

## Abstracts of the 2011 Meeting of the Florida State Horticulture Society

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### [POSTER SESSION \(Brad Burbaugh, 2011 Poster Session Coordinator\)](#)

**Fungicidal Management of Alternaria Leaf Spot on Parsley.** D. D. Sui, UF/IFAS Palm Beach County Extension, West Palm Beach, Fl. and R.N. Raid, UF/IFAS Everglades Research and Education Center, Belle Glade, Fl. [P-1-V]

Florida is one of the nation's leaders for fresh-market parsley production, with much of this acreage being located on the organic soils of the Everglades Agricultural Area in Palm Beach County. Although Septoria leaf spot, caused by *Septoria petroselini*, and powdery mildew, incited by *Erysiphe heraclei*, are occasional problems, Alternaria leaf spot caused by *Alternaria radicina* has become a perennial problem. Capable of surviving on infested seed for several years, the pathogen may also become resident in the soil, surviving as microsclerotia. Unlike the survival stage of another sclerotia-forming fungal pathogen common in the area, *Sclerotinia sclerotiorum*, microsclerotia of this particular pathogen do not appear to be easily controlled by flooding, a common offseason cultural practice in the Glades. To assist growers in learning how to manage this economically important parsley disease, two fungicide trials were conducted during the spring of 2010. 'Dark Green Italian' parsley was direct-seeded in two rows with a 12-in. row spacing on top of 6-in. raised beds formed on 3-ft centers in a 0.5-A field at the UF/IFAS Everglades Research and Education Center in Belle Glade, FL, on 24 Jan. Each experiment consisted of a randomized complete block design with four replications of ten treatments. Experimental units were 2-row 15-ft bed sections, separated on the end by 5-ft alleys. Non-sprayed guard beds bordered each experimental unit and served as inoculum spreader rows. Chemical treatments were applied using a CO<sub>2</sub> backpack sprayer. The hand-held boom was equipped with three Tee-Jet 11002 flat-fan nozzles. Foliar sprays were applied at 30 psi, delivering a spray volume of 60 gal/A. Fungicide treatments were applied on 24 and 31 Mar. and 5 Apr. Disease pressure arose from natural inoculum evenly distributed within guard beds on 22 Mar. Disease was assessed visually by estimating the percentage of foliage exhibiting necrotic lesions on 15 and 19 Apr. Leaf spot was rated on a 0 to 10 scale on 19 Apr, with 0 representing no disease and 10 representing the level of disease in the untreated check. All fungicide treatments provided significant disease control (Table 1). In Trial 1, Luna Sensation, Rovral, and the strobilurin fungicides Cabrio and Quadris provided the most efficacious control,

followed by the broad-spectrum fungicide Bravo, Endura, Switch and Propimax, in that order. In Trial 2, LEM17 and the strobilurin Evito provided the best control, followed by YT669, LBG-61, and Bravo, which provided moderate levels of control. Kocide and Serenade Max provided significant control but were not as efficacious. While several of these products are experimental at this time, these results should prove useful in selecting fungicides to manage this important disease. It is highly recommended that fungicides of dissimilar mode of action be alternated or tank-mixed in order to slow or prevent resistance to certain classes of fungicides.

Table 1. Disease severity and leaf spot ratings of parsley as a response to fungicide treatments.

Fungicide treatment and rate/A <sup>z</sup>	Disease severity (%) <sup>y</sup>		Leaf spot rating <sup>z</sup>
	15 Apr	19 Apr	
<b>Trial 1</b>			
Untreated check	13	39	10.0 a
Luna Sensation 500SC 5.0 fl oz	2	3	1.5 e
Luna Sensation 500SC 7.6 fl oz	1	1	0.6 f
Rovral 4F 2.0 pt	1	3	1.1 ef
Cabrio EG 12.0 oz	2	2	1.2 ef
Quadris 2.08SC 15.2 fl oz	2	2	1.3 e
Bravo Ultrex 82.5WDG 1.5 lb	2	6	2.5 d
Switch 62.5WG 14.0 oz	3	10	4.0 b
Propimax 3.6EC 4.0 fl oz	3	17	4.5 b
Endura 70WG 4.5 oz	4	7	3.1 c
<b>Trial 2</b>			
Untreated check	14	42	10.0 a
Bravo Ultrex 82.5WDG 1.5 lb	2	6	2.5 d
LEM 17 200EC 24.0 fl oz	1	2	1.3 e
YT669 2.08SC 12.0 fl oz	1	4	2.3 d
Prosaro SC 7.0 fl oz	1	8	4.0 c
LBG-61 3.0 pt	2	5	2.4 d
Evito 500SC 5.7 fl oz	1	2	1.3 e
Kocide 3000 2.0 lb	2	14	5.6 b
Gem 500SC 3.0 fl oz	3	8	3.4 c
Serenade Max WP 3.0 lb	4	16	6.0 b

<sup>z</sup> Use or mention of a particular product in these trials does not constitute an endorsement.

<sup>y</sup> Disease was assessed visually by estimating the percentage of foliage exhibiting necrotic lesions on 15 and 19 Apr. Leaf spot was rated on a 0 to 10 scale on 19 Apr, with 0 representing no disease and 10 representing the level of disease in the untreated check

<sup>x</sup> Within trial, means followed by different letters are significantly different according to Fisher's LSD at p=0.05.

**Beginning Farmers: Hmong Grower Meeting Series.** M.E. Henry, UF/IFAS Polk County Extension, Bartow, FL.; C. Snodgrass, UF/IFAS Manatee County Extension, Palmetto, FL. and A. Whidden, UF/IFAS Hillsborough County Extension, Seffner, FL. [P-2-V]

Hmong are a people originally from Laos (a country that borders Vietnam), who immigrated to the United States as a result of persecution in their home country after the Vietnam War. Originally immigrating to areas in the Midwest, Hmong people have recently relocated to Florida where they found a new climate and different soil conditions. In their home country, most Hmong have subsistence family gardens where rice, leafy vegetables and Asian vegetables, such as bitter melon, are grown. Now in Florida, Hmong growers have organized to form the Florida Hmong Community, Inc. to maintain cultural ties and assist each other in transition to their new surroundings. The Florida Hmong Community contacted a legislator for assistance in growing their traditional crops in their new location. Extension administrators were contacted on their behalf, and enlisted local Extension Agents to provide education to help these new Florida residents adapt their native farming practices to their new climate and soil.

Exploratory tours of Hmong farms were conducted, where small plots of rice growing in dry fields and other practices unfavorable for production in Florida were observed. It was also observed that the Hmong community was generally concentrated along the I-4 corridor from Polk to Manatee County, in addition to Highlands and Pinellas County. A five month series of two hour Saturday programs, translated into participants' native language ensued. The program organized by the vegetable Agents of Hillsborough and Manatee Counties and the small farms Agent of Polk County, aimed at increasing the awareness of farming practices and opportunities in Florida.

Program activities included farm visits and collaborative efforts of 4 Agents, 2 Specialists, local USDA and other governmental representatives, as well as an established successful Asian vegetable grower. Teaching methods included presentations, demonstrations of applied entomology, interactive question and answer periods, and equipment displays covering topics such as vegetable production for farmers markets, co-ops, Worker Protection Standards, pesticide licensing, insect pests, disease, and available USDA resources (Fig. 1). Topics chosen were based on interests expressed through a written survey of the participants. 75 contacts were made over the course of the series.

This program was evaluated through discussion with group leaders and an end-of-series printed evaluation (n=9). Results showed that 100% (n=9) increased awareness and understanding of agricultural concepts and opportunities; 89% planned to apply the concepts learned; 78% strongly agreed that the series enabled them to make better decisions regarding their small farm; and, 67% expected increased sales as a result of the series. One grower joined the Polk County Small Farms Advisory Committee and participated in a video on the small farms of the County. Regional Extension agents will continue to work Hmong growers and gauge interest for presenting a second educational series.

Fig. 1. Hmong growers participating in a UF/IFAS Extension program listen attentively to speaker Ken Schuler explaining through a translator how to make vegetable raised beds.



### **Vegetable growers in the Suwannee Valley optimize fertilizer use by implementing best management practices**

D. Fenneman, UF/IFAS Madison County Extension, Madison, FL; E. Toro, UF/IFAS Suwannee County Extension, Live Oak, FL; R. Hochmuth and M. Bauer, North Florida Research and Education Center, Live Oak, FL; and C. Vann, UF/IFAS Lafayette County Extension, Mayo, L. [P-3-V]

Vegetable growers in the Suwannee Valley have adopted drip irrigation and plastic mulch over the past twenty five years to produce vegetable crops such as tomato, bell pepper, eggplant, cucumber, muskmelon, and watermelon. Soils in the area are sandy with low water holding capacity and low organic matter content. Consequently, vegetable production in North Florida requires intense irrigation and fertilization management. University of Florida/IFAS County Extension agents have been working with vegetable growers in North Florida to refine their management of the technology since it was introduced to the region about twenty five years ago. The emphasis of the educational program has been to improve efficiency of water and nutrient management by conducting on-farm weekly sap testing. Plant nutrient status can be determined in the field by squeezing plant sap onto meters that measure either nitrate-nitrogen or potassium (Fig. 1) which provides growers with instant results on plant nutritional status and enables them to make real-time fertilizer application decisions. In addition, updates on nutrient and irrigation management technologies are offered through advanced trainings such as the Drip Irrigation School or the Annual Suwannee Valley Watermelon Growers Meeting. The benefits of improved management have been multifold as reported by cooperating producers: reduction in fertilizer use, improved fruit quality, reduced environmental losses of nitrogen, fertilizer applications to match plant requirements, and improved economic returns to the farm. Suwannee Valley watermelon growers have adopted several BMPs including: irrigation sensors, petiole-sap

testing, and refining fertilization rates; resulting in adoption of UF/IFAS nutrient recommendations on nearly 100% of the area watermelon acreage. In summary, combining these educational programs in the Suwannee Valley area has made a great impact toward the voluntary adoption of BMPs. Growers see and learn on their own farm and often serve as early adopters that help teach other growers. Most county agents in the Suwannee Valley are trained to use sap testing meters and provide this as a service to farmers in their counties.

Fig. 1. Riley Putnal of Putnal Farms, Live Oak, Fl. uses a petiole sap testing meter to monitor crop nutritional status and adjust his fertilizer program.



**Remove the Confusion of Pesticide Licensing.** S. Haddock, UF/IFAS Hillsborough County Extension, Seffner, FL. [P-4-OGL]

Commercial Horticulture and Agriculture Safety Agents provide pesticide applicator license training, examinations and continuing education. There are 33 different pesticide license categories governed by two sections of the Florida Department of Agriculture and Consumer Services (FDACS) and three Florida Statutes. This licensing structure can be confusing to the layman and often the client base and Extension Agents trying to help them need to determine (1) which FDACS section administers each license, (2) which Florida Statute governs each license, (3) who administers the exam, (4) the amount of the initial license fee and renewal fee, (5) the number of CEUs required to renew a license and (6) which specific license the client needs. The objective of this project was to develop a streamline visual approach to increase the efficiency of assisting clients and Extension Agents in determining licensing information. The methodology was to develop an organizational chart format that provides a visual description of the FDACS sections, State Statute authority, license types, costs, renewal and CEU requirements for each license type. This publication provides a clear, easy to follow and time saving method for assessing pesticide applicator license information. Additionally, it serves to enhance Extension Agent professionalism and efficiency. This approach enhances the Agent's understanding of pesticide applicator licensing and ability to educate the industry professional in a visual manner. This format can be utilized by Extension Agents statewide to clarify pesticide license requirements. The format contains a lot of information and requires a basic knowledge of pesticide licensing in Florida.

**Rain Lilies for Central Florida . M. D'Abreau, UF/IFAS Hillsborough County Extension, Seffner, FL.; Z. Deng, R. Rixom, D. Schwaninger and N. West, Gulf Coast Research and Education Center, Balm, FL. [P-5-OGL]**

Rain lilies are defined by the two genera *Zephyranthes* and *Habranthus*. There are about 70 known species and more than 80 cultivars and hybrids. Originating in the Americas, they are grown in zones 7 through 10 and often in the wild along highways and medians. The original species' colors (white, pink, mauve and yellow) have been augmented by those of the cultivars and hybrids (salmon, orange and red). In 2008, University of Florida Gulf Coast Research and Education Center scientist Dr. Geoffrey Denny collected three varieties of *Habranthus* and nine varieties of *Zephyranthes* with the intent to study their performance in Central Florida. Through a partnership with Dr. Marina D'Abreau, Urban Horticulture Extension agent and Master Gardener Volunteer Program coordinator in Hillsborough County, FL, two Master Gardener volunteers – Diane Schwaninger and Roger Rixom – carried out the work directed by Dr. Denny (and subsequently by Dr. Deng) and Biological Scientist, Nancy West. An irrigated 8' x 32' topsoil bed was divided into 182, 1' x 1' sections (7 wide and 26 deep), and the clumps of each variety were planted in a random fashion. An Osmocote Plus extended release fertilizer (15-9-12) was applied at the rate of one tablespoon per clump at the beginning of each 30-week growing season starting on May 1, 2009 and 2010. Four performance criteria (frequency of flowering, length of flowering season, growth factor and resistance to climatic conditions) were used to develop a list of recommended rain lilies for Central Florida (Table 1): *Z. candida* (pale pink/white, stands up well to weather, strong grower with extended prolific flowering); *Z. grandjax* (pale mauve, late prolific flowering); *Z. traubi* (white, extended prolific flowering, strong grower, wilts in rainfall); *Z. grandiflora* (purple, very large flowered, strong grower, not prolific flowering but very showy). The study will continue through year 3 with a reduced replication (3 per variety) to make the count and measurement less labor intensive. In addition, some initial studies will commence on some more modern hybrids. At the start of year 3, approximately 1,500 *Z. candida* bulbs will be incorporated into a nitrogen requirement study at the Gulf Coast Research and Education Center. Several new varieties with larger and more colorful blooms have been obtained from an overseas source. A hybridization program is in its early phase to improve the bloom quality of *Z. candida*. The Master Gardener volunteers will collaborate with Dr. D'Abreau to develop a fact sheet and other relevant educational materials for Central Florida residents.

Table 1. Flowering performance ratings of 12 varieties of rain lilies grown in Central Florida at the UF/IFAS Gulf Coast Research and Education Center in Balm, FL.

Code	No. of Plants	Through 30 weeks; No. of Flowers/Plant		Growth Factor		Flowering Season (weeks of 30-week program)		Notes
		2009	2010	2009	2010	2009	2010	
<b>H</b>	13	8.57	27.57	1.10	1.82	7 to 20	6 to 21	
<b>HB</b>	7	2.14	7.86	1.56	2.64	N/A	6 to 18	
<b>HT</b>	7	5.29	23.29	1.26	0.20	4 to 20	6 to 26	
<b>Z</b>	24	0.96	42.71	1.84	1.55	N/A	6 to 20	
<b>ZC</b>	16	14.25	164.94	1.46	2.44	8 to 26	7 to 27	Good cold and wet weather resistance
<b>ZF</b>	23	7.70	23.43	1.66	0.81	9 to 26	4 to 20	
<b>ZGF</b>	5	3.80	9.20	1.09	0.18	N/A	N/A	Very large showy flowers
<b>ZGJ</b>	24	11.75	61.91	1.64	1.62	6 to 26	6 to 26	
<b>ZJ</b>	2	5.50	15.00	0.02	0.55	N/A	N/A	
<b>ZL</b>	18	5.56	22.89	1.37	0.73	7 to 26	6 to 26	
<b>ZR</b>	6	5.33	18.50	2.35	0.90	N/A	N/A	
<b>ZT</b>	29	16.00	87.30	1.80	1.81	5 to 25	4 to 26	Flowers wilt in wet weather

**Pesticide Formulations: The Benefit of Interactive CORE Workshops.** Erin E. Harlow, UF/IFAS Duval County Extension, Jacksonville, FL. [P-6-OGL]

In 2010, the Florida Department of Agriculture and Consumer Services indicated that 2,571 licensed applicators and 1,777 pest control technicians in Duval County needed General Standards or CORE training to renew their licenses. CORE requirements for renewal may include two or four hours of training within a one to four year period. To be approved for CORE a training class should include material on pesticide safety, handling, laws and regulations, off-site movement, and formulations. Extension offices are the most common place applicators come to receive their CORE training. CORE training can be tedious for both the agents and the audience because the material may not always be interesting. In an effort to make CORE more student-friendly, the agent in Duval County created a hands-on pesticide formulation workshop using a workshop originally developed from material created by a Washington State agent and Penn State specialist. In Duval County, the workshops have been formatted to fit a two hour class or a one hour class. The agent provided this workshop as part of her bi-annual four-hour technician training, at the Jacksonville annual Florida Turfgrass Association regional seminar, and as an invited speaker at the Florida Turfgrass Annual Conference. Over the year, 228 individuals participated in some variation of this workshop. The first part of the curriculum

focuses on the different types of pesticide formulations (Fig. 1) and the second part of the curriculum gives participants a chance to mix household products representing different formulations and determine if they are compatible. County offices would benefit from using this curriculum because it provides an interesting and flexible curriculum that keeps the audience interested. It also provides audiences with an understanding of different formulations and the importance of completing a jar test before chemicals are tank mixed. The negative aspects of this program depend on how much of the program is being completed. If the applicators will be completing the pesticide compatibility mixing then the set-up and clean-up can be tedious. The organizational aspect of this program is the most difficult component of the program. The agent also needs to be somewhat familiar with pesticide formulations to facilitate the workshop. Overall, this has been a very beneficial addition to the Duval County pesticide safety program. The audience always seems to enjoy the interactive aspect of the program. At one particular program, the agent was approached by a chemical supplier who said “they had never seen anything like this and thought it was a great idea”.

Fig. 1. Students work in groups using household products to complete the incompatibility testing portion of the workshop during a CORE training offered by the Duval County Extension Service in Jacksonville, FL.



**Making Impacts with the North Florida Annual Hay Field Day.** C.B. Sanders, and B.J. Wilder, UF/IFAS Alachua County Extension, Gainesville, FL; D.L. Barber, UF/IFAS Columbia County Extension, Lake City, FL; J.W. Breman, Florida Partnership for Water, Agriculture & Community Sustainability, Hastings, FL; M.S. Sweat and B. Burbaugh, UF/IFAS Duval County Extension, Jacksonville, FL; D. Fenneman, UF/IFAS Madison County Extension, Madison, FL; S.A. Gaul, UF/IFAS Nassau County Extension, Callahan, FL; D.B. Nistler, Clay County Extension, Green Cove Springs, FL; E.M. Toro, UF/IFAS Suwannee County Extension, Live Oak, FL; and, T.W. Wilson, UF/IFAS Bradford County Extension, Starke, FL. [P-7-SC]

The Northeast Florida Beef and Forage Group (NFBFG) is a multi-county collaboration of Extension Agents representing Alachua, Baker, Bradford, Clay, Columbia, Duval, Madison, Nassau, Suwannee, and Union counties, in addition to Extension Specialists at the University of Florida. A major goal of this program is to coordinate Extension and Research activities for enhanced forage and cattle production in North Florida. Programs are designed and planned

based on recommendations from an Advisory Committee. One successful Extension program offered through the NFBFG at rotating locations is the Annual Hay Field Day (Fig. 1). For the past ten years, annual attendance at this field day has averaged 85 participants. Educational topics covered at the field day include forage establishment, forage quality, herbicide updates, pesticide updates, forage yields, haylage production, soil testing, and equipment demonstrations. Based on evaluations from the field day and post visits with the producers, fifty-percent of those in attendance understand the importance of estimating dry-matter forage availability in pastures and plan to use a simple method that was taught to assist producer in determining forage dry-matter availability. In addition, sixty-four percent of hay producers plan to make changes to their fertilization program as a result of having a better understanding of the economic returns resulting from recommended rates of N, P and K in Bermudagrass. This Annual Hay Field Day has proved to be a successful Extension educational program, with agent presentations, specialist interaction and participation, research plots, and equipment demonstrations.

Fig. 1. UF/IFAS Extension Agents and North Florida hay producers discuss hay quality and harvest times at the Annual Hay Field Day in Lake City, FL.



**Field Evaluation of Blueberry Pruning Techniques.** R.A. Atwood, UF/IFAS Lake County Extension, Tavares, FL and G.K. England, UF/IFAS Sumter County Extension, Bushnell, FL. [P-8-K]

Pruning blueberry bushes is one of the most labor intensive and costly operations in a commercial planting. Proper pruning of blueberry plants will help obtain the desired plant size and shape, increase plant vigor and establishment of fruiting wood, reduce over fruiting and enhance size and allow sufficient sunlight penetration into the canopy to assist with proper fruit development. In June 2010, immediately after the first harvest of a central Florida commercial blueberry planting that had been established for approximately 15 months, a trial was initiated to compare a grower standard pruning program to three pruning regimes (roof, box, and hedge) and an unpruned treatment in two southern highbush cultivars ‘Jewell’ and ‘Emerald’. Three field days were held throughout the year for growers to evaluate the differences between pruning regimes. Over 80 Central Florida blueberry growers attended a final field day to observe results of pruning techniques. These growers were surveyed to determine if they would adopt any of the pruning techniques that were demonstrated and thirty-two percent of attendees from survey

results indicated that they would. Fifty-three percent of attendees also indicated that they were continuing to evaluate alternative pruning methods, while sixteen percent are planning to maintain their current pruning practices. Production practices for blueberry grown in Florida are still being refined for this emerging industry. Central Florida has a subtropical climate which differs from other areas of the U.S. in which blueberries are produced. This field evaluation allowed growers to determine the effects of different pruning techniques and refine or adopt new pruning techniques for their operations. Proper pruning techniques will maximize returns for Central Florida blueberry production.

