

2009 FSHS MEETING – ABSTRACTS BY SECTION

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CITRUS SECTION

Monday June 8, 2009

10:00 Assessment of Soil Variability and its Effect on Florida Citrus Production: A Astatistical Approach. K. Mann, A. Schumann, UF/IFAS, CREC, Lake Alfred, FL and T. Obreza, UF/IFAS, SWS, Gainesville, FL. [C1] *Student paper competition entry*

Site-specific management of citrus groves based on major yield-limiting soil properties requires an understanding of relationships between citrus production and soil variability in both horizontal and vertical dimensions. To explore these relationships, a 10-ha citrus grove was divided into five productivity zones based on tree canopy volume using ArcView 3.2 GIS software. These productivity zones were termed as “very poor,” “poor,” “medium,” “good” and “very good”. Soil samples were collected from six locations from each productivity zone at four depths (0-15, 15-30, 30-45 and 45-60 cm). The relationships between citrus production and soil properties at four cumulative depths (0-15, 0-30, 0-45 and 0-60 cm) were evaluated using various statistical methods including correlation, stepwise multiple linear regression, partial least squares (PLS) regression, cluster, and discriminant function analyses. Soil organic matter, CEC, Mehlich I extractable P, oxalate extractable Al, soil color, sand and water content at permanent wilting point, contributed greatly to the variability in citrus production, and this contribution was higher at greater soil depths. The predictive models developed using PLS regression analysis explained 45% to 58% and 54% to 71% of the variance for yield and canopy volume, respectively and this variance increased with the increased root-zone depth. The yield in the poor areas of the grove was over-predicted only when the variations in soil properties in the top 15-cm layer were used, but a realistic prediction was observed when including the soil properties up to the 60-cm depth. These predictive models can be used for site-specific management of citrus groves with variable citrus production caused by soil variability.

10:15 Partial Root Zone Drying with and without Salinity Affects Water Use Efficiency of Citrus. Ayako Kusakabe, Juan Carlos Melgar, Jill Dunlop, and J. P. Syvertsen, UF/IFAS, CREC, Lake Alfred, FL 33850. [C2] *Student paper competition entry*

A greenhouse experiment was conducted using partial root zone drying (PRD) with and without saline water on split-root ‘Swingle’ citrumelo seedlings growing in an autoclaved Candler fine sandy soil to evaluate leaf water use efficiency (WUE) and photosynthetic responses. There were five treatments: 1) both root zone halves well watered (WW) with 50% crop evapo-

transpiration (ETc, by weight loss, =100% ETc control), 2) one half of the split root zone irrigated with 100% ETc while the other received no water (PRD), 3) 50% ETc water plus 50% ETc with 50mM NaCl (PRS), 4) both sides irrigated with 50% ETc plus 50mM NaCl (SS), or 5) 50% ETc on one side and 50% ETc plus 50mM NaCl on the other side (WS). All treatments had similar stem water potentials, but water use in PRD and PRS averaged 60% to 69% of water used for WW. Shoot growth and leaf area were reduced similarly across all stress treatments. Leaf N was highest in PRD. Leaf CO₂ assimilation (A_{CO₂}), transpiration, and stomata conductance were decreased after irrigation compare to before irrigation in all treatments. The reduced A_{CO₂} after irrigation significantly reduced WUE except in leaves above the WW and PRD dry side. Although PRD plants grew less than WW plants, leaves above the PRD dry side had higher A_{CO₂} than WW plants. Root abscisic acid (ABA) concentration in the PRD dry side increased 2-fold compared to that in PRD wet side. Much higher ABA accumulated in leaves than in roots in all treatments. Root ABA in the dry sides of PRD and PRS increased 2.1 –fold to 1.3-fold, above the wet sides. Thus, PRD resulted in water savings without loss of leaf function.

10:30 Alternative Methods for Determining Crop Water Status for Irrigation of Citrus Groves. L. Waldo, A. Schumann, UF/IFAS, CREC, Lake Alfred, FL. [C3] *Student paper competition entry*

Due to the increasing demand for water in Florida, the supply of water available for irrigation is decreasing and irrigation costs are rising. Based on previous findings, soil sensors have been found to be inaccurate in small numbers and unable to accurately measure the soil moisture status under trees for scheduling citrus irrigation. As a result, irrigation managers must come up with a method of scheduling irrigation that is based on plant-specific needs in order to apply only the necessary amount of water for the tree to remain productive while avoiding excess. Several methods for measuring tree canopy stress as an indicator of plant water status were tested both in a controlled greenhouse environment and in the field. These methods include infrared radiometers for thermal infrared canopy temperature measurements, multispectral cameras for water stress index using reflectance, and the GreenSeeker® sensor for measurements of canopy NDVI as an indicator of plant water status. All of the measurements taken were plotted against stem water potential (SWP) as a reference of plant water stress. Results showed that the thermal infrared radiometer is capable of predicting water stress using the crop water stress index (CWSI) in a greenhouse setting, while field measurements were found to be less accurate due to instrument sensitivities to wind and low solar radiation levels during cloudy periods. The multispectral camera was able to accurately predict plant water status ($R^2 = 0.90^{***}$) using a ratio of reflectance at the 840 nm and 670 nm wavelengths. Similar results were found using the commercially available GreenSeeker® for NDVI, however the regression analysis showed that while significant, it was less accurate than the multispectral camera ($R^2 = 0.31^{***}$).

10:45 Effect of Cold Acclimation on Growth and Water Uptake of Hamlin Citrus. Smita Barkataky, Kelly Morgan and Robert Ebel University of Florida Southwest Florida Research and Education Center 2686 SR 29N, Immokalee, FL 34142 [C4] *Student paper competition entry*

Severe freezes occurred in central Florida during 1980s, killing many citrus (*Citrus sinensis*) trees. Citrus, particularly young trees, are greatly affected by seasonal variation of climate factors especially temperature and relative humidity. Experiments were conducted at the University of Florida, Southwest Florida Research and Education Center to evaluate the growth, transpiration rate and water use of ‘Hamlin’ citrus trees to different cold acclimation using growth chambers. Results showed that the overall growth of the cold acclimated plants were 55.3% lower than that of the control ones. With low temperatures, transpiration rate was also found to decrease by 68.5%. Furthermore, it was observed that the roots were more resistant to soil water uptake when

temperatures were low decreasing water use by 56.8%. It can be concluded from this study that cold temperatures significantly affects the physiology of ‘Hamlin’ trees reducing water use and reducing the devastating effects of freezing. Based on plant water use during cold temperature, need-based citrus irrigation schedules can effectively be modeled. Optimal irrigation scheduling will optimize water use and minimize leaching of essential nutrients.

11:00 Irrigation Regime and Exogenous ABA Affect Freeze Tolerance in ‘Valencia’ Trees. J.C. Melgar, J. Dunlop and J.P. Syvertsen University of Florida, IFAS, Citrus Research and Education Center, 700 Experiment Station Road, Lake Alfred, FL 33850. [C5]

Abscisic acid (ABA) plays an important role in cold temperature responses of plants and has been reported to increase during cold acclimation. The application of exogenous ABA may alter ABA metabolism and induce cold tolerance. Roots in drying soil synthesize ABA that is transported to the shoot acting as a signal that promotes stomatal closure. In this study, exogenous ABA at 1mM was applied foliarly in late winter to 14-year old ‘Valencia’ sweet orange trees that were under three different irrigation regimes: 1) drought stress (no irrigation and rain shield covered soil during winter), 2) rain only (no irrigation), and 3) normal irrigation with rain throughout the winter. Leaf freezing tolerance based on the lethal freezing temperature from electrolyte leakage was evaluated one and three weeks after ABA applications. Overall, trees under drought stress showed greater freezing tolerance than well irrigated trees although differences were not always significant when compared to the intermediate rain-only treatment. Exogenous ABA did not improve freeze tolerance one week after application but increased it in irrigated trees during the third week. ABA applications in drought stressed trees were not as effective as in well irrigated trees perhaps because foliar absorption was greater in irrigated trees. Thus, drought stress and exogenous ABA can both increase freezing tolerance in ‘Valencia’ orange trees.

11:15 Imidacloprid has Little Effect on Growth or Drought Tolerance of Citrus Rootstock Seedlings without Pests. J.P. Syvertsen and J.M. Dunlop, UF/IFAS, CREC, Lake Alfred, FL 33850. [C6]

Imidacloprid, a widely used systemic chloronicotinyl insecticide, has been credited with being able to increase plant growth and increase resistance to plant stress even in the absence of pest pressures. Greenhouse studies using 6-month-old seedlings of the citrus rootstocks ‘Carrizo’ citrange (Carr) and ‘Cleopatra’ mandarin (Cleo) were repeated in two consecutive years in the absence of pests. Imidacloprid was applied at the manufacturer’s recommended rate either as a soil drench (Admire) or as a foliar spray (Provado). Half of the plants were drought stressed and the other half of the plants were kept well watered. After ten to twelve weeks, leaf photosynthesis and leaf water use efficiency (WUE) were evaluated by gas exchange along with plant water status and growth. Imidacloprid had no effect on plant water status or drought tolerance in either year. Imidacloprid increased root growth but decreased leaf growth in Carr in year 1 but not in year 2. There was a tendency to increase leaf thickness or leaf density but imidacloprid did not increase total plant growth of either species in either year. Imidacloprid increased leaf photosynthesis and WUE of both species under drought stress and well-watered conditions in both years. Thus, imidacloprid changed growth allocation between roots and shoots and increased leaf dry weight per area, leaf photosynthesis and WUE but these responses were not translated into increases in plant water status or total plant growth.

1:30 Cultivar-dependent Gene Transfer into Citrus using *Agrobacterium*. M. Dutt and J.W. Grosser, Citrus Research and Education Center, UF. [C7]

Florida’s citrus industry is currently under severe onslaught from two non-indigenous but now endemic pathogens causing the diseases Huanglongbing (HLB) and Citrus canker. None of the

commercial cultivars are resistant to either disease, which results in severe losses to the industry. Genetic transformation of citrus, to incorporate gene(s) for disease resistance not found in citrus, is gaining importance due to this widespread destruction. In an effort to transform a large number of cultivars via *Agrobacterium* mediated transformation, epicotyl explants of several citrus scion and rootstock cultivars were evaluated for ability to incorporate transgenes into their genome. It was determined that genetic transformation efficiency depended on cultivar studied and cultivars were either relatively easy to transform, moderately difficult or recalcitrant to *Agrobacterium* infection. In general, of the cultivars investigated, ‘Carrizo’ and ‘Duncan’ had the highest transformation efficiency (over 40%), followed by OLL8, a Valencia like somaclone and ‘Hamlin’ (20%-40%). *Poncirus trifoliata*, ‘Marsh’ and ‘Flame’ grapefruit and ‘Valencia’ sweet orange were moderately difficult (10%–20%), while ‘Mexican Lime’, ‘Volkamer Lemon’, *Citrus macroptera* and tangerines were recalcitrant (less than 10%). Our results also suggested that the final recovery rate of transgenics were significantly lower since cultivars also varied in their ability to regenerate after *in vitro* grafting.

1:45 Demonstration of a Sustainable Approach to Citriculture Within a National Wildlife Refuge in the Indian River Area. R. C. Adair, Jr., B. A. Norquist and G. K. Ross, Florida Research Center for Agricultural Sustainability, Inc., Vero Beach. [C8]

U.S. Fish and Wildlife Service officials at the Merritt Island National Wildlife Refuge (Refuge) were required to reduce chemical and other inputs to the citrus operations in the refuge. For several years the past operation of the groves using commercial citrus programs was not economically viable. The Refuge recognized that a sustainable agricultural approach to citrus management would reduce deleterious inputs at the citrus groves and Florida Research Center for Agricultural Sustainability (FlaRes) was interested in determining the horticultural and economic feasibility and environment aspects of a sustainable agricultural approach to citriculture at an operational scale. In 1996, the Refuge and FlaRes signed a Memorandum of Understanding (MOU) to develop a Sustainable Citrus Program (SCP) that would reach these mutual goals. Later in 1998, the MOU was modified to include the entire 1,000 acres of citrus groves located at the Refuge. FlaRes by this agreement managed the groves using its SCP, and collected, documented and reported all agronomic, economic, and environmental details associated with the groves to the Refuge. In this paper, we have condensed these reports with the intent to present the most salient findings observed over a twelve year period of this study. Among these findings include the effectiveness of two bio-rational fungicides, foliar fertilization, and a Geographic Information System (GIS) that was constructed to encompass all management and research areas.

2:00 Implementing Advanced Citrus Production Systems in Florida – Early Result. A. Schumann, J. Syvertsen, UF/IFAS, CREC, Lake Alfred, FL and K. Morgan, UF/IFAS, SWFREC, Immokalee, FL. [C9]

The advanced citrus production system (ACPS) is a short- to medium-term approach now being evaluated in Florida citrus groves for sustainable, profitable citrus production in the presence of greening (Huanglongbing; HLB) and canker diseases. Firstly, ACPS will compress and enhance the citrus production cycle so that economic payback can be reached in fewer years. Early economic fruit production (producing annual net profits) should be reached in as little as three years, thus achieving *early return on investment* with its associated economic advantages. The early, high yields will be achieved primarily with high-density planting and optimum nutrition and water relations using intensively managed computerized daily fertigation, commonly referred to as “open hydroponics”. Secondly, the long-term production of the ACPS grove will be sustained by built-in redundancy since removed diseased trees will simply be compensated for by additional growth of adjacent trees in the high density planting. Four field experiments evaluating ACPS using newly planted and mature trees will be described. Field plot layouts, automated fertigation

system design, equipment selection, irrigation scheduling, monitoring, remote control, fertilizer formulations, and early data from soil and tree measurement will be presented. The information will be useful for growers wanting to convert citrus blocks to ACPS, and will update the research and grower community on the latest Florida-specific research results for this intensively managed production system.

2:15 Citrus Production Systems to Survive Greening – Horticultural Practices. Kelly Morgan, Arnold Schumann, Bill Castle, Ed Stover, Pete Spyke, Fritz Roka, Ron Muraro, and Allen Morris. [C10]

The long-term profitability of citrus groves in Florida is tied directly to yield. Increasingly, two factors outside the control of the growers are forcing Florida citrus growers to re-evaluate the sustainability of their current operations. These factors are: 1) impact of canker and greening diseases on tree health and yields, and 2) continued urbanization within the state. A key to increased profitability is improved early and sustained production on high density groves. Improved early and sustained yields will allow growers to reach earlier return on investment and thus, better deal with potential decreased production due to tree loss from disease. The use of automated irrigation systems and intensive nutrient management is critical to production systems for achieving increased tree growth and yield. “Maintain soil moisture and nutrient concentrations in the tree root zone near optimum levels” is known as The Open Hydroponic System (OHS). The system must be adapted for Florida summer rainy season and sandy soil characteristic so that current fertilizer best management practices (BMPs) are not exceeded and nutrient leaching increased. Current OHS management practices utilized in selected citrus producing countries around the world will be reviewed and compared to proposed Advanced Production Systems practices for high density citrus plantings in Florida. Practices considered will be nutrient ratios and application timing irrigation scheduling and methods, root density distribution, and girdling. Adoption of these intensive citrus management practices has the potential of conserving water, improving nutrient use efficiency, reducing leaching in addition to improving tree growth and yield.

2:30 Citrus Production Systems to Survive Greening – Economic Thresholds. Fritz Roka, Ron Muraro, Allen Morris, Pete Spyke, Kelly Morgan, Arnold Schumann, Bill Castle, and Ed Stover. [C11]

Advanced Production Systems (APSs) are proposed strategies for citrus production that increase early production and sustain production at higher levels through at least the first 10 years of grove life. Higher tree densities, automated irrigation, and intensive nutrient management will increase per acre establishment and annual cultural care costs. Estimates of the changes in these costs and a determination of the required yield increase that an APS grove must achieve to be profitable are presented in this paper. Estimated cost increases will be based on the APS specifications outlined in the proceeding paper “*Citrus Production Systems to Survive Greening – Horticultural Practices*”. Potential tree loss scenarios from citrus greening will be considered in a 10 year analysis of net present value (NPV) under various price and yield assumptions.

