices, and, FNGLA's 17 chapters. Additionally, we targeted FNGLA's Garden Center retailers, approximately 30 businesses to which both pieces are applicable, and for which the smaller version was specifically designed for. 10,000 large pieces and 20,000 smaller "pocket" pieces were printed. Pieces were approximately distributed as follows:

Large Brochures:
7,500: UF Extension Agents/Offices
2,500: FNGLA Chapters

Small Brochures:
5,000: UF Extension Agents/Offices
5,000: FNGLA Chapters
10,000: FNGLA's Garden Center Retailers

Physical Outreach

This was a three-pronged approach. (1) Participation in events was intended to stretch promotions to the end consumer. FNGLA designed and had built a display appropriate for our participation in events. To push Florida's nursery and landscape products and services, FNGLA attended/exhibited in an array of events: Florida Association of Counties Annual Meeting, Garden Centers of America Summer Tour, American Institute of Floral Designers Annual Conference, The Ohio Short Course, Florida Parks & Recreation Association Conference, Garden Writers Association's Annual Symposium, and Greenbuild.

The grant funded additional airings of the previously created GrowSmart! PSA series. These spots aired April 1 through December 30, 2011 on a variety of networks utilizing a partnership program with the Florida Cable Telecommunications Association as a means for educating Florida's homeowners and consumers. Under the program, FNGLA's spots ran 70,455 times at a value of $3,436,189.23. The total amount paid was $116,407.76.

Following are many of the cable channels on which FNGLA's *GrowSmart!* PSA series ran April 1 – December 31, 2011:

A&E Television
ABC Family
America's Health Network
Animal Planet
Bay News 9
Black Entertainment Television
Bravo
Cartoon Network
Channel 13 – City of Tallahassee
Classic Sports Network
CNBC
CNN
CNN Headline News
Comedy Central
Country Music Television
Court TV
The Discovery Channel
E!

ESPN
ESPN2
Eternal World Television Network
Food Network
Fox News
Fox Sports Net Florida
FX Channel
Galavision
Game Show Network
GEMS
The Golf Channel
Hallmark Collection
The History Channel
Home & Garden Television
The Inspirational Network
Knowledge TV
The Learning Channel (TLC)
Lifetime
MSNBC
MTV
Muchmusic
Music Choice
Nickelodeon
Odyssey
Outdoor Life
The Sci-Fi Channel
Speedvision
Sportschannel
Sunshine Network
TBS
Telemundo Group
TNN
TNT
The Travel Channel
TV Guide
Univision
USA Network
VH1
The Weather Channel

These spots continued to air gratis by several Florida stations, mostly run by city governments.

To promote gardening to the next generation of Florida consumers, FNGLA administered an Arbor Day promotion celebration. Partnering with the Florida Department of Education, contact was made with over 2,000 schools via their email distribution list offering (while funds lasted) $50 vouchers were used towards a tree purchase with FNGLA tree growers and/or retail business members. For 2009, 201 vouchers with a face value of $10,050 were awarded. Total student impact was estimated at just under 22,000 Florida school children.

In 2010 with 2,361 schools/fourth grader teachers offering (while funds lasted) $50 vouchers were used towards a tree purchase with FNGLA tree growers and/or retail business members. 240 vouchers with a face-value of $12,000 were awarded. Total student impact was estimated at over 34,000 Florida school children.

All teachers/schools had access to FNGLA Arbor Day materials as downloadable PDFs: Materials available meet the Sunshine State Standards set forth by the State of Florida: **What Is Arbor Day?** (.pdf); **Arbor Day in the classroom** (.pdf); **J. Sterling Morton** (.pdf); **Classroom Curriculum** (.pdf) **Tree Facts** (.pdf); **Planning Your Arbor Day Celebration** (.pdf); **Tree Planting Cue Card** (.pdf); **Sample Press Release for local media coverage** (.doc).

Beneficiaries:
There is a significant list of beneficiaries related to this component. Specific beneficiaries are indicated in the "goals and outcomes achieved" section of this report. In general, beneficiaries included FNGLA members, FNGLA Certified Professionals, future career nursery and landscape professionals, gardening consumers, and specific targeted groups of inter-industry professionals whose business paths directly relate to Florida's end-consumers.

As a result, the industry is better equipped to provide information to Florida's gardening public through the information gained and on-going resources which remain. Adding 2010 grant funds which were awarded to this grant, FNGLA expanded on a very solid foundation to help move the needle on public perception of gardening in Florida and spread awareness to the specific target groups sought.

Please see "goals and outcomes achieved" for quantitative detail related to this component.

Lessons Learned:
Many lessons were learned as a result of facilitating these projects. FNGLA gained details on the public's perception of Florida nursery products and agriculture, specifically the Florida Garden Select program and its logo. We learned the art of not overwhelming consumers with details, yet how to whittle messages into palatable bites for the general consumer. We also learned that sometimes progress in gaining an audience is slow and such is not always a bad thing. FNGLA also learned the power of educating children at young ages and saw the graciousness of industry members as they contributed their business' products free and willingly because they knew they were helping a higher cause than simply their business bottom-line.

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Component (2) Research

Summary:
In FNGLA's research component there are two parts: an economic POTENTIAL IMPACT study and a six-month in-depth study of market trends and buying patterns. This research will give FNGLA a better understanding of how external factors are affecting nursery and landscape industry sales and contributing to changes in buying patterns of nursery products and landscape services.

Project Approach

Research study was conducted and completed in time to present the results during an opening session at the Landscape Show and preparations for final print copy are also being made at this time. Presented below is the executive summary. A full report will be provided upon request.

The economic impacts of the environmental horticulture industry in Florida in 2010 were evaluated through industry surveys, other secondary data sources and regional economic models. Telephone and internet surveys were conducted with over 1,600 industry firms, including wholesale nurseries, landscape services, horticultural retailers, and allied wholesale horticultural suppliers. Based on expanded survey results, total industry sales in 2010 were estimated at $4.27 billion for nurseries, $6.04 billion for landscape services, and $558 million for allied suppliers. Sales for horticultural retailers were independently estimated at $4.49 billion based on gross sales reported to the Florida Department of Revenue. Total direct employment in the industry was estimated at 204,762 jobs, including 157,102 fulltime/permanent jobs and 47,660 temporary, part-time or seasonal jobs, with over half (54%) of all jobs in the landscape sector.

Nursery sales to markets outside of Florida were about $2.36 billion, or 55 percent, and 66 percent of allied supplier sales were exported from the state, while less than 10 percent of landscape service and retailer sales occurred out of state.

Goals and Outcomes Achieved

The survey results were presented to 500 attendees at the Landscape Show. Dr. Alan Hodges provided a powerpoint presentation outlining the survey results and the impact on the nursery and landscape industry of Florida.

This is now a useful tool on FNGLA's website to be used by industry members - http://www.fngla.org/resources/economic-impact-study/EconomicImpacts2010Promotion.pdf

Florida's nursery and landscape industry encompasses a wide range of businesses, including nursery and greenhouse growers; lawn and garden suppliers; equipment manufacturers; landscape design, installation and maintenance services; lawn and garden stores; and, other retail establishments selling plants and related lawn

and garden goods. Florida is a leading state, ranked second only to California in the US in terms of overall industry value. Nursery crops are one of the largest agricultural segments in Florida, along with fruits, vegetables and forest products. This study utilizes 2010 data and is the third study in the series since 2000.

In 2010, total direct sales by Florida nursery, landscape service firms and horticulture retailers were $15.35 billion and total direct employment was 204,700 jobs!

Segment	Sales	Jobs
Nursery/Greenhouse Growers	$4.27 Billion	63,800 Jobs
Landscape Firms	$6.04 Billion	111,000 Jobs
Garden Center Retailers	$4.49 Billion	26,900 Jobs
Horticultural Suppliers	$.558 Billion	3,000 Jobs
Total	**$15.35 Billion**	**204,700 Jobs**

This is a project that the industry plans to do every three to five years. This project produces sales and employment data and offers a study tool of comparative information from previous years and current years studied. FNGLA and the University of Florida have entertained a strong partnership with this and many other programs. The relationship between academia and industry is critical. Our industry needs to have science to back-up industry practices and procedures along with data to quantify and qualify the size of the industry and its impact.

Economic Contributions of the Florida Environmental Horticulture Industry in 2010
Executive Summary

The economic impacts of the environmental horticulture industry in Florida in 2010 were evaluated through industry surveys, other secondary data sources and regional economic models. Telephone and internet surveys were conducted with over 1,600 industry firms, including wholesale nurseries, landscape services, horticultural retailers, and allied wholesale horticultural suppliers. Based on expanded survey results, total industry sales in 2010 were estimated at $4.27 billion for nurseries, $6.04 billion for landscape services, and $558 million for allied suppliers. Sales for horticultural retailers were independently estimated at $4.49 billion based on gross sales reported to the Florida Department of Revenue. Total direct employment in the industry was estimated at 204,762 jobs, including 157,102 fulltime/permanent jobs and 47,660 temporary, part-time or seasonal jobs, with over half (54%) of all jobs in the landscape sector.

Nursery sales to markets outside of Florida were about $2.36 billion, or 55 percent, and 66 percent of allied supplier sales were exported from the state, while less than 10 percent of landscape service and retailer sales occurred out of state.

The largest plant product types for nursery growers were tropical foliage, representing 35 percent of total sales, followed by potted flowering/bedding plants (22%), and shrubs (10%). Florida native plants represented about 7.8 percent of nursery sales. In the landscape services sector 44 percent of sales were for landscape maintenance, 23 percent for landscape installation, and 8 percent for design (landscape designers and architects). For horticultural retailers, over half (51%) of sales were for live plants, 14 percent were for horticultural supplies, 7 percent were for hard goods, and 29 percent were for miscellaneous other goods. For allied suppliers, 39 percent of sales were agrichemicals, followed by financial and insurance services (15%), fertilizer (15%), and nursery containers (13%).

Total economic impacts of the environmental horticulture industry were estimated using multipliers from a regional input-output model for Florida constructed with the *IMPLAN* software and databases (MIG, Inc.). Economic multipliers estimate the economic activity that occurs in other sectors of Florida's economy through the industry supply chain (indirect effects) and spending by employee households and governments (induced impacts). Total employment impacts in the Florida economy, including regional multiplier effects, were estimated at 244,188 fulltime and part-time/seasonal jobs, including 98,439 for nurseries, 112,726 for landscape services, 28,800 for horticultural retailers and 4,223 for allied horticultural suppliers. Total

output (revenue) impacts were estimated at $16.29 billion, while total value added impacts were $9.90 billion, including $6.93 billion in labor income (employee wages, salaries, and proprietor income), $2.30 billion in other property type income (rents, interest, royalties, dividends, etc.), and $668 million for indirect business taxes paid to local, state, and federal governments (Figure ES1, Table ES1).

Comparing the present results to previous studies in 1997, 2000, and 2005, total industry sales for nurseries, landscape services and horticultural retailers increased from $9.30 billion in 1997 to $14.79 billion in 2010, an increase of 59 percent over the 13 year period, representing an average annual compound growth rate of 3.6 percent. Since 1997, the combined total output impacts increased by $2.06 billion (76%), value added impacts increased by $3.09 billion (46%), and employment impacts increased by over 82,000 jobs (52%). During the most recent period between 2005 and 2010, sales and employment impacts increased marginally for the nursery and landscape sectors, however, overall industry sales and employment impacts actually declined, particularly for the retail sector, due to the lingering effects of the economic recession of 2007-08 (Figure ES2, Table ES2).

Economic impact estimates were also developed for the environmental horticulture industry in all of Florida's 67 counties, based on each county's share of total statewide direct employment (excluding allied suppliers). The top six counties for employment impacts were Miami-Dade (38,508 jobs), Orange (23,947 jobs), Palm Beach (18,453 jobs), Hillsborough (15,887 jobs), Broward (15,411 jobs) and Volusia (11,419 jobs), followed by Lee, Duval, Lake and Pinellas (Figure ES3, Table ES3).

Finally, the study evaluated the impacts on the horticulture industry from major freeze events that occurred in January and December, 2010. Some 69 percent of surveyed nurseries, 43 percent of landscape businesses and 36 percent of retailers were reportedly impacted by these freezes, and total freeze damages were estimated at $472 million.

Figure ES1. Total employment impacts of environmental horticulture industry sectors in Florida in 2010.

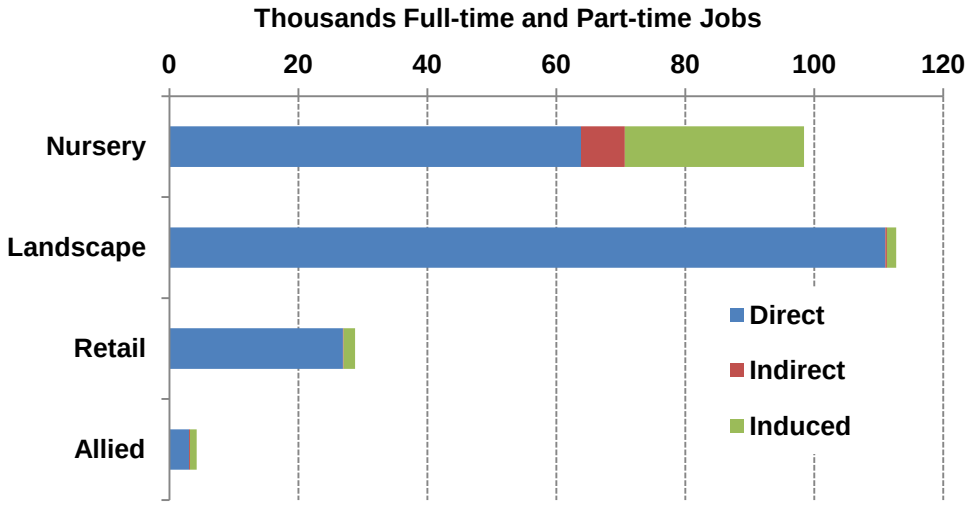

Figure ES2. Trend in value added impacts of environmental horticulture industry sectors in Florida, 1997-2010.

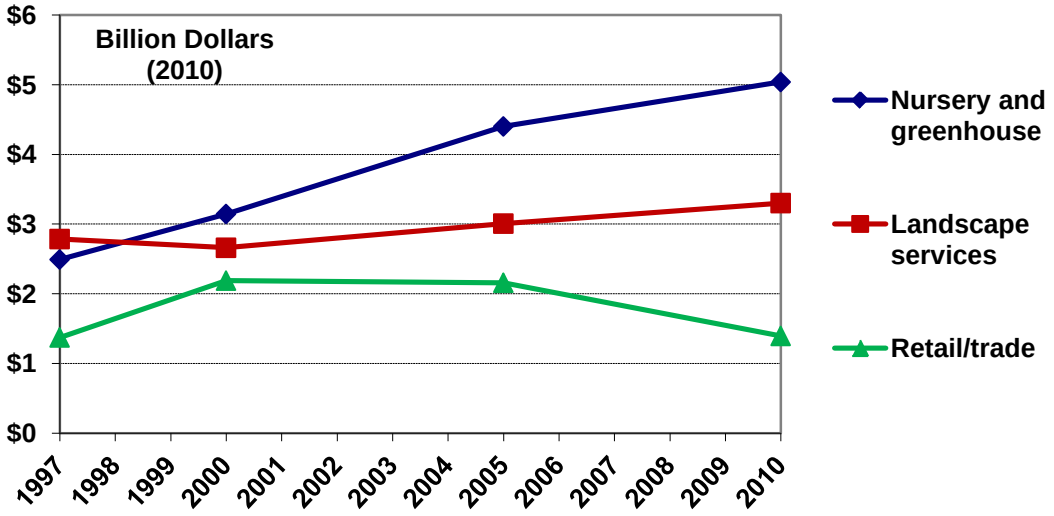

Figure ES3. Total employment impacts of the environmental horticulture industry in the top-ten Florida counties in 2010.

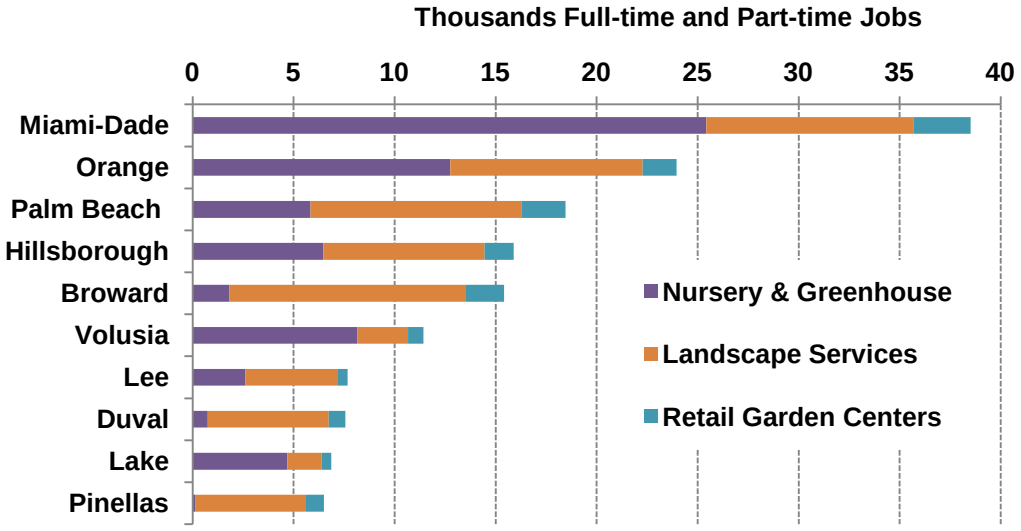

Table ES1. Summary of economic impacts of the environmental horticulture industry in Florida in 2010.

Sector	Employment	Output	Value Added	Labor Income	Other Property Income	Indirect Business Taxes
	Jobs	- - - - - - - - - - - - Million Dollars - - - - - - - - - - - -				
Nursery	98,439	8,122.3	5,038.7	3,546.3	1,265.8	226.6
Landscape	112,726	6,240.6	3,302.0	2,395.4	765.2	141.4
Retail	28,800	1,679.8	1,396.4	887.4	231.2	277.8
Allied	4,223	243.4	160.3	98.1	39.7	22.4
Total All Sectors	244,188	16,286.1	9,897.3	6,927.1	2,302.0	668.2
Direct	204,761	11,873.2	7,134.5	5,169.1	1,510.5	454.9
Indirect	7,380	692.3	402.6	285.9	98.8	17.8
Induced	32,046	3,720.5	2,360.2	1,472.1	692.6	195.5

Note: All monetary values are reported in 2010 dollars; employment impacts represent both full-time and part-time jobs.

Table ES2. Summary of economic impacts of the Florida environmental horticulture industry in 1997, 2000, 2005 and 2010.

Impact / Sector	1997	2000	2005	2010	Change 2005-10	Percent Change 1997-2010	Avg. Annual Compound Growth 1997-2010
	- - - - - - - Million 2010 Dollars - - - - - - - -						
Sales	9,303	12,377	16,859	14,793	-2,066	59.0%	3.6%
Nursery and greenhouse	2,410	2,812	3,327	4,265	938	77.0%	4.5%
Landscape services	3,547	3,885	5,819	6,039	221	70.3%	4.2%
Retail/trade	3,346	5,680	7,713	4,489	-3,225	34.1%	2.3%
Output Impacts	9,102	11,448	13,983	16,043	2,060	76.3%	4.5%
Nursery and greenhouse	3,502	4,342	5,276	8,122	2,847	131.9%	6.7%
Landscape services	3,730	4,241	5,835	6,241	406	67.3%	4.0%
Retail/trade	1,869	2,865	2,872	1,680	-1,193	-10.1%	-0.8%
Value Added Impacts	6,652	7,996	9,569	9,737	168	46.4%	3.0%
Nursery and greenhouse	2,492	3,146	4,401	5,039	637	102.2%	5.6%
Landscape services	2,786	2,661	3,008	3,302	294	18.5%	1.3%
Retail/trade	1,375	2,190	2,160	1,396	-763	1.6%	0.1%
Employment Impacts (jobs)	157,950	187,860	318,573	239,965	-78,608	51.9%	3.3%
Nursery and greenhouse	44,892	54,288	53,551	98,439	44,887	119.3%	6.2%
Landscape services	89,517	64,282	88,073	112,726	24,654	25.9%	1.8%
Retail/trade	23,541	69,290	176,949	28,800	-148,149	22.3%	1.6%

All values are expressed in millions of dollars (2010) adjusted for inflation using the implicit GDP price deflator.

Allied horticultural suppliers not shown because they were not included in studies for 1997, 200 and 2005.

Table ES3. Economic impacts of environmental horticulture industry sectors in Florida Counties in 2010.

	Nursery & Greenhouse			Landscape Services			Horticultural Retailers			All Sectors Combined		
	Output (M$)	Employ-ment (jobs)	Value Added (M$)	Output (M$)	Employ-ment (jobs)	Value Added (M$)	Output (M$)	Employ-ment (jobs)	Value Added (M$)	Output (M$)	Employ-ment (jobs)	Value Added (M$)
Alachua	72.1	874	44.72	25.61	438	21.27	89.15	1,610	47.17	186.86	2,922	113.16
Baker	10.55	128	6.55	1.92	32	1.59	2.85	51	1.51	15.32	211	9.65
Bay	5.28	64	3.27	7.36	127	6.14	47.32	855	25.04	59.96	1,046	34.45
Bradford	5.28	64	3.27	1.92	32	1.59	3.56	64	1.88	10.76	160	6.74
Brevard	21.81	264	13.53	91.17	1563	75.79	115.04	2,078	60.87	228.02	3,905	150.19
Broward	151.31	1,834	93.87	109.76	1882	91.23	647.42	11,695	342.56	908.49	15,411	527.66
Calhoun	15.83	192	9.82	3.85	66	3.20	0.52	9	0.28	20.20	267	13.30
Charlotte	21.1	256	13.09	16.15	276	13.40	34.24	618	18.12	71.49	1,150	44.61
Citrus	14.69	178	9.11	11.93	204	9.92	22.19	401	11.74	48.81	783	30.77
Clay	12.91	156	8.01	19.99	343	16.60	29.83	539	15.78	62.73	1,038	40.39
Collier	145.97	1,769	90.55	50.85	872	42.27	196.13	3,543	103.77	392.95	6,184	236.59
Columbia	15.83	192	9.82	10.87	186	9.03	8.35	151	4.42	35.05	529	23.27
Desoto	65.87	798	40.86	10.53	180	8.76	6.4	116	3.39	82.80	1,094	53.01
Dixie	10.55	128	6.55	3.85	66	3.20	4.41	80	2.33	18.81	274	12.08
Duval	62.3	755	38.65	48.04	823	39.92	331.56	5,989	175.43	441.90	7,567	254.00
Escambia	5.28	64	3.27	41.39	709	34.40	64.16	1,159	33.95	110.83	1,932	71.62
Flagler	10.55	128	6.55	7.02	120	5.83	42.87	774	22.68	60.44	1,022	35.06
Franklin	0	0	0	0.00	0	0.00	1.04	19	0.55	1.04	19	0.55
Gadsden	272.36	3,301	168.96	5.77	98	4.79	8.06	146	4.27	286.19	3,545	178.02
Gilchrist	5.28	64	3.27	5.95	103	4.94	1.61	29	0.85	12.84	196	9.06
Glades	4.01	49	2.48	0.00	0	0.00	2.21	40	1.17	6.22	89	3.65
Gulf	0	0	0	0.00	0	0.00	1.71	31	0.9	1.71	31	0.90
Hamilton	0	0	0	0.00	0	0.00	4.41	80	2.33	4.41	80	2.33
Hardee	73.43	890	45.55	16.48	283	13.70	4.36	79	2.31	94.27	1,252	61.56
Hendry	48.95	593	30.37	2.44	42	2.05	5.07	92	2.68	56.46	727	35.10
Hernando	26.7	324	16.56	5.25	90	4.36	29.07	525	15.38	61.02	939	36.30
Highlands	275.92	3,344	171.17	22.80	391	18.95	17.26	312	9.13	315.98	4,047	199.25
Hillsborough	533.6	6,467	331.02	84.15	1443	69.96	441.62	7,977	233.67	1,059.37	15,887	634.65
Holmes	0	0	0	3.85	66	3.20	1.85	33	0.98	5.70	99	4.18
Indian River	10.55	128	6.55	13.34	228	11.08	71.22	1,287	37.69	95.11	1,643	55.32
Jackson	10.55	128	6.55	5.77	98	4.79	3.98	72	2.11	20.30	298	13.45
Jefferson	31.65	384	19.64	5.77	98	4.79	0.9	16	0.48	38.32	498	24.91
Lafayette	10.55	128	6.55	3.85	66	3.20	4.41	80	2.33	18.81	274	12.08
Lake	387.18	4,692	240.19	27.35	469	22.74	94.27	1,703	49.88	508.80	6,864	312.81
Lee	214.51	2,600	133.07	27.72	475	23.04	254.79	4,602	134.81	497.02	7,677	290.92
Leon	6.23	76	3.87	65.93	1130	54.82	112.95	2,040	59.77	185.11	3,246	118.46
Levy	31.6	383	19.6	3.85	66	3.20	4.32	78	2.28	39.77	527	25.08
Liberty	0	0	0	0.00	0	0.00	4.41	80	2.33	4.41	80	2.33
Madison	10.55	128	6.55	11.23	193	9.34	6.62	119	3.5	28.40	440	19.39
Manatee	162.88	1,974	101.04	34.37	589	28.57	98.3	1,776	52.01	295.55	4,339	181.62
Marion	46.28	561	28.71	49.08	841	40.81	64.21	1,160	33.97	159.57	2,562	103.49
Martin	88.56	1,073	54.94	13.67	234	11.35	70.66	1,276	37.39	172.89	2,583	103.68
Miami-Dade	2,097.89	25,425	1,301.43	164.82	2826	137.02	567.85	10,257	300.46	2,830.56	38,508	1738.91
Monroe	5.28	64	3.27	4.91	84	4.09	28.93	523	15.31	39.12	671	22.67
Nassau	15.83	192	9.82	4.55	78	3.78	19.63	355	10.39	40.01	625	23.99
Okaloosa	10.55	128	6.55	22.80	391	18.95	63.16	1,141	33.42	96.51	1,660	58.92
Okeechobee	54.74	663	33.96	10.53	180	8.76	8.25	149	4.37	73.52	992	47.09
Orange	1,052.95	12,761	653.2	97.49	1671	81.04	526.74	9,515	278.71	1,677.18	23,947	1012.95
Osceola	38.72	469	24.02	12.97	223	10.77	80.52	1,454	42.6	132.21	2,146	77.39
Palm Beach	481.53	5,836	298.72	127.31	2183	105.82	577.62	10,434	305.63	1,186.46	18,453	710.17
Pasco	101.02	1,224	62.67	31.56	541	26.25	118.98	2,149	62.95	251.56	3,914	151.87
Pinellas	12.46	151	7.73	51.89	889	43.16	302.4	5,462	160	366.75	6,502	210.89
Polk	154.87	1,877	96.07	52.26	896	43.43	133.49	2,411	70.63	340.62	5,184	210.13

Putnam	90.79	1,100	56.32	7.36	127	6.14	9.72	176	5.14	107.87	1,403	67.60
Santa Rosa	27.15	329	16.84	24.20	414	20.11	33.53	606	17.74	84.88	1,349	54.69
Sarasota	39.16	475	24.29	27.01	462	22.43	188.59	3,407	99.79	254.76	4,344	146.51
Seminole	60.52	734	37.55	32.26	554	26.83	240.47	4,344	127.23	333.25	5,632	191.61
St Johns	44.95	545	27.88	33.30	571	27.68	50.26	908	26.6	128.51	2,024	82.16
St Lucie	89.9	1,090	55.77	10.53	180	8.76	57.52	1,039	30.43	157.95	2,309	94.96
Sumter	78.33	949	48.59	5.95	103	4.94	13.23	239	7	97.51	1,291	60.53
Suwannee	45.84	556	28.44	22.43	385	18.65	4.6	83	2.43	72.87	1,024	49.52
Taylor	10.55	128	6.55	4.55	78	3.78	1.38	25	0.73	16.48	231	11.06
Union	5.28	64	3.27	3.85	66	3.20	0.52	9	0.28	9.65	139	6.75
Volusia	672.45	8,150	417.15	43.50	746	36.14	139.65	2,523	73.89	855.60	11,419	527.18
Wakulla	10.55	128	6.55	1.92	32	1.59	3.37	61	1.78	15.84	221	9.92
Walton	15.83	192	9.82	5.25	90	4.36	25.99	469	13.75	47.07	751	27.93
Washington	6.68	81	4.14	5.77	98	4.79	88.91	1,606	47.04	101.36	1,785	55.97
Total	8,122.33	98,439	5,038.69	1679.78	28,800	1,396.38	6,240.57	112,726	3,302.00	16,042.68	239,965	9737.07

Note: county impact totals are smaller than the state totals because the impacts from allied suppliers were not included. Impacts include regional multiplier effects.

Sponsored Project Report to the Florida Nursery Growers and Landscape Association

Alan W. Hodges, PhD, Extension Scientist
Thomas J. Stevens, PhD, Post-Doctoral Associate
Mohammad Rahmani, PhD, Coordinator of Economic Analysis
Hayk Khachatryan, PhD, Assistant Professor

Email awhodges@ufl.edu
Report available at http://www.fred.ifas.ufl.edu/economic-impact-analysis/publications
September 28, 2011

Beneficiaries

Based on expanded survey results, total industry sales in 2010 were estimated at $4.27 billion for nurseries, $6.04 billion for landscape services, and $558 million for allied suppliers. Sales for horticultural retailers were independently estimated at $4.49 billion based on gross sales reported to the Florida Department of Revenue. The industry, as a whole, benefits from understanding its impact on the state of Florida. FNGLA has made a commitment to provide industry with the science and documentation to back up the impact.

Lessons Learned

Comparing the present results to previous studies in 1997, 2000, and 2005, total industry sales for nurseries, landscape services and horticultural retailers increased from $9.30 billion in 1997 to $14.79 billion in 2010, an increase of 59 percent over the 13 year period, representing an average annual compound growth rate of 3.6 percent. Since 1997, the combined total output impacts increased by $2.06 billion (76%), value added impacts increased by $3.09 billion (46%), and employment impacts increased by over 82,000 jobs (52%). During the most recent period between 2005 and 2010, sales and employment impacts increased marginally for the nursery and landscape sectors, however, overall industry sales and employment impacts actually declined, particularly for the retail sector, due to the lingering effects of the economic recession of 2007-08

Contact Person

Linda Reindl, Director of Education

Florida Nursery, Growers and Landscape Association

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Component (3) Certification

Summary:

The purpose of this portion of the project was to provide horticulture teachers access to curriculum tools enabling them to prepare their students for industry certification. This was accomplished by: (1) updating and converting the FNGLA Certified Horticulture Professional (FCHP) manual into an electronic format accessible as part of the TeachHort.com program; (2) updating the existing curriculum; (3) providing an annual scholarship to teachers that will provide free access to the TeachHort.com program; and, (4) providing teacher training.

This project built on the 2007 Specialty Crop Block Grant which *developed* the TeachHort.com curriculum program. This portion of the project assured curriculum and all supporting training materials were *accessible* to the instructors.

Project Approach

- Updated horticulture curriculum to comply with changes to Student Performance Standards, Sunshine State Standards and FCAT requirements.
- Updated FCHP Manual & made it available electronically
- Signed up teachers for free access to TeachHort.com.
- Conducted teacher training at Florida Association for Agricultural Education conference, August 2-3, 2010. Attended FFA Career Development Events on February 5, 2011 and the FFA Annual Convention June 14-16, 2011 to talk to teachers about TeachHort.com. Conducted teacher training through Perkins Professional Development Institute, June 20-21, 2011.

Goals and Outcomes Achieved

- Registered 58 teachers for free access to TeachHort.com, far exceeding the 30 teachers targeted
- Trained 39 teachers and certified 28 teachers as FNGLA Certified Horticulture Professionals (FCHPs)
- Registered 8 teachers in 6 schools from the Bahamas for TeachHort.com
- Nearly 400 students from 34 schools took part in FCHP testing with more than 100 students earning the FCHP certification in school years 2010-2011.
- 250 horticulture students attended FNGLA Career Fair at The Landscape Show, September 2011.

Beneficiaries

Horticulture Teachers benefitted by having tools to prepare their students for industry-recognized certifications that coincided with the Florida Department of Education's curriculum requirements while also coinciding with industry standards.

High School Horticulture Students benefitted by receiving education and experience that would assist them in furthering their horticulture education in college or providing them skills to begin a career in Florida's nursery and landscape industry.

Florida's nursery and landscape industry will benefit in the future by having a trained and skilled workforce to enhance their business success.

Lessons Learned

Education and industry standards continue to advance and it takes constant work to keep up with these important changes.

Additional Information

Below are snapshots of the TeachHort.com website as well as the cover of the FNGLA manual.

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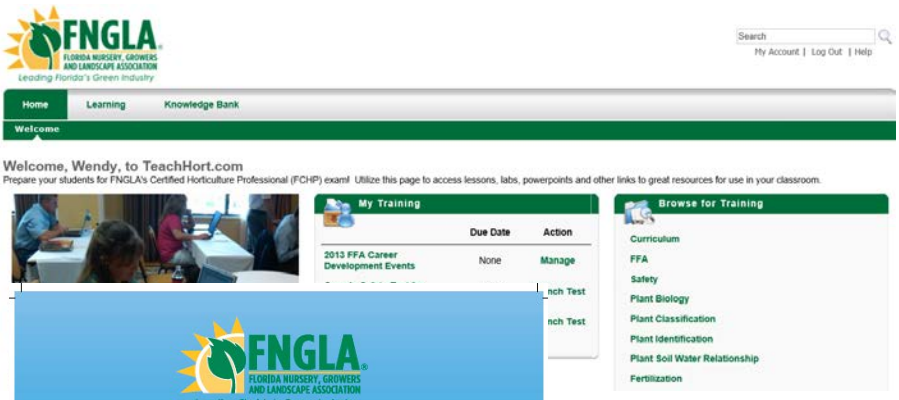


Component (4) Education

Summary:

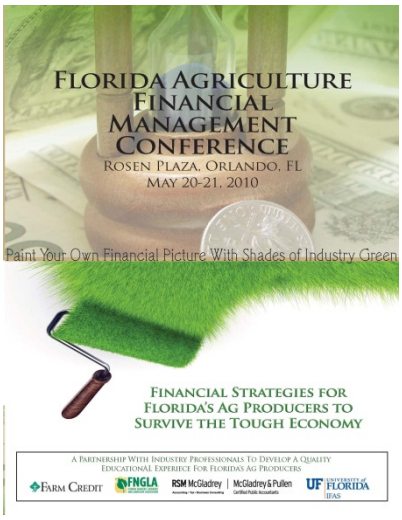
This portion of the grant provided partial funding for existing educational programs and full funding for a new educational concept that will not only be vital to nursery and landscape industry but to all agricultural commodities within the State of Florida. Education is critical to Florida's nursery and landscape industry. The goal was to deliver training in production, marketing and financial risk to specific segments of the industry.

Project Approach

The Educational component of FNGLA's grant agreement was included to provide a vehicle to bring awareness of the potential risks to members from a production, financial and marketing standpoint. All parts of the educational component have now been completed. The programs have focused on specialty crop segments with the different divisions of FNGLA. Whether it has been foliage at TPIE or Floriculture at FNGLA's Floriculture Field Days, the programs have address marketing strategies, production techniques and topics that would keep specialty crops thriving in the state of Florida. In the original grant agreement, the Floriculture Field Day conference was scheduled to take place in 2010 but due to the elimination of the field trials at UF, time was needed to re-evaluate the program's focus. This conference was delayed for a year and took place on May 12-13, 2011.

FNGLA successfully created and executed 5 out of the 5 educational seminars. The goals of (1) ensuring a more unified industry as a whole and a greater understanding of industry members' risks and liabilities; (2) offering leadership training skills to build stronger business relationships; and, (3) providing innovative ways to market products and services were all successfully

Financial Management Clinic:



The program successfully created a new financial management clinic for all of Florida's specialty crop commodities. The educational component was gear specifically to the producers in Florida and provides producers with timely and valuable financial management information as they steered their businesses though this severe economic downturn. The grant allowed the program to bring in highly qualified financial experts from across the country.

Goals and Outcomes Achieved

The program did not reach its original goal of 300-500 producers in Florida's specialty commodities but did bring in over 200 industry members to the program from Floriculture, Foliage, Trees and Woody Ornamental producers. For the first year, it was very successful.

This program brought in high caliber speakers and offered attendees a strong foundation for planning their financial strategies.

WHY ATTEND?

This brand new educational program was designed to help you weather the challenges of our economy. Armed with practical and productive financial tools, attendees will gain key strategies to achieve business success. The 1½ day Financial Management Conference will be held on **May 20-21 at the Rosen Plaza, Orlando, FL**, and is open to all members of Florida agricultural commodities.

Times are tough and providing industry members with proper financial planning is critical. This program has been made affordable in large part by a 2009 USDA Specialty Crop Block Grant awarded to FNGLA. We know industry members who are financially strong will become a driving force in returning Florida's economy to brighter days.

FEATURED SPEAKERS PROFILES

Dr. Michael Boehlje is a distinguished professor in the Department of Agricultural Economics and the Center for Food and Agricultural Business (CAB) at Purdue University. He previously held faculty and administrative positions at Iowa State University, University of Minnesota and Oklahoma State University. Boehlje has devoted his career to helping farm managers

Brian C. Briggeman joined the Omaha Branch Office of the Federal Reserve Bank of Kansas City in January 2009 as an economist in the Regional Affairs Department. His research interests are agricultural finance, farm household decision making behavior, food demand and preferences, and agribusiness management.

Walt Coleman is fifth generation ownwer and controller at Coleman Dairy in Little Rock AK. He received a BS degree with Honors in Business Administration from the University of Arkansas, Fayetteville. He was also a lettermen in baseball in 1972-1974. For the past 21 years, he has been in the homes of many American football fans as an NFL senior referee.

Dr. Michael Gunderson is an Assistant Professor in the Food and Resource Economics Department at the University of Florida with responsibility for five courses. Dr. Gunderson is teaching introductory finance for FRE undergraduates and applied finance for FRE graduate students. He also has taught marketing, entrepreneurship, and strategy in the department.

Dr. Charles Hall is a native of North Carolina, Dr. Charlie Hall received his He then obtained his Ph.D. from Mississippi State University in 1988 and began his academic career at Texas A&M University, where he spent 13 years on the faculty before joining the faculty at the University of Tennessee in 2002. In 2007, Dr. Hall returned to Texas A&M University as Professor and Ellison Chair in International Floriculture.

Jeffrey Hansler has been consulting since 1983, training since 1988, and professionally speaking since 1994. He was a top sales representative for Apple Computer. Vice President of Sales for Holland Automation, an international accounting and manufacturing software company, and then promoted to President of North American distribution.

Dave Hogan was with Farm Credit for 30 years starting as an association loan officer in 1974 and ending as the Vice President/Risk Manager for the AgFirst FCB in 2004. He held virtually every credit position in the bank He retired 5 years ago to open his own business training new loan officers for the associations and FCB's.

Jim Paluch is president of JP Horizons, Inc. Paluch and his team are sought out nationally for their business coaching expertise and implementation of their People Solutions Programs in more than 50 companies each year. Jim has had a successful career as a Landscape Architect, in sales, and in developing residential communities in the Cleveland, OH.

David Poparad is a Tax Manager with RSM McGladrey and has 10 years of public accounting experience. Prior to joining RSM McGladrey, David held tax positions with a regional CPA firm in Lincoln, Nebraska and local CPA firm in Winter Park, Florida. David is responsible for providing tax consulting and compliance services to agricultural, real estate, and professional service. clients.

Dr. Edmond Seifried is Professor Emeritus of Economics and Business at Lafayette College in Easton, Pennsylvania. He also serves as Executive Director of the Sheshunoff CEO Affiliation Programs. In addition, Dr. Seifried is the Chief Economist for m.rae resources Inc, a community bank investment firm. He received his doctorate in economics and business from West Virginia University.

Dick Wittman manages a 19,000 acre Idaho family farm partnership involving crops, cattle and timber. He provides consulting services and seminars in family farm business. He is an adjunct faculty member of Texas A&M University teaching annually at the TEPAP program.

Evaluations as reflected below showed that individuals were interested in attending the program again. Demographics show that the program reached more nursery and landscape companies than any other specialty crop commodity.

	Excellent	Good	Average	Fair	Poor
Changes in Economic Landscape	19	26	2		
Getting Your Financial House in Order	24	22	3		
Working Smarter With Lean Tools	21	23	2	1	
Balance Sheets & Income Statements	26	18	4		
Did You Make Good Mgmt Decisions?	19	23	6		
Business Strategy & Financial Performance	35	9	2	1	
The Challenge To Be The Best	23	16	5		
Can The 2010 Recovery Continue	30	10	2		
Ask A Lender	8	2	8	4	2
Increasing Top-line Revenue Growth	41	6			
Tax Strategies	3	13	20	7	
Language for Growth	33	7	1		

Concurrent Educational Sessions:

	Very Satisfied		Satisfied		Not Satisfied
	5	**4**	**3**	**2**	**1**
Importance	31	7	2		
Session Content	30	7	1		
Handout Value	17	14	5		
Program In Future	**yes**	38	**no**	0	

Business Commodity

Commodity	Amount
Agriculture Lending	3
Cattle	4
Citrus	8
Dairy	2
Nursery	23
Landscape	4
Specialty Crops	3

General Comments

- This might be the best conference that I've ever been to. Very well done, would love to see it next year.
- Excellent Speakers, overall conference was organized very well. Attention to details done well, more information in the area of marketing would have

been a nice addition. My compliments to the conference committee and staff at the Rosen.

- Great job with the speakers and meeting logistics
- Very, very nice job!
- Need better lighting on speakers
- I liked the mix of different types of speakers, to break up the kind of info taught & the delivery method.
- Hard to follow speakers without handouts - maybe list helpful websites?
- Overall excellent, however the content is "intense" and a lot to go through in a short period of time. I would to see 2 full days starting at 9 am and end at 5 - 6 pm. This would keep the audience more engaged. At times it was difficult to hear a speaker but overall the facility was perfect, location & rooms.
- Well done! I had trouble following a couple speakers, maybe bigger pictures would have helped (2 slides per page). Excellent presentations. Food was good! Snacks, cookies, etc. would have been nice in the afternoon. I loved it!
- This program was an incredible value with great presenters
- Speakers @ luncheon/dinner probably not given the same level of attention
- Have some break-out sessions - workshop to pull information... how do we use information/ratios to guide business?
- Great! Please do it again with more notice to get others
- Dr. Michael Gunderson - talked too fast, over people's heads
- Excellent accommodation, great food, Thank you!
- Sound system was a bit rough
- Very useful for helping me plan and execute my business plan. Thank you!
- Larger fonts please!
- I think all the information was good. I believe I could have absorbed more information if it wasn't so much in one day. I was not able to hear the last two because it was late.
- If done again in the future, please do an advanced version, not a repeat

- The conference was much better than the promotion.