Fig. 1. Commercial ‘Emerald’ blueberry planting managed with the “box” pruning practice shown to growers during a UF/IFAS Extension demonstration in Central Florida.



## VEGETABLE SECTION

**Efficacy of Experimental and Registered Miticide Programs for Twospotted Spider Mite on Strawberry.** J. F. Price and C. A. Nagle, UF/IFAS Gulf Coast Research and Education Center. ([jfprice@ufl.edu](mailto:jfprice@ufl.edu)) [V-1]

Strawberries valued at \$362 million were produced on 9,000 acres in Florida during 2010. Every year, most fields experience some occurrence of twospotted spider mites (*Tetranychus urticae* Koch). Programs of biological control with *Phytoseiulus persimilis* exist but some growers prefer programs of miticides. Efficacy of miticidal products often declines through time and new products become available. New and existing miticides were applied in various programs to control twospotted spider mites in field-grown strawberry during winter 2010 and 2011 seasons. Experimental materials included formulations of the fungus derived material *Paecilomyces fumosoroseus*, the bacteria derived materials *Chromobacterium subsugae* and *Burkholderia* sp. strain A396 and materials derived from traditional chemistry cyflumetofen, fenpyroximate (new formulation), and abamectin (biologically derived) formulated with thiamethoxam. Registered materials included abamectin, avermectin B1 formulated with bifenthrin, bifenazate, fenpyroximate, hexythiazox, and spiromesifen. Programs involving experimental biologically derived materials formulated alone were less effective than other programs. Programs of several experimental and registered materials controlled twospotted spider mites well and products involved can provide great value to the strawberry industry.

**Current Status of Melon Thrips (*Thrips palmi* Karny Thysanoptera: Thripidae) in South Florida.** D.R. Seal, UF/IFAS Tropical Research and Education Center. ([dseal3@ufl.edu](mailto:dseal3@ufl.edu)) [V-2]

The melon thrips (*Thrips palmi* Karny) is an economic pest of various vegetable crops in South Florida. It attacks all above ground parts of its host plants causing severe economic loss to marketable yield. In a replicated field study, mean numbers of melon thrips per leaf sample were significantly higher on cucumber followed by bean, eggplant, squash, and pepper. Similar results were documented when samples were collected from growers' fields. Radiant provided significant control of melon thrips when compared with other insecticides and nontreated control.

**Yellow Traps for Assessing Diel Pattern of Density of Leafminer, *Liriomyza trifolii* (Diptera: Agromyzidae) and its Parasitoids, *Opius* spp. (Hymenoptera: Braconidae) and *Diglyphus* spp. (Hymenoptera: Eulophidae).** J. Li and D. R. Seal, UF/IFAS Tropical Research and Education Center; and G. L. Leibe, UF/FAS Mid-Florida Research and Education Center. ([jli59@ufl.edu](mailto:jli59@ufl.edu)) [V-3]

Leafminer (*Liriomyza trifolii*) is a worldwide pest on vegetable and ornamental plants. Hymenopteran parasitoid wasps have been applied in greenhouses and fields for controlling leafminer on economic crops. The diel density pattern of leafminer *L. trifolii* and its two prominent parasitoids, *Opius* sp. and *Diglyphus* spp. were studied by using yellow sticky traps in the bean field, south Florida. In the study, daytime was divided into 5 equal 2 hr intervals of 8:00 – 10:00, 10:00 – 12:00, 12:00 – 14:00, 14:00 – 16:00 and 16:00 – 18:00. In the fall season 2010, leafminer density was significantly higher in the first 2 hr (8:00 - 10:00) than any other

intervals. Parasitoid, *Diglyphus* spp. was significantly more abundant during the second 2 hr (10:00 – 12:00). However, *Opius* sp. did not show any significant diel pattern of density level among all intervals within a day. In the spring season 2011, parasitoids of *Opius* sp. and *Diglyphus* spp. showed a significant abundance in the second and third 2 hr interval, respectively. No significant density level of leafminer was found among all the 2 hr intervals.

#### **Evaluation of Herbicides for Management of Weeds in Sweet Basil (*Ocimum basilicum*).**

David Sui, UF/IFAS Palm Beach County Extension; Dennis Odero and Richard Raid, UF/IFAS Everglades Research and Education Center; and, William Stall, UF/IFAS Horticultural Sciences Dept. ([dsui@ufl.edu](mailto:dsui@ufl.edu)) [V-4]

Sweet basil is one of the world's most popular herbs, with much of the U.S. fresh market basil being produced in Florida. Growers in Palm Beach County plant over 1,000 acres of basil each year. In the field, weed control of prostrate amaranth, purslane, and goosegrass is a continual problem. With few registered herbicides, growers must rely on mechanical or hand weeding, which are frequently ineffective and expensive. Since 2008-09 season, basil herbicide trials have been conducted on a commercial sand soil site. Eight herbicides, napropamide (Devrinol), S-metalochlor (Dual), linuron (Lorox), dimethenamid (Outlook), and halosulfuron (Sanda), were applied pre-emergence, and three herbicides, Lorox, Sandea, and clopyralid (Stinger) were applied post-emergence. Of the pre-emergence treatments, all provided good weed control but Lorox, Outlook, and Dual resulted in crop death at the rates tested. Devrinol (2.0 lb/a) resulted in the highest crop vigor, followed by Sandea (0.375 oz/a). Of the post-emergence treatments, all gave some measure of weed control, with Stinger producing the least crop damage, followed by Sandea, and then Lorox. In a trial conducted on an organic soil site during 2009-10, Lorox was tested at three different rates pre-emergence, followed by Lorox, imazethapyr (Pursuit), and prometryn (Caparol), each at three different rates post-emergence. Lorox as a pre-emergence treatment on muck provided significant weed control and acceptable crop vigor at all three rates tested (0.125, 0.25, and 0.375 lb/a). Of the post-emergence treatments, only Lorox at 0.125 lb/a provided significant weed control with minimal reductions in crop vigor. Caparol resulted in crop death and Pursuit significantly reduced crop vigor at the rates tested. During the 2010-11 season, another basil herbicide trial was conducted on a commercial sandy soil site to re-evaluate 3 herbicides for both pre- and post-emergence treatments. The purpose was to replace V-Pam (\$330/a) for a comparable \$30/a weed control. Pre-emergence wise, Lorox at 0.1 lb/a resulted 100% crop vigor and the highest yield 8,302 lb/a with weed control of 83% (prostrate amaranth), 86% (common purslane), and 57% (goosegrass), respectively. The pre- and post-emergence combination 3 lb/a of Devrinol and 0.1 lb/a Lorox provided 100% crop vigor and the highest yield 12,173 lb/a with weed control of 97% (prostrate amaranth), 88% (common purslane), and 85% (goosegrass), respectively, whereas untreated check with yield of 996 lb/a. The saving from herbicide was \$300/a plus yield gain \$55,885/a.

**Evaluation of Acibenzolar-S-Methyl and Silicic Acid for Control of Phytophthora Blight in Squash Caused by *Phytophthora capsici*.** S. Zhang, W. Klassen, X. Mo, UF/IFAS Tropical Research and Education Center; P. Ji, Department of Plant Pathology, Coastal Plain Experiment Station, University of Georgia, Tifton, GA; and, A.J. Gevens, Department of Plant Pathology, University of Wisconsin, Madison, WI. ([szhang0007@ufl.edu](mailto:szhang0007@ufl.edu)) [V-5]

Phytophthora blight caused by *Phytophthora capsici* is a destructive disease of squash (*Cucurbita pepo*) in Florida and worldwide. Control of this disease remains an intractable problem. Highly resistant varieties of squash with ideal horticultural traits are currently not available. The long-term survival of *P. capsici* oospores in the soil limits the effectiveness of crop rotation. Few registered fungicides are highly effective in Florida. Greenhouse studies were conducted to evaluate the potential of the use of acibenzolar-S-methyl (ASM; Actigard® 50WG) and silicic acid applied separately or jointly for control of Phytophthora blight in squash. Applied as a soil drench or foliar spray, ASM alone at 20 and 30 mg/l significantly ( $P < 0.05$ ) reduced disease severity compared to the nontreated control. ASM applied as a soil drench at 30 mg/l provided the greatest protection with no symptoms developed. Silicic acid applied as a soil drench at 0.015 and 0.15 mM significantly suppressed disease severity by 47.7 and 53.3%, respectively, when compared with the nontreated control. Application of silicic acid in combination with ASM improved the efficacy of silicic acid and ASM each applied separately against Phytophthora blight. *In vitro* testing indicated that neither silicic acid nor ASM at test rates suppressed *P. capsici* by inhibiting growth of mycelia, production of sporangia or germination of zoospores. Results in this study suggest that ASM and silicic acid are effective against *P. capsici* in squash and may be incorporated into integrated management programs to control Phytophthora blight of squash.

**Reduced Incidence of Tomato Plants with Symptoms of Tomato Yellow Leaf Curl Virus Infection Grown on UV-Reflective Soil Mulch.** D.J. Schuster, UF/IFAS Gulf Coast Research and Education Center; and J.P. Gilreath and P.R. Gilreath, PhytoServices, Greenville, SC. ([dschust@ufl.edu](mailto:dschust@ufl.edu)) [V-6]

The sweet potato whitefly (*Bemisia tabaci*) is a major economic pest of tomatoes (*Solanum lycopersicon*) in southern Florida. Direct feeding can cause plant debilitation and disorders, including irregular ripening of tomato fruit. Most economic damage occurs through the transmission of plant viruses, one of the most damaging of which is *Tomato yellow leaf curl virus* (TYLCV) on tomato. Insecticides targeting whitefly adults are most often used to manage TYLCV. Alternative methods would contribute to more sustainable management. In studies conducted in the spring seasons of 2005 and 2006, whitefly adult abundance and incidence of plants with symptoms of TYLCV infection were compared for tomato plants grown on a ultraviolet light (UV)-reflective plastic mulch, a black mulch and a white on black mulch. The numbers of whitefly adults did not always differ statistically on plants grown on the different mulches. However, in both years, tomato plants grown on UV-reflective plastic soil mulch had a lower incidence of symptoms of TYLCV infection compared to tomato plants grown on black or white plastic mulch.

**Evaluation of Sanitizing Agents to Control Fusarium Species on Infested Irrigation Stakes Used for Greenhouse Tomato Production.** Tamika Garrick<sup>1</sup>, Annika Minott<sup>1</sup>, Carrie Harmon<sup>2</sup>, Elena Toro<sup>3</sup>, R.C Hochmuth<sup>4</sup> and C.R. Semer IV<sup>5</sup>. Doctor of Plant Medicine Program<sup>1</sup>, UF-IFAS Plant Disease Clinic<sup>2</sup>, UF-IFAS Suwanee County Extension Office<sup>3</sup>, UF-IFAS, Multi County Extension Agent North Florida Research and Education Center- Suwanee Valley<sup>4</sup>, UF/IFAS Clinical Trials Program. ([ronika2005@gmail.com](mailto:ronika2005@gmail.com)) [V-7] **(Student Best Oral Presentation Competition Entry)**

A commercial grower identified losses in his greenhouse tomato production due to wilt. The grower and County Extension agents identified the planting medium adhering to planting stakes as a possible source of the pathogen, *Fusarium* sp.. This test evaluated several sanitizing materials and practices to control the carryover of the pathogen in planting medium adhering to the planting stakes. Washing the stakes alone did not control the pathogen. A soak in either commercial bleach solution or quaternary ammonium solution for 24 hours was as effective as washing the planting stakes using high pressure water followed by soaking in commercial bleach solution or quaternary ammonium solution for 24 hours.

**Snap Bean Variety Evaluations on Yield and Post-harvest Quality in Florida Sandy and Muck Soils.** Snodgrass, C., UF/IFAS Manatee County Extension Service; M. Ozores-Hampton, UF/IFAS Southwest Florida Research and Education Center; R. Raid, UF/IFAS Everglades Research and Education Center, G. McAvoy, UF/IFAS Hendry County Extension Service; and, D. Sui, UF/IFAS Palm Beach Research and Education Center. ([crys21@ufl.edu](mailto:crys21@ufl.edu)) [V-8]

Florida ranks first nationally in the production, acreage and total value of fresh market snap beans with approximately 52% of the total U.S. market with 32, 800 acres valued at \$172 million. High yield and deep green pod color are the most favorable characteristics to the bean industry. Therefore, the objective of these trials was to update existing Florida snap beans variety recommendations. Two bush-type snap bean variety trials were conducted in sandy (Myakka City, FL) and muck (Belle Glade, FL) soils evaluating 13 and 11 snap bean varieties, respectively. Snap bean variety trials were conducted in fall 2010 in Belle Glade (planted on 4 Oct. 2010 with a single row, 4” between plants) and Myakka City (planted on 5 Oct. 2010 with double rows, 3” between plants and 10” between rows). Data collected were total marketable and unmarketable yields, pod size (length and width), fresh pod weight, color and percent brix. In Belle Glade, only marketable yield was measured. Weather conditions in 2010 during the trials were cold to cool with four freeze events on 7, 8, 14 and 15 Dec. in Myakka City and no freeze events in Belle Glade. Only the top of the bush was damaged. In Myakka City ‘Ambra’, ‘Bronco’, ‘Carlo’, ‘Dusky’, ‘Eureka’ and ‘Prevail’ had the highest yields, but not the deepest green color, a desirable bean quality by the market. Higher yields in ‘Ambra’, ‘Bronco’, ‘Dusky’, and ‘Prevail’ were due to higher fresh pod weight and width. There were no significant differences in pod length and brix among varieties. In Belle Glade, ‘Bronco’, ‘Caprice’, ‘Carlo’, ‘Eureka’, ‘Prevail’ and ‘Valentino’ had the highest yields. There were no significant differences in pod length and brix among varieties. Based on yield and color, no single variety outperformed the others in the most favorable categories.

**Growing and Marketing Beets at Local Green Markets in Southeast Florida, 2007-2011.** Kenneth D. Shuler, Pei-Ann N. Shuler, Daniel G. Shuler, and Deanna V. Shuler, Stephen’s Produce, Jupiter, FL. ([skshuler@aol.com](mailto:skshuler@aol.com)) [V-9]

The growers for Stephen’s Produce grew and marketed beets (*Beta vulgaris* L, ssp. *Vulgaris*) from 2007 to 2011 to help supply local green markets with a weekend supply of garden fresh produce. Both ‘Detroit Dark Red’ and ‘Red Ace’ were grown in 2007-09. Since 2009-10 only

'Red Ace' has been grown. In 2010-11, 31 weekly plantings were made beginning on 23 Aug. and ending 9 Mar. Beet seeds were direct seeded and thinned to one plant per hill. Beets were sold on 27 weekends from 6 Nov. to 8 May. An average of ten bunches were sold each week at \$2.00 per bunch or \$20 per week.

**Use of Real-Time Florida Automated Network Data in Support of Strawberry Cold Protection and Irrigation Scheduling.** Kelly Morgan, UF/IFAS Southwest Florida Research and Education Center, and William R Lusher, UF/IFAS Information Technology. ([rlusher@ufl.edu](mailto:rlusher@ufl.edu)) [V-10]

Weather-related information is essential to Florida's agricultural producers for making sound decisions regarding use of water for cold protection and irrigation. Real-time monitoring of air and wet bulb temperatures is critical for cold protection, and determining daily evapotranspiration rates can significantly impact irrigation scheduling. The Florida Automated Weather Network (FAWN), a program of the University of Florida Institute of Food and Agricultural Sciences (UF/IFAS), has developed many cold protection and irrigation tools for farmers and homeowners. In 2010 FAWN released two tools designed to aid strawberry growers in making these decisions. Growers that register for the FAWN Freeze Alert Tool receive emails or SMS text messages when certain conditions have occurred at a FAWN site - receiving information in this way allows the grower more time in the field on nights when temperatures can be critically low. The FAWN Strawberry Irrigation Scheduler can assist growers in determining the appropriate daily drip irrigation run-time based on evapotranspiration rates and specific crop spacing data, irrigation system design, and soil type. Both of these tools are based on past field research, and were tested in the Plant City area during the 2010-2011 growing season, and resulted in water savings. The tools can be found at <http://fawn.ifas.ufl.edu/tools>.

**Growing and Marketing Dandelion Greens at Local Green Markets in Southeast Florida, 2003-2011.** Kenneth D. Shuler, Pei-Ann N. Shuler, and Stephen J. Shuler Nie, Stephen's Produce, Jupiter, FL. ([skshuler@aol.com](mailto:skshuler@aol.com)) [V-11]

The growers for Stephen's Produce grew and marketed dandelion greens from 2003 to 2011 to help supply local green markets with a weekend supply of garden fresh produce. Common dandelion (*Taraxacum officinale* F. H. Wigg) was grown from 2003 to 2009. Beginning in 2009-10, an Italian dandelion (*Cichorium intybus* L, cv. 'Clio') was grown. In 2010-11 four plantings were made on 26 Aug., 12 Oct., 23 Nov., and 5 Jan. Dandelion seeds were direct seeded and seedlings thinned to one or two plants per hill. Dandelion greens were sold on 29 weekends from 23 Oct. to 8 May. An average of six bunches were sold each week at \$2.00 per bunch or \$12 per week.

**Response of Over-head Irrigated Snap Bean Yield to N Rates in North Florida.** E. Simonne, Guodong “David” Liu and A. Gazula, UF/IFAS Horticultural Sciences Dept., Gainesville, FL; R. Hochmuth, L. Landrum, D. Gast, L.L. Davis, W. Laughlin, R. Randell, and M. Bauer, UF/IFAS North Florida Research and Education Center- Suwannee Valley, Live Oak, FL; Chris Vann, UF/IFAS Lafayette County Extension Service, Mayo, FL; and, Carolyn Saft and Elena Toro, UF/IFAS Suwannee County Extension Service, Live Oak, FL. ([guodong@ufl.edu](mailto:guodong@ufl.edu)) [V-12]

Adequate N rate and sound irrigation management are critical to optimize the yield of a shallow rooted vegetable crop like snap beans (*Phaseolus vulgaris*). Excessive N rates, poor placement, and poorly timed applications coupled with poor irrigation practices can reduce yields, affect pod color, and cause nitrate leaching below the root zone. As prices of energy and N fertilizers escalate, snap bean growers suffer from very thin marginal profitability for increased N rates. In North Florida, snap beans are grown in the Spring and Fall seasons, under center-pivots and are often fertilized with N rates in excess of UF/IFAS recommendations because these rates may be too low or because excessive irrigation is the applied (the later often causing the former). The goal of this project was to establish snap bean yield and pod color responses to N rates under recommended over-head irrigation rates. This study was conducted on a Blanton-Foxworth-Alpin complex sandy soil at the North Florida Research and Education Center – Suwannee Valley near Live Oak, Florida in 2007 and 2008. ‘Bronco’ bush snap bean were fertilized with a total of 0, 40, 80, 120, 160, and 200lb per acre N rates using ammonium nitrate (34-0-0) applied in three identical thirds at planting, first trifoliolate, and first flower buds. Plots consisted of 4, 20-ft long plots and only the two middle rows were harvested. In both years, marketable pod yield (mktyld) response to N rate (Nrate) was quadratic (mktyld =  $-289 \text{ Nrate}^2 + 2719 \text{ Nrate} + 383$  and  $\text{mktyld} = -186 \text{ Nrate}^2 + 1304 \text{ Nrate} + 2337$ , in 2007 and 2008, respectively). Maximum pod yield occurred between 120 and 160, and 80 and 120 lbs/A of N in 2007 and 2008, respectively. Observation of foliar burns on plant receiving the two highest N rates early in the season suggested that early N rates of 1/3 of the total N rates used were excessive when recommended irrigation rates were used. These results also suggest that N management in snap bean could be further improved by using different amounts of N at planting, first trifoliolate, and first flower buds. Preliminary NO<sub>3</sub>-N and K petiole sap interpretative thresholds were also developed.

**Bell Pepper Production under Protective Structures: Evaluation of Soilless Media, Container Types, and Granular Nitrogen Sources.** Emmanuel Torres-Quezada, Carlos Zambrano-Vaca, and Bielinski M. Santos, UF/IFAS Gulf Coast Research and Education Center, Wimauma, FL. ([etorres1618@gmail.com](mailto:etorres1618@gmail.com)) [V-13]

Bell pepper (*Capsicum annuum*) production in Central America and the Caribbean has become one of the main agricultural commodities for exporting into the U.S. and the European Union. To

guarantee constant supply and quality, small and medium-size growers use passively-ventilated protective structures like greenhouse and high tunnels. The main goal of those structures is controlling the growing environment, reduce pests and disease, and improve fruit quality and yields through intensive cultural practices and irrigation and fertilization management. Nevertheless, crop irrigation and fertilization are influenced by the growing media. The wrong selection of the growing media may cause increased fruit flower abortion, lowered fruit number and size, and thus increased postharvest losses. For this reason, two experiments were conducted in west-central Florida. The first trial sought to determine the response of determinate bell pepper grown under a screenhouse with different soilless media and container types. The media used were pine bark, coconut coir, perlite, and potting mix (Fafard Mix 2) combined with boxes (19 L/plant), bags (8 L/plant), and pots (8 L/plant). Plant height, petiole NO<sub>3</sub>-N concentration, leaf greenness (as an estimate of chlorophyll content), marketable yield, and root weight were measured. The results showed no interaction among factors for plant height and early yield. Pine bark, coconut coir, and potting mix had the tallest plants and the highest early yields. On container types, the boxes and pots had the tallest plants. There was no difference among container types on early yields. Interaction between the factors was found for petiole NO<sub>3</sub>-N concentration. The treatments with the lowest values were perlite in pots and perlite in boxes (under NO<sub>3</sub>-N sufficiency range), followed by perlite in bags and potting mix in bags. The low performance of perlite could be related to its low water retention. Pine bark is the cheapest medium and it is readily available in most areas. The second trial was established in a screenhouse and there were two nitrogen (N) rates and 4 different granular sources of N. The N rates were 150 and 200 lb/acre and the N sources were ammonium nitrate (AN), ammonium sulfate (AS), AN + slow-release AN (AN+SRAN), and SRAN in pine bark as a growing medium. The fertilizer rates were split in five bi-weekly applications during the season starting at one week before transplanting. The variables were plant height, petiole NO<sub>3</sub>-N concentration, leaf greenness (as an estimate of chlorophyll content) collected every two weeks, and fruit number and weight. Preliminary data showed that plots receiving AN at either rate outperformed the other fertilizer sources and rates.