2:45 Short-Term Fruit Price Effects Resulting From High Retail Orange Juice Prices and Accumulated Inventories. Robert A. Morris, Citrus Research and Education Center, UF, Thomas H. Spreen, Food and Resource Economics Department, UF, and Mark G. Brown, Florida Department of Citrus. [C12]

During the 1970’s, 1980’s and early 1990’s, U.S. retail market orange juice prices and delivered-in processed Florida orange prices were over 90% correlated, on an annual basis. Much like in the past, when processed orange prices increased reflecting a reduced orange crop following hurricanes in 2004 and 2005, wholesale and retail OJ prices also

increased significantly and OJ consumption declined. However Florida's crop partially recovered in the following season and fruit prices declined, but retail OJ prices remain high. The result is continued low OJ consumption, high and increasing OJ inventories and low cash market fruit prices, considerably below growers' break even costs. This paper analyzes the current relationships between delivered-in processed orange prices, retail OJ prices, and OJ demand, and examines processing firm and market behavior that explains these changed price relationships.

3:30 Interaction of CMNP Concentration and Canopy Shaker Setting on Fruit Removal of Sweet Orange. Robert C Ebel^a, Jackie Burns^b, Kelly Morgan^a, and Fritz Roka^a ^aSouthwest Florida Research and Education Center, Institute of Food and Agriculture Sciences, University of Florida, Immokalee, FL 34142, ^bCitrus Research and Education Center, Institute of Food and Agriculture Sciences, University of Florida, Lake Alfred, FL 33850. [C13]

Maximizing fruit removal and minimizing tree injury are two goals for mechanical harvesting of sweet oranges for the juice industry. CMNP (5-chloro-3-methyl-4-nitro-1H-pyrazole), a chemical that is being applied for a commercial label as an aid to mechanical harvesting, promotes abscission that should help meet the two main objectives of mechanical harvesting. CMNP was applied to 'Hamlin' groves at 0, 200 and 300 ppm at 300 gal/acre in mid December, early January, and late January. Dates for CMNP application were chosen so that for the first 24 hrs after application, air temperatures were near or above 60 F and there was no rain forecasted. Four days after application, the trees were mechanically harvested with a pull-behind canopy shaker at 180, 220, and 260 cpm and a tractor speed of 1 mph. The study was conducted as a randomized complete block, split plot design with shaker cycle speed as the main plot and CMNP concentration as the subplot. There were 4 blocks, and 3 trees per plot. Preharvest fruit drop increased with CMNP concentration and was as high as 25% for the 300 ppm treatment in late January. There was a significant interaction in percent fruit removal by the canopy shaker between CMNP concentration and mechanical harvester setting for all three dates. The difference among CMNP treatments was more evident at lower mechanical harvester settings. The data demonstrate the benefits in removal of fruit by CMNP, especially at lower mechanical harvester settings. However, timing of harvest will have to be advanced than in this study to minimize preharvest fruit drop.

3:45 Elimination of HLB-infected Trees through Application of Herbicides. L. G. Albrigo, CREC, University of Florida. [C14]

As part of the scouting procedure for HLB affected trees, current recommendations call for removal of the infected trees as soon as possible after each scouting, of which there may be 4 per year. This is labor intensive, costly and difficult to schedule during the harvest season. An alternative would be to kill the infected trees in place and remove them at a convenient time and no more than once per year. Tests were conducted to determine which herbicides and application methods were effective in killing mature citrus trees. Canopy sprays of Landmaster or Remedy were effective, but resulted in canopy damage to adjacent trees. Spraying the inside canopy from under the tree was effective if the spray covered the extra growth towards the row middle. Remedy was more effective than Landmaster. Trunk cuts in 4 directions on raised trunk areas and sprayed with concentrated herbicide worked well with imazapyr, but Remedy, Landmaster and 2, 4-D were not effective. Commercialization of this method will probably require a tractor attachment to make the cuts and spray the chemical. Since formulations of imazapyr are not currently cleared for use in citrus, they will require labels. Tests were also conducted with soil injection of the fumigant Midas. This procedure worked well on small to medium size trees, but further testing is needed on large trees. Successful application of one of these methods should be cost effective as a replacement for stumping affected HLB trees.

4:00 Real-Time PCR Increases Efficiency and Sensitivity for Testing Citrus Budwood Source Trees. Peggy J. Sieburth, Karen Nolan, Rick Dexter and Steve Alderman. Bureau of Citrus Budwood Registration, Division of Plant Industry, Department of Agriculture and Consumer Services, 3027 Lake Alfred Road, Winter Haven, FL 33881. [C15]

All citrus nursery trees can trace their origins to fully tested scion and foundation source trees that remain clean and disease-free in screenhouses. Implementation of real-time PCR has led to a dramatic increase in both the testing efficiency and sensitivity in the Florida Bureau of Citrus Budwood Registration testing program. The vectored diseases, *Citrus tristeza virus* (CTV) and Citrus greening, are tested for annually and other graft-transmissible diseases are tested for once every six years. To test the current number of source trees (6,000) yearly, streamlining of collection and extraction of samples was necessary. Advance preparation (including computerized numbering of collection and extraction supplies) allowed greater efficiency during the late summer to early fall months that samples are collected, extracted and tested for citrus greening. A new grinding technique reduced the time needed while yielding better detection. The second yearly collection from the same trees has been carried out during the spring for traditional CTV ELISA testing. An initial investigation of testing for CTV by real-time PCR showed increased sensitivity with fewer missed CTV-infections, even when sample collection was at a non-optimal time. Testing for each additional pathogen can be completed in two weeks, which was an impossible task by conventional PCR. Citrus viroids were the first pathogens tested for using the same extraction as for citrus greening. One collection, one sample, and one extraction save money and allow for thorough, sensitive budwood testing for multiple citrus pathogens.

4:15 Potential Applications of VIS-NIR Spectroscopy and Hyperspectral Imaging for Detecting HLB Infected Citrus Trees. A. Mishra, D. Karimi, R. Ehsani, W. S. Lee, G. Albrigo University of Florida, IFAS, Citrus Research and Education Center, Lake Alfred, FL 33850. [C16]

Scouting and visual inspection for the disease symptoms is currently used by growers to identify HLB-infected trees. However, this method is very time consuming, subjective, and costly. In addition, fatigue and environmental factors can cause errors in identifying infected trees. The long-term goal of this study was to develop a fast screening technique that can assist citrus growers in detecting HLB-infected citrus trees. The objective of this study was to investigate the potential of spectroscopy and hyperspectral imaging for detecting HLB infected citrus trees. Canopy spectral reflectance information was collected in various citrus groves in Florida using a portable Spectrophotometer in the range of 300-2500 nm and a hyperspectral camera in the range of 300-1070 nm. The data were collected from healthy and HLB-infected trees of different varieties of orange. Several classification techniques, including the k-nearest neighbors, logistic regression and support vector machines were applied to the spectroradiometer data. The hyperspectral images were analyzed using standard methods such as spectral matching and statistical classification techniques. The results of these analyses are presented and discussed in this paper.

4:30 Detection of Citrus Greening Using Color Texture Features and Digital Microscopic Imaging. D.G. Kim, T.F. Burks, UF/IFAS, ABE, Gainesville, FL, and A.W. Schumann, UF/IFAS, CREC, Lake Alfred, FL. [C17] *Student paper competition entry*

Citrus greening disease affects fruit yield, quality and value, and will likely result in rapid tree decline and death in Florida over the next years. Because definitive citrus greening symptoms are usually observed on the leaf, detection of citrus greening leaf symptoms can significantly aid in managing disease spread and minimize losses for the citrus industry. This article presents the microscopic image analysis using a color co-occurrence method to differentiate citrus leaves with eight conditions: greening blotchy mottle, greening islands, iron deficiency, manganese deficiency,

zinc deficiency, young flush, and normal mature flush. Thirty-nine statistical features were extracted from transformed hue (H), saturation (S), and intensity (I) images using the color co-occurrence method for each leaf sample. The number of extracted texture features was reduced by a stepwise discriminant analysis. A discriminant function based on a measure of the generalized squared distance was used for classification. Three classification models were performed using (1) all leaves conditions, (2) conditions except young flush, and (3) all condition except young flush and blotchy mottle. The overall performance was demonstrated in a confusion matrix. This research provides an efficient laboratory-based detection method for citrus greening diseases.

4:45 Determining Greening Infection Levels Using Multiple Survey Methods in Florida Citrus. S.H. Futch, S. Weingarten and M. Irey. [C18]

A study was initiated to determine the effectiveness of various scouting methods within multiple blocks in a grove in DeSoto County, Florida. Surveys of the blocks were conducted by 5 different greening survey crews using multiple methods over a 2-week period in January and February, 2009. Survey methods utilized included: walking, ATV, platform alone and platform in combination with ATVs. Each crew flagged the trees which they determined to have greening symptoms. After flagging, the position on the noted tree was recorded and then the flags were removed to allow other crews to survey the blocks. Upon completion of scouting by all crews, each noted tree was tested using a DNA-based laboratory method (PCR) to determine if the tree actually contained greening. Survey results varied between survey methods as well as between crews.

Tuesday June 9

10:00 Detection of Greening in Sprouts from Citrus Tree Stumps. S.H. Futch, R. Brlansky, M. Irey and S. Weingarten. [C19]

A study was initiated to determine if sprouts from citrus trees stumps that were removed because they exhibited visual greening (HLB) symptoms later produce sprouts that contain the bacterium. The study was conducted in a commercial grove in DeSoto County, Florida. All removed trees were visually determined to have greening prior to removal. The 15 selected trees were removed using a standard tree shear mounted to a front-end loader. All stumps were monitored on 30-day intervals to detect sprout formation from the stump or lateral roots. Once sprout formation was noted, the entire stump and exposed lateral roots were enclosed within a screen enclosure to prohibit psyllid feeding on new vegetative growth. At 160 days after clipping, leaf and stem tissue from stump sprouts were tested for greening by a DNA-based laboratory method (PCR). During the study period, 12 of the stumps sprouted and contained 2 to 26 sprouts per stump. Of the 10 stumps that were tested for greening, 80% had one or more sprouts that were greening positive. The percentage of greening positive sprouts recovered from a given stump ranged from 33% to 100%. The broad range in percentage of greening positive sprouts within individual stumps reflect the uneven distribution in the roots and trunk. Controlling sprouts from greening infected trees is essential in controlling the spread of HLB.

10:15 Plant Growth Regulators and Hedging to Manage Citrus Tree Growth: A Strategy for Reducing Psyllid Feeding and Huanglongbing Infection. Timothy M. Spann, Antonios E. Tsigkarakis and James P. Syvertsen, University of Florida, Citrus Research and Education Center, 700 Experiment Station Road, Lake Alfred, FL 33850. [C20]

Reducing the amount of vegetative growth produced annually by citrus trees in Florida would reduce the opportunities for Asian citrus psyllid reproduction and thereby the spread of

Hunaglongbing. This could be done in citrus without detrimental effects on yield because citrus trees in Florida produce an excess of leaves above that required to support maximum fruit yield. Excess tree growth is routinely controlled through hedging, but little research has been done to examine the effects of hedging on vegetative growth. Recent research in Florida has shown that branch re-growth can be reduced when hedging is performed in fall under Florida conditions because of the onset of cool temperatures. Recent research in Florida indicates that late-summer hedging may be able synchronize a final late-season flush and thus, reduce new flush leaves present during the winter to support over-wintering psyllids. In other fruit crops, such as apple, where excessive vegetative growth can be problematic plant growth regulators (PGRs) are routinely used. However, the use of PGRs in citrus has been limited to influencing fruit development and for maintaining post-harvest quality. PGRs not only control vegetative growth, but also offer the potential to reduce insect pest populations either by reducing pest-required vegetative growth or by altering host plant metabolites or nutrition. In addition, some PGRs have been shown to enhance pesticide efficacy. The PGR prohexadione calcium (Apogee, BASF Corp.) has also been shown to be effective at reducing vegetative growth of potted citrus seedlings under greenhouse conditions. Apogee was capable of reducing extension growth of shoots by more than 50%. Psyllid ovipositioning was also reduced by approximately 50% on Apogee-treated seedlings compared to untreated control plants, but variation was large and obscured statistical differences. Based on the current data, we are confident that modifying hedging timing and/or the use of PGRs can be effective management tools to control excess vegetative growth of mature citrus trees in Florida. This will allow better management of the Asian citrus psyllid and thus, reduce the spread of HLB.

10:30 Evaluation of Anti-oxidant Metabolism in Commercially Grown Citrus Cultivars in Florida. Naveen Kumar, [Robert C Ebel](#), and Pamela Roberts Southwest Florida Research and Education Center, Institute of Food and Agriculture Sciences, University of Florida, Immokalee, FL 34142. [C21]

Generation of superoxide radicals and accumulation of hydrogen peroxide (H_2O_2) is a characteristic feature of abiotic and biotic stresses in plants. Plants evolved an array of enzymatic and non-enzymatic anti-oxidants to prevent damage from the oxidative environment. In the present investigation, anti-oxidant metabolism was evaluated in young and developing leaves (40% to 50% expanded) of three commercially grown cultivars of citrus ‘Nagami Kumquat’ (*Fortunella margarita* (Lour.) Swingle), Grapefruit (*Citrus paradise* Macfad), and ‘Hamlin’ (*Citrus sinensis* Pers.). Higher H_2O_2 and malonic dialdehyde (MDA) levels were detected in Grapefruit and ‘Hamlin’ in contrast to Kumquat. However, the total superoxide dismutase (SOD) activity was higher in Kumquat. This higher activity (1.2 to 1.6-fold) in Kumquat appeared to be related to expression of more SOD isoforms (three- Fe SOD, one Mn-SOD and three Cu-Zn SOD). Similarly, catalase (CAT) activity was also higher (1.4 to 1.6-fold) in Kumquat than ‘Hamlin’ and Grapefruit, which was due to four CAT isoforms in this cultivar. Only one CAT isoform was detected in Grapefruit and four in ‘Hamlin’ with two major isoforms. CAT-4 seems to be the major isoform in all three genotypes. Contrary to SOD and CAT activity, a 2.3-fold higher guaiacol peroxidase (POD) activity was observed in Grapefruit in contrast to Kumquat and ‘Hamlin’. Five POD isoforms were detected in Grapefruit and ‘Hamlin’, and only two in Kumquat. H_2O_2 catabolism by Ascorbate peroxidase (APOD) was higher in Grapefruit (2.3-fold) and ‘Hamlin’ (1.6-fold) than Kumquat. In activity gel assays, four APOD isoforms were observed in Kumquat, three in ‘Hamlin’ and two in Grapefruit. APOD-4 was the dominant isoform in all genotypes. Besides having higher POD and APOD activity, H_2O_2 and MDA content were higher in Grapefruit and ‘Hamlin’, which indicates inefficient removal of H_2O_2 and thus more lipid peroxidation. This might be a cause of limited availability of reduced ascorbate which in turn reduced APOD activity and reduced H_2O_2 detoxification. On the other hand, Kumquat leaves with higher CAT activity, which is independent of ascorbate and NADH/NADPH supply, efficiently detoxify H_2O_2 .

10:45 The Role of Plant Nutrients in Disease Development: A Case Study of Citrus and Huanglongbing. Timothy M. Spann and Arnold W. Schumann. University of Florida, Citrus Research and Education Center, 700 Experiment Station Road, Lake Alfred, FL 33850. [C22]

Nutrients are important for the growth and development of plants and microorganisms, and have long been known to be important factors in plant-disease interactions. How each nutrient affects a plant's response to disease is unique to each plant-disease complex and in general nutrient-pathogen interactions are not well understood. Plant nutrients may affect disease susceptibility through plant metabolic changes, thereby creating a more favorable environment for disease development. For example, calcium is known to affect disease susceptibility because of its function in plant membranes. Calcium deficiency can lead to membrane leakage of sugars, amino acids and other low-molecular weight compounds that then become available for pathogen use. In addition to metabolic changes, many nutrients, particularly metals at elevated concentrations are known to have broad anti-bacterial properties in biological systems. Thus, evolution may have favored those pathogens that directly or indirectly reduce these plant nutrients. Relatively little is known about the changes in plant nutrition associated with HLB despite its leaf symptoms often being described as "nutrient deficiency-like." Recent analyses comparing symptomatic (blotchy mottle) and asymptomatic leaves from HLB infected (PCR+) trees and healthy leaves from healthy trees (PCR-) have shown that changes in K, Mg, Ca and B exist in HLB infected trees. Only K increased and the others decreased. Additionally, K and Ca showed intermediate changes in asymptomatic leaves, having levels midway between symptomatic and healthy leaves. Mg and B did not show this trend and were reduced by similar levels in both symptomatic and asymptomatic greening leaves compared to healthy leaves. Several micronutrients, some whose deficiency symptoms are commonly seen on HLB infected trees (e.g. Zn and Fe), were not deficient in HLB infected samples when the dry mass of the samples was corrected for the large amounts of starch accumulation caused by HLB. It remains to be seen whether remedial foliar applications of these or other nutrients can reduce the affects of HLB.