- Bring Back Charles Hall & Edmond Seifried
- Very impressive speakers & program. Wish I saw more of our nursery members here.
- One of the best conferences I have ever attended. Appreciate the intensity, program & meals
- Brian Briggeman was excellent.
- Try to promote more to other ag industries
- Thank you for this program, very informative and done very nicely. I look forward to future programs!
- Challenge to be the best was FUN!!

A reasonable explanation for the decrease in numbers is financial adjustments that many of the segments of our industry have had to make over the last two years verses

the quality of programs and content. Evaluations from attendees reflected a positive outcome and the need still exists to continue to educate the industry.

Beneficiaries

As does any educational program, providing key information to industry members not only affects their businesses personally but it affects the industry as a whole. The following demographics show the type of breakdown of those that attended.

Agriculture Lending	3
Cattle	4
Citrus	8
Dairy	2
Nursery	23
Landscape	4
Specialty Crops	3

Agriculture has a strong impact on Florida's economy. Industry members who are financially strong will be the driving force that helps returns Florida's economy to brighter days. This program was made possible with the financial support of the Specialty Crop Block Crop grant received through the Florida Department of Agriculture and Consumer Services and conference sponsors: Aon Risk Services, Farm Credit, McGladrey, and PNC Bank.

FNGLA Short Course:

The project purpose is to identify and develop risk management education for the nursery and landscape industry. As a well-respected industry conference that began in the 1990's, the FNGLA Short Course is held in conjunction with FNGLA's Landscape Show (TLS) each September/October in Orlando, FL. It offers a two-day format with educational sessions, as well as optional workshops and tours geared to garden center management, grower management, and landscape design and management. Average annual attendance for the FNGLA Short Course is 350 industry professionals.

Goals and Outcomes Achieved

THE LANDSCAPE SHOW

Short Course Schedule

Thursday, September 23

10:30 – 11:30 a.m.

Success with Color (S1) — *Heather Will-Browne, Walt Disney World, Buena Vista, FL* Room 224C

Heather Will-Browne will share her tried and true design secrets that will add the right splash of color to gardens and hanging baskets. She will share both the art and science of color from a Disney horticultural perspective. With over 35 years of experience at WALT DISNEY WORLD® focusing on basket production and bedding plants, some of Heather's Disney magic is sure to rub off on you.

Lounging with Edibles (S2) — *Robert Bowden, Harry P. Leu Gardens, Orlando, FL* Room 224A

This session will go in-depth into the specific plants that flourish in an edible garden setting as well as specific growing techniques that can be shared with customers to enhance their outdoor living experience.

Smart Irrigation Controller Technologies (S3)

Kurt K. Thompson, K. Thompson & Associates, LLC, Pace, FL Room 224D

With over 23 years of experience, Kurt Thompson will share with attendees the newest technological products to manage irrigation currently available to industry professionals. This session will also demonstrate the proper use of smart controls in order to make them an effective tool for the landscape manager to integrate into the overall plant soil-water strategy.

How to Win the Battle with your Competition! (S4) — *Tom Shay, Profits-Plus, St. Petersburg, FL* Room 224B

If Patton ran your business... Then is a war going on out there. Should a business defined its market position, become an attacker, a flanker or a guerrilla warrior? This intense the workshop helps a business owner to define the property strategy and then determine the tactics to implement. Using stories and experiences of General George S. Patton, Tom Shay leads participants in this most useful exercise.

11:45 a.m. – 1:15 p.m.

Luncheon: Passion for Outdoor Living (L1)

Raymond Jungles, Raymond Jungles, Inc., Miami, FL Room 223A

FNGLA is pleased to welcome world-renowned landscape architect, Raymond Jungles, to The Landscape Show. Raymond's passion lies in the creation of three-dimensional garden spaces, where a design of the mind becomes a thriving reality amid the elements of the outdoors. His early experiences as a young boy in Yosemite and Sequoia were followed by a Midwestern upbringing on the edge of human expansion. To Raymond, the natural world is his therapy which continues to renew his spirit to create. He believes a garden is be a stage, with plant placement, water movement, fragrance, color, texture and habitat as its actors. Raymond will discuss how his landscapes reflect his dedication to the preservation of natural habitat and the use of indigenous species.

2010 Short Course Committee

Kristin G. Pategas, FCLD
Hortus Oasis, Chairman

Kerri Leymaster, FCHP
Worlds of Discovery Horticulture

Nancy Wise, FCHP
Benchmark Landscaping, Inc.

Billy Butterfield, FCLC
AmeriScapes Landscape Mgmt. Services

Debbie Mickler
Walt Disney World Horticulture

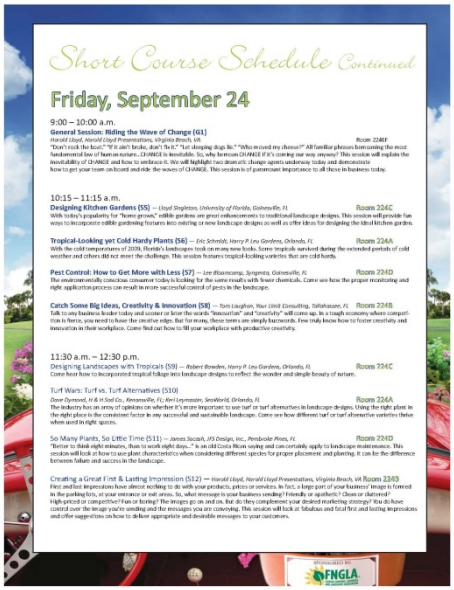
Dr. Thomas Yeager
University of Florida – IFAS

Robert Bowden
Harry P. Leu Gardens

Kevin Riley, FCHP
Rockledge Gardens

Debra Joneck
Coastal Nurseries, Inc

Regina Thomas
Farm Credit of Central Florida


Short Course Schedule Continued

Friday, September 24

9:00 – 10:00 a.m.

General Session: Riding the Wave of Change (G1)

Harold Lloyd, Harold Lloyd Presentations, Virginia Beach, VA Room 224EF

"Don't rock the boat." "If it ain't broke, don't fix it." "Let sleeping dogs lie." "Who messed my cheese?" All familiar phrases bemoaning the most fundamental law of human nature...CHANGE is inevitable. So, why be even CHANGE if it's coming our way anyway? This session will explain the inevitability of CHANGE and how to embrace it. We will highlight two dramatic change agents underway today and demonstrate how to get your team on board and ride the waves of CHANGE. This session is of paramount importance to all those in business today.

10:15 – 11:15 a.m.

Designing Kitchen Gardens (S5) — *Lloyd Singleton, University of Florida, Gainesville, FL* Room 224C

With today's popularity for "home-grown," edible gardens are great enhancements to traditional landscape designs. This session will provide fun ways to incorporate edible gardening features into existing or new landscape designs as well as offer ideas for designing the ideal kitchen garden.

Tropical-Looking yet Cold Hardy Plants (S6) — *Eric Schmidt, Harry P. Leu Gardens, Orlando, FL* Room 224A

With the cold temperatures of 2009, Florida's landscapes took on many new looks. Some tropicals survived during the extended periods of cold weather and others did not meet the challenge. This session features tropical-looking varieties that are cold hardy.

Pest Control: How to Get More with Less (S7) — *Lee Rioscocenp, Syngenta, Gainesville, FL* Room 224D

The environmentally conscious consumer today is looking for the same results with fewer chemicals. Come see how the proper monitoring and right application process can result in more successful control of pests in the landscape.

Catch Some Big Ideas, Creativity & Innovation (S8) — *Tom Laughon, Your Limit Consulting, Tallahassee, FL* Room 224B

Talk to any business leader today and sooner or later the words "innovation" and "creativity" will come up. In a tough economy where competition is fierce, you need to have the creative edge. But for many, these terms are simply buzzwords. Few truly know how to foster creativity and innovation in their workplace. Come find out how to fill your workplace with productive creativity.

11:30 a.m. – 12:30 p.m.

Designing Landscapes with Tropicals (S9) — *Robert Bowden, Harry P. Leu Gardens, Orlando, FL* Room 224C

Come hear how to incorporated tropical foliage into landscape designs to reflect the wonder and simple beauty of nature.

Turf Wars: Turf vs. Turf Alternatives (S10)

Dave Dymond, H & H Sod Co., Kissimmee, FL; Kerri Leymaster, SeaWorld, Orlando, FL Room 224A

The industry has an array of opinions on whether it's more important to use turf or turf alternatives in landscape designs. Using the right plant in the right place is the consistent factor in any successful and sustainable landscape. Come see how different turf or turf alternative varieties thrive when used in right spots.

So Many Plants, So Little Time (S11) — *James Sasaki, JES Design, Inc., Pembroke Pines, FL* Room 224D

"Better to think eight minutes, than to work eight days..." is an old Costa Rican saying and can certainly apply to landscape maintenance. This session will look at how to use plant characteristics when considering different species for proper placement and planting. It can be the difference between failure and success in the landscape.

Creating a Great First & Lasting Impression (S12) — *Harold Lloyd, Harold Lloyd Presentations, Virginia Beach, VA* Room 224D

First and last impressions have almost nothing to do with your products, prices or services. In fact, a large part of your business' image is formed in the parking lots, at your entrance or exit areas. So, what message is your business sending? Friendly or apathetic? Clean or cluttered? High-priced or competitive? Fun or boring? The images go on and on. But do they complement your desired marketing strategy? You do have control over the image you're sending and the messages you are conveying. This session will look at fabulous and fatal first and lasting impressions and offer suggestions on how to deliver appropriate and desirable messages to your customers.

SPONSORED BY FNGLA

Projected numbers of attendees were higher than the actual numbers. A reasonable explanation for the decrease in numbers is financial adjustments that many of the

segments of our industry have had to make over the last two years verses the quality of programs and content. The goals of (1) ensuring a more unified industry as a whole and a greater understanding of industry members' risks and liabilities; (2) offering leadership training skills to build stronger business relationships; and, (3) providing innovative ways to market products and services were all successfully executed.

Above illustrates how the schedule of the program was promoted on-site.

Wednesday, September 22, 2010

1:00 – 5:00 p.m. **Tour to Bok Towers (T1)**
Come take a stroll through the meandering garden created by famed landscape architect Frederick Law Olmsted Jr. This guided tour will showcase the acres of ferns, palms, oaks and pines which provide a year-round backdrop. Let the gardens inspire your landscape designs.

Thursday, September 23, 2010

10:30 – 11:30 a.m.

- **Success with Color** (S1) – *Heather Will-Browne, Walt Disney World, Buena Vista, FL*
  Heather Will-Browne will share her tried and true design secrets that will add the right splash of color to gardens and hanging baskets. She will share both the art and science of color from a Disney horticultural perspective. With over 35 years of experience at WALT DISNEY WORLD® focusing on basket production and bedding plants, some of Heather's Disney magic is sure to rub off on you.

- **Lounging with Edibles** (S2) – *Robert Bowden, Harry P. Leu Gardens, Orlando, FL*
  This session will go in-depth into the specific plants that flourish in an edible garden setting as well as specific growing techniques that can be shared with customers to enhance their outdoor living experience.

- **Smart Irrigation Controller Technologies** (S3) – *Kurt K. Thompson, K. Thompson & Associates, LLC, Pace, FL*
  With over 29 years of experience, Kurt Thompson will share with attendees the newest technological products to manage irrigation currently available to industry professionals. This session will also demonstrate the proper use of smart controls in order to make them an effective tool for the landscape manager to integrate into the overall plant-soil-water strategy.

- **How to Win the Battle with your Competition!** (S4) – *Tom Shay, Profits-Plus, St. Petersburg, FL*
  If Patton ran your business… There is a war going on out there. Should a business defend its market position, become an attacker, a flanker or a guerrilla warrior? This interactive workshop helps a business owner to define the property strategy and then determine the tactics to implement. Using stories and experiences of General George S. Patton, Tom Shay leads participants in this most useful exercise.

11:45 a.m. – 1:15 p.m.

Luncheon: Passion for Outdoor Living (L1) – *Raymond Jungles, Raymond Jungles, Inc., Miami, FL*
FNGLA is pleased to welcome world-renowned landscape architect, Raymond Jungles, to The Landscape Show. Raymond's passion lies in the creation of three dimensional garden spaces, where a design of the mind becomes a thriving reality amid the elements of the outdoors. His early experiences as a young boy in Yosemite and Sequoia were followed by a Midwestern upbringing on the edge of human expansion. To Raymond, the natural world is his therapy which continues to renew his spirit to create. He believes a garden to be a stage, with plant

placement, water movement, fragrance, color, texture and habitat as its actors. Raymond will discuss how his landscapes reflect his dedication to the preservation of natural habitat and the use of indigenous species.

Friday, September 24, 2010
9:00 – 10:00 a.m.
General Session: Riding the Wave of Change (G1) – *Harold Lloyd, Harold Lloyd Presentations, Virginia Beach, VA*
"Don't rock the boat." "If it ain't broke, don't fix it." "Let sleeping dogs lie." "Who moved my cheese?" All familiar phrases bemoaning the most fundamental law of human nature…CHANGE is inevitable. So, why bemoan CHANGE if it's coming our way anyway? This session will explain the inevitability of CHANGE and how to embrace it. We will highlight two dramatic change agents underway today and demonstrate how to get your team on board and ride the waves of CHANGE. This session is of paramount importance to all those in business today.

10:15 – 11:15 a.m.

- **Designing Kitchen Gardens** (S5) – *Lloyd Singleton, University of Florida, Gainesville, FL*
  With today's popularity for "home grown," edible gardens are great enhancements to traditional landscape designs. This session will provide fun ways to incorporate edible gardening features into existing or new landscape designs as well as offer ideas for designing the ideal kitchen garden.
- **Tropical-Looking Yet Cold Hardy Plants** (S6) – *Eric Schmidt, Harry P. Leu Gardens, Orlando, FL*
  With the cold temperatures of 2009, Florida's landscapes took on many new looks. Some tropicals survived during the extended periods of cold weather and others did not meet the challenge. This session features tropical-looking varieties that are cold hardy.
- **Pest Control; How to Get More with Less** (S7) – *Lee Bloomcamp, Syngenta, Gainesville, FL*
  The environmentally conscious consumer today is looking for the same results with fewer chemicals. Come see how the proper monitoring and right application process can result in more successful control of pests in the landscape.
- **Catch Some Big Ideas, Creativity & Innovation** (S8) – *Tom Laughon, Your Limit Consulting, Tallahassee, FL*
  Talk to any business leader today and sooner or later the words "innovation" and "creativity" will come up. In a tough economy where competition is fierce, you need to have the creative edge. But for many, these terms are simply buzzwords. Few truly know how to foster creativity and innovation in their workplace. Come find out how to fill your workplace with productive creativity.

11:30 a.m. – 12:30 p.m.

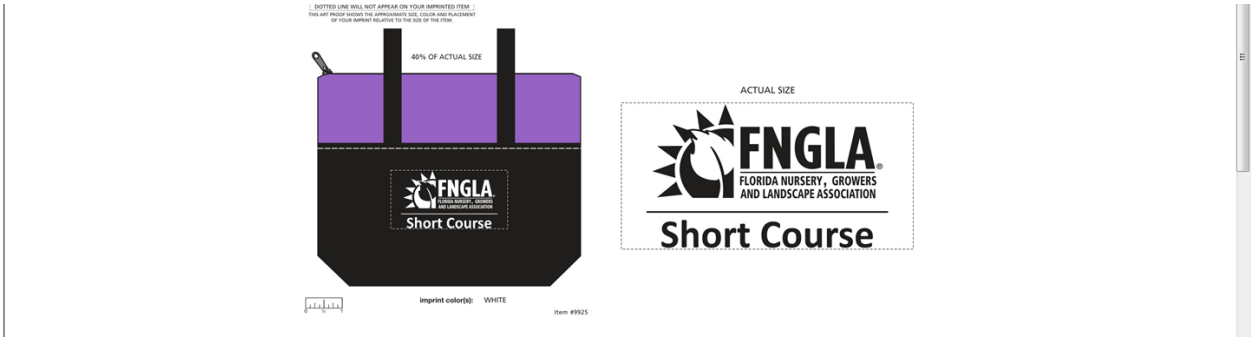
- **Designing Landscapes With Tropicals** (S9) – *Robert Bowden, Harry P. Leu Gardens, Orlando, FL*
  Come hear how to incorporated tropical foliage into landscape designs to reflect the wonder and simple beauty of nature.
- **Turf Wars: Turf vs. Turf Alternatives** (S10) – *Dave Dymond, H & H Sod Co., Kenansville, FL; Keri Leymaster, SeaWorld, Orlando, FL*
  The industry has an array of opinions on whether it's more important to use turf or turf alternatives in landscape designs. Using the right plant in the right place is the consistent factor in any successful and sustainable landscape. Come see how different turf or turf alternative varieties thrive when used in right spaces.

- **So Many Plants, So Little Time** (S11) – *James Socash, JFS Design, Inc., Pembroke Pines, FL*

"Better to think eight minutes, than to work eight days…" is an old Costa Rican saying and can certainly apply to landscape maintenance. This session will look at how to use plant characteristics when considering different species for proper placement and planting. It can be the difference between failure and success in the landscape.

- **Creating a Great First & Lasting Impression** (S12) – *Harold Lloyd, Harold Lloyd Presentations, Virginia Beach, VA*
  First and last impressions have almost nothing to do with your products, prices or services. In fact, a large part of your business' image is formed in the parking lots, at your entrance or exit areas. So, what message is your business sending? Friendly or apathetic? Clean or cluttered? High-priced or competitive? Fun or boring? The images go on and on. But do they complement your desired marketing strategy? You do have control over the image you're sending and the messages you are conveying. This session will look at fabulous and fatal first and lasting impressions and offer suggestions on how to deliver appropriate and desirable messages to your customers.

Conference bags were given out to each attendee who participated in the short course sessions. The following is the approved art that was used for the order.



For FNGLA Short Course program, over 265 attendees participated in the above sessions. Primary audience was industry members in Florida consisting of owners/managers of production and landscape firms. Audience will consist of landscape maintenance, contracting, architecture and design companies, woody ornamental growers, allied suppliers, and garden centers. Not only did attendees have an opportunity to network with industry peers but the incorporation of off-site tours along with the educational sessions, allows attendees the opportunity to see landscape design applications in the field.

Evaluations from attendees reflected a positive outcome and the need still exists to continue to educate the industry. The evaluations indicated that the attendees came for the following reasons.

- CEUs and Education
- Concerned about water conservation
- Design Ideas
- Edibles are interesting!
- High Quality speakers
- Learn about the effective use of color

- Info
- New to the industry
- Subject of interest
- Speaker- Phil Maddux
- To keep up to date on technology
- To learn new information to benefit/market my business
- Professional Development

The following information is reflective of the satisfaction of attendees. There were over 142 people that are return attendees to the educational programs and 160 people plan to return to future programs.

	Yes	No	Undecided
First Time Attendee?	75	142	
Coming Next Year?	160	5	44

Beneficiaries

Out of 228 surveys returned, it indicated that the follow types of business affiliations were represented at the short course

- Garden Center: 3, Grower: 18, Landscape Management: 39
- Landscape Designer: 58, Landscape Contractor: 41
- Other: Tree Service, Landscape Gardner , Decorative Stone, Teacher, Irrigation, Interiorscapes

Floriculture Field Day:

This program had the potential to reach 150-200 attendees in the floriculture industry and we were able to bring in over 200 people and showcase over 236 new varieties of floriculture plants to the industry during the conference. Audience consisted of producers, retailers, landscapers and allied suppliers.

The 2009 Specialty Crop Block grant included funding for the Floriculture Field Day educational conference. In the original documentation that was submitted, it was for the 2010 Floriculture Field Day educational program. Due to re-organization of the program and subsequent plans to postpone a program to 2011, a request was made for those funds to be used for the 2011 conference held on May 12-13, 2011. The 2009 grant helped with the educational conference which became the vehicle to highlight the trial gardens during the conference.

FNGLA's 2010 Specialty Crop Block grant provided funds to cover the startup costs for the field trials that were directly connected to the Floriculture Field Days but were separate events. One program with two very different components but both allow floriculture growers to new varieties and industry information. 2009 funds helped with

facility, speaker expenses, marketing, etc. 2010's funding helped with retrofitting the area of real estate that the trials were planted in. Soil removal, addition of specific soils, addition of irrigation to the area, and paid for landscaping services.

Goals and Outcomes Achieved

The decision to delay the Floriculture Field Day for a year proved to be a positive decision. By taking a year off, industry was able to re-evaluate what was still important to the program, seek out a partner to help execute the field trials and generate more industry participation.

Schedule of Events

Thursday, May 12

7:30 – 8:30 a.m.
Continental Breakfast With the Exhibits

SPECIAL MORNING INSTRUCTIONS:
Today (Thursday):
*If you have a **green dot** on your badge, you should have gotten a green wristband at registration. Your group will be touring the EPCOT Flower & Garden Festival. Group departing for the tour will leave the Cape Cod Lobby starting at 8:30 am.*

*If you have **pink dot** on your badge, you will be attending the performance trials. Groups will depart at 8:15 from the Cape Cod Lobby.*

8:30 – 11:30 a.m.
Morning In The Gardens
MEET IN THE CAPE COD LOBBY
It's a morning filled with facts, flowers and fashionable trends. Conference attendees will either spend their morning at the FFD performance trials or at the Epcot® International Flower and Garden Festival. Those at the trials will enjoy one-on-one time with the breeders, evaluating how their varieties held up to Florida's grueling spring climate. Those not at the trials will spend their morning at the Festival and experience all the magic that Disney has to offer.

LUNCHEON - Salon 3 and 4

11:45 a.m. – 1:15 p.m.- **The Evolution of a Trial Garden**
Dr. Allan Armitage, University of Georgia, Athens, GA
Widely regarded as one of the world's foremost floriculture experts, Dr. Allan M. Armitage is a professor at the University of Georgia, Athens, where he teaches, conducts research on new garden plants, and runs the University of Georgia Horticulture Gardens. He will talk about the garden trial process and how plants make their journey from a simple, unnamed seedling to international-named status.

GENERAL SESSION - Salon 1 and 2
1:30 – 2:30 p.m.
The Buzz From California Pack Trials and Beyond
Chris Beytes, GrowerTalks/Ball Horticulture, Chicago, IL
The Bobbleheads hit the road again this spring for the 2011 California Spring Trials. Chris Beytes will share all the new and exciting things he saw during his travels to CA. Chris' position as Editor & Publisher of GrowerTalks and Green Profit magazine allows him the opportunity to gain a global perspective and see some of the latest innovations and garden center trends in the market today. Come see what will be the right mix of product, merchandising and marketing ideas that will "wow" consumers this year.

2:40 – 3:40 p.m.
Trends in Edible Landscapes
Robert Bowden, Harry P. Leu Gardens, Orlando, FL
With consumers still focusing on "Home Grown" or "Buy Local," the emphasis on edible landscape designs continues to pack a punch. Edible landscaping is more than just planting stuff you can eat. Today's edible gardening trends offer customers great design alternatives and is an innovative marketing tool for the nursery and landscape industry. Come learn what Robert Bowden has in his garden and how new growing techniques are making an impact.

3:40 – 4:00 p.m. - Break

4:00 – 5:00 p.m.
Something Old, Something New, Something Borrowed and Something Stolen
Lloyd Traven, Peace Tree Farms, Kintnersville, PA
Labeled a "mad scientist" and "plant geek" by fellow industry members, Lloyd Traven not only has a true passion for growing quality plants, but a desire to seek out and find unique and unusual plants. Throughout the country and abroad, he has found many treasures; some old, some new and yes, some clandestinely propagated. During this presentation, Lloyd will talk about some of the most favorite plants he has seen during his travels.

6:00 – 7:30 p.m.
Dinner with the Mucks
Dine with you favorite horticultural celebrities. A sign up sheet will be at check-in. Dinner at your own expense. **REMEMBER TO SIGN UP AT REGISTRATION BY 3:00 PM**

Schedule of Events Friday, May 13

7:30 – 8:30 a.m.
Continental Breakfast With the Exhibits

SPECIAL MORNING INSTRUCTIONS:
Today (Friday):
*If you have a **pink dot** on your badge, you should have gotten a pink wristband at registration. Your group will be touring the EPCOT Flower & Garden Festival. Group departing for the tour will leave the Cape Cod Lobby starting at 8:30 am.*

*If you have **green dot** on your badge, you will be attending the performance trials. Groups will depart at 8:15 from the Cape Cod Lobby.*

8:00 – 11:30 a.m.
Morning in the Gardens
It's another morning in the gardens. Attendees will flip flop and experience the second garden in their conference adventure.

LUNCHEON & GENERAL SESSION - Salon 3 and 4
11:45 a.m. – 1:15 p.m.
Trial By Flowers – The Flameproof Favorites
Jimmy Turner, Dallas Arboretum, Dallas, TX
In North Texas, there are many environmental challenges that make selecting the "right" plants crucial to successful gardening. Jimmy Turner, Senior Director of Horticulture at the Dallas Arboretum, will share his favorite plants from their grueling heat-tested trial program. The Dallas Arboretum is one of the oldest independent national testing program and the only testing site for the All-America Selections seed trial program in Texas.

1:30 – 2:30 p.m.
Trials and Triumphs in the Gardens
Kate Santos, Costa Farms, Homestead, FL; & Heather Will-Browne, Walt Disney World, Lake Buena Vista, FL
This session will take an in-depth look at the performance trials taking place both at *Walt Disney World®* and Costa Farms in Homestead, FL. From Zones 9-11, see which varieties shined as great performers and which ones struggled with Florida's heat and humidity. Dr. Kate Santos, Costa Farms, and Heather Will-Browne, Disney's Horticulture, will share their insights on in-house performance trialing and key features that are sure to provide end-consumer satisfaction.

Breakout #1 - Salon 1
2:40 – 3:40 p.m.
Growing Organic Edibles
Candy Traven, Peace Tree Farm, Kintnersville, PA
With the consumer popularity of "Home Grown," how can growers capitalize on this trend? At Peace Tree Farms, herbs have grown from 5,000 plants in their first year to over 800,000 last year. Come hear what innovative ideas and sound instincts have kept edibles one of their growing areas of production.

2:40 – 3:40 p.m.
PGR's & Herbicides
Jim Barrett, University of Florida, Gainesville, FL; and Bob Stamps, Mid Fl Research and Education Center, Apopka, FL
UF research has been evaluating new PGR products and applications. Dr. Barrett's portion of the presentation will cover ConTego (ABA) and other products for delaying drought stress, granular Topflor for size control, branching compounds, and multiple low dose drench applications. Dr. Stamps will present information on the newest products for controlling weeds in floriculture crops plus some tips for making older products work more effectively.

Breakout #2 - Salon 2
2:40 – 3:40 p.m.
Light Up Your Landscape
Dean Bemis, Syngenta Flowers, St. Charles, IL
Light up your landscape with cutting-edge designs. Attendees will see the new varieties showcased in the performance trials and creative ways to use them in today's gardens.

3:40 – 4:00 p.m.: Break

4:00 – 5:00 p.m.: Breakouts
Getting the Most Out of Modern Marketing & New Media
Laurie Scullin, The New Product Group, Gainesville, FL
Laurie Scullin is the owner of a new product and idea development company that is helping industry members stay on top of their marketing strategies. Laurie will talk about how horticulture companies are moving into a new marketing frontier. Should you be spending time on social media such as Facebook and YouTube? What new marketing tools do your customers need?

Beneficiaries

The following are listing of sponsors and breeder companies that participated in the program. They are all beneficiaries of the program. The floriculture industry as a whole benefits because growers are being able to see what new varieties that breeders are working on, the new varieties are then exposed to the garden center professionals and landscape contractors and industry gets exposure to the consumer frequenting Walt Disney World. Walt Disney World is able to tell the story of how plants get their start to an estimated 2.4 million guest that attend the Epcot® International Flower and Garden Festival, this event is an ideal platform to showcase the newest featured annuals and perennials to the industry while building consumer awareness & excitement at the same time.

Great Southern Tree Conference:

For the Great Southern Tree Conference, over 164 attendees participated from 13 different states across the SE. The tree segment of the industry has been drastically affected by the housing marketing and lack of new construction. The conference showed an impact.

Educating this segment of the nursery industry was still accomplished by providing a greater understanding of industry members' risks and liabilities, increase awareness of industry grades and standards and ultimately build stronger community green infrastructures.

This program has brought awareness of the potential risk to members from a production, financial or marketing standpoint and provide them with the tools needed to safeguard their businesses. The topics of the conference are clearly developed to offer attendees the following percentages of risk management education: 40% of the program being production, 40% of the program being landscape/establishment/design; and 20% marketing.

The outdoor demonstration area provided attendees with an outdoor classroom that provides the opportunity to observe the research and demonstration areas and how they are affected and/or change on a yearly basis. Being able to come back to the same location on a yearly basis is very effective in predicting the sustainability of trees subjected to particular procedures.

Goals and Outcomes Achieved

For the Great Southern Tree Conference, over 164 attendees participated from 13 different states across the SE. Projected numbers of attendees were higher than the actual numbers. This program has a narrow focus on the production and installation of tree specifically. A reasonable explanation for the decrease in numbers is financial adjustments that many in this segment of our industry have had to make over the last two years verses the quality of programs and content.

The conference was success in providing those industry members with vital information about grades and standards, efficient fertilization programs, lean business tools for working smarter. See attached for the brochure of the complete program.

Demographics of the Attendees:

State	Number of Attendees
Alabama	2
Arkansas	1
California	1
Florida	140
Georgia	5
Mississippi	1
North Carolina	5
Oklahoma	2
Ohio	1
South Carolina	1
Tennessee	1
Virginia	1
Mexico	3
TOTAL	**164**

Registration Breakdown:

Registration	
Pre-reg Member	88
Pre-reg Non-member	17
On-site Member	6
On-site Non-member	1
Students	
Bonus Only	2
Volunteers/Staff/Comps/Speakers	50

Beneficiaries

TPIE Short Course:

The educational program provided information to end servers of the foliage segment of the industry. Interiorscape benefitted from design and care applications of foliage products which will in turn increase the demand for foliage plants. It reaches 150-200 attendees with critical information on risk management. Marketing, sales and development of innovative ways to sell and distribute more foliage plants were be discussed.

Not only did attendees have an opportunity to network with industry peers while attending the educational sessions but the incorporation of off-site tours allowed out-of-state attendees the opportunity to see tropical foliage production facilities in South Florida.

Increase in awareness and uses for tropical foliage plants which will ultimately increase sales for the specific segment of the industry.

Goals and Outcomes Achieved

The goals of (1) ensuring a more unified industry as a whole and a greater understanding of industry members' risks and liabilities; (2) offering leadership training skills to build stronger business relationships; and, (3) providing innovative ways to market products and services were all successfully executed. Evaluations from

attendees reflected a positive outcome and the need still exists to continue to educate the industry.

The program attracted 63 complete seminar registrations and a combination of 370 single sessions for 7 different sessions and nursery tour.

- The educational program met the goal of providing information to the foliage segment of the industry. It reached its targeted potential of 150-200 attendees with critical information on risk management. Marketing, sales and development of innovative ways to sell and distribute more foliage plants will be discussed.
- Not only do attendees have an opportunity to network with industry peers while attending the educational sessions but the incorporation of off-site tours allows out-of-state attendees the opportunity to see tropical foliage production facilities in South Florida. Over 95 people visited facilities in Homestead area.
- Program helped increased awareness of uses for tropical foliage plants which will ultimately increase sales for the specific segment of the industry.

Overall Lessons Learned:

Management of a multi-component grant takes a team effort from all the staff involved. Proper tracking and accounting for each of the programs is essential. In managing a grant of this size, FNGLA has had to fine-tuned its systems for reporting. There have been some unexpected challenges but allowing flexibility in the timing or execution of a portion of the project has created a successful end result. Example of such was to postpone the economic impact study to the second year of the grant. With the grant being a multi-year funding process, this allowed the study to pull facts for a year that was better reflective of the state of the industry's economic position.

The programs or projects outlined in the grant had clear outcomes and did not produce unexpected results.

Under certification, development of Teach Hort. took longer than expected but outcomes will be realized well after the grant funding is complete.

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PROJECT (12): FLORIDA SPECIALTY CROP FOUNDATION - FARM LABOR CONTRACTOR TRAINING PHASE I

FDACS Grant Contract #15570
Total Funding - $150,000.00
End Date: 6/30/2012

PROJECT SUMMARY

Background for the initial purpose of the project – issue, problem and need addressed by project

Farm labor contractors (FLCs) act as intermediaries between workers and growers. They may perform many different services including hiring, recruiting, supervising, transporting, and/or providing housing for workers. Numerous state and federal laws define the relationships and responsibilities of FLCs and agricultural producers with respect to how seasonal and migrant farm workers should be treated, to best protect farm workers' economic and physical well-being. The regulations are extensive and have evolved over time. Aside from passing a test to receive their initial license, formal training of FLCs has not been required by state or federal agencies. Many FLCs are not aware of the full scope of labor regulations or how the regulations have changed over time. Opportunities for continuing education for FLCs have been limited. Consequently, FLCs violate workplace rules in part because they are unaware of or do not fully appreciate their responsibilities.

A new educational program was developed and launched in the fall of 2010 by the University of Florida/IFAS at the Southwest Research and Education Center in Immokalee, Florida. The target audience for this training program was those individuals who administer farm labor regulations and who directly manage seasonal and migrant farm workers. A 2009 USDA Specialty Crop State Block Grant, managed through the Florida Department of Agriculture and Consumer Sciences, supported the project's first two years. The grant was awarded in 2009 to the Florida Specialty Crop Foundation, which in turn contracted with the University of Florida/IFAS to develop and execute the training program.

The goal of this educational curriculum has been to provide participants with an integrated picture of the regulatory responsibilities involved with managing seasonal and migrant farm workers. The Farm Labor Contractor Core Training program was designed as a voluntary educational program. The underlying rationale is that enhanced knowledge about farm labor laws and regulations will improve the professionalism of FLCs, reduce the number of field violations, and improve overall working conditions of farm workers.

Over the course of the grant period, the program title was modified to "Farm Labor Supervisor Training." This reflects the realization that, in addition to licensed FLCs, permanent employee supervisors of individual farming organizations and the work of office staffs have important implications on how consistently farm labor regulations are followed.

Motivation for the project – importance and timeliness

MSPA, the Migrant and Seasonal Worker Protection Act, passed in 1983, and subsequent government enforcement efforts, have led to an increasing number of inspections by the federal Department of Labor (DOL). Current U.S. Secretary of Labor, Hilda Solis, who is of Mexican descent and once a farm worker, has focused her

attention on enforcement of farm labor regulations. Consequently, the number of DOL "sweeps" of Florida's farming areas has increased since 2008. The importance of farm workers to Sec. Solis was demonstrated on Monday, March,26, 2012 when the DOL inducted the pioneers of farm worker rights into the DOL Hall of Fame. Sec. Solis said, "The farm worker movement was begun by people who didn't have money or clout. Many were new to this country and lived season to season. They were hard-working people of the land who asked only for dignity and fair treatment, and today we are proud to give them the Department of Labor's highest honor." The FLC Training Program developed by UF/IFAS under this grant enhances the abilities of the FLCs and others who supervise the farm workers to comply with laws designed to protect farm workers.

In Florida, the Farm Labor Bureau within the Department of Business and Professional Regulations (DBPR) administers Florida Statute 340, which mirrors the federal MSPA legislation. In 2004, the Florida legislature enacted the Farm Worker Safety Act, which increased penalties and fines on agricultural employers who violated federal Worker Protection Standards (WPS). In addition, the 2004 act along with pressure from activist groups such as Farm Worker Association of Florida and the Coalition of Florida Farmworker Organizations (COFFO) led to the creation of an Interagency Farm Worker Focus group. This group is comprised of representatives from various state government agencies. They were commissioned to meet regularly with agricultural employers and worker representatives to discuss farm worker concerns and guide the appropriate state government agencies on how best to respond to farm worker concerns. A primary emphasis of this group has been on pesticide safety.

PROJECT APPROACH

Summarize activities and tasks performed during the grant period

The development of the Florida Farm Labor Supervisor Training Program can be summarized around three objectives:

1. Develop a training curriculum based on the guidance of local advisory committees.
2. Implement training programs that reach the target audience.
3. Create value for participants in the training program.

An initial advisory committee was formed in Immokalee, Florida during 2010. The committee included farm labor contractors, citrus and vegetable growers, farm labor advocates, and farm labor compliance personnel from various state and federal agencies. With the guidance of the Immokalee advisory committee, the first training curriculum was developed around four core units – General Administration, Transporting Farm Workers, Agricultural Worker Safety, and Personnel Management. Three complete programs were organized between September and November of 2010, all conducted at the UF/Southwest Research and Education Center just outside of Immokalee. All training sessions were conducted in both English and Spanish. Further, each participant received a handout binder that included slides and additional resources to compliment the material presented. Handouts were developed in English and then translated to Spanish.

In 2011, advisory committees in Wimauma and Belle Glade, Florida, suggested a few changes to the original core training program. ***Table 1*** outlines each training module with the specific topics that were covered and the adjustments that occurred between 2010 and 2011. The most significant change was the addition of a fifth unit on Worker Housing. In addition, a section on Food Safety was added to the Field Sanitation topic. Since Field

Sanitation included the access of potable water, the topic was moved from the General Administration to the Agricultural Worker Safety Unit as it complimented discussions on heat stress and pesticide safety.

Six training programs were organized and completed by UF/IFAS staff between August and November 2011 in four locations across south Florida. In addition to the official UF/IFAS training programs, two programs were held in conjunction with a large vegetable production company in Immokalee, Lipman Produce, Inc. UF/IFAS staff and the Lipman training program incorporated farm staff and representatives of the Coalition of Immokalee Workers who explained changes in specific farm policies with respect to worker pay records, housing, and a newly implemented worker grievance process.

Creating value for the training participants is an important goal that will continue to evolve over time. For all participants in the 2010 and 2011 Training Programs, each person received a "Certificate of Attendance" as each unit was completed. Individuals who attended all four units received a "Certificate of Completion" (see Appendix for examples of the certificates). These certificates were well received, particularly in the Spanish-speaking classes.

Discussions have been initiated with the Florida Department of Business and Professional (DBPR) officials as to how licensed labor contractors could receive a special designation for meeting pre-determined criteria as followers of "best practices." (A voluntary "best practice" designation was written into the Florida farm labor statute (F.S. 340) in 2004 but has never been used.) DBPR officials are still working through the process of developing the criteria by which licensed contractors can obtain this designation. It has been proposed that completion of the UF/IFAS training program be one of the criteria adopted by DBPR officials in granting a "best practice" designation. However, the ultimate value for completing this, or any other farm worker management training program, will rest on specialty crop growers who employ the farm labor contractors, crew leaders, and farm personnel who manage and supervise migrant and seasonal farm workers. If specialty crop growers perceive real value in such a training program, they will make completion of such a program a condition of employment.

2b. Present the significant contributions and role of project partners in the project.

Project partners include members of the various organizing committees in Immokalee, Wimauma, and Belle Glade, who provided substantial guidance in the formation of the Core curriculum and suggestions on best times to conduct training sessions in their respective areas. Florida DBPR's and the U.S. DOL compliance staff provided not only assistance on curriculum design, but also reviewed content material. Mr. Mike Bayer, a retired USDOL investigator, contributed a significant amount of his time in the development of the General Administration unit and worked as a presenter for topics in General Administration, Transporting Workers, and Personnel Management. Much of the content for the "Transporting Workers" unit was developed by Ms. Tracy McQuilken, an officer for the FHP (Florida Highway Patrol, formally Florida Department of Transportation). Ms. Kessla Brown provided training materials from EEOC and on several occasions served as the English presenter for the Discrimination and Sexual Harassment portions of the "Personnel Management" unit. Ms Brown's counterparts in the Tampa office made EEOC presentations in both English and Spanish during the Wimauma and Arcadia training sessions. Department of Health staff in Hillsborough and Collier Counties assisted in developing the materials for worker housing and assisted presentations during the Wimauma and Immokalee training sessions. Much of the human trafficking material in the Personnel Management unit was developed by the Collier County sheriff's department and the Florida Coalition Against Human Trafficking.

All efforts were made on this project to ensure that SCBGP funds only benefitted specialty crops. Farm labor contractors perform one or more of the following functions: recruitment, solicitation, hiring, transport, housing, and supervision of seasonal and migrant farm workers. The only agricultural operations in Florida that utilize seasonal and migrant farm workers are citrus, vegetable, berry, and ornamental plant growers. By definition, these operations are "Specialty Crops." Participants register through their various companies and these companies can be easily verified that they all fit the specialty crop definition.

The project educated a significant portion of farm labor contractors:

2010: 182 farm labor supervisors who attended at least one class; 126 people completed the entire program.

2011: 167 farm labor supervisors who attended at least one class; 115 people completed the entire program.

2010 Attendance summary. Three 2-day training sessions all taking place at the Southwest Florida Research & Education Center, Immokalee, FL. During each training session, four 4-hour classes were offered. Titles of each class are listed in the table below. In 2010, a total of 182 people attended at least one class. 126 people completed entire program (i.e. 16-hours of training).

Topic	Sep 22/23	Oct 11-14	Nov 3/4	Total
General Administration	51	28	75	154
Transporting Workers	47	52	70	169
Agricultural Safety	43	37	66	146
Personnel Management	34	36	64	134
2010 Attendance at least (1) unit:				182
2010 Completion Certificates:				126

2011 Attendance summary. Six 2-day training sessions all taking place at four different locations across south Florida. During each training session, four 4-hour classes were offered. Titles of each class are listed in the table below. In 2011, a total of 167 people attended at least one class. 115 people completed the entire program (i.e. 16-hours of training).

Date 2011	Location	Language Class	General Admin	Transport/Housing	Worker Safety	Personnel Mgmt	Completion Certificates
Aug 24-25	GCREC-Wimauma	English	13	12	20	20	**15**
		Spanish	17	13	16	16	**11**
Sep 21-22	EREC-Belle Glade	English	18	20	18	17	**16**
		Spanish	13	16	10	9	**7**
Oct 5-6	SWFREC-Immokalee	English	9	11	11	11	**6**
		Spanish	0	0	0	0	**0**

Nov 2-3	GCREC-Wimauma	English	6	8	5	5	**6**
		Spanish	4	4	4	4	**4**
Nov 9-10	SFCC-Arcadia	English	14	14	13	12	**11**
		Spanish	9	9	13	12	**8**
Nov 16-17	SWFREC-Immokalee	English	22	20	22	19	**19**
		Spanish	17	22	19	13	**12**
	2011 Totals		**142**	**149**	**151**	**138**	**115**
	Number of participants who attended at least one class:						**167**

GOALS AND OUTCOMES ACHIEVED

First Year Goals – 2010

1. **Preparation and organizing an advisory committee**
2. **Design and implement a training curriculum**
3. **Measure and evaluate learning among class participants**

Preparation – Data collection, Surveys, Interviews, Organizing Committee, Preliminary trainings.