### **Effects of Cell Size on the Production of Containerized Strawberry Transplants in Florida.**

Pei-Wen Huang, Bielinski M. Santos, and Vance M. Whitaker, UF/IFAS Gulf Coast Research and Education Center, Wimauma, FL.([agnespei@ufl.edu](mailto:agnespei@ufl.edu)) [V-14]

Strawberries (*Fragaria × ananassa*) in Florida are mostly established from bare root transplants using 7 to 10 days of overhead sprinkler irrigation for 8 h/day to reduce water stress under hot weather in late September and early October. Containerized transplants could be an alternative to save at least 80% of water during crop establishment and relief water sources competition with neighboring residential areas, whereas their price is double compared to bare root transplants. However, this type of transplants is costly and produced outside Florida. It might be possible producing containerized strawberry transplants with successful flower initiation in Florida by manipulation of the red to far-red radiation ratio, which might reduce the current price of these plants. Therefore, optimal plug sizes for containerized transplants production in Florida needs to be determined. Four tray types (36, 40, 50, and 72 cells per tray) were chosen for plugging ‘Strawberry Festival’ strawberry daughter plants. At the crown level, the red to far-red radiation ratio was significantly lower with 36 cells per tray (0.48) than with either 40 (1.08), 50 (1.07) or

72 (1.20) cells per tray. Plants produced from trays with 72 cells had the smallest crowns at both 6 and 12 weeks after transplanting (WAT) compared to other cell sizes, whereas there was no significant difference among trays with 36, 40, and 50 cells at 6 WAT. Plant size was larger when trays with 36 cells were compared to 72 cells at 6 WAT, but this difference was recovered at 12 WAT. Early fruit number and early fruit weight were higher with plants from 36 cells per tray than 72 cells per tray, although there were no yield differences among 36, 40, and 50 cells per tray. Similar trends were observed for total fruit number and total fruit weight.

**Evaluation of Freeze Protection Methods and Plant Establishment Methods for Strawberry Production in Florida.** Bielinski M. Santos<sup>1</sup>, David N. Moore<sup>1</sup>, Teresa P. Salame-Donoso<sup>1</sup>, Craig D. Stanley<sup>1</sup>, Alicia J. Whidden<sup>2</sup>, Crystal A. Snodgrass<sup>2</sup>, and Mary B. Henry<sup>2</sup>. <sup>1</sup> UF/IFAS Gulf Coast Research and Education Center, Wimauma, FL; <sup>2</sup> UF/IFAS Hillsborough, Manatee, and Polk County Cooperative Extension Service, respectively. ([bmsantos@ufl.edu](mailto:bmsantos@ufl.edu)) [V-15]

Most of the water applied during the strawberry (*Fragaria x ananassa*) season occurs during transplant establishment and freeze protection. For transplant establishment, growers rely on bare-root strawberry transplants to establish the crop from late September to mid-October. Hence, sprinkler irrigation is applied from 10 to 14 consecutive days for between 12 and 14 hours a day, which totals approximately 16 to 24 acre-inch/acre (1 acre-inch = 27,154 gal) of water for that period. Because of the current limitations on water usage for strawberry growers in the Plant City area of Hillsborough County, production practices aimed at minimizing sprinkler irrigation without affecting net income are desirable. Two small-plot studies were conducted using seven combinations of number of days of sprinkler irrigation (4 gal/min per sprinkler; 10 hours/day) and timing of kaolin clay (Surround WP; 25 lb/acre) application: 10 days of sprinkler irrigation (control); 8 days of irrigation plus or minus kaolin clay on the 9th day; 6 days of irrigation plus or minus kaolin clay on the 7th day; and 4 days of irrigation plus or minus kaolin clay on the 5th day. Kaolin clay was applied before 9 a.m. on the day after sprinkler irrigation was suspended. Strawberry plant establishment was measured three weeks after transplanting (WAT). The application of kaolin clay on the strawberry foliage the following morning after either 6 or 8 days of sprinkler irrigation resulted in the same plant establishment, plant canopy diameter, and early fruit weight as the 10-day irrigated control. Therefore, a 40% reduction of establishment irrigation volumes can be achieved with the application of kaolin clay, which might represent major water savings for strawberry production. Large-field validations were conducted in growers' fields in 2009 and 2010 to determine strawberry plant establishment with kaolin clay treatments. In 2009, a 5-acre field was used in Hillsborough County, whereas six growers' fields in Hillsborough, Manatee, and Polk Counties were used in 2010. Fields were treated with either 10 days of sprinkler irrigation or 7 days of sprinkler irrigation followed by kaolin clay on the 8th day. Rates and application procedures were similar to that which was used for the small-plot studies. The results demonstrated that the application of 70% of the sprinkler irrigation volume traditionally used by strawberry growers followed by foliar application of kaolin clay on the morning of the 8th day could save a significant water volume (30%) while achieving the same plant establishment and early yields. If this practice were to be implemented, approximately 40,000 acre-inches of water would be saved in 8,300 acres of strawberries in Hillsborough County. For freeze protection, a study was conducted to compare several alternatives to the conventional sprinkler irrigation method. Treatments were: a) 4.5 gal/min sprinklers (control); b) 3.5 gal/min sprinklers; c) heavy row

covers (0.9 oz/yr<sup>2</sup>; Agribon) directly on top of the crop canopy; d) heavy row covers (0.9 oz/yr<sup>2</sup>; Agribon) with 2-ft high loop hoops; e) light row covers (0.6 oz/yr<sup>2</sup>; Agribon) directly on top of the crop canopy; f) light row covers (0.6 oz/yr<sup>2</sup>; Agribon) with 2-ft high loop hoops; and g) 16-ft high tunnels. Preliminary data indicated that there were no early and total fruit yield differences among the different row cover treatments and high tunnels, all of which resulted in higher yields than the two sprinkler treatments.

### **Effects of Oxygen Fertilization on Redox Potential of Flooded Soil and Growth of Basil.**

Guodong Liu, UF/IFAS Horticultural Sciences Dept., Gainesville, FL; Yuncong Li, and Kati K Migliaccio, UF/IFAS Tropical Research and Education Center, Homestead, FL; and, Teresa Olczyk, UF/IFAS Miami-Dade County Extension Service, Homestead, FL. ([guodong@ufl.edu](mailto:guodong@ufl.edu)) [V-16]

Frequently flooding is a major stress in Florida's vegetable production, particularly in the latter half of the rainy season when tropical storms – some reaching hurricane strength – abound. Flooding results in hypoxic problems – oxygen deficiency. The objectives of this study were to (1) improve redox potential of flooded soil by oxygen fertilization; (2) reduce yield loss of flooded basil by the use of a solid oxygen fertilizer; and (3) quantify the effect of oxygen fertilization on phosphorus use efficiency of flooded basil seedlings. This study was conducted with traditional 'Genovese OG' Italian basil with both fast- and slow-release solid oxygen fertilizers in a plastic house in Homestead, FL. Oxygen fertilization significantly enhanced chlorophyll content, growth and yield of basil plants; increased nutrient use efficiency; and improved redox potential of the flooded soil. With solid oxygen fertilization, fresh yields of flooded basil seedlings were up to 79% greater than the control; and their phosphorus use efficiency was 53% greater than the control. Oxygen fertilization improved the redox potential of growth media significantly. Therefore, oxygen fertilization is an effective method to enhance P use efficiency and productivity of crops at risk of stress in excessively wet or flooded soils.

### **The Protected Agriculture Information Network (PAINet): Evaluation of Cultural Practices for Indeterminate Bell Pepper Production under Protective Structures in the Dominican Republic, Nicaragua, Honduras, Costa Rica, and El Salvador.**

Bielinski M. Santos<sup>1</sup>, Teresa P. Salame-Donoso<sup>1</sup>, Henner A. Obregon-Olivas<sup>2</sup>, Jessie E. Inestroza<sup>3</sup>, Ricardo Galeano<sup>3</sup>, Maria G. Cuevas<sup>4</sup>, Marco V. Saenz<sup>5</sup>, Mauricio Martinez<sup>6</sup>, Emmanuel A. Torres-Quezada<sup>1</sup>, and Carlos J. Mendez-Urbaez<sup>4</sup>. <sup>1</sup>Gulf Coast Research and Education Center, IFAS, University of Florida; <sup>2</sup>Agropecuaria San Antonio, Tecolostote, Nicaragua; <sup>3</sup>Corporacion Dinant, Comayagua, Honduras; <sup>4</sup>Instituto Dominicano de Investigaciones Agropecuarias y Forestales, Santo Domingo, Dominican Republic; <sup>5</sup>Laboratorio de Tecnologia Poscosecha, Universidad de Costa Rica, San Jose, Costa Rica; <sup>6</sup>Hidroexpo, San Salvador, El Salvador. ([bmsantos@ufl.edu](mailto:bmsantos@ufl.edu)) [V-17]

The PAINet is a free-of-charge network created to share experiences, research results, and general information on protected agriculture. Bell pepper (*Capsicum annuum*) was chosen as the first model crop for the network because it has become one of the main agricultural commodities

for exporting into the U.S. and the European Union from Central America and the Caribbean. To guarantee constant supply and quality, small and medium-size growers use passively-ventilated protective structures like greenhouse and high tunnels. The main goal of those structures is controlling the growing environment, reduce pests, and improve fruit quality and yields. Nevertheless, small and medium-size growers cannot afford using electric or diesel fans and cooling systems to lower temperatures and relative humidity, which causes increased fruit sun-scalding, lowered fruit number and size, and thus increased postharvest losses (as high as 35% in some colored peppers). For this reason, three types of studies were carried out at the participating countries to determine the effects of cultural practices on yield and postharvest quality in indeterminate bell pepper grown under protected environments. These studies included plant spacing, pruning practices, and use of sun protectants. With regards to pruning types, Spanish pruning (no flower removal on each node) and Dutch pruning (only one flower was left per node) were used. Also, one and two stems were compared for Dutch pruning. The collected variables were plant height, marketable and non-marketable fruit number and weight, and fruit postharvest quality. From the preliminary results in the Dominican Republic, marketable and non-marketable fruit number and weight were the highest at 30 cm between plants, whereas the Dutch pruning showed the highest marketable fruit weight and number. For fruit quality traits, the combination of Dutch pruning and 25 cm between plants and the combination of Spanish pruning and 30 cm between plants resulted on the highest fruit weight, length, diameter, and thickness. Another study in the same location dealt with the effects of flower pruning and number of stems on yield and postharvest quality of indeterminate bell. Three pruning levels were used for this experiment: pruning up to the 10th, 15th, and 20th node in combination with one and two stems. The number of fruit, fruit yield, and number and weight of non-commercial fruit were the highest for plants with two stems. The combination of one stem and pruning either to the 10th or 15th node resulted on the highest fruit weight, length, diameter and thickness. In Costa Rica, the Spanish pruning had the highest fruit number and total yield. With regards to sun protectants, the use of calcium carbonate reduced losses due to sun scalding from 58% to 6% in Honduras.

## [ORNAMENTAL, GARDEN AND LANDSCAPE SECTION](#)

**Identifying and Developing Non-invasive Varieties in Landscape Plants: Progress and Prospects.** Z. Deng, UF/IFAS Gulf Coast Research and Education Center, S.B. Wilson, <sup>UF/IFAS</sup> Indian River Research and Education Center, G.W. Knox, UF/IFAS North Florida Research and Education Center, and R. Freyre, UF/IFAS Department of Environmental Horticulture. ([zdeng@ufl.edu](mailto:zdeng@ufl.edu)) [OGL-1]

Plants are an important component of landscapes in residential, commercial or public areas. Production of plants for landscape use has been one of the most important sectors of the environmental plant industry. While most landscape plants are non-invasive, some have potential to become weedy and/or invasive. One of the important biological factors determining a species' weedy and/or invasive potential is the plant's ability to produce viable pollen and/or seed. Thus, reducing a plant's male and/or female fertility may lead to a reduction, even a knock-out, of its weedy or invasive potential. A research team was established in the UF/IFAS Department of Environmental Horticulture with the goal of identifying and developing non-invasive varieties in landscape plants important to Florida. So far more than 110 varieties (or

taxa) in 16 plant species have been evaluated in Florida for their seed production and viability. A number of highly sterile, non-invasive varieties have been identified in lantana, nandina and ruellia to serve as safe alternatives to the invasive forms of these plants. Several genetic approaches including mutant induction, chromosome doubling, and triploid generation have been applied to lantana, nandina, and ruellia. Highly sterile lines have been selected, and their male and female sterility have been or are being assessed across the state. Similar research efforts are under way in at least five other states in numerous other landscape plants, including autograph tree, octopus tree, burning bush, elaeagnus, Japanese berry, maiden grass, pear, privet, the African tulip tree, trumpet vine, winged euonymus, and tutsan St. Johnswort.

**Effects of Production Shade Levels and Cultivar Selection on Potted and Cut Caladium Performance in Interiorscapes.** R.H. Stamps and H.M. Savage, UF/IFAS Environmental Horticulture Department, Mid-Florida Research and Education Center ([rstamps@ufl.edu](mailto:rstamps@ufl.edu)) [OGL-2]

Caladiums (*C. × hortulanum* Birdsey) are prized for their colorful foliage and are mainly used outdoors as summer bedding plants, but sometimes indoors as potted florists' plants in high light areas. However, caladiums, especially recently developed cultivars, may have potential for use in lower light interiorscapes and as cut foliages in florists' arrangements. Seven cultivars, four fancy-leaved and three strap/lance-leaved, were grown under two shade levels (50% and 88%) and then evaluated under simulated home/office conditions for display life (potted florists' plants) and vase life (cut foliage). Display life ranged from 93 to 121 days with the strap/lance-leaved cultivar 'White Wonder' lasting the longest. Production shade level had an effect on display life with plants produced under 50% shade lasting 18% (17 days) longer than those produced under heavier shade. Vase life ranged from 11.9 ('White Christmas') to 27.7 ('Candyland'). The strap/lance-leaved cultivars lasted longer than the fancy-leaved ones. An interaction occurred between cultivar and production shade level—leaves of 'Florida Calypso' and 'Raspberry Moon' produced under heavier shade did not last as long as those produced under 50% shade. Production shade level did not affect the vase life of the other cultivars. These results suggest that caladiums have good potential for use in interiorscapes with relatively low light levels, both as potted florists' plants and cut foliages.

**The Assumed Effects of Cold Weather on the Flowering of Five Ornamental Trees in Southwest Florida.** S. H. Brown, UF/IFAS Lee County Extension. ([brownsh@leegov.com](mailto:brownsh@leegov.com)) [OGL-3]

The effects of cold weather on the bloom time and duration of five species of ornamental flowering trees were compared. The five species included *Cassia fistula* (golden shower), *Delonix regia* (royal poinciana), *Jacaranda mimosifolia* (Jacaranda), *Plumeria rubra* (frangipani) and *Tabebuia aurea* (yellow Tabebuia). Temperatures below 50°F are regarded as required chilling temperatures for many deciduous fruit trees and which may also affect the flowering habits of tropical flowering trees. There were 28 and 47 days during the winters of 2008-2009 and 2009 – 2010 when temperatures fell below 50°F, respectively. Intense Blooming Days (IBD) is the sum of the days when the opened flowers on a tree are 50% or more of its maximum flowering potential. In all cases, IBD were delayed possibly by the cooler

weather of 2009 – 2010. Royal poinciana had the greatest setback, 22 days; followed by frangipani, 13 days; Jacaranda, 8 days; yellow Tabebuia, 3 days and golden shower, 2 days. IBD declined from 55 to 33 days for the royal poinciana; from 106 to 93 days for the frangipani; from 37 to 28 days for the Jacaranda; from 16 to 13 days for the yellow Tabebuia and from 25 to 23 days for the golden shower.

**Designing an Edible Landscape or Eat Your Yard.** A.S. Neal, UF/IFAS St. Lucie County Extension. ([asn@ufl.edu](mailto:asn@ufl.edu)) [OGL-4]

Designing your landscape with edibles is as simple as replacing ornamental plants with ones that can be consumed. Consumers are looking for simple ways to improve their lifestyle by living healthier and protecting the environment. They are eating more fruits and vegetables, wanting to grow naturally or organically and to use less pesticides or chemicals. The solution is to design fruits, vegetables and herbs right into their landscape. An educational program was developed to assist homeowners with design, plant selection, and maintenance. Several workshops were delivered throughout the county at many different locations over a two year period. Homeowners were surveyed to determine if they incorporated edibles into their landscape or started a garden. The survey also asked if they implemented one of the Best Management Practices suggested at the workshop.

**Does it Pay to Have a Vegetable Garden in South Florida?** A.G.B. Hunsberger, and M. Lamberts, UF/IFAS Miami-Dade County Extension. ([aghu@ufl.edu](mailto:aghu@ufl.edu)) [OGL-5]

With the recent interest in home and school gardening, many new to gardening are finding growing vegetables a challenge, especially in south Florida where growing conditions and season are different from most of the U.S. Trying to grow a garden using traditional methods is very difficult or impossible due to the unique soils of the southeastern portion of the state. Growing your own food can save money or can be uneconomical depending on what is grown and how the garden is constructed. A small demonstration raised bed vegetable garden was developed in Homestead, FL to estimate the value of growing a home garden in south Florida from 2009 – 2011. Garden costs, total harvests and economic value will be discussed.

**Creating a Native Id Garden to Teach Sustainable Landscaping Concepts.** M.S. Orfanedes, UF/IFAS Broward County Extension. ([morfannedes@broward.org](mailto:morfannedes@broward.org)) [OGL-6]

Interest in using native plants has grown significantly in recent years given the push to improve sustainability by reducing water consumption and off-site movement of fertilizer and pesticides that are applied to the landscape. Successful use of native plants in the landscape requires a familiarity with the many different tree, shrub and ground cover species that are available as well an understanding of their individual growth habits, cultural requirements and varied attributes. Such information can be readily obtained by a demonstration garden that trials these plants under local conditions. The garden can be used by Extension agents and Master Gardeners to teach

plant identification skills and evaluate the suitability of various species for use in the landscape. It can also provide a wealth of information regarding pest management needs, required cultural practices, aesthetics and benefits to wildlife. Such information can be readily used to inform brochures, fact sheets and web page articles. Volunteers can be recruited to help design the garden, procure plants, install them and provide needed follow-up maintenance. In addition to serving as an outdoor teaching laboratory, a native id garden can also offer on-going learning opportunities for those who volunteer their time creating and maintaining it. Such activities can strengthen volunteer commitment to the Extension organization. They can also foster camaraderie among volunteers and provide for peer networking along the way.

**Intense Blooming Days of Several Ornamental Flowering Trees of South Florida.** S. H. Brown, UF/IFAS Lee County Extension. ([brownsh@leegov.com](mailto:brownsh@leegov.com)) [OGL-7]

Intense Blooming Days (IBD) is the sum of days when opened flowers on a tree are 50% or more of its maximum flowering potential. The IBD of a species is the average numbers of days the flowers remained open at that intensity for three individual trees over three consecutive years. This is the period of time when the tree is at its showiest and presumably the most marketable. A determination of a species IBD could be a valuable tool in the regional marketing of flowering plants as it would allow landscape architects, landscapers and gardeners to select plants based on the start and duration of IBDs. It would also serve as baseline on the effect of climate change on ornamental flowering trees. The IBDs of 18 flowering trees varied from 16 days for *Tabebuia aurea* to 109 days for *Bauhinia blakeana*.

**Reinforcing Green Industry Best Management Practices Through an Interactive Landscape Field Day.** E.A. Skvarch, UF/IFAS St. Lucie County Extension; D. Culbert, UF/IFAS Okeechobee County Extension; C. Kelly-Begazo, UF/IFAS Indian River County Extension; H. Mayer, UF/IFAS Miami-Dade County Extension; and, W. Schall, UF/IFAS Palm Beach County Extension. ([eask@ufl.edu](mailto:eask@ufl.edu)) [OGL-8]

The Green Industry Best Management Practices program is a University of Florida/IFAS educational approach which provides classroom training to the commercial landscape industry. The six-hour course consists of 5 modules which educate landscape workers on how to conserve and protect water resources by integrating Green Industry Best Management Practice concepts into their daily working routines. To complement the classroom teaching, UF/IFAS Extension educators offered a landscape training field day which consisted of “education stations” designed to transfer classroom theory into real world learning experiences by providing hands-on training. Of the 50 participants 37 had participated classroom Best Management Practices programming.

**Building More Sustainable Water Supplies through Rain Water Harvesting.** B.J. Jarvis, UF/IFAS Pasco County Extension. ([bjarvis@pascocountyfl.net](mailto:bjarvis@pascocountyfl.net)) [OGL-9]

Florida’s water resources are being stressed from overuse. Impacts such as saltwater intrusion in the aquifer and depressed surface water levels are the result of long-term withdrawals. To find

methods to minimize impacts to the environment, Floridians want to find additional low-cost water sources. Research has shown that conservation is the cheapest “new source” of water. One conservation method is rainwater capture. Creating a sustainable water supply through cisterns is a viable, reliable supplement to area water supplies. During the discussion, opportunities and challenges of using cisterns for rainwater capture, including placement, costs of installation and operation, retrofitting existing cisterns, and possible uses of captured water.