11:00 Insecticidal Control of Asian Citrus Psyllid *Diaphorina citri* (Hemiptera: Psyllidae). Jawwad A. Qureshi and Philip A. Stansly University of Florida/IFAS, Southwest Florida Research and Educaiton Center Immokalee, FL 34142. [C23]

The Asian citrus psyllid (ACP) *Diaphorina citri* vectors the bacterium *Candidatus Liberibacter asiaticus* causal organism of greening or "Huanglongbing" disease of citrus. Chemical control plays an important role in pest and disease management. Foliar ground applications of newly developed, experimental, and commonly used insecticides alone or with adjuvants were evaluated for their effectiveness against ACP in 13 year old 'Valencia' orange trees during growing season. Delegate WG (4 oz/ac) + Copper Hydroxide with 435 Oil or Induce, Danitol 2.4 EC (16 oz/ac), Chlorpyrifos EW (5 pts/ac), and Mustang 1.5 EC (4.3 oz/ac) were all equally effective and reduced psyllid adults for 24 days after treatment (DAT) compared to untreated check whereas Delegate WG alone was effective through 17 DAT. Both 435 Oil and Induce a non-ionic surfactant appear to increase the efficacy of Delegate WG. In another study significantly fewer psyllid adults compared to untreated trees were observed for one month on trees treated with Imidan 70 W (1 and 1.5 lbs/ac rates) alone or with Aza-direct (8 oz/ac), GWN 1708 (16, 24, 30 oz/ac rates) with 435 Oil, Danitol 2.4 EC (16 oz/ac), and Supracide 2 E (1 qt/ac). The high rate of Imidan 70 W and the medium and high rates of GWN 1708 provided relatively better control compared to the low rates. Aza-direct alone or with Imidan 70 W was not effective. Treatment effects on adults were more long lasting than those seen on immatures.

11:15 Chemical Control of Asian Citrus Psyllid, *Diaphorina citri* Kuwayama. Dhana Raj Boina, [Masoud Salyani](#) and Lukasz L. Stelinski. University of Florida, IFAS, Citrus Research and Education Center, Lake Alfred, FL 33850. [C24]

The Asian citrus psyllid (ACP), *Diaphorina citri* Kuwayama, is an important pest of citrus crops worldwide. ACP is the vector of *Candidatus Liberibacter*, the presumable causative agent of huanglongbing (HLB) disease. A series of laboratory investigations was conducted to determine the effects of spray droplet size and temperature on the toxicity of insecticides against ACP as well as the sub-lethal effects of imidacloprid. Regardless of insecticide deposition rate or droplet density, ACP mortality increased as spray droplet size decreased. Toxicities of organophosphate, carbamate, and avermectin insecticides increased with increasing temperature. However, the effect was reversed for pyrethroid insecticides. Neonicotinoids, imidacloprid, and thiamethoxam, exhibited a mixed response to increasing temperature. Feeding by ACP adults and nymphs on plants containing a sub-lethal concentration of imidacloprid significantly decreased adult longevity, fecundity, and fertility as well as nymph survival and developmental rates. In the field, we have investigated several insecticides for efficacy against ACP using low volume spray technologies. Thus far, we have found that dibrom, malathion, dimethoate, imidacloprid, zeta-cypermethrin, chlorpyrifos, and spinetoram are effective against ACP when applied as low volume sprays. Diflubenzuron and fenpyroximate were effective against nymph only. In general, low volume applications may offer substantial benefit to the Florida citrus industry by reducing the application cost and quick treatment of large acreages.

11:30 Spot Spraying of Citrus Tree Canopies for Controlling Psyllid. Joe Mari Maja, [Masoud Salyani](#), and Reza Ehsani, University of Florida, IFAS, Citrus Research and Education Center, Lake Alfred, FL 33850. [C25]

Since the Asian citrus psyllid, vector of the Huanglongbing (HLB) disease, feeds primarily on young leaf flushes, it was hypothesized that applying pesticides on only new leaves could mitigate the impact of pesticide loading on citrus trees. A technique capable of recognizing new leaves and spraying the pesticide only on those targets would be of great interest to growers by making the spray applications economical and environmentally sustainable. A sensing system was developed that could differentiate new and old leaves on citrus tree canopies, based on spectral reflectance characteristic of citrus leaves. Based on preliminary results, a laboratory test stand, consisting of a 4-band active optic sensor, control box, and spray system components was built. Using the spectral reflectance data, various vegetative indices were calculated and the utility of each index for differentiating young and old leaves was investigated. The control box and its algorithm, managed different tasks, e.g., communication with the sensor, computation of the vegetation indices, and operation of the solenoid-controlled spray nozzles. A series of tests were carried out to evaluate the performance of the system under various static and dynamic conditions. This paper will report on the development of the system and show the performance of the system under various operating conditions.

11:45 Comparison of Ground and Aerial Applications for Control of Adult Asian Citrus Psyllid, *Diaphorina citri* Kuwayama. [Arevalo, H. A.](#), and P.A. Stansly. Southwest Florida Research and Education Center, UF. [C26]

Huanlongbing (HLB) is considered as the most devastating disease of citrus worldwide. The Asian citrus psyllid (ACP), *Diaphorina citri* Kuwayama, is the insect vector responsible for the spread of *Candidatus Liberibacter asiaticus* a bacterium considered as the causal agent of HLB in the US and several other citrus producing countries. Aerial application is a rapid and efficient way to deploy insecticides, although, effectiveness against ACP compared to ground application has not

been insufficiently evaluated. We assessed selected insecticide combinations during the summer of 2008 on two blocks of 'Valencia' oranges on 'Carrizo' citrange rootstock located in Collier Co., FL. Ground applications were conducted with an airblast sprayer at 125 gallons/acre while aerial applications were conducted with a fixed-wing aircraft at 5 gallons/acre. We used tap samples to evaluate adult psyllid populations in the field. The broad-spectrum insecticides fenprothrin (Danitol) and phosmet (Imidan) functioned well by air and their efficacy was not improved by adjuvants. In contrast, the more selective insecticides spinetoram (Delegate), and imidacloprid (Provado) provided little control when applied by air but performed satisfactorily by ground application. Control with spinetoram seemed to be improved by the addition of 435oil when applied by air as well as by ground.

HANDLING AND PROCESSING SECTION

Monday June 8

10:00 Digestion Patterns of Two Commercial Endopolygalacturonases on Polygalacturonate Oligomers with a Degree of Polymerization from 7 – 21. Randall G. Cameron, Kevin Goodner, Gary A. Luzio, USDA, ARS, Citrus and Subtropical Products Laboratory, Winter Haven, FL, and Brett J. Savary, Arkansas State University, Arkansas Biosciences Institute, Jonesboro, AR [HP1]

Many fruits and fruit juices are enzymatically treated to aid the process of liquefaction, juice extraction, viscosity reduction and juice clarification. Polygalacturonases are a major component of enzyme mixtures used for these purposes. Endopolygalacturonases (EPG) fragment the pectin homogalacturonan chain, cutting the molecule within a contiguous stretch of demethylated galacturonic acid (GA) residues. To increase our understanding of this process, GA oligomers with a degree of polymerization (DP) ranging from 7 – 21 were digested with two commercial endopolygalacturonases (EPG M1 and EPG M2). Peptide mass fingerprinting with MALDI-TOF MS suggested identity of the EPGs as EPG II from *Aspergillus niger* (EPG M1) and endo-PG I from *A. aculeatus* (EPG M2). Aliquots were collected at various time points during the digestion and the resulting fragmentation patterns were determined. Individual oligomer masses were estimated and converted to molar concentrations. The distribution of cleavage products produced by the EPGs differed. Smaller fragments, especially GA monomer, were produced earlier with EPG M1. Rate constants for each of 81 possible reactions were estimated by computer simulation. When compared to optimized data for individual reactions, the experimental data provided a good fit, thus indicating the model is a good approximation of the fragmentation process.

10:15 Variations of Total Phenol, Carotenoid, in vitro Antioxidant Contents, and Phenolic Profiles of the Pulp of Five Commercial Varieties of Mango (*Mangifera indica* L.). Penelope Perkins-Veazie, Plants for Human Health Institute, North Carolina State University, Kannapolis, NC, and John A. Manthey, USDA-ARS, Citrus and Subtropical Products Laboratory, Winter Haven, FL. [HP2]

Mango (*Mangifera indica* L.) is a tropical fruit crop grown worldwide with widely attributed nutritional and health-promoting properties. Extensive studies have been made of the high concentrations of phenolic antioxidants in mango peel, seeds, and leaves, yet less is known about the phenolic antioxidant contents of the fruit pulp. Five varieties of mango from four countries were evaluated over a year of harvests to compare the β -carotene, ascorbic acid, phenolic, and total antioxidant levels of the fruit pulp, and to compare the polyphenol profiles of the individual varieties. Ascorbic acid ranged from 11 to 134 mg/100 g pulp puree, and β -carotene varied from 5 to 30 mg/kg among the 5 varieties. Total phenol content ranged from 19.5 to 166.7 mg gallic acid

equivalents (GAE)/100 g puree. The varieties, 'Tommy Atkins', 'Kent', 'Keitt', and 'Haden' had similar total phenolic content, averaging 31.2 ± 7.8 mg GAE/100g puree, whereas 'Ataulfo' contained substantially higher total phenol content. Similar trends were observed in the total DPPH radical scavenging content for the 5 varieties. In contrast, country of origin and harvest dates had far less influence on these parameters. 'Ataulfo' contained significantly higher amounts of mangiferin and ellagic acid than the other 4 varieties. Large fruit-to-fruit variations in the concentrations of these compounds occurred within sets of mangoes within the same cultivar and the same harvest location and date.

10:30 Influence of Harvest Time on Flavor in 'Valencia' Orange. E.A. Baldwin, A. Plotto, J.A. Manthey, J. Bai, USDA-ARS, Citrus and Subtropical Products Laboratory, Winter Haven, FL, T.G. McCollum, USDA-ARS, Horticultural Research Laboratory, Ft. Pierce, FL, and M. Irey, U.S. Sugar Corp., Clewiston, FL. [HP3]

'Valencia' oranges were commercially harvested from March to June in the South Florida. This study evaluated the effect of harvest time on flavor of orange juice. Fruit were harvested on March 19, April 13, May 15, or June 29, 2009, and juice was analyzed for soluble solids content (SSC), titratable acidity (TA), headspace volatile compounds, and limonoids. SSC remained stable at 10.3%-11.0% regardless of harvest time. However, juice from late harvest fruit had much lower TA content. Thus, SSC/TA ratio steadily increased from 13.2 to 25.5 in March and June harvested fruit, respectively. Volatile productions for most compounds were increased by delaying harvest time, which include acetaldehyde, decanal, ethanol, hexanol, Z-3-hexenol, E-2-hexenol, linalool, octanol, α -pinene, myrcene, limonene, ethyl acetate and ethyl hexanoate. Some compounds, such as methanol and valencene decreased when harvest was delayed. Ethyl butanoate and ethyl-3-hydroxy hexanoate remained at similar levels regardless of harvest date. Limonin and nomilin contents slightly decreased from March to April, however increased thereafter. Hexanal and Z-3-hexenal showed similar patterns, decreasing in April and increasing thereafter. The results indicate that after the fruit reach full maturity, 'Valencia' oranges on the tree continually metabolize acids and limonoids, and accumulate volatiles, leading to sweeter, more flavorful, and less bitter products.

10:45 Ethanol Production from Citrus Processing Waste: SSF of High-Matter-Containing Substrates. Weiyang Zhou, Wilbur Widmer, USDA-ARS Citrus and Subtropical Products Lab, 600 Ave. S NW, Winter Haven, FL, and Karel Grohmann, Renewable Spirit, LLC, Delray Beach, FL. [HP4]

Steam pretreatment followed by simultaneous saccharification and fermentation (SSF) of citrus processing waste (CPW) is a promising technology for the alternative disposal of CPW. Instead of consuming large amount of energy for drying CPW, this new technology uses an enzyme mixture to convert CPW into ethanol and other co-products. In order to make ethanol production economical, it is desirable to obtain a high ethanol concentration in a low viscous fermented mash using a substrate with high solid content and small enzyme loading requirement in the SSF. In this study, we investigated the effects of dry matter content and enzyme loading on SSF and the viscosity of fermented CPW. Two levels of substrates (10% and 20% dry matter) were compared at three different enzyme loadings. It was found that the ethanol yield (as percentage of the theoretical) obtained from 10%-dry-matter substrate was similar to that obtained from 20%-dry-matter substrate. At 20%-dry-matter content, as pectinase loading was reduced from 11 mg/100 g substrate to 1.4 mg/100 g substrate, ethanol yield and the viscosity of fermented CPW did not change significantly. These results could lead to significant savings in enzyme and distillation costs for ethanol production from CPW.

11:15 Evaluation of Aromatic Volatiles in a Population of Tangerine Hybrids. Takayuki Miyazaki, Fred G. Gmitter, Jr., Citrus Research and Education Center, UF, Lake Alfred, FL, Anne Plotto and Elizabeth Baldwin, USDA/ARS Citrus & Subtropical Products Laboratory, Winter Haven, FL. [HP5] *Student competition entry*

Florida tangerine (*Citrus reticulata* Blanco) production accounts for over 50 % of the US production, and is the third largest of all citrus fruit, following oranges and grapefruits. The tangerine fruit is well known for its pleasant aroma, flavor and ease of consumption. This study evaluated the aroma volatile of tangerine hybrids of the University of Florida CREC breeding program. Twenty tangerine hybrids were harvested from Nov. 2007 to Mar. 2008, with 5 commercial cultivars as reference. The aroma volatiles were sampled from hand-squeezed juice by the headspace SPME method, and analyzed by gas chromatography and mass spectrometry. A total of 200 volatiles were identified, and 15 (ethanol, hexanal, α -pinene, β -myrcene, octanal, α -terpinene, cymene, limonene, terpinolene, dehydro-p-cymene, linalool, nonanal, decanal, α -terpineol, carvone) were found in all the samples. A principal components analysis clearly separated 'Sanguinelli', 'Temple' and '9-4' ('Clementine' x 'Minneola' seedling) x tetraploid blood orange from the others due to their high numbers of volatiles. Each hybrid was classified based on the qualitative (presence and absence) and quantitative (relative concentration) volatile profiles, such as hydrocarbons, esters, aldehydes and alcohols. The various genetic backgrounds from tangerine, orange and grapefruit could affect the volatile differences among hybrids. The data of tangerine aroma components, as well as their sensory properties by gas chromatography-olfactometry, will be fundamental for future research on food science and breeding to improve fruit quality.

11:30 Proteins Interact Differentially with Grapefruit Furanocoumarins. K. Myung, and J.A. Manthey, USDA-ARS Citrus and Subtropical Products Lab, 600 Ave. S NW, Winter Haven, FL. [HP6]

Grapefruit juice (GFJ) interferes with the cytochrome P450 3A4 activity responsible for metabolizing certain medications. This interference is referred to as the "grapefruit-drug interaction". Grapefruit furanocoumarins (FCs), such as 6', 7'-dihydroxybergamottin (DHB) and bergamottin (BM), have been shown to be the main compounds which cause this interaction. Previously, we observed that a number of foods sequester FCs in GFJ. In this study, interactions between macromolecules and GFJ FCs were investigated to determine which food components are responsible for the previously found sequestration. When we removed lipids from corn and salmon by extractions with organic solvents, the resulting defatted corn and salmon powders still sequestered FCs in GFJ, indicating that components responsible for the sequestration are still present in the defatted powders. When water-soluble macromolecules such as proteins and carbohydrates, were further removed from the defatted corn powder, the binding phenomenon of DHB completely disappeared, but BM binding still occurred. However, the binding of BM to corn residues after successive acid or base hydrolysis was not observed. These results suggest that the components associated with DHB and BM could link to proteins or carbohydrates but not to lipids. Further binding experiments with cellulose, pectin, and purified fungal cell wall showed that these carbohydrates did not interact with GFJ FCs. In contrast, bovine albumin serum and isolated proteins from foods differentially interacted with GFJ FCs, in which tighter interaction with BM occurred, compared to DHB. Overall, our results suggest that the observed sequestration of GFJ FCs by foods is likely due to protein-FC interactions.

