

## Abstracts of the 2012 Meeting of the Florida State Horticulture Society

Click on the links below to jump to the section of interest:

[Poster Session](#)

[Vegetable Section](#)

[Ornamental, Gardening and Landscape Section](#)

[Krome Memorial Section](#)

[Handling and Processing Section](#)

[Citrus Section](#)

[Natural Resources](#)

### **POSTER SESSION**

**Field Observations of Machine-Harvest Inefficiencies and Suggested Corrective Measures for a Commercial ‘Noble’ Muscadine Grape Block Trained to a Single Cordon.** [Jacque Breman](#)<sup>1</sup> and Paul Laubacker<sup>2</sup>. <sup>1</sup>UF/IFAS Columbia County Extension, Lake City, FL and <sup>2</sup>UF/IFAS Putnam County Extension, Palatka, FL. ([civilday@ufl.edu](mailto:civilday@ufl.edu)) [P-1-K]

‘Noble’ and ‘Carlos’ muscadine grapes are two leading commercially harvested cultivars for contract to Florida vintners. For two growing seasons, 2010 and 2011, in northeastern Florida, several producers sharing the same mechanical harvester, had reported difficulty harvesting ‘Noble’ muscadine grape berries. Single cordons in a block were trained in the same direction. Field observation during the 2011 harvest of a ‘Noble’ muscadine by a model 2720 Braud<sup>®</sup> harvester showed visual differences in berry harvest depending whether harvesting in the direction of the of the single-cordon or against it. An adjacent block of ‘Carlos’ Muscadine did not display signs of alternating patterns. A field transect of the ‘Noble’ grape was conducted. Paired-row replicated hand-harvests with and against-cordon harvests were systematically sampled on a diagonal field transect at progressive, 4-row intervals between harvested sample pairs for a total of four replications. The entire 20-foot cordon of each pair was harvested. Mean berry weight left in the vineyard was 2,158 pounds per acre when harvested in the direction of the cordon compared to 674 pounds per acre when harvested against the direction of the cordon (F-test,  $P = 0.001$ ). Field recommendation was to harvest every other row against the direction of the single cordon immediately. This second pass was costly time-wise, as complete rounds of the block were required of the mechanical harvester for each alternating row. The additional 1,484 pounds of harvestable berries per acre justified the second pass by the mechanical harvester. It would have been advantageous if cordons had been trained in alternating directions in alternating rows for this block of ‘Noble’. Fruiting wood also appeared to have been aggressively pruned, placing the fruiting nodes close to the cordon. Winter pruning recommendation was to not prune so closely to the cordon, so berries would be further from the cordon and perhaps more harvestable. Harvest direction efficiencies may need to be tested across cultivars and multiple seasons before recommending training cordons in alternating

directions for future plantings of machine-harvested ‘Noble’ vineyards. For these growers and with this harvester, cordon direction and pruning may be worthy of investigation.

Table 1. Direction of machine harvest and pounds of ‘Noble’ left on the vine.

Paired Rows	*Cordon against direction of harvest (Pounds/acre)	*Cordon with direction of harvest (Pounds/acre)	Harvestable difference (Pounds/acre)	Harvestable difference value at \$500/ton contract (\$/acre)
1	525	2787	2263	\$565.63
2	688	1774	1086	\$271.50
3	525	2226	1701	\$425.35
4	959	1846	887	\$221.73
Means	674	2158	1484	\$371.05

\*F value is 34.25 with a *P* value of 0.001, for direction of cordon machine-harvested pounds of berries per acre left on the vine.

**Volunteer Mobile Irrigation Lab: Improving Irrigation Efficiency.** Dee Dee Dilger-Jacobson, UF/IFAS Highlands County Extension, Sebring, FL. ([dddilger@ufl.edu](mailto:dddilger@ufl.edu)) [P-2-UGL]

Today, Florida residents consume about 8.3 billion gallons of water per day. University of Florida experts predict the state will grow 21% in the next decade. Between those residents and nearly 70 million tourists a year, total water demand is projected to reach 9.3 billion gallons per day. Furthermore, parts of Florida, including much of Central, South and Southwest Florida, are currently experiencing drought conditions. Records show that 2006 and 2007 were the driest back-to-back calendar years since 1932. In 2008, The Southwest Florida Water Management District’s (SWFWMD) estimated water use report stated public supply water users, including domestic self-supply, constituted the largest single category withdrawing an estimated 542 million gallons each day. Residential irrigation represents the single largest use of water from our municipal water supplies. This water use has seriously impacted the aquifer which is the source of our drinking water and water that supports Florida’s springs and other ecosystems.

To help the residents within the Peace River Basin reduce their potable drinking water usage and pollution to our water systems, the mobile irrigation lab was formed. The Mobile Irrigation Lab audits residential properties by educating residents on their irrigation clocks, and managing their irrigation systems. The goal is to achieve the highest distribution uniformity and efficiency rate for domestic irrigations systems. The Mobile Irrigation Lab also reviews and promotes the nine principles of a “Florida Friendly” landscape. They then provide recommendations (Fig.1) to the residents requesting audits of their landscapes and irrigation systems. Success requires a commitment on the owner’s part to maintain the system to proper specifications and to provide qualified personnel to operate it. Reports generated by audits observe and document the existing irrigation system, make recommendations for improving design, installation, operation, and maintenance of their system.

The results of the Mobile Irrigation Lab have shown that there were a total of 35 lateral line breaks discovered and not realized by the residents. After repairs this equates to 1,512,000 gallons per day saved according to SWFWMD calculations on low volume leaks. As well as

102,720 gallons per day that 428 residents were saved by being taught how to read their irrigation clocks and check their irrigation zones.

Fig. 1 Highlands County Extension helps homeowners reduce water consumption by helping them fine tune their irrigation systems.



**2011 Vegetable and Small Fruit Nutrition Management Workshop.** Crystal Snodgrass<sup>1</sup>, Alicia Whidden<sup>2</sup>, Bielienski Santos<sup>3</sup> and Teresa Salame-Donoso<sup>3</sup>. <sup>1</sup> UF/IFAS Manatee County Extension, Palmetto, FL; <sup>2</sup> UF/IFAS Hillsborough County Extension, Seffner, FL; <sup>3</sup> UF/IFAS, Gulf Coast Research and Education Center, Wimauma, FL. ([crys21@ufl.edu](mailto:crys21@ufl.edu)) [P-3-V]

Fruit and vegetable nutrition is crucial to produce a profitable crop. Under the umbrella of nutrition, fertilizer and irrigation go hand in hand. It is the growers' responsibility to ensure their use of water and fertilizer is responsible while still gaining an economic advantage. Most growers in the Southwest Florida area utilize Best Management Practices (BMPs) in order to achieve this goal. In response to grower and county extension agent requests for educational training in the areas of fruit and vegetable nutrition, a group of agents and a specialist located in Manatee and Hillsborough Counties created a program to meet these needs.

The objectives of this program were: to provide training to fruit and vegetable growers on the nutritional requirements of popular crops and the latest techniques in fertilizer and irrigation application to meet these requirements. Additionally, the goal was to engage extension agents by providing an approved in-service-training, strengthening their knowledge base thus providing better service to their respective clientele. Classroom style presentations were delivered (Fig. 1) that provided in-depth information on nutritional requirements of several key crops. These crops included: blueberry, strawberry, tomato, peppers and cucurbits. The first talk was a general presentation on fertilization to make sure attendees had the basic knowledge needed to understand and learn from the successive presentations. The program also included presentations on important cultural practices related to crop nutrition such as cover crop utilization and green manures.

In order to provide meals and pay travel expenses for agents and specialists, vendors were invited to sponsor the event in exchange for a booth to display their products. Participants were provided PowerPoint presentations as well as other educational materials including EDIS publications and copies of the 2011-2012 Vegetable Production Handbook for Florida.

Approximately 86 participants including large and small growers, extension agents, specialists and industry representatives attended the program. Eleven Extension agents received registered for the course as in-service training. The program provided an interface for vendors and growers potentially allowing growers to improve applications techniques. Eight vendors sponsored the workshop, which provided the meal and covered travel expenses for attendees. A follow-up survey was conducted showing an overall increase in knowledge of 17%.

Due to positive feedback from program attendees, coordinators plan to provide this program annually; adjusting the program focus as new research data and technologies are developed. The advantages of adopting his program in another County include: increased grower knowledge and potentially behavior changes that are conducive to BMPs. Secondly, improved knowledge base of extension agents who are then able to provide pertinent information to growers statewide. Lastly, this event provided an interface for vendors and growers to meet and improve irrigation and fertilization techniques. The disadvantages of adopting this program would be the difficulty recruiting vendors and extended travel distance for speakers and agents.

Fig. 1 Participants in the 2011 Vegetable and Small Fruit Nutrition Management Workshop



### **Using Social Media as an Outreach Tool for Extension Horticulture Programs.**

Adrian Hunsberger<sup>1</sup>, Mary Lamberts<sup>1</sup>, Dan Culbert<sup>2</sup>, Anita Neal<sup>3</sup>, Kim Gable<sup>4</sup>, and Laura Sanagorski<sup>5</sup>. <sup>1</sup>UF/IFAS Miami-Dade County Extension, Homestead, FL; <sup>2</sup>UF/IFAS Okeechobee County Extension, Okeechobee, FL; <sup>3</sup>UF/IFAS St. Lucie County Extension, Ft. Pierce, FL; <sup>4</sup>UF/IFAS Monroe County Extension, Key West, FL; <sup>5</sup>UF/IFAS Palm Beach County Extension, West Palm Beach, FL. ([aghu@ufl.edu](mailto:aghu@ufl.edu)) [P-4-OGL]

Extension Agents are always looking for new ways to reach a diverse audience as part of our outreach for research-based information. University of Florida/IFAS Horticulture Extension agents from southeastern counties of Florida met to discuss new ways to reach our clientele. Most of us work with homeowners and reaching this group is often a challenge. The group started using social media in 2011 as a new communication tool. Lamberts and Hunsberger developed a YouTube video demonstrating proper techniques for planting vegetable seeds. The Southeast Horticulture Extension Agents developed a Facebook page that is updated weekly to provide timely information on horticulture and pest topics. Lamberts has a “work” Facebook page which she uses as an additional avenue for communicating with her clientele.

Lamberts conducted a search of YouTube videos trying to find one that showed how to plant a vegetable garden from seed. She did not find any which were useful for novices. The Miami-Dade County Extension office filmed and produced a ten-minute video (Fig. 1) entitled “How to Plant a Seed.” It was posted online Dec. 2011. As of March 2012, the video had been viewed 203 times. Watch the video by following this link: [Vegetable Gardening 101 – How to plant a seed video](#)

Additionally, a Facebook page was developed in April 2011 for Southeast Florida residents. By March 2012, 91 people “liked” the page and the peak number of people reached was 176 in February 2012. From April 2011 to March 2012, there were 6,284 post views. At a recent Extension Open House, several attendees stated that they learned about the Open House via Facebook invitations. [South Florida Friendly Landscapes Facebook page](#)

Fig 1. The Extension Agents utilized YouTube to post a 10 minute video on how to plant a seed.



### **Fruit & Vegetable Bingo as a Tool to Teach Kids about Locally Grown Produce**

Mary Lamberts, UF/IFAS Miami-Dade County Extension, Homestead, FL. ([lamberts@ufl.edu](mailto:lamberts@ufl.edu)) [P-5-V]

Extension Agents are asked to spend at least 5% of their time on 4-H and youth activities. In large urban counties, people who do not live near the farming area may not know that crops are being grown in their “backyard” so to speak. Children seem to enjoy playing Bingo, so various forms of the game have been developed to teach such things as beef products to fish identification.

A fruit & vegetable “Bingo” game was developed for Miami-Dade County Extension, originally for Farm-City Week which is when winter vegetables are plentiful, though not very many tropical fruit are available. The agent used a total of 25 items of fresh produce grown in Miami-Dade County. She found a bingo card generator (Fig. 1) online to help arrange the produce randomly across 20 different cards. The center contains the words “Fruits & Vegetables” as a free space. All cards were printed in color and are about the size of a postcard. Since it is expensive to print the cards, the agent laminated them.

She planned to use dry erase markers after trying another version of the game with stickers. She finally chose miniature marshmallows in a small cup for each child or pair of children since that allows for a more rapid transition between groups.

Fig.1. Several free bingo card generators can be found on the World Wide Web.



**Capitalizing on Resources of the Small Farms Academy.** Carolyn Saft<sup>1</sup>, Terry DelValle<sup>2</sup>, Jim Devalerio<sup>3</sup>, Dan Fenneman<sup>4</sup>, Bob Hochmuth<sup>5</sup>, Alicia Lamborn<sup>6</sup>, Nichelle Demorest<sup>7</sup>, Wendy Wilber<sup>8</sup>. <sup>1</sup>UF/IFAS Suwannee County Extension, Live Oak, FL; <sup>2</sup>UF/IFAS Duval County Extension, Jacksonville, FL; <sup>3</sup>UF/IFAS Bradford County Extension, Starke, FL; <sup>4</sup>UF/IFAS Madison County Extension, Madison, FL; <sup>5</sup>Suwannee Valley Agricultural Extension Center, Live Oak, FL; <sup>6</sup>UF/IFAS Baker County Extension, McClenney, FL; <sup>7</sup>UF/IFAS Columbia County Extension, Lake City, FL; <sup>8</sup>UF/IFAS Alachua County Extension, Gainesville, FL. ([csaft@ufl.edu](mailto:csaft@ufl.edu)) [P-6-V]

Resources for demonstrations and interactive learning activities are integral in reaching a higher level of learning and practice adoption by our clientele. The Small Farms Academy specializes in interactive learning opportunities for small farmers. Reduced funding has limited the ability of some Agents to provide in-depth training opportunities and shrinking household budgets have limited the Agents' ability to charge a program fee. With that in mind, the NE District Green Team has capitalized on the academy resources and extends their use for district wide Master Gardeners and homeowner trainings (Fig.1).

Lack of knowledge about all aspects of a topic can prohibit some workshops from being given at the county level. Experiential learning is the focus of trainings offered at the Suwannee Valley Agricultural Extension Center (SVAEC). Workshops with demonstrations and hands on activities include: pruning the orchard, hydroponics and integrated pest management (IPM). The curriculum for these courses includes PowerPoint presentations, demonstrations, pruning, tool selection, tool sharpening, building floating gardens, scouting and insect identification activities. Additionally, publications and notebooks are distributed for future reference.

Pruning workshops reached an additional 150 people over the last three years and Hydroponic resources were extended to over 200 Master Gardeners and homeowners over the last two years. The hydroponic demonstrations were also taken to the Suwannee Valley Fair where an additional

2,000 people were exposed to hydroponic gardening. The IPM workshop was limited to 75 people each year. Evaluations indicate 98% of people attending pruning workshops have implemented IFAS recommendations for pruning practices and 96% are using IPM practices. Several hydroponic workshop attendees have expanded their hydroponic systems beyond the starter floating garden obtained at the workshop. Furthermore, clientele have reported an increase in fresh vegetable consumption which leads to a healthier diet. Attendees have also indicated they have extended the season of vegetable production through the use of hydroponics. Clientele reported this is a preferred method of education and look for similar type workshops to attend in the future. Additional impacts include a team approach to program planning and an opportunity to reach a higher level of programming. Master Gardeners have increased opportunities to socialize and network with other Master Gardeners from the district and have brought back new ideas to their counties.

There are many advantages including multiple uses of resources so that the value is extended across a wide range of clientele. There are also increased opportunities for Agents to gain advanced training and become regional experts in specific areas. We have many repeat clients so a strong support base is being developed. Workload is distributed among SVAEC staff and Agents. A unified presentation is being taught district wide for a more unified message. There is an opportunity to learn new teaching techniques from other Agents. Supplies are easily purchased and distributed by the Small Farms Academy Coordinator. One disadvantage is that it takes more planning and communication for district wide events. Another disadvantage is travel time and distances are increased for some attendees and Agents.

Fig. 1. Master Gardener volunteers are being trained utilizing the resources of the Florida Small Farms Academy.



**Using a Hands-on Approach to Teach Vegetable Gardening and to Encourage Healthy Eating Among Adults.** Linda Seals, Elizabeth Shephard, James Fletcher and Sally Scalera. UF/IFAS Brevard County Extension, Cocoa, FL. ([lseals@ufl.edu](mailto:lseals@ufl.edu)) [P-7-OGL]

Interest in backyard vegetable gardens and small farm vegetable production has increased significantly in recent years. Many factors have contributed to the increased interest including rising grocery costs, a desire to eat healthier, and fears of contaminated food. To meet the demand for information on how to grow backyard vegetables, and to encourage healthier eating among adults, a 12-week, hands-on class titled “Be Healthy, Grow Your Own: Vegetable

Gardening in Florida” was created. The class was a collaborative effort between Family and Consumer Sciences, Horticulture, and Agriculture Extension agents. The objectives of the class were to increase vegetable consumption among adults, and to increase participants’ confidence in growing their own vegetables. Participants were assigned a 20’x20’ garden plot (located on the Extension office campus) where they could practice the lessons learned during a weekly, two-hour lecture. They were provided with everything they needed for their garden including soil amendments, fertilizer, irrigation, seeds, and transplants, which were produced in the Extension greenhouse by Master Gardeners. Participants selected the vegetables they wanted to grow, but were encouraged to try vegetables they were unfamiliar with; everything harvested was theirs to keep. They were also encouraged to experiment with different mulch materials, staking techniques, and to be creative in their plots.

The Horticulture and Agriculture agents taught all of the gardening sessions, and the Family and Consumer Sciences agent taught sessions on food safety, harvesting, cooking, and preserving fresh vegetables. After each weekly lecture, participants were encouraged work in their garden. Extension agents and Master Gardeners were on hand to answer questions and provide guidance. Participants also had daily access to the property, so they could tend to their gardens and harvest crops anytime they wanted to. To date, two classes have been delivered with nearly 80 participants in each class. A six-month, follow-up survey was delivered to participants in the first class (the second recently ended). Thirty-eight of the 41 participants who responded to the survey said they felt confident about vegetable gardening on their own after taking the class compared to only 11 who felt confident before taking the class (Table 1). Thirty-two respondents indicated they planned to preserve their fresh vegetables after taking the class; only 12 participants planned to preserve vegetables before taking the class. More surveys will be conducted in the future to determine other impacts the program has had on producing and consuming fresh vegetables. Many Extension offices do not have the resources to deliver this class on such a large scale, but the concept of incorporating hands-on lessons to support lectures can be adapted to fit any horticulture program.

Table 1. Survey results from the first Be Healthy, Grow Your Own: Vegetable Gardening in Florida class.

Question	Before	After
I am confident about starting a vegetable garden at home	29% (n=11)	100% (n=38)
I know how to fertilize my vegetable garden correctly.	15% (n=6)	78% (n=31)
I know how to properly amend my soils before planting my vegetable garden.	34% (n=14)	100% (n=41)
I am confident about managing pests in my vegetable garden.	21% (n=9)	95% (n=40)
I use Integrated Pest Management principles.	29% (n=12)	93% (n=38)
I consider the health benefits of eating fresh vegetables.	93% (n=38)	98% (n=40)
I plan to preserve and/or can fresh vegetables.	29% (n=12)	78% (n=32)

**Introducing Pomegranates to the Dooryard.** Karen M. Stauderman<sup>1</sup> and William Castle<sup>2</sup>.  
<sup>1</sup>UF/IFAS Volusia County Extension, DeLand, FL; <sup>2</sup>UF/IFAS Citrus Research and Education Center, Lake Alfred, FL. ([kstauderman@ufl.edu](mailto:kstauderman@ufl.edu)) [P-8-OGL]

Recent record breaking freezes and citrus disease outbreaks have resulted in loss of dooryard fruit trees including citrus trees in Volusia County landscapes. This diversity of tree loss stemmed from increased interest of alternative Florida-friendly plants to meet the demand of edible fruit trees in their landscape. The University of Florida research and extension team responded by providing educational opportunities to Volusia County homeowners, master gardeners and residents in commercial-scale operations on the establishment of pomegranates as an ornamental tree and/or edible fruit in the dooryard. Individuals were offered educational opportunities through news articles, newsletters, seminars, a public broadcasted television program, radio interviews and a fact sheet on basic establishment of pomegranates. In addition, the educational programs highlighted the aesthetic flower appeal, health benefits and the diversity in growth habit of pomegranates.

A total of 400 trees and a total of 30 different pomegranate varieties were made available, for sale, exclusively to Volusia County residents through a cooperative arrangement between the authors. The plants were produced at the UF-IFAS Citrus Research and Education Center in Lake Alfred, FL as part of an on-going project by W. Castle, professor emeritus, to evaluate pomegranate potential in Florida. The planting locations in either the dooryard or a commercial site of the 400 pomegranate trees sold from the program were recorded on a Volusia County map (Fig.1). Advertising the Volusia County pomegranates program occurred quickly by word of mouth and the media resulting in all of the 400 trees having been sold with future orders exceeding 125 trees.

The proceeds of the tree sale provided funds to purchase horticultural supplies for the county 4-H Horticultural youth program. The sudden popularity of pomegranates from this program sparked the need for further production by two nurseries in the central Florida area to meet the demand. Evaluation data through an email survey showed that 85 participants increased knowledge relating to the establishment of Pomegranate trees in Volusia County. After three months a total of 400 trees planted reflect the growing popularity of pomegranates to Volusia County dooryards.

Fig.1. Pomegranates distributed to homeowners were mapped by the collaborators.



**Web Based Online CEU Program Improves Access to Pesticide Education.** Shawn Steed, UF/IFAS Hillsborough County Extension, Seffner, FL. ([ststeed@ufl.edu](mailto:ststeed@ufl.edu)) [P-9-OGL]

Traditional delivery of pesticide continuing education units (CEUs) is a costly proposition from both a time and resource standpoint. Expenditures are incurred from participants in the form of time availability, program cost and travel expenses. Extension resources are used in terms of agent's time (classroom, development, registration, etc.) materials (refreshments, office supplies), and facilities. In personal conversations with license holders seeking CEUs, the agent found that in many cases, license holders came up short for the requirements of renewal and were not aware of it until the license renewal was due. In that scenario, quick availability of a CEU program and prompt delivery of a CEU credit were necessary. Therefore, a program was launched to make CEUs conveniently available to license holders with minimum agent effort.

The objectives of this program was to deliver CEUs whenever a license holder requested, expedite the delivery of a CEU credit, minimize cost to both the agent and license holder, and automate this CEU testing and delivery as much as possible. The agent developed an industry sponsored online CEU webpage (Fig 1). This format integrates a webpage with online quiz taking software (ProProfs.com). The webpage allows for CEU seekers to scan a list of available CEU programs and choose one to meet their needs. The user then registers through the software, reads the CEU article, and then takes a quiz to confirm subject matter mastery. The software grades the quiz and informs the agent via email, that a participant has taken the quiz. If the participant scored above a 70% on the quiz, the agent can then register the participant with the state of Florida and issue a signed CEU (PDF file) via e-mail to the participant.

To date, 92 CEUs have been distributed to license holders using four different CEU programs (article and quiz). The online CEU website has enabled license holders to access programs any time they are available as long as computer and Internet access is also available. The website enables sponsorship from industry in the form of contact information placed on the website. The estimated economic impact from the program to date is \$294,400 in terms of professionals obtaining CEUs to continue employment in pesticide application.

The online CEU website allows for agents to maximize their time and automate the CEU process. It also allows clients the flexibility in terms of time and location to obtain CEUs. Industry sponsorship also brings in revenue to the extension office to cover costs. It takes approximately 3 to 5 minutes to issue, register, and e-mail a CEU. In the future it may be problematic for the agent to handle too many participants and may need staff help. This may be offset by some of the industry sponsorship. Additionally, the website also allows for agents to publish a paper and get statewide readership.

Fig.1. The online pesticide CEU website allows license holders to quickly and conveniently earn CEUs for pesticide license renewal.



Audie Ham  
Sales Representative  
Diamond R Fertilizer Co.  
Phone 813-478-5806  
Fax 813-752-8355  
[Audie.Ham@Diamondr.com](mailto:Audie.Ham@Diamondr.com)



Winfield Solutions  
Ornamental Account  
Managers

### Hillsborough County Extension Online Pesticide CEUs

Welcome to the Online Pesticide CEU Series. To insure that you receive your CEUs quickly and without problems, please read the following instructions.

#### Instructions:

**Step 1)** Select one CEU from the list below. Click the link to begin.

**Step 2)** Read the material provided thoroughly.

**Step 3)** Click on the link at the bottom of the CEU article to go to the quiz.

**Step 4)** Fill in the information request including your pesticide license number  
(example PV 12345) then answer the quiz questions and submit.

There are 3 questions placed randomly in the quiz that are for informational purposes to receive your CEUs. These questions will not count toward your final grade.

**Step 5)** We will email you a CEU credit form.

#### Available CEUs

**The Fresh Citrus Traveling Road Show.** <sup>1</sup>Tim Gaver, <sup>2</sup>Jamie Burrow, <sup>3</sup>Darren Cole, <sup>4</sup>Christine Kelly-Begazo, <sup>2</sup>Karla Lenfesty, <sup>4</sup>Mark Ritenour. <sup>1</sup> UF/IFAS Citrus County Extension, Lecanto, FL; <sup>2</sup> UF/IFAS St. Lucie County Extension, Ft. Pierce, FL; <sup>3</sup> UF/IFAS Citrus Research and Education Center, Lake Alfred, FL; <sup>4</sup> UF/IFAS Indian River Research and Education Center, Ft. Pierce, FL; <sup>4</sup> UF/IFAS, Indian River County Extension, Vero Beach, FL.  
([Tgaver.49@ufl.edu](mailto:Tgaver.49@ufl.edu)) [P-10-C]

The Treasure Coast's citrus industry contributes \$1.4 billion annually to the local economy, employing 11% of the workforce. Eighty percent of the region's fresh grapefruit are shipped to export markets in Europe and the Far East. Domestic and international trade communities have developed standards on quality and safety aspects of the production and processing of fresh fruits and vegetables. Third party food safety audits, to insure standards compliance, require annual training of production, harvesting and packinghouse employees in pesticide application safety, personal and workplace hygiene, disease identification, and workplace sanitation practices.

A team of UF Extension and REC faculty responded to this need by providing programming (English and Spanish) and documentation to citrus growers/ harvesters/ producers for critical "must have" standards. This programming was provided at a number of venues, including the Indian River Research and Education Center and packinghouses in St. Lucie, Indian River and Polk Counties. Certificates of attendance are generated for attendees of the training, which provide the required documentation of such training required by the audits.