Development of the FLC Core Training program began in July 2009, eight months before the 2009 Specialty Crop State Block officially began. For the next twelve months, time was spent interviewing various stakeholders about the concept and specific content of a training program directed toward FLCs. In addition, data were collected on demographics and scope of the FLC community. These came from informal group meetings, formal advisory committees, and several individual interviews.

FLC Statistics

DBPR maintains a database on licensed FLCs. According to this database, there are just over 800 licensed FLCs within a 2-hour driving radius of Immokalee, FL (south Florida). There are 260 licensed FLCs in Collier County, 90 in Dade, 230 in Hendry, 70 in Lee and 155 in Palm Beach.

Vegetable growers in Collier County surveyed 48 FLCs on relevant demographic information (summer, 2010). Of these FLCs, 87% were male and 13% female. 65% were most comfortable in Spanish, 27% in English, 8% in both. The average time spent in formal education ranged from no school to some college, with the majority saying 6 - 7 years, although the educational content of years of schooling varies between Mexico and the United States.

Their average age is 48, and the average length of time working as a FLC is 16 years. To get into this business, 21% started as field workers, 21% were from FLC families, 11% had been truck drivers, and 27% marked "other" (friend, needed to work, or did not answer.) 65% migrate north ("go up the road") with the crops in the summer, and 38% remain in Immokalee and do other jobs or vacation in Texas or Mexico.

Group and individual interviews.

Numerous group and individual interviews were conducted between July 2009 and August 2010. Responses are summarized below by entity. These interviews provided important insights into development of training content.

a. Farm Labor Contractors (FLCs). In the beginning of the planning period, it was difficult to get FLCs to

describe their work environments and challenges, as they were unsure of the intentions behind the FLC training program. In fact, they were somewhat surprised at our interest in them. As they became more comfortable with the idea, interviews were arranged through churches, at Farmworker Village, Immokalee, and through personal contacts.

b. Growers/Farmers - Growers who employ FLCs were mostly concerned that their FLCs understand and comply with laws that protect farm workers. Some growers hire FLCs as direct employees, and sometimes, in those cases, the growers carry Workers' Compensation insurance. Some growers also manage or assist with FLCs' administrative tasks such as licensing and driver files.

c. Farm Workers - Several advocacy groups arranged meetings for us with farm workers. Groups included Farmworker Alliance of Florida (FWAF), Coalition of Florida Farmworker Organizations, (COFFO), Horizon Village (county-funded housing for single farm workers), and Redlands Christian Migrant Association (RCMA.).

d. Government Agencies - Agencies that assisted us include DBPR (Department of Business and Professional Regulation), DOL (Department of Labor), AWI (Agency for Workforce Innovation), DOT (Department of Transportation) and DOH (Department of Health). People at these agencies provided input on the most common FLC violations and impressions of training content that would improve compliance. They said the biggest violations were related to transportation and condition of buses; adequate insurance; posting of Terms and Conditions of work; proper calculation of field payroll records; and field sanitation (more in citrus than vegetables); These inspectors also suggested ways to make the inspection process easier, including having all documentation readily available, being pleasant, and assisting the inspectors wherever possible.

e. Other - Insurance Agents explained the administrative challenges of the FLCs related to licensing, Workers' Compensation, and Vehicle Insurance.

Local Organizing Committee (LOC)

A Local Organizing Committee (LOC) was formed and first met on 11 February 2010. The committee was charged with advising UF/IFAS staff as to the program content, training times, and scheduling logistics. The committee grew from 8 to more than 15 during the course of five times between February 11 and November 9, 2010 and included growers, government compliance officers, worker advocates, and FLCs.

Preliminary trainings

Preliminary training sessions were held at the UF/IFAS Southwest Research & Education Center (SWFREC) during spring, 2010. These sessions provided important feedback from which topic content was refined.
Training Dates and topics:
April 22, 2010: Trial Training and Feedback Session
10 FLCs, human resource staff from 4 agricultural operations, USDOL and FL DBPR compliance personnel
May 22, 2010: Sexual Harassment
more than 200 farm workers, as part of SWFREC Farm Safety Day
May 24, 2010: DOT "emergency training" in reaction to a bus that was taken out of service for violations the Crew Leader did not understand.
46, primarily FLCs
June 2, 2010: DOT "emergency training"
23, primarily FLCs

Note: Attendance and discussions after the DOT sessions confirmed that training in the area of DOT regulations is a priority area for FLCs.

Design and implementation of the FLC Core Training Program

The initial "Core" program was designed to be four (4) units with 3.5 hours of educational content each. The units were: General Administration, Transporting Workers, Agricultural Worker Safety, and Personnel Management. All

units focus on legal compliance, paying particular attention to commonly misunderstood concepts and issues that were brought to our attention through interviews and through the Local Organizing Committees.

The "Core" FLC Training Program was presented officially for the first time during the fall 2010. The entire program was offered in three separate sessions. A person (i.e. FLC) could choose to attend all four units during a single session, or complete individual units during separate sessions.

2010 Training Schedule – Two types of session arrangements were offered:

September 22-23, 8:00 a.m. to 5:00 p.m., two consecutive days, two units each day. Morning sessions ran from 8:00 a.m. – noon, and the afternoon from 1:00 to 5:00 p.m. Breakfast, lunch and refreshments were served.

October 11-14, 10:00 – 3:00. Four consecutive days, one unit each day. The schedule attempted to accommodate FLCs by allowing them to start their crews in the fields in the early morning and rejoin them by late afternoon. Mon: General Administration. Tues: Agricultural Safety. Wed: Transporting Workers. Thurs: Personnel Management. Lunch was served from 12:00 to 1:00.

November 3-4, 8:00 a.m. to 5:00 p.m. both days, two units each day. The schedule was the same as the first training. The morning sessions ran from 8:00 a.m. – noon, and the afternoon from 1:00 to 5:00 p.m. Breakfast, lunch and refreshments for morning and afternoon breaks were served.

Comment: most people who completed the Core Program attended the sessions in consecutive order. Only 6 people spread their participation in the Core Program over two separate training sessions. Attending two units in one day meant between 6 and 7 hours of concentration and proved to be more mentally taxing. Offering one unit per day, as was done in October, provided a more relaxed educational experience, however, most people seemed to prefer the opportunity to complete the program over a 2-day period rather than stretch out the experience over four or more days.

Handouts – Handouts were developed in both English and Spanish that summarized lecture material and provided supplemental resources.

Language –Early in the development period, UF/IFAS staff was strongly encouraged NOT to teach using simultaneous translation, so separate classes were held in English and Spanish, concurrently in adjacent sections of the auditorium at the SWFREC. Notebooks were developed in English and translated into Spanish.

Certificates – For each unit attended, a "Certificate of Attendance" was awarded. People who attended all four units received a "Certificate of Completion" (see Appendix for examples). These certificates were well received, particularly in the Spanish-speaking classes.

Attendance Statistics – Over the three sessions offered in 2010, a total of 182 people attended at least one Core unit (96 in Spanish and 86 in English). A total of 126 people completed all 4 units (76 in Spanish and 50 in English). The largest number of people attended the Transporting Workers unit (169). Attendance increased over the three training sessions, growing from 50 in September to 75 registrants for the November training. More than 75% (97) of the people who completed all four units were FLCs, the target audience for this training program (see ***Table 2***).

Measure and evaluate learning among class participants

Appropriately assessing the knowledge gained by class participants is important for two reasons. First, assessing what people learned, or did not learn, helps refine course content and teaching methodologies. Second, developing objective measures of knowledge gained and tracking post-training changes in supervisory behavior will provide credibility and add value to the training program.

Two approaches to evaluate knowledge gained were tested during 2010. "Pre- post-tests" and "self-evaluations" were tested for the General Administration (GA), Transporting Workers (TW), and Personnel Management (PM) units. A single, more comprehensive evaluation instrument was developed for the Agricultural Worker Safety (AS) unit.

Pre- and Post-Tests.
Seven questions were created for each of the GA, TW, and PM units about specific points of information discussed during the training sessions. A person was asked to select the best answer from among four (in some cases 5) possibilities for each question. The same sets of questions were given at the beginning and then at the end of each Core unit. Copies of the pre- post-tests for 2010 are included in the Appendix.

Table 3 summarizes the 2010 pre- and post-test results by unit and language. The numerical values represent the percentage of correct responses to the pre- and post-tests. For example, among 27 participants in the English class on General Administration, the average pre-test score was 57% correct and the average post test score was 77%. The improvement in test scores is interpreted as a 43% average gain in knowledge.

At least 70% of those attending any session gained some knowledge as measured by performance on the pre & post tests. The Spanish side scored consistently lower for both pre- and post-tests in each of the three units. In the General Administration and Personnel Management unit, however, participants on the Spanish side achieved a higher percentage gain and a higher percentage of people gaining knowledge. Pre/post tests for both English and Spanish sessions were lowest in the Transporting Workers session, reflecting perhaps the area where most attendees were least aware of the DOT regulations concerning busses and drivers with CDLs (Commercial Drivers Licenses).

Pre- and post-test results for both English and Spanish classes were lowest for the Transporting Workers unit, affirming the lower self-evaluation ratings for Transportation noted previously and the fact that much of the fairly complex DOT information was new to them. Participants in the Spanish classes consistently scored lower than participants in the English classes for both pre- and post-tests. In General Administration and Personnel Management, however, participants in the Spanish classes achieved a higher percentage gain and a higher percentage of people gaining knowledge about the respective topics. The instructors for the Spanish classes observed that many of the participants were not comfortable with the written format of the pre- and post-tests, as they are not literate enough to read this type of material, in any language. Even though the questions and possible answers were read aloud, there still remains the strong possibility that the multiple choice format was confusing. In addition, some questions needed to be examined and rewritten to remove possible ambiguities for both English and Spanish participants.

In some cases, individuals scored lower on the post-test than on the pre-test, which could be interpreted as regressing in knowledge. In other cases, people scored the same on both the pre- and post-tests, reflecting no gain in knowledge. We thought that perhaps the large volume of relatively new material contributed to some confusion

among some of the class participants. However, after reviewing the test questions, it became evident that some questions and answers were ambiguous and need to be rewritten.

Self-Evaluation.

November 2010 participants (between 64 and 75 people for each class) in the GA, TW, and PM units were asked to complete a "self-evaluation" of their "before" and "after" knowledge about six topics presented in unit. The self-evaluation forms for each unit are included in the Appendix. Attendees were asked to rate their level of knowledge before and after the class, on a scale from zero to five; zero if they knew nothing about the topic and five if they considered themselves an expert. The people were encouraged to wait until after a specific topic was covered before self-evaluating their knowledge.

Table 4 presents the average self-evaluation scores by unit, topic, and language. Scores on average were similar across the English and Spanish classes for both before and after training. With the exception of the TW unit, most people rated their prior knowledge on the various topics as between 3.2 and 3.7. After the training sessions, people generally rated their level of knowledge as between 4.4 and 4.8. The "before" training scores in the TW unit were noticeably lower in both languages for all topics presented. In both the English and Spanish classes, DOT regulations regarding the requirement for DOT numbers on vehicles and "hours of service" restrictions for bus drivers received the lowest score for pre-training knowledge. This result correlates with the observed heightened discussion that occurred when these topics were covered – it was clear that most people had little or no prior knowledge of these regulations. In many cases, FLCS (and growers) had interpreted that the existing "Agricultural Exemption" included labor buses, when in fact the Exemption only applies to vehicles carrying produce, not buses carrying people.

While more work needs to be done to develop better evaluation techniques to document knowledge gained, the results of these evaluations indicated that at least 70% of those attending any session gained knowledge. The greatest percentage gain in knowledge occurred in the Spanish General Administration class, where, the average test score more than doubled, from 28% correct to 63% correct.

Agricultural Worker Safety Evaluations

Evaluations for the Agricultural Worker Safety unit were conducted for each training period (Sep., Oct. and Nov.) and for each language class. Evaluation forms are included in Appendix E and results are summarized in ***Table 5***.

Within Safety, as with the other units, the English section scored higher in the pre- test than Spanish section and the Spanish section showed greater knowledge gain. The interactive training activities included in the binder were useful to reinforce knowledge and maintain the audience focused on the training information. Overall, both the English and Spanish section showed a high level of program approval. For the Spanish section, it may be necessary to change the program evaluation format as many of the students are not as familiar with formal testing as the English-speaking students.

Second Year Goals – 2011

1. **Expand the number of training programs and locations through advisory committees representing all important stakeholders to provide guidance into educational content and training logistics.**
2. **Modify and improve training curriculum developed in 2010**
3. **Create value for those participants who invest their time and money into this training program.**
4. **Promote the training program to agricultural employers.**
5. **Measure learning by participants through pre- and post-tests**

Expand the number of training programs and locations through advisory committees representing all important stakeholders to provide guidance into educational content and training logistics.

Organizing Committees.

Wimauma: Two meetings were held at the Gulf Coast Research & Education in Balm (May 18 and June 1). The first meeting included UF/IFAS extension faculty from Hillsborough and Manatee Counties, 4 grower representatives, 1 harvesting contractor, and a representative from the Florida Strawberry Association. The second meeting included area representatives of USDOL,Florida DBPR, and Hillsborough County DOH (Department of Health).

Belle Glade: A second set of meetings were held at the Everglade Research & Education Center in Belle Glade on April 18 and May 25. The first meeting was a general overview of the program and included UF/IFAS extension faculty from Palm Beach County, 4 grower representatives, 1 harvesting contractor, and 2 safety consultants who provide services for growers in the Belle Glade area. The second meeting was a review of current content by a "curriculum committee" of the harvesting contractor, 1 safety consultant, and 1 grower.

Location and schedule of 2011 training programs.

Between late August and mid-November 2011, the Core Training program was offered 6 times at 4 different locations. Each training session was 2 days, starting at 8:00 am and lasting till at least 4:00 pm. Each unit was taught in both English and Spanish, concurrently, in separate rooms Sequence of the units was the same for all sessions.

Day 1: morning – General Administration; afternoon – Transporting Workers & Housing;

Day 2: morning – Worker Safety; afternoon – Personnel Management.

Fall 2011 schedule of training sessions:

- Aug 25-26, Gulf Coast Research & Education Center – Balm/Wimauma
- Sep 21-22, Everglades Research & Education Center – Belle Glade
- Oct 5-6, Southwest Florida Research & Education Center – Immokalee
- Nov 2-3, Gulf Coast Research & Education Center – Balm/Wimauma
- Nov 9-10, South Florida Community College – Arcadia
- Nov 16-17, Southwest Florida Research & Education Center – Immokalee

Attendance Statistics (***Table 6***). Over the six sessions offered during fall 2011, a total of 178 people attended at least one Core unit. Numbers fluctuated slightly by individual teaching units, but the range was fairly close, between 138 and 151 total attendees for the six sessions. A total of 115 people completed all 4 units (42 in Spanish and 73 in English).

In addition to the UF/IFAS organized training sessions presented above, Lipman Produce (formerly SixLs), a large vegetable growing/packing operation in southwest Florida, contacted the UF/IFAS staff and asked for an "in-house" training program specifically for Lipman crew leaders. Lipman staff asked to integrate some of their own material with the UF/IFAS Farm Labor Supervisor Training program. This material included company-specific policies on workers' compensation insurance, food safety, housing, payroll, and the new company code of conduct as required by the Fair Food Agreement signed with the Coalition of Immokalee Workers (CIW). Two 2-day training sessions were held on Nov 7-8 and on Nov 14-15, following the same format as the public, core training described above. Twenty-six primary contractors attended the first training session, and 28 assistant crew leaders attended the second training session. IFAS staff participated in teaching all or parts of each unit. A total of 54

Lipman crew leaders received a certificate of completion that acknowledged the shared participation of UF, Lipman, and the CIW.

Modifications and improvements to the educational content of training program.

Based on first year evaluations and input from the various advisory committees, several changes in the training program were made between 2010 and 2011. ***Table 1*** summarizes the changes from 2010 to 2011. Specific changes included:

a) Title of training program:

Florida Farm Labor *Contractor* Core Training Program, to
Florida Farm Labor *Supervisor* Core Training Program.
This change reflects a realization that several categories of farm personnel in addition to DOL/DBPR-licensed farm labor contractors need to aware of labor regulations regarding the treatment of seasonal and migrant farm workers. Further, office staff and upper level managers have strong influences over employment practices and business policies of a farming operation.

b) Wage & Hour content was expanded in the General Administration unit and Instructional designers from the UF Center for Instructional Technology and Training (CITT) were consulted to rewrite the Wage & Hour Section. Learning objectives were more clearly articulated and a new teaching presentation was developed to incorporate more images and color graphics. An instructor guide was written and several classroom exercises were created to compliment the lecture material. Note: the instructor manual written for the new Wage & Hour section is serving as a template for developing an instructor manual for the complete program.
c) The Field Sanitation section was moved from General Administration to the Worker Safety unit, as adequate hydration and proper sanitary facilities are issues more in line with worker health and safety than with general farm administration.
d) A new section was developed for Food Safety and added to the Field Sanitation section. Proper worker hygiene is important to both the personal welfare of a worker as well as to the mandated use of GAPs (good agricultural practices).
e) The Transporting Workers unit was downsized from 3.5 to 2.5 hours of material. Less discussion was given to "drug and alcohol" testing programs, "compliance reviews," and to the clerical requirements of "driver qualification" and "vehicle maintenance" files. While these topics are important, the learning objective was only to increase awareness of these requirements. Complete understanding of how to set up and run a drug & alcohol testing program or how to set up record-keeping files are beyond the scope of this training. More time, however, was spent on "hours of service" because this DOT requirement directly affects labor bus drivers who were a major part of our training audience. Exercises were created to illustrate how to complete log books and track daily and weekly hours of service.
f) A new section on farm worker Housing was developed and combined with the "Transporting Workers" unit. Staff from the Florida Department of Health in various county health departments was consulted to develop lecture material. During training sessions in Wimauma/Balm and Immokalee, staff from the Hillsborough and Collier County offices, respectively, assisted in presenting the material.

Create value for those participants who invest their time and money into this training program.

Each participant, including the Lipman crew leaders, received a UF course notebook that included copies of all slides, exercises, and supplemental materials for General Administration, Transporting Workers, Worker Housing,

Worker Safety, and Personnel Management. Notebooks were provided in both English and Spanish. (Written first in English and then translated.)

Participants received a "Certificate of Attendance" for each subject unit attended. Participants who attended all four units received a "Certificate of Completion." As in 2010, these certificates were well received, particularly in the Spanish-speaking classes.

The completion of the Core Training program could become part of a "best practice" designation being developed by the Florida Department of Business and Professional Regulations (DBPR). The Florida legislature passed amendments to the FL340 statute in 2004 that included recognition of FLCs who voluntarily follow a criterion of "best practices." The U.S. Department of Labor has also expressed interest in a discussion about adding to the value of the training. While the UF/IFAS staff strongly recommends keeping this training program voluntary and not a requirement for annual FLC license renewal, it is hoped however that specialty crop growers/employers will make completion of the Core Program a requirement for hiring of an individual FLC.

Promote the training program to agricultural employers.

Tri-fold brochures similar to those used in 2010 were created to advertise the fall 2011 training schedules. These brochures were sent to UF county extension offices as well as distributed at the three UF Research & Education Centers (Immokalee, Balm, and Belle Glade) where training sessions were conducted. Examples of these brochures are shown in the Appendix. In addition, county extension faculty promoted the training schedule through their respective newsletters. Press releases were also sent out to local newspapers and radio stations. Finally, UF/IFAS staff made the following presentations during 2011 to inform and promote the training program to agricultural employers. The FLS program staff attended 20 events during 2011 where the FLS Training program was advertised and explained (***Table 10***). More than 2,600 people were addressed during these events.

Measure learning by participants through pre- and post-tests

Knowledge gained by participants in 2011, as in 2010, was measured through pre- and post-tests. The tests were modified before the trainings to reduce the ambiguity noted in 2010. A completely new testing format was used in the General Administration Wage & Hour section, developed by the UF Center for Instructional Technology and Training (CITT). The new format was composed of pictures and illustrations in addition to text for answers, as opposed to just text, the previous year. Also, the order in which the answer appeared in the pre-test versus the post-test was changed. We felt that the new format was easier for our students, particularly those on the Spanish side, and are in the process of re-doing the tests for other units. A new test was added for the new Housing unit.

Table 7 summarizes the percentage gain in knowledge by unit and by language. For the English classes the greatest gains in knowledge occurred during the Transportation and Personnel Management units. Participants in the Spanish classes increased their knowledge during the Transportation unit by nearly 40%, but achieved greater knowledge gains during the General Administration unit which featured Wage & Hour issues and where the tests were in the picture format. Participants in the Spanish Personnel Management section tested low in the pre-test (average 37%) but increased their knowledge in this area by 86%.

Measure learning by participants through Self-Evaluations of Knowledge Gained

Table 8 presents the average self-evaluation scores by unit, topic, and language, for 2011 classes. As in 2010, "before" scores for the Transporting Workers (TW) unit in both languages were lower than General Administration (GA) or Personnel Management (PM). Interestingly, the Spanish "before" scores in TW, in both years, were slightly higher than the English. This is probably attributable to the fact that the Spanish classes had a greater number of bus drivers than the English. The new Housing unit showed a similar (low) lack of pre-class knowledge in both languages, although many of the attendees had no experience with farm worker housing. Within PM, in both languages, Human Trafficking was again the topic where attendees reported the lowest amount of prior knowledge. The Spanish classes reported an equally low amount of knowledge of stress management, possibly indicating a cultural or educational difference in how stress is perceived.

3b. Summarize progress toward long-term goals.

Long term goals:

1. ***Create a voluntary certification program of farm labor regulatory compliance.***

Five "core" units have been developed and assembled into a 16 hour training program. While pre- and post-tests were administered, these "tests" were not used to assess individual knowledge gained but rather to evaluate the program content and teaching methodology. Individuals who completed the entire Core program received a "Certificate of Completion." Long term goal is to create a true "certification" certificate, which, much like a college diploma demonstrates that each recipient has mastered the course of study. In order to achieve a "certificate" we must design assessment tools to objectively measure a student's gain in knowledge and establish a minimum level of performance before a certificate is awarded.

2. ***Create ongoing demand for the "Core" program and continuing education about regulatory responsibilities associated with farm workers.***

Long term sustainability of this program depends on individuals within the target audience (FLCs and farming personnel involved with labor policy and administration) who recognize the value of completing the "Core" program and pursuing other training opportunities. If owners of specialty crop operations recognize this value, we would expect that they make training a condition of employment.

3. ***Measurable decrease in regulatory violations among those specialty crop operations who hire individuals who completed the "Core" program and actively pursued additional training.***

Based on records of violations and interviews with regulatory compliance officers, we should begin to observe a statistically significant decrease the number of farm labor violations among those specialty crop operations which hire individuals who complete the "Core" training program and actively pursue additional training opportunities.

3c. Comparison of actual accomplishments with goals

First year proposed measurable outcomes / *actual accomplishments*:

1. **Hire full-time project coordinator and recruit a faculty colleague from the UF Agric. Educ. Dept.**

Hired a project coordinator and an program assistant for Mr. Cesar Asuaje.

2. **Create and meet 4 times with local advisory committee. Travel to Tallahassee, FL to meet with the Inter-Agency Farm Worker Focus Group.**

The Tallahassee Inter-Agency group met only once. The Immokalee organizing committee was formed and met 5 times between Feb and Dec 2010.

3. **Curriculum training outline and teaching modules.**

Four units created with 3.5 hours of training material developed for each unit.

4. **Work with DBPR staff to "certify" FLC training program as part of "best practice" recognition.**

These discussions have occurred and interest is positive among DBPR staff that this program could have a role in "best practice" FLC recognition. However, state government politics and priorities indicate a possible delay in the "best

practices" designation. There is an indication of possible interest from the Federal Department of Labor along the same lines of giving value to the training program, and discussions will take place soon.

5. **Written report summarizing first year activities.**

Done.

Second year proposed measurable outcomes / *actual accomplishments*:

1. **Publish training modules.**

Version 2 of the Handbook was distributed to class participants and included several changes than what was given out in 2010. The 2011 edition of the handbook included all ffive units.

2. **Meet at least 4 times with local organizing committees and travel at least twice to Tallahassee, FL and meet with the Inter-Agency Farm Worker Focus Group.**

Four meetings were conducted with organizing committees in two areas –Wimauma/Balm and Belle Glade. The Inter-Agency Farm Worker Focus Group in Tallahassee Focus Group only met once, at a time that conflicted with a previously scheduled training session, so we were not able to attend these.

3. **Complete at least 4 training sessions with at least 3 sessions outside southwest Florida**

Achieved beyond stated goals – 6 UF/IFAS sessions were held in 4 different locations plus 2 training sessions with large southwest Florida vegetable grower/packer (Lipman).

4. **Initiate a website for the training program.**

Program logo developed and website outline posted. Materials available on the website include course outlines, program brochures, related publications, links to relevant farm labor laws and government agencies, and UF/IFAS contact information.

5. **Written report summarizing second year activities.**

Done.

BENEFICIARIES

4a. Description of groups and other operations that benefited from project

Farm workers – The purpose of the FLC training is to teach the people who supervise the workers the rules, regulations, and in some cases, techniques related to that supervision. Though we have not measured the direct effect on specific workers yet, the knowledge obtained from our training should translate into better working conditions simply due to increased knowledge and understanding on the part of the supervisors.

FLCs – Farm Labor Contractors' jobs are complicated, especially considering the myriad of government agencies and farm worker advocates that focus on farm workers. Our training focuses on helping the FLCs better do their jobs while complying with various regulations, hopefully making it easier for them to traverse the paperwork and record keeping required. In addition, our training helps the FLCs know what to expect from inspections and how to be prepared. This preparation, meaning everything done according to law, should reduce the number and amounts of fines.

Specialty farm owners and operators benefit by having more competent supervisory employees or contractors and a safer and happier workforce. Also the financial benefits of reduced fines accrue not only to the FLC or supervisor, but, because of joint employment regulations, the grower usually ends up paying a portion of fines as well.

Government personnel involved with farm labor regulatory compliance – individual compliance officers are hearing the regulatory compliance issues of other government agencies and develop a greater appreciation of how their rules and regulations fit into a bigger picture of regulations. In some cases, they begin to see where overlap creates some institutional confusion.

4b. Quantitative data showing how beneficiaries affected by project accomplishments

In 2010, more than 13 growers and 14 major harvesting companies sent 182 FLC/supervisors/office staff to at least one training unit. A total of 126 people completed all units of the Core program. In 2011, 22 growers and 8 major harvesting companies sent 178 individuals for training in at least one of the five offered units. 115 people completed the Core program through the UF/IFAS scheduled training session. An additional 57 FLCs were trained through the Lipman Produce company training. Of the 417 individuals who participated in the Core training program since 2010, 315 were identified as FLCs who directly supervise seasonal and migrant farmworkers. Making a reasonable assumption that each FLC transports and or supervises at least 33 farm workers (size of average labor bus), that means over 8,000 farm workers now work for people with better knowledge of laws, procedures and protections related to the workers' physical and financial safety.

LESSONS LEARNED

5a. Insights learned by project staff

Limitations of Spanish-speaking attendees re: literacy was expected, but not to the degree observed. Even many of those who can read at least minimally were not familiar with the types of reading needed to complete the pre- and post-tests and the evaluation forms. Initially, some of the Spanish attendees thought the self-evaluations were for offering opinions on the quality of the information they were taught. In several cases, the attendees were almost completely illiterate, to the point where teachers or other attendees had to read them the questions and help them understand how to answer them.

Work to be done: Presentations, tests, and evaluations are being re-worked for a less-literate target audience. They will include more pictures and illustrations, and less text. Also, the format of the questions will be consistently multiple choice rather than the mixture of question-types we used this year.

Variability of agricultural environment. The need for workers in the fields is weather-dependent to the point that decisions about workers needed are sometimes made the day before, or even the same morning. This causes issues because the majority of our attendees transport workers to the fields and/or supervise them there. In 2010, our largest classes were in November, when we had a number of "walk-ins" to the training because it was raining. In 2011, we had to cancel a scheduled training session in Belle Glade, even though normally December would have been a good time, because unexpected weather conditions changed the agriculture schedule.

Work to be done: The nature of specialty crop production and of the target audience (supervisors of migrant farm workers) makes a 2-day in-class training difficult. We need to create other formats and venues for instruction. Future plans are to create web-based programs and to explore distance learning technologies so that regular training sessions can be repeated on numerous occasions throughout the entire year. In addition, we plan to market this program to employers and offer them the option of training on their work premises.

5b. Unexpected outcomes or results from implementing the project

A greater understanding of the FLC / worker supervisor environment was gained, especially the complexity of many of the licensing functions. We also gained an appreciation of how difficult the job is, and an understanding of the different levels of management functions that all have the same FLC licenses.

We realized that some of the information we are teaching the supervisors of the farm workers is valuable for the farm workers themselves. We have already held four classes, in Spanish, at Farmworker Village, a county-sponsored housing development in Immokalee, and more are planned at other locations for the future.

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ADDITIONAL INFORMATION

PUBLICATIONS

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Carlene Thissen and Fritz Roka. 2010. Non-Governmental Organizations Serving Farmworkers in Florida. Electronic Database Information System (EDIS), University of Florida, Cooperative Extension Service, Gainesville, FL. Web address: http://edis.ifas.ufl.edu/fe836
Fritz Roka. 2010. Compensating Farm Workers through Piece Rates: Implications on Harvest Costs and Worker Earnings. Electronic Database Information System (EDIS), University of Florida, Cooperative Extension Service, Gainesville, FL. Web address: http://edis.ifas.ufl.edu/fe792.
Roka, F., M. Olexa, K. Smallwood, L. Polopolus, and C. Fountain. 2010. Handbook of Employment Regulations Affecting Florida Farm Employers and Employees. Series of EDIS documents listed below with each document translated into Spanish.

http://edis.ifas.ufl.edu/FE390: Introduction http://edis.ifas.ufl.edu/FE392: Child Labor (State and Federal) http://edis.ifas.ufl.edu/FE393: Civil Rights and Discrimination (Federal) http://edis.ifas.ufl.edu/FE394: Earned Income Tax Credit (Federal) http://edis.ifas.ufl.edu/FE395: Emergency Planning, Right to Know (State) http://edis.ifas.ufl.edu/FE396: Family Medical Leave Act (Federal) http://edis.ifas.ufl.edu/FE397: Farm Labor Contractor Registration and Testing http://edis.ifas.ufl.edu/FE399: Field Sanitation (State and Federal)

http://edis.ifas.ufl.edu/FE400: Florida Landlord-Tenant Law (State)
http://edis.ifas.ufl.edu/FE401: Human Rights Act of 1977 (State)
http://edis.ifas.ufl.edu/FE402: Immigration Reform Programs (Federal)
http://edis.ifas.ufl.edu/FE403: Income Tax Withholding (Federal)
http://edis.ifas.ufl.edu/FE404: Migrant Farm Labor Camps (Federal)
http://edis.ifas.ufl.edu/FE405: Migrant Labor Housing (State)
http://edis.ifas.ufl.edu/FE406: MSPA (Federal)
http://edis.ifas.ufl.edu/FE407: FLSA Minimum Wage (Federal and State)
http://edis.ifas.ufl.edu/FE408: OSHA (Federal)
http://edis.ifas.ufl.edu/FE409: OSHA Hazard Communication (Federal)
http://edis.ifas.ufl.edu/FE410: Plant Closing Notification WARN (Federal)
http://edis.ifas.ufl.edu/FE411: Polygraph Protection (Federal)
http://edis.ifas.ufl.edu/FE412: Portal to Portal (Federal)
http://edis.ifas.ufl.edu/FE413: Right to Know (State)
http://edis.ifas.ufl.edu/FE414: Right to Work (State)
http://edis.ifas.ufl.edu/FE415: Social Security and Medicare (Federal)
http://edis.ifas.ufl.edu/FE416: Transportation – Alcohol and Drug Testing (Federal)
http://edis.ifas.ufl.edu/FE417: Motor Carrier Safety Regs for Drivers of Farm Vehicles (Federal)
http://edis.ifas.ufl.edu/FE418: Motor Carrier Safety Regs for Transport of Migrant & Seasonal Workers (Federal)
http://edis.ifas.ufl.edu/FE419: Transportation of Migrant & Seasonal Workers (State)
http://edis.ifas.ufl.edu/FE420: Unemployment Compensation (State and Federal)
http://edis.ifas.ufl.edu/FE421: Work Opportunity Tax Credit (WOTC)
http://edis.ifas.ufl.edu/FE422: WPS (Federal and State)
http://edis.ifas.ufl.edu/FE423: Workers' Compensation (State)

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PROJECT (13): FLORIDA TOMATO COMMITTEE: FLORIDA TOMATO RESEARCH AND PROMOTION INITIATIVES

FDACS Grant Contract #15557
Total Funding - $563,233.00
End Date: 3/31/2012

Project (13): Florida Tomato Committee: Florida Tomato Research and Promotion Initiatives

FDACS Grant Contract #15557
Total Funding - $563,233.00
End Date: 3/31/2012

Project Summary

The Florida Tomato Committee (FTC) utilized Specialty Crop Block Grant Program funds in a research and promotion program to explore opportunities to help reverse sales erosion of Florida tomatoes with existing retail customers while identifying opportunities to expand share in new markets with new retail accounts. In the summer of 2008, the largest ever outbreak of salmonella contaminated fresh produce in the United States generated over 1,400 illnesses. Initially, tomatoes were fingered as the suspect by the U.S. Food and Drug Administration and as such Florida tomatoes were maligned many evenings in the national news, with tomato shipments from Florida halting as a result. In the end, jalapeño and Serrano peppers from Mexico were genetically proven to be the source of the outbreak, not tomatoes. The potential financial impact to Florida's fresh tomato industry is yet to be fully realized. Though some estimates suggest tomato growers lost upwards of 300 million dollars during the outbreak, the long-term effect of the damage is unfathomable with market share yet to be fully regained four years later. Months after the outbreak, consumer research revealed approximately 33 percent of consumers aware of the outbreak, were still unaware it was safe to eat tomatoes again, with 8 percent vowing never to purchase tomatoes again.

A compounding factor in Florida tomatoes' shrinking market share over the years is that the supermarket tomato section has dramatically changed in terms of category complexity. Driven by new product introductions and off-shore production, the number of tomato products competing for retail space and consumer attention has significantly increased in recent years. The result is a loss of focus at retail as the shelf presence of the key tomatoes that drive a majority of the sales has splintered. Although, past consumer research* suggests consumers prefer to purchase field-grown tomatoes from U.S. producers, these products are often hard for consumers to identify.

**University of Florida, Food Resources & Economics, consumer study, Dr. John Vansickle; Perishables Group consumer survey commissioned by Florida Tomato Committee.*

Considering the FOB price per 25 pound box of Florida tomatoes averaged around $13.71 for the 2007-08 season (45 million boxes), then dropped to a painfully low FOB price per box average of $7.93 the following year due to low demand after the national false

salmonella outbreak in tomatoes, there was a critical need for investigation into how to stave off further erosion and help develop a plan for future growth.

This program has an intense focus on tomato category and marketing research in the form of promotional best practices research, consumer survey research, retailer testing and grocery scanner data review, in addition to a promotional component in place as well to help drive retail traffic and educate consumers on Florida tomatoes' availability and wellness offering.

Project Approach

- Support expanded distribution of Florida tomatoes by identifying obstacles to distribution and sales growth.
- Initiate a process for prioritizing markets and identifying target retail accounts.
- Establish a broad set of retail information to identify purchase triggers and drivers for tomato consumers.
- Develop retail tools to identify optimal strategies to increase retail performance.
- Enhance existing retail relationships through effective partnerships that maximize Florida tomato movement that benefits the Florida tomato industry.
- Develop new relationships and effective partnerships with retailers that will maximize Florida tomato movement that benefits the Florida tomato industry.
- Gain support with retail data evaluation so that effective and ongoing recommendations and plans can be made for key retail accounts.
- Provide promotional support to drive consumer retail traffic and selection of Florida tomatoes

Goals and Outcomes Achieved

Promotional Best Practices

The purpose of conducting a promotional best practices review was to develop a set of fact-based recommendations to use with retailers on optimal Florida tomato promotions. Initially, plans included securing retailer promotion data January through June 2010 and comparing against prior year to develop recommendations, however, due to freezing conditions in January 2010, there has been a limited volume of fresh Florida tomatoes available in stores. As a result, we tempered the timing for the dataset to reflect more typical sales volumes and data in order to make the most accurate analysis. Dataset dates:

2009-2010 Season
Nov. – Dec. 2009

May – June 2010

2008-2009 Season
Nov. 2008-Dec. 2008
Mar.-June 2009

Perishables Group secured additional retailers in September for this analysis and the promotional best practices report was delivered mid-December. The goal of this study was to analyze past tomato promotional activity to identify best practices for tomato promotions. Ten retailers were selected in the Northeast and South regions based on their overall sales performance and promotional activity for tomatoes.

Specific study objectives included: identifying the optimum price discount and promotion frequency for achieving maximum tomato category and field round tomato volume movement and dollar sales lift. The study also analyzed the number of items in the promotion, frequency, tomato items included and feature or front page ads in weekly food supplements/mailers.

Here are some key highlights of the results (this information was provided to retailers and industry members to help maximize Florida tomato sales):

Optimum Discount Level

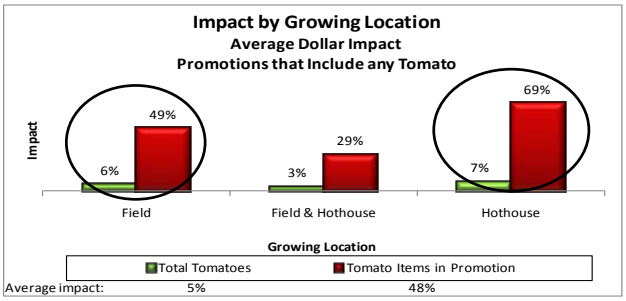
- On average, retailers should discount field tomatoes 31% to 40% when on promotion to achieve the best long-term sales results
- This discount level resulted in larger dollar impacts on the tomato category (7% increase) and field round tomatoes (21% increase)
- While effective, the discount ranges of 41% to 50% should be used sparingly, as regular deep discount promotions can result in lower category dollars

Frequency of Tomato Promotions

- Run one to three field round tomato promotions per month during season (including print ads and ISPRs or in-store price reductions)
- The total tomato category does best when at least one tomato item (from any subcategory) is on promotion each week

Category Items to Include in the Promotions

- **Promote field round tomatoes by themselves:** In promotions that included field tomatoes only, the average dollar lift was 17% with a volume increase of 52%

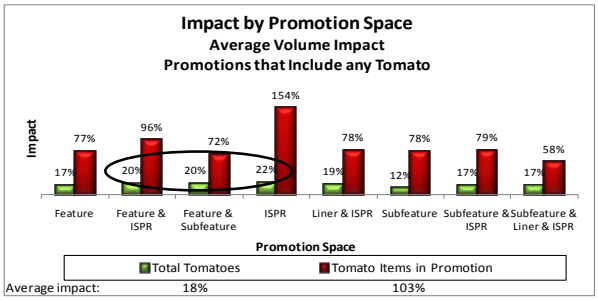


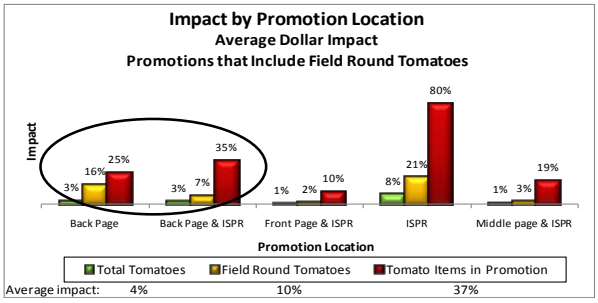
- **Promote field tomatoes separate from hothouse tomatoes.** Keeping field and hothouse tomato promotions separate benefitted each item and the category

- When promoting field tomatoes with other key tomato subcategory Items, include snacking tomatoes in the promotional mix. Featuring up to two tomatoes in promotions that included field round tomatoes along with snacking tomatoes resulted in the highest dollar impacts for the tomato category
- Packaged field tomatoes perform well on promotions; make sure to promote packaged field tomatoes as well as bulk
- The total tomato category does best when multiple varieties of tomato subcategories are promoted together

Type of Promotional Activity

- Promote multiple field tomato items on the same print ad page coupled with an in-store price reduction, or use in-store price reduction promotions only (resulted in a 21% lift for field tomatoes)
- Promote field tomatoes on the back page of print ads which resulted in a 16% sales lift
- For best results, promote field tomatoes as circular sub features coupled with in-store price reductions, or as in-store price reductions only
- Tomatoes that were promoted in a print ad with "x for" pricing coupled with an in-store price reduction (loyalty card) resulted in high volume impacts on the tomato category





The promotional best practices were summarized and combined with some of the findings from the scanner data and the consumer research and highlighted in a Florida Tomato Committee publication called A Recipe for Success: 10 Key Steps to Increase Tomato Category Sales. The promotional research publication was provided to retail partners and to the industry. It is also currently available on the FTC website. As various research projects progressed and finalized, communication pieces were made available to industry and retail partners. A final publication was developed in 2012 spring, "Ten Steps to Grow Your Tomato Category Sales" which gleaned all of the various research projects and is currently available online at the Florida tomato website and in a printed piece for retail buyers.

<u>In-store consumer intercepts</u>

To understand consumer purchase attitudes and preferences and what sorts of activities, promotions, point-of-purchase materials, etc., resonate with consumers, FTC launched a comprehensive survey of 1,500 tomato consumers, with 75 surveys collected per store in 5 stores in each of four chains in the south/east U.S. regions. The survey was approximately 25-30 questions in addition to some demographic classification questions. Primary objective of the in-store research is to identify key sales opportunities and substitution factors impacting Florida tomatoes. The survey was executed by interviewing consumers in the store during the spring of 2010 when Florida tomatoes are readily available.

The FTC was able to secure four different retail chains that allowed their shoppers to be interviewed in the fresh produce department where the buying decisions are made. Initially, the consumer interviews were expected to begin in March 2010, however due to the lack of fresh Florida tomatoes available in stores because of the sustained freezing temperatures in January and early February 2010, the consumer survey intercepts were pushed back to begin fourth weekend of April 2010, when fresh Florida tomatoes would be more readily available. Ultimately, the bulk of the interviews were conducted in May and finished the first week of June, due to product availability. Interviews (1,500) were conducted in the produce departments of four major retailers -- two in northeast and two in southeast regions. The information was consolidated into a consumer research report for the industry. Some of the highlights were included in a newsletter pasted below:

Volume 1, Issue 1

Research Report Update

FLORIDA TOMATOES

800 Trafalgar Court • Suite 300 • Maitland, Florida • Phone 407-660-1949 • FAX 407-660-1656

Top Reasons Why Consumers Buy Tomatoes: Flavor and Health

Preferences for Field Tomatoes Documented in Recent Research Study

About half of consumers surveyed in the produce department of select retailers this past May 2010, reported their primary reason for purchasing fresh tomatoes is the flavor.

In addition, nearly 40% identified health and nutrition as their top reason for purchasing fresh tomatoes.