11:45 Citrus Production and Packing Operation in China. Guiwen 'Alvin' Cheng, Fresh Produce Technologies, JBT FoodTech, Lakeland, FL. [HP 7]

As a leading producing citrus producer, China produced around 20,000,000 citrus in 2007. Improvement in average unit yield had helped the production increase. In 2008, the citrus industry

endured several challenges, including the snowstorm at the start of the year. Post- snowstorm plant rescue and recovery efforts helped reduce the impact of the freezing damage. Loss in production due to the snow storms is anticipated only in the province of Hunan, estimated at ~ 13%. Overall, nationwide citrus production in 2008 is estimated to be the somewhat higher than the year before. The production level was sustained in part due to additional plantation coming into production. Growth area over the last 5 years has been increasing on an average of about 6.5%, reaching 1,941,400 ha in 2007. Citrus packing operation in China consists of mostly small packing houses with 2-5 MT/H packing lines. There are some modern and well equipped lines with electronic sizing and optical sorting at throughput greater than 10 MT/H. Over 200 packing lines are distributed throughout citrus producing areas, capable of handling more than 1,000 MT/H. Citrus with packinghouse treatments including coating is believed to be small portion of the overall production due to constrains including traditional packaging approaches, potential peel damage due to lack of proper handling equipment and a highly price-sensitive domestic market. It is clear that both production and postharvest handling of citrus fruit in China will continue to improve in the years ahead as the industry adapts better technologies and standardizes its operations.

Tuesday Morning

10:00 The Method of Washing Citrus Influences the Rate of Subsequent Degreening. Mark A. Ritenour, Indian River Research and Education Center, UF/IFAS, Fort Pierce, FL. [HP8]

Red grapefruits, navel oranges, and Orlando tangelos were harvested, evaluated for initial color, and exposed to different washing treatments within a day of harvest to determine the effect on subsequent color development during standard degreening treatments. Control fruit were not washed. Washing treatments included brush washing on a small research line, and commercial washing using a brush bed, a high-pressure washer (HPW) system, or a combination of the two. After washing, the fruit were immediately placed under degreening conditions (5 ppm ethylene with 95% RH) at 29°C. Color development of red grapefruit washed on the research packing line was significantly inhibited compared to the control even if the treatment was limited to only 1 minute. Often, washed fruit took about twice as long to degreen as did unwashed fruit. In tests conducted on a commercial packing line, fruit washed on the brush bed or brush bed plus HPW were not significantly different from each other and showed the greatest delay in subsequent color development in all cases. Fruit washed with the HPW system showed intermediate inhibition of color development, showing significantly less inhibition compared to using brushes alone or brushes plus HPW in grapefruit and Orlando tangelos, but usually greater inhibition compared to the unwashed control. Treatments inhibiting fruit color development the most also resulted in the greatest rate of water loss during degreening and storage.

10:15 Effect of Canopy Cover and Harvest Maturity on Blueberry (*Vaccinium corymbosum*) Fruit Quality. Steven A. Sargent, Paul M. Lyrene, Abbie J. Fox and Adrian D. Berry, Horticultural Sciences Department, University of Florida/IFAS, Gainesville, FL. [HP9]

University of Florida blueberry breeding line FL 86-19 has been planted on several hundred acres in northern Florida and southern Georgia because it flowers late and ripens early. However, at times it has irregular quality, noted by non-uniform color at the stem end and poor flavor. This may be attributed to poor canopy development during fruit set and development. Growers report that poorly colored fruits will develop deeper blue color if held overnight at ambient temperature. In spring 2002, blueberries were picked in the late morning at a commercial farm in Windsor, FL, at two ripeness stages, full color (FC) and partial color (PC), and from bushes with well developed and poor leaf canopies. Fruits were immediately brought to the laboratory and sorted. For Test 1, FC were frozen for later analysis, while PC were held for 24h at 20°C (in 225 ml, vented clamshell containers; n=3) and then frozen. For Test 2, FC and PC fruit from both canopy types were stored

in clamshells at 2°C for 7 and 14 days. Best quality was obtained from fruit harvested at FC and from full canopy. Soluble solids content and total acidity were higher, and fruit were firmer both initially and after 7 or 14 d storage. Holding PC fruit for 24 hr at 20°C resulted in slightly deeper color but unacceptable shriveling.

10:30 Use of an Electronic Nose to Classify Avocado Pulp by Maturity Stage. Marcio Eduardo Canto Pereira, Steven A. Sargent and Adrian D. Berry, Horticultural Sciences Department, University of Florida/IFAS, Gainesville, FL. [HP10]

Mature-green ‘Booth 7’ avocados were harvested in Homestead, FL, and transported to Gainesville, FL, where they were stored at 20°C and assessed for Electronic Nose (EN) analysis at three maturity stages: mature-green (30 h after harvest; 193 N whole fruit firmness), mid-ripe (98 N) and ripe (14 N). The EN used was the Cyranose 320, composed of an array of 32 sensors. The EN was attached to a system using compressed air that was filtered for water vapor and other impurities. The initial purge with compressed air was performed for 6 min before readings. The sequence of conditions for each reading were: 60 s baseline purge, 60 s sample draw, 30 s sample gas purge, 150 s air intake purge. Each fruit was peeled, halved and sliced into pieces of approximately 1 cm³. The pulp (100 g) was immediately placed in a 1.7-L glass jar, which was immediately closed. Headspace samples were drawn after 5 min. The whole system was purged with compressed air for 1 min before the next sample. Cross validation of the model was 100% and therefore suitable for class discrimination. Canonical Discriminant Analysis separated the pulp into three clusters according to the maturity stage. Interclass Mahalanobis distance was lower between mid-ripe and ripe fruit (15.32), and much higher between mature-green and mid-ripe (55.74) or mature-green and ripe (68.84). The EN had poor performance on the identification of unknown samples (43%). Nonetheless, adjustments of the methodology are likely to increase the efficacy of sample separation and identification.

10:45 Harvest Maturity and Post-processing Dip to Improve Quality of Fresh-cut Carambola Fruit. Jinhe Bai, Jan Narciso, Anne Plotto and Elizabeth Baldwin, USDA-ARS Citrus and Subtropical Products Laboratory, Winter Haven, FL. [HP11]

‘Arkin’ carambola (*Averrhoa carambola* L.) fruits harvested at color break or full yellow stage were washed with or without an alkaline solution (pH 13.5), cut to 1-cm-thick slices, dipped in calcium ascorbate (Ca ASA), ascorbic acid (ASA) or water, and packaged in perforated clamshells for up to 14 days storage at 4°C. Quality changes of the cut slices were determined during storage. The alkaline wash reduced initial microbial loads on the cut slices and the total microbial population throughout the entire storage period. ASA and Ca ASA inhibited cut surface browning as indicated by lower a* value, higher L* and hue values, and higher panel preference. Ca ASA also maintained a firm and crisp texture as showed by the high firmness break force. An informal sensory panel preferred slices treated with Ca ASA for reduced sourness, astringent, and bitter taste, probably due to the binding of soluble oxalic acid to insoluble Ca oxalate. However, care must be paid to avoid phytotoxicity caused by high pH treatment, and cut surface drying that was enhanced by the Ca ASA application.

11:00 Surface Treatments and Coatings to Maintain Fresh-cut Mango Quality in Storage. Anne Plotto, Elizabeth A. Baldwin, Jan A. Narciso, Jinhe Bai, USDA-ARS, Citrus and Subtropical Products Lab., Winter Haven, FL, and Nithiya Rattanapanone, Chiang Mai University, Thailand. [HP12]

Edible coatings prevent moisture loss and may decrease gas exchange, thereby retaining moisture and flavor of fresh-cut fruit. Previous experiments showed that carboxymethylcellulose (CMC) with added maltodextrin maintained visual quality of stored mango slices also treated with

calcium ascorbate and the antioxidant N-acetyl-L-cysteine. This study evaluated the effect of an antioxidant dip (2% calcium ascorbate, 0.8% citric acid and 0.4% N-acetyl-L-cysteine), followed or not with CMC or a 0.5% carragenan coating on fresh cut mangoes. A fourth treatment consisted of 0.5% chitosan in 5% citric acid with 0.5% glycerol, but was only used in the first experiment. Control slices were left untreated. After the dips, mango slices were drained and stored in clamshell containers at 5°C for 20 d. The treatments were applied on ‘Tommy Atkins’, ‘Kent’ and ‘Keitt’ mangoes harvested from Homestead, FL, and on store bought mangoes imported from Peru. The antioxidant dips maintained the best visual quality in storage for all cultivars as indicated by b*, chroma, L*, and visual evaluation by a panel of 20 laboratory staff. The CMC coating maintained a similar visual quality, but carragenan or chitosan decreased L* and b*. No treatment consistently maintained firmness for all the cultivars. Soluble solids content tended to vary depending on cultivars and ripeness of the fruit, but not due to treatment. The antioxidant treatment maintained higher titratable acidity for ‘Kent’ and ‘Keitt’, resulting in lower sensory sweetness ratings. Overall, repeated experiments showed that calcium ascorbate with citric acid and acetyl-cysteine maintained cut mango slices attractiveness in storage by keeping light color in both varieties, but firmness was maintained only for ‘Keitt’ mango slices.

11:15 Influence of Mechanical Harvesting System and Abscission Agent on Microflora of Citrus Fruit. L.M. Friedrich, T.M. Spann, R. McEgan, R.C. Ebel, and M.D. Danyluk, University of Florida Citrus Research and Education Center 700 Experiment Station Road Lake Alfred, FL. [HP13]

For Florida to continue to compete efficiently in the citrus industry, significant reductions in harvesting costs will be necessary. Mechanical harvesting (MH), a possible means of cost reduction, can be thought of a two-step process: (i) removal of fruit from the tree and (ii) collection of fruit (immediately, by a catch-frame device or during retrieval of fruit from the ground). This study evaluates the microbiology of the surface and juice of citrus fruit collected by various mechanical harvesting systems (OXBO 3220 or OXBO 3210) and with or without the application of the abscission compound 5-chloro-3-methyl-4nitro-pyrazole (CMNP). For each replicate, treatments groups evaluated may include: (i) hand-harvested fruit (control); (ii) ground fruit (picked up directly from ground following canopy shaking); and (iii) mechanically-harvested (MH) fruit (collected from a catch frame), or any of these groups sprayed with CMNP. Microbial analysis included a total plate count (TPC), an acidophilic organisms count (OSA), a thermophilic aciduric bacillus count (TAB) and generic Escherichia coli and Salmonella testing on pooled samples of 5 oranges. Juice samples, were subjected to the same tests, with the exception of TAB. Control fruit generally had fewer microbes on their surface and in their juice than either ground or MH fruit on both TPC and OSA. TAB were rarely detected. Application of CMNP did not significantly alter microflora. However, no real trends can be attributed to harvest method for all runs. Generic E. coli was detected in ground, MH and control pooled fruit and Salmonella spp. was not detected in any of the pooled fruit or juice samples. These results suggest that fruits which come in contact with the ground, catch-frame or CMNP are not consistently or significantly higher in surface or corresponding juice microflora than the hand-harvested control fruits.

11:30 Laser Labeling, a Safe Technology to Label Produce. Preeti Sood, Ed Etxeberria, University of Florida, IFAS, Citrus Research and Education Center, 700 Experiment Station Road, Lake Alfred, FL, Chris Ference and Jan Narcoiso, USDA/ARS, Citrus and Subtropical Products Lab, 600 Ave. S, Northwest, Winter Haven, FL. [HP14]

Due to enhanced biosecurity and pathogenic outbreaks, produce labeling has gained a marked attention in recent years. Laser labeling technology involves the etching of required information on the surface using low energy CO₂ laser beam. The etching forms alphanumerical characters by pinhole dot matrix depressions. These openings can provide an entry site for

pathogens, lead to water loss and blemish the fruit in general. Having described the efficacy and safety of this technique for Citrus fruits, we proceeded to investigate its effect on thinner skinned vegetables. This study was undertaken using tomato (*Lycopersicon esculentum*) and pepper (*Capsicum annuum*) focusing on water loss, peel appearance and potential pathogen entry. The experiments measured water loss from etched areas and decay after exposing the etched areas to the decay pathogens and 4 weeks of storage. There was minimal decay in tomatoes and pepper originating at the etched area in control and inoculated samples. Water loss in unwaxed labels resulted in visible label shrinkage whereas the effect was negligible if wax was applied immediately after labeling. Label distortion was proportional with storage RH and time of storage.

11:45 Evaluation for the Potential of a New Fungicide Pyrimethanil for Postharvest Disease Control of Florida Citrus Fruit. Jiuxu Zhang, Florida Department of Citrus, 700 Experiment Station Road, Lake Alfred, FL. [HP15]

Postharvest decay is one of the most important factors affecting fresh citrus fruit quality and marketing values. Fungicide application is an important measure to achieve effective citrus postharvest disease control. Pyrimethanil (PYR) is a newly registered fungicide for postharvest use in citrus and pome fruit. The effectiveness of PRY for the control of Diplodia stem-end rot (caused by *Lasiodiplodia theobromae*) and green mold (caused by *Penicillium digitatum*) on Florida citrus fruit was evaluated. PYR actively suppressed the mycelial growth of *P. digitatum*, and moderately suppressed the mycelial growth of *L. theobromae* in vitro on potato dextrose agar medium. When 'Valencia' oranges were inoculated with *P. digitatum* for 24 hrs and then dipped in PYR suspension (1,000 ppm) for 30 seconds, PYR reduced green mold incidence by 96.3%-100% compared to controls, similar to the activity expressed by standard postharvest fungicides imazalil and thiabendazole (TBZ). Two simulated commercial drench tests of PYR on 'Fallglo' tangerines and 'Valencia' oranges naturally infected by *L. theobromae* showed that PYR at 1,000 ppm reduced Diplodia stem-end rot by 29.0%-53.6%, while imazalil (1,000 ppm) and TBZ (1000 ppm) reduced it by 62.1%-83.1% and 91.0-96.1%, respectively. A simulated commercial packing line application of PYR (1,000 ppm) using pineapple oranges reduced Diplodia stem-end rot incidence by 29.4%, while imazalil and TBZ reduced it by 70.6% and 84.0%, respectively. Overall evaluation results indicate that PYR is very effective for green mold control, similar to that of imazalil and TBZ, but it exhibits much lower activity for Diplodia stem-end rot control compared to TBZ and imazalil.

KROME MEMORIAL SECTION

Monday June 8

10:00 Evaluation of Potassium Silicate and Yucca Juice Compared to Phosphorous Acid for the Control of *Phytophthora cinnamomi* in Avocado. Gary S. Bender¹, Akif Eskalen², and Gary Tanizaki¹; ¹ University of California Cooperative Extension, San Diego, CA; ² Department of Plant Pathology, University of California, Riverside, CA. [K1]

Organic avocado production in California has been increasing in recent years; approximately 5% of acreage is now organic or has the potential to be organic. Avocado root rot caused by *Phytophthora cinnamomi* is still the most important disease and an organically-approved substitute for phosphonate treatments for root rot control would be highly desirable. Work done in South Africa indicated that potassium silicate (a naturally mined substance) would induce a root rot tolerance in avocado trees. Some of the avocado growers in California also believe that yucca juice has the ability to control root rot. This potassium silicate work was repeated in California using 'Hass' on clonal 'Duke 7' rootstocks planted in a grove where mature avocado trees had died from root rot. Trees in the field trial were treated with root drenches just before planting in July 2007 and

thereafter three times in 2007 and 5 times in 2008. The drenches included low and high rates of potassium silicate (1% and 2% Silmatrix, 2L/tree), low and high rates of yucca juice, (2% and 4% QL, 2L/ tree) a buffered phosphorous acid drench (30 ml/L of 0-28-25, 2L/tree), and a water control. There were 20 replications for each treatment. Results for the potassium silicate and the yucca juice were disappointing compared to the buffered phosphorous acid with final tree health ratings (0=healthy, 5=dead) as follows 4 trees at stage 4 and 5 low rate potassium silicate, 7 trees at stage 4 and 5 high rate potassium silicate, 4 trees at stage 4 and 5 low rate yucca juice, 5 trees at stage 4 and 5 high rate yucca juice, 2 trees at stage 4 and 5 phosphorous acid, 9 trees at stage 4 and 5 water control. Tree growth (as measured by tree height and trunk girth) was also disappointing for the potential organic treatments.

10:15 Effect of Propiconazole on Laurel wilt Development in *Persea americana* Mill.