Delivery methods incorporated lectures with visual and media presentations, interactive discussion and questions, and demonstrations with hands-on/experiential activities. In 2011, programs resulted in 7,740 educational contacts. These trainings fulfilled a significant educational need for employers to meet food safety program requirements and audit criteria.

This educational programming satisfies a regional need for fresh citrus exporters that is unique to the Treasure Coast at this time. However, the national food safety initiative that is gaining momentum is likely to result in similar training needs for fresh citrus packers that target the domestic U.S. markets. There might also be an opportunity for Extension to provide similar required training for other fruit and vegetable producers and packers in Florida. County Extension faculty who get involved in such programming in the future would have to develop appropriate training presentations and perhaps dedicate a significant portion of their time to such an effort. Programming in Spanish needs to be provided to the significant Hispanic portion of the agricultural work force.

Fig.1. Extension Agents provide the necessary training to help growers, harvesters and processors meet food safety guidelines and pass third-party audits.



## **VEGETABLE**

**Field Performance of Lettuce Cultivars Used in Southern Florida.** H. Lu, Everglades Research and Education Center, University of Florida/Institute of Food and Agricultural Sciences, Belle Glade, FL, and D. Sui, Commercial Vegetable & Tropical Fruit, UF/IFAS - Palm Beach County Cooperative Extension, West Palm Beach, FL. ([hjlu@ufl.edu](mailto:hjlu@ufl.edu)) [V-1]

Yield and horticultural quality in lettuce production are dependent on management practice and cultivars used in the production. Selection of cultivars suitable for use in Southern Florida is based on data from the field variety trials. The lettuce variety trials by the University of Florida were discontinued for many years, which have resulted in lack of data for selection of cultivars for use in Florida. Beginning in 2010, we resumed these trials at the UF/IFAS Everglade Research and Education Center in Belle Glade. A total of seven cultivars (three iceberg and four romaine) were tested in the field trials. The results showed that the cultivars varied significantly for yield and other traits. In 2010, the cultivar Gator yielded more than 8074 and Raleigh in iceberg variety trials, while all four romaine cultivars did not differ significantly for yield. In 2011, the three iceberg cultivars yielded similarly. Terrapin and 70096 had higher yield than Manatee in the romaine variety trials. The results indicate that there was a significant genotype by environment interaction for the iceberg lettuce Raleigh and the romaine cultivar Manatee. Manatee and 70096 are resistant to seed thermo-dormancy and generally germinated better than other cultivars. The variety 70096 was found to be resistant to banded cucumber beetles and tolerant to cold weather. All three iceberg cultivars and Manatee were tolerant to aphids.

**Evaluation of Several Lettuce (*Lactuca sativa* L.) Cultivars Grown Inside a Greenhouse Using Nutrient Film Technique.** R.C. Hochmuth, and W.L. Laughlin, Suwannee Valley Agricultural Extension Center, University of Florida, A. Gazula, Alachua County Extension, Gainesville, FL. ([bobhoch@ufl.edu](mailto:bobhoch@ufl.edu)) [V-2]

Small greenhouse and outdoor hydroponic growers in Florida have recently shown an increased interest in growing a wide variety of vegetables for local direct to consumer sales. These markets typically demand a diversity of vegetables, including leafy vegetables such as lettuce (*Lactuca sativa* L.). Very few lettuce variety trials have been conducted in Florida to provide recommendations on the best types or varieties within various types of lettuce that are suitable for greenhouse production. A randomized complete block design trial replicated three times was conducted three times at the Suwannee Valley Agricultural Extension Center in Live Oak Florida during the winter and spring of 2012. The trial was conducted using the nutrient film technique in channels 4 inches wide and 10 feet long. Fifteen varieties of various types of lettuce were evaluated for yield, color, susceptibility to tip burn, and overall quality appearance. Lettuce types included romaine, bibb, and loose leaf. Several varieties performed well in yield and quality during the first trial during January when temperatures were moderate. However, during the subsequent trials temperatures were unusually high and several varieties showed susceptibility to leaf tip burn, a common disorder in lettuces grown in warm greenhouses. The trial results showed the best adapted varieties for Florida greenhouse production using nutrient film technique culture and also showed varieties that are not appropriate in Florida due to size, quality or leaf tip burn concerns.

**Growing Ginger in a High Tunnel - A Niche Crop with Market Potential.** R. Rafie, Ph.D., School of Agriculture, Virginia State University, Petersburg, VA, C. Mullins, School of Agriculture, Virginia State University, Petersburg, VA, T.J. Nartea, School of Agriculture, Virginia State University, Petersburg, VA. ([arafie@vsu.edu](mailto:arafie@vsu.edu)) [V-3]

Ginger root is an internationally important culinary and medicinal herb. American consumer interest and demand in fresh ginger has increased due to medical research and media promotion regarding the health benefits of ginger. Ginger has been cited as a promising and safe treatment for nausea in cancer patients and pregnant women, as well as an anti-inflammatory for arthritic patients. In 2011, the U.S. imported 49,991.5 MT of ginger with a total value of 55.9 million dollars. Hawaii is the only commercial producer of ginger in the United States. Ginger production in Hawaii is on the decline due to ginger wilt caused by a bacterium known as *Ralstonia solanaceum*. Ginger rhizome requires a 9 to 10 month growing season under tropical conditions making temperate cultivation under field conditions impossible. Scientists at Virginia State University considered the potential of fresh ginger production under the protected culture of high tunnel conditions. In 2011, Virginia State University scientists assisted two farm producers to grow and market ginger under high tunnel conditions. The participating growers yielded an average of seven to eight pounds of marketable rhizomes which sold for an average of \$6.00 per pound wholesale to retailers and an average of \$15.00 per pound direct sale to consumers. Preliminary research demonstrates high tunnel produced ginger is an economically viable crop for diversified Virginia small farm businesses engaged in farmers market, retail farm stand and community supported agriculture direct to consumer enterprises.

**Evaluation of Vertical and Horizontal Soilless Production Systems for Strawberry.** T. Salame-Donoso, and B.M. Santos, Gulf Coast Research and Education Center, University of Florida, 14625 CR 672, Wimauma, FL. ([tsalame@ufl.edu](mailto:tsalame@ufl.edu)) [V-4]

Florida strawberries (*Fragaria x ananassa*) are commonly grown in sandy soils in open field conditions. Protective structures are used to improve strawberry yield and quality, which has led to a significant increase of this practice in Florida. Prices of structures are high and there is a need to find the appropriate combination of production systems to increase the space use efficiency, which maximizes strawberry yields. Soil fumigants and land preparation are costs that also could be reduced by using soilless strawberry culture. Two preliminary studies were conducted to determine the performance of four different soilless media under two production systems. For the first study, a soilless horizontal system (wooden boxes) was filled up with different media (pine bark, coconut coir, potting mix, and perlite). In the second study, a vertical (Vertigro®) soilless system was used with the same four media. The results indicated that for the horizontal system, there were no significant differences among treatments for early and total fruit number and weight. For the vertical production system study, there were no significant differences among soilless media for early fruit number and weight, and for total fruit weight. However, the total fruit numbers were the highest in pots filled with either coconut coir, potting mix or perlite.

**Performance of Florida-produced Containerized Strawberry transplants.** P. Huang, B.M. Santos, V.M. Whitaker, C.D. Stanley, Gulf Coast Research and Education Center, University of Florida, 14625 CR 672, Wimauma, FL, and S.A. Sargent, Department of Horticultural Sciences, University of Florida, Gainesville, FL. (Student Competition) ([bmsantos@ufl.edu](mailto:bmsantos@ufl.edu)) [V-5]

Containerized transplant (Plug) is an alternative to bare root transplant (BR) for strawberry (*Fragaria × ananassa*) in order to reduce water use for crop establishment under hot weather in late September to early October in Florida. However, the price of plugs is double compared to BR, which makes fewer growers in favor of using plugs. Therefore, three cultivars of strawberries ('Strawberry Festival', 'Florida Radiance', and 'Winterstar') were plugged at different plugging date (July 26 and August 16 in 2010; August 6 and 16 in 2011) in Florida for evaluating their performance compared to BR with establishment practices including BR with 10 days of sprinkler irrigation [SI], BR with 6 days of SI with kaolin clay application [KC], plugs with 2 days of SI with or without KC. In the season of 2010-2011, plants plugged in August produced 21% more crowns than ones growing from BR with 10 days of SI averaged over cultivars regardless of KC, but no significant difference in crown and plant diameter at 12 weeks after transplanting. Early yield from August-plugs was similar to BR regardless of KC but significantly higher than July-plugs without KC averaged over cultivars, whereas total yield did not differ among all the establishment practices. In the season of 2011-2012, the early yield of plugged plants can be enhanced for 38% if plugged in August 16 compared to ones plugged in August 6, but no enhancement in total yield.

**Using Low-Volume Irrigation Programs and Crop Protectants to Establish Strawberry Transplants.** I. Hernandez-Ochoa, B.M. Santos, C. Stanley, and P. Huang, Gulf Coast Research and Education Center, IFAS, University of Florida, 14625 CR 672, Wimauma, FL. ([bmsantos@ufl.edu](mailto:bmsantos@ufl.edu)) [V-6]

Strawberry (*Fragaria x ananassa*) production in Florida relies in bare-root transplants to establish the crop between September and October. To cool down the strawberry crown and provide moisture to promote new roots and shoot, sprinkler irrigation is applied during 10 to 14 consecutive days, which totals approximately 540,000 gal/acre of water. Two studies were conducted to assess the influence of crop protectants and low volume sprinkler on minimize water volumes during the establishment of bare-root strawberry. A first study determined the effect of days of irrigation (10 and 7 days) and crop protectants (Surround<sup>TM</sup>, Screen Duo<sup>TM</sup>, PurShade<sup>TM</sup>, and Regalia<sup>TM</sup>). There was no significant difference for early (8 harvests) and total (16 harvests) yields among treatments, averaging 1.6 and 3.2 ton/acre, respectively. A second study evaluated the effect of irrigation programs from high impact and mini-sprinklers (i.e. continuous 4.5 gal/min, continuous 1.5 gal/min, and intermittent [10 minutes on and 10 minutes off] 1.5 gal/min irrigation) on strawberry transplant establishment. There were no significant differences among treatments with an average early yield of 1.85 ton/acre.

**Improving Water Management for Tomato Production with Soil Surfactants.** E.A. Torres-Quezada, and B.M. Santos, Gulf Coast Research and Education Center, IFAS, University of Florida, 14625 CR 672, Wimauma, FL. ([bmsantos@ufl.edu](mailto:bmsantos@ufl.edu)) [V-7]

Tomato (*Solanum lycopersicum*) production in Florida mostly occurs in deep sandy Spodosols, which have low water retention and high potential for nutrient leaching. Studies were conducted to determine the influence of IrrigAid Gold (10% alkoxyated polyols and 7% glucoethers) application on tomato growth and yields. Treatments consisted of combinations of three N rates (250, 300, and 350 lb/acre) and IrrigAid Gold application (control and applied). The IrrigAid applied plots received 0.5 gal/acre at transplanting and 0.25 gal/acre at 2, 4, and 6 weeks after transplanting through drip injection. The results indicated that there were no significant N rate by IrrigAid Gold application interactions for leaf greenness, soil moisture, and early and total marketable yields. Application of IrrigAid Gold increased soil moisture by approximately 2% throughout the season, whereas early marketable fruit weight improved by 11% and 9% in spring and fall 2010. These fruit weight increases might be attributed to the increased soil moisture around roots which reduced nutrient leaching and thus higher N absorption.

**Comparison of Potassium Sources and Rates for Tomato Production in Florida.** B.M. Santos, Gulf Coast Research and Education Center, IFAS, University of Florida, 14625 CR 672, Wimauma, FL. ([bmsantos@ufl.edu](mailto:bmsantos@ufl.edu)) [V-8]

Two filed studies were conducted in west-central Florida to assess the effects of two preplant-applied potassium (K) sources and six application rates on the growth and yields of round tomato (*Solanum lycopersicum*). Rates of K were 0, 50, 100, 200, 300, 400, and 500 lb/acre, whereas the sources were sulfate of potash (SOP; 40% K) and muriate of potash (MOP; 50% K). Sulfur was balanced in all studies with gypsum. Studies were conducted in a soil low in K, with rapid infiltration, and organic matter content of <1.5%. Sources were applied into two 1-inch deep

grooves on bed tops before fumigations. Results indicated that there were no plant growth and marketable fruit weight differences between both sources from 0 to 400 lb/acre, while at 500 lb/acre there were higher yields using SOP.

**Optimizing Phosphorus Rate for Enhancing Sustainability of Commercial Snap Bean Production in South Florida.** G. Liu, Horticultural Sciences Department, University of Florida, 1117 Fifield Hall, Gainesville, FL 32611-0690, D. Sui, Palm Beach County Cooperative Extension, University of Florida, 559 N. Military Trail, West Palm Beach, FL 33415-1311, and Y. Li., Tropical Research and Education Center, Soil and Water Science Department, University of Florida, Homestead, FL 33031. ([guodong@ufl.edu](mailto:guodong@ufl.edu)) [V-9]

Florida is ranked first in the production, acreage, and total value of fresh market snap bean in the nation. South Florida is the principal region for snap bean production. The UF/IFAS recommendation of phosphorus (P) rate for snap bean is in a range from 80 to 120 lb/acP<sub>2</sub>O<sub>5</sub>. However, current practice uses as much as 200 lb P<sub>2</sub>O<sub>5</sub> per acre. The objective of this study was to demonstrate the optimal P rate for improving snap bean growth. The study was in a randomized complete block design with four replications with a commercial cultivar (Caprice) and seven P rates: 0, 40, 80, 120, 160, 200, and 240 lb P<sub>2</sub>O<sub>5</sub> per acre in Palm Beach County during November 2011 to February 2012. The marketable bean yields show that 120 lb P<sub>2</sub>O<sub>5</sub> per acre is the optimal P rate for snap bean. Additional P application reduced the marketable bean yield slightly.

**Identification of Phosphorous Efficient Genotypes from Potato Germplasm Banks.** W.C. Lee and G. Liu, Horticulture Sciences Department, University of Florida, 1117 Fifield Hall, Gainesville, FL. (Student Competition) ([weivickylee@ufl.edu](mailto:weivickylee@ufl.edu)) [V-10]

Phosphate mineral rock is the starting point of phosphate fertilizer production. It is a nonrenewable resource and will run out in 50 years over the world. United States is the number two producer of phosphate rock in world market, Florida supplies 80% of the P fertilizer for the nation and 20% for the world market. In 25 years, however, Florida's P rock will be depleted. In order to ease this urgent problem, scientists have been working on how to increase the phosphorous use efficiency and crop productivity. Phosphorous use efficiency differs within the species, due to agricultural biodiversity in mobilization of insoluble phosphate, P uptake and utilization efficiency of different varieties. Since most of the soil is rich in insoluble phosphates which tied up by aluminum and iron in low pH soil or by calcium in high pH. In order to reduce the consumptions of P fertilizer, selecting the varieties mobilizing insoluble phosphate effectively will be the first priority. The overall goal of this study is to identify elite genotypes from potato germplasm banks via hydroponics and using tricalcium phosphate as the only P source to limit the P availability in solution. Different Ca<sup>2+</sup> concentrations were applied in hydroponics to further restrain the solubility of phosphate. Plant growth is inhibited while bioavailable P in hydroponics decrease after the increasing of Ca<sup>2+</sup> concentration. The total biomass is reduced 45-55% and root/shoot ratio is increased about 24-50 % while tricalcium phosphate and 30mM Ca<sup>2+</sup> were treated in Russet, red and white potato.

**Effect of Controlled-Release Fertilizer on Tomatoes Grown with Seepage Irrigation in Florida Sandy Soils.** L.C. Carson, and M. Ozores-Hampton, University of Florida/Southwest Florida Research and Education Center, 2685 State Rd. 29 North Immokalee, FL. (Student Competition) ([ozores@ufl.edu](mailto:ozores@ufl.edu)) [V-11]

Florida best management practices include the use of controlled release fertilizers (CRFs), which are soluble nutrients coated with a resin, polymer, sulfur or a hybrid of sulfur and polymer. The purpose of this study was to evaluate three CRF rates with soluble fertilizer on tomato (*Solanum lycopersicum*) yields, petiole nitrate (NO<sub>3</sub>) and potassium (K) concentration and post-harvest fruit quality. The CRF treatments of 100, 150 and 200 plus 50 lb/acre of soluble nitrogen (N) fertilizer (SNF) for total N of 150 (CRF100/SNF50), 200 and 250 lb/acre were compared with IFAS (200 plus 30 lb/acre) and grower standard (250 lb/acre) of SNF pre-plant incorporated, respectively. Tomatoes were planted on 29 Aug. 2011 using polyethylene mulch and seepage irrigation. Petiole NO<sub>3</sub> and K concentrations were above the IFAS sufficiency range for all treatments, except for grower treatment K at 35 days after planting. Soil temperatures ranged from 59.4 to 104.2 °F and averaged 79.1 °F during the trial, which was higher than manufacture claim guaranteed temperatures for N release. There were no differences in extra-large and total marketable yield at first harvest and total extra-large (three harvests combined) among treatments. However, total marketable yield from IFAS, CRF100/SNF50, CRF150/SNF50, and CRF200/SNF50 had greater yields than the grower standard, which ranged from 1,830 to 2,175 25-lb boxes/acre. Grower standards had the lower firmness (higher fruit deformation) than CRF200/SNF50 13 days after harvest (DAH). Treatment CRF100/SNF50 and CRF200/SNF50 had the greatest red color among the treatments 13 DAH. A hybrid system containing a significant portion of CRF plus soluble fertilizer allows for reduced N application with yields similar to IFAS recommended rates.

**Antioxidant Capacity and Isoflavone Content in Seeds of Five Edamame, Vegetable Soybean *Glycine max* (Merrill) Cultivars Grown in Eastern Virginia.** L.C. Carson, University of Florida, IFAS/SWFREC, 2685 SR29 N, Immokalee, FL, J.H. Freeman, Virginia Polytechnic Institute and State University, Eastern Shore Agricultural Research and Extension Center, 33446 Research Drive, Painter, VA, K. Zhou, Department of Nutrition and Food Science, Wayne State University, Detroit, MI, and G. Welbaum, Virginia Polytechnic Institute and State University, Department of Horticulture Sciences, 301 Saunders Hall, Blacksburg, VA. ([ozores@ufl.edu](mailto:ozores@ufl.edu)) [V-12]

Edamame, immature or vegetable soybeans, has received growing attention in the US largely due to its purported health benefits from antioxidants and isoflavones. However, previous studies predominately focused on antioxidant capacity and isoflavone content of fully mature, dry, grain or agronomic soybeans. The purpose of this study was to measure the antioxidant and isoflavone contents of five commercially available edamame cultivars grown in Painter, Virginia in 2008 and 2009. The 2, 2-diphenyl-1-picrylhydrazyl assay results ranged from 24.1 to 46.5 µmol trolox equivalent (TE)/g. 'Midori Giant' and 'Sunrise' in 2008, respectively. In 2009, 2, 2-diphenyl-1-picrylhydrazyl assay results ranged from 13.0 to 18.0 µg TE/g sample for 'Midori Giant' and 'BeSweet2015', respectively. In 2008, oxygen radical absorption capacity assay ranged from 20.4 to 37.2 µg TE for 'Midori Giant' and 'BeSweet2015', respectively; there were no significant differences. In 2009, oxygen radical absorption capacity assay ranged from 26.0

to 40.2 µg TE for ‘Sunrise’ and ‘BeSweet292’, respectively. Total isoflavone content ranged from 144.6 to 529.2 µg/g and 127.2 to 315.5 µg/g in 2008 and 2009, respectively. Malonyl genistin was the most abundant isoflavone. Antioxidant and isoflavone contents varied by year and cultivar. ‘Midori Giant’ had relatively low antioxidant capacity both years, but the highest isoflavone content. ‘BeSweet2015’ and ‘BeSweet2001’ had relatively high antioxidant capacities, but lower isoflavone contents.

**Growing and Marketing Edible Amaranth (Red and Green Calaloo) and Chrysanthemum Greens at Local Green Markets in Southeast Florida, 2002-2003.** K.D. Shuler, P.N. Shuler, and S.J. Shuler Nie, Stephen’s Produce LLC., 12657 158th St N, Jupiter, FL. ([skshuler@aol.com](mailto:skshuler@aol.com)) [V-13]

The growers for Stephen’s Produce grew and marketed edible amaranth, *Amaranthus tricolor* L. and *Amaranthus viridis* L., and chrysanthemum greens, *Glebionis coronarium* var. *spatiosum* L. H. Bailey during the 2002-2003 season to help supply local green markets with a weekend supply of garden fresh produce. Planting schedules, growing and harvesting methods, yields, and sales figures will be discussed. Redleaf calaloo was direct seeded 14 times beginning 14 Sept. and ending 26 Mar. Greenleaf calaloo was direct seeded six times beginning 14 Sept. and ending 7 Nov. Edible chrysanthemum was a late addition to the crop mix and was planted three times beginning 5 Mar. and ending 19 Mar. Calaloo greens were cut, bunched, and sold on 21 weekends from 19 Oct. to 4 May. For redleaf calaloo, an average of 17 bunches were sold each week at \$1.50 to \$2.00 per bunch or \$29 per week and \$610 for the season. For greenleaf calaloo, an average of 14 bunches were sold each week at \$1.50 per bunch or \$17.75 per week and \$107 for the season. Edible chrysanthemum was cut and bagged (90 to 220 g per bag). For edible chrysanthemum, an average of 13 bags were sold each week at \$1.00 to \$2.00 per bag or \$24 per week and \$170 for the season.

**Evaluating benefits from a summer legume to a Sunflower-Camelina Rotation.** D.O. Chellemi, USDA, ARS, US Horticultural Research Laboratory, Fort Pierce, FL. ([dan.chellemi@ars.usda.gov](mailto:dan.chellemi@ars.usda.gov)) [V-14]

In the absence of soil fumigation, crop rotations that mitigate damage from soilborne pests and generate additional revenue are becoming increasingly important for vegetable growers. Rotating tomato with oilseed crops has demonstrated potential, but its economic feasibility is limited by high input costs, particularly nitrogen fertilizer. Jointvetch (*Aeschynomene americana*), an annual legume native to Florida, was grown as a green manure crop in a sunflower-camelina rotation and evaluated for its soil carbon and nitrogen contribution and effect on camelina yield. Treatments were a 67- and 88-day crop of jointvetch and a tillage fallow. Split plots were fertilized with 171 or 71 lbs/acre of nitrogen during the sunflower crop. No fertilizer was applied to the subsequent camelina (‘Suneson’) crop. The quantity of nitrogen and carbon returned to the soil was 182 lbs/acre and 2,514 lbs/acre, respectively, after a 67 day jointvetch crop and 182 lbs/acre and 3,294 lbs/acre, respectively, after an 88 day crop. Yield of camelina seed was significantly higher in plots where jointvetch was grown as a green manure (585 to 630 lbs/acre) when compared to camelina grown in plots with a tillage fallow (403 lbs/acre). Camelina yield was significantly increased when the previous sunflower crop received the full nitrogen application. For comparison, camelina seed yield in a replicated

variety trial planted at the same time in adjacent plots and fertilized with 70 lbs/acre of nitrogen was 656 lbs/acre. The results demonstrate the potential of manure crops and sequential oilseed rotations for minimizing nitrogen inputs in camelina production.

**Methods for Sampling Soil Surface Arthropods in Bush Beans: Which One Is the Best Method?** H.K. Gill, Citrus Research and Education Center, University of Florida, and R. McSorley, Department of Entomology and Nematology, University of Florida, Gainesville, FL. ([harsimrangill.pau@gmail.com](mailto:harsimrangill.pau@gmail.com)) [V-15]

Mulching using organic matter has been shown to reduce the incidence of some insect pests. Experiments were conducted in fall 2007 at the University of Florida Plant Science Research and Education Unit in Citra, FL. The objective was to determine the impact of different mulches on soil surface arthropods and the experiment was conducted using a randomized complete block design with five replications. Three sampling methods (Berlese funnel, pitfall traps, board traps) were used to sample the arthropods. Soil surface arthropods collected using these sampling methods were identified under a dissecting microscope. In Berlese funnel, the total number of taxa collected was always <3, and it was concluded that Berlese funnel is not a practical sampling method for sandy soils in Florida. Thirteen different taxa were sampled using pitfall traps, and only three taxa were collected under board traps. Pitfall traps caught the maximum diversity and therefore were the most effective sampling method compared to board traps and Berlese-funnel methods.

**Combating melon thrips, *Thrips palmi* Karny (Thysanoptera: Thripidae) on vegetable crops in South Florida.** D.R. Seal and C.M. Sabines. University of Florida, Tropical Research and Education Center, Homestead, FL. ([dseal3@ufl.edu](mailto:dseal3@ufl.edu)) [V-16]

The melon thrips, *Thrips palmi* Karny, is a serious pest of various vegetable crops in the southern Florida since its invasion in 1991. It is more abundant on leaves than on fruits and flowers. In the severe instance of infestation, it may cause complete defoliation of the host crops. Presence of one larva on a fruit may cause significant level of feeding damage rendering the fruit unmarketable. Spinetoram (Radiant™, IRAC Group 5, Dow AgroSciences) and its related product provide superior level of control of melon thrips. In order to avoid frequent use of this insecticide, efforts have been made to evaluate other insecticides to control melon thrips on bean (*Phaseolus vulgaris* L), squash (*Cucurbita pepo* L), cucumber (*Cucumis sativus* L.), and pepper (*Capsicum annuum* L.). In the present study insecticides of various chemical classes with diverse mode of action have been evaluated to determine effectiveness in controlling melon thrips. This information will help growers to use insecticides of different modes of action in rotation to avoid development of resistance in melon thrips.

**Assessment of Sting Nematode Management Using Indirect Measures of Strawberry Yield Potential.** J.W. Noling, A.W. Schumann, and M. Cody, University of Florida, Citrus Research and Education Center, Lake Alfred, FL. ([jnoling@ufl.edu](mailto:jnoling@ufl.edu)) [V-17]

Hyperspectral reflectance and plant sizing methodologies were used to characterize and relate relative differences in strawberry crop yields to within row, green vegetative cover. A tractor mounted GreenSeeker optical sensor (NTech Industries; Ukiah, Ca) was used to scan strawberry

rows to provide estimates of green canopy cover (NDVI) against a backdrop of black plastic mulch covering the raised bed. Cumulative differences in plant numbers and relative yield contribution within each of four plant size categories were then statistically compared with NDVI. Plant size categories, measured as average canopy diameter, were dead (0), small (<20 cm), medium (>20 and < 30 cm) and large (>30 cm). Plant stunting and yield losses were well correlated with final harvest soil population density of the sting nematode. Strawberry yields from commercially hand harvested large plots were well correlated with relative yield values determined from plants of different sizes within the plots. Accurate maps of nematode distribution, crop yields and loss indices were related to the intensity of field sampling and spatial resolution describing nematode, crop, or soil characteristic. Assessments of plant size distribution, relative yield, and NDVI were also descriptive of plant growth differences between various alternative to methyl bromide chemical treatments.