**Fertilizer Selection as a pH Management Tool in Floriculture Production.** C.N. Johnson, P.R. Fisher, and J. Huang. UF/IFAS Dept. of Environmental Horticulture. ([cnjufhort82@yahoo.com](mailto:cnjufhort82@yahoo.com)) [OGL-10]

Fertilizer selection is an important factor to consider in developing pH management programs in floriculture production. The potential of water soluble fertilizer (WSF) to decrease or increase substrate-pH is expressed in calcium carbonate equivalents (CCE) of acidity or basicity per unit weight of fertilizer. The objective was to quantify the effect of eighteen WSFs with varying CCE and nitrogen ratios (% NH<sub>4</sub>-N, NO<sub>3</sub>-N, or urea-N) on substrate-pH response of *Impatiens*, *Petunia*, and *Pelargonium* grown in a peat-based substrate. ‘Ringo Deep Red’ geraniums (*Pelargonium x hortorum* Bailey. L.H.), ‘Super Elfin Bright Orange’ impatiens (*Impatiens wallerana* Hook. F.), and ‘Ultra Red’ petunias (*Petunia x hybrida*) were grown in 70%:30% (v:v) peat:perlite substrate amended with dolomitic hydrated limestone. Six plants per 900 mL, 6-celled container, were top-irrigated with a total of 3.07 L over 4 weeks using one of 18 water WSF applied at 100 mg N·L<sup>-1</sup> without leaching. Change in substrate-pH was dependent on both fertilizer CCE and plant species. Initial substrate-pH of 6.2 decreased in *Impatiens* to 4.7 with the most acidic fertilizer (1560 CCE acidity), increased to 6.3 with the most basic fertilizer (410 CCE basicity), and remained at 6.2 with the “neutral” fertilizer (0 CCE acidity). Substrate-pH in *Pelargonium* decreased from 6.2 to 4.6 with 1560 CCE WSF, remained 6.2 with 410 CCE WSF but decreased to 5.5 with 0 CCE WSF. Substrate-pH in *Petunia* decreased from 6.2 to 4.9 with 1560 CCE WSF, increased to 6.8 with 410 CCE WSF and increased to 6.5 with 0 CCE WSF. CCE explained 67% to 91% of the variation in substrate-pH ( $r^2 = 0.91$ , *Petunia*;  $r^2 = 0.81$ , *Impatiens*;  $r^2 = 0.67$ , *Pelargonium*). A neutral pH-response (pH remained 6.2) for *Impatiens* was observed in 0 CCE acidity WSF, 410 CCE basicity for *Pelargonium*, and 680 CCE acidity for *Petunia*. Nitrogen form (NH<sub>4</sub>-N, NO<sub>3</sub>-N, and urea-nitrogen) accounted for 67% to 88% ( $r^2 = 0.88$ , *Petunia*;  $r^2 = 0.80$ , *Impatiens*;  $r^2 = 0.67$ , *Pelargonium*) of the variation in substrate-pH change, whereby NH<sub>4</sub>-N and urea-N had acidic reactions and NO<sub>3</sub>-N had a basic reaction.

**Chemistry of Copper for Algae Control in Irrigation Systems.** G.S. Mohammad-Pour, D.W. Haskell, J. Huang, and P.R. Fisher, UF/IFAS Dept. of Environmental Horticulture. ([gpour@ufl.edu](mailto:gpour@ufl.edu)) [OGL-11]

Algae growth in irrigation systems can increase equipment clogging and insect pest problems, increases the required application rate for sanitizing agents for controlling waterborne plant pathogens, decreases aesthetic quality on growing media surfaces of ornamental plants, and can be a worker safety hazard on floors. The objective was to quantify the efficacy of copper for inhibiting growth of alga-inoculated nutrient solutions. Transparent vessels (500 mL in volume) contained a blend of used to subirrigation solution from a Florida nursery, 100 mg·L<sup>-1</sup> N from a water soluble fertilizer (17N-1.8P-14.1K), eight Cu concentrations from 0 to 8.0 mg·L<sup>-1</sup> from either Cu ionization by electrolysis or Cu(NO<sub>3</sub>)<sub>2</sub>, Fe at 1 mg·L<sup>-1</sup> from either FeEDTA or FeEDDHA, and de-ionized water, with pH correction to 6.0. After 16 days of incubation in a greenhouse environment, vessels containing 0 to 0.25 mg·L<sup>-1</sup> Cu from Cu(NO<sub>3</sub>)<sub>2</sub> showed similar increases in chlorophyll and biomass, after which algae content decreased to near zero at 4 mg·L<sup>-1</sup> Cu. Yeast and mold content followed similar trends with a 99.9% drop at 2 mg·L<sup>-1</sup> and a near zero count at 4 mg·L<sup>-1</sup>. Cu ionization was more effective at a given Cu concentration than Cu(NO<sub>3</sub>)<sub>2</sub>. Algae content was higher with FeEDDHA than FeEDTA at concentrations of Cu below 2 mg·L<sup>-1</sup>. Aerobic bacteria count, which is an indicator of potential equipment clogging from biofilm, was resistant to all Cu levels and was very high, averaging 3.56x10<sup>6</sup> colony forming units/mL. This study establishes a protocol for quantifying algal content that can be applied to test the effectiveness of other algaecides.

**Review of Efficacy Tests for Chlorination of Irrigation Systems.** R.E. Raudales and P.R. Fisher, UF/IFAS Dept. of Environmental Horticulture; C.L. Harmon, UF/IFAS Dept. of Plant Pathology, and B. R. MacKay, Thomas Baine Ltd., New Zealand. ([rosarodales@ufl.edu](mailto:rosarodales@ufl.edu)) [OGL12] (Student Best Oral Presentation Competition Entry)

Water treatment technologies are used in irrigation systems to control diverse biological problems including algae, biofilms and pathogens. Chlorination is an important treatment option with low installation and operating costs. However, growers face the challenge of identifying the proper chlorine dose for the control of their specific target problem without resulting in phytotoxicity of crop plants. The objective of this project was to develop a searchable database summarizing literature on chlorine efficacy to control plant pathogens and phytotoxicity threshold levels. Search criteria for the database are active ingredient (in this case chlorine, but the database will be expanded to other disinfectants), efficacy or phytotoxicity, and target organism. The returned information is the dose required for control, threshold level for phytotoxicity, practical implications and citations. The database includes mortality efficacy data of 11 genera of plant pathogens (22 species), and phytotoxicity thresholds of 22 plant species. The efficacy of chlorine varied with pathogens species and within species it varied with life stage. The dose required to achieve 90% mortality ranged from 0.1 to 25 mg·L<sup>-1</sup> with a range in

contact times 2 to 10 minutes. The phytotoxicity threshold ranged from 2.5 to 30 mg·L<sup>-1</sup> and depended on host crop and application method. Given the high dose required to control certain pathogens, chlorination should be viewed as only one component of an overall sanitation and integrated pest management approach. This database can be used by growers as a reference guide for proper usage of chlorine.

**Disinfectant Chemicals to Control Waterborne Pathogens are Deactivated by Peat Particles in Water.** J. Huang, D.P. Meador, D.B. Decio, W. Easton Horner, and P.R. Fisher, UF/IFAS Dept. of Environmental Horticulture. ([huangj@ufl.edu](mailto:huangj@ufl.edu)) [OGL-13]

Recycling of irrigation water increases water use efficiency, but can also increase the risk of disease transmission to crops. Disinfectant chemicals applied to control pathogens may also react with unfiltered peat and other organic particles present in recycled water. The objective was to quantify the persistence of sodium hypochlorite (using Clorox® Regular-Bleach), activated peroxide (using ZeroTol™), and quaternary ammonium chloride (QAC, using GreenShield™) in water containing peat-based substrates. Free chlorine concentration dropped rapidly (within 30 mins.) from 2 to 0 mg·L<sup>-1</sup> following addition of 0.2 g (dry weight) of a 60% peat/40% perlite (v/v) substrate to 1 L of chlorinated water, and total chlorine dropped from 2 to 0.3 mg·L<sup>-1</sup>. Concentrations of hydrogen dioxide (H<sub>2</sub>O<sub>2</sub>) and peroxyacetic acid (PAA) in the activated peroxide solution and QAC in the Greenshield® solution also decreased in the presence of a 100% peat substrate, but were less sensitive than chlorine to peat substrate. At 300 mg·L<sup>-1</sup> H<sub>2</sub>O<sub>2</sub> and 20 mg·L<sup>-1</sup> PAA, residual concentration decreased to 217 and 3 mg·L<sup>-1</sup> at day 7 for H<sub>2</sub>O<sub>2</sub> and PAA, respectively, following the addition of 1 g (dry weight, equivalent to 10 mL·L<sup>-1</sup>) of a 100% peat substrate to 1 L of activated peroxide solution. QAC concentration dropped from 615 to 250 mg·L<sup>-1</sup> within one day following 1 g of the dry peat substrate in 1 L of QAC solution. Results emphasize the decrease in disinfectant efficacy with increasing organic load, and the need for both filtration and real time monitoring of sanitizing chemical concentration.

**Using Landscape BMP Training to Improve Water Quality.** J.V. Morse, UF/IFAS Pinellas County Extension. ([jmorse@ufl.edu](mailto:jmorse@ufl.edu)) [OGL-14]

The Objectives of this project were to reduce the amount of nitrogen and other pollutants entering waterways, and to improve knowledge of sound horticultural practices for healthier landscapes by teaching landscape best management practices to the landscape maintenance industry. A two-hour class was developed. PowerPoint modules taught proper landscape practices, and equipment maintenance and storage procedures to reduce or prevent non-point source pollution during landscape maintenance activities. Pre- and post-training tests were administered using TurningPoint Technology and included 20 multiple choice questions. Vehicle decals were given to those passing the exam. Decal holders committing violations are given an automatic fine without warning. Six classes have been taught with 213 attendees. Passing rate (must obtain 75% correct) was 98%. A passing rate of 98% showed they have the

knowledge to prevent or reduce pollutants entering waterways by using sound horticultural practices and proper equipment maintenance and storage.

**Components of Sustainable Production Practices for Container Plant Nurseries.** A. Bolques, Gadsen County Extension, FAMU, Quincy, FL; G. Knox, UF/IFAS NFREC, Quincy, FL; Linda Landrum, UF/IFAS-NFREC-SV, Live Oak, FL; E. Duke, FAMU, Tallahassee; and M. Chappell, University of Georgia, Athens, GA. ([abol@ifas.ufl.edu](mailto:abol@ifas.ufl.edu)) [OGL-15]

Sustainable production practices in container plant nursery operations are methods developed to conserve or reduce natural resources needed to produce a crop. These include production practices aimed at 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. A listing of sustainable nursery production practices derived from a review of current literature and site visits to selected nursery operations in Florida and Georgia will be provided.

**Successful Implementation of Florida-friendly Landscaping™ in a Community Setting.** L.A. Barber, UF/IFAS Hillsborough County Extension, and B.A. Niemann, UF/IFAS Florida-Friendly Landscaping™ State Office. ([labarber@ufl.edu](mailto:labarber@ufl.edu)) [OGL-16]

The Florida-Friendly Landscaping™ (FFL) Program was created to help preserve, protect and conserve the state's natural water resources. The program teaches nine landscaping principles that educate Floridians on how to design, install, and maintain an attractive, healthy and environmentally friendly landscape while saving time, energy, and money. These principles include: right plant-right place, water efficiently, fertilize appropriately, maximize mulch, attract wildlife, control yard pests responsibly, recycle, reduce storm water runoff and protect the waterfront. Homeowners, builders, developers, community associations, and maintenance professionals are the primary target audiences. Recent Florida legislation makes the prohibition of FFL illegal in municipalities and community associations. Several communities statewide embrace FFL and enjoy significant cost savings. The program has a host of FFL resources for homeowners, community associations and municipalities.

**Lawncare USA: Putting Landscape Sustainability into Practice.** J.C. Sierra, Lawncare USA ([juan.sierra@lawncareusa.com](mailto:juan.sierra@lawncareusa.com)) [OGL-17]

Lawncare USA, of Weston, FL, is a locally owned lawn and landscape maintenance company that specializes in environmental landscape management. Our philosophy is putting the earth's well being first by listening to our customers needs and educating them about how they can have a beautiful and affordable landscape with minimal impact on the environment. We offer research-based solutions to landscape problems including but not limited to managing weeds and water use in turf, scouting for targeted pest control, fertilization based on plant needs, tree selection, installation and maintenance for longevity plus much more. Our services are based

upon the latest best management practices informed by UF/IFAS and Green Industry Best Management Practices (GI-BMP) certification. Our company is committed to achieving environmental excellence through customer outreach, rigorous employee training and routine site visits and customer service evaluations to verify outcomes.

**Weevil Problems in the Landscape with Emphasis on *Myloccerus undatus* (Sri Lanka Weevil).** H. Mayer, UF/IFAS Miami-Dade Extension Service, and C. Mannion, UF/IFAS Tropical Research and Education Center. ([hmayer@ufl.edu](mailto:hmayer@ufl.edu)) [OGL-18]

Weevils such as the palm weevil, various root weevils, silky cane weevil, leaf-rolling weevil, Mexican bromeliad weevil, *Eurhinus magnificus*, and the Sri Lanka weevil are common problems in the landscape and in production of ornamental plants. Damage is commonly caused by feeding from adults which is often exhibited as leaf notching. The larvae are also sometimes considered pests as root feeders. The level of damage is dependent on the type of weevil and host plant. Two of the most devastating weevils in the landscape are the palm weevil and the Sri Lanka weevil. Palm weevil, *Rhynchophorus cruentatus* is the largest weevil in North America and is native to Florida. The most common palms this weevil attacks include the cabbage palmetto, canary island date palm, washingtonia spp., and royal palms. Symptoms vary but generally include decline of younger leaves and destruction of the crown. A similar weevil, the red palm weevil, *Rhynchophorus ferrugineus*, which is considered a global dilemma, had never been reported in North America, until late 2010 when it was detected in southern California. The Sri Lanka weevil, *Myloccerus undatus*, was first found in Florida in 2000 but has been a growing landscape problem. The adults are small, white and black and feed on the foliage of many ornamental and fruit plants. High populations of the adults can cause severe damage to leaves. The larvae are root feeders but the level of damage is unknown.

**Performance of Soil Solarization and Methyl Bromide in Sites Infested With Root-Knot Nematodes.** R. McSorley, H.K. Gill, H.N. Hanspetersen, UF/IFAS Dept. of Entomology and Nematology; E.N. Roskopf, and N. Kokalis-Burelle, USDA-ARS Horticultural Research Laboratory, Ft. Pierce, FL. ([mcsorely@ufl.edu](mailto:mcsorely@ufl.edu)). [OGL-19]

Fumigation with methyl bromide has been a principal means of managing soil-borne pest problems for many years. Interest in effective alternatives increased during the phase-out of methyl bromide, and will become more acute as existing stocks are depleted. Since it can reduce plant-parasitic nematode infestations, soil solarization could be a useful component in a nonchemical alternative program, but questions remain about its efficacy relative to methyl bromide. The performance of solarization and fumigation with methyl bromide:chloropicrin (50:50) were compared in snapdragon (*Antirrhinum majus* L.) cut flower crops in sites with a history of problems from root-knot nematodes (*Meloidogyne* spp.). In most instances, snapdragon plants exhibited lower levels of galling caused by root-knot nematodes following preplant fumigation than following solarization. Fumigation also resulted in increased plant height, but crop yield was unaffected, due to variability among plots. Following the solarization

treatment with drenches of Biophos® did not improve results over solarization alone. Solarization was not as consistent as soil fumigation in reducing galling from root-knot nematodes. Although it can be useful in an integrated program as a non-chemical alternative to methyl bromide, solarization should be used with caution in sites with heavy pressure from root-knot nematodes.

**Countertop Production of Predatory Mites for Public Distribution.** J. Popenoe, UF/IFAS Lake County Extension; W.L. Schall, UF/IFAS Palm Beach County Extension; L.S. Osborne, UF/IFAS Mid Florida Research and Education Center. ([jpopenoe@ufl.edu](mailto:jpopenoe@ufl.edu)) [OGL-20]

Predatory mites can be an effective and sustainable way to control arthropod pests. However, a majority of the public do not know about them, how to use them, or how to obtain them. Additionally, even once a supplier is identified, the costs of shipping and handling are often greater than that of the mites due to their perishability. In the past, rearing predatory mites involved raising pest arthropods for them to eat as well as the predatory mites themselves. Keeping both populations separate and healthy can be difficult. This project is part of a statewide research grant to determine how best to rear predatory mites on countertops for use in distribution and education of the public. Several different rearing procedures were assessed to determine the easiest and most effective method for rearing and distribution. The best method was rearing the predatory mites in dishes with water “moats” to contain them, feeding them pollen, and providing cotton balls for egg laying and subsequent distribution. Extension agents participating in the project are poised to promote this program statewide to interested Extension agents and clientele. Clients whose plants show whitefly, spider mite or thrips damage can be given a cotton ball in a plastic bag to provide biological pest control, and be informed about biological control. UF/IFAS Extension will be able to lead the way in promoting biological control with the public, reducing chemicals in the environment, and providing clients with immediate pest control solutions.

**Effect of Different Inorganic/synthetic Mulches on Weed Suppression During Soil Solarization.** H. K. Gill, UF/IFAS Citrus Research and Education Center; R. McSorley, UF/IFAS Dept. of Entomology and Nematology. ([harsimrangill.pau@gmail.com](mailto:harsimrangill.pau@gmail.com)) [OGL-21]

Soil solarization is a method in which clear plastic films are used to increase soil temperature to manage soilborne plant pests such as insects, diseases, nematodes, and weeds during the summer time. Several kinds of plastic films were evaluated in 2007 and 2008 for weed suppression. Treatments were arranged in a randomized complete block design with five replications. In 2007, treatments were five plastic films (ISO, VeriPack, Poly Pak, Bromostop<sup>®</sup>, white plastic, and control). In 2008, treatments were Polydak<sup>®</sup>, Poly Pak, Bromostop<sup>®</sup>, white plastic, and control. Films were evaluated for weed suppression based on weed ratings using a scale that estimated amount of ground covered by weeds. Purple nutsedge (*Cyperus rotundus*) was the

major weed throughout both years. Transparent plastic films such as ISO, Polydak<sup>â</sup>, and Poly Pak consistently outperformed white plastic and control treatments, but the clear plastics differed in suppression of nutsedge. Best results were achieved with UV-stabilized plastic films, which were highly effective for weed control.

### **Efficacy of Fungicides for Control of *Colletotrichum Gloeosporioides* on Dendrobiums.**

R.T. McMillan, Jr., Kerry's Nursery, Inc., Homestead, FL. ([rmcmillan@kerrys.com](mailto:rmcmillan@kerrys.com)) [OGL-22]

Dendrobium clone were potted in hard coco on 10 Sept. 2010 and fertilized weekly with 150 ppm Peters Professional 20-20-20 water soluble fertilizer (The Scotts Company, Marysville, OH). The experimental plants were inoculated with conidia spores of *Colletotrichum gloeosporioides*. Ten plants per treatment were arranged in a completely randomized design. Fungicide treatments were sprayed until runoff using a compressed air hand pump sprayer from 10 March to 10 May. The foliage was allowed to dry and the inoculum was applied using a spray bottle. Plants were immediately placed into clear plastic bags for three days to create favorable disease conditions. *Colletotrichum gloeosporioides* lesions were counted on 17 May. Plants were rated on a scale of 1 to 10, where 0=no disease and 10=plant defoliated. Treatments were Control, Pageant 38% WG at 6.0 oz. per 100 gal., Pageant 38% WG at 12.0 oz. per 100 gal., Cleary's 3336 4F at 6.0 fl. oz. per 100gal., Pentathlon LF at 32.0 fl. oz. per 100 gal., Heritage 50 WG at 4.0 oz. per 100 gal., Insignia 20% WG at 4.0 oz. per 100 gal., and Insignia 20% WG at 8.0 oz. per 100 gal. All fungicide treatments gave some control of *C. gloeosporioides*. Pageant at 12.0 oz. and Insignia at 8.0 oz. provided excellent control followed by Heritage and Cleary's 3336.

### **Evaluation of Ten Groundcovers as a Landscape Banker Plant in the Absence of Prey.**

M.E. Henry, UF/IFAS Polk County Extension; S. Park-Brown, UF/IFAS Gulf Coast Research and Education Center; and S. Arthurs, UF/IFAS Mid-Florida Research and Education Center. ([mbhenry@ufl.edu](mailto:mbhenry@ufl.edu)) [OGL-23]

A research project was conducted, in partnership with Specialists, to evaluate landscape groundcovers as potential banker plants for predatory mites in the absence of prey. A predatory mite (*Amblyseius swirskii* McGregor) has been shown to feed on Chilli thrips (*Scirtothrips dorsalis* Hood), a significant pest of landscape roses, and was maintained on pepper longer than another predatory mite, possibly due to an ability to reproduce on a diet of pollen or other plant nutrient sources such as extrafloral nectaries. Groundcovers expected to provide favorable conditions and potential to be used as a companion plant to landscape roses were 1) sterile lantana, *Lantana camara*; 2) sensitive plant, *Mimosa strigillosa*; 3) alyssum 'Snow Princess'<sup>TM</sup>, *Lobularia hybrid*; 4) beach sunflower, *Helianthus debilis*; 5) 'Hip Hop' Euphorbia, *Euphorbia hypericifolia* 'Hip Hop'<sup>TM</sup>; 6) stoloniferous perennial peanut, *Arachis pintoi*; 7) blue daze, *Evolvulus glomeratus*; 8) verbena, *Verbena sp.*; 9) wild petunia *Ruelia caroliniensis*; and 10) black foot daisy *Zinnia paladosa*. Five replications were studied in two four week trials. Plants

were enclosed within screen cages, infested with 30 predatory mites, and maintained in a greenhouse. The tallest three meristems were inspected with a hand-held lens weekly. Numbers of predators and other pertinent observations were recorded. At trials' end, remaining predatory mites were collected using Berlese funnels. Results were variable, however significant differences between treatments ( $p=0.05$ ) were observed and significantly more mites were collected from 'Snow Princess'<sup>TM</sup> alyssum than other ground cover treatment. This plant will be infested and installed in a rose garden for field evaluation.