These results are based on a consumer research study conducted by the Perishables Group on behalf of the Florida Tomato Committee. The study surveyed 1,500 tomato consumers in-store across four major U.S. retailers in the Southeast and Northeast. The goal of the study was to understand consumer attitudes and preferences for tomatoes and key purchase drivers.

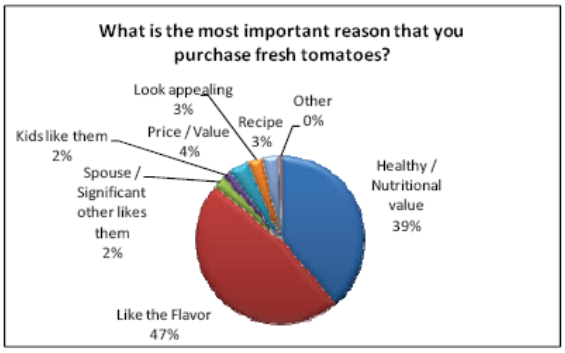


Figure 1: Perishables Group, Consumer Survey

Inside this Issue:

Preferences for USA Grown compared to Imports

Promotional Opportunities for Field Tomatoes

Consumer Research: Demographic Profile

For more information on the research study results or label information contact Samantha Winters Florida Tomato Committee 407-660-1949.

Key facts regarding consumer purchase behavior:

Planned vs. Impulse Buys

- Tomato purchases are generally planned. Three-fourths of consumers know what type of tomato they will purchase before entering the store

Variety Preference

- Nearly 30% of consumers said round field-grown tomatoes are their favorite type of tomato
- A quarter said hothouse cluster tomatoes are their favorite, and 21% prefer Roma tomatoes
- Three-fourths of consumers overall chose their preferred tomato based on flavor

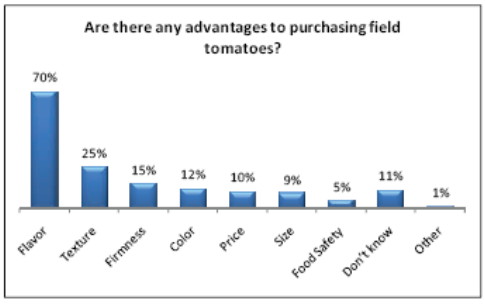


Figure 2: Perishables Group, Consumer Survey

Field vs. Hothouse Tomatoes

- More than half of tomato consumers surveyed are aware that some tomatoes are field-grown and others are hothouse-grown
- Of those who are aware that there is a difference between the two, 70% stated they prefer the flavor of field tomatoes

Trends & Recommendations

Consumers Surveyed Rate U.S.A. Grown tomatoes as appealing as Locally Grown

According to the 2010 research study, conducted by the Perishables Group, at least 60% of consumers surveyed said locally-grown, U.S.-grown and Florida-grown tomatoes are appealing or very appealing.

In addition, nearly half of consumers would be willing to pay more for USA grown tomatoes over imports.

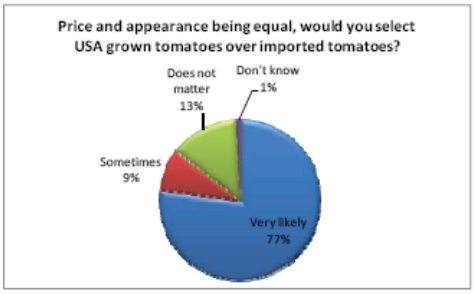


Figure 3: Perishables Group, Consumer Survey

USA and/or Florida-Grown POS signage from the Florida Tomato Committee is available and beneficial for Florida tomato merchandising displays, especially during peak season promotions. Our USA Grown Florida Tomatoes PLU label is also available for Florida tomato suppliers and handlers to use with Florida field-grown tomatoes.

2010 Consumer Research Demographic Profile

Consumers surveyed
1,500 tomato consumers

Household income
About a third of those surveyed earn between $25,000 and $75,000 per year

Household size
More than half of respondents reported having no children at home

Another 22% have two or more children under 18 in the home

Age
Shoppers of all ages were surveyed, with a third between the ages of 25 and 44

Ethnicity
The following ethnic groups were represented in the study: Caucasian, African American, Hispanic and Asian consumers

Gender
Seventy-percent of consumers surveyed were female

Opportunity to Increase Promotional Activity of Field Tomatoes

Tomatoes are an important category ranking among the top 5 vegetable categories in the produce department. Most importantly, field tomatoes are the category's foundation – the key staple for planned purchases.

Recent consumer research from the Perishables Group indicates that:

- Consumers generally include their favorite tomato variety on their shopping list
- Yet, 60% of consumers surveyed would consider purchasing another type of tomato if it were on sale

Nationwide, field tomatoes account for about 20% of tomato category sales and volume; yet, nearly 30% of consumers said round field-grown tomatoes are their favorite type of tomato. Although, consumers may be motivated by sale price they are also motivated by purchasing locally or USA grown produce compared to imports.

This provides an opportunity for retailers to increase promotional activity on field tomatoes from Florida to maximize sales and spur increased impulse purchases.

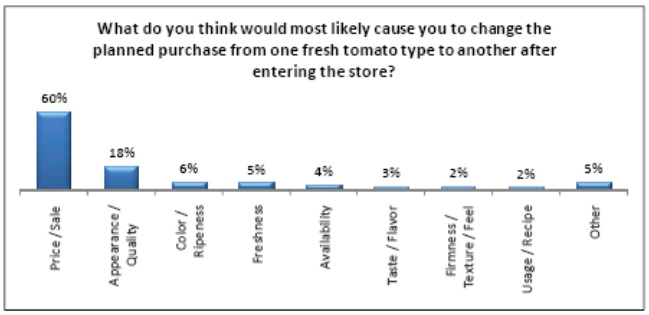


Figure 4: Perishables Group, Consumer Survey

Retail Testing Component

This study compared three chains that were doing great with Florida tomatoes and three chains that were doing poorly with field tomatoes. Interestingly, the chains that did well with field tomatoes and gave field tomatoes appropriate pricing and display price, had exceptionally better sales of the entire tomato category. This strengthens our case with retailers for why they should be promoting field-grown tomatoes from Florida. Some of the highlights from the study:

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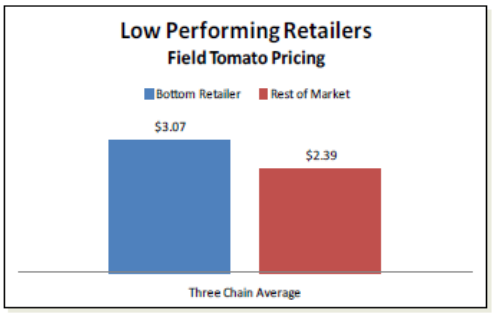
High performing chains priced Florida tomatoes more aggressively than market competitors.

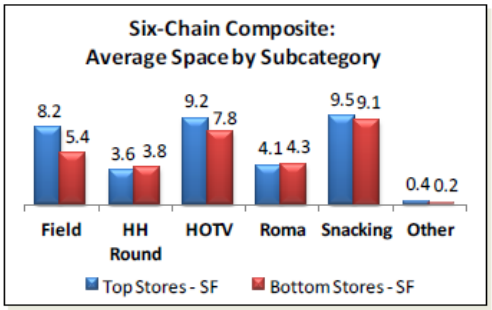
Chains with the strongest overall performance priced Florida tomatoes 18% lower than the competitive market.

- Chains with low performance priced Florida tomatoes 28% higher than the competition, hurting category sales.



Stores with top tomato category performance build larger Florida tomato displays.

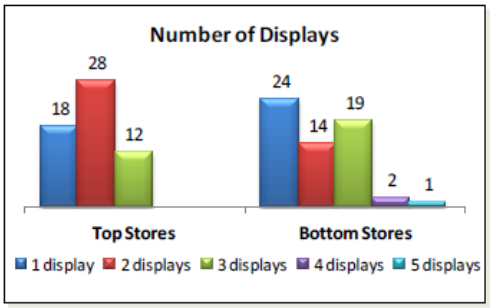
In 120 space audits, the largest difference noted between stores with strong and weak tomato performance was the space allocation for field tomatoes.



Top performing stores use secondary tomato displays.

Nearly 50% of top-performing stores use strong secondary tomato displays.

- Only 23% of bottom stores use secondary displays.
- Bottom stores were more likely to split displays into small ribbons since they have less category space.



The importance of Florida tomatoes to category success directly increases closer to the Florida production area.

- This is particularly strong in a radius of 500 miles.
- One New England chain generated double-digit volume share in Florida tomatoes while outperforming market competitors.

For more information and a copy of the complete report, please contact Samantha Winters, Director, Education and Promotion, at the Florida Tomato Committee: Samantha@floridatomatoes.org.

Driving Retail Traffic

Another major activity in the promotional allowance component was the radio and billboard campaign. The radio program included a series of live endorsements by local radio personalities in each of the targeted markets. FTC received a copy of the live endorsements and is satisfied with the 3-part messaging regarding Florida tomatoes being available now, the best flavor in years and not to refrigerate them.

CBS Radio – Florida Tomato Committee Campaign 4/25/11 – 5/15/11,

Audience Estimates

Based on Demographics: Adults 25-64

Survey Periods: April 2011 & May 2011Arbitron

Live Endorsements – Two (2) Week Campaign 4/25/11 -5/6/11

Market	Total Spots	Audience
Orlando, FL – WOCL-FM	10	171,700
Orlando, FL – WOMX-FM	10	115,700
Tampa, FL – WRBQ-FM	10	155,900
Tampa, FL – WQYK-FM	10	198,500
West Palm Beach, FL – WEAT-FM	10	97,800
Philadelphia, PA – WOGL-FM	10	480,100
Charlotte, NC – WSOC-FM	10	211,200
Atlanta, GA – WZGC-FM	10	194,200
TOTALS	**80**	**1,520,970**

Additional Radio Commercials – Three (3) Week Campaign 4/25/11 - 5/15/11

Market	Total Spots	Audience
Orlando, FL – WOCL-FM	81	482,700
Orlando, FL – WOMX-FM	81	532,700
Tampa, FL – WRBQ-FM	102	608,400
Tampa, FL – WQYK-FM	81	467,600
West Palm Beach, FL – WEAT-FM	81	328,600
Philadelphia, PA – WOGL-FM	81	1,289,300
TOTALS	**507**	**3,709,300**

Promotion – Florida Tomato Committee $50 American Express Card Prize Pack Giveaway 5/9/11-5/13/11

Market	Total Spots	Audience
Orlando, FL – WOCL-FM *	10	171,700
Orlando, FL – WOMX-FM	5	87,800
Tampa, FL – WRBQ-FM	5	140,000
Tampa, FL – WQYK-FM	5	147,000
West Palm Beach, FL – WEAT-FM	5	71,900
Philadelphia, PA – WOGL-FM	5	350,000
Atlanta – WZGC-FM	5	142,800
TOTALS	**40**	**1,111,200**

- ***5/9/11 – 5/22/11***

TOTAL # CAMPAIGN COMMERCIALS = 587
TOTAL # PROMOTIONAL ANNOUNCEMENTS = 40
TOTAL # DIFFERENT LISTENERS = 6,341,470

Billboards:
The FTC had two billboards up in Florida – one in Ft. Pierce on I95 and one in Lakeland on I4. In terms of the quantitative audience numbers, the most important number is the D.E.C. That is considered the Daily Effective Consumer Purchasing Power over the age of 18. On the Ft. Pierce board, an estimated 35,090 consumers over the age of 18 viewed the billboard every day. 35,090 consumers (Adults 18+) x 28 days = 982,520 consumers (Adults 18+) that viewed the billboard for the month duration.

For the board that was on I-4 in Lakeland, the D.E.C. number is 30,850 consumers (Adults 18+) that viewed the billboard on a daily basis x 28 days = 863,800 consumers (Adults 18+) that viewed the billboard from 4/25/11 – 5/22/11.

Merchandising Team Component
FTC engaged two expert merchandisers, Sheila Carden and Cece Krumrine, with close retail partnerships to aid in the communication and outreach to existing and new retail partners throughout the eastern and southern regions of United States. Retail outreach began in December 2010, just before the season. Merchandisers actively set up promotions with retailers and communicated the status of the fresh Florida tomato crop via email, telephone, mailings and face-to-face meetings. They offered the retail buyers FTC quality and handling tools, point-of-purchase materials, promotional best practices (Recipe for Success-10 key steps to increase tomato category sales) and engaged promotions. Initially, the FTC had planned to promote throughout the entire spring season, however sustained freezing temperatures in January and February were extremely damaging to the fresh Florida tomato crop. In fact, estimates are that nearly 80 percent of the tomato crop was destroyed by cold temperatures.

Promotional Allowance Component
This component was used to power retail promotions and drive consumer traffic to buy Florida tomatoes. The FTC worked with retail partners to spur tomato sales movement

through communications and promotions including customized sales contests, in-store radio, cooking demonstrations and sampling programs, display contests, as well as advertising circulars and newsletter and magazine support. The Committee provided point-of-purchase promotional posters, shelf cards and new tear-off recipe pads this past season to help spark merchandising creativity.

We were able to secure support from retailers during Florida tomato production months with ad circular ads and email blasts to customers that pushed Florida tomato sales, display and sales contests as well as demos and in-store and drive-time radio. Through our merchandising team, we also secured placements in high-color retail grocery magazines and brochures. One sales contest was estimated by the retailer to increase sales 41 percent.

As also outlined earlier in this report, FTC conducted a 4-week radio, billboard and data messaging campaign with CBS radio in south and northeast markets, as well as a full page Family Features media piece distributed for print and online usage. The page featured FDACS' Florida Chef Justin and included an online cooking video. The feature went out in early April and ended June 7, but secured a print and online presence in the form of 25 million impressions. Print secured 128 articles for 5.2 million readers. Online presence was estimated to be 489 placements reaching 18 million and newswire placements garnered 245 placements reaching 24 million online. According to Family Features, the ad equivalency is estimated to be $373,820, which is a 36:1 ROI on the $10,000 investment:

you say TOMATO

Recipes fresh off the vine

FAMILY FEATURES

There's nothing like a juicy, ripe tomato to wake up a recipe and put a smile on your face. And tomatoes' versatility means that you can enjoy them in a wide range of dishes that make friends and family smile, too.

"Florida tomatoes have been the inspiration for many of my most treasured recipes," said Chef Justin Timineri, Executive Chef and Culinary Ambassador, Florida Department of Agriculture and Consumer Services. "But honestly, my side dish of choice — the simple joy of fresh raw Florida tomatoes seasoned with a sprinkle of sea salt."

Chef Justin Timineri

Chef Justin has created these recipes that maximize that fresh-off-the-vine taste and minimize your time in the kitchen.

For more Florida tomato recipes, visit www.floridatomatoes.org.

Your Recipe Could Win $500

To celebrate the versatility and great flavor of fresh Florida tomatoes, the Florida Tomato Committee is hosting its Most Delicious Dish Recipe Contest. Submit an original recipe that incorporates fresh Florida tomatoes. The winning recipe will be selected on the basis of taste, appearance and ease of preparation, with attention also given to clear and creative photos. Get all the details at www.floridatomatoes.org.

Arugula and Mozzarella Spiked Tomatoes with Basil Vinaigrette

Yield: 4 servings

4 medium sized Florida tomatoes
1 pound fresh mozzarella cheese
1 bunch fresh Florida arugula (or basil)

Vinaigrette:
1/3 cup olive oil
2 tablespoons apple cider vinegar
1 tablespoon honey
2 tablespoons chopped fresh basil
1 clove garlic, minced
Kosher salt and fresh ground pepper to taste

For vinaigrette: In medium sized bowl, whisk together olive oil, vinegar, honey, basil and garlic until completely emulsified. Taste and adjust seasoning with kosher salt and fresh ground pepper.

Rinse tomatoes under cold running water and pat dry with clean paper towels. With a sharp serrated knife, cut each tomato into an even number of wedges. Then make a horizontal cut near the tip of each wedge, being careful not to cut all the way down. Set aside sliced tomatoes.

Cut mozzarella into slices that will fit into the slices made in the tomatoes. (Try to fit one piece of mozzarella into a tomato to see what size you'll need to cut the rest.) To assemble, insert a slice of mozzarella into each tomato wedge. Arrange wedges on a plate and top with arugula or basil leaves. Garnish with basil vinaigrette. Season with kosher salt and fresh ground pepper to taste. Serve at room temperature.

Classic Tomato Flavoring Partners

When creating your own tomato dishes, keep these great flavor partners in mind:

- Basil
- Black Pepper
- Kosher Salt
- Lemon
- Lime
- Chili Peppers or Powder
- Curry Powder
- Garlic
- Orange Zest
- Oregano
- Rosemary
- Tarragon

Storing Tomatoes

Are you one of the 60 percent of people who currently store tomatoes in the refrigerator? Chef Justin says that kills flavor and texture.

Instead, ripen your tomatoes in a bowl on your counter where they can reach full flavor and color — a treat for your eyes and your palate. To hasten ripening, place tomatoes in a sealed paper bag or fruit-ripening bowl.

Sunshine Mary

Yield: 6 servings

6 large ripe Florida tomatoes, peeled, seeded and diced
3 tablespoons freshly squeezed lemon juice
3 tablespoons freshly squeezed lime juice
2 tablespoons Worcestershire sauce
4 cloves fresh garlic, minced
2 teaspoons hot sauce, (or more if desired)
2 teaspoons fresh horseradish (or prepared)
1 teaspoon kosher salt
1 teaspoon seafood boil seasoning (Cajun seasoning will do)
2 teaspoons celery salt
1 teaspoon fresh ground pepper
Salt or sugar to taste, for glass rims

In a blender, combine all ingredients except last until smooth. Taste and adjust seasoning to preference. Pour Sunshine Mary mix into a food storage container or pitcher, cover and chill.

To assemble, combine 1 ounce of good quality vodka to every 6 ounces of Sunshine Mary mix. Pour salt on a napkin. Moisten the top of the glass and rotate the rim in the salt. For a sweet twist, try sugar instead of salt. Pour drink from pitcher over ice and garnish with celery sticks.

Tomato and Cucumber Salsa

Yield: 4 to 6 servings

2 large Florida tomatoes, diced
1 large Florida cucumber, seeded and diced
1/2 cup red onion, chopped
1/2 cup Florida bell pepper, chopped
1/4 cup fresh parsley, chopped
1 tablespoon red wine vinegar
1 teaspoon Italian seasoning
1 lemon, juiced
Kosher salt and fresh ground pepper to taste

In medium sized mixing bowl, combine all ingredients. Stir to combine. Taste and adjust seasoning with salt and pepper.

Communications Component

Point of purchase materials were designed and printed. Several retailers signed on to sales and display contests that also required poster and shelf card printing, kitting and shipping.

As mentioned earlier, recipe cards and retail brochures were designed and printed for retail partners and tomato industry to use to move more Florida field-grown tomatoes. The brochure highlights the purchase triggers gleaned from FTC's consumer research, promotional best practices and scanner data, supported by this grant!

The FTC was able to secure four different retail chains that allowed their shoppers to be interviewed in the fresh produce department where the buying decisions are made.

Beneficiaries

Over 80 growers of fresh Florida tomatoes are directly impacted by the loss of retail share. These growers collectively affect several thousand employees and around 955 million pounds of fresh Florida tomatoes annually. The objective of this effort was to initiate an "intelligent selling" platform to establish and/or enhance retail relationships across a range of retail customers and channels for Florida tomato growers. FTC has received tomato category performance data (retail supermarket scanner data) from A.C. Nielsen/Perishables Group for key regions/markets. This includes volume and pricing. Upon receipt, FTC has been making this information available to the industry, who could share that information with their customers. FTC merchandisers also communicated the positive pieces of this dataset to retailers as well. The information has helped the FTC in identifying opportunities and planning which markets and retailers to target for promotions, promotional dollars and outreach. It will also be used as a benchmark in moving forward and planning future marketing activities.

FTC received its last dataset in March 2012 to finish the 2011 year, however the data is still available online to Florida's tomato growers. Each research and promotion initiative component accomplished in this program will continue to be leveraged to gain retail support to moving more Florida tomatoes. This data, as well as consumer research, promotion practices research and retail testing is made available to industry via the FTC's web site.

Lessons Learned

The quantitative and qualitative key learnings from the category, consumer and retail research were put into several reports and archived on the Florida tomato website where industry and retail may access them. Key highlights have been addressed earlier in this report and included in some of the communications vehicles that were provided to the trade.

Due to the volatility of the fresh tomato market and production in Florida, we faced many obstacles in procuring the research results. Adverse weather phenomenon made us adjust plans several times including for example in the consumer survey project. Initially, the consumer interviews were expected to begin in March 2010, however due to the lack of fresh Florida tomatoes available in stores because of the sustained freezing temperatures in January and early February 2010, the consumer survey intercepts were pushed back to begin fourth weekend of April 2010, when fresh Florida tomatoes would be more readily available. Ultimately, the bulk of the interviews were conducted in May and finished the first week of June, due to product availability. Ultimately, we were able to accomplish our research but in the future, I would recommend to allow for flexibility with scheduling and an understanding that some activities may need to be delayed until appropriate supply is available.

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Additional Information

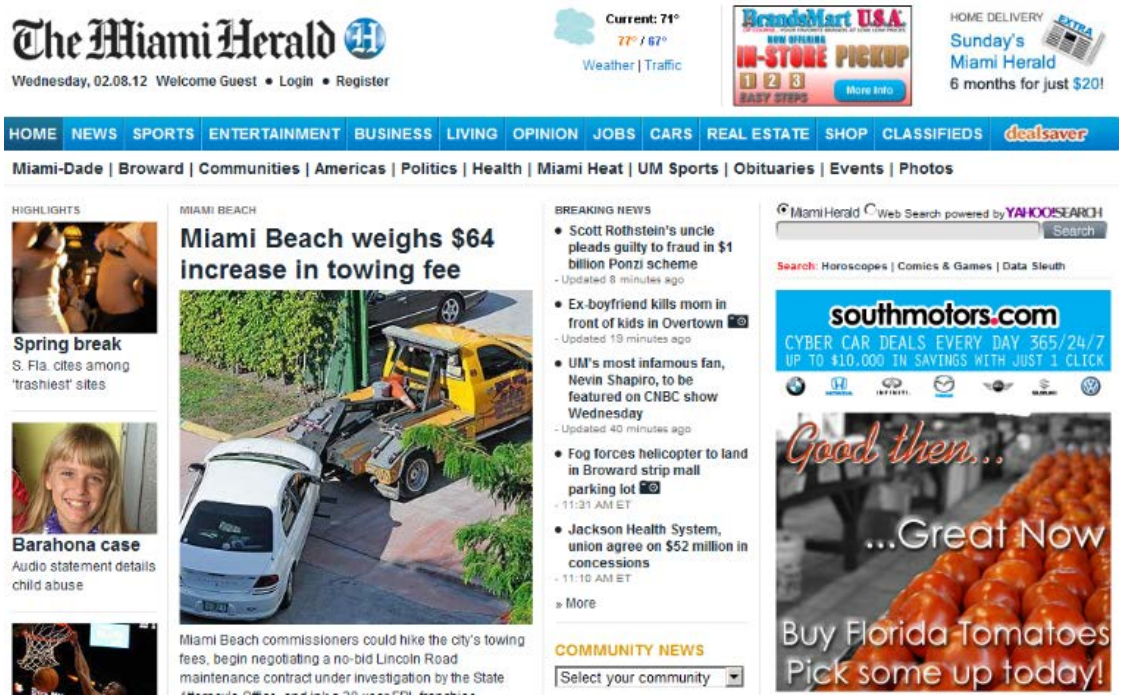
Each research and promotion initiative component accomplished in this program will continue to be leveraged to gain retail support to moving more Florida tomatoes. The information in this program will be used in an ongoing basis, for instance, FTC developed a new retailer brochure in 2012 based on the scanner data, promotional best practices and recent consumer research that will be used in subsequent seasons in retail meetings and other outreach with retail partners.

During January 2012, adjustments were made to the program budget in order to strengthen a final spring promotional push that was needed due to an early season glut of product. We had an amendment approved to the Grant Contract#015557 in order to fund a targeted retail and marketing promotion with the FDACS Marketing Division. Although the program was amended, the goal remained the same – to maximize Florida tomato sales.

The FTC teamed up with the FDACS to place a Florida tomato ad in 21 online Florida newspapers for 30 days, beginning February 6. The list of newspaper websites and online report with number if impressions per site follows. The CTR (click-thru rate) was 4x the national average (which is .02%)!

Site Name	Ordered Impressions	Served Impressions	Total Clicks	CTR
Bradenton Herald	46,331	61,545	117	0.19%
Daytona Beach News Journal	61,720	64,528	118	0.18%
Florida Today	192,941	206,354	78	0.04%
Ft Myers News Press	112,393	118,886	75	0.06%
Jacksonville Florida Times	167,177	245,277	295	0.12%
Lakeland Ledger	84,745	89,618	94	0.10%
MiamiHerald.com	549,124	601,650	801	0.13%
Naples Daily News	112,908	133,105	122	0.09%
Ocala Star Banner	69,072	73,072	139	0.19%
Orlandosentinel.com	570,098	598,820	353	0.06%
Palm Beach Post	387,246	461,080	535	0.12%
Panama City News Herald	44,281	43,317	80	0.18%
Pensacola News Journal	97,650	104,053	66	0.06%
Port Charlotte Sun Herald	9,933	10,349	15	0.14%
Sarasota Herald Tribune	91,848	96,557	108	0.11%
Sun Sentinel	492,950	529,605	275	0.05%
Tallahassee Democrat	55,714	55,092	29	0.05%
Tampa Bay Times	369,342	352,241	323	0.09%
Tampa Tribune	290,481	359,420	235	0.07%
The Gainesville Sun	94,298	99,455	96	0.10%
Treasure Coast News Press	99,750	110,073	71	0.06%
Totals	**4,000,002**	**4,414,097**	**4,025**	**0.09%**

The following is a graphic of the Florida tomato/FDACS ad on the Miami Herald website:



Good then...
Good then...
...Great Now
Good then...
...Great Now
Buy Florida Tomatoes
Pick some up today!

PROJECT (14): NEW NORTH FLORIDA COOPERATIVE ASSOCIATION, INC: FARM-TO-SCHOOL PROGRAM - ENHANCING SPECIALTY CROP CONSUMPTION FOR SCHOOL MEAL PROGRAMS

FDACS Grant Contract #15556
Total Funding - $80,000.00
End Date: 6/30/2011

Project (14) New North Florida Cooperative - Farm to School - $80,000

PROJECT TITLE
Enhancing Specialty Crop Consumption for School Meal Programs

FINAL PERFORMANCE REPORT

Project Summary
Both schools and small farmers benefitted from participation in the "farm-to-school" initiative. Schools provided children fresh, tasty, nutritious produce, while small farmers acquired new market opportunities. Schools were able to provide fresh produce quickly and with lower transportation costs by buying it from small farmers instead of from distant markets. Moreover, children learned about how the produce is grown and the role it plays in a healthful diet; thereby experiencing the value and appeal of fresh fruits and vegetables first-hand in the cafeteria. The project confirmed that farmers must consider a number of logistical issues to provide produce to schools. Products must be supplied in the volume, variety, quality, and selection that the schools need, and must be delivered when schools want it. Generally, it was found to be essential to join together in a cooperative or some larger organization in order to meet the schools' needs. Equally important, school officials must have a genuine commitment to placing local produce on their menus.

Specialty crop farm operations have been the foundation for many farming areas in Florida. These operations have historically been the backbone for many of these economies. However over the past few decades, Florida farm communities have experienced economic difficulties and obstacles, and are in need of economic stimulus. Recent market analyses determined that integrating school nutrition programs into the market alternatives for specialty crop production can provide economic, social and nutritional benefits. USDA food programs have been encouraging providing fresh fruit and vegetables, i.e. specialty crops, for school nutrition programs. This marketing effort not only provides a source of nutritious food products, but also fosters harmony between small farmers and local schools. School nutrition programs may not be a large market outlet, but can prove important and remunerative to small-scale specialty crop producers. Schools can serve a stable and consistent market for small-scale producers because of the size of the population served seldom vary significantly and set menus are served at regular intervals.

The purpose of the proposed project was to enhance the competitiveness of specialty crop enterprises by increasing child nutrition knowledge and consumption of specialty crops. The project sought to encourage local school district consumption of specialty crop products through participation in Farm-to-School efforts. Farm-to-School allowed for schools to have access to locally grown specialty crop products, at the same time guided school feeding programs toward promoting healthy eating habits among children.

Project Approach
Training and Outreach - Identified school districts for participation in pilot training demonstrations

- ☐ Developed collaborative relationship with FL Dept of Education Child Nutrition Program to promote consumption of specialty crop products through Farm-to-School in select Florida school districts.
    1. Three meetings with staff persons were conducted over the project period.

2. These efforts assisted in recruiting school district participation and implementation of NNFC Farm to School model

- ☐ Twenty-four (24) districts were trained in the basic tenets of Farm to School and incorporation of specialty crop products into school meal programs.
    1. *All of the identified districts participated in at least one (1) one-on-one training session during the project period (See Table for list of school training activities).*
    2. Training topics included developing farm to school efforts, incorporating specialty crop products into school meal programs, menu planning, procurement requirements and distribution logistics.

- ☐ Fourteen (14) out of twenty-four (24) identified districts participated in pilot training activities.
    1. **Refer to proposal citing as a specific activity *"to identify school districts for participation in pilot demonstrations."* Pilot definition: a small scale preliminary study conducted before the main decision is made.**
    2. NNFC conducted pilot training demonstrations designed to introduce and train school districts in facilitating Farm to School efforts in order to incorporate fresh specialty crop products into school meal programs.
    3. Fourteen (14) districts participated in training activities that involved receiving specialty crop products as product demonstrations and/or promotions to be served in school meals during the spring semester 2010, fall semester 2011 and spring semester 2011.

Santa Rosa - 25,000	Okaloosa - 31,000
Washington – 3,500	Jackson - 7,300
Bay – 26,000	Gulf – 2,100
Liberty - 1,500	Calhoun – 2,200
Gadsden – 6,400	Leon – 35,000
Wakulla - 5,200	Duval - 122,000
Osceola – 51,000	Miami-Dade – 40,000 (selected schools)

       Lake and Orange were interested in participating in the pilot activity, however, their local produce distributor was not.
       - These districts incorporated fresh green beans, leafy greens, value-added sweet potatoes and/or strawberries.
    4. The outcomes include implementation of successful pilot training activities and the participating schools districts willingness to incorporate specialty crop products into their menus for the 2011-12 school year.

Provided training and assistance for specialty crop producers

- ☐ Conducted three (3) on-station specialty crop production demonstrations with leafy greens (collards and turnips) and green beans in spring 2010, fall 2011 and spring 2011.
    - On-station training activities were hands-on group, as well as one-on-one training, with participating specialty crop producers.
    - Weekly sessions and one-on-one assistance were conducted.
    - Training topics included seedbed preparation, planting, crop management, irrigation and water management, nutrient and pest management, harvesting and post-harvest handling, value-added processing and packaging, market development and distribution logistics.

- Nine (9) specialty crop producers and four (4) youth entrepreneurs participated in on-site hands-on production/marketing training activities at NNFC site in spring 2010.
- Seven (7) specialty crop producers and four (4) youth entrepreneurs participated in on-site hands-on production/marketing training activities at NNFC site in fall 2010.
- Thirty (30) specialty crop producers and seven (7) youth entrepreneurs participated in on-site production/marketing training activities at NNFC site in winter/spring 2011.

☐ Conducted five (5) on-farm specialty crop production demonstrations
- Training topics included market development, leafy greens (collards, turnips) and green bean crop production and management, harvesting and post harvest handling, value-added processing and packaging, market development and distribution logistics.
- Two (2) specialty crop producers were trained on-farm in marketing strawberries to schools in spring 2010.
- Four (4) specialty crop producers were trained through on-farm demonstrations in production and marketing of collards, turnips and green beans in spring 2010. These farmers served as farmer mentors and trainers.
- Four (4) specialty crop producers were trained through on-farm demonstrations in production and marketing of collards and green beans in fall 2010.
- Thirty (30) specialty crop producers and five (5) youth entrepreneurs were trained through on-farm demonstration in production, value-added processing and marketing of collards and turnips in spring 2011.

<u>Specialty Crop Research/Product Development</u>

Identified and evaluated specialty crop products that can be incorporated into school meal programs

☐ Established on-station specialty crop production demonstration site
1. Project utilized collaborations with Florida A&M University Cooperative Extension Programs and North Florida Research & Extension Center-Suwannee Valley in training and assistance in product selection, crop production and management, business management and market development.

☐ The project also collaborated with larger producer to accommodate product volume needed until producers participating in on-farm demonstrations product was ready for harvest.
1. Phil Hart, a green bean producer/processor who has farming activities in both Florida and Georgia.
2. This operation was identified based on their relationship with south Florida farmers supplying green beans in Palm Beach County Schools (contact made during the 2010 Florida Small Farm Conference).
3. Mr. Hart works with farmers in Georgia and Florida to cover the seasonality of green bean production.
4. The project utilized his services to provide green beans to schools until the participating farmers' product was ready for harvest.

☐ Specialty crop products selected for project activities include:
1. Leafy greens (Collards, Turnips)

2. Green Beans
3. Sweet Potato Sticks/Chunks/Snack Packs
4. Strawberries
5. Products were selected based on production feasibility, value-added capabilities, customer acceptance, and nutritional value.

- ☐ Developed partnership with local produce providers to assist in distributing specialty crop products to schools.
    1. Due to changes in procurement laws, partnerships had to be developed with local produce providers/food distributors in order to facilitate vending with school districts participating in project activities.

    2. Conducted informational meetings with nine (9) produce providers to assess food safety, produce quality and assurance standards required for specialty crop producers and to assist with distribution of products to schools.
        1. Adams Produce (formerly K&D Produce) – Tallahassee, FL
        2. Adams Produce (formerly Crestview Produce) – Pensacola & Destin, FL
        3. Adams Produce (corporate office) – Birmingham, AL
        4. C&K Produce – Osceola County
        5. FreshPoint – Jacksonville
        6. Frozen Treats – Miami, FL
        7. Frank's Produce – Birmingham, AL
        8. Big Charlie's Produce – Mobile, AL
        9. ACC Distributors – Albany, GA

    3. Five (5) produce providers were trained in utilizing the NNFC Farm to School model.
        1. Adams Produce (Tallahassee) – Leon, Wakulla, Gulf, Liberty, Calhoun, Washington, Jackson school districts
        2. Adams Produce (Pensacola/Destin) – Santa Rosa, Okaloosa, Bay school districts
        3. C&K Produce – Osceola school district
        4. FreshPoint – Duval school district
        5. Frozen Treats – Miami-Dade school district

- ☐ Acquired additional producer/processor and food safety certifications and licenses needed to accommodate participating specialty crop producers in procuring with participating school produce providers.
    1. Additional certification and license was required to facilitate vending with schools due the changes in the procurement regulations.
    2. Perishable Agricultural Commodity Act (PACA)
    3. U.S. Federal Drug Administration (FDA) registration number

- ☐ Local produce providers increased variety of products distributed to schools through working with small-scale specialty crop producers and NNFC. These products also have the potential to be marketed to additional outlets, such as grocery stores, restaurants and other institutions.
    1. Adams Produce used specialty crop products as promotional items to introduce these products to additional market representatives, including FSU food service (K-12 & university), other school districts and markets with which Adams had

and/or planned to contract. The specialty crop items were provided at no cost to the event.

Significant Contributions and Role of Project Partners in the Project.

- Florida A&M University Cooperative Extension provided training and assistance in product selection, crop production and management, business management and market development.
    1. The project utilized the collaboration of FAMU to promote specialty crop products at select events, including Youth Agriculture & Entrepreneurship Learning Day, Summer Youth Institute Summit.
    2. The target audience for these events was K-12 youth in Leon and surrounding school districts.
    3. The products were used as promotional items to highlight and demonstrate Farm to School and value-added production as a viable agricultural entrepreneurship venture for K-12 youth.
    4. The specialty crop items were provided at no cost to the event.

- Florida Department of Education Child Nutrition provided assistance in recruiting school districts and clarification of USDA and FL school nutrition procurement regulations and procedures.

<u>Goals and Outcomes Achieved</u>

Training and Outreach

The outcomes include implementation of successful pilot training activities and the participating schools districts willingness to incorporate specialty crop products into their menus for the 2011-12 school year. The goal of the project was to increase awareness of Farm to School by reaching 10-15 school districts over the project period. Only six of the identified school districts had procured specialty crop products through NNFC's Farm to School model prior to the beginning of this Project.

- Twenty-four districts were trained in basic tenets of Farm to School and incorporation of specialty crop products into school meal programs.
- Fourteen (14) school districts participated in 2010-2011 pilot training activities. These training activities were designed to introduce and train school districts in facilitating Farm to School in order to incorporate fresh specialty crop products into school meals.
- School district personnel were trained in developing farm to school efforts, incorporating specialty crop products into school meal programs, menu planning, procurement requirements and distribution logistics
- **Overall, school districts were trained in how NNFC's Farm to School Model can be utilized as a viable alternative for integrating products grown by small-scale farmers**
- Participating school districts incorporated specialty crop products into school meal programs:

		Collards	Turnips	Green Beans	Strawberries	Value-added Sweet Potato	
Santa Rosa				612#			
Okaloosa		4,294#		2,516#		9,000#	
Washington		1,280#				225#	

Jackson		200#					
Bay		200#		400#			
Gulf		Product Samples				Product Samples	
Liberty		200#					
Calhoun		100#					
Gadsden		10,354#	2,280#	1,768#	180 flats	1,597#	
Leon		4,080#		664#		150#	
Wakulla		200#					
Duval		10,000#					
Osceola				2,500#			
Miami-Dade		720#					

- Developed partnership with local produce providers to assist in distributing specialty crop products to schools. Due to changes in procurement laws, partnerships had to be developed with local produce providers/food distributors in order to facilitate vending with school districts participating in project activities.
    1. Five (5) produce providers were trained in utilizing the NNFC Farm to School model.
        1. Adams Produce (Tallahassee) – Leon, Wakulla, Gulf, Liberty, Calhoun, Washington, Jackson school districts
        2. Adams Produce (Pensacola/Destin) – Santa Rosa, Okaloosa, Bay school districts
        3. C&K Produce – Osceola school district
        4. FreshPoint – Duval school district
        5. Frozen Treats – Miami-Dade school district
- Acquired additional producer/processor and food safety certifications and licenses needed to accommodate participating specialty crop producers in procuring with participating school produce providers.
    1. Additional certification and license was required to facilitate vending with schools due the changes in the procurement regulations.
    2. Perishable Agricultural Commodity Act (PACA)
    3. U.S. Federal Drug Administration (FDA) registration number

Training and Assistance for Specialty Crop Producers

The Project also sought to increase awareness and knowledge of market opportunities with schools for specialty crop producers. Enhancing specialty crop production and marketing opportunities can result in increased income-generating potential for small-scale specialty crop producers.

- Approximately fifty (50) specialty crop producers and youth entrepreneurs were trained through on-station and on-farm training demonstrations in production and marketing of specialty crop products to local schools.
    1. Two specialty crop producers marketed strawberries to one Florida and two Alabama school districts.
    2. Thirty-five specialty crop producers marketed collards, turnips to local schools.

Specialty Crop Research/Product Development

The Project sought to promote Farm to School efforts in Florida schools to encourage consumption of specialty crop products in school meals.

- ☐ Specialty crop products evaluated for project activities include:
    1. Leafy greens (Collards, Turnips) – year-round production, full year school market
    2. Green Beans - seasonal production, full year school market
    3. Value-Added Sweet Potatoes - year-round availability, full year school market
    4. Strawberries - seasonal production, full year school market
- ☐ Specialty crop products can be procured from small-scale producers through a several innovative ways:
    - Work through existing NNFC network (NNFC is the quality control agent for the schools bearing cost of processing, packaging, storage, distribution, product liability and insurance)
    - Direct sale to school districts and/or produce provider – producers become vendor with district and/or produce provider
    - Efficient pricing of products must take in consideration the profitability for farmers and cost-effectiveness to the school district.
    - Schools typically prefer to pay under $0.13 per serving for side item of fruit or vegetable
    - Farmers often have to take a reduction in price to accommodate markup by produce providers either by the unit, case or flat rate distribution cost.
        - This is evident with larger school districts where utilization of a produce provider is necessary due to the number of schools to be served
        - **To accommodate the larger districts participating in Project activities, a specialty crop promotion, in the form of a reduced price, was utilized to allow schools to test specialty crop products for Farm to School that kept them within an acceptable price.**

Beneficiaries

Provide a description of the groups and other operations that benefited from the completion of this project's accomplishments.

Florida School Districts (Child Nutrition Programs and school children) including:

- Gadsden – Bonnie Wood
- Leon – Rae Hollenbeck
- Okaloosa – Kelli Williams
- Washington – Bobbie Dawson
- Jackson – Jack Noonan
- Miami-Dade – Carol Chong, Erin Healy
- Duval – Wayne Atwood
- Osceola – Jeam Palmore
- Bay – Kim Blackwell
- Gulf – Bill Carr
- Liberty – Karen Peddie
- Calhoun – Vicki Davis
- Wakulla – Gail Mathers
- Santa Rosa – Clark Meyer
- Palm Beach – Fran Hickman
- Franklin – Robin Tennille
- Alachua – Maria Eunice
- Escambia – Glenna Taylor
- Walton – Terry Miller
- Jefferson – JoAnn Clark

- Madison – Jan McHargue
- Suwannee – Margaret Wooley
- Lake – Gary Dodds
- Orange – Lori Gilbert

- ☐ School nutrition programs improved the nutritional value of school meals by incorporating specialty crop products. The products were also procured at a price that allowed them to remain within an acceptable range for price per serving.
- ☐ Schools incorporated approximately 53,340 lbs. of specialty crop products into school meal programs (volume includes collards, turnips, sweet potatoes and green beans; an additional 180 flats of strawberries were utilized by schools).
- ☐ **Local Produce Providers/Food Distributors** including:
    - Adams Produce (formerly K&D Produce) – Tallahassee, FL
    - Adams Produce (formerly Crestview Produce) – Pensacola, FL
    - Adams Produce (corporate office) – Birmingham, AL
    - C&K Produce – Osceola County
    - FreshPoint – Jacksonville
    - Frozen Treats – Miami, FL
- ☐ Local produce providers increased variety of products distributed to schools through working with small-scale specialty crop producers and NNFC. These products also have the potential to be marketed to additional outlets, such as grocery stores, restaurants and other institutions.
    - The project utilized the collaboration of FAMU and Adams Produce to promote specialty crop products at select events, including Youth Agriculture & Entrepreneurship Learning Day, Summer Youth Institute Summit and FSU Pre-football event.
    - The specialty crop items were provided at no cost to the event in order to:
        - FAMU Event: Highlight and demonstrate Farm to School and value-added production as a viable agricultural entrepreneurship venture for K-12 youth.
        - Adams event: Introduce products to additional market representatives, including FSU food service (K-12 & university), other school districts and markets with which Adams already had a contract or had plans to contract.
- ☐ **FAMU Cooperative Extension Programs** – existing collaborative efforts helped provide hands-on comprehensive approach to train small-scale specialty crop producers. Project activities increased number of clientele reached by extension programs, as well as enhanced potential productivity and profitability of small-scale specialty crop producers.
- ☐ **North Florida Specialty Crop Producers** – Forty-nine (49) participating farmers and youth entrepreneurs increased awareness and knowledge of crop production and management for facilitating Farm to School market opportunities.