**Weed Population Dynamics after Summer Solarization.** R. Seman-Varner and R. McSorley, Department of Entomology and Nematology, University of Florida, Gainesville, FL. ([rmcs@ifas.ufl.edu](mailto:rmcs@ifas.ufl.edu)) [V-18]

Soil solarization, a non-chemical method of soil pest control, has been used to manage insects, nematodes, and weeds in agricultural systems. This study focused on optimizing the duration of solarization for weed management in northern Florida by examining weed coverage, density, and biomass, and by comparing solarization effects on several summer weeds. In the summer of 2003, solarization plots were installed for durations of 2, 4, and 6 weeks concluding on 13 August. After treatment, weed coverage and density were monitored every 2 weeks. All durations of solarization reduced weed coverage compared to non-solarized plots throughout the experiment. Weed densities were 200 times lower in solarized than non-solarized plots at 14 days post-treatment. Even at the conclusion of the experiment (56 days post treatment), population counts were lower in solarized plots, there was no difference in weed density among solarization durations, and there was a 90% reduction in total weed biomass in solarized treatments when compared to non-solarized treatments. *Indigofera hirsuta* and *Cyperus rotundus*, the two dominant species, responded better to 4- and 6-week solarization treatments than to the 2-week treatment.

**Sweet Corn Tolerance and Weed Control of S-metolachlor Applied Preemergence Followed by Various Postemergence Herbicides.** P.J. Dittmar, Horticultural Sciences Department, University of Florida, Gainesville, FL. ([pdittmar@ufl.edu](mailto:pdittmar@ufl.edu)) [V-19]

S-metolachlor is applied preemergence in sweet corn for early season weed control. A postemergence herbicide is required for mid and late season weed control. The objective of this study was to study sweet corn tolerance and weed control of registered postemergence herbicides following S-metolachlor applied preemergence. Postemergence herbicides included carfentrazone at 8.9 g/ha, clopyralid at 8.9 g/ha, fluthiacet at 4.9 and 7.3 g/ha, halosulfuron at 39.9 g/ha, and mesotrione at 106.3 g/ha. Sweet corn 'Fantastic' (*Zea mays* L.) was planted March 30, 2011 at the Plant Science Research and Education Center in Citra, FL. S-metolachlor PRE was applied at 2 days after planting (DAP) and POST treatments were applied 28 DAP. Nutsedge (*Cyperus* spp.), common lambsquarters (*Chenopodium album* L.), and goosegrass [*Eleusine indica* (L.) Gaertn.] were predominate weed species in the field. Sweet corn was

harvested at maturity by hand on June 6 (68 DAP). At 33 DAP, nutsedge control was greatest in plots treated with fluthiacet at 7.3 g/ha (81%) and was similar to halosulfuron (76%). At 40 DAP, halosulfuron had the greatest nutsedge control (88%). At 33 and 40 DAP, halosulfuron and fluthiacet at 7.3 g/ha had greater control than *S*-metolachlor alone. Mesotrione had similar nutsedge control (35% and 25% at 33 and 40 DAP) to the weedy control (0%). At 33 DAP, all herbicide treatments had greater lambsquarters control (40 to 93%) than the weedy control. Lambsquarters control was greatest with fluthiacet at 7.3 g/ha (86%) and was similar to clopyralid (64%) and fluthiacet at 4.9 g/ha (73%). At 33 and 40 DAP, halosulfuron (45 and 43%) and mesotrione (50 and 51%) provided lambsquarters control similar to *S*-metolachlor alone (55 and 25%). Carfentrazone (95%) and fluthiacet at 7.3 g/ha (65%) provided the greatest goosegrass control. At 40 DAP, halosulfuron (40%) and clopyralid (33%) were similar to *S*-metolachlor alone, however, had lower goosegrass control than the other POST herbicides (76 to 90%). Yield was similar among weedfree control and all herbicide treatments ranging 10766 to 24008 kg/ha.

**Can Two-Year Old Synthetic Mulch Affect Marketable Yield, Arthropod Populations, Weeds and Diseases on Field-Grown Strawberries?** T.W. Nyoike, and O.E. Liburd.

Entomology and Nematology Department, University of Florida, P.O. Box 110620, Bldg. 970 Natural Area Drive, Gainesville, FL. (Student Competition) ([nyoiket@ufl.edu](mailto:nyoiket@ufl.edu)) [V-20]

Florida is the second largest producer of fresh-market strawberries (*Fragaria ananassa* Duchesne) in the United States. However, this crop is one of the most expensive to grow due to high costs of production per hectare. There is a possibility of reducing costs of production by re-using the black synthetic mulch for a second crop. We evaluated the effect growing a second crop on a 2-yr old plastic mulch with and without strawberry thatch (old strawberry plant crowns and roots from the previous season) on arthropod populations, disease incidence, plant growth, and marketable yields of strawberries. Two field experiments were conducted in 2010/2011 and 2011/2012 strawberry growing seasons in Citrus County, FL. During transplanting, one treatment had all strawberry thatch removed before planting, while in the second treatment the thatch was left to grow with the new plants. Data were collected throughout the growing seasons on plant growth, spider mites and insect pest populations and marketable yield of strawberries. Results indicated that there were no significant differences in spider mites numbers, insect pests, and natural enemies' populations on strawberry plants growing with and without the thatch. Strawberry plant mortality due to fungal diseases was higher on plants growing with the strawberry thatch in 2011/2012 season. These plants also had significantly lower yields than those without thatch. No significant differences were recorded in marketable yields between the treatments in 2010/2011 growing season. The most common weed was Carolina geranium. Growers can save up to \$3700 per ha by re-using the plastic mulch with the old plants without affecting marketable yields.

**Feasibility Analysis of Using Grafting for Field Tomato Production as an Alternative to Soil Fumigation.** X. Zhao, Horticultural Sciences Department, University of Florida, Gainesville, FL, Z. Gao, Food and Resource Economics Department, University of Florida, Gainesville, FL, and R.C. Hochmuth, Suwannee Valley Agricultural Extension Center, Live Oak, FL. ([zxin@ufl.edu](mailto:zxin@ufl.edu)) [V-21]

Interest in vegetable grafting is increasing recently in the U.S., particularly as a partial alternative to methyl bromide. However, high cost of grafted transplants remains as the major concern for large-scale field production of grafted vegetables. In this field study conducted in fall 2008 at Live Oak, FL, 'Bella Rosa' tomato grafted onto 'Multifort' rootstock was grown in herbicide treated soil in comparison with non-grafted 'Bella Rosa' grown under soil fumigation with methyl bromide:chloropicrin (50:50). Marketable fruit yield did not differ significantly between grafted and non-grafted tomato production. Using the yield and fruit price information and taking into account the costs of soil fumigation and herbicide application, the profits of grafted and non-grafted tomato production were compared. When soil fumigation cost was less than \$1200/acre, grafted tomato production resulted in lower net profit than non-grafted tomato production even when the two types of transplants had the same prices. The advantage of using grafted transplants became more obvious with increasing soil fumigation cost. When soil fumigation cost increased to \$3000/acre, grafted tomato production could remain more profitable than non-grafted tomato production as long as the price difference between grafted and non-grafted transplants did not exceed \$0.30/plant. Cost of preemergence herbicide application had minimal impact on the economic analysis. Although transplant cost is the limiting factor for economic feasibility of grafted tomato production, the use of grafting as a cultural practice deserves more examination given that the cost of grafted transplants may continue to decrease and soil fumigation regulations become more stringent.

**Evaluation of silicic acid on suppression of bacterial spot of tomato.** X. Mo, Y. Fu, X. Fan, and S. Zhang, University of Florida Tropical Research and Education Center, University of Florida, IFAS, Homestead, FL. (Student Competition) ([luckymo1982@ufl.edu](mailto:luckymo1982@ufl.edu)) [V-22]

Bacterial spot of tomato, caused by *Xanthomonas perforans*, is an important disease of tomato in the world. It is a severe threat to tomato production especially in Florida due to the high moist and warm weather which is favorable for disease development. An effective integrated management program would reduce chemical use and ensure economically and environmentally sustainable production of tomato in Florida. The aim of this study was to evaluate the effect of silicon (Si) in suppression of bacterial spot as well as to elucidate the mode of action. Three weeks old seedlings of tomato (cv. 'Sanibel') were transplanted into 6-inch plastic pots containing soil collected from the field at TREC in Homestead, Florida. Two weeks after transplanting, tomato plants were treated once a week for two times with silicic acid at 0.015 mM, 0.15 mM and 1.5 mM by soil drench or foliar applications. One week after last silicic acid treatment, plants were inoculated with *X. perforans* at  $2 \times 10^7$  cfu/ mL by foliar sprays until run-off. Disease severity was rated by estimating the percentage of leaf surfaces with bacterial spot lesions 7 days and 14 days after inoculation (DAI). All treatments with Si at various concentrations significantly ( $P < 0.05$ ) reduced the disease severity of bacterial spot at 14 DAI compared to the nontreated control. Treatment with Si at 0.15 mM by soil drenches at 1.5 mM by foliar sprays reduced disease severity by 58% and 54% respectively, compared to the nontreated

control. Plants were sampled for determining silicon contents before the pathogen inoculation. Si content of roots was significantly higher in tomato plants supplied with Si by soil drench than that in nontreated control plants. Si accumulated in roots, but not in leaves, indicating a silicon-induced resistance against *X. perforans* in tomato plants. Supplying Si to tomato seedlings can reduce the disease severity of bacterial spot could provide an alternative strategy for integrated management of this important disease.

**Growth and Yield of Basil (*Ocimum spp.*) Varieties as Affected by the Downy Mildew (*Peronospora belbahrii*) Under Greenhouse and Field Conditions of South Florida.** Z. Mersha, and S. Zhang, Tropical Research and Education Center, Homestead, FL. ([mershaz@ufl.edu](mailto:mershaz@ufl.edu)) [V-23]

Basil, most popular culinary herb, has been cultivated worldwide since ancient times and it is used as a fresh-cut or dry processed product. In the U.S., the recent discovery of the downy mildew disease (*Peronospora belbahrii*) from south Florida in 2007 has drawn the attention of many stakeholders to contain the spread and to control the disease. In this study, 7 varieties of basil (*Ocimum spp.*) were grown in the greenhouse and under field conditions of Homestead, Florida to evaluate host growth, marketable yield (MY) and disease resistance. The citroderium type ‘Lemon basil’ showed the highest resistance to the disease and a significantly higher MY than the other 6 varieties when grown in the field and harvested 70 days after planting. Disease severity (DS) in the field was > 83.5% for the susceptible varieties ‘Cinnamon’, ‘Genovese’, ‘Large leaf Italian’ and ‘Thai’ compared to 52% of the *purpurascens* type ‘Red rubin’ and 1.9% of ‘Lemon basil’. This disease pressure resulted in a yield loss of 93.1% when the 4 susceptible varieties were compared to ‘Lemon basil’. DS in greenhouse grown ‘Lemon basil’ and ‘Red rubin’ was significantly lower ( $p < 0.0001$ ) than the other 5 varieties but MY from ‘Red rubin’ and ‘Genovese’ was higher than ‘Lemon basil’ when measured 8 days after inoculation. This study demonstrated importance of early protection of popular broad-leafed sweet basil varieties for a successful economic return. It had implications for future breeding efforts of combining the desirable traits of disease resistance to the best yielding and popular basil varieties.

**Reducing *Fusarium* Spp. Inoculum in Irrigation Systems: A Sanitation Case Study in Greenhouse-grown Tomatoes.** E. Toro, Suwannee County Extension, FL, R.C. Hochmuth, Suwannee Valley Agricultural Extension Center, UF, C.L. Harmon, Extension Plant Disease Clinic and Department of Plant Pathology, and E. Belibasis, Beli Farms, Wellborn, FL. ([etoro@ufl.edu](mailto:etoro@ufl.edu)) [V-24]

*Fusarium* spp. fungi cause several serious diseases in tomato in Florida, notably Fusarium wilt and crown rot. The fungus persists in soil and crop debris and requires intensive efforts to eradicate propagules on field and greenhouse equipment and implements. Samples of greenhouse-grown tomatoes from Suwannee County were diagnosed with Fusarium wilt by the UF-IFAS Plant Disease Clinic in Gainesville, FL, in 2009. The plants were grown in coconut fiber-filled lay-flat plastic bags and irrigated by drip emitters at the top of the media. All components of the irrigation system were reused with each new crop and thus were suspected of contributing to the perennial Fusarium disease occurrence. Upon confirmation of the problem, additional samples of irrigation stakes were obtained and tested for *Fusarium* spp. *Fusarium* spp. were isolated from inside the plastic tubing and the planting media trapped in the ridged

shape of the irrigation stakes. Subsequent samples of irrigation stakes were collected and subjected to six sanitization regimens including pressure-washing with and without soaking in sanitizing solutions. We found that washing the stakes to remove planting media and plant debris prior to treatment with any sanitizing solution reduces the inoculum to below detectable levels. Although preliminary, this testing indicates that incorporation of this simple and low-cost step into sanitation protocols may reduce carry-over of *Fusarium* disease inoculum from one crop to subsequent crops.

**Potential Spread of *Phytophthora cactorum* from Tailwater Ponds and Irrigation Sources in Commercial Strawberry Fields.** M.S. Oliveira, T.E. Seijo, and N.A. Peres, Gulf Coast Research and Education Center, University of Florida, 14625 CR 672, Wimauma, FL. ([nperes@ufl.edu](mailto:nperes@ufl.edu)) [V-25]

Strawberry fields in Florida are severely affected by *Phytophthora* crown rot, an important disease caused by *Phytophthora cactorum*. This pathogen is spread by water. A current trend in Florida agriculture to conserve water is to irrigate with surface runoff water (tailwater) recovered in retention ponds and canals. However, dissemination of plant pathogens in irrigation water may be aggravated by the increasing use of recycled water. This project investigated whether the use of recycled water could increase the incidence of *Phytophthora* crown rot in commercial strawberry fields. Six collections of water were made at four different strawberry farms. Each sample was filtered at 200 ml, 100 ml, 50 ml and 20 ml and all the filtrations were plated into P<sub>5</sub>ARPB media. DNA extractions, PCR amplifications and enzymatic digestions were made from the colonies which were isolated on the P<sub>5</sub>ARPB media. There were 85 colonies that looked like *P. cactorum* morphologically, but after the digestion, the presence of the pathogen could not be confirmed. Apparently, the main source of contamination of strawberry with *P. cactorum* is infected transplants from the nursery rather than irrigation water.

**Management of Lettuce Downy Mildew with Fungicides.** R.N. Raid, and D. Sui, University of Florida, Everglades Research and Education Center, Belle Glade, FL. ([rnraid@ufl.edu](mailto:rnraid@ufl.edu)) [V-26]

Incited by the obligate parasite *Bremia lactucae*, downy mildew is one of the most devastating diseases of lettuce worldwide. Attempts to manage this disease using host-plant resistance have frequently failed due to the development of new races of the pathogen. Therefore, chemical control is of the utmost importance in humid areas where environmental conditions are very favorable for disease development. Numerous fungicide field trials have been conducted in south Florida on both muck and sandy soils over the past several years with definitive results. Of currently registered compounds, mandipropamid (Revus) and fenamidone (Reason) have repeatedly provided for the highest levels of control, with no significant difference between the two. Presidio (fluopicolide), dimethomorph (Forum), dimethomorph plus ametoctradin (Zapro), cyazofamid (Ranman), and propamocarb (Previcur Flex) have also provided significant control. With regards to new chemistries, the experimental compound V-10208 has looked very promising when applied foliarly. As a group, the aforementioned fungicides represent a wide array of different modes of action, meaning that they may be alternated or tank-mixed with other fungicides in a program to prevent fungicide resistance. This is indeed fortunate, as lettuce downy mildew has developed insensitivity in the past. With potassium phosphites and the broad spectrum EBDC fungicide mancozeb holding lettuce registrations,

lettuce growers now have a wide selection of fungicides for managing this important disease. However, prevention and cultural practices, such as destroying old crop debris, should also be part of the program.

### **Management of Celery Early Blight Using Conventional and Low-risk Chemistries.**

R.N. Raid and D. Sui, University of Florida, IFAS, Everglades Research and Education Center, Belle Glade, FL. ([rnraid@ufl.edu](mailto:rnraid@ufl.edu)) [V-27]

Early blight, caused by *Cercospora apii*, is the most serious disease of celery in Florida. Two field experiments were conducted during the 2011/2012 growing season to investigate the efficacy of conventional fungicides and chemistries that are considered “low-risk”, primarily plant activators (Systemic Acquired Resistance or SARs) in combination with copper or biofungicides. Both experiments were randomized complete block designs with four replications of 12 treatments. In comparing conventional fungicides, two strobilurin fungicides, pyraclostrobin (Cabrio and Headline) and azoxystrobin (Quadris), provided high levels of disease control, particularly when applied in premixture with carboximide (Merivon and Priaxor) or sterol inhibiting (Quilt) fungicides. In the low-risk trial, three plant activators, acibenzilar (Actigard), anthraquinone (Regalia), and taminarin (Vacciplant), provided significant suppression by themselves when applied on a 9-10 day schedule, but blight management was significantly enhanced when topped with foliar applications of copper fungicides (Kocide 3000 and Phyton 27) or the biopesticide *Bacillus subtilis* QST713 (Serenade Max). Treatment of celery with two foliar applications of the foliar materials per week provided significantly better control than those receiving only weekly applications. Although providing significant control, none of the low-risk treatment combinations provided control equal to that provided by the strobilurin/carboximide premixture Pristine. It is important to note that activators were applied prior to disease onset and no phytotoxicity or yield drag was observed.

**Evaluation of natural extract products for control of powdery mildew on squash.** S. Zhang, Tropical Research and Education Center, University of Florida, IFAS, Homestead, FL. ([szhang0007@ufl.edu](mailto:szhang0007@ufl.edu)) [V-28]

Powdery mildew of squash, caused by *Sphaerotheca xanthii*, is an important disease in the United States and worldwide. Although many fungicides have been registered for control of this disease, management of resistance to fungicides in populations of this pathogen remains a major challenge. Regalia SC, an extract from giant knot weed and HMO 736, an extract from seaweed were evaluated alone or in alternation with the conventional fungicide triflumizole (Procur 480SC) for their efficacy against powdery mildew on squash under greenhouse and field conditions in Florida. In greenhouse assays, Regalia SC alone significantly ( $P < 0.05$ ) reduced the severity of powdery mildew compared to the water-treated control, and in four out of five trials was as effective as triflumizole, the standard fungicide treatment. HMO 736 alternated with triflumizole statistically improved disease control over triflumizole alone and the water-treated control in three repeated experiments. More interestingly, Regalia and HMO 736 showed improved efficacy when alternated with triflumizole in one of the greenhouse experiments. In field trials conducted on squash in Homestead, applications of Regalia alone and HMO 736 significantly reduced powdery mildew severity during the early stage of disease development, but not during later stages when disease pressure was high. Both Regalia SC and HMO 736 in

alternation with triflumizole improved the control of powdery mildew over triflumizole alone. This study demonstrated that a management program based on the biopesticides Regalia SC or HMO 736 integrated with triflumizole was sufficient to control powdery mildew on squash in Florida.

## **ORNAMENTAL, GARDEN AND LANDSCAPE SECTION**

**Growth of Ornamentals in Containers Shaped like a Star.** K. Moore, N.C. Ripak, L. Fisher, University of Florida, Fort Lauderdale Research and Education Center, 3205 College Ave, Fort Lauderdale FL 333314. ([klock@ufl.edu](mailto:klock@ufl.edu)) [OGL-1]

One of the concerns when growing ornamental plants in traditional round containers is circling roots. Three experiments were conducted to compare the shoot and root growth of different ornamental species in traditional round pots and in containers shaped like a five point star. In experiment 1, live oak (*Quercus virginiana*) and scrub oak (*Quercus ionpina*) shoot growth was similar between the two container styles but root growth was in the star containers than the round containers. Similarly, *Hibiscus rosa-sinensis* shoot growth was similar between the containers but root growth was greater in the star containers. Finally *Dieffenbachia* sp and *Philodendron* sp shoot growth showed the same trend as previously noted. *Philodendron* root growth was greater in the star containers but there was no difference in *Dieffenbachia* root growth between the containers. The next phase of this research will be to investigate the transplant success of plants grown in the star containers.

**Root Manipulation Strategies for Improving the Quality of Container Stock and Tree Sustainability in the Landscape.** M. Orfanedes, Broward County Extension Education, UF. ([morfanedes@broward.org](mailto:morfanedes@broward.org)) [OGL-2]

In the aftermath of the busy 2004 and 2005 hurricane seasons, interest in improving the quality of root systems in trees has grown exponentially. This development was borne out of an increasing realization that the fate of trees in the landscape is determined in part by the quality of their root systems, both during production and for the life of the trees once they have been installed in the landscape. Research conducted in Florida and in other tree production areas has shown that root defects in young trees can often be easily corrected so long as recommended practices are put into place early on and root system quality is monitored closely. Likewise, longevity of trees in the landscape can often be improved if quality trees are planted properly and if recommended follow-up maintenance practices are implemented. This presentation explores some common root defects that are present in container production operations and in the landscape. It also reviews specific recommended practices for remediating such trees with the overall goal of improving their quality and longevity.

**Sources and Survival of *Colletotrichum acutatum* Spores and Their Significance for Fern Anthracnose Management.** D.J. Norman and J.O. Strandberg. ([djn@ufl.edu](mailto:djn@ufl.edu)) [OGL-3]

Fern anthracnose, incited by *Colletotrichum acutatum*, is a highly contagious disease in commercial ferneries causing immature fronds of Leatherleaf fern [*Rumohra adiantiformis* (Forst.) Ching] to become unsuitable for floral use. This research quantifies inoculum

populations, defines factors relating to spore longevity and survival and identifies sources that could disseminate primary inoculum or spread secondary inoculum in commercial ferneries. Spores of *C. acutatum* were found to survive up to 36 days on the surfaces of leatherleaf fronds and up to 49 days in leaf debris associated with the soil surface. These spores can function as secondary inoculum sources in ferneries. Temperatures were found to affect both spore survival and germination of these secondary sources of inoculum. Results from tests designed to mimic spore survival on equipment showed that spores could survive up to 42 days on metal, rubber, or wood surfaces and could function as a major mechanism of spread. Significant differences in spore counts on clothing were found following harvesting activities under wet and dry foliage conditions.

**Fancy-leaved Caladium Varieties Recently Introduced by the UF/IFAS Caladium Breeding Program.** Z. Deng, University of Florida, IFAS, Environmental Horticulture, Gulf Coast Research and Education Center, 14625 County Road 672, Wimauma, FL. ([zdeng@ufl.edu](mailto:zdeng@ufl.edu)) [OGL-4]

Florida supplies more than 95% of the caladium tubers used in the United States and some 40 foreign countries in the world. Fancy-leaved caladium varieties account for the majority of the caladium tubers Florida growers produce. Developing new fancy-leaved varieties has been a priority breeding objective for the UF/IFAS's caladium breeding program. Toward this objective, six new fancy-leaved varieties have been released since 2008. 'Tapestry' (large pink-blotches), 'Strawberry Star' (white with red spots), 'Royal Flush' (red center with green margins), and 'Berry Patch' (green with purple spots) have different leaf colors or coloration patterns, but they all have shown much improved sun burn tolerance and landscape performance. They are suitable for growing in large containers and sunny or shady locations in the landscape. 'Cranberry Star' and 'Summer Pink' were selected for their novel coloration patterns (bright white leaves with green veins and numerous purple spots, or pink face, pink main veins against a white background) and produce attractive plants when forced in containers. These two varieties have shown sensitivity to sun burns, and they are more suited for growing in shady locations for best color display.

**Scheduling of Flowering and Fruiting of Southern Highbush Blueberry as a Container Ornamental Plant.** J.E. Lopez and P.R. Fisher, UF/IFAS Department of Environmental Horticulture, Gainesville, FL. ([pfisher@ufl.edu](mailto:pfisher@ufl.edu)) [OGL-5]

There is increasing market interest in blueberry as a container ornamental plant with intact flowers or fruits for retail sales to home owners. The objective was to manipulate cultural conditions with southern highbush blueberry cultivars in order to control flower and fruit development and extend the marketing season. 'Emerald', 'Gulf Coast', and 'Sunshine Blue' from 72-count tissue-culture liners were planted into 15-cm-diameter pots with peat-perlite substrate at UF Main Campus, Gainesville, FL. on 15 July 2011 and 16 June 2010 for Emerald. "Natural flowering" plants in an unheated plastic-covered hoop house flowered on 18 Jan. 2012, 27 Jan. 2012, and 9 Dec. 2011 for 'Emerald', 'Gulf Coast', and 'Sunshine Blue', respectively, with maximum open flower number of 20, 25, or 152 flowers/ plant for the three cultivars. These results were consistent with previous trials where 'Sunshine Blue' was an early and very floriferous cultivar and illustrated that market season extension can be achieved by growing

different cultivars. A late pinch on 15 Nov. 2011 delayed flowering, and also reduced flower number. Night interruption lighting from 25 Sept. to 15 Nov. 2011 delayed flowering by 4 to 5 weeks without reducing flower number. Night interruption lighting combined with 26 °C day/ 15 °C night air temperature from Jan 10 onwards accelerated flowering by 2 to 3 weeks. Moving plants from the natural environment to a cooler at 2 °C with a 9-hour photoperiod from 10 Jan. to 6 Mar. 2012 delayed flowering, indicating potential to hold flowering plants for late sales.

**Effects of Preemergence Herbicides on Perennial Peanut Establishment.** R.H. Stamps, UF/IFAS, Dept. of Environmental Horticulture, Mid-Florida Research and Education Center, Apopka, FL. ([rhs@ifas.ufl.edu](mailto:rhs@ifas.ufl.edu)) [OGL-6]

Low-growing perennial peanuts are being used as groundcovers in landscapes. Because it takes time for the plants to fill in ground beds and become very competitive with weeds, there is a need to find preemergence herbicides that can help control weeds during the establishment period. Three relatively new granular herbicides (Biathlon, FreeHand and Snapshot), each containing two active ingredients with different mechanisms of action, were applied to newly planted perennial peanut cultivars *Arachis glabrata* 'Ecoturf', *A. pintoi* Golden Glory, and *A. glabrata* 'Brooksville 67'. Another herbicide (active ingredient indaziflam), not yet labeled for use on ornamentals, was also applied. Plants were monitored for visual symptoms of acute phytotoxicity and chronic toxicity was determined by estimating the percentage of the plots that were covered with perennial peanut foliage (ground cover establishment). Plots were hand-weeded weekly to remove any weed competition that might affect the growth of perennial peanuts. The herbicide treatments were applied three times. The only treatment that caused significant acute phytotoxicity and reduced the establishment of perennial peanuts was indaziflam. Under the conditions of this experiment, Biathlon, FreeHand and Snapshot did not inhibit the establishment of perennial peanut groundcover.