**A Severe Outbreak of Xanthomonas on *Ficus elastica* in South Florida.** E.V. Campoverde, UF/IFAS Miami-Dade County Extension; and A.J. Palmateer, UF/IFAS Tropical Research and Education Center. ([evcampoverde@ufl.edu](mailto:evcampoverde@ufl.edu)) [OGL-24]

A severe outbreak of Xanthomonas blight on Rubber tree (*Ficus elastica*) was observed in several nurseries throughout Miami-Dade County during late summer of 2010. Florida is known for being a leading state in foliage plant production, and *F. elastica* is a very popular interior foliage plant. Young plants infected with Xanthomonas expressed symptoms of water soaked lesions with irregular borders near the leaf margin. Eventually the lesions turn brownish-black with chlorotic halos and the abaxial surface remains water soaked in appearance. Bacterial identification was conducted at the UF/IFAS Florida Extension Plant Diagnostic Clinic, Homestead, FL. Bacteria were isolated from diseased plants and maintained on YDC agar for DNA extraction and PCR. The 16S rDNA gene was sequenced and GenBank search showed the isolated strain is 99% identical to that of *Xanthomonas campestris*. Pathogenicity was confirmed by spraying a bacterial cell suspension of  $1 \times 10^8$  CFU/ml onto 12 potted *F. elastica* cv. 'Burgandy'. Water was used as a negative control. Plants were placed in a humidity chamber (polyethylene bags) for 48 hours and then maintained in a shade house where temperature ranged from 23-32 C and 60-95% relative humidity. Symptoms started to develop within 10 days and *X. campestris* was re-isolated and identified using the above methods. *X. campestris* has been previously reported on other species of Ficus. However, this is the first report on *Ficus elastica*. Further characterization of the pathogen, host range studies, and the effect of temperature and light on disease development are underway.

**Using TurningPoint Technology to Train and Evaluate Knowledge Gain by Participants in a Limited Commercial Landscape Maintenance Program.** J.V. Morse, UF/IFAS Pinellas County Extension. ([jmorse@ufl.edu](mailto:jmorse@ufl.edu)) [OGL-25]

The objectives of this project were to (1) use technology to record and tabulate pre- and post-test results and a class evaluation; and (2) reduce staff time needed for tabulation. TurningPoint Technology was used to develop pre- and post-tests and a class evaluation in a PowerPoint format. Class participants were given a transponder to use for recording their answers electronically. Using this technology, the Extension agent was able to gather and tabulate test answers and class evaluations automatically. It worked significantly better than paper tests

which were frequently lacking information. Considerable staff time was saved because the system does all the calculations.

## [KROME MEMORIAL SECTION](#)

**FamC30-5-1: A Potential Red Wine Selection for Florida.** Z. Ren, J. Lu, X. Xia and F. Bradley. Florida A&M University, Tallahassee, FL. ([zxren@hotmail.com](mailto:zxren@hotmail.com)) [K-1]

Adaptability, productivity, and wine quality with nice and stable color are the challenges for Florida wine grape industry, due to the hot and humid growing environment that lead to high disease incidents. In the efforts to improve the wine industry in Florida, FAMU's grape breeding program selected a Pierce's Disease resistant breeding line FamC30-5-1. This selection has produced high quality red wine with excellent and stable color. The wine color intensity is outstanding and aroma is very good. This selection could be a milestone for the future development of red wine grapes for Florida wine industry.

**Resistance Screening for Crown Gall Disease in Various Grapevine Cuttings Inoculated by *Agrobacterium vitus* C493 and C4612.** Xia Xu<sup>1</sup>, Jiang Lu<sup>1</sup>, Jeong Ho Roh<sup>1,2</sup>, Zhongbo Ren<sup>1</sup>, Fitz Bradley<sup>1</sup>, and Hong Huang. <sup>1</sup>Center for Viticulture and Small Fruit Research, Florida Agriculture and Mechanical University, Tallahassee, FL. <sup>2</sup>Visiting Scientist, National Horticultural Research Institute, RDA, Suwon 440-706, Korea. ([jiang.lu@famu.edu](mailto:jiang.lu@famu.edu)) [K-2]

Crown gall of grapevines is an important disease worldwide. In Florida, crown gall is commonly found in grapes, apples, peaches, raspberries, and roses, which reduces vine vigor and causes substantial economic loss for growers. In this experiment, we screened green (September) and dormant cuttings (December) of six to seven-year old of European bunch grapes (*Vitis vinifera*), Florida hybrid bunch grapes, and Muscadine grapes (*V. rotundifolia*) inoculated by using *Agrobacteria* C493 and C4612. Cuttings without inoculation and cuttings inoculated with sterilized distill water were used as controls. Gall incident rate and gall weight were scored at inoculated sites and top sites of the cuttings two months after the inoculation. All the green cuttings from Muscadine inoculation including control showed about 0.1-0.2 g callus/gall growth in the inoculated sites for both C493 and C4612. However, only inoculated cuttings from *V. vinifera* and Florida hybrid bunch grapes showed callus/gall growth ranged from about 0.2 to 0.3 g at inoculated sites either inoculated with C493 or C4612. No callus/gall growth was noticed for controls. Electronic scanning analysis of the growth tissue found the present of bacteria in inoculated ones but not in control for all cultivars screened. This showed that pathogen C4612 was more virulent than C493, Muscadine grape seems had a genius healing power for wound at inoculate sites, and *V. vinifera* and Florida hybrids were more susceptible to *Agrobacterium* than Muscadine grapes.

**Molecular Assessment of Synchronized *in vitro* Red Cell Cultures of American Native Grapes.** A.O. Ananga, S. Krastanova, S. Sutton and V. M. Colova (Tsolova), CESTA, Center for Viticulture and Small Fruit Research, Florida A&M University, Tallahassee, FL. ([anthony.ananga@gmail.com](mailto:anthony.ananga@gmail.com)) [K-3]

The common *Muscadine* possesses one of the highest antioxidant levels among fruits. Due to the different biological activities of plant secondary metabolites, their regular consumption may have significant consequences for human health. Study of 13 differentially expressed genes in the flavonoid biosynthesis was carried out to confirm their expression in *in vitro* cell suspensions from berries of *Muscadine* and *aestivalis* as a system for genomics studies and relevant source for production of grape nutraceuticals. Cell suspensions were initiated from ‘Noble’ and ‘Cynthiana’, American native grape varieties. The presence and expression of 13 differentially expressed genes involved in critical steps of the flavonoid pathway was verified in the ‘Noble’ *Muscadine* var. and ‘Cynthiana’ *aestivalis* var. cell suspension, respectively, by real-time PCR. Similar expression patterns were revealed in ‘Noble’ and ‘Cynthiana’ with 11 gene transcripts, and two transcripts showed the expression patterns that were significantly different in each of the varieties. Out of the 13 analyzed genes involved in the flavonoid biosynthesis, 11 revealed similar expression patterns in ‘Noble’ and ‘Cynthiana’. The results of this study act as a preliminary research that will lead to the assessment of the medicinal value of commercial American native grape varieties and a feasible strategy for using *in vitro* red cell suspensions as an alternative, more reliable, and efficient source for molecular farming. This is the first step towards understanding the expression of nutraceutical compounds under predictably produced and controlled *in vitro* cell culture in North American grapes.

**Genetic Transformation of Synchronized *in vitro* Muscadine Grape Cell Cultures.** S. Sutton, S. Krastanova, A. Ananga, S. Leong and V. Colova (Tsolova), Center for Viticulture and Small Fruit Research, College of Engineering Sciences, Technology and Agriculture, Florida A&M University, Tallahassee, FL. ([ssutton33@gmail.com](mailto:ssutton33@gmail.com)) [K-4]

Muscadine grapes are considered among the most important *Vitis* species cultivated in the Southern US. They contain several unique flavonoid compounds that have beneficial nutraceutical properties. The genetic enhancement was performed in Muscadine grape cell suspensions in order to investigate regulation of the biosynthetic pathways of flavonoid compounds in varieties such as, ‘Noble’, ‘Supreme’, and ‘Darlene’. The Muscadine pericarp cells from the super epidermis of the cell line from ‘Noble’ and the embryogenic cell lines from the petioles of ‘Darlene’ as well as ‘Supreme’ were transformed using *Agrobacterium tumefaciens* harboring the *MYB* gene. Molecular analysis confirmed the proper integration and over expression of the *MYB* gene. The purpose of this work was to verify the feasible bio-process strategy needed to shift the metabolic flux towards over expression of flavonoids in genetically enhanced *in vitro* grape cell cultures. This approach will allow us to assess the nutraceutical value of commercial North American grape varieties, and to contribute knowledge

about genomic mechanism affecting the production of flavonoid compounds in grape. In addition, it proves to be a feasible technology for using genomic sequences to improve nutritional and health benefits of the native grapes.

**Enhancing Resveratrol Content of Muscadine Grape Using External Stimulus.** Hemanth KN. Vasanthaiah, Devaiah Kambiranda and Sheikh M. Basha, Plant Biotechnology Laboratory, Center for Viticulture and Small Fruit Research, Florida A&M University, Tallahassee, FL. ([hemanth.vasanthaiah@gmail.com](mailto:hemanth.vasanthaiah@gmail.com)) [K-5]

Muscadine (*Vitis rotundifolia*) is a popular crop across the Southern US because of its natural adaptability, resistance to diseases and insects, long vine life and high concentration of polyphenols which are known to possess health benefits. Resveratrol is one of the important phenolic compounds found in Muscadine grape and has been linked to its versatile characteristics. Our previous research has shown that stilbene synthase genes, which codes for resveratrol are not expressed at higher level in grape plants under normal growing condition. Therefore a study was conducted to determine the effectiveness of external stimuli in enhancing the nutraceutical value of grape berry including Florida hybrid bunch and Muscadine grapes. Our research using external stimuli such as UV irradiation, application of plant activators and pathogenic attack resulted in enhanced resveratrol and other beneficial / nutraceutical compound production in grape berry. Both quantitative real-time –Polymerase Chain Reaction and High Performance Liquid Chromatography analyses showed higher expression of stilbene synthase gene and resveratrol content in treated grape berry compared to control among various genotypes studied. This study determined the effectiveness of external stimuli in enhancing the nutraceutical value of grape berry including Florida hybrid bunch and Muscadine grapes. Additionally, the berry extracts from these treatments will be analyzed for their anti-cancer activity to determine the effectiveness of these treatments in enhancing grape nutraceutical value.

**Leaf Net CO<sub>2</sub> Assimilation and Electrolyte Leakage and Alcohol Dehydrogenase Activity in Roots of Mamey Sapote (*Pouteria sapota*) Trees as Affected by Root Zone Oxygen.** Mark T. Nickum<sup>1</sup>, Jonathan H. Crane<sup>1</sup>, Bruce Schaffer<sup>1</sup> and Frederick S. Davies<sup>2</sup>. <sup>1</sup>UF/IFAS Tropical Research and Education Center, Homestead, FL. <sup>2</sup>UF/IFAS Department of Horticultural Sciences, Gainesville, FL. ([jhcr@ufl.edu](mailto:jhcr@ufl.edu)) [K-6]

Net CO<sub>2</sub> assimilation (A) of leaves and root electrolyte leakage (EL) and alcohol dehydrogenase enzyme (activity) (ADH) in roots of mamey sapote (*Pouteria sapota*) trees were assessed in response to different oxygen concentrations in the root zone. In separate experiments, ‘Pantin’ and ‘Magaña’ scions on mamey sapote seedling rootstocks were grown hydroponically with an oxygen concentration of 7-8 mg O<sub>2</sub> L<sup>-1</sup> H<sub>2</sub>O in the root zone maintained by bubbling air into the hydroponic medium (aerated treatment) or with an oxygen concentration of 0-1 mg O<sub>2</sub> L<sup>-1</sup> H<sub>2</sub>O maintained by purging O<sub>2</sub> from a hydroponic medium with N<sub>2</sub> gas (O<sub>2</sub>-purged treatment). Net CO<sub>2</sub> assimilation of ‘Magaña’ leaves from the O<sub>2</sub>-purged treatment declined over time until by 8 days after treatment (DAT) it was at or near 0. Net CO<sub>2</sub> assimilation of ‘Pantin’ leaves in the

aerated treatment was higher than that of leaves in the O<sub>2</sub>-purged treatment at 2-6 DAT only. Electrolyte leakage from roots was significantly greater in the O<sub>2</sub>-purged treatment than in the aerated treatment. Two days after treatments had begun, root ADH activity in both cultivars tended to be consistently higher in the O<sub>2</sub>-purged than aerated treatment. The ADH activity of Mamey sapote roots appears to be up-regulated as a result of root-zone hypoxia. However, increased ADH activity alone is apparently not sufficient to limit low soil oxygen stress of Mamey sapote trees as evidenced by decreased A of leaves and increased EL from roots of trees exposed to low oxygen content in the root zone.

**Fertilizer Rates, Application Timing, Growth, and Yields of Papaya Plants in North Central Florida.** Frederick S. Davies<sup>1</sup>, [Jonathan H. Crane](#)<sup>2</sup>, Bruce Schaffer<sup>2</sup>, Kati Migliaccio<sup>2</sup> and Glenn Zalman<sup>1</sup>. <sup>1</sup>UF/IFAS Department of Horticultural Sciences, Gainesville, FL. <sup>2</sup>UF/IFAS Tropical Research and Education Center, Homestead, FL. ([jhcr@ufl.edu](mailto:jhcr@ufl.edu)) [K-7]

Optimum nitrogen (N) fertilizer rates and application timing have not been established for papaya plants in north central Florida. Annual N application rates vary from 160 to 500 kg ha<sup>-1</sup> and papaya growers in Florida often band fertilizer within the row before and after planting. ‘Red Lady’ papaya (*Carica papaya* L.) seedlings were transplanted to the field in Gainesville, FL. For the N rate study, granular fertilizer was applied to the soil. Nitrogen was applied at 50, 100, 200, or 300 kg/ treated ha per year to determine the N rate for optimum papaya growth and yields. A second set of experiments compared the effects of various application timings on papaya growth and yields. Treatments consisted of all fertilizer (223 kg N ha<sup>-1</sup>) applied prior to planting (preplant); 2/3 preplant and 1/3 applied after planting (post-plant); 1/3 preplant and 2/3 post-plant; and all fertilizer applied post-plant three times per year. Total plant vegetative fresh weight increased linearly from the 50 to the 300 kg/treated ha annual N rate in both years and stem diameter also increased linearly with time, but independent of treatment. Total fruit yield per plant, fruit weight, and fruit number increased reaching a maximum level at the 223 kg/ treated ha rate. In the fertilizer application timing study, there were no significant treatment effects on growth of any plant part except root fresh weight. Root fresh weight was lowest when fertilizer was applied entirely pre-plant in 2005. Application timing generally had no effect on growth, yields or petiole N content.

**Time after Scion Harvest and Grafting Method Influence Graft Success Rate for Purple-fruited Pitanga (*Eugenia uniflora* L.).** Malcolm M. Manners<sup>1</sup>, [John L. Griffis, Jr.](#)<sup>2</sup> and Ty G. McDonald<sup>3</sup>. <sup>1</sup>Florida Southern College, Lakeland, FL. <sup>2</sup>Florida Gulf Coast University, Ft. Myers, FL. <sup>3</sup>University of Hawai’i at Manoa, Manoa, HI. ([jgriffis@fgcu.edu](mailto:jgriffis@fgcu.edu)) [K-8]

Pitanga (*Eugenia uniflora* L., family Myrtaceae) is a large shrub or small tree, native to South America. It has considerable commercial potential, but clonal propagation is challenging. Propagation by seed is easy, but the seedlings are highly variable; the desirable, purple-fruited varieties do not come true from seed. Propagation by cuttings, air layerage, or other methods that require the formation of adventitious roots almost always fails. Grafting has been successful

for some propagators, but it is not common. The goals of this project were to discover a grafting method that would give an acceptably high rate of success, and to test the effect of storing budwood for several days before grafting. Scion wood of the superior, purple-fruited ‘Zill Dark’ cultivar was harvested in Lakeland, FL, and carried in hand luggage to Honolulu, HI, where veneer grafts and chip buds were made at the University of Hawaii at Manoa and at the Kona Experiment Station at Kealahou. The scion wood was stored in polyethylene bags, slightly damp, at ambient temperature (21-28 °C) until grafted. At the Manoa site, 77% of the first-day ‘Zill Dark’ veneer grafts were successful, whereas only 5% of chip buds survived and grew. Of second-day grafts, 50% of veneer grafts and 6% of chip buds survived and grew. At the Kona site, only 15% of third-day veneer grafts of ‘Zill Dark’ and no chip buds survived. It appears that the veneer graft method has the potential to give reasonably high rates of graft success for *Eugenia uniflora*.

**Field Evaluation of Blueberry Pruning Techniques.** Gary K. England<sup>1</sup>, Ryan A. Atwood<sup>2</sup> and Jeffrey G. Williamson<sup>3</sup>. <sup>1</sup>UF/IFAS Sumter County Extension, Bushnell, FL. <sup>2</sup>UF/IFAS Lake County Extension, Tavares, FL. <sup>3</sup>UF/IFAS Horticultural Sciences Dept., Gainesville, FL. ([gke@ufl.edu](mailto:gke@ufl.edu)) [K-9]

Pruning blueberry bushes is one of the most labor intensive and costly operations in a commercial planting. According to UF/IFAS Publication #HS985, proper pruning of blueberry plants will help obtain the desired plant size and shape, increase plant vigor and establishment of fruiting wood, reduce over fruiting and enhance size and allow sufficient sunlight penetration into the canopy to assist with proper fruit development. In June 2010, immediately after the first harvest of a central Florida commercial blueberry planting that had been established for approximately 15 months, a trial was initiated to compare a grower standard pruning program to three pruning regimes and an un-pruned treatment in two southern highbush cultivars, ‘Jewell’ and ‘Emerald’. The pruning regimes were (1) roof, where cuts starting at two feet were angled to meet at a point approximately four feet high in the middle of the row; (2) box, where lateral shoots were cut back to the margin of the pine bark bed and an even top was cut at approximately three feet; and, (3) hedge, where just the lateral shoots were trimmed back to the outer margin of the pine bark bed and no topping. With ‘Emerald’, only a treatment called severe box, where the lateral shoots were trimmed into the center of the row an additional six to nine inches and even top was cut at approximately two and a half feet was established. The grower treatment removed approximately 80% of the top growth back to a height of one and a half feet. In spring 2011 a count of fruitlets from two terminals of four random plants in each treatment revealed that with ‘Emerald’, the roof and severe box were lower than the grower treatment and in ‘Jewell’, only the box had a lower count than that of the grower treatment. Yield will be measured in April 2011.

**Pomegranate in Florida for Commercial Enterprises and Homeowners.** William S. Castle, James C. Baldwin and Megh Singh, UF/IFAS Citrus Research and Education Center, Lake Alfred, FL. ([bcastle@ufl.edu](mailto:bcastle@ufl.edu)) [K-10]

The pomegranate is being explored as a species for commercial and homeowner uses in Florida. A collection of ca. 75 accessions has been assembled. From those selections ca. 3,500 plants have been propagated in a commercial nursery and are distributed to grower-cooperators and nurseries for evaluation. Two foundation trials have been established in Central Florida, one at the University of Florida, IFAS, Citrus Research and Education Center, Lake Alfred, FL, and another at Water Conserv II, Winter Garden, FL. The initial effort showed that all the pomegranate selections were easy to propagate and in the field, nursery plants in 1-gallon containers grown on a citrus-based irrigation and nutritional program reached heights of 4 to 5 ft in 1 year with a healthy appearance. The plants at Water Conserv fruited after 1 year with many selections producing 15 to 35 fruits. *Cercospora* leaf spot caused some leaf drop and other unknown pests and/or diseases affected fruit development. An herbicide study using containerized ‘Parfyanka’ plants grown in sand soil showed unacceptable phytotoxicity to label rate applications of Indaziflam, diuron and norflurazon, but the injury from pendimethalin and simazine was  $\leq 10\%$ .