Participating Farmers & Youth Entrepreneurs

Kevin Dasher	Larry Mack	John Gooden	Dan Wright	Andrell Blount
Stevie Dasher	Sherman White	Johnny Wilson	Terrell Bradley	Eugene Pittman
Richard Beck	Derrick Sorey	Alfonso White	Evie Tucker	Johnathan Gaines
Vicky Beck	Jimmy Reed	James Brown	Rubbie Watts	Stephon Gaines
Dwan Ellenburg	Robert Walker	Malachi Watts	Rowena Dixon	Diallow Martin
Gary Gullig	Matthew Tucker	Ladon Bembow	Chad Brown	Hakeem Holmes
Adam Clayton	Carl Henderson	James Blount	Hazel Pittman	Jamila Holmes
Jason Smith	Joe Pittman	George Hall	Pearline Jones	Glyen Holmes II

Willie Morgan	Cullen Pittman	Kenneth Gray	David Pittman	Eddie Rory
William Smith	Johnnie Beechem	Delrinthus Walton	Lee Otis Britt	

Lessons Learned

NNFC's model for Farm to School has been highly successful over the past sixteen years. This project aided in further promoting and demonstrating this model for implementation in Florida schools, developing collaborative relationships with the school food service industry, as well as demonstration schools as an alternative market opportunity for small-scale specialty crop producers. Lessons learned and/or reinforced by the Project activities included:

- Farm to School was demonstrated to be a valuable opportunity for school districts to incorporate fresh local/regional specialty crop products into school meal programs.
- Farm to School allowed an opportunity for schools to increase variety of fresh products served on school menus, therefore improving the nutritional value of school meals.
- NNFC's model allowed the opportunity for school districts to evaluate Farm to School based on their individual procurement and product/student/administration acceptance requirements on their terms in a non-invasive manner.
- Farm to School was demonstrated to be a viable marketing opportunity for small-scale specialty crop producers, and may allow for increase income-generation either by increased price (i.e. value-added product) or increased volume of product produced and/or sold.
- Farm to School allowed the opportunity for small-scale producers to produce crops with minimal lost due to non-sale. The acreage could be pre-determined by volume and frequency of the product being served on the school menu over the specified time period (i.e. seasonal, one semester or entire school year).

Contact Person

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Table 1: Group Training Activities

Date	Training Activity	Location	Participants
11/30/09	Developing Farm to School efforts; Incorporating specialty crop products into meal programs	Milton	Santa Rosa County Schools Food Service/ Sodexco
1/26/10	Developing Farm to School efforts; procurement requirements	Quincy	Gadsden County Schools Food Service
2/3/10	Farm to School efforts in Gadsden County Schools	Quincy	Gadsden County Schools Food Service, UF-IFAS, FAMU
2/23/10	Developing Farm to School efforts; menu planning with specialty crop products	Quincy	Gadsden County Schools Food Service
2/10 – 6/10	On-station and On-farm demonstrations: Collards, Green Beans, Turnips, Strawberries, Value-added sweet potatoes	Marianna Live Oak	Participating specialty crop producers
3/4/10	Developing Farm to School efforts; Incorporating specialty	DeFuniak Springs	Walton County Schools Food Service

	crop products into meal programs	Niceville	Okaloosa County Schools Food Service
3/8/10	Developing Farm to School efforts; Incorporating specialty crop products into meal programs	Jacksonville Gainesville	Duval County Food Service/ Chartwells Alachua County Food Service
3/9/10	Developing Farm to School efforts; Incorporating specialty crop products into meal programs	Chipley Panama City	Washington County Schools Food Service, Bay County Schools Food Service
3/17/10	Developing Farm to School efforts in Washington County Schools; implementation of NNFC model	Chipley	Washington County School Board & Food Service; local farmers
3/15/10	Developing Farm to School efforts; Incorporating specialty crop products into meal programs	Marianna	Jackson County Schools Food Service
3/23/10	Developing Farm to School efforts; Incorporating specialty crop products into meal programs	Pensacola	Escambia County Schools Food Service
3/31/10	Developing Farm to School efforts; Incorporating specialty crop products into meal programs	Wakulla - Madison	Wakulla County Schools Food Service Madison County Schools Food Service
3/31/10	Farm to School procurement and bid process	Gainesville	Alachua County Schools Purchasing and Food Service
4/5/10	Procurement requirements and distribution logistics	Tallahassee	Adams Produce (Tallahassee)
4/7/10	Developing Farm to School efforts; Incorporating specialty crop products into meal programs	Blountstown Bristol Port St. Joe, Appalachicola	Calhoun County School Food Service Liberty County School Food Service Gulf County School Food Service Franklin County School Food Service
4/8/10	Developing Farm to School efforts; Incorporating specialty crop products into meal programs	Monticello, Live Oak	Jefferson County School Food Service Suwannee County School Food Service
4/13/10	Developing Farm to School efforts; procurement requirements	Gainesville	Alachua County School Food Service
4/26/10	Developing Farm to School efforts; procurement & distribution logistics	Marianna	Jackson County School Food Service
4/27-28/10	Farm to School: overview and implementation of NNFC model (pilot project)	Orlando	POWER Buying Group Meeting
5/11/10	Developing Farm to School efforts; Incorporating specialty crop products into meal programs	Monticello Perry Lake City	Jefferson County Food Service Taylor County Food Service Columbia County Food Service
6/9/10	Developing Farm to School efforts; Incorporating specialty	Howie-in-the-Hills Kissimmee	Lake County Food Service Osceola County Food Service

	crop products into meal programs	Orlando	Orange County Food Service
6/22/10	Farm to School Marketing Opportunities for Specialty Crop Producers	Milton	Farmer information meeting with specialty crop producers
7/10 – 10/10	On-station and On-farm demonstrations: Collards, Green Beans, Value-added Sweet Potatoes	Marianna	Participating specialty crop producers
8/11/10	On-farm demonstration: Green Beans	Walnut Hill	Participating specialty crop producers
1/25/11	Developing production and marketing plan for on-farm demonstrations (collards, turnips)	Marianna	Participating specialty crop producers
2/15/11	Developing production and marketing plan for on-farm demonstrations	Marianna	Participating specialty crop producers
3/11-14/11	On-station & On-farm demonstration: Seedbed preparation and planting	Marianna	Participating specialty crop producers
4/4/11	Farm to School; product demonstration	Miami	Miami-Dade School Food Service
4/13/11	Increasing product usage by Jackson County schools; answer questions from cafeteria managers	Marianna	Jackson County School Food Service
4/23/11	On-station & On-farm demonstration: Crop nutrient management	Marianna	Participating specialty crop producers
4/26/11	On-station demonstration: Value-added processing, packaging & storage	Marianna	Participating specialty crop producers
5/11/11	On-station demonstration: Market development & distribution logistics	Marianna	Participating specialty crop producers
5/17/11	On-station & On-farm demonstration: Crop nutrient management	Marianna	Participating specialty crop producers
6/6-7/11	On-station & On-farm demonstration: Harvesting, post-harvesting handling	Marianna	Participating specialty crop producers
6/13-14/11	On-station & On-farm demonstration: Harvesting, post-harvesting handling	Marianna	Participating specialty crop producers
6/ 20-22/11	On-station & On-farm demonstration: Harvesting, post-harvesting handling	Marianna	Participating specialty crop producers

PROJECT (15): USDA HORTICULTURE RESEARCH LAB: DEPLOYMENT DEVICE FOR SEMIOCHEMICALS IN SPECIALTY CROPS

FDACS Grant Contract #15634
Total Funding - $125,466.00
End Date: 12/31/11

PROJECT SUMMARY

Our purpose was two-fold. First, we intended to perfect a versatile and economical device for delivery of semiochemicals in specialty crops. Second, we sought to develop a mating disruption application using our device that will provide effective and season-long control of the citrus leafminer (CLM). We designed, engineered, built and field-tested two devices to deliver an emulsified wax (SPLAT) for sustained release of insect semiochemicals in specialty crops. We sought to address questions related to the optimal method of deployment and placement of SPLAT using the citrus leafminer (CLM) as a model system. Existing deployment methods for semiochemicals are limited by cost and labor required to deploy the devices. SPLAT™, an emulsified wax formulation, was developed to be machine-applied and to provide a slow-release matrix for sustained delivery of semiochemicals such as sex pheromones used in mating disruption. However, the SPLAT material is cumbersome to apply directly to crops and in some applications, e.g., grapes, causes damage to fruit if applied directly to the crop. Our devices were intended to overcomes these limitations in two distinct ways: by adhering it to a simple and flexible delivery device that can be applied by hand, machine or aircraft; and by developing an entirely new automated, tractor-mounted applicator based on peristaltic pumps to handle high viscosity products. We demonstrated effective mating disruption of CLM using components of its sex pheromone. Our delivery devices provide a new and economical method for effective and environmentally appropriate control of CLM and canker for citrus growers. The devices can also be used in other pest/crop situations such as the Asian citrus psyllid or the grape berry moth.

Our objectives were to develop an effective and efficient delivery device for insect semiochemicals in specialty crops, and to optimize mating disruption of the citrus leafminer (CLM). The results of this project will have broad application across a number of crop and pest situations where delivery of disruptants, repellents, attractants, etc. would be advantageous. An immediate result has been the production of a control option for CLM. This will affect citrus growers throughout Florida by reducing yield loss to direct leafminer damage and by reducing the incidence and severity of citrus canker disease. Consumers will benefit from reduced need for chemical pesticides to control CLM. Similarly, producers and consumers or other crops will benefit from the new device. CLM was discovered in southern Florida in 1993 and has since spread to all Florida citrus-growing counties and the states of Alabama, Louisiana, Texas in 1994, and California and Hawaii in 2000. Damage includes loss of photosynthetic capacity from mining, stunting and malformation of leaves, and from increased susceptibility of leafminer-damaged leaves to the citrus canker pathogen. In mature (15-yr-old) groves, direct CLM damage was estimated to result in a 39% reduction in the number of fruit and 62% reduction in fruit weight per tree. In 5-yr-old groves, losses in unprotected trees were over 70% for both number and fruit weight per tree compared with the best pesticide regime. Economic losses to increased spread and severity of citrus canker disease due to CLM feeding are difficult to quantify but can be severe in cases where trees are eradicated to control canker spread, or in the case of lost markets for fresh fruit. In addition to a specific application in citrus, we envision a broad application for these devices in specialty crops, especially tree crops, and in situations where multiple pests are amenable to simultaneous control with semiochemicals.

The end product will specifically enhance the competitiveness of specialty crops by enhancing food safety (reduced need for chemical pesticides) and by providing a sustainable and organic method of pest and disease control.

PROJECT APPROACH

Activities performed and tasks performed during the grant period. Activities and tasks were divided between two project goals: the design and refinement of application methods for SPLAT, and the specific use of a SPLAT-based product (SPLAT-CLM) for control of the citrus leafminer in commercial citrus operations in Florida. We designed and fabricated two delivery devices and tested these in large scale field trials. The first device was designed for use in small operations and/or dooryard citrus. Approximately 10,000 IFM-413 devices (Fig. 1) were constructed, loaded with SPLAT-CLM and placed in trees. Mating disruption was equivalent to mating disruption achieved by manual application of SPLAT. A manuscript describing the device and the results of field tests to determine optimal placement in citrus was published (*Lapointe, S.L., L.L. Stelinski and R.D. Robinson. 2011. A novel pheromone dispenser for mating disruption of the leafminer Phyllocnistis citrella (Lepidoptera: Gracillariidae). Journal of Economic Entomology 104: 540-547*). This device was judged to be inappropriate for large scale applications and not adaptable to machine application.

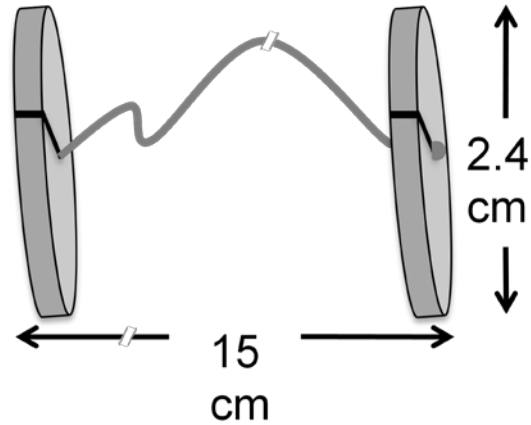

Figure 1. The IFM-413 device.

A second device (IFM-5051, Fig. 2) was iteratively developed starting with a crude prototype and progressing to a fully functional, computer-controlled tractor-mounted applicator capable of applying SPLAT to 250 acres/day and incorporating GPS telemetry and digital output. The device was used during 2011 to treat approximately 300 acres of citrus in St. Lucie and Charlotte counties. A total of six applications, three each at two locations, were made during 2011 to address issues associated with longevity and the feasibility of reducing coverage to minimize cost. The advanced prototype IFM 5051 applicator performed well and applied SPLAT-CLM to within 5% of the target rate. We conducted field trials to determine recommended dosages and coverage patterns for on-farm grower validation trials we expect to conduct in collaboration with ISCA Technologies and International Fly Masters in the spring of 2012 in response to what we expect to be an emerging demand for SPLAT-based products. A manuscript was published describing the results of field trials (*Lapointe, S. L. and L. L. Stelinski. 2011. An applicator for high viscosity semiochemical products and intentional treatment gaps for mating disruption of Phyllocnistis citrella. Entomologia Experimentalis et Applicata 141: 145-153*).

Figure 2. SPLAT applicator mounted via 3-point hitch and controlled from the cab by a field computer.

Significant contributions and role of project partners: Mr. Robinson collaborated with SLL in the assembled the devices and conducted field trials in collaboration with LLS. SLL and LLS wrote the manuscript. Mr. Robinson designed and fabricated the IFM-5051 device with feedback on design elements from SLL. SLL designed and conducted field trials with assistance from LLS. SLL and LLS wrote the manuscript.

GOALS AND OUTCOMES ACHIEVED

All goals of the project were achieved. Measurable outcomes of the project include the design and production of two novel devices for delivery of semiochemical-based high viscosity products for control of insect pests of specialty crops, and the publication of the results of experimental applications for specific control of the citrus leafminer through mating disruption. Activities included design and fabrication of the devices and use of the devices to apply SPLAT-CLM in commercial citrus groves followed by intensive sampling of citrus leafminer populations. Actual accomplishments coincided with the established goals. The success of the project can be assessed by the interest of grove managers in purchasing SPLAT-CLM and application by the IFM-5051 applicator, and the promotion of SPLAT-CLM by ISCA Technologies, Inc. While we anticipate rapid adoption of this technology by Florida citrus growers, we also believe the applicator has potential for use in other specialty crops where SPLAT-based products are available such as grapes.

Results of the research have been shared through scientific publications (Stelinski et al. 2010, Lapointe et al. 2011, Lapointe & Stelinski 2011 and Lapointe et al. *in prep*), popular press articles (Burfield 2010, O'Brien 2010, Owens 2010) presentations at scientific meetings (Entomological Society of America 2010 annual meeting, San Diego, CA; Fifth Asia Pacific 2009 Conference on Chemical Ecology, Honolulu, HI; International Society for Chemical Ecology 2010 annual meeting, Tours, France), presentations to grower groups in Florida (e.g., Peace River Valley Citrus Growers Association) and multiple ongoing presentations to grower tour groups at the U.S. Horticultural Laboratory at Ft. Pierce, FL. Results of this project directly contributed to the commercialization of SPLAT-CLM™ (www.iscatech.com/exec/SPLATCLM.htm). Results have been presented at the Citrus Expo seminar and trade show and will be promoted at the Florida Citrus Show, Jan. 25-26, 2012, Ft. Pierce, FL by ISCA Technologies, Inc. Presentations of results will be made at the 2012 annual meeting of the Florida Entomological Society and the 2012 annual meeting of the Entomological Society of America, Knoxville, TN. Additional venues will be sought during 2012 in trade magazines and at grower meetings.

BENEFICIARIES

The immediate beneficiaries of the project are Florida's citrus growers, packers and shippers and consumers. Growers benefit from the availability of a new technology, the first semiochemical-based control method of a major citrus pest and the application technology for its use in commercial scale citrus groves. Packers and shippers of fresh citrus benefit from improved control of citrus leafminer and associated citrus canker disease. Consumers benefit from the use of a nontoxic alternative to conventional pesticides for insect control. Environmental benefits accrue from a potential reduction in use of toxic pesticides. Benefits from these achievements will continue to accrue through the ability of researchers to study mating disruption in specialty crops on a scale equivalent to commercial applications. Measuring the effect application of volatile compounds such as pheromones in the field is sensitive to scale. Results from small plots put out by hand are often not able to be extrapolated to real world conditions. The availability of the application technology we have developed allows researchers to execute large field trials with confidence that results apply to commercial situations. This will further the developement of semiochemical-based products for specialty crops and the study of mating disruption in general.

Update as of 4/18/2012: We are now early adoption at 5 locations where SPLAT CLM has been purchased and applied for control of leafminer and canker in production groves. This represents adoption by growers who have become familiar with the product through publications, trade magazines trade shows and public

presentations. Applications of SPLAT CLM purchased by growers have been made in St. Lucie, Charlotte, DeSoto, Okeechobee and Highlands counties. The experience of these growers will be critical in promoting wider adoption of this technology. Our continuing involvement in early adoption locations over the coming year (2012) will document impact and efficacy and we will share these results with the industry through trade shows and popular publications including extension bulletins.

LESSONS LEARNED

We demonstrated the effectiveness of mating disruption as a viable means of controlling a major pest of citrus. If adopted by growers as we expect in the short term, this will be the first use of nontoxic, environmentally appropriate semiochemicals for a citrus pest. We also effectively collaborated with an independent enterpreneur and mechanical engineer (Mr. Robinson) and the manufacturer of SPLAT to design and execute a design to meet a clearly defined need. The collaboration between USDA, University of Florida, ISCA Technologies and International Fly Masters was excellent. The quality of the data collected from field experiments was outstanding, leading to immediate publication of results and insight into improved methods of application of high-viscosity products such as SPLAT. Interests of citrus growers in utilization of the technology generated under this project may be gauged by contacting the collaborating grove managers listed at the end of this document. We also provide the contact information for the president/CEO of ISCA Technologies, the producer of SPLAT products, as testimonial to the value of the activies carried out through the support of this project.

CONTACT PERSON

Contact Person for the Project: Dr. Stephen L. Lapointe
Telephone Number: 772-462-5914; Cell: 772-216-1242
Email Address: Stephen.lapointe@ars.usda.gov

ADDITIONAL INFORMATION

Peer-reviewed Scientific Publications:

1. Lapointe, S. L., L. L.. Stelinksi, T. J. Evens, R. P. Niedz, D. G. Hall and A. Mafra-Neto. 2009. Sensory imbalance as mechanism of mating disruption in the leafminer *Phyllocnistis citrella*: elucidation by multivariate geometric designs and response surface models. J. Chem. Ecol. 35: 896-903.

2. Stelinski, L. L., S. L. Lapointe, and W. L. Meyer. 2010. Season-long mating disruption of citrus leafminer, *Phyllocnistis citrella* Stainton, with an emulsified wax formulation of pheromone. J. Appl. Entomol. 134: 512-520.

3. Lapointe, S. L., L. L. Stelinski and R. D. Robinson. 2011. A novel pheromone dispenser for mating disruption of the leafminer *Phyllocnistis citrella* (Lepidoptera: Gracillariidae). submitted to J. Econ. Entomol. 104: 540-547.

4. Lapointe, S. L. and L. L. Stelinski. 2011. An applicator for high viscosity semiochemical products and intentional treatment gaps for mating disruption of *Phyllocnistis citrella*. Entomol. Exp. et Appl. 141: 145-153.

5. Lapointe, S. L., L. L. Stelinski, C. Keathley and A. Mafra-Neto. (2012). Coverage patterns incorporate treatment gaps to optimize cot of mating disruption for the leafminer *Phyllocnistis citrella*. *In preparation.*

Popular Publications:

Burfield, T. 2010. Advances in SPLAT CLM, MalEx rein in citrus pest. Citrus & Vegetable Magazine, March, 2012. http://www.thegrower.com/issues/citrus-vegetable/Advances-in-SPLAT-CLM-MalEx-rein-in-citrus-pest-141462693.html

Burfield, T. 2010. New solutions to an old problem: pheromone-based materials combat citrus leafminers without hurting beneficials. Citrus & Vegetable Magazine, May, 2010, pp. 14-16. http://www.thegrower.com/issues/citrus-vegetable/new_solutions_to_an_old_problem_117876529.html

O'Brien, D. 2010. Throwing a citrus pest off its scent. Agricultural Research Magazine, August, 2010, p. 19.

Owens, S. 5 April, 2010. "Leafminer control: USDA's nice guy finishes first". Treasure Coast Business Journal newspaper

Grove managers involved in field experimentation:

Mr. David Kemeny, TRB Groves, Punta Gorda, FL. Tel. 941-628-1942. Email: TRBGrove2@aol.com

Mr. Tom Stopyra, Technical Crop Advisor, The Packers of Indian River, Ft Pierce, FL 34979. Tel. 772-216-4764; Email: tstopyra@packerscitrus.com

Contact at ISCA Technologies, Inc.

Dr. Agenor Mafra-Neto, President and CEO, ISCA Technologies, Inc., 1230 Spring St., Riverside CA 92507. Tel. 951-686-5008; Email: president@iscatech.com

Project (16) University of Florida – Small Farms Conference - $15,000

PROJECT TITLE
UF-IFAS Small Farms Conference

FINAL PERFORMANCE REPORT

Project Summary
Background. The USDA defines a small farm as one that has gross annual sales of $250,000 or less. Based on the USDA definition, well over 90% of the 47,000+ farms in Florida are small farms. According to the 2007 Ag Census, 89% of the Florida farms report less than $100,000 in product sales. The other common characteristic of these operations is they are family-oriented farms dependent upon the family for management and labor. Florida reported an 8% increase in farm numbers from 2002 to 2007, essentially all in the small farm category (USDA, 2009). Florida, along with Alabama and Pennsylvania, are the top three states east of the Mississippi River reporting growth in total farm numbers; each state with over 3,000 more farms in 2007 than 2002.
The University of Florida (UF) and Florida Agricultural and Mechanical University (FAMU) Small Farms and Alternative Enterprises Focus Team is a partnership of state and county extension faculty who collaborate on the design and implementation of educational programming to serve the needs of small to mid-size farmers in Florida. The team was formed in 2005 to serve the small farms industry in response to public comments during county listening sessions throughout the state. The team provides relevant, science-based information and technology to sustain the health of Florida's citizens, communities and natural resources. Since its administrative inception less than five years ago, this team of over 100 faculty has implemented over 2,000 field days, workshops, short courses, and hands-on instruction to over 100,000 small farm attendees including their technical service providers and allied industry/agency representatives.
Project Relevance and Previous Work. Through formal evaluations of small farm clientele at extension programs, informal discussions with industry stakeholders, and team planning and visioning sessions, this team identified several barriers to the success of the small farm industry including beginning farmers with a lack of agricultural or entrepreneurial experience, limited market access especially through indirect market channels, difficult to overcome a long-standing negative stereotype from Florida's traditional agricultural industry, and small farm operators were poorly organized as a group. Although county and regional programming was ongoing, the team and the clientele believed a state conference was necessary to make real progress to removing barriers. UF and FAMU partnered to begin planning a statewide conference in 2007, the following objectives: 1) to encourage greater participation of small farmers in UF extension programming, on-farm research, local and state policy discussions, and partnership building; 2) to improve the economic, social and production sustainability of the small farms industry; and 3) provide a setting where clientele could experience educational programming from farm to fork and beyond all in one place. *The first conference was held in 2009 and was supported by a USDA Florida Specialty Crop Block grant.* Attendees, speakers, exhibitors and organizers agreed the conference was a resounding success. Based on written evaluations from 2009 conference attendees requesting a 2010 conference, planning began immediately.
A recent statewide survey of Florida farmers indicated the barriers to sustainability of small farms include: access to markets, regulations, labor, locating materials and supplies, scale-appropriate production, technologies and adoption of practices to conserve our natural resources (soil, water, biodiversity) (Unpublished data from the 2008 Florida Small Farms Survey; methodology described in Gaul et al., 2009). A variety of educational methods are

employed by UF and FAMU extension faculty to meet these educational needs of Florida's small farm operators based on their educational preferences (Gaul et al., 2009).

Project Approach

Activities. The Small Farms Focus Team followed a similar approach to planning the 2010 state conference as they did for the 2009 conference. Industry stakeholders, farmers and state and county extension specialists served on planning committees and fully participated in the process. The demographically and professionally diverse committee structure contributed to the strength of programming and attracted a diverse clientele. Committees met regularly in person or by conference calls. A four-member executive committee met face-to-face monthly and provided administrative and financial oversight, and ensured progress was occurring in a timely manner. We maintained regular engagement with a 5-member stakeholder advisory group. Dialog with this group was very beneficial as they provided excellent advice when we arrived at forks in the road. A second stakeholder group consisting of over 90 members also received regular updates on progress and frequently contributed to the planning and execution of the event. Except for our event coordinator from the UF Office of Conferences and Institutes, all 72 planning participants were volunteers.

Goals and Outcomes Achieved

The 2010 Florida Small Farms and Alternative Enterprises Conference was successfully implemented July 31-August 1, 2010 with nearly 800 total attendees, all interested or involved in the small farms industry in Florida. Based on tracking the attendance at the various sessions, it was determined at least 600 of the 800 attendees were professionally involved with or had an interest in Florida specialty crops. The overall educational program included 30 sessions. The funding from this grant supported the implementation of those tracks and sessions related to specialty crops. Those tracts specifically included: Business and Marketing, Horticulture, Alternative Enterprises, Policy and Regulation, Organic and Sustainable Farming, and Alternative Energy. Evaluations presented at the end of educational sessions provided opportunity to gauge learning and intended changes in practices. As a result of this grant, specialty crop growers gained knowledge in the following areas:

- Supplying specialty crops to new markets by using a web based tool, Market Maker
- Producing and marketing specialty crops in hydroponic systems
- Using high tunnels and other protected culture to extend the season and reduce risk
- Growing and marketing specialty crops legally and safely
- Expanding production of stone fruits, grapes, and other minor fruit crops
- Using social networking and E-technology to market specialty crops and products
- Making compost for organic specialty crop production
- Learning how to reduce risk of food borne illness in fruits and vegetables
- Maintaining post harvest quality in fresh fruits, vegetables, and herbs
- Strengthening local food systems
- Accessing government programs for small specialty crop growers in Florida
- Marketing fresh produce through Community Supported Agriculture (CSA)
- Diversifying a crop income portfolio to increase cash flow and reduce risks
- Improving disease management of organic specialty crops
- Increasing income by supplying fresh fruits and vegetables to schools

An evaluation of attendees was conducted at the end of the Conference. The evaluation results have been shared with the conference stakeholders and committee chairs and members and will be used to improve the conference in 2011 in the most meaningful way possible. The survey

results were compiled by Linda Landrum, UF/IFAS Multi-county Extension Agent and the highlights follow here.

An evaluation survey was designed by state and county faculty with knowledge of instrument design and experience with the small farms industry. The evaluation was completed by a total of 125 attendees, 100 with an interest in the Florida Specialty Crops industry. A majority of respondents (avg. 79%) indicated that they were moderately to completely confident that they would be able to apply the knowledge gained immediately and could now locate additional information, supplies and technology needed for their farm or organization.

Activities that respondents would do differently on their farms as a result of attending ranged from just starting a new farm to simply improving an existing enterprise and adopting a new production system such as blueberries and eggs. Respondents also noted that they intended to broaden their marketing efforts by developing a new client base such as a buying club for locally grown organics, starting a CSA and selling to restaurants in addition to adding various crops/products/activities such as agri-tourism to an existing enterprise. Respondents indicated they were now going to reach out to consumers by using E-technology, such as MarketMaker, Facebook, YouTube and Blogging in addition to using more traditional direct market methods such as local farmers markets, CSA, handing out flyers and mass media advertising. On reaching out to farmers, an overwhelming response was to increase networking for both farmers and consumers by hosting farm tours, getting involved with local farm groups/Extension, using web site/emails and other educational efforts.

Networking seemed to be the biggest positive for the conference as an overwhelming majority (80%) rated this high in several questions. Helping small farmers understand challenges and identify opportunities was successful as over 78% of respondents felt like they now understood what lay ahead for those in small scale production and marketing. Eighty percent felt like this statewide conference should be held every year.

Interestingly, one consumer and one allied industry person, five educators, seven prospective farmers and six current farmers indicated they had changed their view of the importance of Florida's small farm industry. There was a long list of suggested topics for the next conference which indicates that the attendees are hungry for more in-depth programming not available at the local or regional level. As was the case with last year's conference attendee survey, the largest number of responses indicated that networking and meeting with the vendors were the most valuable experiences from attending. It has been determined the measurement of adopted practices or concepts is best measured at the next annual conference, now that this conference has been established as an annual event. In addition, many of these concepts will take longer than three months to adopt. The response rate in person is expected to be higher than with the originally planned follow up mail out survey. Therefore, the instrument to measure the adoption of changes of attendees of the 2010 conference will be conducted at the 2011 Florida Small Farms and Alternative Enterprises Conference in July of 2011.

A second evaluation instrument was provided to the 90 exhibitors in 2010 and summarized by Susan Kelly, UF/IFAS Sumter County Extension Director. Although the exhibitor evaluation was not specifically supported by funds from this grant, it is important to mention the feedback from exhibitors because the exhibitor area is a very important component to the success of such a conference. Approximately two-thirds of the exhibitors were commercial suppliers and one-third educational or non-profit in nature. Of those responding to the exhibitor survey, 100% rated the conference as excellent or good. All exhibitors indicated they were able to see and meet the

clientele they wanted. Over 95% of the exhibitors indicated they plan to exhibit again in 2011. This is a very positive indicator for the overall strength of the conference.

Several members of the planning team reported the methods and results of the 2010 conference at national academic and extension meetings.

Treadwell, D.D., R. Hochmuth, N. Wilson, R. Kluson, and S.A. Kelly. Building Capacity for Florida's Small Farm Specialty Crop Industry with a Statewide Conference. American Society for Horticultural Sciences Annual Meeting, Palm Desert, CA July 2-5 2010.
Kluson, R.A., R.C. Hochmuth, S.A. Kelly, D. Treadwell and N.M. Wilson. 2010. Building Capacity for Florida's Small Farm Industry and Extension with a Statewide Conference. National Association of County Agricultural Agents Annual Meeting, Tulsa, OK July 11-15, 2010.

Conclusions and Recommendations. In summary, this FDACS Specialty Crops Block Grant was critical in 2009 and again was critical in 2010 to the successful implementation of the Florida Small Farms and Alternative Enterprises Conference. The funding provided an opportunity for specialty crop small farmers to increase their knowledge in many important production, marketing, business management, regulatory, and food safety areas, all of which will improve their long term success. In addition, the funding support helped in meeting the overall goals of the conference planners by bringing together farmers, allied industry representatives, researchers, educators, institutional members, policy-makers, commodity association, foundations, and others interested in strengthening the small farms community in Florida. The University of Florida is the funding partner in this FDACS Specialty Crops Block grant and is the lead organization in implementing all aspects of the conference. The Conference Executive Committee, made of faculty members of the University of Florida, provides overall leadership and financial oversight for the conference. To others who wish to use this event as a model, we recommend that communication infrastructure be created to allow equal flow of information and ideas among planners and beneficiaries, that programming reflect current research and be presented for easy adoption by small farmers, that sessions include a variety of formats such as demonstrations, hands-on activities, role-playing, round table discussions and panels, and finally that our partnership with an experienced event coordinator ensured the event was managed in a timely, fiscally-responsible and professional manner.

Beneficiaries

The following groups of specialty crop beneficiaries were positively impacted by this project:

State Agencies: A number of state agencies were represented at the conference and staff and decision-makers from those agencies participated as speakers in sessions and/or manned an exhibition booth. Agencies included: FL Dept. Education, Food and Nutrition, Natural Resource Conservation Service, Florida Department of Agriculture and Consumer Services, and USDA Rural Development just to name a few. The event served as a soft roll-out for the Farm-to-School Program's new publications and website to assist Florida fruit and vegetable farmers access institutional buyers. This was one of the most popular sessions at the event, with over 170 in attendance.

Industry Partners: Many industry partners present at the event participated in the exhibition hall at their booth and the exhibitor's evaluation survey summarized their benefits. Traffic in the exhibition hall was excellent, and exhibitors were satisfied with the level of interaction and interest from participants. Industry representatives also attended educational sessions and interacted with participants beyond the exhibition hall.

Beginning and Underserved Farmers: Sessions were offered to provide specialty crop farmers a holistic suite of information to support them from the development of a business plan, to advice on obtaining credit, to planning crop rotations, identifying market channels, and methods for producing products that are in demand by consumers. Agency and industry representatives provided a network of support, and new and underserved farmers benefitted by being able to access all of these resources readily and under one roof.

Heritage Farmers: Experienced farmers were valuable participants and session speakers during the conference. Both institutions value programming efforts that increase farmer-to-farmer networking. We have discovered experienced farmers who are well-respected by their peers have positive influence on new and beginning farmers. Many experienced farmers who attended have been involved in formal on-farm research, serve on county extension advisory boards, or hosted university field days. Their relationship with our institutions, their willingness to learn and to make changes set excellent examples for new farmers and any small farm stakeholder who is just learning about UF-IFAS and FAMU.

University Researchers and Extension Specialists and Secondary Education Instructors:
This event brought a diverse group of educators together to both lead educational sessions in their areas of expertise but also to learn from one another. Informally, educators who attended appreciated the opportunity to teach but also to learn from other participants. In addition to learning about current topics from other research programs, the wide variety of session formats and teaching styles gave educators some new ideas on information delivery to take back to their own programs.

University Administrators: Administrators including Department Chairs, Associate Deans and Deans from the University of Florida and Florida Agricultural and Mechanical University had the opportunity to interact directly with all beneficiaries to learn about the issues and opportunities of Florida's small farms.
Funding from the Specialty Crop Block Grant Program (SCBG) was used to support the specialty crop portions of the state conference program. Total funding from Florida SCBG was $25,000, and was approximately 15% of the total cost of the specialty crop portions of the event. Remaining costs were supported by sponsorships and exhibitor and attendee registration fees. Sponsorships were provided from the following organizations (in order beginning with the greatest dollar contribution): University of Florida, Institute of Food and Agricultural Science, Florida A & M University, Whole Foods Market, USDA, Farm Service Agency, Florida Farm Bureau Federation and Insurance, Verti-Gro, Global Organic Specialty Source, Inc., Destiny Organics, Florida Association of Community Farmers' Markets, Aramark, Farm Credit of Florida, Bowen Brothers, Inc., Hani's Mediterranean Organics, OIA North America, and Triangle Chemical.

Lessons Learned

We began this project with a clear roadmap of activities, deadlines, persons responsible and deliverables. While there were occasions when small things did not immediately fall into step with our plans, our stakeholder advisory group, executive committee and program committee chairs and members responded quickly with great ideas. There were no significant problems or delays encountered in implementing the conference in 2010.

Contact Person

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LITERATURE CITED

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Gaul, S. R.C. Hochmuth, G.D. Israel, and D. Treadwell. 2009. Characteristics of Small Farm Operators in Florida: Economics, Demographics and Preferred Information Channels and Souces. University of Florida-IFAS Electronic Document Information System. Document No. WC088. < http://edis.ifas.ufl.edu/wc088>

Project (17) Florida Watermelon Association - $50,000

PROJECT TITLE
Watermelon Promotional Campaign

FINAL PERFORMANCE REPORT

Project Summary

- The project's purpose was to inform the general public of the health benefits of eating watermelon, and to highlight the economic benefits of supporting local farm family agriculture. Watermelon crops in Florida generate $ 152 million dollars worth of revenues each year for the state of Florida. Additional, the byproducts of the crop (fertilizer sales, equipment sales, fuel, maintenance, etc), add considerably to the overall economic foundation for the state. In these difficult economic times, it is imperative that the public is aware of the statewide benefits from the production of Florida Watermelons'. Along with the knowledge of the health benefits that watermelons offer.
- This project allowed us the opportunity to develop ads and videos that were displayed in local and regional markets informing the public of all that watermelons can offer both health wise and economic value. Our spokesperson the Florida Watermelon Queen does an outstanding job at informing the consumer of all the goodness of Florida Watermelons. With this additional budget she was able to increase the public's awareness of all that watermelons offer.

Project Approach:

- Elementary school visits by the Florida Watermelon Queen and chaperone. Education of the lunchroom staff and students on the benefits of eating Fresh Florida Watermelon, as well as providing fresh watermelon samples to illustrate the deliciousness of fresh Florida Watermelon. By educating the lunchroom staff, students and teachers on the benefits of eating fresh Florida Watermelon the Queen was able to provide important nutritional information. Not only could this information be used in providing a healthy alternative in lunch selections but this valuable information could also be used in the personal lives of the staff and students. This type of presentation also boosted the awareness of fresh Florida Watermelon in turn attempted to boost sales. The Queen is viewed by the students this age as a celebrity causing them to pay closer attention and retain more of the information she provided.
- Retail visits by the Florida Watermelon Queen and chaperone, providing free samples to consumers, boosting sales in store and educating the public on the benefits of eating Fresh Florida Watermelon. This also provides additional exposure of the fruit. The Queen also visited stores outside the State of Florida in an effort to provide additional exposure of fresh Florida Watermelon in an attempt to widen the market.
- State of Florida Welcome Center appearances by the Florida Watermelon Queen and chaperone to provide visitors to the great State of Florida a sample of Fresh Florida Watermelon as well as education on the health benefits associated with eating watermelon. It also allowed for a smiling, welcoming encounter to the visitors to the great state of Florida in hopes of leaving a lasting positive impression of the state as well as helping to leave a lasting impression that would be remembered as they visited the produce section during their supermarket visits.
- Relay for Life participation by the Florida Watermelon Queen to provide additional exposure to the Florida Watermelon industry as well as participating in a great cause. Relay for life is an organization throughout the United States that is ran by local

communities that raises awareness of cancer treatment and prevention. This type of venue offers larger exposure to a wide range of individuals allowing for a larger educational campaign of the benefits of eating fresh Florida Watermelon, as well as adding additional exposure for an amazing cause by having a local celebrity present.

- Ronald McDonald house charity event participation by the Florida Watermelon Queen to provide additional exposure to the Florida Watermelon industry as well as participating in a great cause. This type of venue offers larger exposure to a wide range of individuals allowing for a larger educational campaign of the benefits of eating fresh Florida Watermelon as well as adding additional exposure for an amazing cause by having a local celebrity present.
- Local and Regional sales promotion ads depicting the great benefits of eating fresh Florida Watermelon as well as additional exposure of the Florida Watermelon industry.

Goals and Outcomes Achieved:

- 4 of the 4 Ronald McDonald House Charities events were completed.
- The videos and ad campaign was completed.
- Consumption of Florida Watermelon grew 9% during grant period.
- 2 of the 4 Relay for Life events were completed
- 2 of the 4 Welcome Centers were visited.
- 6 of the 20 Elementary Schools were visited.
- 7 of the 40 Retail outlets were visited.

Beneficiaries:

- Consumers were educated on the health benefits of eating fresh Florida Watermelon.
- Due to the 9% increase in sales of Florida Watermelon, growers, seed companies, heavy equipment companies as well as fertilizer companies should have realized a growth in sales as well. Thus helping bolster the Florida economy.
- Lunchroom personnel in elementary schools received education on providing another healthy and delicious alternative for school lunch. This information can also be transferred to their home life and hopefully sparking an interest in fresh Florida Watermelon.
- According to the The Packer, a produce magazine three-quarters of those surveyed in household with kids said they bought watermelon in the past two years, compared to 69% of those without kids. The green skinned fruit is clearly a kid favorite.
- Working with charities such as Relay for Life and Ronald McDonald House allowed us to reach and educate a wider range of audience that in many cases would not know or receive the educational information on the benefits of consuming fresh Florida Watermelon, again boosting the exposure of the Florida watermelon industry. While providing the educational and promotional exposure of Florida Watermelon during these events the Queen was able to provide additional exposure to worthwhile community charities. No federal funds were used to promote these causes, just the mere presence of the Queen at such an event allowed for further interest of the community in these charities. This in turn allowed the Queen to reach a larger audience in an attempt to educate and boost watermelon sales.

Lessons Learned

- Through this grant we were able to discover a barrier to accessing retail locations. Due to the lower price of watermelons being offered by countries such as Mexico, Florida growers are finding it harder to compete in our local and national markets, opening the

door further for foreign competitors to gain a larger market share, hence negatively impacting the Florida grower and watermelon sales of Florida Watermelon.

- The Florida Watermelon Association also found it imperative to attempt to enter the markets outside Florida in an effort to gain greater market share in an attempt to compete with foreign growers and offset the not as high as estimated growth seen in the Florida market.
- Through this grant and our inability to meet many of the promotional goals we also discovered funding requested for things such as personnel and travel were not adequate to meet all of the travel needs required due to the increase in cost of travel and additional distance of a new reigning queen with the association support staff, as well as the additional cost incurred by the need to attempt to enter markets outside the State of Florida.
- During our initial grant request we had an arrangement with a national retail chain to visit 35 of their stores to promote fresh Florida Watermelon. After receiving approval of the grant the retail chain pulled out of the arrangement diminishing our ability to meet the retail promotions as stated.

Contact Person:

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Additional Information

- For additional information and to view our ad campaign please visit our website at: www.flfwa.com

Project (18) FDACS Division of Marketing and Development, Fresh From Florida Kids Program-Children's Expo Orlando

FDACS Grant Contract Number: None
Total Funding – $24,100.00
End Date: 9/30/2012

Project Summary

- The purpose of this program was to expose young children to specialty crops, strawberries in particular, and to encourage parents to prepare nutritious, specialty-crop based snacks for their children. The need addressed was early adoption of dietary habits which emphasize specialty crops in the hope that these habits become ingrained as children grow older.

  The Fresh From Florida Kids Program showcased Florida specialty crops by creating vivid displays, generating awareness and availability of produce, sampling and recipe stations, health and nutrition workshops with hands-on demonstrations for 40 kids using only specialty crops.
- By distributing Fresh From Florida Kids Booklets, both in English and Spanish, to the younger kids; Fresh From Florida Kids Postcards and Activity Books to the older kids; and cooking conversion guides and Florida produce booklets with recipes for specialty crops to the parents; we exposed whole families to the advantages of eating a more nutritious diet utilizing specialty crops.
- This project has not been submitted to or funded by any other state or federal grant program. The Florida Department of Agriculture has not previously participated in this event.