**New and Improved Potting Soils for Ornamental Crops of Florida.** R.T. McMillan, Jr., Kerry's Nursery, Inc. B. Jacobson, Berger Peat Moss Ltd., Québec, Canada. [OGL-7]

The ornamental plant industry, comprising decorative plants, shrubs, bushes, and trees is the single largest segment of the county's agricultural industry. In the 2010-2011 crop season Berger's potting soils BM6 PBH-Rice Hull, BM6 15% Perlite and BM4 Euro were compared with CORE plus pine bark, Peat, Peat w/15% Perlite, Pinstrup. Test crops were Colored Aglaonema, Ferns, Pathos, Ivey, and Christmas Cactus. All of the Berger soils outperformed the comparison potting soils with more root mass, root hairs, foliage, and better leaf color. The cutting loss ratio in the Ivy trial was shown to be sticking 18 cuttings and ending up with less than 15 surviving in the comparison potting soil. The plants potted in BM 4 Euro consistently had root mass that held the potting soil tightly making transplanting easier. The Colored Aglaonema cutting rooting trial of BM4 Euro compared with CORE plus Pine Bark showed that the BM2 Euro significantly had 80 to 90 percent more root mass, rooted faster, leaf numbers of 8 to 9 as compared with 4 to 5 in the CORE plus Pine Bark and were ready for transplanting one to two weeks earlier. Cutting loss ratio in the Aglaonema trial was 10 to one in the comparison potting soil. Faster rooting time has the side benefit of reducing the need for preventative fungicide drenches. Cost analyses are discussed.

**Sustainable Production Resources for Container Plant Nurseries.** A. Bolques<sup>1</sup>, G. Knox<sup>2</sup>, L. Landrum<sup>3</sup>, and M. Chappell<sup>4</sup>. <sup>1</sup>Florida A&M University/Cooperative Extension, Gadsden County Extension, Quincy, FL <sup>2</sup>UF/IFAS, North Florida Research Education Center, Quincy, FL, <sup>3</sup>UF/IFAS North Florida Research and Education Center, Live Oak, FL, <sup>4</sup>University of Georgia, Athens, GA. ([abol@ufl.edu](mailto:abol@ufl.edu)) [OGL-8]

Sustainable production practices are methods that conserve or reduce natural resources needed to produce a crop. A team from the University of Georgia, Florida A&M University and University of Florida compiled and developed resources for Extension faculty to help move the container nursery industry towards sustainability. An advisory committee of existing nursery producers assisted in developing and revising resources and curriculum to result in effective, "real-world" tools for county Extension faculty and their clientele. Sustainable production topics include reducing the levels of chemical fertilizers and pesticides; managing insects, diseases and weeds by utilizing an integrated pest management approach; reducing, reusing or recycling materials and supplies; increasing production efficiency; and using conservation practices aimed at reducing water consumption, managing runoff and controlling erosion. Resources for Extension faculty include a website, publications, PowerPoint presentations and a series of short videos illustrating sustainable practices filmed at selective nursery operation site visits in Florida and Georgia. The long-term goal of this project is to enhance the environmental sustainability of nursery production while maintaining economic sustainability.

**Florida's Green Industries Best Management Practices Education Program.** L.E. Trenholm, Environmental Horticulture Dept., UF, D.P. Rainey, Florida-Friendly Landscaping™ Program, UF. ([letr@ufl.edu](mailto:letr@ufl.edu)) [OGL-9]

The Green Industries Best Management Practices (GIBMP) Educational Program was developed for commercial lawn care providers in Florida in 2002. The training covers plant selection, fertilization, irrigation, and pesticide practices as well as regulations covering the industry. Class attendees who received a score of 75% or better on the post test are awarded a "Certificate of Completion" in the BMPs. For the period from 2003 through June 2010, 6700 workers were certified in the BMPs. Pre and post test scores indicated that average knowledge increase from the training ranged from 15.9 to 23.7%. Follow up surveys indicated that attendees made some practice changes, including increased use of slow release nitrogen (N), leaving untreated buffer zones around water bodies, and increased soil testing. It is difficult at this time to assess if this program has caused a reduction in nitrate or phosphorus levels in ground or surface waters resulting from lawn and landscape fertilization.

**FAWN Interactive Landscape Irrigation Tool.** W.R. Lusher, and K.W. Miglaccio. ([rlusher@ufl.edu](mailto:rlusher@ufl.edu)) [OGL-10]

A new interactive irrigation tool has been developed for homeowners, irrigation professionals, and others for investigating different irrigation schemes using site-specific irrigation system specifications and real-time data from the Florida Automated Weather Network (FAWN) stations located around the state of Florida. The tool combines user input, simple water balance calculations, and real-time FAWN data to provide the user with information on either how much excess water the lawn received – as a combination of irrigation and rainfall - or how many days

the lawn experienced water stress, i.e., too little water. All results of the tool are provided to the user via a weekly email, with results based on calculations from the previous week. This interactive tool as well as other FAWN data and tools are organized and available free of charge on the FAWN web site (<http://fawn.ifas.ufl.edu>).

**Social Marketing Promotes Adoption of Green Industry Best Management Practices.** S. Haddock. Hillsborough County Extension Service, UF. ([szcrmchz@ufl.edu](mailto:szcrmchz@ufl.edu)) [OGL-11]

The Green Industries Best Management Practices (GI-BMP) certification training focuses on the negative environmental effects of non-point source pollution resulting from nutrient run off and leaching from urban landscapes. The program teaches practicing proper landscape and irrigation design, using correct landscape inputs, integrated pest management and having reasonable performance standards with the ultimate goal of preserving water quality and quantity. A survey of horticulture professionals showed the need for additional reinforcement of how the environmental conditions of the sites managed and landscape maintenance practices contribute to non-point source pollution. Some horticultural professionals are reluctant to change practices due to a fear of losing clients in difficult economic times and resentment of regulations requiring certification. A social marketing campaign was designed to focus on the effects of non-point source pollution and encourage attitude and behavioral change that benefit the environment and promote horticultural professionalism.

**The Difficulties Of Watering Your Lawn While Conserving Water.** L. Felter, Orange County Extension, UF, P.F. Monaghan, Dept. of Agricultural Education & Communications, UF. ([lfelter@ufl.edu](mailto:lfelter@ufl.edu)) [OGL-12]

Orange County, Florida is facing a looming water crisis. The St. Johns River Water Management District has determined that the county, which includes metropolitan Orlando, will reach the limit of its consumptive use permit in 2013 and no additional groundwater withdrawals will be allowed. The largest waste of potable water is in the landscape, specifically on the lawn. Homeowners can't keep up with home owner association demands and do not understand the maintenance needs of their yards or the technology of their irrigation system. The most common response for homeowners is to set their irrigation timer and forget it, not making adjustments based on rainfall or the needs of the lawn. Traditional public education programs used by County Extension offices face a daunting task when confronted with these complicated behaviors and attitudes. Several classes were held. Participants were taught about how much water, when to water and the efficiency of irrigation heads. Each class had 15 irrigation clocks all functioning. Participants worked in small groups based on the type of clock they had at home. All participants touched the clock and made adjustments. Pre-test of knowledge score was 20 percent out of 100 and the post test score was 85 percent, a 65 percent gain in knowledge. Results of the pre-test and post- test prompted the use of a survey called Your Florida Yard and You. The goal is to understand how Floridians think about their yards and care for them. Survey data will be discussed.

**Use of Petrifilms to Quantify Aerobic Bacteria in Irrigation Water.** D.P. Meador and P.R. Fisher, UF/IFAS Department of Environmental Horticulture, M.Teplitski, UF/IFAS Department of Soil and Water Sciences, Gainesville, FL. ([dmeador@ufl.edu](mailto:dmeador@ufl.edu)) (student presentation) [OGL-13]

A protocol was developed using Petrifilms™ (3M, St. Paul, MN) to quantify density of aerobic bacteria in irrigation water as an easy-to-use onsite monitoring technique. To validate this method, quantification of colony-forming units (CFU) of aerobic bacteria in one mL (CFU·mL<sup>-1</sup>) of recirculated irrigation water was compared between Petrifilm and standard culture media, with 18 subsamples of 300 mL and 9 log dilutions. The Petrifilm is a dehydrated medium containing guar gum, xanthan gum, nutrients and triphenyl tetrazolium chloride on a card with a plastic cover. The comparison method used was APHA Standard Methods (#9215C.6c) for Heterotrophic Plate Count, using Spread Plate Method with R2A media. Substrate (Petrifilm or R2A) and measurement day (3 or 7) and their interaction were significant (p<0.0001) with ANOVA. Estimated CFU·mL<sup>-1</sup> (x 10<sup>4</sup>) using the Petrifilms increased from 52.2 at measurement day 3 to 84.6 at day 7, whereas use of the R2A substrate resulted in higher values of 71.2 at day 3 or 149.3 at day 7 (standard error= 4.0). Comparison of the estimated CFU·mL<sup>-1</sup> by each method for all samples and measurement dates resulted in a linear regression equation of R2A= 1.60±0.06 (gradient±standard error) x Petrifilm, with an intercept parameter not significantly different from zero, p<0.0001, and adjusted-R<sup>2</sup>=0.92). Results indicated that the Petrifilm provides a valid substrate for quantifying bacterial density in irrigation water, although a calibration curve is needed to interpret results compared with R2A.

**Effectiveness of Rain Garden/Bioretention to Mitigate Nutrient and Zinc Contaminants in Surface Runoff in an Urban and an Agricultural Setting.** A. Bolques<sup>1,2</sup>, J. Cherrier<sup>2</sup>, and M. Abazinge<sup>2</sup>, <sup>1</sup>Gadsden County Extension, <sup>2</sup>School of the Environment, Florida A&M University, Tallahassee, FL. ([abol@ufl.edu](mailto:abol@ufl.edu)) [OGL-14]

Rain garden and bioretention systems are stormwater management practice used to manage and treat stormwater runoff. They are designed to capture, retain, or detain directed surface flows into a plant-based system to encourage soil infiltration of water and pollutant removal via plant root uptake and biogeochemical processes. Rain gardens are easy to install, inexpensive, sustainable, aesthetically pleasing in residential landscapes, and are typically smaller than bioretention systems, which are better, suited for larger runoff volume from non-residential areas. An urban and an agricultural rain garden/bioretention systems, one on the campus of Florida A&M University and the other at a container plant nursery were evaluated for their effectiveness to mitigate NH<sub>4</sub><sup>+</sup>, NO<sub>2</sub><sup>-</sup>, NO<sub>3</sub><sup>-</sup>, TN, PO<sub>4</sub><sup>3-</sup>, Total Zn and Dissolved Zn from stormwater and irrigation runoff at pre and post exposure intervals from a planted and non-planted gardens. 38, 38, 58, 42, 68 and 7 percent reduced nutrients in the agricultural site for NH<sub>4</sub><sup>+</sup>, NO<sub>3</sub><sup>-</sup>, TN, PO<sub>4</sub><sup>3-</sup>, Total Zn, and Dissolved Zn, respectively and 57, 5, 38, and 61 for NH<sub>4</sub><sup>+</sup>, NO<sub>2</sub><sup>-</sup>, NO<sub>3</sub><sup>-</sup>, and TN in the urban site. Rain garden/bioretention systems are increasingly being used to address surface runoff management and water quality concerns for receiving water bodies to lessen the amounts of dissolved pollutants in runoff thereby reducing harmful algal blooms, improving aquatic environments and promoting healthier riparian corridors.

**Soil Profile Variability in an Established Residential Community.** D.P. Rainey University of Florida/IFAS Extension Agent II, Sarasota, FL. A.L. Shober and G. Shurberg, Soil & Water Science Department University of Florida/IFAS Gulf Coast REC, Wimauma, FL. ([drainey@ufl.edu](mailto:drainey@ufl.edu)) [OGL-15]

Urban soils have highly variable chemical, physical, and biological properties than undisturbed natural soils. Landscape cultural management practices including mowing, supplemental fertilization and irrigation practices may alter urban soil properties and functionality. The objective of this study was to demonstrate physical and chemical spatial variability of soils collected from established (>10 years) residential yards. Yards were sampled in the Rivendell Estates community, constructed in phases between 1998 and 2003, in Osprey, Sarasota County, Florida. Undisturbed soils were collected from Oscar Scherer Park, which borders Rivendell Estates on the east and south. Deep core samples were collected to a depth of 48 in from 16 ornamental landscape beds and two park locations using a bucket auger. Bulk density and composite soil samples were collected at a depth of 0 to 6 inches from lawn and landscape plant beds at 48 residential units and four park locations. Composite soil samples were analyzed for pH, electrical conductivity, organic matter, total Kjeldahl N, ammonium-N, nitrate-N, and Mehlich 3 P and K. Significant chemical and physical differences were identified between the residential soils and the undisturbed park soils (mapped as EauGallie and Myakka fine sands) when examining deep core samples. Significant building phase effects on measured soil properties were identified. This is due to the use of different fill materials used at the time of development and landscape management practices since establishment of the landscapes. Our goal is to use the information from this study to influence soil management practices in future residential landscapes.

**Introducing Pomegranates to the Dooryard.** K. Stauderman, UF/IFAS Volusia County Extension, DeLand, FL and W. Castle, UF/IFAS Citrus Research and Education Center, Lake Alfred, FL. ([kstauderman@co.volusia.fl.us](mailto:kstauderman@co.volusia.fl.us)) [OGL-16]

Recent record breaking freezes and citrus disease outbreaks have resulted in loss of dooryard citrus trees in Volusia County landscapes. Interest has increased from individuals looking for alternative plants to meet the demand of edible fruit trees in the landscape. The UF research and extension team responded by providing educational opportunities to Volusia county homeowners, master gardeners and commercial-scale operations on the establishment of pomegranates as an ornamental tree and/or edible fruit in the dooryard. Educational opportunities included news articles, newsletters, seminars, a public broadcasted television program, radio interviews and a fact sheet on basic establishment and aesthetic appeal of pomegranates. 400 pomegranate trees (30 varieties) were produced at the UF-IFAS Citrus Research and Education Center in Lake Alfred, FL as part of an on-going project by W. Castle, professor emeritus, to evaluate pomegranate potential in Florida. The planting locations in either the dooryard or a commercial site of the 400 pomegranate trees sold from the program were recorded on a Volusia County map. All of the 400 trees were sold with future orders exceeding 125 trees. \$2400 in proceeds of the tree sale provided funds for the county 4-H youth program. Evaluation data through show of hands showed that 98% (n=85) participants increased knowledge relating to the establishment of pomegranate trees. All 400 trees were successfully planted in Volusia County

dooryards. Popularity generated from this program sparked the need for further production by two nurseries in the central Florida area to meet the demand.

**Backyard Composting.** L. Barber, Hillsborough County and UF IFAS Extension.  
([labarber@ufl.edu](mailto:labarber@ufl.edu)) [OGL-17]

The current economy and renewed interest in home gardening has increased opportunities to teach Backyard Composting basics to Hillsborough County residents. Participants (n=1,298) increased their knowledge and commenced on-site composting of landscape clippings and kitchen scraps. Florida-Friendly Landscaping™ staff taught thirty-eight educational Backyard Composting workshops in 2011. Tours of the compost demonstration area were included in the training. Various composting bins were in use and on display with pros and cons discussed. Eighty-seven percent of survey respondents began composting after workshop participation and 48% had finished compost within 3-6 months. Fifty-two percent are using finished compost as a soil amendment; 32% as a potting mix. Pre- to post-workshop knowledge gain reflected a 58% increase. Heightened knowledge of Backyard Composting procedures (proper mixture of carbons and nitrogens, bin type and size, appropriate moisture level, aeration, finished and unfinished compost uses) resulted in significant increases in Backyard Composting, recycling on-site and cost savings from using created soil amendments versus purchasing them.

**Creating a Teaching Garden with Florida-Friendly Landscaping™ Principles**  
L. Barber, Hillsborough County Extension. ([labarber@ufl.edu](mailto:labarber@ufl.edu)) [OGL-18]

The Bette S. Walker Discovery Garden, located in the courtyard of the Hillsborough County and UF-IFAS Extension Service, was created to provide dynamic, small gardens demonstrating environmentally friendly design and management techniques of the Florida-Friendly Landscaping™ Program. An overall plan was created based on the order of construction phases with the assistance of a Master Gardener engineer and the conceptual plan created by a landscape architect. Products were selected based on pervious vs. impervious surfaces, utilization of recycled products, microirrigation, organic mulch and plant materials that were drought-tolerant and site selected. Master Gardener volunteers were the major labor force. Docent and self-led tours were a frequent occurrence as were speaker system taped environmental messages. The most significant lesson to be learned by garden visitors (n=6,500+ to date) was the benefit of choosing Florida-Friendly, drought-tolerant plants that require minimal water, fertilizer and pesticides to help reduce the overall effects of non-point source pollution and stormwater runoff. Visitors liked the plant signage, organic mulches displayed, landscape design and maintenance ideas and have made Florida-Friendly changes in their home landscapes. Creating a construction plan while utilizing Florida-Friendly Landscaping principles has positively affected Tampa Bay by providing homeowners with examples they can experience in person and implement in their own yards after visiting the garden and attending our educational programs.

**Bismarck Palms Failing in Southwest Florida.** R.E. Mitchell, Charlotte County, UF.  
([ralph.mitchell@charlottefl.com](mailto:ralph.mitchell@charlottefl.com)) [OGL-19]

Growing up to fifty feet tall, the magnificent palm known as the Bismarck palm, *Bismarckia nobilis*, has become a popular and successful landscape palm throughout Southwest Florida.

Planted as an accent specimen in many landscapes, beautiful silver-blue Bismarck palms have towered over other plantings to the pride of homeowners. However, over the past several years, there has been an increasing amount of Bismarck palms suddenly failing. All of these deaths have been observed in large mature Bismarck palms of ten to twelve years old and associated with infestations of Palmetto weevils, *Rhynchophorus cruentatus* Fabricius. Speculations on why these failures occurred have included cryptic cold damage related to several years of below normal winter temperatures, possible nutrient deficiencies or other unknown factors that predisposed these palms to attack by opportunistic Palmetto weevils. A brief observational study of some of these failures, both in Charlotte County and in surrounding counties, provided an overview of possible factors and variables that attributed to an abnormally significant rash of Bismarck palm deaths.

**Rugose Spiraling Whitefly: A sticky situation in the Florida Keys.** K.E. Gabel, University of Florida, Monroe County Extension Service, 1100 Simonton Street, Suite 2-260, Key West, FL. ([gabel-kim@monroecounty-fl.gov](mailto:gabel-kim@monroecounty-fl.gov)) [OGL-20]

In the Florida Keys, the Rugose Spiraling Whitefly (*Aleurodicus rugioperculatus*) has become a sticky situation that is frustrating homeowners, landscapers, businesses and governmental officials. The Monroe County Extension Agent has applied different educational and control methods for dealing with this new insect pest. Educational approaches have followed traditional Extension methods, such as: speaking on the radio, disseminating information through the internet, educating and utilizing the Master Gardeners, conducting site visits and holding workshop presentations Keyswide. Some non-traditional approaches have included presentations at City and County Commission meetings; developing an evaluation control method tip sheets for people to use to determine how effective or ineffective their control treatments are; and advising local college and high school students in developing a whitefly presentation and tri-folder brochure for use at the Key West Botanical Garden. Control methods being developed or tested by the Agent include an applied research experiment using aerated vermicompost tea as a root drench or a foliar spray to determine its' effectiveness on controlling the Rugose Spiraling Whitefly; and rearing and releasing the beneficial wasp, *Encarsia guadalupae* and predatory beetle, *Nepasphis oculata* on public right-of-ways and public parks.

***Colletotrichum sansevieriae* Causing Anthracnose of *Sansevieria trifasciata* 'Laurentii' and 'Moonshine' in South Florida.** E.V. Campoverde, UF/IFAS Miami-Dade County Extension. 18710 SW 288<sup>th</sup> Street. Homestead, FL 33030 and A.J Palmateer, UF/IFAS Tropical Research and Education Center. 18905 SW 280<sup>th</sup> Street Homestead, FL 33030. ([evcampoverde@ufl.edu](mailto:evcampoverde@ufl.edu)) [OGL-21]

Sansevieria (snake plant) is known to be an easy plant to grow and can be seen throughout the South Florida landscape as ground cover. Its attractive foliage makes it a popular choice for the interiorscape. During mid to late summer of 2010, several ornamental nurseries submitted diseased samples of Sansevieria to the Florida Extension Plant Diagnostic Clinic, Homestead, FL. Infected plant leaves were covered with circular water-soaked lesions that rapidly enlarged and coalesced resulting in severe leaf blight. Characteristic brownish black acervuli were observed on lesions and maintained on Potato Dextrose Agar (PDA) Sequences of the rDNA internal transcribed spacer (ITS) region of two isolates (GenBank Accession Nos. JF911349 and

JF911350) exhibited 99% nucleotide identity to an isolate of *C. sansevieriae* (GenBank Accession No. HQ433226). Pathogenicity of sequenced isolates was evaluated in greenhouse experiments. Twelve-week-old Sansevieria plants were inoculated with conidial suspensions ( $1 \times 10^6$  conidia/ml) of *C. sansevieriae*. Inoculum or autoclaved water was sprayed over the foliage until runoff. Four plants of each of two cultivars were sprayed per treatment and the experiment was repeated twice. Inoculated plants were placed in a greenhouse at 29°C with 70 to 85% relative humidity. Within 10 days of inoculation for both cultivars. No symptoms developed on the control plants. Foliar lesions closely resembled those observed in the affected nurseries and *C. sansevieriae* was consistently re-isolated from symptomatic tissue. It was determined that this disease must be managed preventatively and local nurseries discarded hundreds of thousands of plants due to the disease outbreak.

**Invasion of new insect pests in southwest florida: Four new Ficus pests; is this the end of a previously invincible landscape plant? Plus a new species of plant bug damages florida privet.** D.L. Caldwell, Collier County Extension Service, Institute of Food and Agricultural Sciences, University of Florida, 14700 Immokalee Road, Naples, FL 34120. ([dougbug@ufl.edu](mailto:dougbug@ufl.edu)) [OGL-22]

Both the Cuban-laurel (*Ficus microcarpa* [or *retusa*]) and the weeping fig (*Ficus benjamina*) now have insect pests which can cause major defoliation or worse. Previously, Ficus species were low maintenance, bullet proof plants. The Cuban-laurel is attacked by a small wasp (*Josephiella* sp.) which arrived in 2007. It causes leaf galls and subsequent defoliation. *Ficus benjamina* is under attack from these new pests: a leaf-roll thrips (*Gynaikothrips uzeli*) arrived from southeast Asia in 2003; in 2008 the eye-spot leafminer midge (*Horidiplosis ficifolii*), which is a rather inconspicuous fly arrived in 2008; a major pest, the ficus whitefly (*Singhiella simplex*) arrived in the Naples area in January 2009; and in December 2011, Bondar's nesting whitefly (*Paraleyrodes bondari*) was discovered. A new species of plant bug (*Tropidosteptes forestierae*) was found defoliating a large hedge of the native Florida privet (*Forestiera segregata*: Oleaceae). Information on the biology and impact of these new pests are discussed.

**Google Survey Tool – Free and Easy.** L. Barber, Hillsborough County Extension. ([labarber@ufl.edu](mailto:labarber@ufl.edu)) [OGL-23]

Utilize a survey tool that is easy for the creator and user, furnishes a comprehensive summary of the surveys, including graphs and charts, and provides impacts and outcomes needed for ongoing reporting. Several survey tools were evaluated including those used in the past. Many were challenging in the creation process; some allowed others to change the survey or delete it, resulting in rework and frustration. All Florida-Friendly Landscaping staff have utilized the Google Survey tool and found it to be the most user-friendly. Surveys can be created in a short amount of time with emails generated from Google Survey or Extension staff. More completed surveys were received utilizing Google Surveys than when other survey tools were used. Google survey cannot be deleted or changed by others inside or outside of the organization. It provides an excellent summary of survey results, simplifying the processes used by many agents and staff. The Google survey tool is a very effective, no cost, easy to use technology for county agents who need to capture programmatic results.

## **HANDLING AND PROCESSING**

**HPLC-Fluorescence Analysis of Phytochemicals in Healthy and HLB Symptomatic Hamlin and Valencia Orange Leaves.** John A. Manthey, USDA-ARS-U.S. Horticultural Research Laboratory, Ft. Pierce, FL., Faraj M. Hijaz, Jose R. Reyes-De-Corcuera, Svetlana Y. Folimonova, Craig L. Davis, Shelley E. Jones, Citrus Research and Education Center, Lake Alfred, UF. [HP-1]

Huanglongbing (HLB), putatively caused by the phloem-limiting bacterium *Candidatus Liberibacter asiaticus* (Clas), represents a potential threat to a major portion of the U.S. citrus crop. Efforts to find early-occurring marker compounds, other than by PCR analysis, remain unfulfilled, but yet have provided important information about phytochemical changes associated with this disease. As part of this effort to detect marker compounds, HPLC-fluorescence detection was used to analyze the secondary metabolite profiles of sweet orange (*C. sinensis* L.) leaves following the progression of HLB in greenhouse-grown trees. Such studies provided the detection of a large number of fluorescent compounds in both healthy and HLB-affected leaves, primarily including hydroxycinnamates, coumarins, and polymethoxylated flavones. Numerous other fluorescent compounds were also detected, but little is currently known of their chemical structures, although additional UV/Vis and mass spectra analysis has added to their preliminary characterizations. To better characterize the hydroxycinnamates, coumarins, and polymethoxylated flavones in the orange leaf extracts, fluorescence emission and excitation spectra were recorded for known compounds in these three classes of compounds. Also determined were the detection parameters (i.e. emission and excitation wavelength maxima and minimum detection limits) for known standards. Real time fluorescence spectra of a number of the unknown compounds in the healthy and HLB-affected orange leaves closely resembled the spectra of these known standards. Of particular interest was the observation that during the progression of HLB in the Clas-infected trees, there were significant increases in the levels of early- and mid-eluting hydroxycinnamates. This observation complements similar findings obtained with HPLC-MS instrumentation with these same leaf samples.