**Optimizing Fruit Spacing in Florida Peach Production.** Gary K. England<sup>1</sup>, Ryan A. Atwood<sup>2</sup> and Mercy Olmstead<sup>3</sup>. <sup>1</sup>UF/IFAS Sumter County Extension, Bushnell, FL. <sup>2</sup>UF/IFAS Lake County Extension, Tavares, FL. <sup>3</sup>UF/IFAS Horticultural Sciences Dept., Gainesville, FL. ([mercy1@ufl.edu](mailto:mercy1@ufl.edu)) [K-11]

Peach production in Florida has garnered much attention as a profitable alternative crop for growers seeking farm diversification. To produce the quality of fruit required to meet market and consumer demands, several intensive production practices must be completed at the proper time. Marketable fruit size ranges from 2.25 in (5.7 cm) diameter to >2.5 in (6.4 cm) diameter, with growers receiving premium prices as they are able to produce larger fruit. Four fruit thinning treatments (no thinning, 4” [10 cm], 6” [15 cm], and 9” [23 cm]) were applied to ‘Floridaprince’, ‘Tropicbeauty’, and ‘UFBeauty’ planted at Water Conserv II (Winter Garden, FL), and ‘Floridaprince’ in Citra, FL during the 2010 growing season. Harvest of all cultivars occurred at commercial maturity and fruits were divided into three categories: high grade fruit (2.5 inch [6.4 cm] diameter and greater), marketable fruit (2.5 to 2.25 inch [5.7 cm] diameter) and non-marketable fruit (less than 2.25 inch [5.7 cm] diameter). At both locations, fruit spaced at the 6” spacing were the largest, followed by those at the 9” spacing. The greatest amount of non-marketable fruit was produced when trees were not thinned. Thus, these results indicate the fruit should be thinned with 6” – 9” between fruit for maximum size and profitability.

**Performance of Blueberry Cultivars under High Tunnels.** Teresa P. Salame-Donoso and Bielinski M. Santos, UF/IFAS Gulf Coast Research and Education Center, Wimauma, FL. ([terrych@gmail.com](mailto:terrych@gmail.com)) [K-12]

Studies were conducted over two blueberry (*Vaccinium* spp.) seasons in a grower field in Alachua County, Florida. Adult ‘Springhigh’ and ‘Snowchaser’ plants were covered with 18-ft high tunnels and their production was compared to open-field plants of the same cultivars. At the same time, temperatures inside and outside the high tunnels and water use for freeze protection were monitored. Data indicated that blueberry earliness was affected by the high tunnels. Both cultivars produced in average about 1.4 ton/acre inside the high tunnels to the first week of April of each season in comparison with no production in the open fields. There were 39 days with temperatures at or below 36°F outside the tunnels (minimum temperature was 17°F), while inside the structures there were only 19 days with temperatures below this threshold. Water volumes for freeze protection inside the high tunnels were approximately 25% of those used in the open fields. These results indicated that blueberry production under high tunnels can improve fruit earliness and reduce water consumption for freeze protection.

## **HANDLING AND PROCESSING SECTION**

**Habitual Orange Juice Intake Contributes to the Stability of Weight, Body Fat and Body Measurements in Humans.** Jacqueline Q. Silveira, Claudia G. Lima, Thaïs B. Cesar, São Paulo State University, UNESP, Faculty of Pharmaceutical Sciences, Rod. Araraquara-Jaú km 1, Araraquara, SP, Brazil, 14801-902. ([tcesar@fcfar.unesp.br](mailto:tcesar@fcfar.unesp.br)) [HP-1]

This study investigated the association between chronic consumption of orange juice and anthropometric and dietary parameters. A total of 47 healthy, normal weight and overweight volunteers participated in this study. They consumed 750mL of orange juice daily for 8 consecutive weeks. The data collected included anthropometry, circumferences, body fat (skinfold thicknesses and bioimpedance) and food intake, before and after orange juice consumption. Body weight, body mass index, circumferences and percentage of body fat did not change in men or women after eight weeks of orange juice consumption. On the other hand, the dietary consumption of energy and carbohydrates by men increased 6% and 19%. Women increased carbohydrate intake by 11%, decreased fat intake by 15%, without changing the total energy of their diets. Vitamin C consumption by men and women increased threefold and fourfold, respectively, and folate intake doubled in both genders. In conclusion, regular orange juice consumption was associated with constancy of body weight, circumferences and percentage of body fat, suggesting that orange juice does not contribute to weight gain or increase the risk for chronic diseases.

### **The Effect of Fruit Size and Health Status on Orange Juice Consumer Acceptance**

**Attributes.** R.M. Goodrich, C.O. Ipechukwu, C.A. Sims, UF/IFAS Food Science and Human Nutrition Dept.; and, M.D. Danyluk and T. Spann, UF/IFAS Citrus Research and Education Center. ([goodrich@ufl.edu](mailto:goodrich@ufl.edu)) [HP-2]

This study examined the sensory impact of the combined factors of size and health (citrus greening) of oranges on sweetness, orange flavor and overall acceptability. A sensory evaluation test was carried out on the University of Florida Campus with an untrained panel (n=99) performing a consumer acceptance test on juice from two sizes (large and small) and two health-affected (healthy and greening) oranges. Panelists rated the sensory characteristics (sweetness, orange flavor and overall acceptability) of four juice samples from 'Healthy Small', 'Healthy Large', 'Greening Small' and 'Greening Large' oranges using the 9 point hedonic scale. Overall, the panelists rated the juice from 'Healthy Small' the highest in all three sensory categories. Similarly, panelists rated the juice from 'Greening Large' oranges the lowest in all three sensory categories. Juice from 'Greening Small' oranges were found to be rated higher in all three sensory categories than juice from 'Greening Large' fruits. This may be relevant in large scale commercial orange juice processing where juice from greening small fruits may be more acceptable when blended with juice from healthy oranges.

### **Dietary Intervention with Orange Juice on the Oxidative Status of Patients with Chronic**

**Hepatitis C.** Delfina A. Manjate, Ana Lúcia M. Nasser, Paulo Inacio da Costa, Thaís B. Cesar, São Paulo State University, UNESP, Faculty of Pharmaceutical Sciences, Rod. Araraquara-Jaú, Araraquara, SP, Brazil, 14801-902. ([tcesar@fcfar.unesp.br](mailto:tcesar@fcfar.unesp.br)) [HP-4]

Hepatitis C virus (VHC) is a major cause of viral hepatitis that can progress to hepatic fibrosis, hepatic steatosis, hepatocellular carcinoma, and liver failure. VHC infection is characterized by a systemic oxidative stress caused by a combination of chronic inflammation, liver damage, and proteins encoded by VHC. The increased generation of reactive oxygen species, with the decreased antioxidant defense, promotes the progression of hepatic complications of VHC infection. The aim of this study was to evaluate oxidative status of patients with chronic hepatitis before and after the orange juice consumption for 8 weeks. Twenty three patients (ten women and thirteen men) with chronic hepatitis C included in the study were evaluated for dietary parameters, anthropometric and biomarkers of oxidative stress before and after the dietary intake of 500 mL/d for 8 weeks of pasteurized orange juice. The results showed no change in the anthropometrics variables after the orange juice treatment, but it was verified a significant decrease of TBARS and increase of antioxidant capacity in the serum of patients (DPPH). In conclusion, the intake of orange juice increases the availability of flavanones and vitamin C in the body and expressively improved the antioxidant capacity and significant effect on the lipid peroxidation.

**Effect of Abscission Agent on Citrus Juice Quality.** M.D. Danyluk, L.M. Friedrich, and T.M. Spann. UF/IFAS Citrus Research and Education Center, Lake Alfred, FL. ([MDDanyluk@ufl.edu](mailto:MDDanyluk@ufl.edu)) [HP-4]

The abscission agent CMNP (5-chloro-3-methyl-4-nitro-1H-pyrazole) is evaluated for use in combination with mechanical harvesting to aid in citrus harvesting. This study evaluated the standard juice quality and microbiology of fruit harvest following the application of CMNP and stored for up to 7 days to determine if CMNP application had any effect on these parameters. One ‘Hamlin’ and one ‘Valencia’ trial were harvested for testing. Fruits 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 were also determined.

**Stability of Headspace Volatiles in an Orange Juice-NaCl Matrix System at Room Temperature.** Elizabeth Baldwin, Jinhe Bai, and Anne Plotto, USDA-ARS Citrus & Subtropical Products Laboratory, Winter Haven, FL. ([liz.baldwin@ars.usda.gov](mailto:liz.baldwin@ars.usda.gov)) [HP-5]

More and more gas chromatography systems are equipped with autosamplers. Samples held in the autosampler tray may stay one day or longer at room temperature, since most trays are not equipped with a cooling mechanism. The prerequisites for headspace volatile research under such conditions are based on the following assumptions: there are no chemical and/or biochemical reactions in both the liquid and gas phases; changes for partitioning into the headspace at room temperature is negligible; and, all headspace concentration changes caused by holding the sample at room temperature is represented by changes in an internal standard (IS). The objective of this research was to determine if the above assumptions are correct by using orange juice (OJ) as a model. Orange juice (3 mL) with 3 mL saturated NaCl and 1 ppm 3-hexanone (IS) in 20 mL vials was sampled every hour using solid phase microextraction (SPME) of the headspace at room temperature. Significant changes were found in both absolute peak area (APA) and relative peak area (RPA, relative to the IS) for all 16 compounds tested (hexanal, *E*-2-hexenal,  $\alpha$ -thujene,  $\alpha$ -pinene, octanal,  $\alpha$ -terpinene, *p*-cymene, d-limonene, linalool nonanal, butyl-2-methylpropionate,  $\alpha$ -copaene,  $\alpha$ -caryophyllene, and valencene), including the IS (3-hexanone), and for 13 of the 15 compared to the IS, respectively. Generally, APA increased with holding time, and RPA (compared to 3-hexanone) decreased at same time. However, there were exceptions in which APA decreased and/or RPA increased, such as  $\alpha$ -thujene, butyl-2-methylpropionate, hexanal, *E*-2-hexenal, and octanal.

**Food Safety in the Fresh Produce Industry: Current Status and Future Direction.** John M. Siddle. JBT FoodTech, Lakeland, FL 33813. ([john.siddle@jbtc.com](mailto:john.siddle@jbtc.com)) [HP-6]

The microbial and chemical safety of fresh produce is of paramount concern. For the past ten years, produce food safety compliance has been driven by produce buyers such as grocery store chains and wholesale distributors rather than regulatory agencies. While the buyers are still driving food safety criteria in the fresh produce industry, the United States government will be

undertaking an increasing role and placing more emphasis on food safety in the fresh produce industry. The recent passage of the Food Safety Modernization Act in January 2011 gives the Food and Drug Administration (FDA) new powers for expanded enforcement and records access and requires biennial registration of all production facilities. The Act also calls for an update to FDA's Good Agricultural Practices Document as well as a proposed rule dealing specifically with the safety of fresh produce within one year of the passage of the Act. It is likely that existing programs, such as the California/Arizona Leafy Greens Marketing Agreement (LGMA) and the Florida Tomato Good Agricultural Practices (T-GAP) standards will serve as models for other produce groups. Produce buyers will most likely still contract with independent auditing firms to monitor compliance in packing operations.

**Quantifying Norovirus Contamination and Removal from Produce and Food Contact Surfaces during Food Preparation and Handling.** Jennifer L. Cannon, Chris P. Sharps, Qing Wang, Rebekah I. Turk and Chris Smith. Center for Food Safety, University of Georgia, Griffin, GA 30223. ([jcannon@uga.edu](mailto:jcannon@uga.edu)) [HP-7]

Human noroviruses cause an estimated 58% of all foodborne illnesses in the United States, and are the leading cause of outbreaks associated with fresh produce. Such outbreaks are often associated with ill food handlers in food service, but produce can also become contaminated prior to reaching the kitchen. This study investigates the likelihood and degree of norovirus transfer to and removal from produce and utensils following produce handling and typical preparation strategies. Human norovirus (Genogroup I, genotype 3b (GI.3b) or genogroup II, genotype 4 (GII.4)) or murine norovirus was inoculated on gloved hands, produce, or stainless steel surfaces. After contact between two or more surfaces, or after utensil use, the transfer of norovirus to and from each surface was determined by quantitative realtime RT-PCR or virus plaque assay. Norovirus removal from produce by brushing, peeling, or rinsing was also investigated. Up to 7.97 log genomic copy numbers of norovirus (~10%) was transferred from fingertips to produce (strawberries, raspberries, grapes, and blueberries) upon handling. Transfer occurred more readily between wet surfaces than between dry surfaces. Norovirus transfer from contaminated produce (strawberries, carrots, and tomatoes) to kitchen utensils (knives and graters) occurred readily (up to 3.97 log virus pfu) upon typical use. Produce (melons, carrots, and lettuce) decontamination by brushing, peeling, or rinsing was variable, but frequently incomplete. Results indicate norovirus contamination by food handlers both in the field and in the kitchen can occur readily and decontamination is difficult. Effective hand and produce sanitation strategies are needed to minimize food safety risks associated with the handling and preparation of produce in the kitchen.

**Environmental Conditions Encountered during Distribution from the Field to the Store Affect the Quality of 'Albion' Strawberry.** Yun-Pai Lai and M. Cecilia N. Nunes Food Quality Laboratory, College of Human and Social Sciences, University of South Florida Polytechnic, Lakeland, FL. ([mariacecilia@poly.usf.edu](mailto:mariacecilia@poly.usf.edu)) [HP-8]

Strawberries are one of the most appreciated fruits due to its delicate flavor. However, the fruit is fragile and deteriorates rapidly if handled under adverse conditions. Long transit times from the field to the retail store and poor handling conditions often result in short shelf-life and poor

overall quality. In order to understand the impact of transit conditions on the quality of 'Albion' strawberry, two shipments of strawberries were monitored from the field in California, through the distribution center (DC), and finally to a retail store in Georgia. Strawberries were selected and evaluated at the field for appearance, weight, incidence of bruise and decay, and soluble solids content (SSC). Temperature and humidity data loggers were placed inside clamshells containing the selected fruit to monitor the environmental conditions during transit. Quality of the selected fruit was then evaluated after pre-cooling, upon arrival to the DC, and at the store. The transit times varied between 7 and 9 days, with temperatures ranging from 0 to 30°C and 34 to 87% RH. Overall, results from this study showed unacceptable strawberry quality due to poor appearance upon arrival to the DC. Weight loss, incidence of bruise and decay increased during transit while appearance and SSC decreased. The major causes of fruit rejection at the store level were decay and bruise which affected 26.8% and 75.3% of the fruit, respectively. Long transit times and inadequate temperatures shortened the shelf-life of the strawberries and contributed to poor fruit quality.

**Potential for Grading, Sanitizing and Hydrocooling Fresh Strawberries.** Angelo P. Jacomino, Steven A. Sargent, Adrian D. Berry, and Jeffrey K. Brecht. UF/IFAS Horticultural Sciences Dept ([jkbrecht@ufl.edu](mailto:jkbrecht@ufl.edu)) [HP-9]

Strawberries are currently field-packed into consumer containers and as a result, growers are not able to sell a product that has been rinsed with sanitized water or sorted to exceed minimal grade standards. The current strawberry cooling method is forced-air, which typically takes 1 to 2 h and results in non-uniform fruit temperature within a pallet. New methods and technologies have the potential to permit growers to hydrocool uniformly, rinse, sanitize, grade and pack fruit at a central facility. 'Festival' strawberries were commercially harvested in early morning brought to the laboratory and 7/8 cooled the same day by forced-air in clamshells or by immersion hydrocooling in small baskets. Forced-air-cooling required about 1 h, whereas hydrocooling with chlorine (200 ppm) required 13 min. During 16 d storage in clamshells (7 d at 1°C, 7 d at 5°C and 2 d at 20°C), there was no decay in fruit cooled by either method. Hydrocooled fruit retained more weight (2% to 5%) than forced-air-cooled fruit. Firmness values were between 1.1 and 1.4 N, but there were no differences due to cooling treatments. Fruit from both cooling methods remained shiny and had turgid calyxes during cold storage; however after 2 days at 20°C the fruit became dull with wilted calyxes. Bruise incidence was higher in hydrocooled fruit due to additional handling. Hydrocooling can be a viable cooling option for strawberries that also provides an opportunity to sanitize and grade the fruit, but further experiments are necessary to optimize this process.

**Detection of Fluorescent Compounds in Citrus Leaf Cankers.** John A. Manthey and Jan A. Narciso. USDA-ARS, Citrus and Subtropical Products Laboratory, Winter Haven, FL. ([John.Manthey@ARS.USDA.GOV](mailto:John.Manthey@ARS.USDA.GOV)) [HP-10]

Citrus canker caused by *Xanthomonas citri* subsp. *citri* (Xcc) has tremendous potential to seriously damage citrus production, especially for the fresh fruit market in Florida. Xcc is typically spread by wind and rain and enters into stomates and sites of tissue damage. The

chemical and microbial ecologies of cankers in greenhouse-grown grapefruit leaves are under investigation. Chemical changes following Xcc infection have been monitored by HPLC-MS and fluorescence spectroscopy. Particular attention is given to analyses of coumarins (C) and furanocoumarins (FC); both are groups of compounds containing known phytoalexins. Such analyses have shown that physical abrasion of grapefruit leaves dramatically decrease many of the Cs and FCs normally present in healthy grapefruit leaf tissue. Xcc infection of these physically damaged leaves further induces the production and accumulation of new Cs and FCs. Identification of these compounds is in progress through comparisons with known standards as well as by analyses of mass spectrophotometry fragmentation patterns.

**Trichoderma Rot on ‘Fallglo’ Tangerine Fruit.** Cuifeng Hu<sup>1</sup>, Erin Roskopf<sup>2</sup>, and Mark A. Ritenour<sup>1</sup>; <sup>1</sup>UF/IFAS Indian River Research and Education Center, Fort Pierce, FL; <sup>2</sup>USDA, ARS Laboratory, Ft. Pierce, FL. ([ritenour@ufl.edu](mailto:ritenour@ufl.edu)) [HP-11]

In September 2009, *Trichoderma* rot symptoms were observed on ‘Fallglo’ fruit after 7 weeks of storage. Fourteen days prior to harvest, fruits were treated by dipping into one of four different fungicide solutions. Control fruit were dipped in tap water. After harvest, the fruit were degreening with 5 ppm ethylene for 5 days. Decaying fruits were collected from the control treatment, which had an average of 2.6% decay. The decay area became brown and leathery and was round to elliptical in shape with an average diameter of 4 to 6 cm. A fungus was isolated from the diseased peel of symptomatic fruit. The fungus grew rapidly on potato dextrose agar (PDA) medium and produced white mycelium after one day on PDA at 25°C and filled the Petri dish (100 X 15 mm) after 5 days. The colony turned white to grey after 14 days with scattered green tufts. Green conidia were formed in concentric rings and first observed on PDA at 25°C within 72 hours. Conidiophores were branched with flask-shaped phialides. The fungus was identified as a *Trichoderma* sp. based on the morphology, which was confirmed by sequencing of the internal transcribed spacer regions and portions of the gene encoding translocation elongation factor 1-alpha. Speciation utilizing TRICHOBLAST is currently underway. ‘Fallglo’ fruits developed the same symptoms that were previously observed 4 days after wound-inoculated with a spore suspension (2.1 X10<sup>7</sup>/ml). Fruits dipped in Switch, Topsin-M, HDH Peroxy, and Bravo had 0.0% incidence of decay.

**The potential Role of New Citrus Postharvest Fungicides in Penicillium-resistance Management in Florida Packinghouses.** John Zhang, Florida Department of Citrus, Lake Alfred, FL. ([Jzhang@citrus.state.fl.us](mailto:Jzhang@citrus.state.fl.us)) [HP-12]

Citrus green mold caused by *Penicillium digitatum* is one of the most important citrus postharvest diseases. Fungicide application is a key measure for green mold control in commercial packinghouse operations. Penicillium-resistance to fungicides can be a severe problem since its resistant strains can develop readily in large populations of spores. Imazalil and thiabendazole (TBZ) are major commercial postharvest fungicides. The Penicillium-resistance to imazalil and TBZ has been evident in many citrus growing regions such as California. New postharvest fungicides such as fludioxonil might have provided new chemical

tools for managing the Penicillium-resistance problems. Studies were conducted both *in vitro* and *in vivo* to evaluate the potential role of fludioxonil for managing *P. digitatum* resistance to imazalil and TBZ. The results *in vitro* showed that fludioxonil effectively suppressed the mycelial growth of both imazalil- and TBZ-resistant strains and the wild-type strains of *P. digitatum*. When fruit were inoculated with the wild-type or the imazalil- and TBZ-resistant *P. digitatum* strains, and then treated with imazalil, TBZ or fludioxonil using a dip or a packingline drip test method, fludioxonil effectively reduced disease caused by both the wild-type and the resistant-type strains, but imazalil and TBZ only effectively controlled the disease caused by the wild-type strains. The data suggest that fludioxonil provided a new chemical mode of action for the future management of *P. digitatum* resistance problems to imazalil or/and TBZ in Florida packinghouses.

**Development of Chromatography System for Simultaneous Measurement of Gas Components in Storage Atmosphere of Horticultural Crops.** Jinhe Bai and Elizabeth Baldwin. USDA-ARS, Citrus & Subtropical Products Laboratory, Winter Haven, FL 33881. ([Jinhe.Bai@ARS.USDA.GOV](mailto:Jinhe.Bai@ARS.USDA.GOV)) [HP-13]

A new gas chromatograph (GC) system was developed to determine oxygen (O<sub>2</sub>), carbon dioxide (CO<sub>2</sub>), nitrogen (N<sub>2</sub>), argon (Ar), and ethylene simultaneously. The system consists of a GC equipped with one thermal conductive detector (TCD), one flame ionization detector (FID), one split/splitless inlet and one packed column inlet. The system uses porous polymer and molecular sieve capillary PLOT columns to perform the separation of the target gases. A gas sample is introduced by a 2-position valve to two sub-systems within the GC. One path goes directly from the packed inlet, through a styrene divinylbenzene column to FID to detect ethylene. Another one goes through the split/splitless inlet, and then is further separated to two columns, one to separate and detect CO<sub>2</sub> and another one to separate and detect Ar, O<sub>2</sub> and N<sub>2</sub> by TCD. The subsystem for Ar, O<sub>2</sub> and N<sub>2</sub> separation contains a guard column and a separation column (molecular sieve) connected by a 2-position valve. After Ar, O<sub>2</sub> and N<sub>2</sub> pass through, the valve is switched before the water and CO<sub>2</sub> elute from guard column to the molecular sieve column. Water and CO<sub>2</sub> would cause deactivation of the molecular sieve column. The entire run takes less than 6 min. This system has been used in analysis of internal gas in fruit coated by different waxes, monitoring of gas combination in controlled atmosphere storage rooms and other applications. It is a key tool to conduct individual fruit physiology and quality research, and for finding direct correlation between internal gases and fruit physiological metabolism and quality.