  This project was important and timely because we believe that establishing specialty crop consumption as a habit during a child's formative years will influence their purchasing decisions later in life. This event in particular was timely because it fell at the beginning of the school year, when parents are establishing a routine of preparing meals and snacks for children. We believe this is the best time to help children form healthy eating habits based on increased consumption of fruits and vegetables.

Project Approach

- Through the information and workshops available at this event, we were able to expose the kids & the parents to specialty crops they may not have tried before. The information made available for young mothers in the Fresh From Florida Kids Booklet suggests ways to use fresh fruit and vegetables for baby food while making dinner for the whole family. The Fresh From Florida Kids Postcard gave older kids a fun and nutritious way to utilize specialty crops for snacks. Our Florida Produce Package informed parents not only when specialty crops are in season, but also how to buy, tips for storage, cooking and nutritional info and healthy recipes.
- FDACS was able to partner with Donna Wolter, Supervisor of Food Services for the Osceola County School District, to conduct food demonstrations for 40 kids to

make
frozen strawberry pops.

- Also partnering with FDACS were seven staff members from the Osceola County Extension Office, who assisted by discussing two federally funded programs, Expanded Food and Nutrition Education Program and Family Nutrition Program. Both provided nutritional education to children and adults.

Goals and Outcomes Achieved

- Goal: Distribution and presentation of all written materials produced by FDACS:
  - 1500 Fresh from Florida Kids Booklets
  - 500 Fresh from Florida Kids Booklets in Spanish
  - 2000 FFF logo flexible cutting boards
  - 2000 Fresh From Florida Kids Postcards
  - 2000 Fresh From Florida Kids Activity Book w/2000 crayons
  - 1000 Fruit dog tags
  - 1000 Veggie dog tags

  Outcome: Participants gained knowledge and expressed intentions to buy and eat more fresh fruit and vegetables.

- Expected Measurable Outcome: Conduct four health and nutritional workshops with hands-on demonstrations explaining the importance of healthier eating and demonstrating the advantages of Florida specialty crops in achieving a more nutritious diet.
  - Three educational sessions on nutrition in cooperation with the Osceola County Extension Office with Grisel Negron and staff 6.
  - Time constraints and longer-than-expected setup times for the demonstrations during this one-day event restricted the number of workshops to three.

- For the breakout sessions, a clicker system was used to count traffic at the booth. 935 participants were engaged and received educational information and materials.
  - 11:30 am class - What's in your fast food?
  - 1:00 pm class - Healthy Snacking
  - 3:00 pm class - What's in your fast food?

  Note: The education sessions entitled "What's In Your Fast Food?" were sponsored and conducted by the Osceola County Extension Office and held at a different location from the booth used for the SCBGP-funded programming. They are included here for the purpose of acknowledgment because they helped drive foot traffic to the FDACS booth, which assisted us in reaching a larger audience.

Outcome: 44 participated in two presentations. 15 attended the Healthy Snacking & 29 attended the "What's in your fast food?" presentation.

- Goal : Conducted (2) food demonstrations with Donna Wolter, Supervisor Food Service for the Osceola School District:
  - 40 kids were given instructions on how to make frozen strawberry pops
  - Fresh strawberries were given to each participant
  - Nutritional information was discussed
  - 40 aprons distributed
  - 40 lunch bags distributed

  Outcome: all 40 participants and their parients gained knowledge and expressed intentions to eat more fresh fruit and vegetables.

- Prior to conducting the food demonstrations, the kids participated in an oral and written survey to test their knowledge on nutrition and health for kids their age. The survey consisted of four questions:
  (1) Do you know what calories are? Explain.
  (2) What is nutrition?
  (3) Do you know how many fruit and veggies you should eat a day? If so, how many?
  (4) Do you know how many strawberries are in a cup?

  As the kids made strawberry pops, Donna Wolter gave a lesson on the facts of nutrition and health for kids ages 4-13. Following the food demonstration and nutrition lesson, the kids participated in another oral and written post-survey to
  test their knowledge on nutrition and health for kids their age. The survey consisted of four questions:
  (1) How many calories should you consume each day?
  (2) Are eating fresh fruit and veggies nutritious? Why?
  (3) How many fruit and veggies should you eat each
  day?
  (4) How many strawberries would you need to meet your fruit requirement for the day?

  The results of the pre-survey showed only 4 out of 20 participants answered at least
  2 questions correctly. The results of the post-survey showed 16 out of 20 participants answering all 4 questions correctly. These results account for over a
  60% increase in the amount of participants answering questions correctly.

Beneficiaries

- FDACS location at the event was front and center. Everyone that entered came by our exhibit. Total attendance was 4,679.

- We were able to reach 935 participants through the efforts of the Osceola Extension Office. 40 special kids and their parents were able to attend the food demonstration conducted by Osceola Food Service District School representative.

Lessoned Learned

- Great venue for getting our message of healthier eating habits and nutritional information to the right audience. The number of participants was not what was expected but the interest in the subject matter was extraordinary.
- The volume of participants interested in the materials that we provided was largely impressive.
- The measurements that were derived from the survey were not as detailed as expected. More staffing may have prevented that and ensured that at least one staff member be dedicated to attaining survey results. We were striving for an 80% increase awareness of eating healthier and achieved 60%.

Contact Person

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Additional Information

Please see following pages

Additional Information

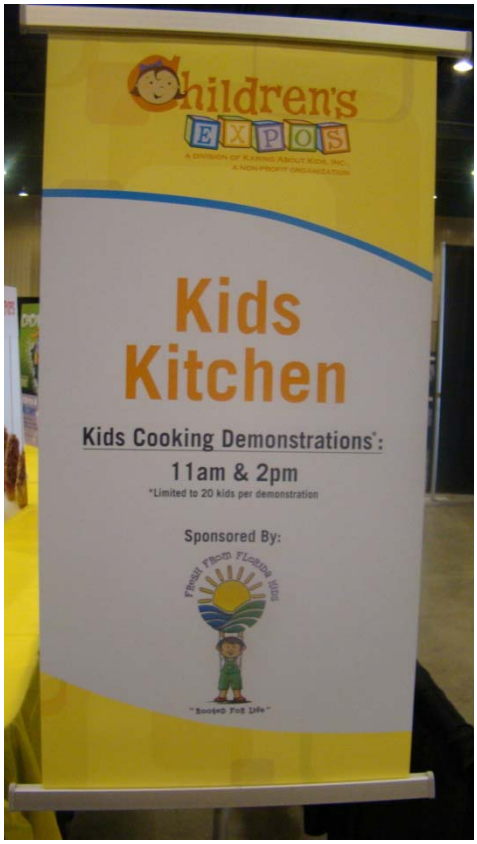
- Attendance: 4679
- Flyers: 30,000 (Logo Included)
- Online ChildrensExpos.com Presence: Sponsor Page, Kids Kitchen Page, Exhibitor Marketplace Page

Marketing:
- Orlando Family Magazine 25,000/mo.
- Orlando Kids Directory –22,000/mo x 3 = 66,000
- El Sol de la Florida Newspaper - 65,000/mo x 2 = 130,000
- Billboard –3 Billboards for 3 weeks – 1,128,051
- Social Media – Children's Expos Facebook page (over 2500 fans) plus exhibitor Facebook posts prior to the Expo

- Onsite Fresh From Florida Logo Presence:
- Welcome & Registration Signs (5) – Inside Exhibition Building
- Welcome Banner (1) – Outside Exhibition Building
- Kids Kitchen Custom Signage (2)
- Stage Schedules (2)
- 6 Fresh From Florida Tablecloths
- 2 Pop-up Fresh From Florida signs

Main Display Area

Kids Kitchen featuring Donna Wolter & Alyssa McKnight



Fresh
from
Florida

Osceola County Extension Office Staff

Thoroughly saturated participants after attending our workshops

PROJECT (19): EVALUATION OF TWO MICRO-INJECTIONSYSTEMS AND ONE LOW VOLUME IV-BAG INFUSION SYSTEM FOR APPLICATION OF TILT INTO AVOCADO TREES

FDACS Grant Contract #19430
Total Funding - $20,740.00
End Date: 9/30/2012

PROJECT SUMMARY

Micro-injection and low volume infusion of Tilt®

This work is being conducted by the private research group of Brooks Tropicals, LLC. Inc., Homestead, FL. Mr. Armando Monterroso, Dir. of Research and Development and Mr. Jose Perez-Martinez, Asst. Dir. of Research and Development, are conducting this work in avocado groves infested with laurel wilt. Dr. Jonathan Crane, Tropical Fruit Crop Specialist,
UF/IFAS, TREC, is assisting with reporting this work. As this research is on-going, this report will cover the period of7/9/2012 to 11/10/2012.

Background

The exotic laurel wilt pathogen, *Raffaelea lauricola,* vectored by the exotic redbay ambrosia beetle *(Xyleborus glabratus)* attacks trees in the Lauraceae, including avocado *(Per sea americana).* It appears tree decline and death is due to disruption of the water conducting tissue (xylem) and a hypersensitive reaction of the tree to the presence of the pathogen. Field observations have shown the pathogen is capable of moving from one avocado tree to another via the natural root grafts which occur among mature avocado trees. Previous investigations and trials in progress suggest that propiconazole can control the pathogen. However, the most efficacious application technique is not known and the xylem and fruit residue levels resulting from different application techniques are not known. Furthermore, the phytotoxicity of Tilt® on avocado is not known. With this in mind an investigation into two application methods of Tilt® was initiated to determine the resulting propiconazole residue levels xylem tissue. This project is timely because laurel wilt has not yet completely spread throughout the commercial avocado production area and demonstration of techniques and protocols to inhibit spread of the pathogen are vitally important. This work compliments and enhances previous projects which demonstrated propiconazole has the potential to control the pathogen (Ploetz et al., 2011).

PROJECT APPROACH

Investigate the feasibility of utilizing two micro-injection systems (i.e., QuikJet System, Arborjet Inc., Woburn, MA or Wedgle Direct-Inject System, ArborSystems, Omaha, NE) and one low volume (IV -bag infusion) system for Tilt® applications into avocado trees and the resultant xylem wood residue levels. Eight year-old 'Wheeling' avocado trees at the Jeran Grove and 25-year-old 'Donnie' avocado trees in the Aurora Grove were used to test two micro-infusion systems (i.e., QuikJet and Wedgle) and the lV-bag infusion system with Tilt® (propiconazole; 41.8% ai).

Tree trunk diameters (diameter at breast height, DBH) at the Jeran Grove used for trunk injections ranged from 8 to I 0 inches with an average of 9 inches. Each tree was treated with 7 ml Tilt® per inch DBH using 6

injection points with the QuikJet System, and 10 injection points with the Wedgle Direct-Inject System per tree. The fungicide was diluted in 27 mil of water for each injection per tree. For the IV -bag infusion method the same rate of Tilt® (7 ml per inch DBH) was mixed with 300 ml of water per tree; there were 4 injection sites per tree. At the Aurora Grove, tree diameters (DBH) ranged from I 0 to 16 inches with an average of 14 inches. Trees were injected with 98 ml of Tilt® mixed with 40 ml of water per tree. There were 6 to 8 injection sites with the QuikJet System and 10 to 12 injection sites with the Wedgle Direct-Injection System per tree. Tree infused with Tilt with the IV -bag system was mixed with 300 ml per tree. Trees were injected or IV-bag infused and xylem wood residue samples taken approximately every month after treatment.

Trees in the Aurora Grove were treated on 31 July-! Aug., 2012, to date xylem wood was sampled on II September 2012; phytotoxicity data was taken 5, 14, 42, 49, and 63 days after treatment (Table 1). Trees in the Jeran Grove were treated on 7 Aug., 2012 and to date xylem wood was sampled on II September 2012; phytotoxicity data was taken I, 7, 36, 43, and 50 days after treatment. All residue samples were analyzed for propiconazole by ABC Research Laboratories, Gainesville, FL.

GOALS AND OUTCOMES ACHIEVED

Phytotoxicity. To date phytotoxicity data has been taken five times (Table 2). No phytotoxicity was noted from any application method at the rates of Tilt® tested.

Xylem wood (sawdust) residue. In the Aurora Grove, mean Tilt sawdust residues of25-year-old 'Donnie' trees were variable when applied by the Wedgle Direct-Inject System (ranged from 0.13 ppm to 2.13 ppm), QuikJet System (ranged from 0.05 ppm to 2.44 ppm) and IV -bag system (0.17 ppm to 0.99 ppm) (Table 3). On average the residue concentrations were higher with the Wedgle Direct-Inject System than the QuikJet System and IV-bag systems. In the Jeran Grove, mean Tilt sawdust residues were variable but higher than with the 8-year-old 'Wheeling' trees compared to the 25-year-old 'Donnie' trees in the Aurora Grove (Table 3). Tilt residue concentrations when applied by the Wedgle Direct-Inject System (ranged from 2.25 ppm to 9.1 ppm), QuikJet System (ranged from 2.04 ppm to 8.78 ppm) and IV-bag system (0.7 ppm to 3.81 ppm) (Table 3). On average Tilt residue concentrations were higher with the Wedgle DirectInject System than the QuikJet System and IV -bag systems.

Discussion. To date, no phytotoxicity was noted from injecting Tilt by Wedgle Direct-Inject System, QuikJet System, or IV -bag system. The Tilt residue concentrations varied greatly among samples for each application method and may have been due to (I) sampling location; (2) limited number of samples/treatment and; (3) the uneven distribution of Tilt when applied with the number of injection or infusion sites used in this demonstration. This work plan is on-going and xylem wood sampling will continue.

Performance measures and outcomes achieved

1. Effect of two Tilt injection methods and one IV-bag infusion method on avocado tree phytotoxicity.
   Outcome: No phytotoxicity was detected from any of the application techniques demonstrated at the rates of Tilt used. Performance data exceeded expectations since ratings were taken up to 63 days post application.
2. Effect of two Tilt injection methods and one IV-bag infusion method on avocado tree

xylem wood residue concentrations about I month post treatment.
Outcomes: Tilt residue concentrations were higher in the younger 'Wheeling' trees compared to the older 'Donnie' trees. All xylem wood Tilt residue concentrations were variable with all application methods probably due to uneven distribution of the fungicide.

Goals achieved

1. This work demonstrated that concentrations of Tilt in younger avocado trees was higher than in older avocado trees at the rates used in this work
2. That application method did not cause tree phytotoxicity.
3. This work suggests the Wedgle Direct-Inject System may be superior to the other two systems demonstrated.
4. That more injection/infusion sites may be necessary to evenly distribute Tilt within the xylem wood of avocado trees.

Outreach Goals

Results from this project were presented at a meeting of the Laurel Wilt Working Group and the report sent via email to Avocado Administrative Committee, growers, and packers. To date feedback from the producers and the Committee is positive in that it appears grower field trials are headed in the right direction in developing methods to infuse/inject avocado trees with fungicides and insecticides to protect avocado trees from LW and RAB.

Bark directed sprays and soil drenching of fungicides does not appear to be efficacious, and none of the producers surveyed are using this as a common commercial practice. However, producers know that whereas the results from microinjection and IV-infusion to date appear somewhat promising for control of laurel wilt, more time and xylem wood residue testing is needed to determine their ultimate usefulness in precluding LW infection.

BENEFICIARIES

The beneficiaries of this work include the commercial avocado producers of Florida (and potentially California, Hawaii, Texas, and Puerto Rico if the pest is introduced into those areas), the numerous packinghouses that pack, ship, and market Florida avocados nationally, the State (FDACS, DEP) and Federal (EPA, USDA) regulatory agencies with responsibility for pesticides use in agriculture, the chemical companies which develop and market pest control products (e.g., Syngenta) and research and educational institutions that are investigating techniques and protocols to control or mitigate the effect of laurel wilt on avocado production. All these groups may use the results of this work to (a) control and/or mitigate the effect of laurel wilt on avocado production; (b) utilize this information for registration of propiconazole for avocado production in the U.S.; (c) provide information to chemical companies on proper use patterns

and food safety ofpropiconazole and; (d) provide background information for researchers investigating technology, protocols, and strategies to control laurel wilt.

All avocado producers and managers in Miami-Dade County have benefited from the project. Producers were informed of the results of these projects through meetings (698 participants), handouts (8 produced, hundreds disseminated), PowerPoint presentations (15 by the Extension Specialist alone, numerous more by speakers at the various meetings), reports (3 produced), and electronic media (i.e., Internet websites (803 on UF/IFAS/TREC Laurel Wilt website; not know how many to FDACS-DPI Laurel Wilt website), electronic publications (4,837 downloads), and videos (not counted). Reports, updates, handouts, and recommendations (new and revised) are continually sent out by email through the avocado grower database of the Avocado Administrative Committee.

LESSONS LEARNED

To date the researchers and beneficiaries have learned that various application methods of applying Tilt at the rates used results in no plant phytoxicity and variable concentrations of fungicide in xylem wood residues. The project will extend beyond the work plan through in-kind contributions and hopefully other funding sources.

Outreach. Results from this work plan will be extended to the avocado industry, researchers and regulatory agencies during a Laurel Wilt Working Group meeting (slated for early December 2012) and by emailing this report to the working group and other interested parties (including but not limited to, IR-4, FDACS-DPI, and chemical companies).

CONTACT PERSONS

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ADDITIONAL INFORMATION

Please see additional information on following pages.

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Table 1. Tree micro-injection with QuikJet and Wedgle Direct-Inject systems and IV-bag infusion treatments and dates of data collection for 8-year-old 'Wheeling' avocado trees at the Jeran Grove and for 25-year-old 'Donnie' avocado trees at the Aurora Grove.

			Date	Date of	
Location	Cultivar	Treatments	Treatment applied	Xylem wood sampling	Phytoxicity data
Aurora Grove	Donnie	Micro-injection[z]	7/31/12 – 8/1/12	9/11/12	8/6/12
				9/9/12[y]	8/14/12
				3/9/13[y]	9/12/12
				6/9/13[y]	9/19/12
				-	9/26/12
Aurora Grove	Donnie	IV-bag infusion	7/31/12 – 8/1/12	9/11/12	8/6/12
				9/9/12[y]	8/14/12
				3/9/13[y]	9/12/12
				6/9/13[y]	9/19/12
				-	9/26/12
Jeran Grove	Wheeling	Micro-injection[z]	8/7/12	9/11/12	8/8/12
				11/14/12[y]	8/14/12
				3/12/13[y]	9/12/12
				6/12/13[y]	9/19/12
				-	9/26/12
	Wheeling	IV-bag infusion	8/7/12	9/11/12	8/8/12
				11/14/12[y]	8/14/12
				3/12/13[y]	9/12/12
				6/12/13[y]	9/19/12
				-	9/26/12

z, separate trees were micro-injected with QuikJet system or a Wedgle Direct-Inject system.
y, dates of future sampling.

Table 2. Effect of Tilt application techniques on avocado tree phytotoxicity.

Grove	Experiment (application technique)	Days after first treatment application				
		5	14	42	49	63
Aurora	Wedgle	NO	NO	NO	NO	NO
	QuikJet	NO	NO	NO	NO	NO
	IV-bag	NO	NO	NO	NO	NO
		Days after first treatment application				
		1	7	36	43	50
Jeran	Wedgle	NO	NO	NO	NO	NO
	QuikJet	NO	NO	NO	NO	NO
	IV-bag	NO	NO	NO	NO	NO

Table 3. Tree micro-injection with QuikJet and Wedgle Direct-Inject systems and IV-bag infusion treatments and xylem wood residue concentrations for 8-year-old 'Wheeling' avocado trees at the Jeran Grove and for 25-year-old 'Donnie' avocado trees at the Aurora Grove.

Grove	Avocado cv and age	Experiment (application technique)	Residue concentration (ppm)				Mean
			Replication				
			1	2	3	4	
Aurora	Donnie, 25 years old	Wedgle	0.58	0.13	0.24	2.13	0.77
		QuikJet	2.44	0.06	0.13	0.05	0.67
		IV-bag	0.99	0.51	0.25	0.17	0.48
Jeran	Wheeling, 8 years old	Wedgle	3.55	2.25	9.1	7.26	5.54
		QuikJet	2.05	4.2	8.78	2.04	4.27
		IV-bag	0.7	2.34	3.81	1.98	2.21

Literature cited

Anonymous. 2011. Propiconazole, pesticide tolerances. Federal Register Volume 76, Number 91 (Wednesday, May 11, 2011). Pages 27261-27268. [http://www.gpo.gov/fdsys/pkg/FR-2011-05-11/html/2011-11564.htm].

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PROJECT (20): EVALUATION OF TILT RESIDUES IN AVOCADO TREES APPLIED AS SOIL DRENCHING, TOPIC, AND MICRO-INJECTION

FDACS Grant Contract #19431
Total Funding – $34,650.00
End Date: 9/30/2012

PROJECT SUMMARY

Injection, drenching, and directed bark spray of Tilt®

This work is being conducted by the private research group of Brooks Tropicals, LLC. Inc., Homestead, FL. Mr. Armando Monterroso, Dir. of Research and Development and Mr. Jose Perez-Martinez, Asst. Dir. of Research and Development, are conducting this work in avocado groves infested with laurel wilt. Dr. Jonathan Crane, Tropical Fruit Crop Specialist, UF/IFAS, TREC, is assisting with reporting this work. As this research is on-going, this report will cover the period of 7/9/2012 to 11/10/2012.

Background. The exotic laurel wilt pathogen, *Raffaelea lauricola,* vectored by the exotic redbay ambrosia beetle *(Xyleborus glabratus)* attacks trees in the Lauraceae, including avocado *(Persea americana).* It appears tree decline and death is due to disruption of the water conducting tissue (xylem) and a hypersensitive reaction of the tree to the presence of the pathogen. Field observations have shown the pathogen is capable of moving from one avocado tree to another via the natural root grafts which occur among mature avocado trees. Previous investigations and trials in progress suggest that propiconazole can control the pathogen. However, the most efficacious application technique is not known and the xylem and fruit residue levels resulting from different application techniques are not known. Furthermore, the phytotoxicity of Tilt® on avocado is not known. With this in mind an investigation into three application methods at three rates of Tilt® was initiated to determine the propiconazole residue levels in avocado fruit and xylem tissue.

This project is timely because laurel wilt has not yet completely spread throughout the commercial avocado production area and demonstration of techniques and protocols to inhibit spread of the pathogen are vitally important. This work compliments and enhances previous projects (Ploetz et al., 2011) and on-going projects of which this is a part.

PROJECT APPROACH

Three experiments were conducted to investigate the effect of application methods and rates of Tilt® (41.8% ai) on tree phytotoxicity and on avocado fruit and xylem wood residue levels (Table I and Table 2). Each trial consisted of 12 to 16 trees and 4 mature avocado trees per treatment. Trees ranged in age from 25 to 40 years-old and are adjacent to known laurel wilt pathogen positive avocado trees. Trees were trunk injected, bark-directed sprayed, or root drenched with three to four rates of Tilt® (Table 2). A QUIK-jet Kit (by ARBOR jet, Inc., Woburn, MA; http://www.arborjet.com/) tree injector system was used to inject trees with Tilt® (Photograph 1). Trees ranged from 10 inches to 12 inches in trunk diameter. A low (73 mlltree equivalent to 7.3 liters per acre), medium (113.6 mlltree equivalent to 11.4 liters per acre) or high (!54 mlltree equivalent to 15.4 liters per acre) rate of Tilt® was injected per tree and applied on 9 July 2012 Q'able 1). A small amount of water was mixed with the Tilt® prior to injection. The rate of Tilt for each tree was subdivided and injected into 6 to I 0 injection sites around the trunk and as close as possible to the ground of each tree.

Bark-directed applications were made by mixing Tilt® at a rate of9.1 ml (low), 18.2 (medium), or 27.3 ml (high) per tree with I liter of water and 25 ml Pentrabark (adjuvant cone. At 2.5%) and sprayed onto the tree trunk from a 3ft height to the ground (Table 2). A total of 8 applications per year, with the same rate and in the same way per treatment, will be performed approximately every 6 weeks.

Soil drench applications were made by mixing Tilt® at a rate of9.1 ml (very low), 18.2 (low), 27.3 ml (medium) or 36.4 ml (high) per tree with 7.6liters (2 gallons) of water and applied with a watering can under the canopy from 30 em from the trunk to the drip-line (Table 2). A total of 8 applications per year using the same rate and application technique will be made approximately every 6 weeks. Trees treated by bark-directed (topical/bark) and soil drench have been treated twice; trees injected once.

Data collected and in-progress includes phytotoxicity and fruit and/or sapwood residue levels (Table I). Observations for phytotoxicity included leaf burn, stem dieback, limb dieback and tree death. Fruit from trees injected with Tilt® were randomly harvested around 4 trees per treatment for residue analysis and shipped immediately postharvest via ACD freezer truck to ABC Research Labs, Gainesville, FL. Wood samples were collected by severing limbs and then drilling into the sapwood (xylem) and collecting the sawdust (about 100 g fresh wt) and was shipped immediately postharvest via FedEx to ABC Research Labs, Gainesville, FL.

GOALS AND OUTCOMES ACHIEVED

Phytotoxicity. To date phytotoxicity data has been taken three to four times (I to 31 day interval) (Table 1). No phytotoxicity was noted from any application method or any rate of Tilt® tested (Table 3).

Tissue residue. Mean 'Donnie' fruit Tilt® residue concentrations 38 days after treatment ranged from 0.007 ppm (high rate) to 0.009 (low rate) (Table 4). This is far below the established tolerances for the citrus crop group I 0-10 (8.0 ppm), stone fruit crop group 12 except plum (4.0 ppm), plum (0.6 ppm), bush berry subgroup 13-07B (1.0 ppm), and cane berry subgroup 13-07 A (1.0 ppm) (Anonymous, 2011; Anonymous, 2012). Mean saw dust (xylem wood) residue concentrations from trees injected with Tilt® ranged from 0.149 ppm to 2.116 ppm (Table 4). Mean saw dust (xylem wood) residue concentrations from trees bark spray directed with Tilt® plus Pentrabark ranged from 0.060 (high rate) to 0.448 (medium rate). Mean saw dust (xylem wood) residue concentrations from soil drench treatments with Tilt® ranged from 0.063 (high rate) to 0.544 (medium rate).

Discussion. To date, no phytotoxicity has been noted for any of the Tilt® application methods and rates tested. However, additional bark directed spray and soil drench application will be made in the future. The range in propiconazole residue concentrations in 'Miguel' fruit was 0.005 ppm to 0.011 ppm. However, the mean fruit propiconazole residue concentrations were at or below 0.009 ppm which is well below established residue tolerances for the citrus, pome, bushberry, and caneberry fruit groups. There was great variation in saw dust (xylem wood) residue concentrations between and among treatments. This may be due to uneven Tilt® distribution within the large avocado trees. Additional, sawdust residue samples are planned for the future and whether Tilt® will accumulate in the xylem sapwood will be determined.

Performance measure and outcomes achieved

1. Effect of soil drench, injection, and bark directed applications of Tilt on avocado tree phytotoxicity 7 and 21 days post treatment.
   Outcome: No phytotoxicity was detected from any application method or rate of

propiconazole used. Performance data collected exceeded expectations since ratings for phytotoxicity were taken I, II, 28, and 67 days post trunk injection and 18, 26, and 57 days post the first bark directed spray and soil drench and 15 days post the second bark directed spray and soil drench.

2. Effect of one injection and two soil drench, and bark directed application of Tilt on avocado Tilt (propiconazole) xylem wood and fruit residue concentrations about I month post treatments. Outcome: Fruit and xylem wood residue concentrations were monitored and this
demonstrating the potential safety and efficacy ofpropiconazole for control of the laurel wilt pathogen. 'Donnie' fruit residue concentrations were far below established tolerances for citrus, stone fruit, and berries suggesting propiconazole is safe. Xylem
wood residue levels demonstrated that injection of propiconazole results in greater tissue concentrations than bark-directed sprays and soil drenches (after 3 applications).

<u>Goals achieved</u>

1. This work demonstrated the rates of propiconazole applied as trunk injection, barkdirected sprays, or soil drench to the roots does not result in phytoxoicity.
2. This work demonstrated that the rate of propiconazole trunk injected resulted in very low fruit residue concentrations; suggesting registration of this product for avocado production would not pose a health risk for consumers.
3. This work demonstrated that to date injection ofpropiconazole appears to result in greater xylem wood concentrations than bark-directed or soil drench applications.

Outreach Goals

1. Presentation entitled 'Threat to the Lauraceae in the western hemisphere and avocado specifically' at the UF Horticultural Sciences Department, Gainesville, FL. Approximately 25 attendees.
2. Poster presentation entitled 'Early detection and suppression of laurel wilt, caused by Raffaelea lauricola, in the primary commercial avocado production area in Florida'. Co-authors: Crane, J.H., J.E. Peña, R.C. Ploetz, and E.A. Evans. 2012 American Soc. Hort. Sci. Annual Conference
3. In-Service Training of Extension Master Gardeners (MG). Master Gardeners are trained by the UF/IFAS Extension Service and are volunteers that help to answer inquires for information and guidance from Florida's urban residents. Ninety-three MG in four training sessions were educated on RAB-LW and the current recommendations for control for urban residents with avocado or native host trees in their backyards. These MG were from Miami-Dade, Monroe, Sarasota, and Martin Counties.
4. <u>Avocado Laurel Wilt Subcommittee meetings</u>. A group of approximately 10 avocado producers/packers and grove management companies, UF/IFAS/TREC scientists and the Tropical

Fruit Crop Specialist met 26 times during 2012 (about 260 participants during 2012) to discuss on-going research, LW aerial and ground surveys and sampling, and RAB/LW control tactics appropriate to grove situations. During meetings everyone discusses the current situation, experiences, and observations and collaborates on revising recommendations for control of the pathogen and beetle.

BENEFICIARIES

The beneficiaries of this work include the commercial avocado producers of Florida (and potentially California, Hawaii, Texas, and Puerto Rico if the pest is introduced into those areas), the numerous packinghouses that pack, ship, and market Florida avocados nationally, the State (FDACS, DEP) and Federal (EPA, USDA) regulatory agencies with responsibility for pesticides use in agriculture, the chemical companies which develop and market pest control products (e.g., Syngenta) and research and educational institutions that are investigating techniques and protocols to control or mitigate the effect of laurel wilt on avocado production. All these groups may use the results of this work to (a) control and/or mitigate the effect of laurel wilt on avocado production; (b) utilize this information for registration of propiconazole for avocado production in the U.S.; (c) provide information to chemical companies on proper use patterns and food safety of propiconazole and; (d) provide background information for researchers investigating technology, protocols, and strategies to control laurel wilt.

All avocado producers and managers in Miami-Dade County have benefited from the described projects above. Producers were informed of the results of these projects through meetings (698 participants), handouts (8 produced, hundreds disseminated), PowerPoint presentations (15 by the Extension Specialist alone, numerous more by speakers at the various meetings), reports (3 produced), and electronic media (i.e., Internet websites (803 on UF/IFAS/TREC Laurel Wilt website; not know how many to FDACS-DPI Laurel Wilt website), electronic publications (4,837 downloads), and videos (not counted). Reports, updates, handouts, and recommendations (new and revised) are continually sent out by email through the avocado grower database of the Avocado Administrative Committee.

Commercial avocado producers and managers now know that:

1. Currently, no spray-applied physical barrier has demonstrated enough promise to be recommended as an RAB control. However, they also know more testing is in progress.
2. Bark directed sprays and soil drenching of fungicides does not appear to be efficacious no one is using this as a common commercial practice. However, producers know that whereas the results from microinjection and IV-infusion to date appear somewhat promising for control of laurel wilt, more time and xylem wood residue testing is needed to determine their ultimate usefulness in precluding LW infection.

LESSONS LEARNED

To date the researchers and beneficiaries have learned that various methods of applying a known fungicidal control agent (i.e., propiconazole) results in no phytoxicity, variable concentrations of fungicide in xylem wood residues, and poses little to no risk to the safety of the fruit. The project will extend beyond the work plan through in-kind contributions and hopefully other funding sources.

Outreach. Results from this work plan will be extended to the avocado industry, researchers and regulatory agencies during a Laurel Wilt Working Group meeting (slated for early December 2012) and by emailing this report to the working group and other interested parties (including but not limited to, IR-4, FDACS-DPI, and chemical companies).

CONTACT PERSONS

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ADDITIONAL INFORMATION

Note: While research activities for this and other LW-related project are ongoing, SCBGP funding for these programs ended on September 30, 2012. Ongoing activities are being funded by other sources.

Literature cited

Anonymous. 2011. Propiconazole, pesticide tolerances. Federal Register Volume 76, Number 91 (Wednesday, May 11, 2011). Pages 27261-27268. [http://www.gpo.gov/fdsys/pkg/FR-2011-05- 11/html/2011-11564.htm].

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management of laurel wilt of avocado. Plant Dis. 95:977-982.

Please see tables on following pages.

Table 1. Experiments, application methods, treatment parameters and dates.

Experiment				
Trunk injection				
Location	Aurora grove, Miguel avocado cultivar.	Dates	Item	Comments
Installed (injected)	Trunk injection	7/9/2012	Applied	Done
Data collection				
Phytotoxicity 1st	All treatments	7/10/2012	1st reading	Done
Phytotoxicity 2nd	All treatments	7/20/2012	2nd reading	Done
Phytotoxicity 3rd	All treatments	8/6/2012	3rd reading	Done
Phytotoxicity 4th	All treatments	9/14/2012	4th reading	Done
Residue Fruit sampling	All treatments	8/16/2012	Collected	Done
1st. Saw dust residues	All treatments	9/16-17/2012	Collected	Done
2nd Saw dust residues	All treatments	9/27/2012	Collected	Done
3th Saw dust residues	All treatments	3/9/2013		Pending
4th Saw dust residues	All treatments	6/9/2013		Pending
Bark directed spray+Pentrabark				
Location	Aurora grove, Donnie avocado cultivar.	Dates	Item	Comments
1st Treat. appl. (installed)	Bark directed +Pentrabark	7/19/2012	Applied	Done
2nd Treat. application	All treatments	8/30/2012	Applied	Done
3rd Treat. application	All treatments	10/11/2012	Applied	Done
4th Treat. application	All treatments	11/22/2012		Pending
5th Treat. application	All treatments	1/3/2013		Pending
6th Treat. application	All treatments	2/23/2013		Pending
7th Treat. application	All treatments	5/10/2013		Pending
8th Treat. application	All treatments	6/28/2013		Pending
Data collection				
Phytotoxicity	All treatments	8/6/2012	1st reading	Done
Phytotoxicity	All treatments	8/14/2012	2nd reading	Done
Phytotoxicity	All treatments	9/14/2012	3rd reading	Done
1st Saw dust residues	All treatments	8/20-21/2012	Collected	Done
2nd Saw dust residues	All treatments	9/27/2012	Collected	Done
3rd Saw dust residues	All treatments	3/9/2013		Pending
4th Saw dust residues	All treatments	7/19/2013		Pending
Soil drench				
Location	Aurora grove, Donnie avocado cultivar.	Dates	Item	Comments
1st Treat. Appl. (installed)	Soil drench	7/19/2012	Applied	Done
2nd Treat. application	All treatments	8/30/2012	Applied	Done
3rd Treat. application	All treatments	10/11/2012	Applied	Done
4th Treat. application	All treatments	11/22/2012		Pending

5th Treat. application	All treatments	1/3/2013		Pending
6th Treat. application	All treatments	2/23/2013		Pending
7th Treat. application	All treatments	5/10/2013		Pending
8th Treat. application	All treatments	6/28/2013		Pending
Data collection				
Phytotoxicity	All treatments	8/6/2012	1st reading	Done
Phytotoxicity	All treatments	8/14/2012	2nd reading	Done
Phytotoxicity	All treatments	9/14/2012	3rd reading	Done
1st Saw dust residues	All treatments	8/20-21/2012	Collected	Done
2nd Saw dust residues	All treatments	09/27/2012	Collected	Done
3rd Saw dust residues	All treatments	3/9/2013		Pending
4th Saw dust residues	All treatments	7/19/2013		Pending

Table 2. Summary of Tilt® application treatments of mature avocado trees.

Experiment	Application technique	Treatment level	Tilt® rate/ tree (ml)	Water rate (ml)	Cultivar	Date of initial application
Trunk injection	QUIK-jet Kit	Low	73.0	27.0	Miguel	7/9/12
		Medium	113.6	36.4	Miguel	7/9/12
		High	154.0	46.0	Miguel	7/9/12
Bark directed[z]	Handgun spray	Low	9.1	1000.0	Donnie	7/19/12
		Medium	18.2	1000.0	Donnie	7/19/12
		High	27.3	1000.0	Donnie	7/19/12
Soil drench	Liquid soil application	Low	9.1	9500.0	Donnie	7/19/12
		Medium	18.2	9500.0	Donnie	7/19/12
		High	27.3	9500.0	Donnie	7/19/12
		Low	36.4	9500.0	Donnie	7/19/12

z, Pentrabark penetrant adjuvant at 25 ml/tree was added to the bark directed application.

Table 3. Effect of Tilt® application technique on mature avocado tree phytotoxicity.

Experiment (application technique)	Tilt rate/tree	Days after first treatment application			
		1	11	28	67
Trunk injection	Low	NO	NO	NO	NO
	Medium	NO	NO	NO	NO
	High	NO	NO	NO	NO
		Days after first treatment application			
		NA[y]	18	26	57
Bark directed	Low	NA[z]	NO	NO	NO
	Medium	NA	NO	NO	NO
	High	NA	NO	NO	NO
		Days after first treatment application			
		NA[y]	18	26	57
Soil drench	Low	NA	NO	NO	NO
	Medium	NA	NO	NO	NO
	High	NA	NO	NO	NO

y, Not applicable; z, None observed.

Table 4. Tissue residue concentrations (ppm) after injection, bark directed sprayed, or soil drenched with Tilt®.

Experiment (application technique)	Tilt rate/tree	Tissue type	Residue concentration (ppm) Replication 1	2	3	4	Mean
Trunk injection	Low	Whole fruit	0.01	0.009	0.005	0.011	0.009
	Medium		0.006	0.007	0.009	0.008	0.008
	High		0.005	0.007	0.01	0.004	0.007
Trunk injection	Low	Saw dust[z]	2.3	0.151	5.11	0.904	2.116
	Medium		1.72	0.463	0.304	0.798	0.821
	High		0.171	0.174	0.043	0.202	0.148
Bark directed	Low	Saw dust[z]	0.051	0.174	0.039	0.168	0.108
	Medium		0.353	0.061	1.34	0.037	0.448
	High		0.028	0.059	0.032	0.12	0.060
Soil drench	Very low	Saw dust[z]	0.117	0.513	0.049	0.062	0.186
	Low		0.534	0.149	0.202	0.306	0.298
	Medium		0.088	1.96	0.052	0.075	0.544
	High		0.021	0.078	0.033	0.12	0.063

z, saw dust = xylem wood tissue

Photograph 1. Components of the Quik-jet trunk injection system.

PROJECT (21): INSECTICIDE TREATMENTS FOR THE CONTROL OF AMBROSIA BEETLES IN FLORIDA AVOCADO GROVES

FDACS Grant Contract #19432
Total Funding - $10,610.00
End Date: 9/30/2012

PROJECT SUMMARY

- Background: Laurel wilt, as transmitted by RAB, is the most significant threat to Florida's avocado industry at present. The industry is pursuing a widely varied set of possible management strategies which work at different stages of the infection/disease process. This project aims to create an effective strategy for postponing or prevent infection of avocado trees in areas where RAB is endemic or newly populating. The project is timely because RAB is not yet completely spread throughout the avocado production area in Miami-Dade County, and the window of opportunity to combat laurel wilt at the source remains open.

- Existing work indicates several insecticides show promising results to control the redbay ambrosia beetle thus reducing colonization potential in avocado trees. The work proposed in this project will expand the scope of knowledge and practical use of several insecticides with an adjuvant to prolong the efficacy of the products. Better insecticide treatments coupled with other mitigation strategies under investigation would provide a higher level of protection to commercial avocado production from laurel wilt disease introduction into healthy groves.

- The primary objective of this project is to expand an existing work and knowledge regarding the efficacy of several insecticides that show promise as a chemical barrier to prevent ambrosia beetle infestations of avocado trees thus protecting them from laurel wilt disease. We selected the insecticide malathion as the model insectidie in combination with several adjuvants and determined if these surfactants could prolong efficacy of the control of the red bay ambrosia beetle under grove conditions

- This project builds on previous SCBG funded work. Project (2) from the 2011 Florida SCBG State Plan which investigated the effectiveness of selected pesticides in controlling RAB; and Project (21) from the 2010 State Plan, which proposed to identify and select avocado cultivars which could be more resistant to infection. This project builds mostly upon the 2011 project, and seeks the most effective method of using adjuvants to enhance and prolong the controlling effects of the pesticides indentified by the previous project.

PROJECT APPROACH

- **Stock Colony**; Wood samples were collected from different Persea hosts with verified symptoms of laurel wilt located in the Highlands and Miami-Dade Counties and transported to the quarantine facility of the University of Florida, Tropical Research and Education Center in Homestead, FL. Trees were cut and wood over 10 cm in diam., were placed in emergence chambers. Beetle emergence and identification to the species level was verified every day by 2 individuals. Beetles were placed in containers and used the same day or the day after emergence.

- One hundred and fifty (5-7 cm diam. and 10 cm ht.) bolts were cut from cv. Lula avocado trees, grown at the Tropical Research and Education Center. Sets of 25 bolts were individually sprayed with a hand-gun sprayer calibrated to deliver approx 100 gpa at approx. 2.2 mph with each the following six pesticide-adjuvant solutions, which were prepared based in labels recommended rates. The selected adjuvants were Nu-Film 17 (Pinene diterpene polymers), Bond (synthetic latex (45%), MSO (methylated seed oil), VaporGard (di-1-p-Menthene). Malathion 5EC was selected as the insecticide to be tested based on results of previous studies which indicate that, among the pesticides registered for use in avocado, this is the most effective for controlling RAB and the one available to be used by Florida avocado growers. Other type of insecticides will be used later on in order to verify the results of these tests. After treatment, two separate tests were conducted.
- First, to test the persistence of the pesticides under normal field conditions a subset of treated bolts were hung in an avocado grove located at UF-TREC-Homestead and exposed to environmental conditions. Then, 1, 5, 12, 19, and 26 after treatment bolts were exposed to 10 RAB beetles and beetle mortality recorded 1 day after. During the experiment, bolts were exposed to a range of rainfall of approx. 0.69 to 14.65 inches of rain that fell per day during the test.
- Second verify the residual effect of the insecticide + adjuvant solutions under the harshest rainfall conditions, bolts were brought into storage and then dipped in water every day allowed to dry and exposed to 10 RAB individuals and beetle mortality determined in a daily basis.