**Reference gene selection, primer design and amplification interference of quantitative real-time PCR in tomato and orange subjected to environmental and disease stress.** Jinhe Bai, Elizabeth Baldwin, USDA, ARS, US Horticultural Research Laboratory, Ft. Pierce, Hui-ling Liao, Igor Kostenyuk, Jacqueline Burns, Lake Alfred Citrus Research and Education Center and Mike Irely, US Sugar Corp., Clewiston, FL. [HP-2]

Response of gene expression in the oxylipin pathway to chilling and heating in tomatoes at full ripe stage was investigated. Total RNA was isolated from tomato pericarp tissue, and gene expression of *Tomlox A-Tomlox D*, *HPL* and *ADH* were determined by real-time PCR using the SYBR Green PCR kit, and expressed as  $\Delta\Delta_{CT}$  in comparison to the reference controls, *GAPGH* and *RPL8*. The widely used reference gene *GAPGH* was more stable than *RPL8* in the postharvest stress research. Primer PCR efficiencies of the genes were determined using a 100-fold dilution series of a bulked complementary DNA (cDNA) sample over three dilution points, and the results showed that primers designed using Primer Express 3.0 (Applied Biosystems) had higher efficiency over other primer design programs in the ABI PRISM 7500 Sequence Detection Fast System. For orange research, total DNA was extracted from Huanlongbing

infected fruit juice. Citrus cytochrome oxidase (COX) was selected to represent host gene, and 16S rDNA was selected to represent the pathogen bacteria, *Candidatus Liberibacter asiaticus* (CLAs). Amplification of 16S rDNA was inhibited by unknown PCR enzyme inhibitors presented in the DNA extraction. However, the inhibitors were removed by passing through a silicon spin column. A multiplex qPCR of COX and CLAs 16S DNA showed that the amplification of CLAs 16S DNA was inhibited by COX in an ABI PRISM 7500 FAST sequence detection system.

**The Effect of Nutritional Spray Regimes on Orange Juice Quality in Relation to Juice Las DNA Detection.** Elizabeth Baldwin, Jinhe Bai, Anne Plotto, Sharon Dea, Jan Narciso, USDA, ARS, US Horticultural Research Laboratory, Ft. Pierce and Mike Irey, US Sugar Corp., Clewiston, FL. [HP-3]

Huanglongbing (HLB) has been spreading statewide in Florida. Removal of infected trees is the most effective way to control spread of the disease. However, under the current decreasing production trend (annual production down from 220 million boxes before two severe hurricane seasons in 2004 and 2005 to currently less than 140 million boxes) it is difficult to remove more trees for any reason. Thus, many growers have set up their management strategy on two major practices: reducing psyllid populations with insecticides, and applying a nutritional spray program to alleviate HLB tree symptoms. As a result, more and more fruit for juice extraction will be HLB infected. Orange juice processed from symptomatic HLB infected fruit have been associated with bitter taste and/or off-flavor. However, there is no single indicator that can be used to predict quality loss of juice due to HLB. Furthermore, it is unknown how nutritional sprays influence fruit and juice flavor. The objectives of this research are to determine how quantitative real-time PCR (qPCR), one of the most reliable HLB diagnostic methods can be adapted to detect the HLB supposed pathogen DNA in juice, and then how nutritional spray regimes influence juice quality and qPCR results. ‘Hamlin’ and ‘Valencia’ orange trees with or without HLB infection were sprayed with three different nutritional formulations: Keyplex, wet powder or the Maury Boyd cocktail. The fruit were harvested and processed using a commercial juicer. The samples were analyzed using instruments for sugars, acids, limonoids, and volatiles, and evaluated by sensory panels for the aroma and taste, and qPCR for the pathogen bacteria population. The results showed that juice processed from symptomatic HLB fruit contained more of the bitter compounds, limonin and nomilin, and was perceived by the panel as bitter, astringent, grapefruit-like, sour, metallic, earthy, or simply “flat”. The pathogen population detected by qPCR was higher in HLB symptomatic fruit. Juice processed from asymptomatic fruit had less off flavor and lower pathogen population. Fruit grown under the nutritional spray programs had lower pathogen population and less off flavor problems, especially for ‘Hamlin’ fruit which is more susceptible to HLB induced off flavor.

**Citrus Black Spot Detection Using Hyperspectral Imaging.** D.Q. Kim, T.F. Burks and M. A. Ritenour, Gainesville, UF. [HP-4]

The marketability of fresh Florida citrus is being threatened by yet another disease in addition to canker and citrus greening, namely citrus black spot. Citrus black spot (CBS) reduces fruit production and quality exhibiting symptoms that include hard spot lesions, virulent spot, cracked spot, and false melanose, appearing on the fruit surface which make the fruits unacceptable for

fresh market. Significant trade barriers are in place to prevent the spread of CBS. Therefore it is imperative to identify fruits that are infected with CBS prior to distribution. This article presents the development of a hyperspectral imaging approach for the identification of fruits infected with citrus black spot. Hyperspectral images of fruit samples infected with black spots along with other common peel conditions, such as greasy spot, wind scar, melanose, and market quality, were collected using a hyperspectral imaging platform. Hyperspectral image processing and analysis techniques, Spectral Angle Mapper (SAM) and Spectral Information Divergence (SID), were used to classify the fruit samples into two categories as either black spot or non-black spot. Results showed that black spot detection accuracy for the two approaches were virtually the same with SAM achieving 97.90% accuracy, and SID achieving 97.14% accuracy. Consequently, results demonstrate the potential for hyperspectral classification of CBS under laboratory conditions, which may lead to real-time packingline detection of citrus black spot.

**Comparative Effects of Postharvest Fungicides for Diplodia Stem-end Rot Control of Florida Citrus.** Jiuxu Zhang, Florida Department of Citrus, Lake Alfred. [HP-5]

*Diplodia* stem-end rot caused by *Diplodia natalensis* is one of the most important citrus postharvest diseases in Florida. Fungicide application is an important measure to effectively control *Diplodia* stem-end rot. In this study the activities of new postharvest fungicides azoxystrobin (AZY), fludioxonil (FLU) and pyrimethanil (PYR) for *Diplodia* stem-end rot control were evaluated and compared both *in vitro* and *in vivo* to those of existing fungicides imazalil (IMZ) and thiabendazole (TBZ). All fungicides inhibited the mycelial growth of the fungus on PDA, and varied in their activities. The ED<sub>50</sub> of FLU, TBZ, IMZ, PYR and AZY against the fungus was estimated at 0.01, 0.15, 0.79, 1.12 and 102.69 ppm, respectively. The decay control efficacy tests of the fungicides were conducted on Fallglo tangerine hybrids and Pineapple oranges using dipping, drenching and packingline spraying application methods. At three weeks of fruit storage at 21°C after fruit treatments with aqueous fungicides at 1,000 ppm by three separate tests, TBZ, IMZ and FLU that reduced the decay by 73.5 to 96.7% were much more effective than PYR and AZY which reduced the disease by 17.4 to 67.0%. TBZ performed better than or similarly to IMZ and FLU. PYR performed similarly to AZY. The duration of effective decay control by these fungicides were different. Overall studies indicate that TBZ, IMZ and FLU, but not AZY and PYR, are effective for *Diplodia* stem-end control on Florida citrus.

**Continuing the Search for an Effective Preharvest Fungicide with Residual Postharvest Diseases Control for Florida Fresh Citrus.** Mark A. Ritenour, Cuifeng Hu, Indian River Research and Education Center, Fort Pierce, UF and Jan Narciso, USDA, ARS, Horticultural Research Laboratory, Fort Pierce. [HP-6]

A series of six studies were conducted between 2009 and 2011 on ‘Fallglo’ or ‘Sunburst’ tangerines and ‘Marsh’ or ‘Ruby Red’ grapefruit to evaluate the effectiveness of compounds applied preharvest for reducing postharvest decay. These continue studies that have been conducted in this lab almost annually since 1999. Commercially mature fruit were harvested two or three different times (2 – 28 days) after application, degreened when necessary, washed, waxed (carnauba; without fungicide), and then stored at near ambient conditions between 72 and 80 °F (22.2 – 26.7 °C). Relative humidity was not controlled during two of the studies, but was

maintained around 90% during the others. As in previous years, preharvest application of benomyl (Benlate) or thiophanate-methyl (Topsin) usually resulted in significantly less decay after storage compared to the control (unsprayed) fruit. Unfortunately, these two materials are no longer available for use on citrus. Other materials evaluated included fludioxonil (Scholar), cyprodinil + fludioxonil (Switch), chlorothalonil (Bravo), pyraclostrobin (Headline), hydrogen peroxide (HDH Peroxy), and peroxyacetic acid (VigorOx). Not all materials were used in each test. Results using Switch or Scholar were mixed with significantly less postharvest decay developing in some tests, whereas other tests showed no effect. Treatments with Bravo, Headline, HDH Peroxy, or VigorOx were not significantly different from the control in the three experiments where they were tested. Even though materials containing fludioxonil occasionally reduced postharvest decay, none of the materials appear to be consistent replacements for Benlate or Topsin.

**Mycotoxins in Fruit and Fruit Products.** D.C. Lewis, R. Goodrich-Schneider, Food Science and Human Nutrition Department, UF. ([truth8@ufl.edu](mailto:truth8@ufl.edu)) [HP-7]

The term ‘mycotoxin’ is generally associated with secondary metabolic toxic products of filamentous fungi to which humans and animals can be exposed, most often through ingestion. This exposure can result in a range of toxicities (acute to chronic), and a spectrum of effects (mild to severe) including carcinogenicity and death. The history of mycotoxicoses has been long and dramatic, including a cereal-associated outbreak of ergot contamination that is thought to have catalyzed the unfortunate events known as the Salem Witch Trials. While many significant mycotoxins are associated with grain-based food products, fruit and fruit products can also be affected. Patulin, a mycotoxin produced by many *Penicillium* spp., is a known hazard in the apple juice industry where its levels are under regulatory control (no more than 50 ppb in apple juice). Orange juice and fermented fruit beverages such as wine are also susceptible to mycotoxin contamination from *Fusarium* and *Aspergillus* spp., respectively. Other fruits support the growth of mycotoxin-producing fungi, although specific conditions that lead to the production of mycotoxins are not well-elucidated. Inconsistencies in reports and lack of survey data on the prevalence and level of mycotoxins in fruit products makes the risk assessment of mycotoxins in fruit products challenging.

**Thermal Inactivation of Stationary Phase, Acid and Non Acid Adapted *Salmonella* Gaminara in Single-Strength Orange Juice.** Z. Topalcengiz and M.D. Danyluk, Lake Alfred Citrus Research and Education Center, UF. (Student Competition) ([zeynal84@ufl.edu](mailto:zeynal84@ufl.edu)) [HP-8]

Thermal inactivation parameters of stationary phase, acid and non-acid adapted pathogens, primarily as cocktails of multiple strains, have been studied in various juice products. The objective of this study was to evaluate the heat resistance of stationary phase and acid adapted *Salmonella* Gaminara in orange juice. *Salmonella* Gaminara from an orange juice outbreak was evaluated. The strain was grown in TSB, supplemented with 1% glucose for acid adaptation, and inoculated (ca.  $10^9$  CFU/ml) into single-strength pasteurized orange juice without pulp. Juice was sealed into microcapillary tubes. Tubes were immersed into water baths at 55, 58, and 60°C, removed at predetermined time intervals, and placed immediately onto ice. Thermally treated and sterilized tubes were crushed in 0.1% peptone using sterile glass rod for microbiological analysis. *Salmonella* populations were enumerated on a tryptic soy agar

supplemented with 0.1% sodium pyruvate. Linear regression equations were used to calculate D-values. D-values for acid adapted and non-adapted *Salmonella* Gaminara at 55, 58, and 60°C are  $0.91 \pm 0.04$  and  $0.83 \pm 0.06$  min,  $0.32 \pm 0.09$  and  $0.35 \pm 0.14$  min,  $0.15 \pm 0.29$  and  $0.15 \pm 0.30$  min, respectively. A comparison of D-values by the students t-test indicate acid adapted *Salmonella* Gaminara has a higher D-value at 55°C than non-adapted *S. Gaminara*. However, non-adapted cells are more heat resistant at 58°C. No differences are seen between acid adapted and non-adapted strains at 60°C. Currently, all available D-values for *Salmonella* in orange juice were obtained using strain cocktails. Evaluation of individual strains using the microcapillary tubes will allow understanding of strain to strain variability that may impact public health.

**Effect of Abscission Agent on Citrus Juice Quality, Year 2.** M.D. Danyluk, L.M. Friedrich, and T.M. Spann, Lake Alfred Citrus Research and Education Center, UF. [HP-9]

The abscission agent CMNP (5-chloro-3-methyl-4-nitro-1H-pyrazole) is being evaluated for use in combination with mechanical harvesting to aid in citrus harvesting. This study evaluates the standard juice quality and microbiology of fruit harvest following the application of CMNP and during storage for up to 7 days to determine if CMNP application has any effect on these parameters. Results presented here are year two of a three year study. Two Hamlin and two Valencia trials were harvested in 2011 and 2012 for testing. Fruit were divided into treatment groups and stored for up to 7 days. Treatment groups included storage at 10, 20, 30°C and ambient conditions. Within each group, non-defective fruit were randomly selected and enumerated for total counts, total acidophiles and *Alicyclobacillus* spp. Fruit were juiced by hand and °Brix, Acid, %oil, and color was determined. Results continue to follow the trends established during the 2010-2011 season. Application of CMNP does not appear to alter juice quality or microbiology during postharvest storage of fruit for up to 7 days.

**Chronic Consumption of Red Orange Juice Significantly Decreased Blood Pressure and Improved the Serum Lipid Profile in Adults.** C. G. Lima, L. G. Basile, J. Q. Silveira, T. B. César. Faculty of Pharmaceutical Sciences, São Paulo State University, Araraquara, São Paulo, Brasil, Paulista University (UNIP), São José do Rio Preto, São Paulo, Brazil. [HP-10]

This study had as objective investigates the effect of the chronic consumption of the red orange juice on the nutritional status, lipid, hemodynamic and inflammatory profiles in adults residents in the cities of Araraquara, SP, Brazil and Matão, SP, Brazil. The variety of red pulp orange is also known as Mombuca blood orange, and its color is due to the carotenoids, especially from beta-carotene and lycopene. The study included 19 men and 16 women, which received 750 mL/d of pasteurized red orange juice during 8 weeks. It was evaluated in all subjects: weigh, height, skin folds (triceps, biceps, subscapular and suprailiac) and waist circumference. Biochemical parameters were accomplished for total cholesterol, HDL cholesterol, apolipoproteins A1 and B, C reactive protein, homocysteine, triglycerides and glucose. For hemodynamic assessment were observed systolic and diastolic blood pressure and dietary evaluation was estimated using 24h food record. All evaluations were accomplished before and after consumption of red orange juice. The results showed that the consumption of red orange juice decreased total cholesterol by 9%, LDL-cholesterol by 11%, apo B by 5% and the C reactive protein by 49%. Systolic blood pressure was reduced 4% among eutrophic participants and the diastolic blood pressure reduced 4% among the pre-obese participants. There was no

significant reduction on anthropometric variables. Consumption of red orange juice increased 10 folds the intake of vitamin C and double the intake of folate for all volunteers. Regular consumption of red orange juice has shown hypolipidemic, hypotensive and anti-inflammatory properties.

**The Effect of Orange Juice on Nutritional Status, Inflammation and Oxidative Status of Patients with Chronic Hepatitis C.** Thaïs B. Cesar, Delfina A. Manjate, Ana Lúcia M. Nasser, Paulo I. Costa, São Paulo State University (UNESP), Faculty of Pharmaceutical Sciences, Araraquara, SP, Brazil, Angela A. Costa<sup>2</sup>, Walter M. Figueiredo, University of Sao Paulo (USP), School of Public Health, Araraquara Special Health Service (SESA). [HP-11]

According to the World Health Organization (WHO) approximately 3% of the world population is infected by the hepatitis C virus (HCV) and about 3 to 4 million of individuals are infected every year. Chronic infection for the HCV increases reactive oxygen species (ROS) and inflammation on the liver parenchyma that can lead to cirrhosis, liver failure and hepatocellular carcinoma. High level of vitamin C and citrus flavonoids in the blood can help inactivate ROS, protect cellular components from the liver damage and stimulate the production of interferon, anti-inflammatory cytokines and proliferation of T lymphocytes, among other positive effects. The greatest sources of vitamin C and citrus flavonoids in the human diet are citrus fruits, especially orange juice. This study is aimed to evaluate the nutritional, biochemical and oxidative status of patients with chronic hepatitis C infection. All patients were using hepatitis C drugs (Pegylated Interferon and Ribavirin) and they were invited to consume daily 500 mL of orange juice for eight weeks. Before and after the orange juice experimental period, they were evaluated for dietary, anthropometric, biochemical parameters. The results showed that regular intake of orange juice did not change the nutritional status, but reduced cholesterol (TC and LDL-C) and lipid peroxidation (TBARS) and increased antioxidant capacity on blood serum (DPPH). Furthermore it was detected a significant decrease of C reactive protein (CRP) showing a reduction on the liver's inflammation.

**Active packaging for control of post harvest disease.** Jan Narciso, Jinhe Bai, Anne Plotto and Elizabeth Baldwin, USDA/ARS US Horticultural Research Lab, Ft. Pierce. [HP-12]

Active packaging (or intelligent or smart packaging) refers to packaging that is used with products to extend shelf life, maintain freshness and improve safety and convenience. The term active designates functions beyond the inert passive containment and protection of the product. Active packaging is becoming more common as quality expectations change and consumers are less tolerant of fresh foods with chemical residues or preservatives. Previous studies on active packaging at the Citrus and Subtropical Products Research Unit were twofold; one, to remove any remaining bacteria in small cankers on canker infected citrus and prolong shelf life of fresh citrus, and two, to extend the shelf life of small fruits (i.e. blueberries and strawberries). These goals were selected as field packed small fruits do not have a sanitizing and cleaning step and active packaging could have a place in maintaining freshness and reducing decay. For citrus, as fruit from canker infected groves cannot be included in international markets for fear of carrying viable bacteria in the peel, active packaging would eradicate any bacteria and make the fruit safe to ship. Also, presence of antimicrobial in packing boxes of non-diseased citrus would maintain freshness for a longer period. Studies with active packaging utilized a novel form of crystalline

chlorine dioxide. This compound was slow release and maintained a low level of antimicrobial gas in the clamshell (container) and significantly reduced decay in strawberries and blueberries. Experimental fruit was also fresher and of higher quality than the controls. For the cankered fruit, data from cankered fruit samples in containers with the chlorine dioxide show that no canker causing bacteria was isolated from the fruit peel, even from fruit that had aggressive cankers going into the experiment. Citrus fruit stored with chlorine dioxide in the packing boxes had a longer storage life than control fruit. Studies are ongoing to use similar packaging for cut fruit.

**Adoption of Plastic Field Crates to Reduce Mechanical Injuries in Postharvest Handling of Haitian Mango.** Arthur J. Bonicet, Steven A. Sargent and Arthur Teixeira, Gainesville, UF. (Student Competition) ([abonicet@ufl.edu](mailto:abonicet@ufl.edu)) [HP-13]

One of the best factors that motivate the buying decision of any consumer is the appearance of the product. And, the final objective of any grower is to meet the requirements of the buyer and/or consumer. So, from the field to the retail store, postharvest scientists are constantly doing research in order to extend the quality of the commodities. In Haiti, since the 1980's, new technologies have been introduced in the packinghouses in order to export fresh mangos that meet the requirements of the importer, and the final consumer. But, in the field the growers are still using traditional methods to produce and to handle the harvested fruits. As a consequence, the rejection rate is dramatically high. Actually, the most common method is to load and transport fruits from field to a collection point by donkey or mule, where a truck picks them up for transport to the packing facility. The most common method for carrying mangos to the collection center is a handcrafted woven bag made of palm strips that do not permit regular circulation of air and allow the fruits to be damaged: by, compression, impact vibration and by heat produced by high respiration rate. The USAID-WINNER Project of Haiti supports current research projects in the postharvest area with the goal of increasing grower income and reducing the watershed's degradation to finally improve the living conditions of people located in its intervention areas. In fact, last year the project provided more than 1500 plastic field crates to different growers associations. Those crates are actually used to transport fruits from the collection points to the packinghouses and to significantly reduce losses due to mechanical injuries. The objective of this research is to evaluate reductions in mechanical injuries for mangos carried in plastic field crates using a pack frame as compared to traditional woven bags. The preliminary results have shown that the use of the plastic crate instead of woven bag to transport fruit from the field to the collection point reduced losses due to mechanical injuries from 41% to 19%. More research is needed to confirm the usefulness of the new transport methods to significantly reduce postharvest losses.

**Gas chromatography – olfactometry analyses of volatiles produced by Fallglo and US Early Pride mandarins.** Clotilde Leclair<sup>1</sup>, Alice Biotteau<sup>1</sup>, Greg McCollum<sup>2</sup>, Jinhe Bai<sup>2</sup>, Liz Baldwin<sup>2</sup>, Christian Chervin<sup>1</sup>, Anne Plotto<sup>2</sup>. <sup>1</sup>ENSAT/ENFA, Toulouse, France. <sup>2</sup>USDA, ARS, Fort Pierce, FL. (Student Competition) [HP-14]

'Fallglo' is a popular tangerine cultivar grown in Florida with about 12,000 acres of commercial production. 'Fallglo' has high eating quality, but may contain as many as 30-40 seeds per fruit, a trait undesirable to consumers. 'US Early Pride' is an irradiation-induced mutant of 'Fallglo'

which has fruit quality attributes of similar to 'Fallglo', but averages only 1.8 seeds per fruit. Results of consumer panel evaluations indicate that 'Fallglo' was perceived to have greater tangerine flavor than did 'US Early Pride'. In the current study our objective was to determine if 'Fallglo' and 'US Early Pride' fruit differ in the composition or quantity of flavor volatiles produced over times representing the commercial harvest window (Oct. to Dec.). Segments of the same fruit served to consumer panelists were juiced and used for gas chromatography (GC-O) study using the Osme method. Two trained panelists smelled the GC effluent in triplicate runs and rated the odor intensity of aroma-active peaks on a 0-10 sliding scale while giving a descriptor. Gas chromatographic and olfactometry profiles were similar for the two cultivars. The average number of aroma-active peaks for each run was  $21 \pm 2$ . The same peaks (characterized by their retention time, odor description, and intensities) were present in both varieties. For peaks with fruity-floral, green-grassy and citrus-fruity characteristic, intensity was higher for 'Fallglo' than for 'US Early Pride'. When comparing harvests, peak intensities increased for both cultivars as a function of harvest date, especially at the last harvest. For 'Fallglo', more than half of the peaks were perceived with a higher intensity, especially an herbal-plastic, a fruity-floral, a fruity-sweet, a green-fatty, and a citrus peak. For 'US Early Pride', the intensity increased with harvest date for 35% of the peaks, especially for an herbal-plastic and a citrus peak. Differences between 'Fallglo' and 'US Early Pride', even slight, may explain why 'Fallglo' was perceived with greater tangerine flavor than 'US Early Pride' by consumer panelists.

#### **A Comparative Study of Fallglo Tangerine and Its Seedless Mutation: Sensory Evaluation.**

Alice Biotteau, ENSAT/ENFAT, Toulouse, France, Clotilde Leclair, Greg McCollum, [Anne Plotto](#), USDA, ARS, US Horticultural Research Laboratory, Fort Pierce. [HP-15]

'Fallglo' is an early-maturing attractive colorful tangerine cultivar that has been grown commercially in Florida since the 1990s. In spite of its high eating quality, it also has many seeds, which may be not so desirable for consumers. 'US Early Pride' is an irradiated-induced mutant of 'Fallglo'; it combines many quality attributes of 'Fallglo', but has very few seeds: 1.8 seeds per fruit in comparison with 'Fallglo' which may have 30 to 40 seeds per fruit. 'Fallglo' and 'US Early Pride' from the same grove were compared in a consumer taste panel biweekly during the harvest season (Oct. to Dec.). Fruit were washed, sanitized, peeled and segments were separated. Half of the segments were mixed in a bowl to present random samples to 55-60 untrained panelists. The other half of each fruit was juiced and analyzed for soluble solids content (SSC) and titratable acidity (TA). Panelists were asked to taste the two samples and indicate which sample they preferred; a follow up questionnaire had them indicate the reasons for preferring one sample over the other. Results show that there was no preference between 'Fallglo' and 'US Early Pride' at any of the four sessions. 'US Early Pride' was perceived as having less seeds, but this was not the only reason why it was preferred. Either sample could be perceived sweeter, more sour or having more tangerine flavor, depending on panelist and on session. Differences between samples for SSC and TA were only measured on the first harvest (Oct. 26), with 'Fallglo' having greater SSC and TA than 'US Early Pride'. Differences in SSC/TA were seen only on the second harvest (Nov. 3), with 'Fallglo' having greater SSC/TA than 'US Early Pride'. This explained that 'Fallglo' was perceived as being sweeter on that session.

**Prevention of Cold Storage Damage in Apple and Pear Fruits by Low Oxygen Atmosphere or 1-MCP Pretreatment.** Edna Pesis Department of Postharvest Science, The Volcani Center, Bet Dagan 50250, ISRAEL. [HP-16]

For many crops, low-temperature storage results in oxidative stress and chilling injury, caused by increased production of superoxide anions which in turn leads to the generation of other dangerous reactive oxygen species (ROS). Application, prior to cold storage at 0°C, of 0.5% low-oxygen (LO<sub>2</sub>) atmosphere for 10d at 20°C or 500ppb 1- methylcyclopropene (1-MCP) for 20°C, was effective in reducing superficial scald in ‘Granny Smith’ apple. Moreover, LO<sub>2</sub> pretreatment was also effective in preventing bitter pit development in Californian ‘Granny Smith’ and Israeli ‘Starking’ apples. The LO<sub>2</sub> and 1-MCP -treated fruit exhibited lower levels of ethylene, alpha farnesene and its oxidation product, 6-methyl-5-hepten-2-one (MHO), as determined by SPME/GC-MS technique. In addition, LO<sub>2</sub> pretreatment applied to Californian ‘Bartlett’ or Israeli ‘Spadona’ pears, was effective in reducing superficial scald, senescent scald and internal breakdown, after 4 months of cold storage at 0°C. Confocal laser-scanning microscopy and H<sub>2</sub>O<sub>2</sub> measurements of apple peel, revealed high accumulation of ROS in control fruit, while low amounts were found in LO<sub>2</sub> and 1-MCP-treated fruit. Gene-expression of ROS-scavenging enzymes was up-regulated by the various pretreatments: *catalase* (*CAT*) was induced by LO<sub>2</sub> treatment, whereas *Mn superoxide dismutase* (*MnSOD*) was induced by 1-MCP treatment. We propose that LO<sub>2</sub> and 1-MCP-pretreated fruit remained healthier due to reduced production of ethylene and ROS, such as MHO, during cold storage.