**Establishing CO<sub>2</sub> Tolerance of Pink Tomatoes in MAP at Elevated Handling Temperatures.** Angelos I. Deltsidis, Eleni D. Pliakoni and Jeffrey K. Brecht. UF/IFAS Horticultural Sciences Dept., Gainesville, FL. ([adeltsidis@ufl.edu](mailto:adeltsidis@ufl.edu)) [HP-14]

Fresh tomatoes are chilling sensitive, with the sensitivity decreasing as the fruit ripen, but the fruit can suffer aroma loss even at handling temperatures that are at or above the putative chilling threshold for unripe tomato fruit of 12.5°C (54.5°F). Modified atmosphere packaging (MAP) with reduced O<sub>2</sub> and elevated CO<sub>2</sub> retards ripening and has been reported to reduce tomato

chilling injury. Tomatoes can tolerate different concentrations of CO<sub>2</sub> depending on the temperature and duration of exposure, but the effect of ripeness stage on CO<sub>2</sub> sensitivity is unclear. In this study, pink ripeness stage tomatoes were evaluated to establish CO<sub>2</sub> tolerance levels in MAP during storage at elevated handling temperatures. Tomatoes were stored at 12.5°C (54.5°F), 15°C (59°F) and 18°C (64.4°F) for 2 weeks. Gas exchange was allowed through three different sizes of holes - 6.35 mm (1/4 in), 12.7 mm (1/2 in) and 19.0 mm (3/4 in). A microperforated film was used to cover the holes and allow diffusion. CO<sub>2</sub> was injected into the packages immediately after sealing to establish 3-10% CO<sub>2</sub> (expected equilibrium concentrations). Color changes, titratable acidity, total soluble solids, firmness and decay appearance were evaluated. CO<sub>2</sub>, O<sub>2</sub> and ethylene concentrations were also measured in the headspace of the packages. CO<sub>2</sub> concentrations were about 6.3% in the containers that had 6.35 mm holes after an equilibration period of 5 days at all temperatures. Severe CO<sub>2</sub> injury symptoms developed only in fruit stored at 12.5°C. The symptoms included streaky external color development and green internal color along with lower firmness than would normally be expected for a given stage of color development.

**Shelf Life of Vine Tomato (*Lycopersicon esculentum*) Stored at Non-Chilling Temperature and Different Relative Humidity Levels.** Debra Chilson, Astrid Delgado and M. Cecilia N. Nunes. Food Quality Laboratory, College of Human and Social Sciences, Univ. of South Florida Polytechnic, Lakeland, FL. ([mariacecilia@poly.usf.edu](mailto:mariacecilia@poly.usf.edu)) [HP-15]

Optimum temperature and relative humidity (RH) during storage are crucial to the marketable quality of fruits and vegetables and have a major impact on their shelf life. Vine tomatoes were harvested at the light red color stage twice from a commercial greenhouse in Florida and were stored during 16-22 days at a non-chilling temperature (15°C) and five RH levels (41, 52, 79, 88, and 92%). Visual and instrumental color, firmness, shriveling, stem freshness, decay incidence, slicing characteristics, taste, aroma, and compositional quality were evaluated every 2 days. The objectives of this study were to obtain quality curves at low and recommended RH levels and identify for each RH which quality attributes limit vine tomato marketability. The results showed that RH had a significant effect on the shelf life and quality of vine tomatoes. Tomatoes stored at RH lower than 88% had higher weight loss, were softer, more shriveled, and stems became wilted and dry. When stored below 88% RH tomatoes also had lower acidity, soluble solids and ascorbic acid contents, and more decay incidence than tomatoes stored at higher RH. Overall, visual quality attributes attained the limit of acceptability before flavor of vine tomato was considered unacceptable. The quality attributes that limited the shelf life of vine tomato included, stem freshness and slicing at 41 and 50% RH; firmness, slicing, and stem freshness at 79% RH; color and firmness at 88 and 92% RH. Maximum shelf life and best overall quality was obtained when tomatoes were stored at 92% RH.

**Effect of Fruit Coating on Litchi Postharvest Shelf Life.** Guiwen ‘Alvin’ Cheng<sup>1</sup> and Daoming ‘Kevin’ Li<sup>2</sup>, <sup>1</sup>JBT FoodTech, Lakeland, FL 33881, USA and <sup>2</sup>JBT (Ningbo), Guangzhou, China. ([alvin.cheng@jbt.com](mailto:alvin.cheng@jbt.com)) [HP-16]

Litchi fruit has a short postharvest shelf life, usually a few days under ambient temperature. The rapid postharvest deterioration begins with the browning of the fruit peel which greatly limits the fruit’s marketability. The discoloration is even fast when fruits have been in cold storage. Dehydration is considered to be a key contributing factor leading to the discoloration. One common benefit of fruit coatings is minimizing dehydration of fruits by creating additional layer of water vapor exchange physical barrier on the fruit surface. Two JBT fruit coatings were tested on litchi fruit at various concentrations to evaluate their effect on fruit weight loss and fruit peel discoloration. In general coated fruit showed a fresher appearance. The coating also helped reducing whole fruit weight loss. The advance of peel discoloration was also delayed by the selected coating treatments. The test results indicate coating application could be an important part of future integrated solutions for litchi postharvest fruit preservation.

**Pepper Bruising Increases with Lower Temperature and Higher Turgidity.** Jeffrey K. Brecht and Steven A. Sargent. UF/IFAS Horticultural Sciences Dept., Gainesville, FL. ([jkbrecht@ufl.edu](mailto:jkbrecht@ufl.edu)) [HP-17]

Peppers can be easily bruised and cracked during postharvest handling, which can include a number of transfers during typical harvest, handling and packinghouse operations. Pepper handlers have reported that peppers harvested during wet, rainy conditions, especially in cold weather, are more likely to be injured on the packingline and during handling. Peppers harvested early in the morning were equilibrated to 5, 10, 15, 20 or 25°C within 1 h after harvest by immersion in water. Drop test damage evaluation and Instron measurement of the bio-yield force required to break the carpel wall showed that peppers were more susceptible to bruising at less than or equal to 15°C (59°F) than at 20°C (68°F) or above. Peppers were also harvested before sunrise after several days of rain (thus fully turgid) and bruising susceptibility was measured initially and every 4 h at room temperature as the bio-yield force. Bruising susceptibility was high initially and began to decline after the peppers had lost about 3% of their original weight.

**Sensory Evaluation of Tangerine Hybrids at Multiple Harvests.** Anne Plotto and Elizabeth Baldwin, USDA/ARS Citrus & Subtropical Products Laboratory, Winter Haven, FL; Fred G. Gmitter, Jr., UF/IFAS Citrus Research and Education Center, Lake Alfred, FL; Greg T. McCollum, USDA/ARS Horticulture Research Lab, Fort Pierce, FL. ([Anne.Plotto@ARS.USDA.GOV](mailto:Anne.Plotto@ARS.USDA.GOV)) [HP-18]

The University of Florida and USDA/ARS have active citrus breeding programs. Hybrids that pass many selection steps and approach release are evaluated for horticultural traits and postharvest characteristics. Seven advanced selections and three commercial cultivars were

harvested multiple times from the research fields in Lake Alfred and Leesburg, FL. A panel of 10 members was trained to evaluate citrus fruit and reached an agreement for ten descriptors of fresh tangerines. Fruit were washed, sanitized, peeled, and halved longitudinally so that one half of each fruit was evaluated by the taste panel, and the other half was analyzed for quality parameters (total soluble solids and titratable acidity). Segments of each half fruit were then separated, cut in half, and placed in a fruit bowl to assure that each panelist would evaluate a sample from multiple fruits. Half segments (about 10) were served in 4oz plastic cups, together with reference standards for sensory evaluation. In general, panelists could perceive increased ripeness from increased sweetness, decreased sourness paralleled with decreased bitterness. For most selections, juiciness decreased with maturity, except for 'Murcott' and its low seed mutant. There was no specific trend for tangerine, fruit and floral flavors due to harvest maturity; however, sulfury and pumpkin/spicy flavors increased with maturity for some selections, and may be an indicator for over-ripe fruit. 'Temple' remained stable over harvest times, with more orange than tangerine flavor.

## CITRUS SECTION

**Salinity Tolerance of Cleopatra Mandarin Seedlings and Two of its Trifoliata Hybrids, US-897 and x639.** Jim Syvertsen and Wije Bandaranayake, UF/IFAS, Citrus Research and Education Center, Lake Alfred, FL. ([jmsn@ufl.edu](mailto:jmsn@ufl.edu)) [C-1]

In a greenhouse study, we evaluated growth, leaf  $\text{Cl}^-$  and  $\text{Na}^+$  concentrations along with physiological responses of seedlings of the citrus rootstock 'Cleopatra' mandarin (Cleo) and two of its commercial hybrids, Cleo x Flying Dragon trifoliata (US-897) and Cleo x Rubidoux TF (x639). These hybrids have some horticultural advantages over Cleo but their relative tolerance to salinity is not known. Well-fertilized and well-watered 4-month-old seedlings were grown in a high peat soilless potting mix and salinized with either 0, 30 or 60 mMol NaCl (max. TDS = 5,000 ppm) for 3 months. Both hybrids grew more than Cleo regardless of salinity level. Total plant dry weight (TPDW) of x639 exceeded that of US-897 at the high salinity level as TPDW of x639 was not reduced by salinity. Seedlings of x639 had the highest root to shoot dry weight ratio as x639 allocated relatively more growth to roots than to shoots. x639 also accumulated the highest concentration of  $\text{Cl}^-$  in roots but Cleo accumulated the highest  $\text{Na}^+$  in roots. Both hybrids accumulated more  $\text{Cl}^-$  in leaves than Cleo regardless of salinity level but leaf  $\text{Na}^+$  concentrations were similar in all three types. Overall, salinity reduced leaf photosynthesis and water use efficiency but leaf gas exchange characteristics among the rootstock types were not remarkably different. The greater growth and higher leaf  $\text{Cl}^-$  in seedlings of x639 and US-897 than in Cleo support the idea that both hybrids are more salt tolerant than Cleo and x639 was more salt tolerant than US-897.

**Measuring and Modeling Transpiration in Relation to Citrus Tree Size using Sap Flow Sensors.** Laura Waldo, Kirandeep Mann, Arnold Schumann, UF/IFAS, Citrus Research and Education Center, Lake Alfred, FL. ([ljwaldo.ufl.edu](mailto:ljwaldo.ufl.edu)) [C-2]

The water requirement of citrus trees changes with tree growth and seasonal evapotranspiration. Therefore, estimations of actual water usage by citrus trees at different times of the year are

necessary for accurately scheduling irrigation. The relationship between water loss via transpiration and stem sap flow was evaluated for young and mature citrus trees. Actual transpiration was measured with the heat balance method using Dynagage sap flow sensors (Dynamax, Inc., Houston, TX) attached to the tree trunks or branches. Different sized sensors corresponding to stem or branch size of the trees were installed four times in a year (Nov. 2009, Feb. 2010, May 2010 and Sept. 2010). The sap flow data collected from sensors for 15 days were used to estimate the tree water usage. Canopy volume of each branch or the whole tree was measured and weather data (reference crop evapotranspiration, solar radiation, air temperature and relative humidity) were downloaded from the Florida Automated Weather Network (FAWN) website. Correlation analyses showed that diurnal and seasonal tree water usage was strongly related to the tree canopy volume and weather parameters. Tree canopy volume and reference crop evapotranspiration (ET<sub>o</sub>) were used to develop predictive models for tree water usage using multiple regression and partial least squares (PLS) regression analyses. The predictive models could explain more than 65% variation in the tree water usage for different time periods of the year suggesting that tree canopy volume and ET<sub>o</sub> can be successfully used to estimate water usage by citrus trees of any size for accurately scheduling irrigation.

**Citrus Shoot Age and Flowering Potential.** L. Gene Albrigo and Eduardo J. Chica, UF/IFAS, Citrus Research and Education Center, Lake Alfred, FL. ([albrigo@crec.ifas.ufl.edu](mailto:albrigo@crec.ifas.ufl.edu)) [C-3]

Three hurricanes in Florida starting in late summer of 2004 caused severe leaf loss, which stimulated many fall shoots. Flush occurred after each hurricane and by December, shoots were 6 to 12 weeks-old prior to cool temperatures capable of causing flower bud induction. To evaluate the potential for these flushes to mature buds that could be induced to flower, flushes which were stimulated on potted trees in a greenhouse were allowed to mature 4, 6, 8 or 10 weeks before moving trees to flower-inducing conditions for 6 weeks in a growth chamber [15/10 ° C (day/night)]. Plants were then returned to the greenhouse at 20 ° C or higher (ambient), until buds sprouted. Further experiments were conducted during the next two seasons. Only 1 % of sprouting buds on shoots matured for 4 weeks had flowers. In shoots that matured for 6 weeks, 18 % had flowers. After 8 weeks of growth, 57 % of the buds that sprouted were flower buds, while after allowing 10 weeks for shoots to mature, induction resulted in 68 % of the buds producing flowers. Consequently, 8 weeks of development were necessary for citrus shoots to develop mostly mature buds that responded to flower inductive conditions. This is about the same amount of time required for new citrus leaves to fully mature.

**Stimulation of Flowering in Basal Buds of Sweet Orange by Removal of Terminal Buds before Floral Induction.** Eduardo J. Chica and L. Gene Albrigo, UF/IFAS Citrus Research and Education Center, Lake Alfred, FL. ([echica@ufl.edu](mailto:echica@ufl.edu)) [C-4] (**Student Best Oral Presentation Competition Entry**)

Under Florida conditions, most sweet orange flowers (~80%) are formed in the 4 most apical buds of 1 year old or younger shoots. Experiments were conducted to determine whether removal of the 4 most apical buds of 1 year old sweet orange shoots before floral induction stimulates flowering in the remaining buds (more basal that do not usually flower). Clipped shoots had fewer buds starting growth in the spring and fewer inflorescences than intact shoots. However, more buds started growth and more inflorescences were formed in clipped shoots in

buds at formerly homologous positions to intact shoots (i.e. buds in positions 5 or greater counting from the original apex). The stimulation of basal buds to flower after clipping was stronger in 'Valencia' than in 'Hamlin' trees. In addition, stimulation of flowering in more basal buds by clipping was greater when shoots are clipped in November (just before the onset of floral-inductive temperatures) than when shoots were clipped in October or January. Clipped shoots produced more new vegetative shoots and formed inflorescences with greater leaf:flower ratio than buds at formerly homologous positions in intact shoots. These results indicate that removal of apical buds just before the onset of floral induction stimulates flowering at more basal positions of sweet orange shoots. Results are discussed in relation to the potential application of this knowledge to minimize the impact of routine hedging and topping on flowering in Florida.

**Lack of Transmission of Huanglongbing (HLB) by Citrus Seed.** Jim Graham, Evan Johnson, Diane Bright, UF/IFAS Citrus Research and Education Center, Lake Alfred, FL; Mike Irey, Univ. of Florida, US Sugar Corp., Clewiston, FL 33440. ([jhgraham@ufl.edu](mailto:jhgraham@ufl.edu)) [C-5]

In Florida nurseries, rootstock seed trees are located outdoors and only protected from psyllid transmission of *Candidatus Liberibacter asiaticus* (Las) by insecticide applications. In 2008, a survey detected two Carrizo'' citrange trees as HLB+. Given the potential risk for seed transmission and introduction of Las into nurseries by seed from source trees, assays of seedlings derived from seed extracted from symptomatic fruit were begun in 2006. From 2006 to 2008 seed were collected from mature Pineapple sweet orange trees in Collier Co. and in 2009 from Murcott tangor trees in Hendry Co., FL. For Pineapple orange, 415, 723 and 439 seedlings and for Murcott, 332 seedlings were tested at least twice by qPCR using 16S primers. In 2007, a single Pineapple seedling was suspect HLB+ but upon repeated testing was negative. From nurseries in 2008, 290 seedlings were recovered from fruit located on symptomatic branches of 2 Carrizo trees, and in 2009, 125 seedlings were recovered from 2 trees of Swingle citrumelo, 649 from 4 trees of 'Kuharske' Carrizo, 100 from 1 tree of Cleopatra mandarin and 100 from 1 tree of Sekwasha mandarin. In 2008, one suspect HLB+ Carrizo seedling was detected but HLB+ status was not confirmed after repeated testing. In 2009, a single questionable PCR detection for Cleopatra mandarin was obtained. Despite the occasional HLB+ test results, no plants have ever developed HLB symptoms and repeated testing has never confirmed anything other than the transient presence of Las in seedlings grown from seed obtained from Las-infected trees.

**Starch Analyses of HLB-affected and Control Healthy Leaves Reveal Variations in the Amylose/Amylopectin Ratio.** Ed Etxeberria and Pedro Gonzalez, UF/IFAS, Citrus Research and Education Center, Lake Alfred, FL. ([eje@crec.ifas.ufl.edu](mailto:eje@crec.ifas.ufl.edu)) [C-6]

Leaves from HLB-affected citrus trees accumulate massive amounts of starch compared to leaves from healthy trees. It has been established that the levels of plant starches and their physical, chemical and morphological characteristics are highly influenced by conditions ranging from environmental factors, genetic alterations, and pathogen infection. Therefore, differences in starch properties induced by HLB could be used to determine HLB infection. Leaf starch was isolated from HLB-affected trees and from control healthy girdled branches. Starch samples were reacted with 2% iodine and absorption spectra determined before and after separation into amylose and amylopectin. In addition, starch granules were examined morphologically by scanning electron microscopy, polarized light microscopy and their ring structure observed after

partial digestion with amylase. Starches from HLB-affected leaves and control leaves did not show considerable variations in any of the properties investigated except for their amylase:amylopectin ratio, which was considerably higher in starches from HLB-affected leaves.

**NAA Thinning of ‘W Murcott’.** Ryan Atwood, UF/IFAS, Lake County Extension, Tavares, FL; Nick Faryna, Faryna Grove Care & Harvesting, 465 E Collins St., Umatilla, FL; and, Ed. Stover, USDA/ARS, USHRL, 2001 S. Rock Rd., Ft. Pierce, FL. ( [raatwood@ufl.edu](mailto:raatwood@ufl.edu)) [C-7]

This study was conducted to determine if NAA thinning may be useful for managing crop load in Florida ‘W Murcott’. Trials were conducted in two groves of ages 4 and 6 years. NAA was applied on 13 May 2010, when fruitlets averaged 10-13 mm in diameter. A randomized complete block design was used, blocked by crop load and location. Airblast applications were made using non-ionic surfactant at 0.05%. Three spray variants were used: 250 ppm NAA, 2.4 kph, and 1170 L·ha<sup>-1</sup>; 500 ppm NAA, 2.4 kph, and 1170 L·ha<sup>-1</sup>; and 500 ppm NAA, 4.8 kph, and 585 L·ha<sup>-1</sup>. Fruit were harvested on 7 Feb 2011 and number of boxes per tree, number of fruit per tree, and limb breakage were counted. Prior to harvest, a random sample of 20 fruit per tree was collected to determine fruit size distribution. In the 4<sup>th</sup> year trees, non-thinned fruit averaged 158 g·fruit<sup>-1</sup> and peaked on 80 to 100 carton size, while in the 6<sup>th</sup> year trees non-thinned fruit averaged 127 g·fruit<sup>-1</sup> and peaked on 100 to 120 carton sizes. Mean fruit weight was significantly increased by each NAA treatment in both groves, ranging from 9 -12% increase in the 4<sup>th</sup> year trees and 22-38% increase in the 6<sup>th</sup> year trees, substantially shifting fruit into larger carton sizes. Boxes per tree and limb breakage were not affected by NAA treatment in either grove. Initial economic analyses indicate that crop value was significantly increased by NAA treatments in the older trees but not the younger trees.

**Comparison of Copper Formulations for Control of Citrus Canker on ‘Hamlin’ Orange.** Jim Graham and Megan Dewdney, UF/IFAS Citrus Research and Education Center, Lake Alfred, FL; Henry Yonce, KAC Agricultural Research, Inc., Deland, FL 32720. ([jhgraham@ufl.edu](mailto:jhgraham@ufl.edu)) [C-8]

Protection of Hamlin orange fruit from infection by *Xanthomonas citri* subsp. *citri*, the cause of citrus canker, is necessary to reduce premature fruit drop. The objective was to evaluate copper formulations for control of canker infection and fruit drop in 6 to 8 yr-old Hamlin trees. Copper sprays were applied at 21-day intervals starting when fruit were ~1.0 cm dia. until ~5.0 cm dia. The period of canker susceptibility of fruit was established by different number of applications through the fruit growth period. Separate treatments ended at each 21-day interval so that there were 4 to 7 applications per season. In 2008, early season infection occurred during rains before copper sprays commenced in late April. After early season infection, more than 4 sprays did not further reduce canker incidence on fruit, and all copper formulations were relatively ineffective for controlling fruit drop. In 2009 and 2010, early season infection and fruit drop did not occur because copper treatments were initiated before significant spring rainfall. After minimal early season infection, cumulative fruit drop was about 5% and, in 2009, more than 4 sprays did not further reduce the incidence of fruit canker or fruit drop. Overall, there were few differences among copper formulations for reducing canker incidence and fruit drop except that control by copper sulfate pentahydrate applied at substantially lower rates of metallic copper, was more

variable than for other copper formulations. Fruit infection after mid-July did not induce premature fruit drop, hence 4 copper applications were sufficient to attain maximum control.