(Avocado) Trees. Tomas Ayala-Silva¹, Raymond Schnell¹, Alan W. Meerow¹, Michael Winterstein¹, and Francis Zee²; ¹USDA, ARS, National Germplasm Repository Subtropical Horticulture Research Station, 13601 Old Cutler Road, Miami, FL 33158; ²USDA, ARS Pacific Basin Tropical Plant Genetic Resources Management Unit. P.O. Box 4487 Hilo, HI 96720. [K2]

Laurel wilt is a vascular disease of Lauraceous plants caused by a fungus (*Raffaelea* spp.) that is carried by a recently introduced, nonnative ambrosia beetle (*Xyleborus glabratus*). The disease is devastating to *Persea* species including redbay (*Persea borbonia*) and avocado (*Persea americana*) trees in forests, parks, orchards and residential areas in the southeastern United States. Avocado, is the most important agricultural crop susceptible to laurel wilt. Management strategies for reducing its impact in *Persea* sp (specifically *P. americana*) are needed. The USDA ARS NPGS collection of avocado is conserved at the National Germplasm Repository (NGR) in Miami-Dade County, FL. Although the avocado collection is currently free from the ambrosia beetle and the laurel wilt disease, it is believed to be only a matter of time before this insect/disease complex reaches the collection. Macro infusion of the fungicide Propiconazole (Alamo) has been shown to control the disease in red bay. In this study, the use of the systemic fungicide propiconazole (Alamo) macro infusion through the root system will be infused at the recommended doses. Plants will be infused every three months at the prescribed levels. The rate of application will varies greatly with the diameter of tree trunk at breast level (dbf). The rates recommended on the Alamo label will be the rates we use initially. Removal of all flowers and fruit (if any flowers were missed) from all infused trees will be necessary to ensure no human or wildlife consumption of the fruit. Results suggest that propiconazole could be useful in preventing laurel wilt in redbay and other *Persea* species. Our objective is to test the limitations of the fungicide regarding duration of efficacy and rate of uptake. We are also establishing a backup collection of avocado at the NGR in Hilo Hawaii. The collection will be established in Hilo and in Kona on the island of Hawaii.

10:30 Foliar Applications of Aliette and Prophyt on Avocado (*Persea americana*) Are not Phytotoxic. J.H. Crane, A.J. Palmateer and E.A. Evans' University of Florida, IFAS, Tropical Research and Education Center, 18905 S.W. 280 St., Homestead, FL 3303. [K3]

The phytophthora root rot (*Phytophthora cinnamomi*) (PRR) pathogen is ubiquitous in the soils of south Florida and is the most economically important disease when avocado tree roots are exposed to flooded soil conditions. Research has demonstrated that properly timed applications of foliarly applied phosphonates are effective in preventing avocado tree decline or death due to phytophthora root rot. However, there are concerns that foliar applications of phosphonates in conjunction with regular foliar applications of copper fungicide would be phytotoxic to leaves and fruit. With this in mind, a field and container demonstration on the effect of foliar phosphonate (Prophyt[®] or Aliette[®]) and copper applications was established to look at their potential for phytotoxicity. Container grown grafted 'Simmonds' trees were sprayed 3 times with Prophyt[®] or

Aliette[®] applied at a 28-36 day interval and; a non-phosphonate sprayed control. Roots from trees in all containers were infested with the *P. cinnamomi*. Copper was applied foliarly 1-2 days after each treatment application. Subsequently, trees were flooded 4 times for 3-7 days. No foliar phytotoxicity was observed after any treatment application. Only non-phosphonate treated trees showed leaf wilting, chlorosis, browning and senescence. A grafted, 3-year-old ‘Simmonds’, ‘Donnie’, and ‘Monroe’ grove was sprayed with 4 foliar applications of Prophyt[®] or Aliette[®] at 28-53 day intervals followed with foliarly applied copper 1-20 days later. No phytotoxicity to leaves, stems, or fruit was observed. Economic analysis found Prophyt[®] applications to be 55% less expensive than Aliette[®] applications.

10:45 Performance of Ten Cultivars of Rabbiteye Blueberries in North Florida. Peter C. Andersen, University of Florida North Florida Research and Education Center, 155 Research Rd., Quincy, FL 32351; Jeffrey G. Williamson, E. Paul Miller, and Paul M. Lyrene, University of Florida Department of Horticultural Sciences, Fifield Hall, Gainesville, FL 32611. [K4]

Ten cultivars of rabbiteye blueberries (*Vaccinium ashei* Reade) were evaluated from 2006-2008 at the North Florida Research and Education Center in Quincy, FL. ‘Austin’, ‘Brightwell’, ‘Cimax’, ‘Powderblue’ and ‘Premier’ were planted in the spring 2003. ‘Arapaho’, ‘Ira’, ‘Ochlocknee’, ‘Savory’ and ‘Yadkin’ were planted in the spring 2005. Plant growth, yield estimates, berry weights and berry soluble solid concentrations were determined. At an in-row spacing of 1.5 m, most cultivars formed a hedgerow after 3 to 4 years of growth. Berry weights averaged about 1 gram, but soluble solids varied from 12 to 18 °Brix depending on cultivar and year. Details of ten cultivars will be discussed.

11:00 New and Potential Herbicides for Blueberries. G. K. England, Sumter County Extension, UF, W. M. Stall, Horticultural Sciences Department, UF, A. W. MacRae, Gulf Coast Research and Education Center, UF and K. R. Muzyk, Gowan Company, Brandon, FL. [K5]

Interest in the establishment of commercial blueberry farms in the west central Florida region has increased over the last 10 years. Weed management has been one of the most important considerations that growers undertake in their normal production operations. Since the majority of the blueberry farms in the region utilize pine bark culture as their production system, it is important to evaluate the efficacy and crop tolerance of registered and potential herbicides in this system. Growers have been reporting phytotoxicity to blueberries treated with herbicides containing the active ingredient glyphosate. In 2007, a trial was established to evaluate Rely 1E as an alternative to glyphosate-containing products. Rely at 6qts./Acre provided control of Brazilian pusley *Richardia brasiliensis* (BPUS) comparable to glyphosate (Roundup Weathermax), while only glyphosate resulted in acceptable yellow nutsedge *Cyperus esculentus* (YNS) control. No significant crop phytotoxicity was observed. Results of this trial were utilized as support for the registration of Rely 1E in Florida commercial blueberry farms. In 2008, two new herbicides registered in blueberries called Chateau and Callisto, plus one product with potential to be efficacious in blueberries grown in pine bark culture called Sandea were evaluated. Sandea provided excellent yellow nutsedge *Cyperus esculentus* (YNS) control for 28 days. A tank mix of Rely 1E + Chateau Herbicide provided acceptable Brazilian pusley *Richardia brasiliensis* (BPUS) control through 43 days. In 2009, an additional trial with Chateau and Callisto alone and tanked mixed with Rely 1E was established. Initial results indicate acceptable weed control from both products.

11:15 Growth and Yield of Southern Highbush Blueberry in Pine Bark Culture under Varying Fertilizer Regimes. J.G. Williamson and E.P. Miller, Horticultural Sciences Dept., IFAS, University of Florida, Gainesville, FL. [K6]

Southern highbush blueberry (*Vaccinium corymbosum* hybrid) plants were grown on pine bark beds using several rates of granular or liquid fertilizers. Estimated canopy volume and berry yield per plant increased linearly as fertilizer rate increased up to the highest rate tested. Berry yields per plant were closely correlated with canopy size. No consistent differences in plant growth or yield were observed between granular or liquid fertilizer. However, 'Star' but not 'Misty' mean berry weight was greater for the granular fertilizer treatments than for the liquid fertilizer treatments. Visual examination of excavated plants at the end of the study indicated that roots of blueberry plants grown on pine bark beds were largely restricted to the pine bark layer and only a few roots were located in the underlying native soil. Limited water and nutrient holding capabilities of pine bark, coupled with frequent irrigations required in pine bark beds, appeared to have contributed to nutrient leaching resulting in a higher than expected fertilizer requirement.

11:30 Eastern U.S. Market Potential for Florida Sub-Tropical Peaches. L. Harrison, Leon County Extension; E. Harrison, Florida Department of Agriculture and Consumer Services; J.X. Chaparro, and J.G. Williamson, Horticultural Sciences Department, IFAS, University of Florida. [K7]

The objective of this research was to measure potential consumer acceptance of sub-tropical peach cultivars developed by the University of Florida (UF) breeding program and to estimate market potential. Survey questionnaires and interviews were used to estimate the market potential and acreage required to satisfy demand. Randomly selected individuals were interviewed about their preferences for fruit in general, and for peaches in particular, and they were provided fruit samples for evaluation. Test sites were: Atlanta, Georgia; Richmond, Virginia; Albany, New York; Lansing, Michigan; and Indianapolis, Indiana. The research was funded by a grant from the USDA - Federal State Market Improvement Program (FSMIP). Our results suggest that Florida has potential to develop an economically viable peach industry based on the sub-tropical peaches cultivars developed by UF. Acceptance testing indicated 54% of the respondents wanted the Florida peaches several times a week. An additional 16% wanted Florida peaches "once or twice a month". There are over 1.7 million potential consumers in the five cities where research was conducted. To satisfy the expressed demand for this population alone would require between 575 and 775 acres of Florida peaches. Producers have an opportunity to a market window (April and early May) when no other peaches are available in the U.S.

1:30 Investigations into the Origin of 'Norton' Grape using SSR Markers. Ed Stover, USDA/ARS, USHRL, 2001 S. Rock Rd., Ft. Pierce, FL; Gerald Dangl and Judy Yang Foundation Plant Services, University of California, One Shields Ave., Davis, CA; John Bautista and Malli Aradhya, USDA/ARS NCGR, University of California, One Shields Ave., Davis, CA. [K8]

'Norton' produces excellent wine in some regions where *Vitis vinifera* is difficult to grow. The high-quality and disease resistance of 'Norton' make it attractive to generate hybrids of similar parentage, producing cultivars with traits distinct from 'Norton' but with similar adaptation. 'Norton' is frequently described as *V. aestivalis*, but was initially declared a hybrid between an American grape ('Bland') and *V. vinifera* ('Miller's Burgundy', a synonym for 'Pinot Meunier'). To try to identify the parents of 'Norton', simple sequence repeat (SSR) markers were compared across *V. vinifera* cultivars and accessions derived from American species. The precise parentage could not be identified using available data. Allele frequencies were compared among 181 Euvitis of N. American origin and 354 *V. vinifera* cultivars for which there were data at 13 loci. At least one 'Norton' allele at all 13 loci was present among the *vinifera* cultivars, while at 6 loci the other

'Norton' allele did not occur among the vinifera cultivars, suggesting these alleles were likely from a non-vinifera parent. Allelic frequency distributions for different *Vitis* series indicated that the putative non-vinifera 'Norton' alleles were most common within the aestivales. These data are consistent with 'Norton' being a *V. vinifera* x *V. aestivalis* hybrid. 'Norton' alleles for locus VVMD36 are rare and offer the best opportunity for identifying 'Norton' parents. Interestingly, 'Enfariné Noir', a vinifera cultivar which has similarities in synonymy, morphology and origin with 'Pinot Meunier', shares the rare as well as most common alleles with the presumed 'Norton' vinifera parent.

1:45 The Inheritance of Flower Types and F1 Survivals in a Complex Advanced Breeding Line of 'N18-6' Grape. Z. Ren, J. Lu, X. Xu, Center for Viticulture, Florida A&M University, Tallahassee, FL 32317. [K9]

Over 1,500 F1 hybrids of advanced breeding line N18-6 crossed with vinifera and Florida grapes were evaluated for the survivals and flower sex segregation at 5th year. The survival rate with *V. vinifera* was 9.6%, while the rates with Florida hybrids and other disease resistant germplasm were higher. When this female flower grape was crossed with different perfect grapes, the F1 hybrids segregated into 1 perfect: 1 female flowers basically, while 0.2%~7.8% male flower plants were observed among the crosses, which indicates the flower inheritance of N18-6 is more complicated than previous understanding.

2:00 Screening for Crown Gall Disease Resistance in Grapes using Green and Dormant Cuttings. Xia Xu¹, Jeong Ho Roh^{1,2}, Jiang Lu^{1*}, ¹Center for Viticulture and Small Fruit Research, Florida Agriculture and Mechanical University, 6505 Mahan Drive, Tallahassee, FL 32317. ² National Horticultural Research Institute, RDA, Suwon 440-706, Korea. [K10]

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 six grapes by inoculation of green and dormant cuttings using *Agrobacteria* C493 and C4612. Green and dormant cuttings from six to seven-year old of European grape (*V. vinifera*, Florida hybrid bunch grapes, and muscadine grapes (*V. rotundifolia*) were collected in September and December for pathogen inoculation. Five cuttings were used for each treatment, two types of controls were also used: cuttings without inoculation and cuttings inoculated with sterilized distill water. Inoculated sites were wrapped with paraffin tapes and cuttings were maintained in Magenta square box filled with water, which changed every three days. Incident rate and gall weight were scored at inoculated sites and top sites of the cuttings two months after the inoculation. Interestingly, all the green cuttings from muscadine 'Gold Isle' and 'Higgins' including control showed about 0.1-0.2 g callus/gall growth in the inoculated sites for C493 and C4612, respectively. 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 for C493 and 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. It appeared 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.

2:15 Investigation into Uneven Ripening Problem in Muscadine Grape for Enhancing their Enological Characteristics. Hemanth KN. Vasanthaiah, Ramesh Katam, Devaiah K. and Sheikh M. Basha. Center for Viticulture and Small Fruit Research, Florida A & M University, 6505 Mahan Drive, Tallahassee, Florida 32308. [K11]

Grapes are relished both in the tropical and temperate climatic region of the world. Grape berries are eaten fresh, processed into juice, jam, and jellies, and also fermented into wine. Uniformly ripened berries are a prerequisite for superior quality products. Muscadines are extensively cultivated in Florida and are native to Southeastern United States. It is hardier and resistant to diseases and pests. Muscadines have a characteristic aroma and sweetness that enhances their potential to expand their cultivation and market value. But it is hampered due to problems such as uneven berry ripening, fruit drop and short shelf life. Hence, an investigation was initiated to identify the gene/s associated with ripening, and variation in their regulation in muscadine (non-uniform ripening) and bunch (uniform ripening) grape berry during ripening to understand the molecular basis of ripening. Isolation and characterization of the transcripts expressed during different stages of berry ripening using gene specific amplification and subtractive hybridization techniques has helped identify the transcripts differentially expressed in both muscadine and Florida hybrid bunch grapes. Their role in relevance to muscadine grape berry ripening problem will be discussed. Further analysis will help in developing muscadine grape cultivars with uniform ripening characteristics to increase product quality, grower's profits and product marketability.

2:30 Comparative Leaf Proteomics Studies in *Vitis* Species. Sheikh M Basha, Ramesh Katam, and Hemanth KN. Vasanthaiah. Center for Viticulture and Small Fruit Research, Florida A & M University, 6505 Mahan Drive, Tallahassee, Florida 32308. [K12]

Grape is one of the important fruit crops of the world. Among the cultivated grape species major differences exist in their berry quality and adaptability to biotic and abiotic stresses. Our study was aimed at identifying differences in protein composition among cultivated grape species to determine interrelationship between leaf protein composition, disease resistance and berry sugar content. A high throughput 2-dimensional polyacrylamide gel electrophoresis (2-DE) was conducted on leaf proteins of *Vitis vinifera* (Bunch), *V. rotundifolia* (Muscadine) and *Vitis spp* (Florida Hybrids) to document differences in protein expression profile among *Vitis* species. Our data has shown that muscadine grape leaf expressed highest number of proteins followed by Florida hybrids and bunch grapes, which indicates that the muscadine genome is more complex than the bunch and hybrid grape genome. The level of protein expression also varied within the *Vitis* species. 2-DE resolved muscadine leaf proteins in to more than 200 polypeptides with pI between 3.5 and 8.0 and molecular weight between 14 to 75 kD. Selected protein spots were excised from the gel and their identity was determined by LC/MS. The results showed that these proteins are homologous to rubisco subunits, glutamine synthetase, glutamine synthetase precursor, and chalcone isomerase, which are known to have photosynthesis and defense functions. Comparative analysis of 2-DE profiles of *Vitis* species showed major differences in their leaf polypeptide profiles suggesting these differences may play role in their unique characteristics, photosynthetic efficiency and disease tolerance level.