**Fate of *Escherichia coli* O157:H7 and *Salmonella* on Full Ripe and Three-quarter Ripe Strawberries.** Thao Nguyen, and Michelle Danyluk, Lake Alfred Citrus Research and Education Center, UF. (Student Competition) ([thaonguyen4@ufl.edu](mailto:thaonguyen4@ufl.edu)) [HP-17]

Strawberries harvested at or near full ripe maturity, for superior eating quality, tend to be more susceptible to bruising during harvest and transport, possibly increasing food safety risks. The objective of this research was to quantify *Escherichia coli* O157:H7 and *Salmonella* populations on bruised and intact strawberries at full or ¾ red maturity, at shipping and retail display temperatures. Strawberries were bruised by dropping a 32.6 g steel ball into a 23 cm PVC pipe onto a strawberry. A five-strain cocktail of rifampicin-resistant *E. coli* O157:H7 or *Salmonella* (20 µl; ca. 10<sup>7</sup> CFU/ml), was spot inoculated onto bruised or non-bruised surfaces. Strawberries, stored at 2°C and 15.5°C, were sampled at 0, 2, 5, and 24 h and days 0, 1, 3, and 7, respectively. Populations were enumerated on selective and non-selective media supplemented with rifampicin. Populations of *E. coli* O157:H7 and *Salmonella* decreased under all experimental conditions. At 2°C, *E. coli* O157:H7 populations decreased by 1.1 and 1.0 log CFU/berry over 24 h on bruised and intact full red strawberries and by 1.0 and 1.1 on bruised and intact ¾ red strawberries, respectively. *Salmonella* populations decreased by 0.9 and 1.1 log CFU/berry over 24 h on bruised and intact full red strawberries and by 0.4 and 1.1 log CFU/berry on bruised and intact ¾ red strawberries, respectively at 2°C. At 15.5°C, *E. coli* O157:H7 populations decreased by 1.8 and 1.6 log CFU/berry over 7 days on bruised and intact full red strawberries and by 1.5 and >1.6 on bruised and intact ¾ red strawberries, respectively. *Salmonella* populations decreased by 2.0 log CFU/berry over 7 days on both bruised and intact full red strawberries and by >2.4 and 1.4 log CFU/berry on bruised and intact ¾ red strawberries, respectively at 15.5°C. There were no significant differences (p<0.05) in *E. coli* O157:H7 populations at 2 or 15.5°C

and for *Salmonella* at 2°C, for any treatment. At 15.5, some significant differences ( $P < 0.05$ ) in *Salmonella* populations occurred on day 3. The current practice of harvesting strawberries with at least  $\frac{3}{4}$  red color, whether bruising occurs or not, does not likely impose any additional food safety risks.

### **Colour and Pigment Development of Mature-green Tomatoes Treated with Hot-water.**

Francisco E Loayza, Jeffrey K Brecht and Amarat H. Simonne, Horticultural Sciences Dept., Gainesville, UF. (Student Competition) ([francisco.loayza@ufl.edu](mailto:francisco.loayza@ufl.edu)) [HP-18]

Reversible (i.e., noninjurious) stress can induce upregulation of the antioxidant system in plants. It has been demonstrated that applying a mild heat stress in the form of a hot water treatment to tomato fruit can promote the synthesis of beneficial antioxidant components such as lycopene and other carotenoids. However, it has been also shown that hot-water treatment of some cultivars at the mature green developmental stage, particularly ‘Florida 47’, doesn’t result in higher carotenoids at the fully ripe stage, even if they visually show more rapid color development. The objective of this experiment was to demonstrate that hot-water treatment induces higher carotenoid accumulation in early ripening stages, but total carotenoid accumulation is limited by a cultivar’s genetic potential. Mature-green ‘Florida 47’ tomatoes were immersed in water at 25 or 52°C for 5 min, followed by treatment with 100 ppm ethylene for 48 hours at 20°C. External color (CIE  $a^*$ ) at the blossom end, and internal color of the upper, middle and central pericarp were measured; homogenates of 10 tomatoes were prepared for moisture and carotenoids analysis. Hot-water treatment significantly increased total carotenoids ( $p = 0.0022$ ) and moderately increased lycopene ( $p = 0.1156$ ). Hot water resulted in faster accumulation of lycopene and total carotenoids during ripening, with the highest significant differences occurring 7 days after treatment ( $p = 0.00940$  and  $p = 0.0322$ , respectively). In conclusion, hot-water treatment had a highly significant effect on the synthesis of carotenoids, and a moderately significant affect on lycopene, but their final accumulation was apparently limited by the cultivar’s genetic potential.

### **Development of Botrytis Rot in Stored Strawberries as Affected by Ripeness, Temperature and Atmosphere.**

M.C.N. Nunes, Food Quality Laboratory, University of South Florida Polytechnic, A.M.M.B. Morais, Escola Superior de Biotecnologia, Universidade Católica Portuguesa, Portugal, J. K. Brecht and S.A. Sargent, Horticultural Sciences Department, UF, J.A. Bartz, Plant Pathology Department, UF, R.A. Allen, J.H. Lee, D.M. Pires and J. Pittet-Moore, Food Science & Human Nutrition Department, UF, FL. [HP-19]

We sought to evaluate the development of postharvest decay in strawberries in general and *Botrytis* fruit rot in particular, specifically: 1) the effect of controlled atmosphere (CA; 5% O<sub>2</sub> + 15% CO<sub>2</sub>) on different developmental stages of the pathogen; 2) the interaction of fruit ripeness and CA storage among fruit stored for 1 or 2 weeks at normal cold storage temperatures (4 or 10°C) for commercial handling; and 3) the residual effects of CA storage after transfer to air on strawberry susceptibility to fruit rot. Delaying CA establishment for 12 or 24 hours at 20°C after wound inoculation resulted in progressively more disease development, suggesting that the CA had a greater inhibitory effect on *Botrytis cinerea* spore germination versus mycelial growth. The least decay occurred on three-quarter colored fruit stored in CA versus air and at the lower temperature, and CA had a greater effect at 10°C than at 4°C. These effects persisted during a

24-hour display treatment (fruit held in air at 20°C after the main storage treatments). Additionally, inoculation following 1 or 2 weeks storage at 4 or 10°C indicated that CA helped strawberry fruit maintain resistance to Botrytis rot, especially at the higher storage temperature.

**Interaction of Temperature and Ethylene Treatment in the Ripening of Stony Hard x Melting Flesh and Stony Hard x Nonmelting Flesh Peach Selections.** Octavio A. Menocal-Barberena, Tropical Research and Education Center, UF; José X. Chaparro, and Jeffrey K. Brecht, Horticultural Sciences Department, UF. (Student Competition) ([omenocal@ufl.edu](mailto:omenocal@ufl.edu)) [HP-20]

Most commercial fresh market peach cultivars possess either the melting flesh (MF) or nonmelting flesh (NMF) fruit texture traits. Stony hard (SH) peaches possess a mutation that has been reported to confer lack of fruit ethylene production without loss of ethylene responsiveness since SH fruit ripen when treated with ethylene. This suggests that SH peaches could be ripened postharvest to desirable ripeness, and no further, by manipulation of exogenous ethylene exposure. We characterized the ripening behavior of five SH x MF (AP01-15S, AP02-16WS, AP05-12S, AP05-17S, and AP07-24WS) and two SH x NMF (AP00-30WBS and AP01-20WS) peach selections grown in Gainesville, FL and Attapulgus, GA in 2009 and 2010 by measuring ethylene production and flesh firmness during storage at 0, 5, 10, 15, or 20 °C. Peaches were harvested at commercial maturity and measurements were made every 5 and/or 2 days, depending on the storage temperature. For selections AP00-30WBS, AP01-20WS, AP02-16WS, and AP05-12S, ethylene production was greatest at 10 °C, intermediate at 15 °C, and very low or absent at 0, 5, and 20 °C; AP05-17S also produced significant ethylene at 20 °C and AP07-24WS also produced significant ethylene at 0 °C, but AP01-15S did not produce ethylene at any temperature. Ethylene production rates often differed significantly between growing locations and harvests for the same selection. Firmness changes mirrored the changes in ethylene production. It appears that SH was misidentified originally as non-ethylene producing. Ripening of SH peaches probably represents an alteration of the temperature optima for ethylene synthesis and/or perception.

**Impacts of Alternative Cropping Systems on Fruit Quality: Opportunities for Collaborative Research.** Greg McCollum, E.N. Roskopf, N. Kokalis-Burelle, and M.G. Bausher, USDA, ARS, US Horticultural Research Laboratory, Ft. Pierce. [HP-21]

*Abstract.* Methyl bromide (MB) is a soil fumigant that has been critical for the production of vegetable crops, cut flowers, and strawberries in Florida. However, the continued phase-out of soil uses of this broad-spectrum fumigant necessitates the implementation of alternatives for controlling soil borne pests. Significant research efforts continue and have resulted in some effective, environmentally friendly, and sustainable alternatives to MB. For the most part, such research is focused on the effects of MB-alternatives on soil borne pest control and yield of crops of interest, with little attention given to potential effects on product quality. However, it is possible that alternative production practices may have impact on fruit and vegetable quality. Because significant amounts of produce are generated in mid- to large-scale field trials, the opportunity exists for a collaborative research effort to determine if alternative production practices do impact postharvest quality. We have quantified standard fruit quality parameters for tomatoes, eggplant, bell peppers, cantaloupe melons, and watermelons produced in field trials

testing alternative fumigants, transplant grafting, and biologically-based alternative cropping systems as alternatives to MB. Important components of these trials will be presented along with perspectives related to conducting such investigations.

## **KROME**

**Using an Ethylene Inhibitor to Increase Fruit Size, Firmness, and Storage Quality in Florida Peach Production.** M. Olmstead, Department of Horticultural Sciences, Gainesville, FL, Steve Futch, Citrus Research and Education Center, Lake Alfred, FL. ([mercy1@ufl.edu](mailto:mercy1@ufl.edu)) [K-1]

Products to slow the ripening process such as aminoethoxyvinylglycine (AVG) retard the development of ethylene in many tree fruit crops such as apples and peaches, allowing growers to delay harvest to improve fruit size, fruit quality, fruit color, or market position of fruit intended to be marketed as fresh fruit. In some peach varieties, AVG has been shown to increase the firmness and storage quality; however the impact of AVG on fruit quality is dependent upon cultivar and environmental conditions. To assess the impact of AVG on fruit yield, fruit firmness, fruit size, brix, pH, and titratable acidity (TA), AVG (ReTain®, Valent Biosciences) with a gibberellic acid (GA) was applied to two separate peach orchards in two varieties, 'UFSun' (non-melting flesh) and 'TropicBeauty' (melting flesh) and compared with an untreated control. Applications of AVG or AVG + GA were made 2 weeks prior to anticipated harvest. Fruit quality parameters were measured at harvest including firmness, size, brix, pH, and TA. Preliminary results indicate that firmness and overall uniformity of harvests were improved with applications of AVG + GA compared with a control; however, brix and soluble sugars were not affected by these applications. AVG is a promising compound for growers in Florida to enhance the physiological maturity of the fruit before harvest.

**Effectiveness of Flumioxazin Pre-emergence Control of Parthenium (*Parthenium hysterophorus*) Under Grove Conditions in Homestead, Florida.** M. Barbier, J. Crane, and J. Castillo. University of Florida, IFAS, Tropical Research and Education Center, Homestead, FL. ([jhcr@ufl.edu](mailto:jhcr@ufl.edu)) [K-2]

*Parthenium hysterophorus* L., a member of the Asteraceae is indigenous to Mexico and Central and South America and an invasive weed in India, Australia, Taiwan, and Ethiopia and 23 U.S. states and 24 of Florida's 67 counties. Parthenium invades urban and disturbed areas as well as the vegetable fields and fruit groves throughout southern Miami-Dade County. Three herbicides alone, Roundup PowerMax®, Rely® and Chateau® were tested alone and Rely® plus Chateau in several combinations were investigated in a field trial for their efficacy in controlling parthenium under south Florida grove conditions. Treatments were laid out in a completely randomized design with three plots per treatment. Parthenium plants population was assessed by counting green live plants within a 19-inch square grid 1 day prior and 10 times at a 15 day interval post herbicide application. Data were analyzed as repeated measures analysis. In this trial parthenium control was significantly greater for the combination of Chateau® + Rely®, followed by Chateau® alone, then by Rely® alone and at last Roundup® alone. All treatments were significantly better than the untreated water sprayed control. The combination of Chateau® plus Rely® appeared to have a synergistic effect and there was no significant difference in parthenium

control among the three Chateau<sup>®</sup> rates combined with the one rate of Rely<sup>®</sup> treatments investigated under grove conditions in south Florida.

**Field Observations of Machine-Harvest Inefficiencies and Suggested Corrective Measures for a Commercial ‘Noble’ Muscadine Grape Block Trained to a Single Cordon.** J. Breaman<sup>1</sup> and P. Laubacker<sup>2</sup>. <sup>1</sup>UF/IFAS Columbia County Extension, Lake City, FL. <sup>2</sup>UF/IFAS Putnam County Extension, Palatka, FL. ([civilday@ufl.edu](mailto:civilday@ufl.edu)) [K-3]

For two growing seasons, 2010 and 2011, in northeastern Florida, several producers sharing the same mechanical harvester, had reported difficulty harvesting ‘Noble’ muscadine grape berries. Field observation during the 2011 harvest of a ‘Noble’ muscadine by a model 2720 Braud<sup>®</sup> harvester showed visual differences in berry harvest depending whether harvesting in the direction of the of the single-cordon or against it. Paired-row replicated hand-harvests of with and against-cordon harvests were systematically sampled on a diagonal field transect at progressive, 4-row intervals for a total of four replications. Mean berry weight left in the vineyard was 2,158 pounds per acre when harvested in the direction of the cordon compared to 674 pounds per acre when harvested against the direction of the cordon (F-test,  $P = 0.001$ ). Field recommendation was to harvest every other row against the direction of the single cordon immediately. The additional 1,484 pounds of harvestable berries per acre justified the second pass by the mechanical harvester. Fruiting wood also appeared to have been aggressively pruned, placing the fruiting nodes close to the cordon. A recommendation was to not prune so closely to the cordon, so berries would be further from the cordon and more harvestable. Harvest direction efficiencies may need to be tested multiple seasons with this harvester before recommending training cordons in alternating directions for future plantings of ‘Noble’ vineyards.

**Weed control of flumioxazin and simazine tank mixed with postemergence herbicides in peach.** P.J. Dittmar. Horticultural Sciences Department, UF, Gainesville, FL. ([pdittmar@ufl.edu](mailto:pdittmar@ufl.edu)) [K-4]

On-farm research was conducted for the effect of a preemergence herbicide tank mixed with a postemergence herbicide. Treatments were factorial with 2 postemergence programs x 2 preemergence herbicides. The two POST herbicide programs were glufosinate at 1.5 lb. a.i./A alone and carfentrazone at 0.031 lb. a.i./A + clethodim at 0.21 lb. a.i./A tank mixed. The two preemergence herbicides were flumioxazin at 0.29 lb. a.i./A and simazine at 3 lb. a.i./A. The predominant weed species were Florida pusley (*Richardia scabra* L.) and a mix grass population. Carfentrazone and clethodim labels require a surfactant for optimal weed control, however, a surfactant was not included in this study. The absence of a surfactant in the carfentrazone + clethodim treatment caused weed control to be lower at 21 days after treatment (DAT) than weed control by glufosinate. Tank mixing flumioxazin with carfentrazone + clethodim increased Florida pusley control at 21 DAT compared to carfentrazone + clethodim without a preemergence herbicide. At 34 DAT, flumioxazin caused greater weed control than simazine regardless of the POST herbicide in the tank mix. At 221 DAT, flumioxazin provided greater Florida pusley control than simazine. Grass control was similar among all treatments. Peach injury was less than 10% at 21 DAT and occurred only on low hanging limbs or suckers.

**Performance of *Jatropha (Jatropha curcas L.)* Accessions under Different Microclimate Conditions in Florida.** W.A. Vendrame<sup>1</sup>, K. Moore<sup>2</sup>, A.C. Wilkie<sup>3</sup>, J.H. Crane<sup>1</sup>, A.P. Costa<sup>1</sup>, W. Montas<sup>1</sup>, <sup>1</sup>Tropical Research and Education Center, UF, Homestead, FL. <sup>2</sup>Fort Lauderdale Research and Education Center, UF, Ft. Lauderdale, FL. <sup>3</sup>Soil and Water Science Department, UF, Gainesville, FL. ([vendrame@ufl.edu](mailto:vendrame@ufl.edu)) [K-5]

*Jatropha (Jatropha curcas L.)* is a pantropical species in the Euphorbiaceae suitable for biofuel production. Seeds produce oil of high quality for biodiesel and jet fuel use. However, *jatropha* is undomesticated, breeding and genetic improvement programs are limited and best management practices need development. For successful selection, breeding, and genetic improvement, performance trials under different climatic conditions are essential. Field growth performance, and reproductive and yield characteristics are of interest under multi-locational trials. The objective of this study was to perform trials of *jatropha* accessions in three distinct microclimates in Florida. Seedlings from *J. curcas* accessions from India were established at three University of Florida locations; the Tropical Research and Education Center, in Homestead; the Ft. Lauderdale Research and Education Center, in Ft. Lauderdale, and the Energy Research and Education Park, in Gainesville. Trials were conducted for two years. Climate and soil conditions were assessed and evaluations of growth parameters and yield components performed. For each tree, averages of plant height, stem caliper, number of stems, number of flowers, number of fruits, number of seeds, and seed dry weight (g) were recorded. For each year, total number of seeds harvested, total seed dry weight, date of first flower, and date of onset of dormancy were evaluated. Cold protection measures were also assessed during the winter season for both years. Overall, trees performed well under the different microclimates. Differences were observed for flowering times, dormancy onset, as well as for other parameters evaluated.

**Evaluation of beneficial arthropods for control of thrips in blueberry.** O.E. Liburd<sup>1</sup> and T.W. Nyoike<sup>2</sup>, <sup>1</sup>Professor and Graduate Student<sup>2</sup> Entomology and Nematology Department, UF, Gainesville, FL. ([oeliburd@ufl.edu](mailto:oeliburd@ufl.edu)) [K-6]

The Florida flower thrips, *Frankliniella bispinosa* (Morgan) is the key insect pest that affects southern highbush blueberries. Adults and larvae feed on the floral tissues and can negatively affect yield. *Orius insidiosus* (Say) and *Amblyseius swirskii* Athias-Henriot are beneficial predatory arthropods that are used for biological control in vegetables. We evaluated 3 treatments including 1) *O. insidiosus*, 2) *A. swirskii* and an untreated control for suppression of *F. bispinosa* in southern highbush blueberries. The experimental design was a randomized complete block with 4 replicates. Individual plot size was 30 m by 50 m and treatments were applied by hand using manufacturer's recommendations. Samples were taken 3 days prior to treatment application and once per week after treatments were applied. Samples were collected by clipping 15 flower clusters (5 flowers per cluster) and placing into vials with 75% alcohol. In addition, 1 white sticky board was placed randomly in each plot for monitoring adult thrips. Sticky boards were collected and replaced weekly throughout the flowering period. The results from our sticky board counts indicated that plots treated with *A. swirskii* had significantly fewer *F. bispinosa* than those treated with *O. insidiosus* and untreated plots at the 7 and 14 day sampling periods. There were no difference between plots treated with *O. insidiosus* and untreated blocks. With respect to our flower samples, no differences were recorded among the treatments. Potential for biological control in southern highbush blueberries is discussed.

**Observations of the February 2012 Freeze and Effect on Commercial Blueberry Plantings.** G.K. England. UF/IFAS Lake County Extension, Tavares, FL. ([gke@ufl.edu](mailto:gke@ufl.edu)) [K-7]

Producers of commercial southern highbush blueberries often have to take precautions to protect their crop from freezing conditions encountered during the growing season. The cultivars that produce fruit in the optimum market window for Florida producers ranging from late March to early May, are often are subject to damaging temperatures to expanding floral buds, flowers and developing fruit during freeze events from late January to March. During early February in 2012, a two night freeze caused significant damage in fields in north and central Florida. Normally freezes during this time frame do not pose a significant threat to commercial fields, unless temperatures are very low (20 F or lower) because the floral buds generally have not expanded to the point where temperatures in the mid 20s to freezing would cause damage. Due to warmer than normal temperatures, commercial blueberry crops had progressed to the point where significant bloom and developing fruit were present. Most growers consider 32 F to be the critical temperature to freeze protect developing fruit. Since many growers in the region expected temperatures below 32 F, they planned to utilize overhead irrigation to protect their crop. After the two nights of freeze, significant cold damage was reported. Much of the damage was associated with irrigation system failure or inadequate coverage. Growers who took wet bulb temperature into consideration as the trigger to begin applying overhead water typically fared better in the freeze.

**CITRUS**

**The Economics of the Control Strategies of HLB in Florida Citrus.** A.W. Salifu, K. Grogan, T. Spreen, UF/IFAS – FRE, Gainesville, FL, and F. Roka, UF/IFAS – SWFREC, Immokalee, FL. (Student Competition) ([wahab242001@yahoo.com](mailto:wahab242001@yahoo.com)) [C-1]

*Huanglongbing* (HLB), also known as citrus greening, is a bacterial disease that affects all varieties of citrus. HLB was first discovered in Florida in 2005 and is now found in all counties where commercial citrus is produced. It is spread by a small leaf-feeding insect, the Asiatic citrus psyllid. HLB disrupts the phloem of the tree, limiting the tree's ability to uptake nutrients. Initial symptoms of HLB include yellowing of leaves, premature fruit drop, and small, misshapen fruit that contain bitter juice with no economic value. As disease severity of an affected tree increases, eventually the tree is of no economic value (Brlansky et al. 2011). At the present time, there are no known measures that effectively combat the disease. There are three available strategies to cope with greening in Florida citrus. Strategy 1 is to do nothing, allowing the disease to spread and taking no measures to slow its spread or mitigate its impact. Under Strategy 2, an aggressive inspection program is initiated to identify symptomatic trees, and once found, are immediately eradicated (Brlansky et al. 2008). An aggressive psyllid control program is also put into place to suppress psyllid populations. Strategy 3 treats the symptoms of HLB through foliar application of micro and macro nutrients. Symptomatic trees are not removed and no scouting occurs. As with Strategy 2, growers use a strong psyllid control program. This paper seeks to determine the profitability of each strategy given average grove age, age at first detection and annual rate of spread of HLB.

**Production of Nitrous Oxide by the Abscission Agent CMNP and its Impact on Citrus Fruit Loosening.** S. Sharma, R.C. Ebel, and N. Kumar, UF/IFAS – SWFREC, Immokalee, FL. (Student Competition) ([rdebel@ufl.edu](mailto:rdebel@ufl.edu)) [C-2]

The following study was conducted to determine if the abscission agent CMNP (5-chloro-3-methyl-4-nitro-1H-pyrazole) can produce nitrous oxide, if nitrous oxide (NO) promotes fruit abscission, and if alcohol dehydrogenase (ADH) can produce NO. One-half of a 'Valencia' tree was sprayed to drip with 300 ppm CMNP in April, 2011. Fruit detachment force (FDF) of treated fruit decreased from 80 N to 10 N. NO increased in treated fruit from undetectable to about 1.2 nM/g fresh wt by 48 hours after application and declined to below 0.2 nM/g fresh wt by 120 h. Additional untreated fruit were clipped from a 'Valencia' tree and dipped in a 2.0 mM solution of sodium nitroprusside, which releases NO upon exposure to water. FDF of fruit dipped for 45 min in the solution and held at 25°C declined similarly as application of CMNP to the field grown tree. FDF of treated fruit held at 10°C did not decline. Fruit dipped in solutions had ADH activity ranging from 35 nM/min to 0 nM/min for the control and 1.5 mM CMNP, respectively, a result that has been reported previously. Purified ADH in solution with CMNP added produced NO. The results indicate that CMNP applied to field grown trees may be converted to NO by ADH and that the NO promotes abscission of sweet orange.

**Geographical Distribution of Strobilurin Resistance Of *Alternaria alternata*, Causal Agent Of Alternaria Brown Spot In Florida Citrus Groves.** B. Vega, and M.M. Dewdney, UF/IFAS – CREC, Lake Alfred, FL. (Student Competition) ([bryon.vega@ufl.edu](mailto:bryon.vega@ufl.edu)) [C-3]

*Alternaria* brown spot is the most important fungal foliar disease affecting tangerines and tangerine hybrids. Control is mainly based on fungicide applications such as copper and strobilurins, however control failure with strobilurins was detected recently. A statewide survey was initiated to evaluate the sensitivity of *A. alternata* isolates to azoxystrobin and pyraclostrobin. More than 300 monoconidial isolates of *A. alternata* from 28 groves in 7 counties were evaluated using a RZ-based microtiter assay. Strobilurin resistance occurred in all surveyed counties. On average, 64% of tested isolates were highly resistant to strobilurins, with EC<sub>50</sub> (effective concentration to inhibit 50% growth) values greater than 5 µg/ml for azoxystrobin and 1 µg/ml for pyraclostrobin, while mean EC<sub>50</sub> values for sensitive isolates were 0.172 and 0.0211 µg/ml. Resistance to the two fungicides was highly correlated ( $P < 0.001$ ) indicating cross resistance. Isolates were frequently recovered from cultivars Murcott (45%) and Minneola (34%) and less frequently from Dancy (8%), Sunburst (5%), Orlando (4%) and Lee (4%). The highest proportion of resistant isolates by cultivar was from Minneola (84%); followed by Orlando (76%), Dancy (59%), Murcott (53%) and Sunburst (25%). A mixed population between sensitive and resistant isolates was found in 15 orchards and a resistant population in 10 orchards. Disease severity was high in Minneola and Dancy and low in Sunburst and Orlando. Based on our observations, strobilurin resistance occurred more frequently on susceptible cultivars with intense fungicide use. Molecular characterization of the target gene will confirm the point mutation associated with resistant phenotype.