GOALS AND OUTCOMES ACHIEVED

- **Experiment 1.** Under field conditions and under a range of a maximum of 14 inches of rain malathion applied without an adjuvant caused only 10% mortality to RAB individuals, while the insecticide solutions containing Nufilm, Bond and VaporGard caused 90% mortality to RAB individuals and MSO + malathion caused 60% beetle mortality. However, 12 days after treatment the Vapor Guard + malathion combination was providing the highest mortality of approximately 75% of the tested beetles (Fig 1). Twelve days after treatment, Nu-Film + malathion and MSO + malathion were only eliminating 30-50% of the beetles, respectively. The solution of Bond + malathion and malathion by itself were only causing 20% mortality compared to the untreated control. The experiment is being continued. In conclusion, use of the adjuvant Vapor guard appeared to be the only one that can be recommended for RAB beetle control during outside weather and heavy rainfall conditions.

Figure 1

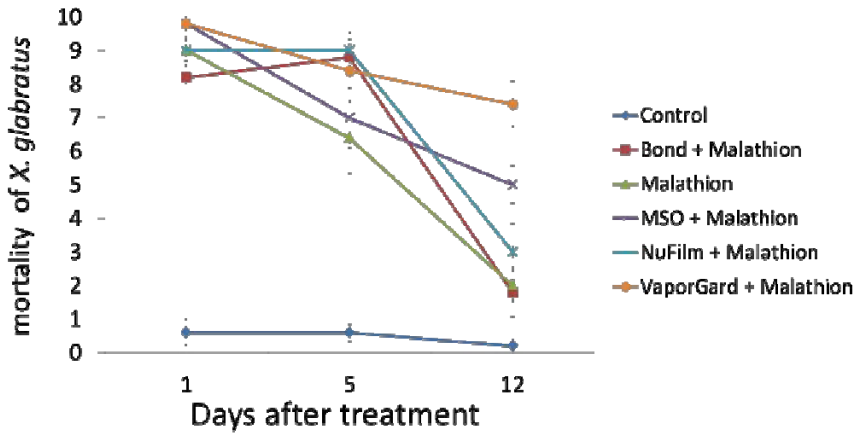

FIG. Number of *X. glabratus* that died after being exposed to bolts treated with combinations of Malathion EC and several adjuvants. After treatment bolts were hung in an Avocado grove and exposed ton environmental conditions. In days 1, 5, 12, 19, and 26 after treatment bolts were exposed to 10 *X. glabratus* and beetle mortality recorded.

- **Experiment 2.** Daily washing of the treated logs showed that the adjuvant VaporGuard was efficient for during the first 13 days after application providing beetle mortality that fluctuated between 100% (one day after application) to 70% mortality, 13 days after application (Fig 2). The efficacy of malathion when applied by itself was reduced from 90% mortality (1 day after treatment) to 40% mortality, just 5 days after treatment. Thirteen days after treatment, the other solutions of Bond + malathion, MSO + malation, Nu-film +malathion provided a a low range of beetle mortality that fluctuated between 30-50% (Fig 2). All solutions using adjuvants when exposed to extreme simulated rainfall conditions were not efficient at 15 days after treatment.

Figure 2

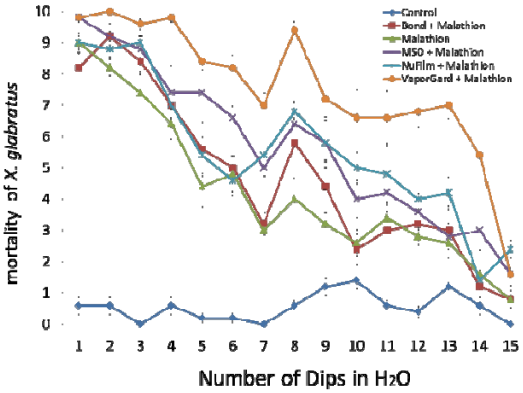

FIG. Number of X. glabratus that died after being exposed to bolts treated with combinations of Malathion EC and several adjuvants. After treatment bolts were dipped in water, allowed to dry and exposed to 10 X. glabratus in a daily basis.

Conclusions and Recommendations:

- Vapor Guard is the only adjuvant that is recommended to be used in combination of insecticides during rainfall conditions for control of the red bay ambrosia beetle in avocado.
- The recommended dose of VaporGard (3.84 L/100 gal)+ Malathion 5EC is 1 gallon of Vapor Guard for 100 gallons of water and 4.5 pints of Malathion for 100 gallons of water.
- The experiment will be repeated during Winter or Spring 2013 when a lower rainfall pattern is expected.

<u>Measurable Outcomes</u>

- We tested if adjuvants (Nu-Film 17, MSO, Vapor Gard and Bond helped to maintain insecticide residuality against the red bay ambrosia beetle during the rainy season in Florida

- Vapor Gard is the only adjuvant that is recommended to be used in combination of insecticides during rainfall conditions for control of the red bay ambrosia beetle in avocado.
- The recommended dose of VaporGard (3.84 L/100 gal)+ Malathion 5EC is 1 gallon of Vapor Guard for 100 gallons of water and 4.5 pints of Malathion for 100 gallons of water.

Growers now know that, of the registered contact insecticides, Malathion and Danitol in combination with Vaporgard adjuvant are the best contact insecticides for controlling RAB. They also know that registration of Hero, Endigo, and Brigade is in progress. Most to all producers are using Malathion or Danitol sprays to wood chips and in the area of LW positive avocado trees.

RAB repellents have been identified and further testing is necessary prior to any recommendations are possible. This methodology is not being utilized at this time.

Currently, no spray-applied physical barrier has demonstrated enough promise to be recommended as an RAB control. However, they also know more testing is in progress.

Adjuvants to prolong the insecticidal efficacy of pesticides were tested under field conditions and one (VaporGard) was identified superior to the others tested in prolonging pesticide efficacy. This is now recommended to the growers when spraying to control ambrosia beetles.

Outreach Goals:

LW Sampling Field Demonstration. This demonstration was held twice (twice in English, twice in Spanish) in a commercial avocado grove with recently LW positive and symptomatic avocado trees. Prior to the demonstration, improper and non-usable plant tissue samples were submitted to the Plant Diagnostic Lab for LW diagnosis. The purpose was to demonstrate the needed equipment and proper techniques for xylem wood sampling LW suspect avocado trees in commercial groves. The Extension Specialist and Sr. Biologist demonstrated how to identify LW suspect trees, where to sample the tree and how to sample the xylem wood, and what information should be recorded and reported on the sample submitted to the Plant Diagnostic Clinic. Five educational handouts were provided all 41 participants. Since the demonstration, over 90% of the LW xylem wood samples submitted to the diagnostic lab have been useable for LW diagnosis and people attempting to submit non-suitable samples are provided a handout on how to properly sample for LW.

Laurel Wilt Avocado Grower Meeting. This meeting was held soon after the official announcement that LW had been confirmed in a commercial avocado grove in Miami-Dade County. Nearly 100 participants attended (some people did not formally sign-in), six handouts which complimented the four presentations were provided. Presentations were made on the location and extent of DPI's ground survey for LW and RAB, current recommendations for grove scouting, sampling and disposal of infested trees, and insecticide and fungicide recommendations once a LW symptomatic tree is found. Any and all questions were answered.

Urban Resident and Commercial Industry Educational Internet Outreach. This is collaboration among UF/IFAS and FDACS-DPI. The UF/IFAS Internet effort includes two websites:

a. Laurel Wilt of Avocado, http://trec.ifas.ufl.edu/RAB-LW-2/, which includes links to research program information and extension documents on the current status of LW and RAB and information and recommendations for commercial avocado groves and urban residents. During 2012, 803 web hits and 453 downloads were recorded for this site.

BENEFICIARIES

- The Florida avocado growers are benefitting from the completed research. The avocado growers have been informed that, it is necessary to use an adjuvant in order to prololong efficacy of insecticides used against the red bay ambrosia beetle. Among the different adjuvants used, Vapor Gard helped more than MSO, Nu- Film-17 and Bond to prolong residual activity of the insecticide malathion.
- These results will be presented again at grower workshops and through electronic and print media. Pre- and post-workshop surveys will be used to determine the potential use rate of the recommendations.

All avocado producers and managers in Miami-Dade County have benefited from the described projects above. Producers were informed of the results of these projects through meetings (698 participants), handouts (6 produced, hundreds disseminated), PowerPoint presentations (12 by the Extension Specialist alone, numerous more by speakers at the various meetings), reports (2 produced), and electronic media (i.e., Internet websites (803 on UF/IFAS/TREC Laurel Wilt website; not know how many to FDACS-DPI Laurel Wilt website), electronic publications (4,837 downloads), and videos (not counted). Reports, updates, handouts, and recommendations (new and revised) are continually sent out by email through the avocado grower database of the Avocado Administrative Committee.

LESSONS LEARNED

- A major constraint for the project was the time constraint as this project was conducted under the most severe weather conditions. It will benefit to repeat this project during Winter or Spring under less severe rainy weather conditions..
- Because of the time constraint, it was not possible to test insecticides with different mode of action mixed with the adjuvants.

CONTACT PERSON

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UF Tropical Research and Education Center
18905 SW 280 Street
Homestead, FL 33031

PROJECT (22): EARLY DETECTION AND SUPPRESSION OF LAUREL WILT AND THE REDBAY AMBROSIA BEETLE THROUGH AERIAL SURVEY AND TREE DESTRUCTION

FDACS Grant Contract #19433
Total Funding - $14,000.00
End Date: 9/30/2012

PROJECT SUMMARY

Problem: Avocado is considered Florida's second most important fruit crop after citrus. Production of avocado in Florida is valued at $30 million a year. The red bay ambrosia beetle (RAB), *Xyleborus glabratus* Eichhoff (Coleoptera: Curculionidae: Scolytinae) represents a major threat to the avocado industry. This beetle vectors the fungal pathogen, *Raffaelea lauricola,* T.C. Harr., Fraedrich & Aghayeva (Harrington et al. 2008) which causes Laurel wilt (LW), a lethal disease of trees in the family Lauraceae, including avocado, *Persea americana* Mill. (Crane et al. 2008, Mayfield et al. 2008a). RAB was first detected during 2002 in southeast Georgia (Rabaglia et al. 2006), and the rapid spread of the vector has resulted in severe mortality of several important native ornamental and forest trees such as red bay *[Persea borbonia* (L.) Spreng.] and swamp bay *[P. palustris* (Raf.) Sarg.] in South Carolina, Georgia, and Florida (Fraedrich et al. 2008, Hanula et al. 2008). In 2007, LW began to eliminate backyard homeowner avocado trees in northern Florida.

Similar rapid progression of this disease was observed during 2010 in an abandoned commercial avocado grove located in central Florida in Highlands Co. Infestations of RAB on avocado have also been detected in other counties, i.e., Saint Lucie and Indian River. RAB continued to move south, and early in 2011, a large infestation of swamp bay trees was detected in Miami-Dade County, 10 miles north of Florida's main avocado production area in Homestead, Florida (Carrillo et al. 2012). This site is presumed to be the source of infestation for the avocado grove diagnosed with LW in the Homestead area in May 2012 (FDACS, 2012) where RAB was detected a few months later. Over 90 percent of avocados in Florida are grown in the southern tip of the peninsula where RAB has now been found. Fortunately, at this initial stage of the RAB's invasion ofthe commercial avocado growing region, vector populations are low and limited to relatively few groves at present, which indicates that there is an urgent need to quickly mitigate the spread of this problem throughout the entire Florida avocado industry.

This project is geared toward early detection of suspicious Laurel Wilt (LW) infested avocado trees within our commercial avocado groves. We have aerial surveyed the entire commercial avocado acreage in Miami-Dade County in the search for LW suspect avocado trees. These locations have been mapped and a data base of these locations have been identified so that property owners or their prospective maintenance companies can be notified of any suspicious trees that have been observed from these flights and that proper procedures can be implemented to prevent the spread of this disease.

PROJECT APPROACH

This project had four primary objectives:

1. Prevent establishment of the Redbay Ambrosia Beetles (RAB) and LW in our commercial avocado groves. Eliminate or drastically reduce any potential RAB reproduction in the commercial avocado production area.
2. Quickly survey the south Florida avocado acreage for LW -RAB suspect trees by helicopter. The industry will be surveyed in four quadrants.
3. Provide GPS information on the location of the suspect trees to a Detection-Suppression Coordinator. The Coordinator will use Google earth to identify the street location along with the use of the county website to identify the street location and ownership of the grove owners and their managers. Owners/managers then will ground truth the suspect trees and sample trees by molecular testing for LW if warranted. The

Coordinator then verifies on a spot basis with the prospective owners or maintenance companies that
LWRAB suspect trees have been visually inspected and tested for LW if needed.

4. Record location of LW positive avocado trees to aid in tracing the movement of this beetle and this disease
in the commercial avocado production area which will be available for review to all members of the industry.

GOALS AND OUTCOMES ACHIEVED

1. Two aerial surveys of the entire commercial avocado production area in Miami-Dade County, Florida were completed during this time frame. Any commercial avocado tree(s) that were showing signs of stress that were observed during these flights were entered into our GPS and were later transferred to a Google Earth program.
2. After the mapping process a meeting of property owners and grove maintenance personnel met short! y after
each flight to view and discuss these mapped locations to help identify property ownership and aid us in the notification of any suspicious avocado trees so that these locations could be ground- truthed and sampled for Laurel Wilt if needed.
3. Any locations that were observed and noted from these flights have been identified and their property owners have been identified so that further steps can be taken to help prevent the spread of this disease

Outreach goals:

Avocado Administrative Committee meetings. The Florida Avocado Administrative Committee meets monthly and updates and verbal reports are provided to the committee by the Tropical Fruit Crop Specialist. The Specialist attended nine of their meetings and addressed and took questions from approximately 225 participants in those meetings during 2012.

Avocado Laurel Wilt Subcommittee meetings. A group of approximately 10 avocado producers/packers and grove management companies, UF/IFAS/TREC scientists and the Tropical Fruit Crop Specialist met 26 times during 2012 (about 260 participants during 2012) to discuss on-going research, LW aerial and ground surveys and sampling, and RAB/LW control tactics appropriate to grove situations. During meetings everyone discusses the current situation, experiences, and observations and collaborates on revising recommendations for control of the pathogen and beetle.

BENEFICIARIES

1. The entire commercial avocado industry is in great benefit of the timely results from these aerial surveys. This procedure of survey allows detection of suspicious trees within our growing area so that we can get a quick handle on preventive detection that would possibly go unnoticed for longer periods. Early detection is a key factor in maintaining a health grove to prevent "hot

spots" of LW from being established in our commercial growing area.

2. Communication with grove owner/management firms and encouraging pro-active approaches to identified suspect trees has assisted in managing new "hot spots" when a single tree is in question has been very effective. In addition, communication to grove owners/managers to be diligent in periodically monitoring the property during maintenance/picking periods has been undertaken.

All avocado producers and managers in Miami-Dade County have benefited from the described projects above. Producers were informed of the results of these projects through meetings (698 participants), handouts (6 produced, hundreds disseminated), PowerPoint presentations (12 by the Extension Specialist alone, numerous more by speakers at the various meetings), reports (2 produced), and electronic media (i.e., Internet websites (803 on UF/IFAS/TREC Laurel Wilt website; not know how many to FDACS-DPI Laurel Wilt website), electronic publications (4,837 downloads), and videos (not counted). Reports, updates, handouts, and recommendations (new and revised) are continually sent out by email through the avocado grower database of the Avocado Administrative Committee.

LESSONS LEARNED

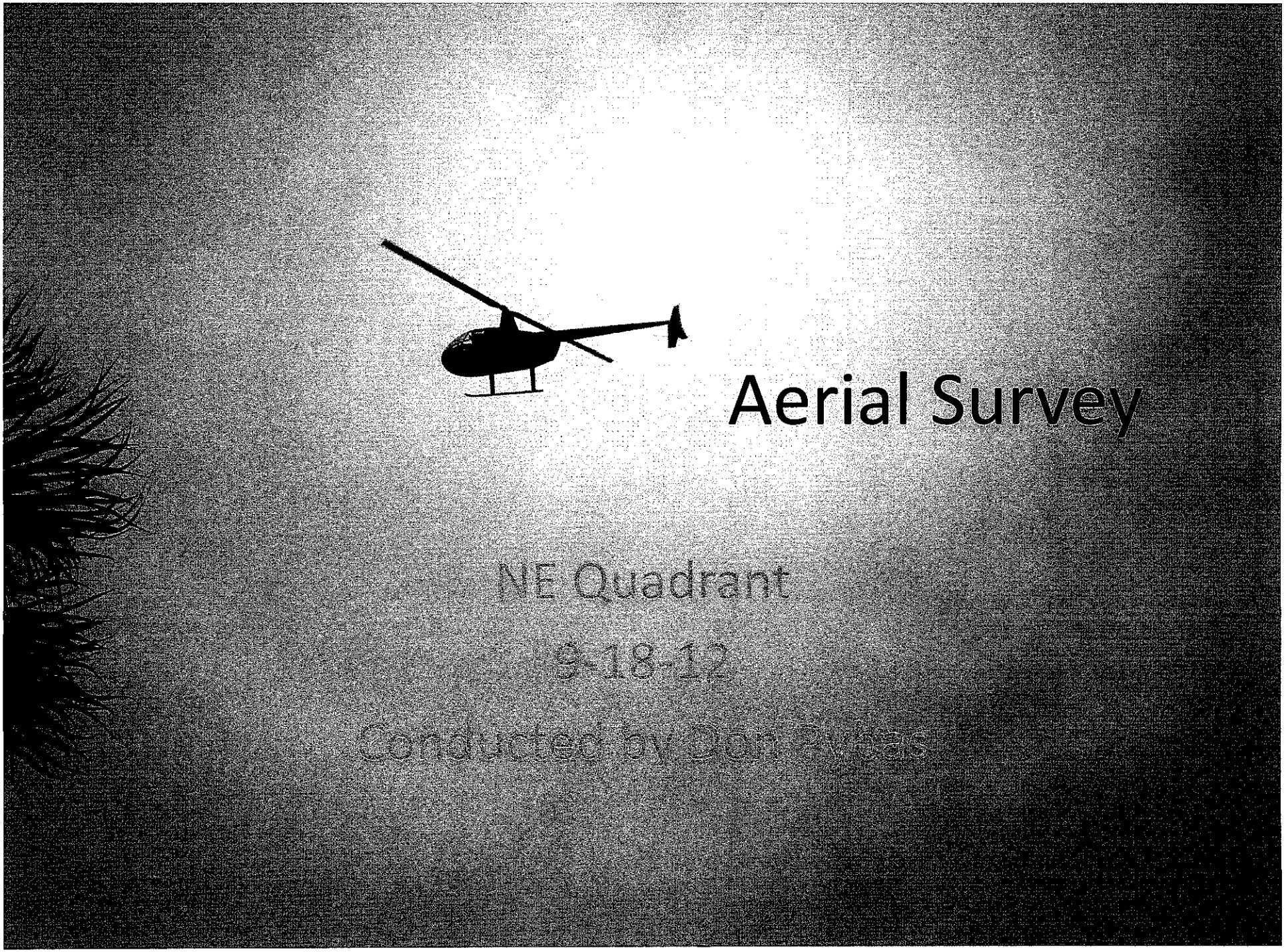
Identification of suspect avocado trees in groves is greatly enhanced by low-level aerial surveys, especially via helicopter due to maneuver and hover over areas. This greatly aided in ground location of suspect trees, particularly in large blocks.
2. One challenge that greatly complicates pro-active management of certain groves with suspect trees is the matter of absentee ownership, with little or no active management, as the properties are investment, speculative properties. Working with existing managers and others to identify and communicate with them is time consuming. Some properties are
referred to FDACS-DPI.

Contact Person

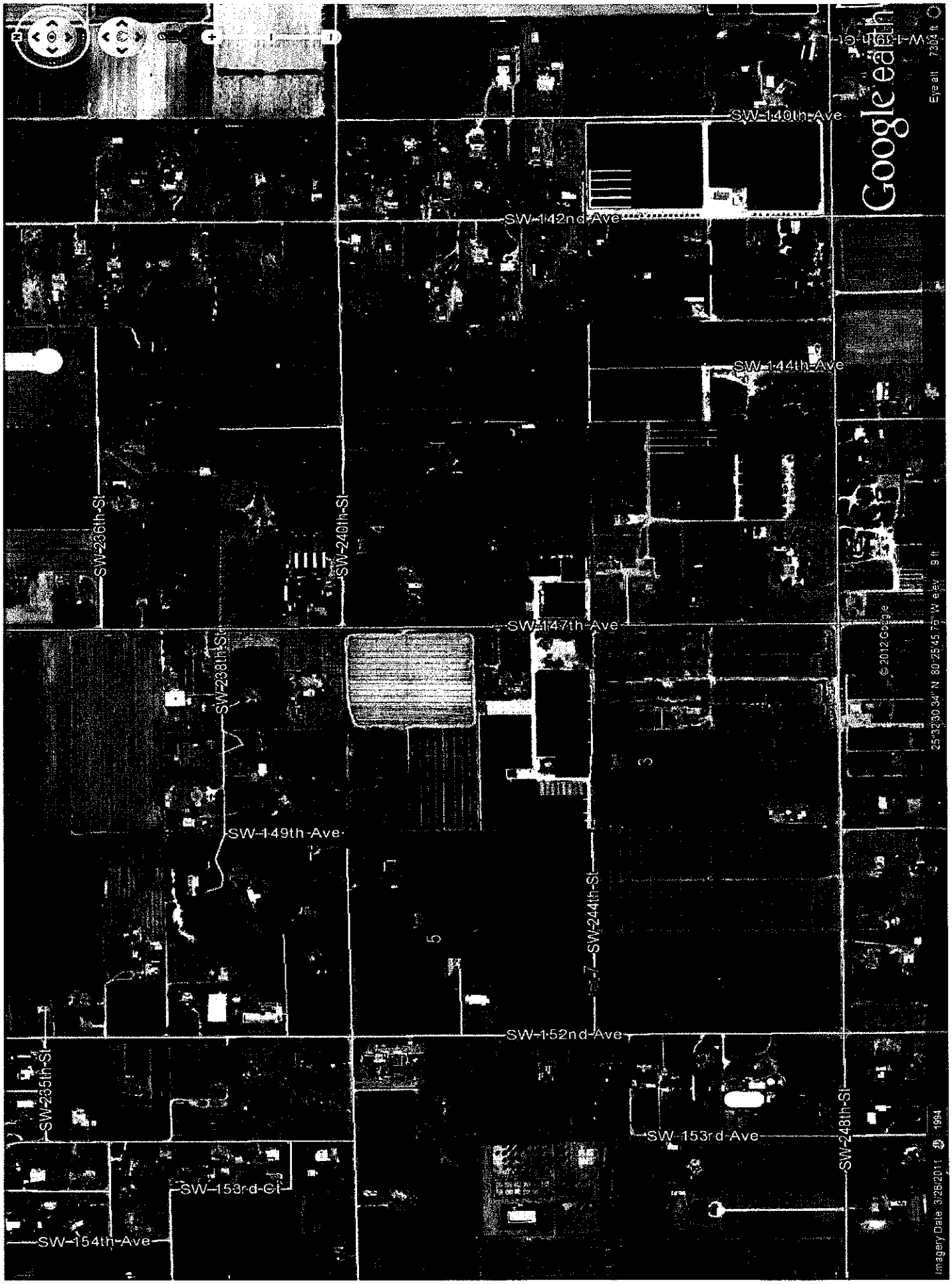
Don Pybas
Laurel Wilt Coordinator
Avocado Administrative Committee

Additional Information:

The following are maps used and aerial photos taken during the course of this project. The map segment printed indicate the area surveyed. The photos were taken during flyover of these areas, where suspect trees were identified. The discolored trees appear symptomatic for LW and RAB infestation.


Aerial Survey
NE Quadrant
9-18-12
Conducted by Don Wiens

Newton Rd
SW 246th St
SW 159th Ave
SW 248th St
SW 249th St
SW 160th Ave
Farm Life School Rd
SW 162nd Ave
Google earth
Eye alt 3132 ft
25°32'10.63" N 80°27'01.45" W elev 8 ft
© 2012 Google
Imagery Date: 3/26/2011 1994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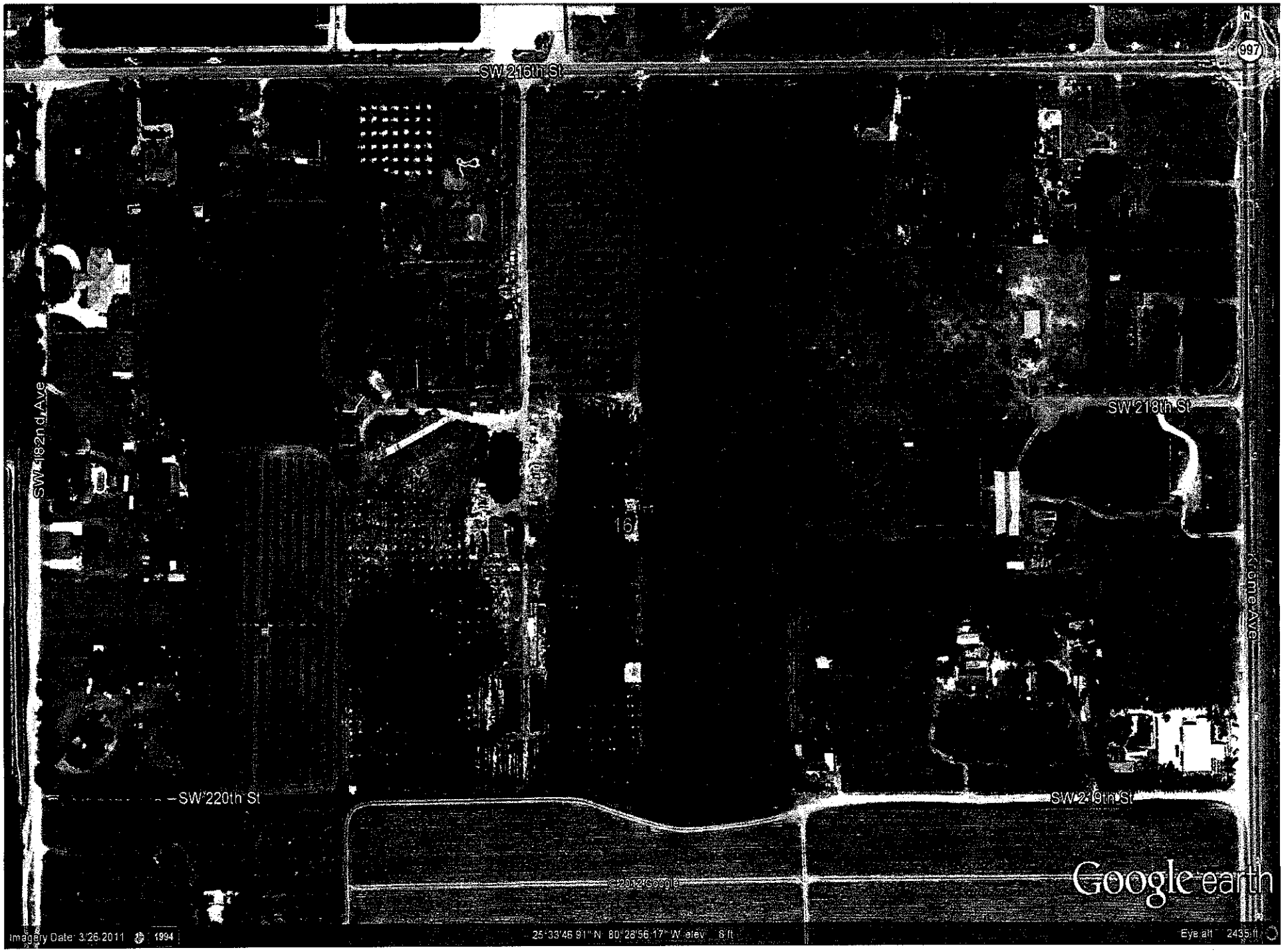
SW-142nd-Ave
SW-144th-Ave
SW-147th-Ave
SW-149th-Ave
SW-152nd-Ave
SW-153rd-Ave
SW-153rd-Ct
SW-154th-Ave
SW-236th-St
SW-238th-St
SW-240th-St
SW-244th-St
SW-248th-St
SW-235th-St
Google earth
Eye alt 7304 ft
© 2012 Google
25°32'30.34" N 80°25'45.75" W elev 9 ft
Imagery Date: 3/26/2011 1994

SW-154th-Ave
SW-154th-Ct
SW-154th-Ave
Newton Rd
SW-228th-St
SW-216th-St
Farm Life School Rd
SW-218th-St
SW-215th-St
SW-164th-Ave
SW-214th-St
SW-220th-St
SW-167th-Ave
SW-224th-St
SW-169th-Ave
SW-213th-St
SW-172nd-Ave
SW-172nd-Ct
Google earth
© 2012 Google


SW 216th St
997
SW 218th St
SW 182nd Ave
16
Krome Ave
SW 220th St
SW 219th St
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Google earth
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1994
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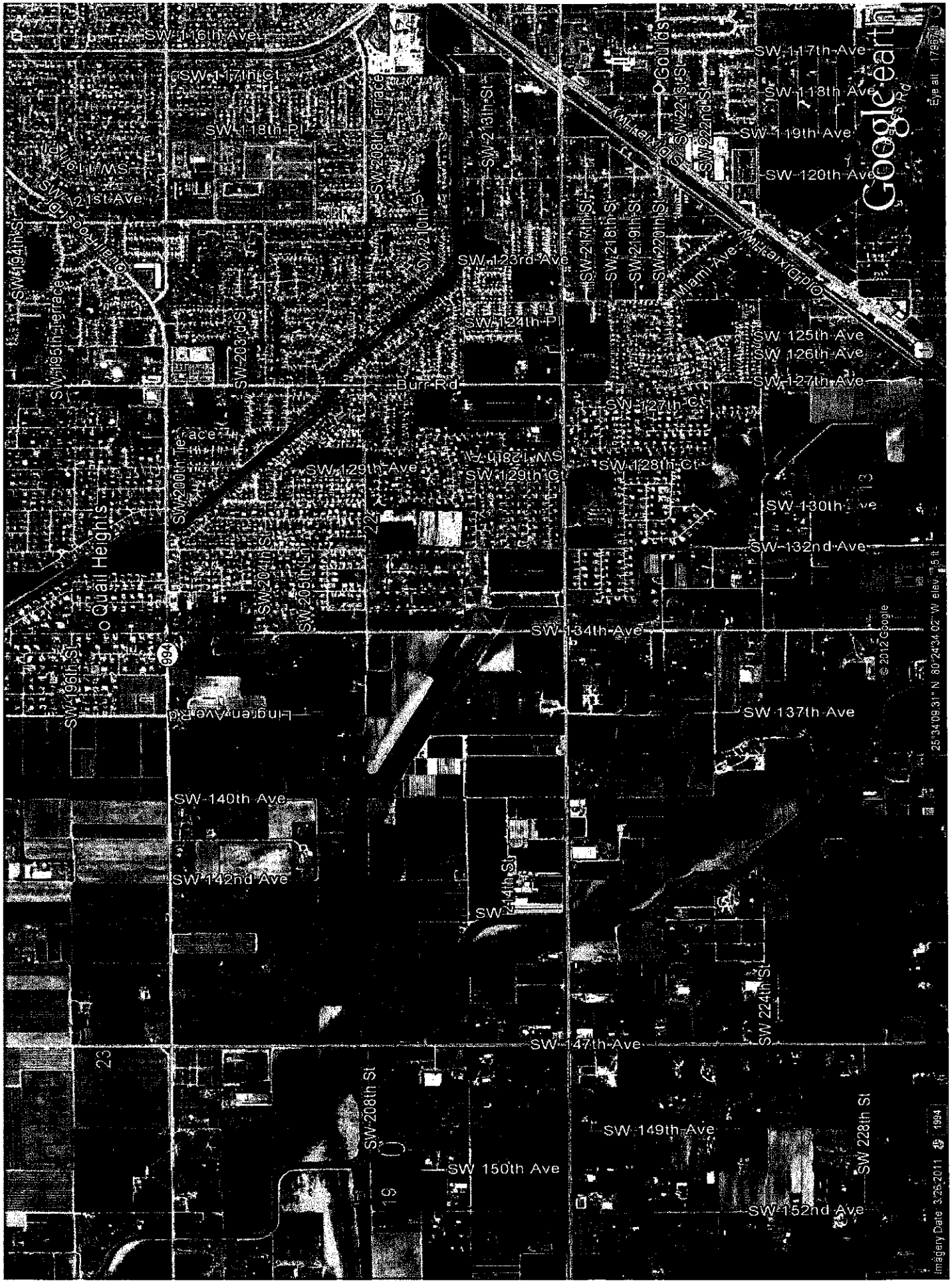
Eye alt 2435 ft


SW 116th Ave
SW 117th Ct
SW 118th Pl
SW 117th Ave
SW 118th Ave
SW 119th Ave
SW 120th Ave
Gottlieb
SW 221st St
SW 222nd St
SW 213th St
SW 208th Terrace
SW 210th St
SW 217th St
SW 218th St
SW 219th St
SW 220th St
Miami Ave
Turnpike
SW 123rd Ave
SW 124th Pl
SW 125th Ave
SW 126th Ave
SW 127th Ave
SW 127th Ct
Burr Rd
SW 128th Ct
SW 129th Ave
SW 129th Ct
SW 130th Ave
SW 132nd Ave
SW 134th Ave
SW 137th Ave
Quail Heights
SW 196th St
SW 194th St
SW 195th Terrace
SW 203rd St
SW 204th St
SW 205th St
SW 200th Terrace
Ingraham Avenue
SW 140th Ave
SW 142nd Ave
SW 224th St
SW 147th Ave
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SW 149th Ave
SW 150th Ave
SW 228th St
SW 152nd Ave
Google earth
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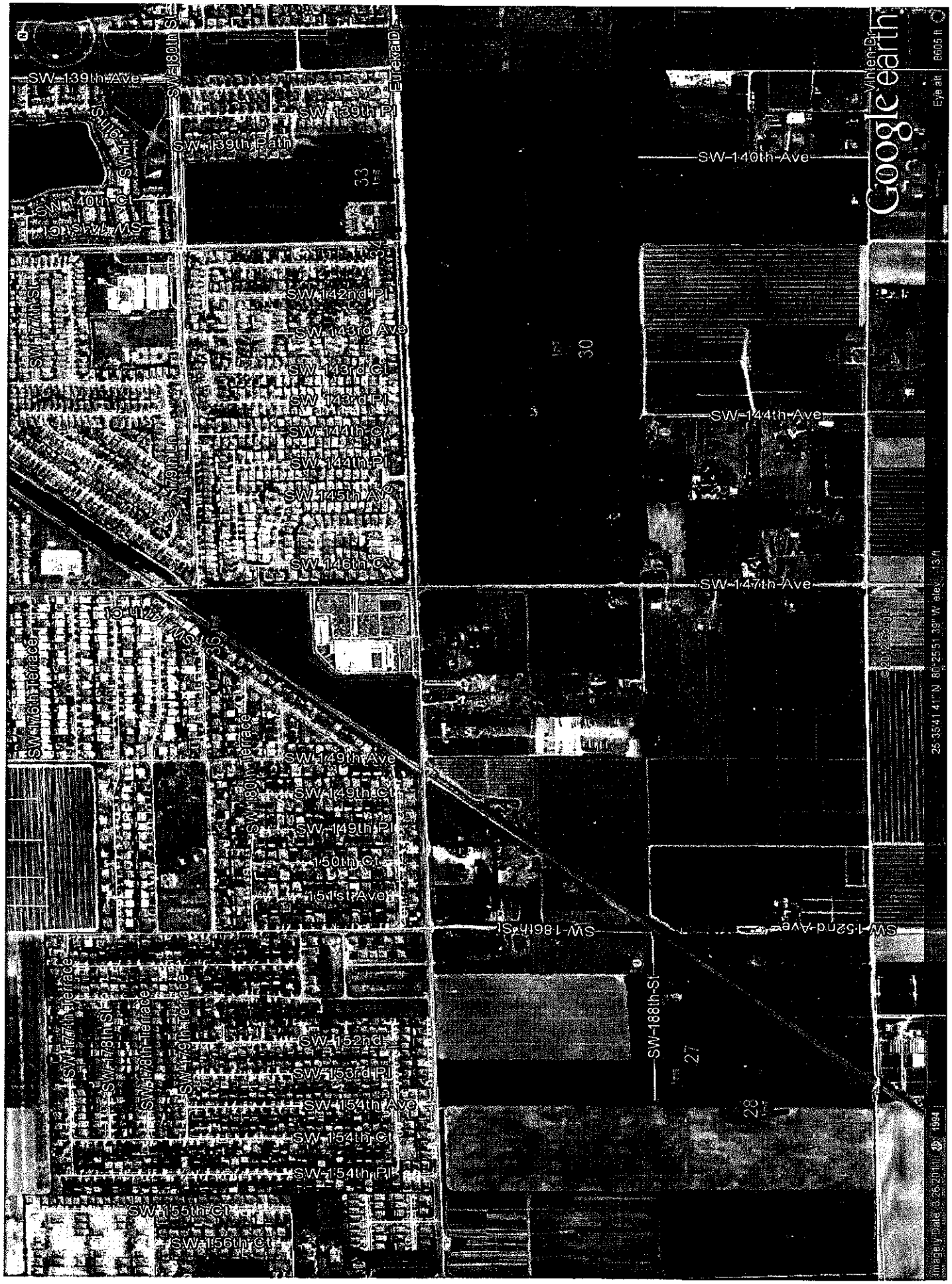
SW-139th-Ave
SW-139th-Pl
SW-139th-Path
SW-140th-Ave
SW-140th-Ct
SW-142nd-Pl
SW-143rd-Ave
SW-143rd-Ct
SW-143rd-Pl
SW-144th-Ave
SW-144th-Ct
SW-144th-Pl
SW-145th-Ave
SW-146th-Ave
SW-147th-Ave
SW-149th-Ave
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SW-150th-Ct
SW-151st-Ave
SW-152nd-Ave
SW-152nd
SW-153rd-Pl
SW-154th-Ave
SW-154th-Ct
SW-154th-Pl
SW-155th-Ct
SW-156th-Ct
SW-188th-St
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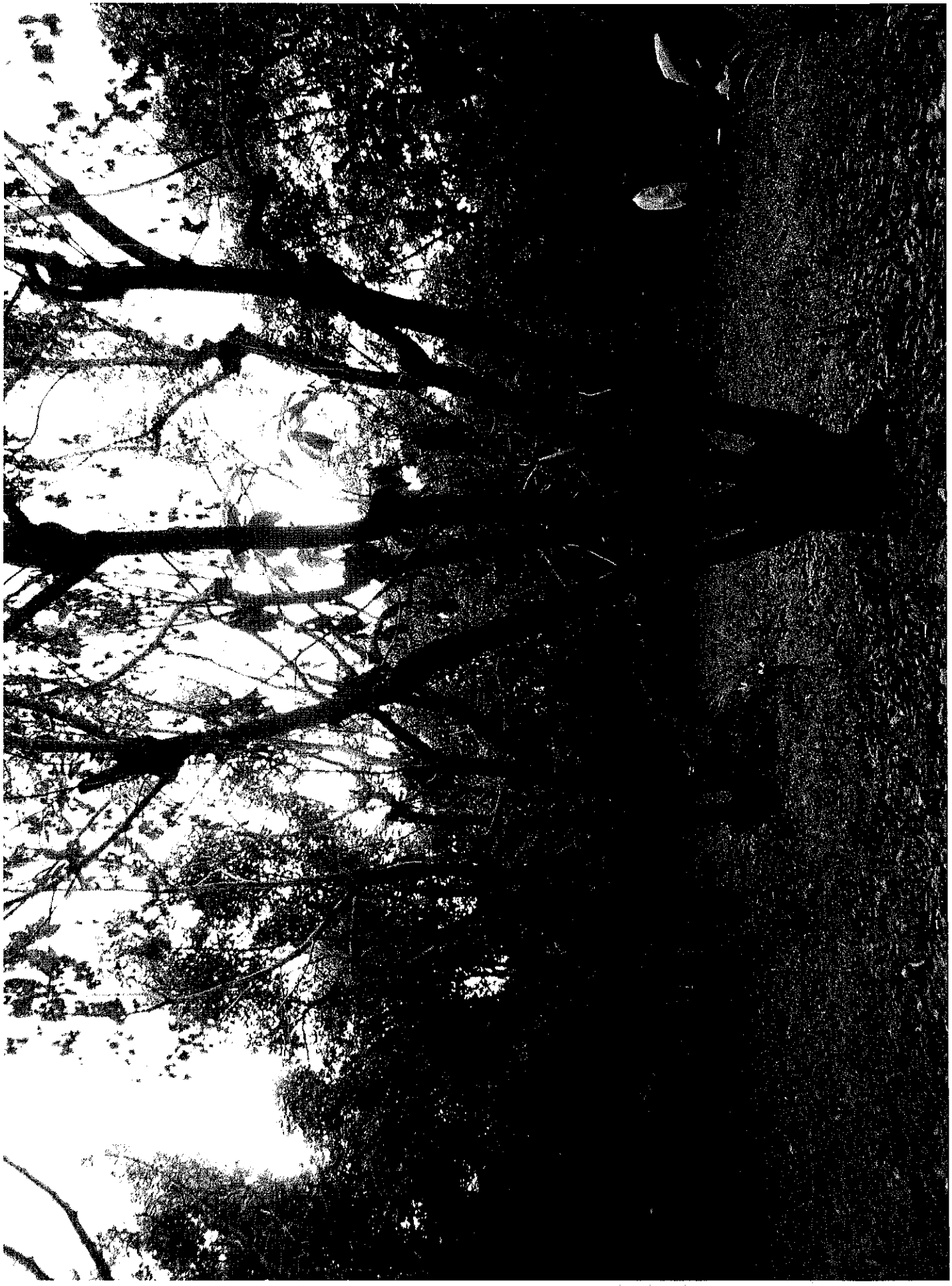
SW-179th-Terrace
SW-180th-St
Eureka-Dr
Google earth



Google earth
SW-162nd-Ave
SW-206th-Terrace
SW-206th-Terrace
SW-206th-St
SW-163rd-Ave
SW-210th-Terrace
Bagdad-St
Aladdin-Blvd
Madisellen-Rd
SW-214th-St
SW-167th-Ave
SW-212th-St
SW-208th-St
SW-207th-St
SW-172nd-Ave
© 2012 Google
Imagery Date: 3/26/2011 1994