**Foliar Sprays of Insecticides Targeted at Flushing Citrus to Control Asian Citrus Psyllid and Citrus Leafminer.** Jawwad A. Qureshi, Barry Kostyk and Philip A. Stansly, UF/IFAS Southwest Florida Research and Education Center Immokalee, FL. ([jawwadq@ufl.edu](mailto:jawwadq@ufl.edu)) [C-9]

The Asian citrus psyllid (ACP) *Diaphorina citri* vectors the bacterium *Candidatus Liberibacter asiaticus*, causal organism of “Huanglongbing” or citrus greening disease. Feeding damage from citrus leafminer (CLM) larvae facilitates the spread of citrus canker caused by *Xanthomonas axonopodis* pv. *citri*. Therefore, control of both ACP and CLM is critical in developing integrated management strategies to reduce the spread of the associated diseases in Florida citrus. Both pests require young shoots for oviposition and development of immatures. Sprays of insecticides were evaluated in 15-year-old *Citrus sinensis* (L.) Osbeck ‘Valencia’ orange trees infested with both pests. In the first experiment conducted in May, 435 Oil (horticultural spray oil) alone, Spirotetramet (Movento 240 SC) + 435 Oil, NAI-2302 + 435 Oil, Abamectin + thiamethoxam (Agriflex, MK 936) + 435 Oil, Diflubenzuron (Micromite 80 WGS) + 435 Oil, Flubendiamide (Belt 4SC) + Induce (non-ionic surfactant), M-Pede (soap) + Addit (vegetable oil) and Fenpyroximate (Portal 0.4EC) all provided significant reduction in psyllid populations compared to the control for up to 17 days after treatment (DAT). Significant reduction in CLM populations compared to the control was observed in all treatments through 10 DAT except 435 Oil alone at 3 DAT, Portal at 10 DAT and M-Pede + Addit at both observations. In the second experiment conducted in July-August, treatments of 435 Oil alone, Spinetoram (Delegate 25 WG) + 435 Oil, Imidacloprid (Provado 1.6 F) + Induce, Movento 240 SC + 435 Oil and BYI02960 with or with 435 Oil or Induce all provided significant reduction in psyllid populations for more than seven weeks except 435 Oil alone. Both 435 Oil and Induce were effective adjuvants for BYI02960. Significantly fewer CLM larvae compared to the control were observed with Delegate 25WG and Provado 1.6F at 3 and 10 DAT. However, at 17 DAT, BYI02960, Delegate 25 WG, and Movento 240SC all applied with 435 Oil had significantly fewer CLM larvae than control. Treatment effects were more pronounced against ACP than CLM.

**Evaluation of Wind Speeds within a Central Florida Citrus Grove: Potential Implications for Pesticide Spray Applications.** W.C. Oswald, UF/IFAS Polk County Extension, Bartow, FL; R.A. Atwood, UF/IFAS Lake County Extension, Tavares, FL; S.H. Futch and M.E. Rogers, UF/IFAS Citrus Research and Education Center, Lake Alfred, FL ([wcoswalt@ufl.edu](mailto:wcoswalt@ufl.edu)) [C-10]

In Florida, low-volume sprayers have been adopted as a cost effective way to reduce Asian citrus psyllid populations. Low-volume sprayers are calibrated to deliver 2 to 5 gallons per acre with a volume mean diameter droplet size of 100 microns. This relative measure of droplet size describes the population of droplet sizes where 50% are smaller than 100 microns and 50% are larger. Smaller droplets are more susceptible to environmental conditions and drift at the time of application. A review of the literature on drift and droplet size identified a number of environmental conditions that could affect the deposition of these small droplets. This study monitored these environmental conditions in a Florida citrus grove from June to December 2010

and provided insight into the prevalence of the favorable weather conditions for low volume spray applications.

**A Summary of Nematode Soil Sampling Results From the Indian River Area in 2010-2011.**

Timothy P. Gaver, UF/IFAS St. Lucie County Extension, Ft. Pierce, FL; Larry Duncan, UF/IFAS Citrus Research and Education Center, Lake Alfred, FL; and Alex Truszkowski, DuPont Crop Protection. ([tgaver.49@ufl.edu](mailto:tgaver.49@ufl.edu)) [C-11]

Soil samples containing feeder roots were collected at 212 locations in 2010 and 2011 from Martin, St. Lucie and Indian River counties. Representative samples containing 4-6 subsamples were taken February-May or September-November from areas with declining trees in over 27 groves. Assays were conducted for Citrus (*Tylenchulus semipenetrans*), Burrowing (*Radopholus similis*), Dagger (*Xiphinema vulgare*) and Sting (*Belonolaimus longicaudatus*) nematodes and evidence of root sloughing or fragmentation. Citrus nematodes were found in 47% (99) of the samples, with 10% (22) at population levels above 1000 nematodes per 100 grams of soil. Dagger nematodes were found in 54% (114) and Sting nematodes in 14% (27) of the samples. No Burrowing nematodes were detected in the samples. Root sloughing or fragmentation was noted in 34% (72) of the samples.

**Cold Injury Following Horticultural Treatments to Overcome Juvenility in Citrus**

**Seedlings.** Ed Stover, Greg McCollum, and Kim Bowman, USDA/ARS, USHRL, 2001 S. Rock Rd., Ft. Pierce, FL. ([Ed.Stover@ARS.USDA.GOV](mailto:Ed.Stover@ARS.USDA.GOV)) [C-12]

Citrus seedling juvenility delays new hybrid evaluation, slows cultivar release, and slows introgression of new traits. A horticultural program reporting to overcome citrus juvenility was tested at the Whitmore Citrus Research Foundation farm (Lake County), using replicated Hirado x Clementine seedlings and standard cultivars all propagated onto US-812 rootstock. Treatments compared on each genotype were: 1) untrained control, 2) training to a single upright shoot (TSUS), 3) TSUS with weekly thorn removal, 4) TSUS with girdling in December, 5) TSUS with weekly thorn removal and girdling (complete juvenility reduction program), and 6) TSUS with soil paclobutrazol in December. Trunk diameter increased faster on untrained vs. TSUS trees. In Jan 2010 23 hours were <-4.4°C and one hour <-6.7°C. Trees were scored for cold damage: average rating of untrained trees was “slight defoliation” while TSUS trees averaged “complete defoliation and substantial dieback”. In control trees 14% were killed and 23% were dead or displayed dieback (DODB), while TSUS trees of treatments 2, 3 and 6 had mortality of 9-17%. Girdled trees had higher mortality at 29-43%. Percent of trees with DODB were 54%-77% in TSUS treatments. Even though a cold protection tarp system was installed and used on surviving trees, further damage occurred following freezing conditions in Dec 2010 with 17 hours <-4.4°C and one hour <-6.7°C. TSUS trees again showed much more damage than untrained trees. These techniques increase risk of serious cold injury, and require more elaborate cold protection to be implemented in colder areas such as Lake County.

### **Dolomitic-phosphate-rock-based Slow Release Fertilizer for Agriculture and Landscapes.**

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Most soils in Florida are very sandy with minimal holding capacity for water and nutrients, including phosphorus (P). Phosphorus applied in water-soluble fertilizers that is not taken up by the plants is subjected to leaching loss into surface or ground water, causing environmental pollution. Alternate fertilization strategies such as slow release P fertilizers are greatly needed to minimize the impacts of agriculture on water quality. The phosphate industry in Central Florida produces significant amounts of dolomite phosphate rock (DPR), such as reject pebbles, phosphatic clays, and oversize debris. These materials contain Ca, Mg, and P in amounts which may potentially be useful for agricultural production and landscaping plants. The objective of this study was to evaluate the agronomic effectiveness of the developed DPR fertilizers and to assess the environmental impact of the DPR fertilizers, as compared with water soluble P fertilizers. The DPR fertilizers were developed from the DPR material and N-viro soil and used for greenhouse studies. A typical agricultural soil (Alfisol) in Florida was used and the tested crop plants included ryegrass (*Lolium multiflorum*) and citrus (*Citrus reticulata* Blanco). Based on the results from greenhouse experiments, we found DPR fertilizers contain adequate amounts of P in a slow release nature and other nutrients and are promising for application in acidic sandy soils where P leaching is a problem. DPR fertilizers appear superior to water soluble fertilizer for the growth of ryegrass, a pasture plant in term of both dry matter yield and nutrient concentrations in plant. DPR fertilizers raised pH of acidic soils, increased soil organic matter, total and available nutrients. However, it slightly increased the concentration of Mehlich 3 extractable metals such as Cr, Ni, and Pb in the soils, but the concentrations of these metals in plant tissue (especially in plant shoot) were actually reduced due to raised soil pH.

**Response of Citrus to Exogenously Applied Salicylate Compounds during Abiotic and Biotic Stresses.** Kirandeep Mann, Arnold Schumann, Timothy Spann, UF/IFAS Citrus Research and Education Center, Lake Alfred, FL. ([mannkk@ufl.edu](mailto:mannkk@ufl.edu)) [C-14]

Citrus is exposed to several of abiotic and biotic stresses during production, which may limit yields and fruit quality. Exogenous application of the phytohormone salicylic acid (SA) can elicit various defense mechanisms of plants which help them to cope with adverse environmental and biotic (disease) stresses. The effect of exogenously applied SA in alleviating stress damage in citrus leaves during exposure to high or low temperatures and disease was investigated. Sodium salicylate (Na-SA) reduced the electrolyte leakage percentage (ELP) in both heat (up to 84%) and cold (up to 20%) stressed leaves and visibly maintained the integrity of citrus leaf tissue. The protective effect of Na-SA was highly concentration dependent, with lower (<0.08 mM) and higher (>0.20 mM) concentrations failing to induce heat or cold tolerance. A narrow concentration range of 0.10 to 0.16 mM was most effective in protecting citrus leaf tissue from heat and cold stresses. Application of 0.14-0.18 mM Na-SA to Huanglongbing (HLB)-infected field-grown citrus trees increased leaf sap pH from 6.1 to 6.5 after one week. The leaf sap pH of healthy, uninfected citrus leaves averaged about 6.5. Salicylic acid applied to HLB-infected citrus trees also significantly increased new foliage growth. Collectively, our results suggest that SA applied at appropriate concentrations can partially alleviate heat, cold and disease stresses in

citrus. In addition, appropriate concentrations of SA could be used to help regulate and synchronize the emergence of leaf flushes and flowering in HLB-infected citrus trees.

**Quantification of Furanocoumarins and Acids in Grapefruit Hybrid Populations to Evaluate Their Relation and Assist Selection.** Chunxian Chen, Fred Gmitter Jr., UF/IFAS Citrus Research and Education Center, Lake Alfred, FL; Carl Haun and Paul Cancalon, Florida Department of Citrus, Lake Alfred, FL. ([exchen@ufl.edu](mailto:exchen@ufl.edu)) [C-15]

Several clinical studies have shown that grapefruit furanocoumarins (FCs) can inhibit the intestinal cytochrome P450 CYP3A4. As a result, the level of some oral drugs in blood has been shown to increase to various degrees. This drug interaction had a significant effect on the sale of grapefruit and grapefruit juice. Grapefruit diploid and triploid hybrids were selected to quantify the concentration of different FCs and acids derivatives toward evaluation of their biosynthetic relation and selection of new grapefruit varieties with low FCs and acids, and seedlessness (triploids). Measured FCs included bergamottin, 6',7'-dihydroxy bergamottin (6,7-DHB), paradisin C, bergaptol, isoimperatorin, 5',8'-dimethylallyloxypsoralen (5,8-DMP), and epoxybergamottin (EBM). The concentrations of FCs greatly vary among those hybrids, ranging from 0 to several hundred micrograms per liter juice. There were varied degrees of correlations among the concentrations of these FCs, and acids. This effort, along with the valuable data, will lead to breeding low-FC, low- acid, and possible seedless grapefruit varieties for greater market appeal.

**Air Temperatures within a Central Florida Citrus Grove using Microsprinkler Irrigation for Cold Protection.** W.C. Oswalt, UF/IFAS Polk County Extension, Bartow, FL; R.A. Atwood, UF/IFAS Lake County Extension Service, Tavares, FL; and, T.M. Spann, UF/IFAS Citrus Research and Education Center, Lake Alfred, FL. ([wcoswalt@ufl.edu](mailto:wcoswalt@ufl.edu)) [C-16]

Microsprinkler irrigation is used extensively in Florida citrus groves as a method to protect mature and young trees from freezing temperatures. Historical studies have documented the effectiveness of this methodology to protect young citrus trees from freeze damage. However limited information exists on the effectiveness of under tree microsprinkler irrigation for freeze protection of mature citrus trees. This project documents the effect of under tree microsprinkler irrigation for freeze protection during the December 14 through 16, 2010 in a Central Florida Citrus Grove.

**Economic Arguments for and against Tree Eradication to Control HLB.** Fritz Roka, UF/IFAS Southwest Florida Research and Education Center, Immokalee, FL. ([fmroka@ufl.edu](mailto:fmroka@ufl.edu)) [C-17]

Growers are being urged to be aggressive in their efforts to scout and eradicate HLB-infected trees. From an industry perspective, this is a sound policy. From an individual grower perspective, it may very problematic. Once HLB infection rates reach a threshold level, following a tree eradication strategy could decimate an individual's grove, and consequently their economic future as a citrus grower. As more and more growers move away from tree eradication, the probabilities of success for the remaining growers to control overall HLB inoculum level diminishes. Whatever is in the best economic/financial interest of a

grower may not correspond to the best strategy for the whole industry. If tree eradication is, in fact, the only true path to sustaining the Florida citrus industry with HLB, industry wide policies must be approved and enforced. These policies include revisiting the old canker program - mandatory tree removal with compensation for individual growers. As with any such program, growers would collectively pay through a box tax.

**Balanced Mineral Nutrition Decreases Greasy Spot Incidence in Citrus.** Kirandeep Mann, Arnold Schumann, and Timothy Spann, UF/IFAS Citrus Research and Education Center, Lake Alfred, FL. ([mannkk@ufl.edu](mailto:mannkk@ufl.edu)) [C-18]

Citrus diseases are a serious threat to profitable fruit yields and quality. Disease control with continuous use of agrochemicals only is not an acceptable, sustainable option due to environmental contamination, pesticide residues in the food chain, and pesticide resistance. Therefore, alternative integrated pest management (IPM) techniques need to be developed and evaluated. Mineral nutrition could increase or decrease disease resistance by affecting both plant and pathogen growth. To evaluate the effect of mineral nutrition on greasy spot disease (*Mycosphaerella citri*) infection of citrus, a greenhouse hydroponics experiment was established for precise control of nutrient elements. Valencia orange plants (*Citrus sinensis* [L.] Osb.) were grown in plastic pots filled with graded quartz sand, automatically drip-irrigated with deionized water. The experiment was conducted in a completely randomized design (CRD) with seven nutritional treatments and ten replications. The treatments included full strength Hoagland's nutrient solution (T1), one tenth concentration Hoagland's nutrient solution (T2), full strength Hoagland's minus Mg (T3), minus Ca (T4), minus B (T5), minus Mn (T6), and minus Zn, Cu, Mo, Fe (T7). Nutrient solution specific to each treatment was applied weekly. A high humidity was maintained in the greenhouse to encourage greasy spot spore germination and leaf infection. The foliar symptom expression and defoliation of citrus plants naturally infected with greasy spot fungus was highest in T2, T4, and T7 treatments. The full-strength balanced nutrient solution greatly reduced the greasy spot infection. Electrolyte leakage, which is an indicator of compromised cell membrane integrity, was highest in T2, T4 and T7 treatments. Leaf sap pH was lower in the different nutrient deficient treatments (pH 6.0-6.2) compared to the balanced nutrition (pH 6.3). Stem diameter and SPAD chlorophyll index values were lowest for T2 and T4 treatments. The results confirm Liebig's law of minimum, and suggest that a complete balanced nutrition supply for citrus may significantly reduce the occurrence of greasy spot, reduce pesticide spray requirements, promote overall tree health and enhance production efficiency.

**Rehabilitation of HLB Infected Trees by Severe Pruning and Good Nutrition.** Bob Rouse, UF/IFAS Southwest Florida Research and Education Center, Immokalee, FL. ( [rrouse@ufl.edu](mailto:rrouse@ufl.edu)) [C-19]

Citrus trees infected with HLB (citrus greening) bacteria often become weak and experience dieback as they begin to 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" for HLB trees, and two other

micronutrient products (Fortress and Energy) that contained nutrients as phosphites plus nickel and cobalt. Both heavily buckhorned pruned trees and unpruned standard trees were compared for shoot growth and canopy development. Pruning was done in February 2010 before the spring flush. Spring, summer, and fall shoot growth was significantly greater on pruned trees. The spring growth shoot flush on the pruned trees was twice the length of the unpruned standard trees and had larger leaves. The summer flush on the pruned trees was two and one-half to 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.

**New Somatic Hybrid Rootstock Candidates for Tree-Size Control and High Juice Quality.** J.W. Grosser and G.A. Barthe, UF/IFAS Citrus Research and Education Center, Lake Alfred, FL. ([jgrosser@ufl.edu](mailto:jgrosser@ufl.edu)) [C-20]

New citrus production systems that feature high density plantings being developed and adapted for Florida growing conditions will require improved tree-size controlling rootstocks that bear early and produce good yields of fruit with juice of high quality. Flying Dragon, the standard dwarfing stock of the industry, grows slowly in the nursery and generally does not yield adequately. Improved alternative rootstock choices are desirable. Tetraploid rootstocks, both autotetraploids and allotetraploids, have been shown to have a capacity to reduce tree size when budded with commercial diploid scions. We have been exploring somatic hybridization of complementary diploid rootstocks via protoplast fusion to generate allotetraploid rootstock candidates for many years. Our early work featured production of somatic hybrids of many complementary rootstock combinations, including hybrids of sweet orange and mandarins with Flying Dragon. Field testing of such hybrids showed excellent tree size control, good yields and juice quality; however, there were usually one or more problems with each hybrid, such as inadequate seed production for standard propagation, or poor tree survival at one or more locations. We have subsequently produced additional somatic hybrids of complementary rootstocks that appear to have solved these problems, which also include parentage for cold-hardiness. Although replicated field trials of these somatic hybrid rootstock candidates were destroyed by the state-run canker eradication program, we were able to obtain yield and juice quality data over three consecutive seasons from a blight tolerance trial in St. Cloud, FL, in collaboration with Mr. Orie Lee. Features of five such tree-size controlling somatic hybrid rootstock candidates will be presented, including information on seed production, tree size, yield and juice quality. For example, the somatic hybrid of ‘Changsha’ mandarin + 50-7 trifoliolate orange consistently produces 2.25 boxes of Valencia fruit per tree with high juice quality on trees of similar size to those budded to Flying Dragon. These new somatic hybrid rootstocks should have good potential in emerging advanced production systems for Florida.

**Update on the Advanced Citrus Production System in Florida.** Arnold Schumann, Kevin Hostler, Kirandeep Mann, and Laura Waldo, UF/IFAS Citrus Research and Education Center, Lake Alfred, FL. ([schumaw@ufl.edu](mailto:schumaw@ufl.edu)) [C-21]

During the past two years the “open hydroponics” (OH) method of advanced crop production has been intensively studied for proof of concept and adaptation to a new method of growing citrus

in Florida. A major incentive for the improved, more efficient citrus production system is the need to remain economically viable despite an increasing incidence of introduced diseases such as citrus greening or Huanglongbing (HLB). The foundation of a successful OH system is based on early, high yields, made possible through 1) high density planting, and 2) accelerated growth from optimal balanced nutrition and water relations achieved with precise computerized fertigation. This paper will discuss the outcomes from 2.5 years of 'Hamlin' orange growth in a scientifically conducted Central Florida field experiment. Recent results of fruit yield and quality, fertilizer and water use, nitrate-nitrogen leaching, and pest and disease control will be discussed.

**Optimal Replacement Times for Citrus Groves: The Use of Advanced Production Systems to Mitigate Endemic HLB.** Robert A. Morris and Ronald P. Muraro, UF/IFAS Citrus Research and Education Center, Lake Alfred, FL. ([ramorris@ufl.edu](mailto:ramorris@ufl.edu)) [C-22]

Prior to the discovery of HLB in Florida, resetting unproductive trees was usually the most economically viable strategy for maximizing the economic life of citrus groves. In some situations, replanting the entire grove was required, but the replanting decision was obvious since the grove had probably suffered irreparable damage. Endemic HLB has made the grove replacement decision more complex and more critical to maximizing the profitability and economic life of citrus groves. For grove replanting decisions, maximizing the net revenues from a citrus grove over its life is best accomplished by comparing the net revenues from operating the grove for another season with the opportunity to earn higher future net revenues realized by replanting the grove during that season. The optimal replacement time is when the net revenue of the existing grove is less than the annualized present value of the stream of net revenues to be generated by replanting the grove. An advanced production system (APS) entails planting at a density of 225-350 trees per acre, with nutrients and water precisely managed through a drip irrigation system. The additional trees per acre help offset the higher tree mortality from greening. This analysis compared a grove planted at traditional densities of 150 trees per acre to self replacement and to replacement with a grove planted with 270 trees per acre utilizing APS. It also compared an APS grove planted at 270 trees per acre to self replacement, with and without resetting.