**Influence of Soil-Applied Fertilizer on Greening Development in New Growth Flushes of Sweet Orange.** U. Handique, R.C. Ebel, and K.M. Morgan, UF/IFAS – SWFREC, Immokalee, FL. (Student Competition) ([rdebel@ufl.edu](mailto:rdebel@ufl.edu)) [C-4]

The following study was conducted to determine if soil applied fertilizer can affect movement of *Candidatus Liberibacter asiaticus*, the putative causal agent of citrus greening, into new growth flushes of citrus in the absence of its primary vector, Asian psyllid. A 2 cultivar x 2 *Liberibacter* x 2 fertilizer experiment was conducted in an enclosed greenhouse. *Liberibacter* was introduced by grafting two infected buds on each tree in August, 2010. In October, 2010, the fertilizer was terminated on one half of the trees. Two growth flushes occurred in March/April and May/June and leaves from each flush were removed for sampling. Plants with Ct values between 32 and 36 were removed from the study since in this range it is unclear if they are infected. Of the remaining plants, infected trees had infection rates ranging from 64 to 100 %. Uninfected trees had a 0% infection rate. The infection rate tended to be higher for ‘Valencia’ than ‘Hamlin’ and was not affected by fertilizer treatment. Incidence of the disease symptoms leaf mottling, Zn island greening, veinal chlorosis, and vein corking were much higher on trees that did not receive fertilizer. There was a significant interaction between fertilizer treatment and Ct value for P and Mn with unfertilized trees having low levels of both nutrients across Ct values and fertilized trees having declining Ct values. Ca and Mg did not exhibit the same pattern as P and Mn perhaps because of the high concentrations of these nutrients in the well water used to water the trees. Zn declined with Ct value with fertilization having little effect. The fertilization treatments in this study were extreme and yet had little effect on the incidence of *Liberibacter* in the two growth flushes that occurred after infection.

**Under Severe Citrus Canker and HLB Pressure, Triumph and Jackson are More Productive than Flame and Marsh Grapefruit.** E. Stover, G. McCollum, J. Chaparro, USHRL, USDA/ARS, Ft. Pierce, FL, and M. Ritenour, UF/IFAS - IRREC, Ft. Pierce, FL. ([Ed.Stover@ars.usda.gov](mailto:Ed.Stover@ars.usda.gov)) [C-5]

Trees of ‘Triumph’ (T), ‘Jackson’ (J), ‘Flame’ (F), and ‘Marsh’ (M) were established at the USDA Ft. Pierce farm in 2003/ 2004. ‘Triumph’ closely resembles a seedy white grapefruit except with lower early acidity and bitterness, and is presumed to be a grapefruit x sweet orange. ‘Jackson’ is a low-seeded budsport of ‘Triumph’. ‘Flame’ and ‘Marsh’ are standard grapefruit cultivars. Asian Citrus Canker (ACC) and Huanglongbing (HLB) were confirmed in trees at this farm in 2006, these diseases were essentially left uncontrolled and quickly became widespread. HLB symptoms, ACC symptoms, and overall tree health were assessed annually using a visual scale. In each year overall tree health was significantly greater on T and J compared to F and M, with significantly lower severity of ACC symptoms but no difference in HLB symptoms which were severe in all trees. F/M were almost completely defoliated in some years while T/J had normal canopy density. PCR for *Liberibacter asiaticus* in 2009 showed no marked differences between cultivars. In contrast analyses of T/J vs. F/M cumulative fruit/tree (T=255; J=220; F=129; M=66) and tree height were greater in T/J and canopy volume was greater in some years but trunk cross sectional area was not different. Fruit drop was greater in F/M most years and cumulatively (T=15%; J=14%; F=50%; M=53%). Fruit quality assessments were made each growing season with T/J showing generally acceptable commercial fruit quality and F/M having

low Brix/acid. In 2011/2012 many F/M were small and/or misshapen while T/J displayed normal size and shape.

**Susceptibility of common rootstocks and scions to citrus canker under Florida conditions.**

S.H. Futch, and J.H. Graham. UF/IFAS – CREC, Lake Alfred, FL. ([shf@ufl.edu](mailto:shf@ufl.edu)) [C-6]

Citrus canker (*Xanthomonas citri* subsp. *citri*) has been introduced into Florida numerous times. The most recent eradication efforts were suspended in 2006 after a series of hurricanes in 2004 and 2005 spread the disease statewide. In central Florida, 10 rootstocks and 10 scion varieties were evaluated after 18 months in a trial of nonbearing trees planted adjacent to young grapefruit trees highly infected with citrus canker. All rootstocks and scions were susceptible to citrus canker to varying degrees. Rootstocks were ranked as predicted by the known susceptibility of the parents to canker. Swingle citrumelo (trifoliolate hybrid with grapefruit) was most susceptible, followed by Carrizo and Kuharske citrange (trifoliolate hybrid with sweet orange) and sour orange (pummelo parentage). X639, US812 and US897 (trifoliolate hybrids of Cleopatra mandarin or Sunki) were somewhat susceptible. Volkamer lemon, Cleopatra mandarin and Kinkoji were the least susceptible rootstocks to citrus canker. Within the scion varieties, Minneola tangelo, Murcott, Valencia, Fallglo tangerine, Sunburst tangerine and Orlando tangelo exhibited relatively low susceptibility. Ponkan (mandarin hybrid) and Satsuma mandarin were the least susceptible of the scion varieties.

**Salinity Tolerance of Promising Tetraploid Citrus Rootstock Candidates.** J.W. Grosser, J.A.

Gmitter, J.P. Syvertsen, UF/IFAS – CREC, Lake Alfred, FL, and A.A. Omar, Zagazig University, College of Agriculture, Biochemistry Department, Zagazig, Egypt. ([jgrosser@ufl.edu](mailto:jgrosser@ufl.edu)) [C-7]

A significant effort at the UF/CREC has been the production of allotetraploid rootstock candidates by somatic hybridization, and more recently by conventional breeding at the tetraploid level using selected somatic hybrid parents. We determined responses to salinity stress (50 mM NaCl  $\approx$  4,400 ppm TDS) of one-year-old ‘Valencia’ orange trees on 18 new allotetraploid citrus rootstock candidates plus Carrizo citrange rootstock for comparison in a greenhouse. All trees were watered to leaching weekly with a 100 ppm N fertilizer solution containing a complete 7-2-7 Citrus blend fertilizer plus iron. There were 19 salinized rootstocks plus a non-salinized Carrizo with 6 replicate trees per treatment. After 5 months, all trees were visually rated from 1-10 with a rating of 10 representing the healthiest appearing trees with no phytotoxic symptoms or leaf loss and a rating of 1 for completely defoliated trees. Using fully expanded mature leaves from the mid stem area on each tree, an index of leaf chlorophyll was estimated using a SPAD meter. At harvest, mature leaves were briefly rinsed in deionized water, oven dried and leaf Na<sup>+</sup> and Cl<sup>-</sup> concentrations were determined. Overall, leaf Na<sup>+</sup> and Cl<sup>-</sup> were strongly related but high leaf Cl<sup>-</sup> was more strongly correlated to low SPAD values and to low appearance ratings than high leaf Na<sup>+</sup>. Two ‘tetrazyg’ (allotetraploid zygotic hybrid cross from two allotetraploid somatic hybrids) rootstock selections of ‘Nova’ mandarin hybrid + HiradoBuntanPummelo zyg. somatic hybrid x Cleopatra + Argentine trifoliolate orange (*Poncirus trifoliata*) somatic hybrid (denoted O3 and O4), and two tetrazyg rootstock selections of Sour orange + Rangpur somatic hybrid x Cleopatra + Sour orange somatic hybrid (S11 and S18), were able to exclude Na<sup>+</sup> and Cl<sup>-</sup> ions from ‘Valencia’ leaves while maintaining good growth

with no phytotoxic symptoms. These 4 tetrazyg rootstock selections merit further salinity tolerance studies in the field.

**Salinity Tolerance Of ‘Hamlin’ Orange Trees On The Hybrid Rootstocks Us-897 And X639 Is Greater Than Of Trees On Cleopatra Mandarin.** J.P. Syvertsen, and W. Bandaranayake, UF/IFAS – CREC, Lake Alfred, FL. ([jmsn@ufl.edu](mailto:jmsn@ufl.edu)) [C-8]

In a greenhouse study, we evaluated growth, physiological responses and leaf Cl and Na concentrations of salinized 2 year-old ‘Hamlin’ orange trees on the relatively salt tolerant Cleopatra mandarin (Cleo) rootstock and on two of its commercial hybrids, Cleo x Flying Dragon trifoliata (US-897) and Cleo x Rubidoux TF (x639). Trees on these hybrid rootstocks have some horticultural advantages over Cleo but their relative tolerance to salinity has not been described. Well-fertilized and well-watered trees were grown in a high peat soilless potting mix and salinized with 0, 30 or 60 mM NaCl (maximum EC= 7.36 dS m<sup>-1</sup> or TDS = 5,152 ppm) for 4 months. Trees on Cleo were the smallest, had the highest root/shoot dry wt ratio (R/S) and used the least water regardless of salinity level. Trees on US-897 grew the most and had the lowest R/S but had the lowest tree transpiration rates when water use was corrected for leaf area. Total tree dry weight (TTDW) of trees on all 3 rootstocks was reduced similarly by salinity as R/S ratio was affected little by salt stress. Rootstock had little effect on leaf Na but leaf Cl concentration and Cl accumulation were lowest in trees on Cleo. Roots of x639 had some ability to sequester Cl at the intermediate salt level (30mM) but this ability was overcome at 60mM as all leaves accumulated more Cl than roots at the high salinity level regardless of rootstock. Net assimilation of CO<sub>2</sub> (A<sub>CO2</sub>) was lowest in leaves on Cleo at 0 and 30 mM NaCl but high salinity reduced A<sub>CO2</sub> similarly across rootstocks. Leaf gas exchange was not related to leaf Na concentration but leaf A<sub>CO2</sub> and water use efficiency decreased with increasing leaf Cl. The greater shoot growth and higher leaf Cl levels of trees both US-897 and x639 support the idea that both hybrid rootstocks were similarly more salt tolerant than Cleo.

**Production in a southwest Florida grove using the Boyd Nutrient/SAR Foliar Spray.** R.E. Rouse, UF/IFAS – SWFREC, Immokalee, FL, M.S. Irey, U.S. Sugar Corporation, Clewiston, FL, M.M. Boyd and, T.D. Willis, McKinnon Corporation, Felda, FL. ([rrouse@ufl.edu](mailto:rrouse@ufl.edu)) [C-9]

Fruit production in Maury Boyd’s Orange Hammock Citrus grove in Felda has maintained its production level since being confirmed with citrus greening disease known as Haunglongbing (HLB) in 2006. The trees have been receiving the Boyd cocktail mix of nutrients and SARs (Systemic Acquired Resistance) since HLB was confirmed. The grove is now 95% infected with HLB. The grove consists of ‘Valencia’ and ‘Hamlin’ oranges on Swingle citrumelo and Carrizo citrange rootstocks. The mean yield the six years before HLB for ‘Hamlin’ was 569, and after finding HLB has been 576 boxes per acre. Mean yield for ‘Valencia’ the six years before HLB was 460, and after HLB has been 454 boxes per acre. Plots of ‘Valencia’ on Swingle citrumelo rootstock containing 100 trees each were PCR tested in 2008, 2010 and 2012. Leaf samples were collected from each tree and processed by real-time PCR for detection of the HLB bacteria. Trees tested 40% positive in 2008, 92% positive in 2010, and 95% positive in 2012. Trees were rated for symptoms of HLB using a 0 to 5 scale. In 2012 the disease severity of all trees were rated less severe than in previous years.

**Characteristics of Foliar Nutritional Spray Tank Mixes applied to Citrus in the Indian River Area.** T. Gaver, UF/IFAS – St. Lucie County Extension, Ft. Pierce, FL. ([tgaver.49@ufl.edu](mailto:tgaver.49@ufl.edu)) [C-10]

A high infection rate of Huanglongbing (HLB) in the Indian River production area of Florida has resulted in the increased use of foliar nutritional sprays on citrus to attempt to manage the debilitating effects of the disease. Foliar sprays containing various combinations of nitrogen (N), potassium (K), boron (B), iron (Fe), manganese (Mn), zinc (Zn) and phosphite products are often combined in tank mixes with insecticides and copper (Cu) fungicides. Many copper fungicide labels recommend that tank mix combinations be adjusted to a pH of 6.5 to avoid phytotoxicity, or peel burns, to fresh citrus fruits. Both surface and artesian water sources may be utilized in spray mix operations, resulting in considerable variability in the pH of these tank mixes and a potential for phytotoxicity. Peel blemishes are an issue in the fresh fruit industry, perhaps indicating that the acidity of tank mixes is not being effectively monitored in the field. During the spring of 2012, tank mix ingredients, pH, total dissolved solids (TDS) and compatibility data were collected from a number of tank mix combinations utilized by growers. The results from this project will indicate how effectively the pH of these tank mixes is being managed by growers and guide the possible development of practical recommendations to avoid phytotoxicity.

**Phloem Anatomy of Citrus Trees: Healthy versus Greening.** E. Etxeberria, and C. Narciso, UF/IFAS – CREC, Lake Alfred, FL. ([eetxeber@ufl.edu](mailto:eetxeber@ufl.edu)) [C-11]

Phloem cells from HLB-affected trees become obstructed with callose and P-protein plugs. The presence of these plugs is believed to hinder the transport of photoassimilates (nitrogenous and reduced carbon compounds) to the root system. However, even with a seemingly collapsed phloem tissue, citrus trees remain viable and produce fruit for some time, suggesting either incomplete plugging of phloem elements or the existence of alternative routes for photoassimilate transport. In this study, we examined the basic structure of phloem tissue from HLB-unaffected and HLB-affected trees under light and scanning electron microscopy. To avoid any possible interference with callose induced by injury during sampling, we employed freeze substitution technique. Sieve elements from HLB-unaffected trees show sizable lateral pores to phloem and ray parenchyma. The cells have very angular sieve plates and appear relatively clean from cellular components. HLB-affected phloem cells contain massive amounts of amorphous material clearly traversing sieve plates and lateral pores. Eventually, these cells totally collapse into almost a solid cell wall barrier. Occasionally, wound phloem appeared along the petiole cortex in HLB-affected trees. Most notably is the large number of wall perforation all along the cortex parenchyma with abundant pit fields. These anatomical features will be discussed in terms of alternate routes for photoassimilates.

**Rehabilitation of HLB Infected Citrus Trees using Severe Pruning and Nutritional Sprays.** R. Rouse, UF/IFAS – SWFREC, Immokalee, FL. ([rrouse@ufl.edu](mailto:rrouse@ufl.edu)) [C-12]

Citrus trees infected with HLB bacteria become weak and develop dieback as they lose production. These trees eventually decline to a production level that is not economical to maintain in a citrus operation. Fifteen-year-old ‘Valencia’ orange citrus trees on Swingle

rootstock that were 100% infected with HLB and in decline, and losing production were severely pruned to stimulate regrowth and the new flush treated with foliar nutritional sprays. Nutritional sprays included the 'Boyd cocktail' and two other nutrient treatments that contained nutrients as phosphites plus nickel and cobalt. Both heavily pruned buckhorned trees and unpruned standard trees were compared for shoot growth and canopy development. Pruning was done in February 2010 before the spring flush. Spring shoot growth on the pruned trees was twice the length of unpruned standard trees with larger leaves. Summer flush on the pruned trees was three times the length of the unpruned trees. Both pruned and unpruned trees bloomed and set fruit in the spring of 2011. Rejuvenation of HLB trees by severe pruning and foliar nutritional sprays may be an alternative to tree removal and replanting with new trees when existing citrus trees begin to lose production due to HLB infection.

**Effect of high temperature on different genotypes of citrus.** N. Kumar, and R.C. Ebel, UF/IFAS – SWFREC, Immokalee, FL. ([naveenkumar@ufl.edu](mailto:naveenkumar@ufl.edu)) [C-13]

High temperature can be deleterious to the growth and development of citrus plants. In the present investigation, grapefruit and sweet orange were exposed to high temperature to explore the mechanism of high temperature tolerances among these two genotypes. Plants were grown in 15 x 8 cm plastic pots containing Fafard Mix 4P. Mineral nutrition was provided periodically using Peters' professional fertilizer. Plants were kept at  $700 \mu \text{mole m}^{-2} \text{s}^{-1}$  PAR with a 12-h light and 12-h dark photoperiod in environmental growth chambers and acclimatized for 90 days before applying treatments. Plants were exposed to 38°C for 10 days and then allowed to recover at 27°C for 5 days. High temperature severely affected sweet orange foliage compared to grapefruit. Heat injury caused the development of tiny circular necrotic spots on the abaxial sides of leaves in sweet orange. The necrotic lesions enlarged at 8 days after heat treatment followed by extensive leaf defoliation. However, no such injury was observed in grapefruit. Heat induced oxidative stress was more pronounced in sweet orange than grapefruit. Grapefruit displayed better antioxidant defense system under high temperature regimes than sweet orange. It seems sweet orange will be more susceptible to rising global temperatures.

**GC-MS analysis of secondary metabolites in leaves from orange trees infected with Huanglongbing: A 9-month time series study.** S.E. Jones, S.Y. Folimonova, C.L. Davis, F.M. Hijaz, and J.R. Reyes-De-Corcuera, UF/IFAS – CREC, Lake Alfred, FL, and J.A. Manthey, USHRL, USDA/ARS, Ft. Pierce, FL. ([jireyes@ufl.edu](mailto:jireyes@ufl.edu)) [C-14]

Citrus Huanglongbing (HLB) is considered the most serious threat to the citrus industry. We previously characterized non-targeted metabolite profiles of healthy, zinc deficient, and HLB-infected orange leaves from mature 'Valencia' trees located in commercial citrus groves. The current greenhouse study was performed in seedlings newly grafted with budwood from symptomatic field trees. Trees of the same variety and age were used as controls and were inoculated with budwood from HLB-free trees. After extraction, derivatization, and GC-MS analysis of metabolites, principal component analysis (PCA) was performed on the normalized area percent of each compound in the chromatogram. PCR data was compared with PCA results. 85% of the young 'Hamlin' trees and 95% of 'Valencia' trees were infected by week 40 (confirmed by PCR). For 'Valencia', differences in GC-MS metabolite profiles could be detected beginning at Week 16 (20 weeks post-leaf graft). However, 5 of 9 trees were already HLB

positive when tested at Week 10. For ‘Hamlin’, 3 of 9 trees tested PCR+ in week 10, but strong PCA clustering was not observed until Week 32. Strong PCA clustering correlated well with symptom development. Of the 44 compounds identified by GC-MS as leaf metabolites, only three (3) were consistently found in both ‘Hamlin’ and ‘Valencia’ in sufficient quantity for a potential biomarker. Compounds from both varieties that were significantly different by T-test between the control and HLB-infected trees were malic acid, malonic acid, and quinic acid.

**HPLC-MS analysis of secondary metabolites in leaves from orange trees infected with Huanglongbing: A 9-month time series study.** F.M. Hijaz, J.S.Y. Folimonova, C.L. Davis, S.E. Jones, J.R. Reyes-De-Corcuera, UF/IFAS – CREC, Lake Alfred, FL, and J.A. Manthey, USHRL, USDA/ARS, Ft. Pierce, FL. ([jireyes@ufl.edu](mailto:jireyes@ufl.edu)) [C-15]

Huanglongbing (HLB) disease presumably caused by *Candidatus Liberibacter asiaticus* (Clas) is threatening one million acres of commercial citrus groves that have an annual production value of approximately \$3 billion across the U.S. The objectives of this study were to identify the earliest significant difference in metabolome of leaves from citrus infected with HLB, and to characterize the evolution of differences in metabolite profile as related to bacteria titer and symptom development *in planta*. Twenty 8-month-old sweet orange seedlings from variety ‘Valencia’ or ‘Hamlin’ were grafted with budwood from PCR-positive HLB source tree. Five inoculated trees of each variety and 3 control trees were sampled biweekly and analyzed by HPLC-MS and PCR. Fourteen weeks after inoculation, Clas was detected in newly growing flushes in 55 and 42% of the inoculated ‘Valencia’ and ‘Hamlin’ trees respectively. Graft-inoculated trees remained asymptomatic in the first 20 weeks. However, the symptoms were evident 30 weeks after grafting. No metabolomic differences were detected in leaves from HLB-infected trees 24 weeks after inoculation. However, 28 weeks after inoculation, metabolomic differences between control leaves and those from HLB-infected trees were clear. The abundance of 27 out of the 38 detected metabolites in leaves from infected Valencia trees increased with time, 2 metabolites decreased with time, and the rest did not change significantly. The response Hamlin metabolites to HLB was similar to Valencia; 24 out of the 38 detected metabolites increased with symptoms development, 5 metabolites decreased as symptoms increased, and the rest of did not change significantly.

**Registered and Experimental Insecticides for Control of Asian Citrus Psyllid and Citrus Leafminer on Mature Orange Trees.** J.A. Qureshi, B. Kostyk, and P.A. Stansly, UF/IFAS – SWFREC, Immokalee, FL. ([jawwadq@ufl.edu](mailto:jawwadq@ufl.edu)) [C-16]

The Asian citrus psyllid (ACP) *Diaphorina citri* vectors *Candidatus Liberibacter asiaticus*, a bacterium which causes Asian form of “huanglongbing” (HLB) or citrus greening disease. Through its feeding damage larvae of citrus leafminer (CLM) *Phyllocnistis citrella* exposes cuticle to *Xanthomonas axonopodis* pv. *citri*, a bacterium which causes citrus canker disease. Insecticides are critical in developing integrated management strategies to reduce the incidence of ACP and CLM and associated diseases. Foliar sprays of registered and experimental insecticides with or without adjuvants were evaluated on 16-year-old *Citrus sinensis* (L.) Osbeck “Valencia” orange trees producing new growth attractive to both ACP and CLM for oviposition and development of immatures. In the first experiment conducted in Jun-Jul, fenpropathrin (Danitol 24 EC, 16 oz/ac) spinetoram (Delegate 25 WG, 4 oz/ac), sulfoxaflor (Sulfoxaflor 20 SC,

4.28 or 5.7 oz/ac) and flupyradifurone (Sivanto 200 SL, 10.5 or 12 oz/ac), all applied with 435 oil (horticultural spray oil, 2-3%) reduced ACP compared to untreated control through 40 days after treatment (DAT). Sulfoxaflor worked better with citrus oil than without, with no advantage for the 5.7 oz/ac rate over the 4.28 oz/ac rate. Sivanto at 14 oz/ac worked better with citrus oil than with Induce, a non-ionic surfactant, however, 10.5 oz/ac rate seemed to be adequate. Significantly fewer CLM larvae compared to control were observed in all treatments at 5 DAT except for spirotetramat (Movento MPC, 16 oz/ac) + 435 oil and only Delegate + 435 oil was providing larval reduction at 12 DAT. In the second experiment conducted in Aug-Sept, treatments of fenpropathrin (Danitol 24 EC, 16 oz/ac), thiamethoxam (Actara 25 WG, 5.5 oz/ac), abamectin + thiamethoxam (Agri-flex 8.5 oz/ac) and naled (Dibrom 8 E, 16 oz/ac) all applied with 435 oil (2%); thiamethoxam + chlorantraniliprole (Voliam Flexi, 7.5 oz/ac) and fenpyroximate (Portal 0.4 EC, 32 oz/ac) applied alone; Mpede + Addit (Soap 2% + Vegetable oil 0.50%) ; and treatments of bioinsecticide MBI 203 and MBI 206 applied with hyperactive reduced ACP compared to untreated control for 31 DAT. Significantly fewer CLM larvae compared to the control were observed with Actara 25 WG + 435 oil, Agri-flex + 435 oil, Voliam Flexi, Dibrom 8 E + 435 oil, Portal 0.4 EC and Mpede + Addit at 3 DAT but only with Agri-flex + 435 oil and Voliam Flexi at 10 DAT. Treatment effects were more pronounced against ACP than CLM.

**Control of the Asian Citrus Psyllid with *Isaria fumosorosea* (Hypocreales: Cordycipitaceae).** K. Stauderman, UF/IFAS – Volusia County Extension, DeLand, FL, and S. Arthurs, UF/IFAS - MFREC, Apopka, FL. ([kstauderman@co.volusia.fl.us](mailto:kstauderman@co.volusia.fl.us)) [C-17]

A laboratory bioassay was developed to evaluate strains of the entomopathogenic fungus, *Isaria fumosorosea* Wize, against the Asian citrus psyllid (*Diaphorina citri* Kuwayama). All of adult psyllid were killed after 12 days with all three isolates. The Apopka 97 strain (commercially available as PFR-97) was tested against established *D. citri* infestations in potted orange Jessamine, (*Murraya*) and Benton citrange [*Citrus sinensis* (L.) Osb. x *Poncirus trifoliata* (L.) Raf] in greenhouse cages. Fungal treatments at label rates reduced psyllid populations over 3 weeks. The combination of PFR-97 with emulsifiable oils did not enhance psyllid mortality compared with either agent alone. Imidacloprid applied as a drench served as the industry standard. Subsequent greenhouse tests conducted under humid conditions were hampered by natural dissemination of *I. fumosorosea* to untreated psyllid, suggesting that this fungus is spread easily by air movement or other factors. In later greenhouse tests, a naturally occurring *Cladosporium* spp. rapidly colonized psyllid cadavers and leaf surfaces, but was not pathogenic. Our studies confirmed the potential of *I. fumosorosea* for control of *D. citri*, although it may be less effective in the short term compared with chemical insecticides.

**Aerial Application of Insecticides for Control of Citrus Leafminer, *Phyllocnistis citrella* Stainton, in Oranges.** M.M. Jones and P.A. Stansly., UF/IFAS – SWFREC, Immokalee, FL. ([mmjones2@ufl.edu](mailto:mmjones2@ufl.edu)) [C-18]

The citrus leafminer (CLM), *Phyllocnistis citrella* Stainton (Lepidoptera: Gracellariidae), was first detected in Florida in 1993 infesting young citrus shoots and quickly spread throughout the state. The problem gradually abated but flared up recently with growers concerned over increased damage and associated canker spread. Insecticides applied to foliage with standard

ground equipment generally meet with limited success, in part due to a narrow window of larval susceptibility. Therefore, more rapid and effective application methods are needed. There is limited experience with aerial applications against CLM, so we also initiated a trial in July 2011 with two treatments of Intrepid (methoxyfenzide) by ground vs. aerial compared to Delegate (spinetoram) applied by air. Advantages to Intrepid include modest price, selectivity and novel mode of action not otherwise used in citrus. Three treatments and an untreated check were arranged in a RCBD on 165 acres of commercial 'Valencia' orange. Leaf damage was assessed and rated using a modified Horsfall and Barratt (1945) rating system. Treatment differences in incidence and intensity of leafmining damage analyzed using ANOVA. Intrepid 2F (aerial/ground) applications showed least damage of leaves compared with Delegate or untreated. We concluded that aerial applications of Intrepid worked just as well as ground sprays.