2:45 Identification and Characterization of Xylem Components Associated with Pierce's Disease Tolerance in Grape. Ramesh Katam, Sheikh M Basha, Hemanth Vasanthaiah and, Hifza Mazhar, Center for Viticulture and Small Fruit Research, Florida A & M University, 6505 Mahan Drive, Tallahassee, Florida 32308. [K13]

Commercial production of grapes in Florida requires cultivars that are resistant to Pierce's disease (PD). Florida grape cultivation is restricted to Muscadines (*Vitis rotundifolia*) and Florida hybrid bunch grapes, which are considered tolerant to PD. PD is caused by *Xylella fastidiosa* which clogs xylem vessels leading the plant to wilt. PD-tolerant vine produces unique components in xylem tissues during the infection that help combat the pathogen. The objectives of this study is to i) develop xylem proteome fingerprint of bunch, Florida hybrid and, muscadine grape; ii) determine the differences in protein composition among *vitis* spp with varying degree of tolerance to PD and, iii) identify and characterize xylem and xylem sap proteins contributing to PD tolerance in grape

genotypes. Xylem and xylem sap were collected from *Vitis vinifera* (Bunch), *V. rotundifolia* (Muscadine) and *Vitis sps* (Florida Hybrids) and, subjected to a high throughput 2-dimensional polyacrylamide gel electrophoresis (PAGE). The proteins were sequenced in LC/Mass Spectrophotometer. Significant genetic variation in protein profiles was observed among *Vitis* genotypes with different degree of PD tolerance. Qualitative and quantitative differences were found among several low molecular weight polypeptides (35 to 75 kD) xylem sap tissue. We found three proteins that are unique to muscadine and Florida hybrid bunch grape. Glucanase and peroxidase involved in defense and oxygen evolving enhancer protein involved in generating oxygen. Further studies on xylem proteome will be discussed to understand the correlation of proteins from both tissues contributing towards PD tolerance.

3:30 The effect of K-phite and Salicylic Acid on Container Grown Citrus Graft Inoculated with HLB budwood. R.A. Atwood, Lake County Extension Service, UF, R.H. Brlansky Citrus Research and Education Center, UF. [K14]

A greenhouse trial was done to evaluate the effect of salicylic acid and K-phite on HLB infected young citrus trees. K-phite was applied at two different rates as a soil drench and a foliar spray. K-phite was also applied with two different rates of salicylic acid. Treatments were administered on five dates over a seven month period. Six months after inoculation 46% the trees were HLB positive and 4% questionable according to PCR results. There were no differences between treatments or the controls.

3:45 Postharvest Fludioxonil Dip Protects ‘Arkin’ Carambola (*Averrhoa carambola* L.) from *Dothiorella* Fruit Rot. Aaron Palmateer and Jonathan Crane, TREC, Homestead, FL. [K15]

South Florida has about 150 acres of commercial carambola worth an estimate \$2.5 million annually. ‘Arkin’ carambola is typically harvested and then stored at 41-55°F and 95% RH. Prior to storage or packing fruit are dipped in a 1% to 2% chlorine solution to remove a superficial blackish discoloration on the peel caused by *Gloeodes pomigena*. More recently fruit rot consisting of a complex of organisms (primarily *Dothiorella* spp.) has become a problem in commercial carambola packing houses causing up to a 75% loss of packed fruit. Light-brown streaks on the peel surface typically expand as the disease progresses resulting in collapse of the pulp and splitting of the peel. An investigation to determine the effect of dipping fruit in chlorine and/or fludioxonil was initiated to determine if chlorine dip caused an increase in disease progression and if fludioxonil stopped or prevented disease progression. Fresh and stored (2-weeks at 48°F) ‘Arkin’ carambola fruits were postharvest treated in 2007 and 2008. In 2007, treatments included no dipping in chlorine (CH) or fludioxonil (FL), dip in CH alone, FL-low rate, FL-high rate, CH dip followed by FL-low, CH dip followed by FL-high. In 2008, treatments included no dipping in CH or FL, dip in CH alone, FL-low, FL-high, or dipping in a mixture of CH-FL-high. After treatment all fruits were placed in polyethylene bags and stored at 52-55°F and periodically assessed for fruit rot symptoms. In general, pre-stored fruit developed fruit rot symptoms earlier than freshly picked fruit. No dipping (control) and CH treated fruit developed fruit rot symptoms earlier than FL and CH followed by FL and CH-FL high treated fruit.

4:00 Using Polycom for Statewide Distance Education. J.V. Morse, Pinellas County Extension, UF. [K16]

The Integrated Pest Management Update (IPMU) is a yearly program that has been presented statewide with four live locations and traveling speakers. With restricted budgets, travel to locations for seminars is cost prohibitive for both speakers and participants. Polycom is a new tool that can be used effectively, and efficiently to provide seminars statewide without incurring travel costs. Setting up polycom presentations for statewide distribution takes coordination and

certain procedures need to be carried out for a well run seminar to occur. Continuing education units, site reservations, speaker formats, and location formats are some of the items that must be coordinated. Findings from the IPMU polycom program and what was needed to provide a successful program, as well as obstacles will be discussed.

ORNAMENTAL, GARDEN AND LANDSCAPE SECTION

Monday June 8

10:00 Education and Extension Opportunities for Biofuel Careers in Florida and Latin America. J.C. Alleyne, Highlands County Extension Service, UF and L. E. Baucum, Hendry County Extension Service, UF. [OGL1]

Production and use of liquid biofuels (ethanol, biodiesel) from agricultural feedstocks, cellulosic ethanol and butanol from non agricultural feedstocks have been implicated as renewable forms of energy. At the *2008 International Conference on Research and Educational Opportunities in Biofuel Crop Production*, Earth University, Guacimo, Limon, Costa Rica, participants concluded there was a dire need and opportunity for University level renewable energy Research, Education and Extension education programs in Florida and Latin America. With the exception of the Agrarian and the Zamorano Universities of Columbia and Honduras, respectively, no institution in the hemisphere provided specific renewable biomass energy information. There are opportunities to build upon current related programs and consensus for cooperation among institutions and countries. Existing University curricula must be transformed or incorporated into other disciplines. Such curricula must be market driven, innovative, entrepreneurial, and socially, and environmentally responsible. Extension of biofuel education is in the infancy of any type of programming. Agents need scientifically and economically based information to develop formal extension programs at the grower level. We are at the beginning of the Extension Education model; primarily working with Researchers, other Specialists, interested growers and processors in order to identify potential crops, establish field trials and determine economic viability, including food security issues.

10:15 Natural Resources: Analyzing Extension Needs of Spanish-speakers in Florida. C. Asuaje, UF/IFAS Cooperative Extension Service, Palm Beach County County, FL, M. Wyman, and F. Escobedo, UF School of Forest Resources and Conservation, Gainesville, FL, H. Mayer, UF/IFAS Cooperative Extension Service, Miami-Dade County, FL, M. Swisher, UF/IFAS, Department of Family, Youth and Community Sciences, Gainesville, FL, and A. Delgado, UF/IFAS, Department of Horticulture Science, Gainesville, FL. [OGL2]

Hispanics are the fastest growing minority group in the U.S. and Florida's largest minority group. Hispanics are also expanding into areas not previously populated by this group. While this points to growing opportunities to serve this audience, in many cases language barriers still exist, especially for recent immigrants and adults. Although many programs designed for Hispanics exist, little evaluation has taken place to assess their effectiveness. This study identified and assessed the need for Spanish language extension of natural resources and the environment with Florida extension agents. Questions were asked concerning perceptions and attitudes on the need, quality, and dissemination methods for Spanish extension materials. Results showed extension is an important information source for Hispanics after family and friends. However, extension agents and materials are not adequately prepared to outreach to this segment of the population, especially on important natural resource topics to the state, such as catastrophic events management, environmental horticulture and arboriculture. This study shows that the need to prioritize Spanish

extension outreach in Florida exists, especially in South Florida. As Florida's population becomes more diverse, extension needs to make sure it is not leaving any group behind.

10:30 Preparing and Transporting Palm Trees to Exhibit at an International Plant Show in Essen Germany. E. A. Skvarch, St. Lucie County Extension, UF/IFAS. [OGL3]

According to a 2005 nursery and landscape industry impact report by Haydu and Hodges on Florida's Economy, Nursery Grower Sales were \$3.007 billion. These sales were fueled by the need for landscape material for new construction homes in cities such as Port St. Lucie Florida, where newly constructed homes totaled 10,000 in 2005. However fast forwarding to 2009, building upstarts have dropped 80% to 2000, with a negative growth rate projected for the next two years. This troubling trend propelled one St. Lucie County nursery grower to search out global markets through an international plant trade show known as IPM Essen located in Germany. IPM Essen is one of the largest shows of its kind with approximately 110,000 square meters of floor space, 16 contiguous exhibition halls and attracts 60,000 visitors from over 90 countries and 1,447 exhibitors from 47 countries. To display plant material at IPM Essen, the grower prepared 10 separate varieties of palm trees for cargo shipment departing from his farm in Ft. Pierce Florida with eventual destination to Essen Germany, a distance of 4,700 miles.

10:45 The Landscapes and Gardens of China: From Beijing to Guangzhou. T. Olczyk, Miami-Dade County Extension, UF; T. Friday, Santa Rosa County Extension, UF; P. Vergot, North Florida Research and Education Center, UF; L. Buss, Entomology and Nematology Department, UF; and, J. Xin, Office of Information Technologies, UF. [OGL4]

As part of the USDA and the Chinese Ministry of Agriculture Exchange Program, a group of five UF/IFAS Extension faculty members visited China from 12 to 25 October, 2008 participating in many official meetings and visits to the Ministry of Agriculture; Chinese Academy of Science; Plant Protection Stations at the provincial, city, county and township levels; and horticultural research facilities evaluating new plant cultivars and producing transplants for growers. The group also had a unique opportunity to explore Chinese history and culture and visit several cultural treasures including the Great Wall of China, the Forbidden City, the Summer Palace, Temple of Heaven, the Lama Temple in Beijing and the magnificent historical gardens surrounding palaces and temples. While traveling between Beijing, Nanjing, and Guangzhou in the South Eastern part of China, we were able to observe changing urban and rural landscapes including massive plantings along hundreds of miles of highways and noticed the strong impacts of industrialization and urban development on the landscapes of China. We also had a chance to visit one of the most famous gardens in China the "Humble Administrator's Garden" in Suzhou, the "East and West Gardens" of the Presidential Palace in Nanjing, other private gardens, city parks and street landscapes and some of the plant decorations left from the 2008 Summer Olympic Games. This paper will illustrate and summarize the unique horticultural experiences and lessons learned from this visit to China, one of the oldest and now rapidly changing civilization.

11:00 Laboratory Accuracy of Soil Moisture Sensor Irrigation Controllers. B. Cardenas-Lailhacar and M. D. Dukes, Agricultural and Biological Engineering Department, UF/IFAS. [OGL5]

The use of reclaimed wastewater has become an important irrigation source in many municipalities in Florida. Soil moisture sensor systems (SMSs) have demonstrated that can save irrigation water. However, SMSs have not been tested under Florida soils, irrigated with reclaimed wastewater, which contains salts that can affect the measured soil moisture content. The objective of this research is to test different commercially available SMSs under controlled conditions, and analyze their responses and readings under different levels of water salinity, and over a range of

temperatures. Three brands/models were selected for this experiment, Acclima/SCX, Baseline/WaterTec S100, and Dynamax/IL200-MC. Three different design methods were pre-tested. The selected method consisted of containers with packed soil to allow the installation of at least one probe each. The containers were manufactured so that they could be saturated from the bottom to minimize entrapped air and fitted with sintered metal filters to allow vacuum application for water removal in a timely manner. The containers were installed in a controlled-temperature chamber and will be saturated and dried down across three temperatures (5, 25, and 35°C). The water applied will have an electrical conductivity similar to that found in reclaimed wastewater used for irrigation. Each container was placed over a platform-scale to determine soil-water losses, by weight variation over time. The scale readings are corrected through the gravimetric method from soil samples at the end of each batch test. The scale readings are then compared to the SMS readings, and a calibration curve is developed through regression analysis. Preliminary results show linear regressions with R^2 values higher than 0.95, verifying that this laboratory system is adequate to test the accuracy of the SMSs over a range of salinity values, water contents, and temperatures.

11:15 Testing of Climate-based Irrigation Controllers in Florida. Stacia L. Davis and Michael D. Dukes, Agricultural and Biological Engineering Department, UF/IFAS. [OGL6]

Water resources are limited in Florida similarly to other parts of the United States experiencing water shortages. It was found in recent research performed by the University of Florida that 64% of residential water use was used for irrigation. Though automatic, in-ground irrigation systems are the most commonly installed system, they have been shown to decrease water use efficiency while increasing the demand for more efficient irrigation techniques. The irrigation industry responded to this demand by developing so-called smart technologies that are designed to use water efficiently while maintaining exceptional landscapes. Climate-data-based controllers are one type of smart irrigation controllers that use an estimation of reference evapotranspiration (ET_o) for automatic irrigation scheduling. The objectives of this study were to evaluate the ability of three brands of climate-data-based controllers to schedule irrigation for a virtual landscape compared to a simulated soil water balance and determine the variability in irrigation scheduling by ET controllers of the same brand. The ET controllers were as follows: Smart Line Series controller (Weathermatic, Inc., Dallas, TX), Intelli-sense (Toro Company, Inc., Riverside, CA) utilizing the WeatherTRAK ET Everywhere service (Hydropoint Data Systems, Inc., Petaluma, CA), and Smart Controller 100 (ETwater Systems LCC, Corte Madera, CA). Results showed that there were no differences in weekly water application between controllers of different brands. There were also no differences in weekly irrigation application within each brand. However, irrigation scheduling techniques were different between controllers of different brands. Some techniques did not account for reasonable irrigation system hydraulics.

11:30 Efficacy of Paclobutrazol Drench Treatments to Petunia and Impatiens Is Affected by Application Method and Irrigation Method. J.T. Watson, C.A. Bartuska and J.E. Barrett. Environmental Horticulture Department, UF/IFAS. [OGL7] [Student competition entry](#)

Paclobutrazol is used to control size of annuals and other greenhouse crops and is often applied as a drench to the media surface. Previous research indicates that paclobutrazol binds to the organic components and slowly moves down through the media profile. The use of sub-irrigation systems is expanding, but the movement of paclobutrazol within media in sub-irrigation is not fully understood. Given this information, a set of experiments were carried out with *Impatiens wallerana* and *Petunia x hybrida* to determine the efficacy of paclobutrazol when application is to the media surface or applied through the bottom of the container (bottom application) and subsequent irrigation is either overhead or by sub-irrigation. Plants were grown in 4.5-inch pots using a peat-based media. Paclobutrazol in bottom application treatments had greater effect on plant size than when applied to the media surface. For petunia in both the surface application treatments and those

treated by bottom application, paclobutrazol efficacy was greater when subsequent watering was in sub-irrigation compared to overhead. The difference due to irrigation was greater in plants treated by bottom application. These results illustrate that both application technique and irrigation method can affect paclobutrazol efficacy, which will likely lead to differences in recommendations for optimum chemical concentrations.

11:45 Determining Seasonal Water Use and Crop Coefficients for Central Florida Turfgrasses. B. Wherley and T. Sinclair, UF/IFAS Agronomy Dept.; Michael Dukes, UF/IFAS Agricultural and Biological Engineering Dept.; and, Grady Miller, NC State University Crop Science Dept. [OGL8]

As Florida's population increases, demand for urban landscape irrigation is placing additional strains on water supplies. Therefore, it is important that appropriate quantities of water are being allocated for landscape irrigation. Current estimates for statewide landscape irrigation permitting and planning are based on evapotranspiration data from a South Florida study. It is unlikely that these estimates are relevant for more northern regions of the state, where considerable differences in climate and shorter growing season exist. The objective of this research is to determine consumptive water use and crop coefficients for commonly used lawn species growing in North Central Florida. Lysimeters (25.4 cm diameter x 30.5 cm depth) containing either 'Floritam' St. Augustinegrass, 'Empire' zoysiagrass, or 'Argentine' bahiagrass established atop native soil have been installed in research plots at the University of Florida Plant Science Research and Education Unit, Citra, Florida. Turfgrass in lysimeters and surrounding plots are maintained at lawn mowing heights and well-watered. Turfgrass evapotranspiration is determined periodically throughout the year based on gravimetric water loss occurring over 48 to 72 hour periods. Results from the initial year indicate that 1) Evaporative demand and evapotranspiration are highest in spring and fall, but noticeably decline in summer months, 2) Once all species have emerged from dormancy and are actively growing, there is little difference between species evapotranspiration rates, and 3) Crop coefficients (K_c) for the species range from 0.6 to 0.8, indicating that these species usually require less water than would be predicted from reference ET alone.