SW-162nd Ave
SW-192nd St
Google earth
37
SW-180th St
SW-167th Ave
SW-176th St
Eureka Dr
40
SW-170th Ave
41
43
SW-168th St
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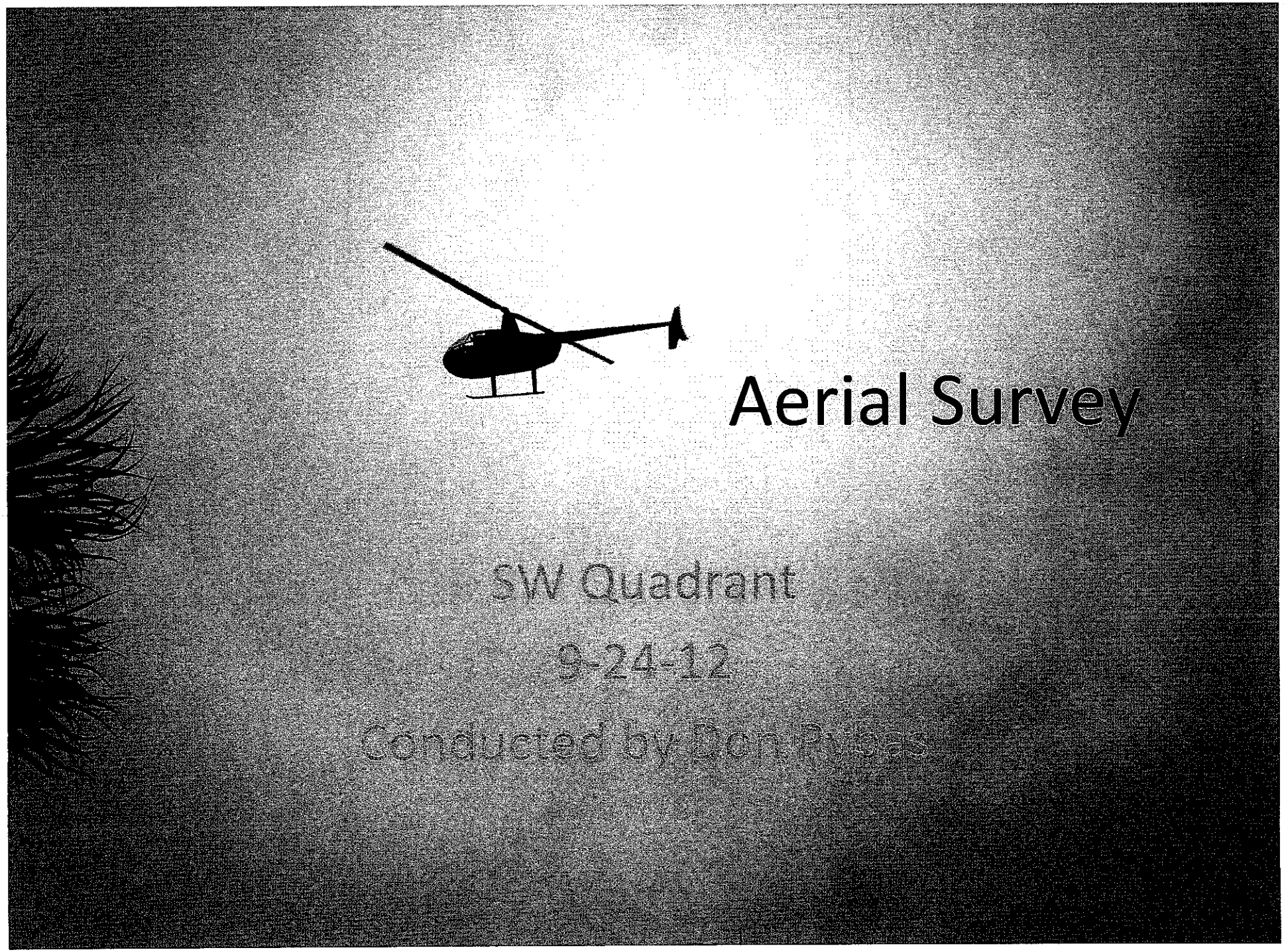
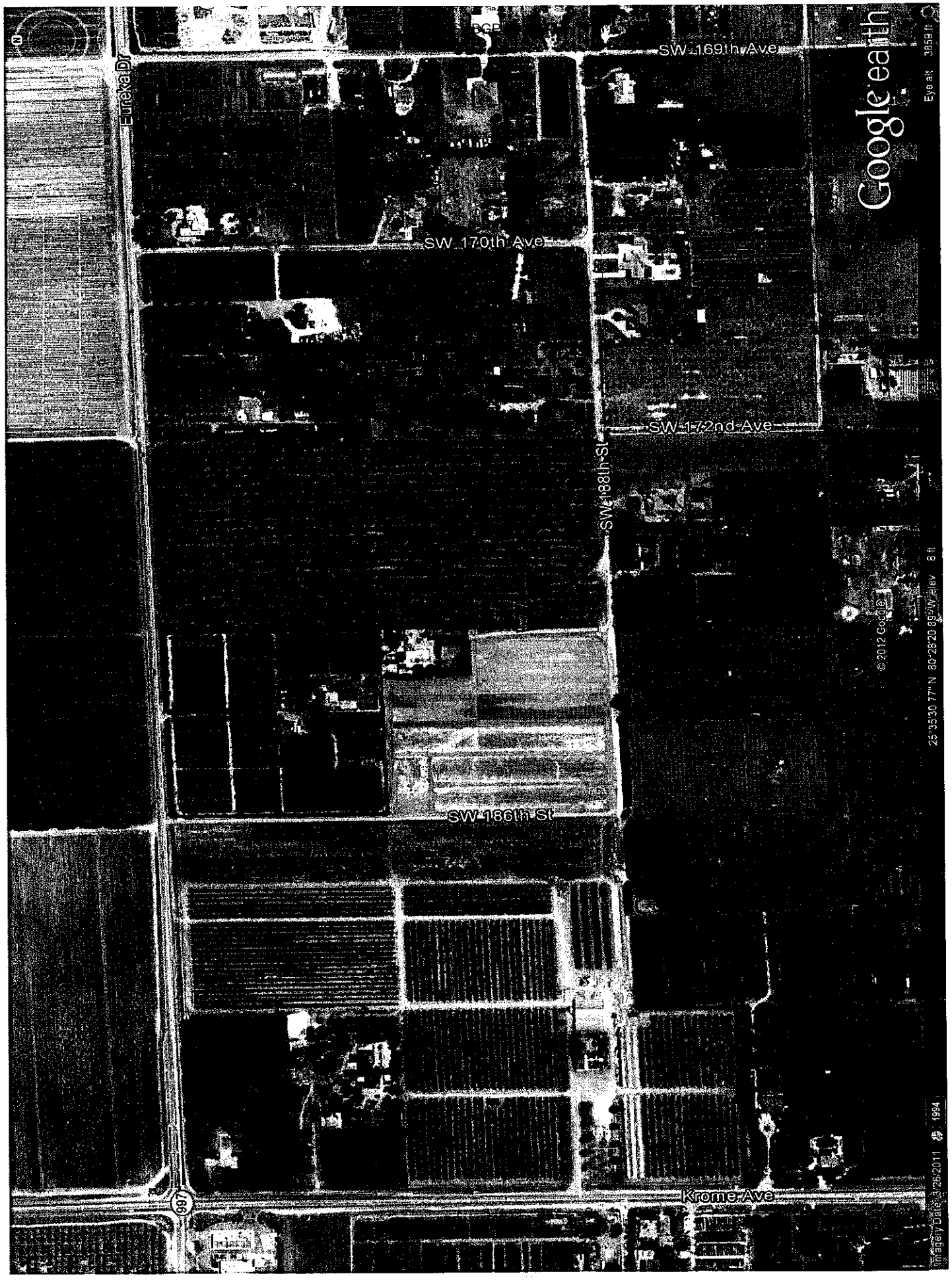
© 2012 Google
Eye alt 6638 ft


Aerial Survey
SW Quadrant
9-24-12
Conducted by Don Pribas


BGE
SW 169th Ave
Eureka Dr
SW 170th Ave
SW 172nd Ave
SW 188th St
SW 186th St
Krome Ave
997
Google earth
Eye alt 3859 ft
© 2012 Google
25°35'30.77" N 80°28'20.80" W elev 8 ft
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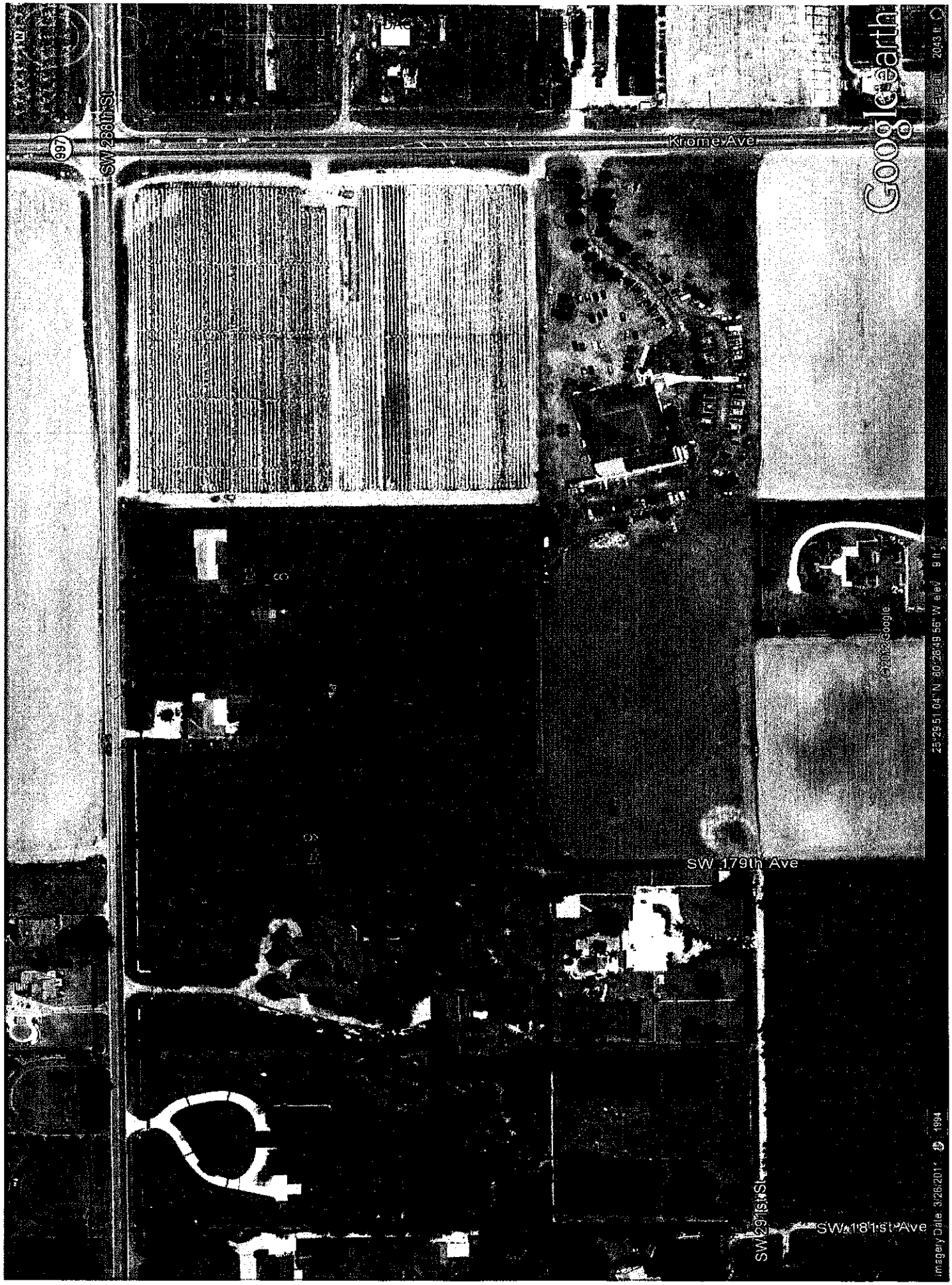
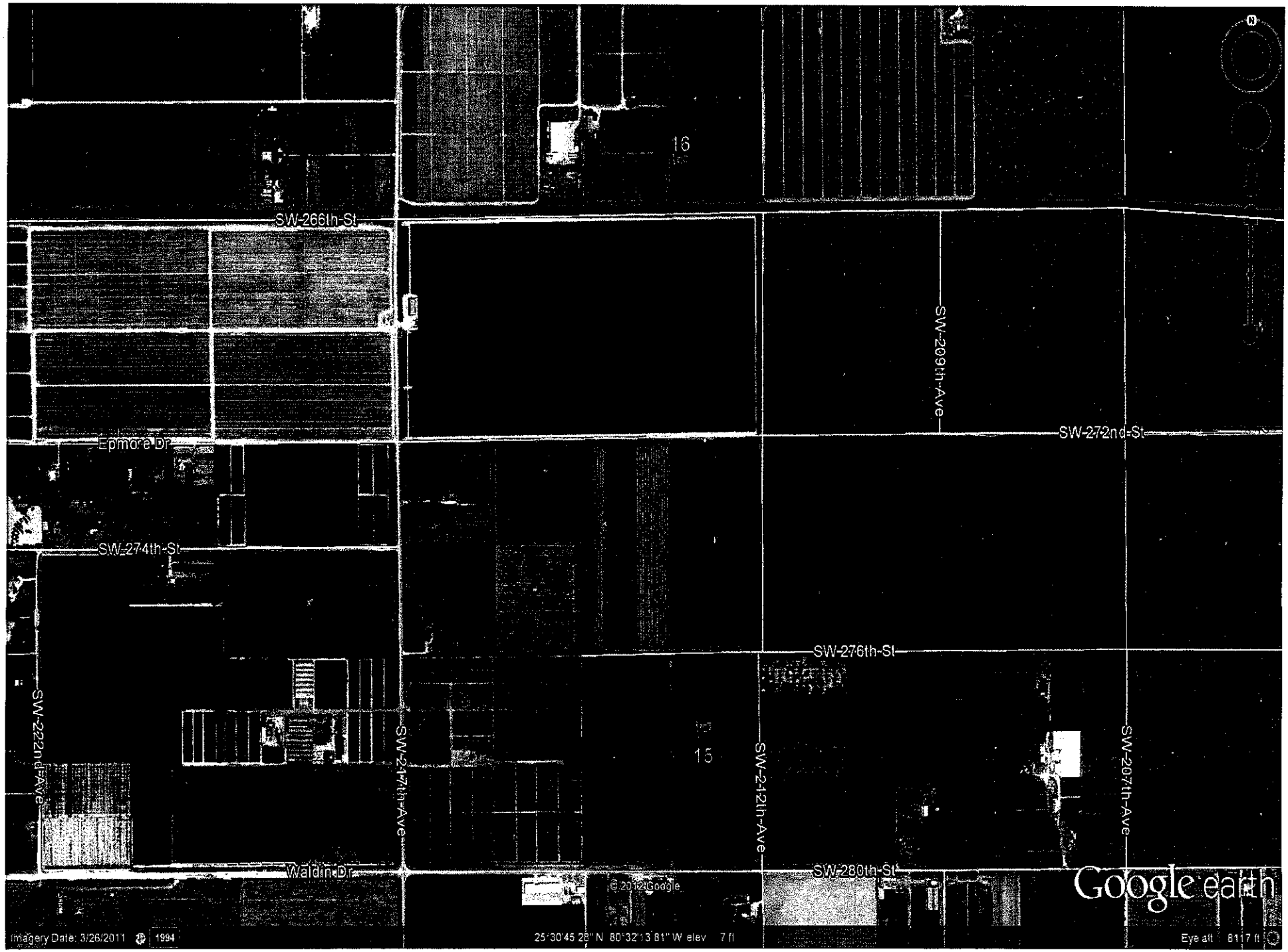

SW 288th St
(997)
Krome Ave
SW 179th Ave
SW 129th St
SW 181st Ave
Google earth
25°29'51.04" N 80°28'49.56" W elev 8 ft
© 2012 Google
Imagery Date: 3/26/2011 1994
2043 ft

Tower Rd
SW 197th Ave
SW 364th St
Google earth
© 2012 Google
25°25'37.97" N 80°30'29.21" W elev 5 ft
Imagery Date: 3/26/2011 1994
Eye alt 4.63 ft

NW 7th Pl
NW 7th Ave
NW 8th Ave
NW 8th Pl
W 8th Ct
NW 15th St
NW 14th St
NW 12th St
NW 10th St
NW 9th St
NW 8th St
NW 6th Terrace
NW 3rd Terrace
NW 3rd St
NW 2nd St
NW Palm Dr
SW 1st St
SW 2nd St
SW 3rd St
SW 5th St
SW 6th St
SW 36th St
SW 327th St
Tower Road
Tower Rd
SW 332nd St
SW 194th Ave
Palm Dr
13th St
Dirt Rd
Richard Rd
SW 197th Ave
SW 8th St
Arthur Vining Davis Pkwy
SW 334th St
SW 348th St
SW 202nd Ave
SW 328th St
SW 336th St
SW 204th Ave
SW 340th St
SW 207th Ave
© 2012 Google
Imagery Date: 3/25/2011 1994
25°27'07.20" N 80°30'25.92" W elev 5 ft
Eye alt 1805 ft

SW-208th-Ave
SW-322nd-St
SW-209th-Ave
SW-210th-Ave
SW-324th-St
SW-328th-St
SW-212th-Ave
Lucy St
SW-217th-Ave
SW-218th-Ave
SW 219th-Ave
Mowry Dr
Google earth
Eye alt 5171 ft
25°27'57.47" N 80°32'08.87" W elev 7 ft
© 2012 Google
Imagery Date: 3/26/2011 1994


16
SW-266th-St
SW-209th-Ave
SW-272nd-St
Epmore Dr
SW-274th-St
SW-276th-St
SW-222nd-Ave
SW-217th-Ave
15
SW-212th-Ave
SW-207th-Ave
Waldin Dr
SW-280th-St
© 2012 Google
Google earth
Imagery Date: 3/26/2011
1994
25°30'45.28" N 80°32'13.81" W elev 7 ft
Eye alt 8117 ft

SW 268th St
SW 272nd St
Roberts Rd
Moody Dr
FD
Google earth
Eye alt 2613 ft
© 2012 Google
25°30'54.54" N 80°29'03.29" W elev 6 ft
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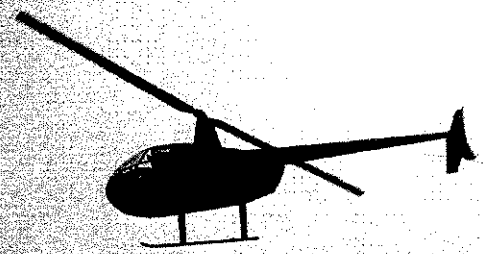
Krome Ave
SW 256th St
Roberts Dr
SW 254th St
SW 183rd Ct
Redland
Google earth
©2012 Google



Aerial Survey

SW Quadrant

9-26-12

Conducted by Ben Rivers

Country Club Rd
SW 228th St
SW 207th Ave
SW 224th St
Google earth
Eye alt 4146 ft
25°33'16.33" N 80°31'24.96" W elev 7 ft
© 2012 Google
Imagery Date: 3/26/2011 1994

Google earth
Krome Ave
SW 224th St
997
Eye alt 2110 ft
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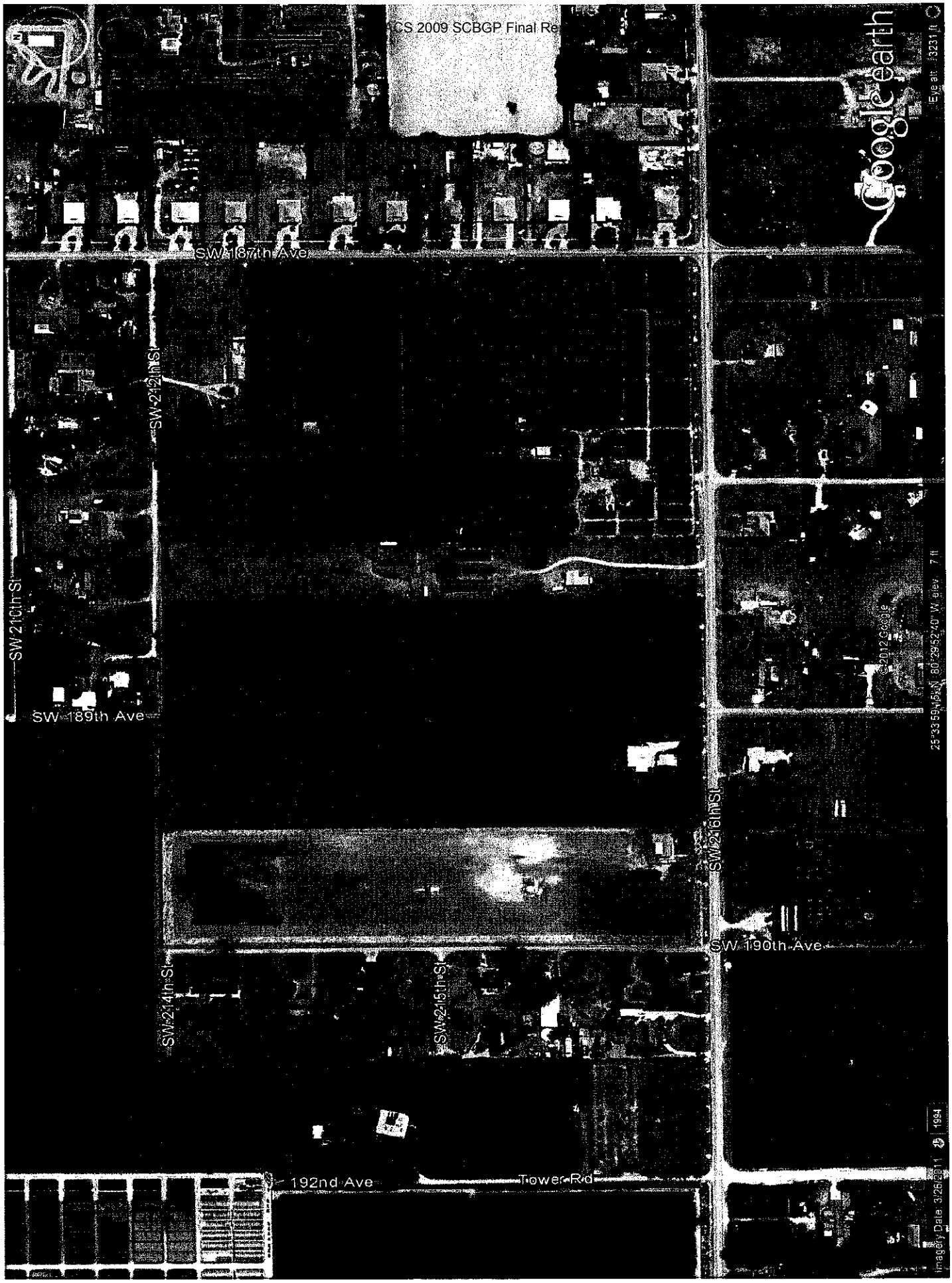
© 2012 Google
Imagery Date: 3/26/2011


SW 187th Ave
SW 212th St
SW 216th St
SW 189th Ave
SW 190th Ave
SW 214th St
SW 215th St
192nd Ave
Tower Rd
Google earth
Eye alt 3231 ft
25°33'59.45" N 80°29'52.40" W elev 7 ft
© 2012 Google
Imagery Date: 3/26/2011 1994

SW 209th Ave
Google earth
Eye alt 2721 ft
Hainlin Mill Dr
SW 210th Ave
SW 213th Ave
© 2012 Google
25°33'53.77" N 80°32'07.65" W elev 7 ft
Imagery Date: 3/26/2011 1994

SW 187th Ave
SW 202nd St
SW 204th St
SW 200th St
Google earth
Eye alt 3138 ft
25°34'40.33" N 80°29'50.77" W elev 5 ft
© 2012 Google
Imagery Date: 3/26/2011 1994

SW 182nd Ave
SW 172nd St
SW 187th Ave
Google earth
© 2012 Google
25°36'13.36" N 80°29'30.33" W elev 7 ft
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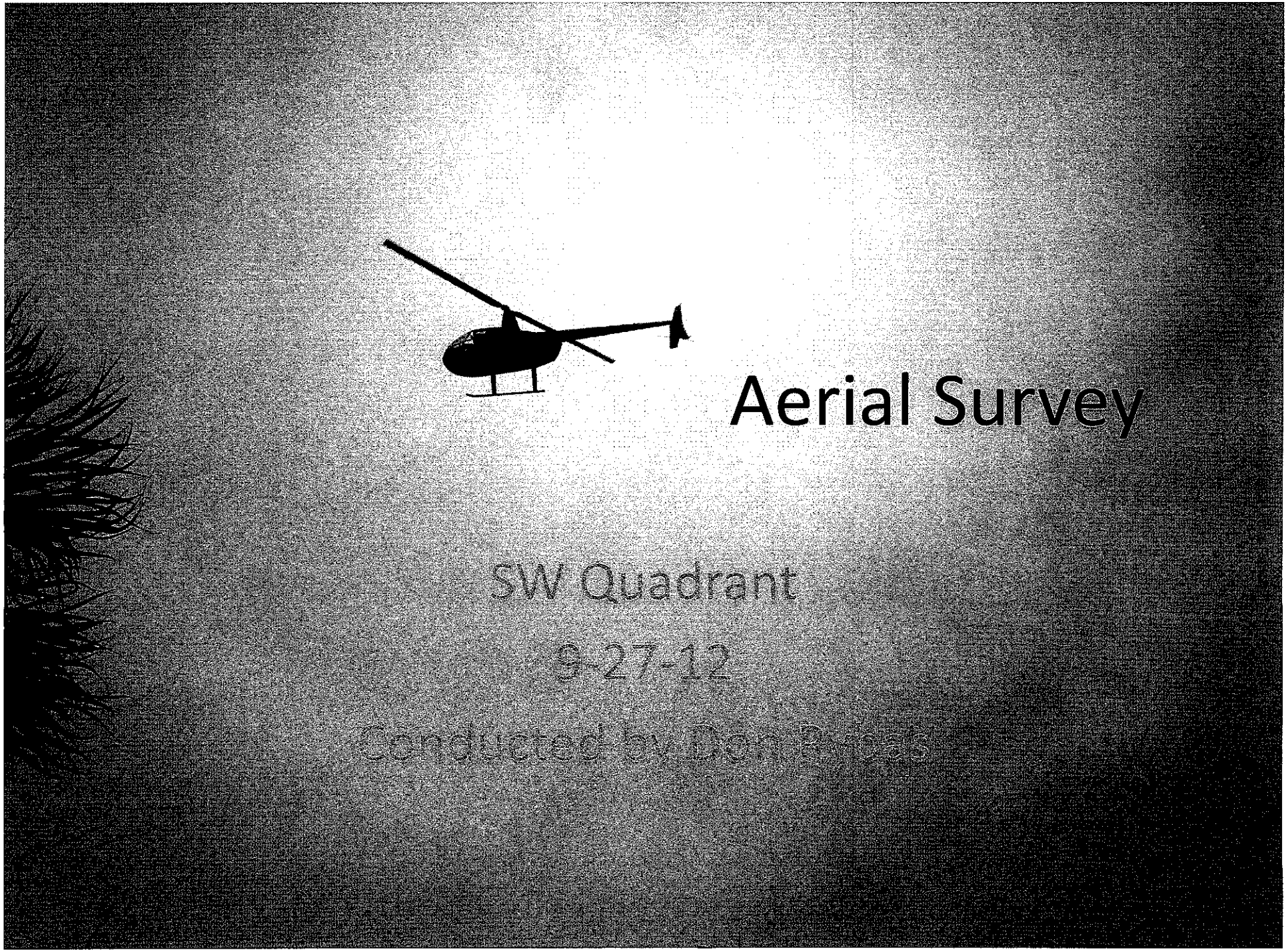
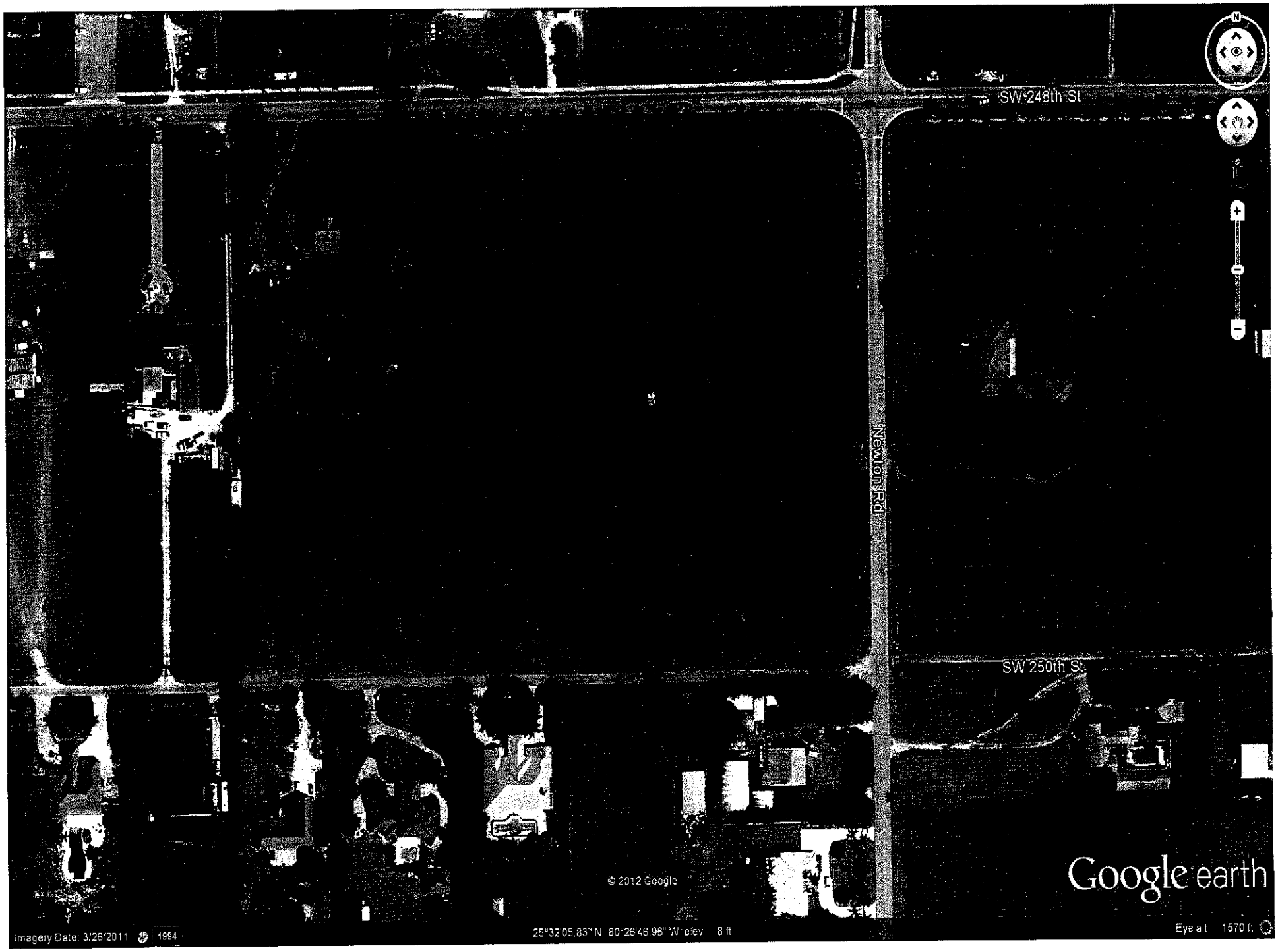

Aerial Survey
SW Quadrant
9-27-12
Conducted by Don Rhodes


SW 248th St
Newton Rd
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© 2012 Google
Google earth
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1994
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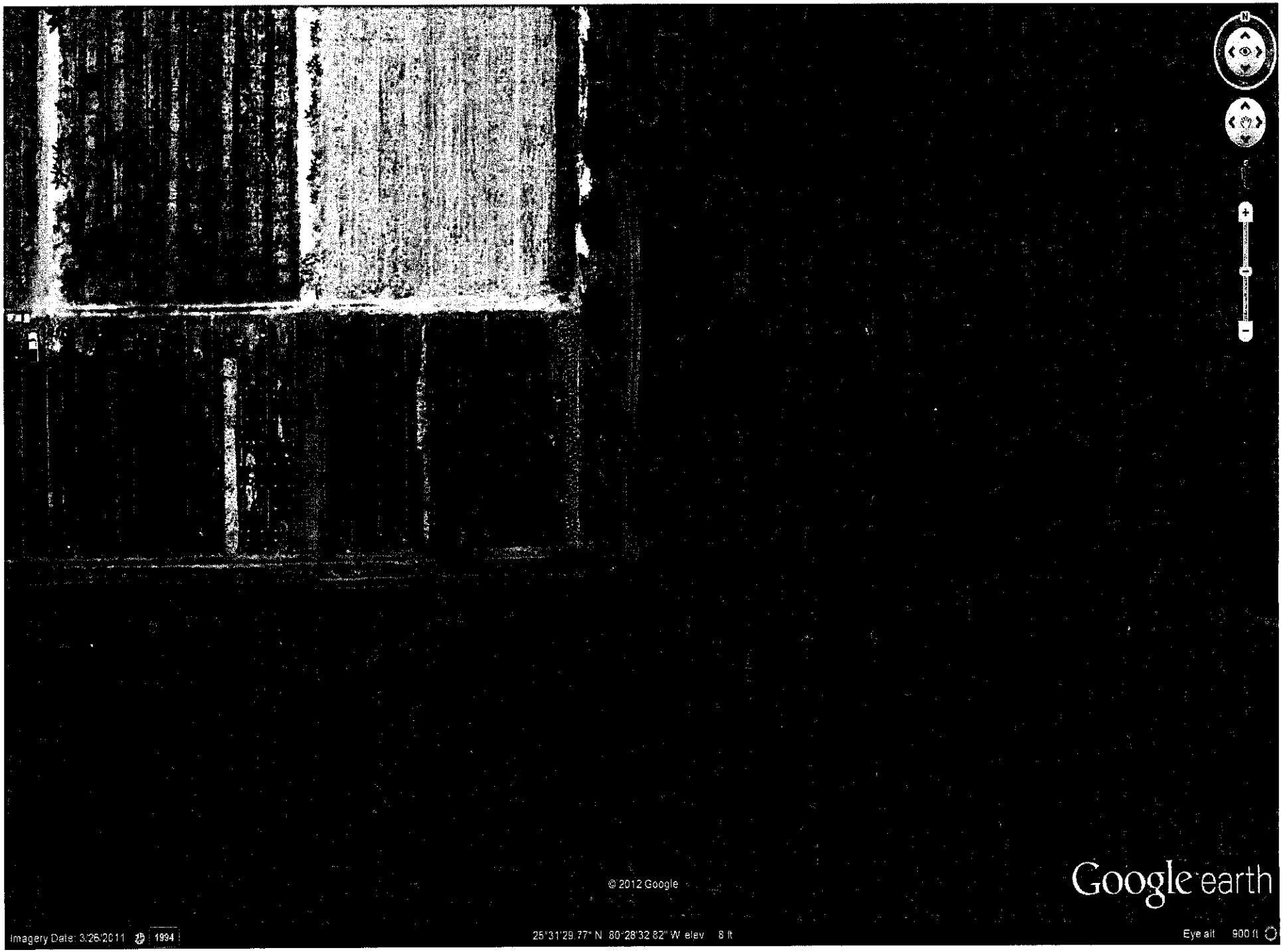
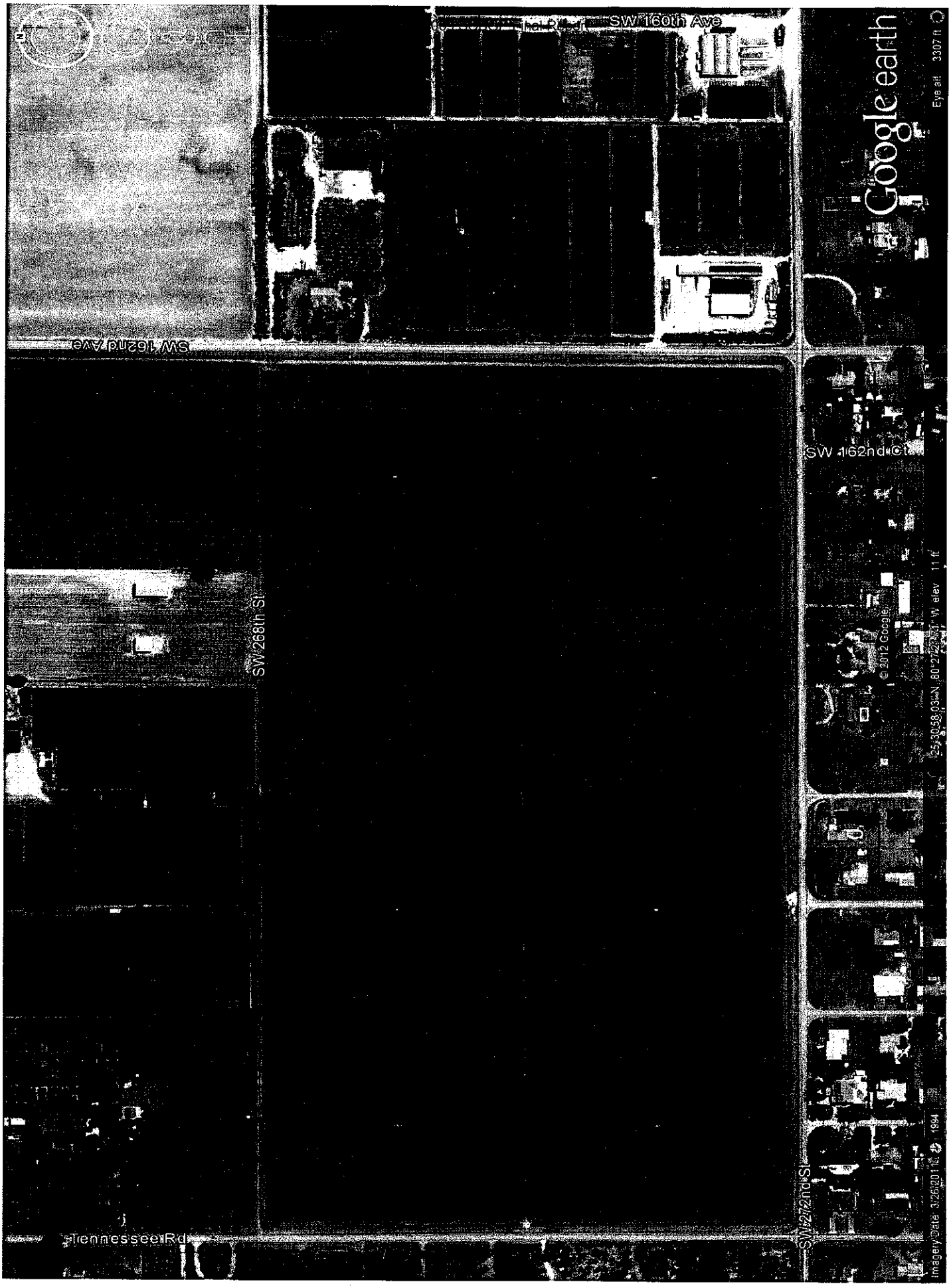
Eye alt 1570 ft


© 2012 Google
Google earth
Imagery Date: 3/26/2011 1994
25°31'29.77" N 80°28'32.82" W elev 8 ft
Eye alt 900 ft

SW 154th Ave
SW 147th St
SW 155th Ave
SW 270th St
Newton Rd
SW 159th Ave
SW 2nd St
SW 160th Ave
Google earth
Eye alt 2973 ft
25°30'45.50" N 80°25'45.36" W elev 1 ft
©2012 Google
Imagery Date: 3/26/2011 1994


SW 160th Ave
SW 162nd Ave
SW 162nd Ct
SW 268th St
Tennessee Rd
SW 272nd St
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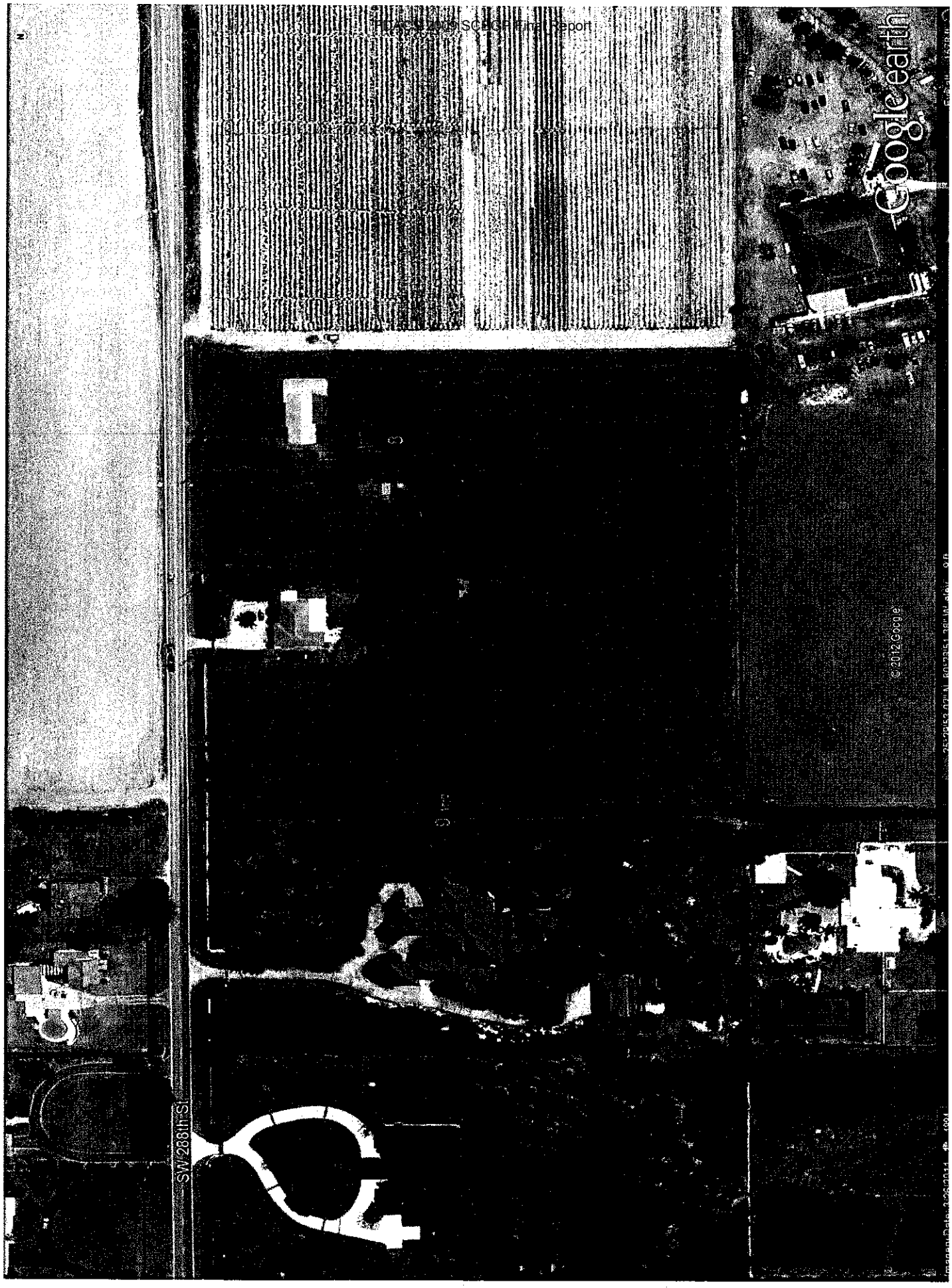
Eye alt 3307 ft
Imagery Date: 3/26/2011 1994


SW 288th St
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