Keywords: Citrus leafminer, *Phyllocnistis citrella* Stainton, Intrepid 2F, methoxyfenzide

**Evaluation of fungicides to control Citrus Black Spot on Valencia caused by *Guignardia citricarpa* in south Florida.** P.D. Roberts, K.E.M. Hendricks, UF/IFAS - SWFREC, Immokalee, FL, C. Brooks, and H. Yonce. KAC Agricultural Research, Inc., Deland, FL. ([pdr@ufl.edu](mailto:pdr@ufl.edu)) [C-19]

Experiments to evaluate the efficacy of various fungicides and spray regimes to control the recently introduced fungus, *Guignardia citricarpa*, causing Citrus Black Spot (CBS) were initiated. Field trials were established at a commercial site in a block of Valencia that was identified with CBS in 2011. Fifteen treatments including ten products were applied at intervals starting after fruit harvest and continuing through September. Ratings on the number of the symptomatic fruit on the tree and the number of dropped fruit with symptoms were taken in December 2011 and February and March 2012. In general, most fungicidal regimes were effective in protecting fruit, however a few products were identified that did not confer suppression of CBS in this trial. The efficacy of controlling CBS with copper products was evaluated in the field and also by *in vitro* testing.

**Responses of *Citrus medica* var. *sarcodactylis* during *Xanthomonas citri* pv. *citri* Infection.** N. Kumar, R.C. Ebel, and P.D. Roberts, UF/IFAS – SWFREC, Immokalee, FL. ([naveenkumar@ufl.edu](mailto:naveenkumar@ufl.edu)) [C-20]

Asiatic citrus canker (*Xanthomonas citri* pv. *citri*; (*Xcc*)) is a serious bacterial disease that causes potential economic losses in citrus production and marketing throughout world. In the present investigation, canker development was examined in Buddha Hand (*Citrus medica* var. *sarcodactylis*), which is an ornamental tree. Basal matured leaves (fully expanded) were inoculated using a tuberculin syringe (1 cc) without needle. *Xanthomonas citri* pv. *citri* inoculum ( $1.1 \times 10^6$  CFU/cm<sup>2</sup>) was slowly infiltrated in to the abaxial leaf surface on both sides of the mid vein to produce a zone of water soaked tissue. Control leaves were mock inoculated with sterile nutrient broth. Canker development is governed by a characteristics sequence of specific events. Water soaking was the initial symptom observed at 3 dai (days after inoculation). The epidermis became raised and thickened at 5 dai and thereafter several small necrotic zones of host tissue were observed at 6 dai in the zone of canker infection. These necrotic lesions enlarged by 12 dai. The highest *Xcc* population ( $1.9 \times 10^{11}$  CFU/cm<sup>2</sup>) was observed at 8 dai and thereafter declined. This decline was associated with higher oxidative redox of host tissue. These results showed that

Buddha Hand (*Citrus medica* var. *sarcodactylis*) represents a delayed type of hypersensitive response, which induced cell death at 6 dai. Buddha Hand may serve as an important citrus species to produce canker resistant transgenic and hybrid plants.

**Water Holding Capacity of WashGard Spray and Effect on Efficacy of Copper Hydroxide Treatments.** W. Widmer, C. Narciso, and J. Narciso, USHRL, USDA-ARS, Fort Pierce, FL. ([Wilbur.Widmer@ars.usda.gov](mailto:Wilbur.Widmer@ars.usda.gov)) [C-21]

Qualities of a successful protectant for plant disease control include little deterioration of the protectant as it sits on the plant surface and reactivity of the chemical compound. For control of citrus canker in Florida citrus groves, copper hydroxide is used as a protective spray. However, copper hydroxide is easily removed from plant surfaces during periods of heavy rain, which is when the plant is most susceptible to canker infection. Copper hydroxide is also eroded by UV light from the sun and often flakes off in strong wind. Studies show that copper hydroxide is most active when hydrated, yet copper hydroxide dries after spraying and is not re-hydrated until it rains, at which point much of it is washed off the plant.

The Citrus and Subtropical Products Lab, in a cooperative agreement with Industry, formulated and tested a compound that helps make copper hydroxide a more successful protectant against citrus canker. WashGard®, when combined with copper hydroxide, serves several functions. WashGard significantly retains more moisture than copper hydroxide alone keeping the copper hydroxide hydrated and reactive for longer periods of time. In addition WashGard is resistant to UV light, rain and wind erosion. It only needs re-application due to leaf expansion and exposure of new tissues to disease. By deflecting UV light the Washgard reduces deterioration of the copper. Data show that combining copper hydroxide with WashGard significantly reduces infection and lesions caused by the citrus canker bacterium (*Xanthomonas citri* subsp. *citri* or Xcc) when compared to copper hydroxide sprays alone and does not interfere with photosynthesis or other physiological processes of the tree.

**Some Citrus Flower Characteristics and Honey Bee Preference.** L.G. Albrigo, R. Rouseff, R.A. Bazemore, UF/IFAS, CREC, Lake Alfred, FL, and R.V. Russ, Aparies, Tyner Rd., Haines City, FL. ([albrigo@ufl.edu](mailto:albrigo@ufl.edu)) [C-22]

Pollination by honey bees (*Apis mellifera*) is important to production of most hybrid citrus cultivars grown in Florida as they require cross-pollination to set commercial crops of fruit, but bees often appear to prefer other cultivars than those requiring cross-pollination. Poor fruit set of the cultivar, ‘Ambersweet’, increased awareness of the problems associated with bee requirements and activity. To investigate these problems, flower nectar volume and sugar concentration were measured in commercial and research blocks of several citrus cultivars throughout Central Florida. Large-flowered cultivars had higher nectar content. Large-flowered cultivars such as oranges and grapefruit produced more nectar per flower (9 to 21 µl/flower), but the sugar concentrations often were lower than in small-flowered mandarin hybrid cultivars. Large-flowered hybrid cultivars were usually intermediate in nectar production (4.3 to 10.5 µl) and low to intermediate in sugar concentration compared to other cultivars, while small-flowered mandarin hybrids had the lowest nectar volumes (2.1 to 3.3 µl). Flower volatiles were measured and some cultivar differences were found, most notably high limonene content in grapefruit, and 4 major compounds, pinene, myrcene, limonene and linalool, were low in ‘Ambersweet’ and

‘Robinson’. In two years, a round white mesh cage was used to determine bee preference for citrus flowers of different cultivars. Bee behavior in the cage appeared to approximate natural bee activity with flights tapering off by noon. The large-flowered cultivars ‘Valencia’ and ‘Hamlin’ orange, as well as large-flowered ‘Orlando’ tangelo and the small-flowered mandarin hybrid, ‘Robinson’, were preferred over large-flowered ‘Ambersweet’. Large-flowered ‘Orlando’ and ‘Minneola’ tangelos were preferred over small flowered hybrids, such as ‘Dancy’, ‘Robinson’ and ‘Murcott’, which had the lowest bee preference. Average nectar volumes per flower, which were highest in large-flowered non-hybrid cultivars, appeared to relate best to observed bee preference compared to sugar concentration or flower volatiles.

**The Citrus Industry of China.** T.H. Spreen, Z. Gao, UF/IFAS – FRE Gainesville, FL  
F. Gmitter, UF/IFAS – CREC Lake Alfred, FL, and R. Norberg, FDOC, Bartow, FL.  
([tspreen@ufl.edu](mailto:tspreen@ufl.edu)) [C-23]

According to production statistics from the UN Food and Agricultural Organization, China has now surpassed Brazil as the world’s leading citrus producing country. The Florida Department of Citrus commissioned a study by the University of Florida to provide an assessment of the market for citrus products in China with special reference to processed oranges and pummelos. In this paper, preliminary results from that study are presented. These results include the varieties of citrus fruit grown in China, regions of production, trends in imports and exports, and recent developments in the market for orange juice in China.

**Long-run Supply and Demand Forecasts for Processed Oranges.** M. Salois, FDOC,  
Gainesville, FL. ([msalois@ufl.edu](mailto:msalois@ufl.edu)) [C-24]

This paper presents long-run production and consumption forecasts, coupled with price forecasts, for Florida processed oranges. This is accomplished through a quantitative model of the world orange juice market. By conducting model simulations, possible answers to key questions about the future of the Florida citrus industry are provided. Will prices be high enough to cover costs? What will be the size of the Florida citrus industry in the future? What will be the impact of the citrus industry on the Florida economy? Although answers to such questions can only be provided in a probabilistic sense, such answers are critical for future planning purposes. In addition, the role of the Florida Department of Citrus is discussed. Special attention is given to the role of the Economic and Market Research Department, which provides relevant information impacting the Florida citrus industry and the Florida citrus growers. The Department responds to informational needs expressed by the Florida Citrus Commission, trade organizations, individual industry firms, and by staff members of the Florida Department of Citrus. Discussion will focus on the current portfolio of projects as well as plans for future projects within the Department.

**Evolution of Citrus Disease Management Programs and Their Economic Implications.** R.P. Muraro, UF/IFAS – CREC, Lake Alfred, FL. ([rpm@ufl.edu](mailto:rpm@ufl.edu)) [C-25]

This presentation focuses on the expanded costs of managing exotic citrus diseases as they become endemic or established within a citrus industry; Florida is used as an example. The Florida example begins before 2004 when Tristeza and blight-decline were the major disease problems; average annual sprays were 2 for processed juice fruit and 6 sprays for fresh market

grapefruit. When citrus canker became endemic after the 2004-2005 hurricanes and the ending of the eradication program in 2006 the number of sprays to manage the disease increased to 3 or 4 sprays for processed juice fruit and 10 sprays for fresh grapefruit. With the 2005 discovery of HLB in Florida, costs again increased to manage this disease; now the annual spray program includes 8 or 9 sprays for processed juice fruit and 14 for fresh market grapefruit.

The story told is how both total costs and specifically spray costs have increased in Florida as the citrus industry went from basically no exotic diseases except blight and Tristeza to citrus canker and HLB-greening. In 2010-11 values, the total base cultural costs for processed juice fruit would have been \$1,154/acre (spray costs \$190/acre) and fresh market grapefruit \$1,368/acre (spray costs \$393/acre). Now managing citrus canker and HLB-greening, the total cultural costs have increased to \$1,669/acre (spray costs \$453/acre) for processed juice fruit and \$2,142/acre (spray costs \$928/acre) for fresh market grapefruit. The message of this paper is managing new exotic endemic diseases is very costly and that Florida and U.S. government should focus on preventing the introduction of other diseases such as CVC and Leprosis.

**Worker Productivity of Gleaners, Implied Piece Rates, and Implications for Mechanical Harvesting.** F.M. Roka, UF/IFAS – SWFREC, Immokalee, FL. ([fmroka@ufl.edu](mailto:fmroka@ufl.edu)) [C-26]

Many horticultural crops are harvested with hand labor. The purpose of this paper is to estimate a functional relationship between worker productivity and available crop yield. The extent to which productivity is influenced by fruit availability could have important implications on predicting the necessary piece rate for hand harvesters to “glean” after mechanical harvesting systems, and to provide some economic guidance into engineering goals for improved fruit recovery performance by a mechanical system. Field level data on orange production and harvesting were collected from 112 blocks in southwest Florida. Available yield was found to have a significant and positive effect on worker productivity. Worker productivity increased at a decreasing rate with more yield until worker productivity reached near 10 boxes or oranges per hour, which suggests an upper limit to human performance with respect to harvesting oranges. Gleaning costs are expected to increase at an increasing rate as fruit removal percentage of a mechanical harvesting system approach 95%. The high current value of fruit, however, should continue to encourage gleaning even if a mechanical system collected 99% of available fruit.

**NATURAL RESOURCES**

**Utilization of Anaerobic Digester Effluent as a Fertilizer Source.** R. Toussaint, School of Natural Resources and Environment, and A.C. Wilkie, Soil and Water Science Dept., UF/IFAS. ([acwilkie@ufl.edu](mailto:acwilkie@ufl.edu)) [NR-1]

The continuous growth of the world’s population has led to a constant need to increase global food production. This required increase in food production necessitates an augmentation of agricultural inputs, specifically fertilizers. Anaerobic digester effluent, the liquid end-product of the anaerobic digestion of organic matter, can be employed as an alternative fertilizer. Utilization of effluent as fertilizer recycles the nutrients from organic wastes generated on-farm and therefore closes farm nutrient cycles. Synergistically, anaerobic digestion produces biogas, which can be used as a renewable energy source. Utilization of biogas and digester effluent

alleviates greenhouse gas emissions through direct fossil fuel displacement and the diminution of inorganic fertilizer production. In this study, the effluent of an anaerobic digester that has been fed kitchen wastes and crop residues was analyzed for major plant nutrients and tested as a fertilizer source compared to conventional fertilizers. Laboratory results showed that the digester effluent contained 486 mg/L of Total Kjeldahl N, 85 mg/L of P and 374 mg/L of K. After adjustment for nitrogen losses, this material can supply 200 lbs N/acre, 112 lbs. P<sub>2</sub>O<sub>5</sub>/acre and 260 lbs K<sub>2</sub>O/acre at an application rate of 2.5 inches/acre. At this rate, digester effluent supplies 100% of the N and K required by tomato, bean, and sweet corn, while 74% of the phosphorous required can be supplied. Increasing the application rate to 3.4 inches/acre will provide all of the nutrients recommended for these crops. Preliminary growth studies using anaerobic digester effluent as a fertilizer source have shown promising results.

**Determining the Agronomic and Physiological Characteristics of the Castor Plant (*Ricinus communis* L.): Developing a Sustainable Cropping System for Florida.** D. Campbell, D. Rowland, R. Schnell, and J. Ferrell, Agronomy Dept., and A.C. Wilkie, Soil and Water Science Dept., UF/IFAS. ([dlrowland@ufl.edu](mailto:dlrowland@ufl.edu)) [NR-2]

An increased energy demand combined with rising costs of fossil fuels has created an interest in renewable bioenergy sources and the refinement and optimization of cropping systems for sustainable production. Several U.S. states including Florida are considering Castor (*Ricinus communis*) as a biodiesel and industrial feedstock due to its unique oil composition and high potential yield. Castor has been studied in the past and rejected as a feedstock due to the presence of the toxin ricin and excessive height and vegetative growth. Recent breeding efforts have produced a dwarf variety of castor, Brigham, which contains approximately 10% of the ricin found in the standard cultivar, Hale. We conducted research into the basic agronomic practices that would be best suited for castor production in Florida. The efficacy of plant growth regulators and harvest aids on the yield of both Brigham and Hale cultivars provided information on control of excessive vegetative growth and crop termination in the semi-humid environment of north Florida. Basic phenological data such as leaf area index, plant height, and seed count were quantified throughout the growth season. Physiological measurements including sap flow, gas exchange and leaf relative water content were also measured. Finally, seed yield and expressed oil was determined at crop maturity and the conversion to biodiesel was examined. This research will help determine the best practices to increase yield, while reducing cost and water use for castor production in Florida.

**Biochar Applications in Agriculture for Resource Conservation.** S.I. Friedman, and D.D. Treadwell, Horticultural Sciences Dept., A.C. Wilkie, Soil and Water Science Dept., A.R. Zimmerman, Dept. of Geological Sciences, and B. Rathinasabapathi, Horticultural Sciences Dept., UF/IFAS. ([ddtreadw@ufl.edu](mailto:ddtreadw@ufl.edu)) [NR-3]

Biochar is the final product of any kind of organic matter (such as wood, crop debris, sewage sludge, manure, and yard trimmings) that has been heated in a closed container with little or no available oxygen in a process known as pyrolysis. The agricultural community is becoming increasingly interested in the application of biochar to production fields due to reported benefits of increased soil water and nutrient retention, in addition to long-term benefits with respect to retaining soil carbon. Scientific studies have shown that biochar offers two main benefits to

farmers: 1) it is more stable than any other amendment to the soil; and 2) it has a higher capacity to hold nutrients than any other amendment to the soil. Depending on the feedstock from which it is produced, biochar can provide a small amount of nutrients to the soil but the contribution to crop productivity would be minor. Nevertheless, its stability in soils, water holding capacities, and adsorption of nutrients suggest that biochar has significant potential to increase irrigation and fertilizer efficiencies. Field and greenhouse studies show that biochar can significantly improve crop biomass and yield in varying contexts. When added to the poultry manure composting process, biochar has been shown to significantly improve retention of nitrogen, and has been shown to retain phosphorous from anaerobically digested dairy manure effluent. Biochar's agricultural and conservation effects in soils have been shown to be especially pronounced in acidic sandy soils.

**Can Lotus (*Nelumbo* spp.) be used to Remove Heavy Metals from Contaminated Florida Soils?** W.O. Obando, FLREC, UF/IFAS, F.M. Woods, and K.M. Tilt, Auburn Univ., D. Tian, Shanghai Chenshan Plant Science Research Center, J.R. Kessler, F. Dane, W.G. Foshee, J.L. Sibley, A. Caylor, J. Olive, D. Fields, J.A. Chappell, and D. Cline, Auburn Univ., and L.A. Gettys and K. Moore, FLREC, UF/IFAS. ([orozcow@gmail.com](mailto:orozcow@gmail.com)) [NR-4]

Heavy metals often accumulate in Florida soils and water bodies as a result of anthropogenic activities such as urban run-off, agricultural operations and landscape cultivation. Some aquatic macrophytes are able to absorb and transform heavy metals from contaminated soils and polluted waters, but proper plant selection plays an important role in the success of remediation efforts. Lotuses (*Nelumbo* spp.) are sturdy, herbaceous aquatic perennials that produce large amounts of biomass. Little work has been done regarding the pattern of accumulation of heavy metals in this genus, which includes Asian lotus (*N. nucifera*) and American lotus (*N. lutea*), a species native to Florida. Baseline tissue composition for ornamental cultivars of lotus was determined and patterns of Mn accumulation were assessed by exposing mature plants to different Mn concentrations (0, 5, 10, 15 and 50 mg/L). Despite high foliar levels of several metals (e.g., Mn, Ni, Na and Zn), plants exhibited minimal visual signs of toxicity. Increasing Mn concentrations in treatment solutions resulted in linear accumulation of Mn in leaves (>3,000 mg/L). Mn treatments did not affect accumulation of As, Cu, Cr, Fe, Ni, Pb or Zn mg/L in leaves, but concentrations of As, Cu, Fe, Ni and Zn in rhizomes increased linearly over time. Na accumulation was affected by Mn concentration and longer exposure periods (4 to 6 weeks) resulted in higher Na accumulation, predominantly in petioles. Lotus plants hyperaccumulated Al and Fe in rhizomes (> 9,500 and > 6,000 mg/L, respectively) and Na in petioles (>13,000 mg/L) without visible signs of toxicity. This research demonstrated that lotus has potential for use in phytoremediation of soils and water contaminated with heavy metals.

**Use of Barn Owls for Sustainable Rodent Control in Agricultural Areas.** R.N. Raid, University of Florida, Everglades Research and Education Center, Belle Glade, FL, and W.T. Haller, Agronomy Dept., UF/IFAS. ([rnraid@ufl.edu](mailto:rnraid@ufl.edu)) [NR-5]

In the Everglades Agricultural Area (EAA) of south Florida, rodent pests annually inflict millions of dollars in crop losses to vegetables, sugarcane, and rice. For decades attempts were made to control rodent populations through the sole use of chemical rodenticides. However, rodenticides are costly and pose risks to non-target species. With sustainable rodent control as

the ultimate goal, University of Florida extension specialists have implemented a program encouraging agricultural producers to erect nesting boxes for barn owls (*Tyto alba*) on agricultural lands. Seeking to satisfy multiple objectives, the UF Barn Owl Project utilizes these prodigious rodent predators as a model system for instructing youth and the general public about symbiotic relationships that frequently exist between the environment and agriculture. Student and adult volunteers enthusiastically support the project by assisting in the construction of nesting boxes while learning about this highly beneficial raptor. Due to a paucity of suitable natural nesting sites, the nesting boxes are quickly colonized, and research indicates that barn owl densities in the EAA are now some of the highest in North America. A number of growers report that they no longer even use chemical rodenticides. But perhaps the greatest beneficiaries of the UF Barn Owl Project are students and teachers. Owl pellets, regurgitated masses containing the undigested remains of rodents and other owl prey, are routinely collected, heat-sterilized, and used for providing hands-on lessons in predator/prey relationships. The personal involvement facilitated by the Barn Owl Project provides all participants with a sense of contribution and accomplishment.

**Feral Hog Management Practices Inventory.** K.T. Gioeli, St Lucie Co. Extension, UF/IFAS, E. Underwood, Wrensong Science & Environmental Education, and J. Huffman, Florida Master Naturalist Program, UF/IFAS. ([ktgioeli@ufl.edu](mailto:ktgioeli@ufl.edu)) [NR-6]

It is believed that hogs were first brought to Florida in 1539 when Hernando de Soto brought swine to provision a settlement established at Charlotte Harbor in Lee County. However, it is possible that hogs had been brought to the same site in 1521 by Ponce de Leon during a brief visit. During the next four centuries, explorers and settlers brought pigs with them throughout Florida. Many of these animals escaped from captivity and established feral populations. The population of feral hogs may exceed 500,000 animals in Florida. Land managers often determine that feral hogs must be managed for several reasons: 1) Rooting and tusking are extremely destructive and detrimentally impact natural biological communities and pose a threat to native, rare and endangered plants; 2) Rooting can alter hydrology and create severe ground disturbances; 3) Soil disruption can result in establishment of undesirable invasive exotic plants; 4) Transmittable diseases such as swine brucellosis occur within the population; 5) Females can give birth twice a year with as many as 13 piglets per litter; 6) They may be aggressive to people. The UF/IFAS St Lucie County Cooperative Extension conducted a feral hog management practices survey to determine what practices are being undertaken by public and private natural areas managers as well as feral hog trappers.

**Evaluating Master Planned Communities Design Impacts on Water Quality with the Watershed Assessment Model: The Restoration Project Case Study.** F. Hazan, School of Natural Resources and Environment, UF/IFAS, P. Jones, Program for Resource Efficient Communities, UF/IFAS, D. Bottcher, Soil and Water Engineering Technology, and B. Larson, Program for Resource Efficient Communities, UF/IFAS. ([jimj@ufl.edu](mailto:jimj@ufl.edu)) [NR-7]

Anticipating the impacts precipitated by urbanization has clear environmental and economic advantages. Dynamic watershed simulation models have a potential role in urban planning and design, as an important accessory to regional strategies, particularly TMDL programs, providing a more reliable alternative to the current “rebuttable presumption of compliance.” This study sheds light into the environmental impacts to aquatic ecosystem services precipitated by land use

change as well as stormwater and landscaping best design and management practices associated with land development. It does so by evaluating the nutrient loading to the Spruce Creek and Indian River Lagoon sub-basins projected to originate from proposed development plans of the Restoration Development of Regional Impact in Edgewater, FL. Two very distinct (compact and extensive) master plan alternatives of the 5,187 acre, 8,500 dwelling-unit master planned community are compared and contrasted to the pre-development conditions by means of the Watershed Assessment Model (WAM).

**Community Associations' Impact on Water Quality and Water Use.** A. Post, Sarasota County Extension, UF/IFAS. ([post@scgov.net](mailto:post@scgov.net)) [NR-8]

The Sarasota County Extension Florida-Friendly Landscaping™ Program for Community Associations was established to educate community associations, neighborhoods, and associated professionals on how to create and maintain landscapes that help reduce the pollutant load in stormwater runoff. The program addresses these goals by establishing educational programs that promote environmental sustainability through good landscape and natural area management practices. The program seeks commitment from participants through actively involving the target group, through site visits and presentations. Participants at site visits are interviewed after one year. Those present at presentations receive an evaluation form. 425 (94%) of the 447 communities that received site visits since the start of the program made positive changes: 389 (87%) reported changes to irrigation system management and 49 (11%) reported removing invasive plants and/or restoring natural areas. Of the approximately 2500 attendees at educational programs annually, 99% indicated on evaluation forms that they intend to make changes in their landscape practices. The knowledge gain is rated as 35%. Observed water savings of four Community Associations was approximately 390,000 gal/acre. Potential future water savings of the 620 associations visited (total acreage approximately 10,622) based on 90% participation ( $10,622 \times 0.9 = 9,560$  acres  $\times 390,000$  gal/acre  $\times 50\% = 1,864,200,000$  gal/year, conservatively. The success of this program has led to continued county funding through 2014, and was also the incentive for the Southwest Florida Water Management District to fund similar programs in several other Florida counties.

**Aquaponics – Sustainable Vegetable and Fish Co-Production.** R.V. Tyson, Orange Co. Extension, E.H. Simonne, Office of District Extension Directors, and D.D. Treadwell, Horticultural Sciences Dept., UF/IFAS. ([rvt@ufl.edu](mailto:rvt@ufl.edu)) [NR-9]

Aquaponics combines hydroponic plant and aquaculture fish production into a sustainable agriculture system that integrates plant and animal production, uses natural biological cycles (nitrification) to supply nitrogen, and thus minimizes the use of the non-renewable resources required when using fertilizer crop production inputs. A review of existing aquaponic systems will focus on opportunities and challenges to system sustainability. These systems will be discussed with emphasis on management and integration of the plant and nitrifying bacteria system components and their effect on biofiltration, nitrogen production and usage. Sustainable opportunities include the potential for biological nitrogen production rates of 80-90 g/m<sup>3</sup>/day nitrate nitrogen from biofilters and plant uptake of aquaculture waste water. Challenges are balancing the aquaponic system environment for the optimum growth of plants, fish, and nitrifying bacteria and minimizing effluent discharges to the environment. Preliminary data from

an aquaponic research/demonstration at Orange County Extension's Exploration Gardens will be presented.

**Greenhouse Culture of Submersed Aquatic Vegetation "Sod".** L.A. Gettys, FLREC, and W.T. Haller, Agronomy Dept., UF/IFAS. ([gettys@ufl.edu](mailto:gettys@ufl.edu)) [NR-10]

Lake restoration projects can be challenging due to the limited availability of submersed native plant material, the difficulty of installing plants in an underwater environment, and the instability of many submersed sediments. Significant resources are expended to execute these types of projects, but success is often hindered because newly planted vegetation fails to anchor, establish and expand from the transplant site. These roadblocks can be addressed by producing "sod" of submersed vegetation in the greenhouse. This technique starts with a small number of plants that are plugged into a biodegradable matrix and cultured in tanks for several months, and culminates with well-rooted, densely vegetated mats that can be rolled up and transported to the restoration site. "Sod" produced in this manner is easily installed in the field and results in an instant population of submersed native vegetation that quickly establishes and expands from the transplant site.