1:30 Influence of Mowing Height and Nitrogen Rate on Nitrate Leaching in St. Augustinegrass. S. Shweta, L.E. Trenholm, J.B. Unruh, and J.B. Sartain. UF/IFAS Environmental Horticulture Dept., Gainesville, FL [OGL9]

Concerns regarding nitrate leaching from fertilization of lawns are increasing. Many published papers report on the effect of nitrogen (N) rate in St. Augustinegrass, with most observing very low leaching of nitrates when N is applied at close to recommended rates. There is little published data, however, documenting the effects of mowing height and N rate on nitrate leaching. The objective of this study, therefore, was to study nitrate leaching from Floritam St. Augustinegrass due to N rate and mowing height. The research was conducted from Feb 2008 through Aug 2008 in the University of Florida Turfgrass Research Envirotron. Grasses were established in polyvinyl chloride (PVC) tubs with dimensions of 0.6 m by 0.5 m. Nitrogen was applied as urea (46-0-0) at rates of 2.5, 4.9, 7.4 and 9.8 g N m⁻² per application three times over the study at two month intervals. Grass was mowed at heights of either 10.1 or 7.6 cm. Leachate was collected at 15-day intervals and analyzed for nitrate-N concentration at the University of Florida Analytical Research Lab. Results showed that in the first two fertilization cycles, there were no differences in nitrate leaching due to N rate, although in the last fertilizer cycle, higher nitrate leaching occurred at higher N rates. There was more leaching at the lower mowing height in the first fertilizer cycle. There was an interaction between N rate and mowing height in the first fertilizer cycle, with generally higher nitrate leaching occurring with the lower mowing height. Percent of applied N leached was generally less than 1% over the course of the experiment. Based

on results of this research, it would appear that the environmental impact from nitrate leaching from St. Augustinegrass is minimal, particularly when proper mowing heights are maintained.

1:45 The Value of the Best Management Practices Outreach Education Program. D. P. Rainey, Sarasota County Extension and L. Trenholm, UF/IFAS Environmental Horticulture Dept., Gainesville, FL. [OGL10]

Sarasota County was one of the first to require professionals who apply fertilizers in landscapes to pass a five hour class entitled “Best Management Practices for Florida Green Industries” (BMP). Since, other counties and municipalities have passed similar education code requirements. The State target audience is 100,000 landscape management professionals Statewide. Sarasota extension is actively measuring the overall value of the BMP program it has on the individual and environment. Measurements are made using pre-class and post-class tests, voluntary evaluations and an annual follow-up survey. The process: 1) Statewide leadership in the Fertilizer Ordinance/BMP Facilitation with University of Florida Extension and Florida Department of Environmental Protection; 2) Guidance to stakeholders and several adjacent counties and cities regarding similar fertilizer ordinances; 3) Information dissemination through over 3,000 mailings; 4) Maintenance of a BMP website calendar; 5) Creation and maintenance of an online registration system for the five hour class; 6) Creation and maintenance of an online annual follow up survey; 7) Production of a 63 page class reference manual, a 12 minute County television PSA. 8) Development of a computer database, “Hort Stats” that tracks the BMP participants, and publishes results on the County Extension website. Over 1,250 professionals have attended the training in Sarasota, and over 85% have received the mandatory BMP certification. A 2008 follow up survey of 383 participants showed an overall improvement in recommended fertilizer practices. One of the most significant was a 27% increase in the number of professionals who use slow release nitrogen products.

2:00 Role of Nitrogen Rate and Clipping-Return on Nitrate leaching and turf quality in Empire Zoysiagrass. J. Bae and L. E. Trenholm, UF/IFAS Environmental Horticulture Dept., Gainesville, FL. [OGL11]

Turf clippings are known to contain abundant nutrients and organic matter, but are often collected and deposited in landfills. It is not clear how clipping management may affect nitrate leaching from lawn grass systems or how clipping management may affect turf nitrogen (N) requirement. The objectives of this study were to evaluate the role of clipping management and N rate on nitrate leaching, turf visual quality, and turf growth and physiology. Established ‘Empire’ Zoysiagrass (*Zoysia japonica* Steud.) received N at rates of 0, 0.5, 1.0, 1.5, 2.0, or 3.0 lbs / 1,000 sq. ft. at 60-day intervals throughout the growing season. The two clipping-management regimes were ‘clipping-return’ and ‘clipping-remove’. Evaluations were made of visual quality, root and shoot weights, multispectral reflectance, and nitrate leaching. The field experiment was conducted at the UF/IFAS Plant Science Research and Education Center in Citra, FL, between July 2008 and October 2008. There were a total of 36 plots with 3 replications. Plots had polyvinylchloride (PVC) lysimeters buried underground to facilitate leachate collection. The amount of nitrate leached was sampled weekly by applying a vacuum to the base of the lysimeter and emptying percolate from the lysimeter. Leachate sub-samples were analyzed for nitrate-N at the Analytical Research Lab at UF. Clippings were collected monthly, and roots were harvested at the end of the year. Results from year 1 were analyzed with SAS ANOVA procedures. The research will continue through the 2009 growing season.

2:15 Fertilization Requirements of ‘Empire’ Zoysiagrass and Bahiagrass. L. E. Trenholm and J.B. Unruh, UF/IFAS Environmental Horticulture Dept, Gainesville, FL. [OGL12]

The interest in alternatives to St. Augustinegrass for use in home lawns is increasing throughout Florida. Due to a lack of information about precise nutritional requirements of some alternative grass species, this research was undertaken to determine responses of ‘Empire’ zoysiagrass and ‘Pensacola’ bahiagrass to nitrogen (N) and potassium (K) and to determine optimal needs for these nutrients. The research was conducted at Schroeder-Manatee Ranch Sod Farm in Bradenton, FL, from 2001 through 2003. Nitrogen was applied as ammonium sulfate at 0, 3, 6, or 9 lbs of N 1,000 ft² and potassium was applied as potassium chloride at 0, 3, or 6 lbs of K 1,000 ft² in three applications over the growing season. Mowing was provided every 7 to 14 days throughout the growing season and irrigation was as needed. Evaluations included visual quality and color ratings, multispectral reflectance measurements, and root and shoot growth. Data were analyzed for differences due to treatments and regression analysis was used to determine at what nutrient application rates optimal responses occurred. Data indicated that ‘Empire’ zoysiagrass could be adequately maintained under moderate maintenance levels in central Florida with 3 lbs. of N per 1,000 ft² annually, but that higher rates of N would be required to maintain the same level of quality if cultural practices were less than adequate. ‘Pensacola’ bahiagrass did not respond well to increasing N rates, with best performance occurring at 2-3 lbs N per 1,000 ft² annually. There were no responses to K for either grass. Results of this suggest that these grasses may be maintained with less N than would be required for a typical St. Augustinegrass lawn.

2:30 Structural Pruning and Root Remediation: Tools for Building Sustainable Urban Tree Canopy. M. Orfanedes, UF/IFAS Broward County Extension; C. W. Hoyt, Tree Trimmers and Associates, Inc., Oakland Park; and, E. Gilman, UF/IFAS Environmental Horticulture Dept., Gainesville, FL. [OGL13]

Co-dominant stems with bark inclusions are conditions that commonly develop in urban tree canopy and can result in reduced wind tolerance and branch failure. Structural pruning, a procedure which shortens and in some cases eliminates co-dominant stems, can be used to improve the structural integrity of trees. Circling and stem girdling roots are another common defect that is increasingly being viewed as contributing to early decline of trees. This condition may be related to the quality of the root system at installation, planting technique and long-term maintenance practices. In many situations, removing circling and stem girdling roots can improve tree health and longevity. Communities interested in building sustainable urban tree canopy may benefit from investing in such remedial tree care practices.

2:45 Effects of Organic Matter and Irrigation Frequency on Shrub Growth during Establishment. Kimberly K. Moore UF/IFAS Fort Lauderdale REC; and Amy L. Shober, UF/IFAS Gulf Coast REC, Wimauma, FL. [OGL14]

Irrigation management is an important component of the urban landscape. Poor growth of container-grown plants during landscape establishment and/or transplant failure is generally attributed to water stress. The addition of organic matter to soil is known to improve the soils ability to store and transmit air and water. Our objective was to evaluate the addition of Black Kow (composted cow manure) or yard waste in relation to irrigation frequency (water every 2 or 4 days) on the establishment of hibiscus and viburnum in the landscape. Canopy growth measured 28 weeks after transplanting (WAT) was greater for hibiscus and viburnum plants watered every 2 days than for plants watered every 4 days. Hibiscus and viburnum plants watered every 2 days and grown in soil amended with Black Kow had greater canopy sizes than plants watered every 2 days and grown in soil amended with yard waste or grown in soil that was not amended with organic matter. Although the addition of Black Kow appeared to stimulate shoot growth, there were no

differences in root extension. The least hibiscus and viburnum root extension was observed for plants watered every 4 days and grown in soils amended with yard waste. Soil moisture and transpiration measurements were lower for plants watered every 2 days than for plants watered every 4 days. The addition of Black Kow or yard waste did not appear to influence soil organic matter content. Furthermore, soil moisture status and leaf transpiration did not differ among the amendment treatments but did differ between the two irrigation frequencies. Addition of Black Kow did significantly increase the concentration of Mehlich 1 P, K, and Mg in the soil. Enhanced growth in the Black Kow amended soils is thought to be due to the additional nutrients supplied by the Black Kow material.

3:00 Comparison of four types of Southwest Florida Soils. S. H. Brown, UF/IFAS Lee County Extension, Ft. Myers, FL. [OGL15]

Southwest Florida soils are notoriously poor in plant nutrients. This study was done to compare the soil nutrition contents of four commonly found soils when left unattended or affected by garden and landscape practices. The soils were undisturbed or native soil; “fill” soils with no plant material; fill soils maintained under the principles of Florida Yards and Neighborhood (FYN) recommendations; and fill soils covered by high maintenance St. Augustinegrass lawns. Twenty-one samples were taken from each of the four soil types and analyzed by the university of Florida soil testing laboratory, Gainesville. The soils were analyzed for pH, P, K, Mg, Ca, Cu, Mn, Zn, Fe, organic matter, and electrical conductivity. The averages of the results are reported. The undisturbed and the lawn soils had pH’s of 7.4. The pH’s in the FYN yards and lawns were 7.7 and 8.3, respectively. Calcium and Mg were excessively high in all soils. At one extreme, the fill soil had low P and insufficient K. At the other extremes, the FYN soil had very high P and the lawns had the highest concentration of available K. The undistributed and fill soils had levels of Cu, Mn, and Zn below which is expected to be a plant response when these nutrients are added to the soil as fertilizers. The lawns had the lowest concentration of Fe, 4.86 mg/L, and the FYN soils had the highest averaging 16.11 mg/L. Generally, the fill soils were the lowest in soil nutrients and organic matter. The lawn soils were highest in Mn and Zn and the FYN soils were highest in organic matter content.

3:45 Effect of Root Pruning and Planting Depth on Growth and Root Ball Quality in Container Production of Royal Poinciana *Delonix regia*. M. Orfanedes, UF/IFAS Broward County Extension and E. Gilman, UF/IFAS Environmental Horticulture Dept. [OGL16]

Increasingly, producers and consumers are realizing that roots play a major role in tree quality and that quality begins in the nursery. To remain competitive, producers need to find economically viable methods of producing trees to meet rising quality standards, particularly with regard to root systems. Three different root pruning methods and two planting depths were evaluated as 1-gallon container grown Royal Poinciana, *Delonix regia* where shifted into 7-gallon containers. Root pruning had no impact on trunk caliper or tree height, and no impact on primary root diameter. Root pruning increased the number of straight roots inside the root ball but had no impact on the percentage of the trunk encircled by roots. Trees planted with the top-most root 4 inches below the 7-gallon substrate surface had more root defects than trees planted with roots close to the surface.

4:00 Fort Lauderdale Trial Garden – Year 7 (2008-2009). Luci E. Fisher and Kimberly K. Moore, UF/IFAS Fort Lauderdale REC. [OGL17]

Rooted cuttings of vegetatively propagated annuals from Proven Winners were planted on May 8, 2008 for the summer trial, and on December 8, 2008 for the winter trial. All cultivars were planted as three groups of six plants with the groups being randomly placed in the garden. For the

summer trial garden, one set of plants were planted in full sun, one set was planted under partial shade, and the remaining set was planted under 30% shade while the plants grown in the winter garden were planted under 30% shade. Monthly evaluations were conducted to record plant height, plant width, flower number, number of plants with flowers, insect and disease damage, and quality rating. Quality was rated on a scale of 0 to 5 with 5 = top performance, 3=plants of interest, 1=poor performance, and 0=dead. One consumer preference survey was conducted on the winter trial garden in March 2009. Quality data and consumer preference results will be presented.

4:15 Selected Daffodils For Central Florida Gardens. B.J. Jarvis and Wilma Hayes, UF/IFAS Pasco County Extension, Dade City, FL. [OGL18]

Daffodils and other flowering bulbs typically struggle in peninsular Florida because of the low number of chilling hours. However for the last five years, the Florida Daffodil Society and ten county Extension Offices in central Florida collaborated to determine if there were varieties of daffodils that would repeat-bloom in this zone. In the winter of 2004, twelve varieties were planted in demonstration gardens, including Pasco County. Since then Pasco County has monitored the performance of the twelve varieties for green growth and flower production. Many of the varieties have not re-bloomed over time or have even declined or died; however several daffodil varieties have performed satisfactorily and may be suited to the low chilling experienced in west-central Florida according to the trial. This presentation will discuss those varieties of daffodils which did not perform consistently and those that performed well. These varieties may be good candidates for wider usage in Florida home or commercial landscapes.

4:30 2008 Survey of Caladium Growers in Florida. Z. Deng, Gulf Coast REC, Balm, FL and J. C. Alleyne, Highlands County Extension. [OGL19]

Caladium growers in Florida supply >95% of the caladium tubers used worldwide for pot plant production and garden planting. A survey of the caladium growers was conducted in 2008 to find the predominant caladium varieties in production and to seek growers' input for prioritizing caladium breeding objectives and research activities. Respondents of the survey reported 1206 acres in 2007 and 1144 acres in 2008 planted for commercial tuber production, which represents greater than 85% of the total acreage in the industry. Among the 74 cultivars reported, the top 10 fancy-leaved varieties grown in 2008 were 'White Christmas' (107.1 acres), 'Candidum' (93.1 acres), 'Frieda Hemple' (70.6 acres), 'Carolyn Whorton' (66.1 acres), 'Pink Beauty' (62.7 acres), 'Red Flash' (61.6 acres), 'White Queen' (52.6 acres), 'Aaron' (46.0 acres), 'Postman Joyner' (45.3 acres), and 'Fannie Munson' (42.5 acres). The top 10 lance-leaved varieties grown in 2008 were 'Florida Sweetheart' (36.6 acres), 'White Wing' (19.6 acres), 'Florida Red Ruffles' (19.0 acres), 'Gingerland' (18.2 acres), 'Red Frill' (14.0 acres), 'Pink Symphony' (7.8 acres), 'Pink Gem' (7.5 acres), 'Lance Whorton' (6.6 acres), 'Florida White Ruffles' (4.1 acres), and 'White Knight' (4.0 acres). Responding growers indicated urgent needs for improving caladium for resistance to Pythium root rot, Fusarium tuber rot, and root-knot nematodes and more research on weed control, disease management, and methyl bromide alternatives.

4:45 Sugarcane Eye Propagation for back yard production in North Florida. L. Muralles, A. Bolques, FAMU/CESTA Gadsden County Extension and H. Grant, UF/IFAS Gadsden County Extension, Quincy, FL. [OGL20]

Sugarcane in North Florida is a grown on a small-scale and in back yard landscapes. The objective of this study was to propagate sugarcane from cane nodes in a protective environment to overcome early frost of seed stock. Normally, sugarcane is grown by planting stalks in furrows which usually yields one to two plants per stalk. To overcome late season frost, sugarcane can be

propagated using cane nodes. By using this technique, one can increase the number of plants per stalk and shorten the field growing season. Two varieties were used in this trial, CP31-511 a chewing variety and CP67-500 Syrup variety, which are the most desired varieties for chewing and syrup making. This study evaluates the germination rate of two sugarcane varieties after hot water treatments. The hot water treatments consisted of a control, 100°F, 110°F and 120°F. Each stock was divided into segments and designated as tops, middles and bottoms. Overall sugarcane tops had the best germinating rate (83-94%), compared to middles (11%-67%) and bottoms (0%-39%). There were no significant differences between tested varieties and temperature treatments. These findings are important due to the high demand of planting material for homeowner landscapes and small-scale farming.

5:00 Utilization of Farmed Algal Mats for Nutrient Scrubbing and Biofuel Production in Florida Horticultural Operations. T.J. Evens and J.P. Albano, USDA-ARS, US Horticultural Research Laboratory, Ft. Pierce, FL. [OGL21]

Several significant economic and environmental concerns exist with the loss of nutrients from horticultural operations. Nutrients that are not taken up by plants and enter surface-/ground-waters represent lost revenue for growers and can migrate off-site to potentially contribute to eutrophication processes. We are presently exploring the farming of periphytic algae which are filamentous algae that grow attached to a substrate, as a method of capturing nutrients such as nitrogen and phosphorus, in run-off water. The resultant biomass is regularly harvested and can be processed into marketable, value-added products such as compost, green manure, aquaculture feed, livestock feed and/or biofuel feedstock. Preliminary efforts have determined that the productivity of farmed algal mats is as good as or better than traditional raceway ponds and can be easily harvested with a small tractor. The farmed algal mats are complex natural communities of algae, bacteria and microscopic herbivores. This community structure automatically adjusts to changes in temperature, irradiance and rainfall, which assures optimal productivity year-round. We will examine the potential scrubbing efficiencies of farmed algal mats, discuss the production potentials of value added products, and provide a first-order economic analysis of a system sized for a representative nursery operation.

Tuesday June 9

10:00 Effectiveness of Seed Matriconditioning on Germination and Storability Parameters of Creeping Bentgrass. Gokhan Hacisalihoglu and Zakiya Ross. Biology Department, Florida A&M University, Tallahassee, FL. [OGL22]

Creeping bentgrass (*Agrostis stolonifera*) is a commonly used grass for lawns and golf courses worldwide. One of the most important challenges of creeping bentgrass is the speed and uniformity of germination and seedling emergence. It has been known that matriconditioning (MC), a controlled hydration seed treatment, can enhance the parameters of germination and soil emergence. The primary objective of this study was to determine the effectiveness of optimum MC on nonaged and aged creeping bentgrass seeds. Seeds were matriconditioned with Micro-Cel E carrier and water at 25 °C for seven days. Optimum seed, carrier, and water proportions were 1 g, 0.5 g, and 2 mL respectively. Accelerated aging was induced by storing nonprime and primed seeds for 0, 10, and 20 d at 42 °C and 95% RH. Creeping bentgrass seeds treated with MC germinated quicker and with higher final germination percentage than non-treated control seeds. Current progress in this study and further results in support of our hypothesis will be presented.

10:15 Evaluation of Seed Treatments for Improved Germination of Starry Rosinweed, *Silphium asteriscus*. J.A. Mangandi and S. Park-Brown, UF/IFAS Gulf Coast REC, Balm, FL. [OGL23]

Starry rosinweed (*Silphium asteriscus*) is a native wildflower of Florida's pine flatwoods. This herbaceous perennial reaches three to five feet and bears yellow ray florets May through September. Starry rosinweed is gaining popularity as a landscape plant, but little information exists describing specific propagation methods by either sexual or asexual means. The objective of this study was to determine the effect of various pretreatments on the germination rate and percentage of *S. asteriscus*. In September 2008, 160 seeds were collected and stored in polyethylene bags at 39° F for 30 days. In addition, 80 seeds were stratified in potting media under the same conditions. After 30 days, 80 of the stored (non-stratified) seeds were water-soaked for 24 hours before planting. Before sowing, half of the seeds from each treatment were cleaned by removing the pericarp. A second set of 160 seeds was collected 30 days after the first harvest of which, 80 were water-soaked for 24 hours before planting and 80 were not. At planting time, 40 each of the water-soaked and non water-soaked seeds were cleaned by removing the pericarp. All ten treatments were then sown under greenhouse conditions (average temperature, 73° F). Seed that received the moist-stratification period began germinating five days after sowing. A uniform germination percentage of 90% was observed in two weeks. No differences were noted between cleaned and uncleaned seeds. Germination rates were slower and germination percentages were lower for all other treatments.

10:30 Rules for a Successful IPM Program. S.A. Shives, and K.Oliver, UF/IFAS Manatee County Extension, Palmetto, FL. [OGL24]

Implementing an Integrated Pest Management (IPM) program in your nursery can be very rewarding. You and your workers are exposed to less toxic pesticides, and you know that you are doing your best to preserve the environment. You can advertise your plants as grown without pesticides, if none are used. And you may save money if you practice IPM properly. Plus you will not have to worry about pesticide licenses or pesticide laws. You can be very successful if IPM is handled properly. If you ignore the rules, IPM can end up as a disaster. It depends on whether you follow the "rules". I have developed these "rules" after many years of working with nurseries attempting to implement IPM with some failures and many successes. These rules include: 1) Keep spray records for at least 6 weeks before using any beneficials; 2) Start with a small test area to prove to yourself that this can work; 3) Be honest with yourself and/or your consultant. Know which chemicals you can use and which you should not use. Plan your program with the knowledge of the effects the chemicals can have on your IPM plan; 4) Use of IPM does not mean that you cannot use chemicals, and 5) Be consistent. If you agree to suspend the use of certain chemicals, follow through. In my experience, this is the broken law that causes most IPM programs to fail. In my experience, anyone can have a successful IPM program if they follow basic rules.

10:45 Possibilities for Biological Control of Root-knot Nematodes by Natural Predators in Florida Soils. Robert McSorley, UF/IFAS Entomology and Nematology Dept., Gainesville, FL; and, Koon-Hui Wang, Department of Plant and Environmental Protection Sciences, University of Hawaii at Manoa, Honolulu, HI. [OGL25]

Root-knot nematodes (*Meloidogyne* spp.) are important pests of many landscape and commercial ornamentals grown in Florida. However, soils may contain naturally-occurring predators that may provide some biological control of nematodes. A greenhouse experiment was conducted to evaluate the potential of invertebrate predators in agricultural and natural soils to suppress *M. incognita* (Kofoid & White) Chitwood on coleus (*Coleus blumei* Benth.). Soil from adjacent natural and agricultural habitats was collected from three locations in Florida (Quincy,

Homestead, Citra). Each soil was placed into pots, planted with coleus seedlings, inoculated with 2000 eggs of *M. incognita*, and arranged in a 3 x 2 factorial design. Root-knot nematodes were suppressed in natural soils compared to agricultural soils by the end of the experiment. A variety of invertebrates were monitored in all soils including tardigrades, Collembola, mites, japygids, and ants. Omnivorous and predatory nematodes and enchytraeid worms did not show population patterns consistent with the biological suppression of root-knot nematodes observed in natural soils. However, Collembola and mites were generally more abundant in natural than in agricultural soils, and increased in numbers over time. Japygids, ants, and tardigrades were also more abundant in all or some natural soils initially, but numbers declined over time. Results support the ideas that nematode suppression occurs in Florida soils, that relative suppression of root-knot nematodes is greater in natural than in agricultural soil, and that the occurrence of some invertebrate predators, especially mites and Collembola, is consistent with the nematode population declines observed.

11:00 Problems in Controlling *Phytophthora cactorum* on Cattleya Orchids. R.T. McMillan, Jr., Kerry's Nursery, Inc, Homestead, FL. [OGL26]

The major fungus on Cattleya orchids in Florida and in the New and Old World countries is *Phytophthora cactorum* (Lebert & Cohn) J. Schroet., which causes Black Rot of Leaf and Heart Rot during the cooler months of the year. All species of Cattleya and their interspecific and intergeneric hybrids are susceptible to it. *Phytophthora cactorum* infects leaves, pseudobulbs, rhizomes, and flower buds. Recovery studies of infected plants which involved cutting out the infected tissue were found not to be effective, even with treatments of fungicides such as Banrot, Natriphene, Shield Brite, Truban, and Phyton 27. A second study of fungicide sprays and drenches of Banrot, Heritage, Shield Brite, Stature, Truban, Pentathlon, Aliette, Subdue Maxx, and Insignia, for the control of *Phytophthora* infected leaves, pseudobulbs, and rhizomes, was conducted from 2005-08. The fungicides Aliette, Insignia, Stature, and Subdue Maxx when applied as preventive sprays, were found to be significantly effective for the control of Cattleya leaf and flower bud infection. However, Aliette was only effective for control of *P. cactorum* when applied to leaves that were in the receptive stage. The fungicides Insignia, Shield Brite, Stature and Subdue Maxx when applied as preventive drench, were found to be significantly effective for the control of *P. cactorum* in community pots of Cattleya seedlings.

11:15 Effects of Pesticides on the Arthropod Community in the Agricultural Areas near the Everglades National Park. D.M. Amalin, J.E. Peña, R. Duncan, UF/IFAS Tropical REC, Homestead, FL; J. Leawengood, Division of Plant Industry, Gainesville, FL; and, S. Koptur Department of Biology, Florida International University, University Park, Miami, FL. [OGL27]

We investigated the effect of chemical sprays on the arthropod community in the agricultural areas near the Everglades National Park (ENP). Sampling of arthropods was done using visual observation, destructive sampling, pitfall trap and sweeping methods in two successive years, 2000 and 2001, in a field planted with native ornamental plants, which are also commercially used for landscaping. The field was divided into two pest management regimes: a biological system and a chemical system. Overall results showed that more arthropod taxa were present in the biological system than in the chemical system. Likewise, greater arthropod diversity was calculated in the biological system than in the chemical system. These findings suggest that chemical application in the agricultural areas near the Park should be used sparingly and wisely (if chemicals cannot be avoided) to maintain the natural balance in the arthropod community existing near the Everglades National Park.

11:30 Tracking the Spread of Pink Hibiscus Mealybug (*Maconellicoccus hirsutus* Green) and its Parasitoids in Miami-Dade County, Florida using GPS/GIS Mapping System. D.M. Amalin, UF/IFAS Tropical REC, Homestead, FL; L.R. Nieves, Dept. of Interior, Baker City, Oregon; A. Roda, USDA-ARS-SHRS, Miami, FL and C. Mannion, UF/IFAS Tropical REC, Homestead, FL. [OGL28]

The movement of *Anagyrus kamali* Moursi and *Gyranusoidea indica* Shafee, two parasitoids of pink hibiscus mealybug (PHM), *Maconellicoccus hirsutus* Green (Hemiptera: Pseudococcidae), was assessed in the initial infested core area in Miami-Dade County where these parasitoids were released. A comprehensive survey was done to determine the spread of the mealybug infestation and its parasitoids beyond the original parasitoid release sites. The survey consisted of two randomly selected locations in Miami-Dade County: Miami and Kendall. Each survey area was divided into 6 transects starting at the boundary line of the known release sites and original infested core area. A total of 90 and 80 locations were surveyed in Miami and Kendall areas, respectively. Data were evaluated and presented using Geographic Information System (GIS) program (ESRI®). GIS mapping of the data showed that PHM had not spread widely beyond the initial infested core area in both the Miami and Kendall areas 12 months from the initial detection. Out of 90 locations in the Miami area, only 5 locations showed PHM infestation. In the Kendall area, 8 locations out of 80 surveyed locations had PHM infestation. All locations with PHM infestation also had PHM parasitized by *A. kamali* and *G. indica*, which confirmed the movement of these parasitoids along with the PHM.

VEGETABLE SECTION

Monday June 8

10:00 Using a Float System to Grow Hydroponic Lettuce for Sale at Local Green Markets in Southeast Florida. Kenneth D. Shuler, Stephen J. Nie, Deanna V. Shuler, And Pei-Ann N. Shuler, Stephen's Produce, Jupiter, FL. [V1]

A float system was used to grow hydroponic lettuce for sale at local green markets. Lettuce seedlings were grown in horticultural-grade rockwool cubes. In 2001, four floats measuring 4 feet x 8 feet x 8 inches were used. Each float was lined with 6-mil thick, clear polyethylene sheeting and filled with 125 gallons of water to which a 20-20-20 soluble fertilizer supplemented with additional magnesium sulfate was added. Thirty-six holes were drilled into 2-inch thick sheets of Styrofoam insulation measuring 4 feet x 4 feet. By the 2007-2008 season, a total of 27 floats had been made and an average of three floats were being planted each week (216 plants per week). The newer floats were 5.5 inches tall and held 80 gallons of water.

10:15 The Market Gardening Project – An Agriculture Extension Program in Diversified, Small Scale Horticultural Production. Robert Kluson, UF/IFAS Sarasota County Extension, Sarasota, FL. [V2]

The new models across the nation for the education of beginning small farmers include multi-disciplinary approaches that provide holistic training of different production and direct marketing systems for increased sustainability and success of their enterprises. The Market Gardening Project is an agriculture extension program that provides a curriculum partly based on these approaches and designed for highly diversified, small scale, horticultural production systems. It was developed in response to needs identified at past South-central FL regional workshops of the UF/IFAS/FAMU Small Farm and Alternative Enterprise Program. One of these needs is an introductory training program for beginning market gardeners in both rural and urban locations who

are interested in the opportunities of emerging local markets. Market gardening is defined as the commercial production of vegetables, fruits, flowers, and other plants, on a scale larger than a home garden, yet small enough that many of the principles of gardening can be applied, and is often oriented toward local markets, such as farmers markets. To address the needs of these farmers in Sarasota County, the curriculum of the Market Gardening Project was developed to provide the following information: 1) holistic management; 2) agroecosystem analysis; and, 3) diversified production, business and market planning of horticultural crops. In addition, the curriculum employs a format using the following approaches: 1) classes based on multi-media presentations, and augmented with guest speakers and visits to local market gardeners and local markets; 2) online resources of free references as curriculum materials; and, 3) promotion of the UF/IFAS/FAMU Small Farm & Alternative Enterprise Program.

10:30 Growing and Marketing Hydroponic Lettuce at Local Green Markets in Southeast Florida. Kenneth D. Shuler, Stephen J. Nie, Deanna V. Shuler, And Pei-Ann N. Shuler, Stephen's Produce, Jupiter, FL. [V3]

The growers for Stephen's Produce began growing and marketing hydroponic lettuce in 2001 to help supply local green markets with a weekend supply of Agarden fresh produce. Planting schedules, growing and harvesting methods, yields, and sales figures will be discussed. For the 2007-2008 season, five types of lettuce were grown: Boston, red Boston, red leaf, romaine, and a Boston/romaine type. Lettuce was sold at all of the 30 weekends for the sales season which began 20 Oct. and concluded 11 May. Lettuce was grown in a float system and plants were pulled out and stored in a cooler with ice the night before sales. Heads of Boston and red Boston were generally sold for \$2.50 each and heads of romaine, Boston/romaine, and red leaf for \$2.00 each. In 2007-2008, an average of 194 total heads of all types was sold each week. [V3]

10:45 Influence of Irrigation Programs on Strawberry Cultivar Growth and Yield. Maricruz Ramirez¹, Bielinski M. Santos¹, Craig K. Chandler¹ and Steve A. Sargent²; ¹Gulf Coast Research and Education Center, IFAS, University of Florida.²Horticultural Sciences Department, IFAS, University of Florida. [V4]

Field trials were conducted at the Gulf Coast Research and Education Center, University of Florida, to determine the effects of different irrigation programs on the yields of 'Strawberry Festival' and 'FL-99-117' strawberries. The irrigation programs consisted of six combinations of water volumes and frequencies of irrigation. The water volumes were 100, 200 and 300 gal/100 ft of row per week, while the irrigation frequencies were one and two cycles per day. The average reference evapotranspiration (ET_o) value for strawberry production in West Central Florida is approximately 200 gal/100 ft per week. Data showed that each cultivar responded differently to the irrigation programs. There was no significant effect of the irrigation programs on 'FL-99-117' growth and early and total fruit weight. 'Strawberry Festival' yields were influenced by the watering programs. For early yields (first 10 harvests), there were no differences among treatments, regardless of water volume or frequency of irrigation. Total yields (24 harvests) were influenced by water volumes when two irrigation cycles per day were used, increasing from 10.8 to 13.2 ton/acre with 100 and 200 gal/100 ft per week. However, there were no significant changes in total yields when one irrigation cycle per day was used, averaging about 12.2 ton/acre. These results preliminarily demonstrated that total strawberry yield increased when irrigation volumes of 200 gal/100 ft per week or higher were applied in comparison with only one irrigation per day. On the other hand, when lower water volumes are utilized, then irrigation should occur only once per day. It appears that the crop can be produced with average irrigation volumes lower than the average ET_o values without reducing early yields.

11:00 Influence of Mulches, Fumigants, and Irrigation Programs on Tomato Performance.

Bielinski M. Santos, UF/IFAS Gulf Coast Research and Education Center, Balm, FL. [V5]

Two field studies were conducted during 2007 and 2008 in Balm, FL, to evaluate the effects of four irrigation programs and three combinations of soil fumigants and polyethylene mulches on soil moisture, NO₃-N absorption and tomato yields. The irrigation programs consisted of: a) subsurface (seepage) irrigation at 1500 gal/acre/day; b) seepage irrigation at 3000 gal/acre/day; c) seepage irrigation at 1500 gal/acre/day plus drip irrigation at 48 gal/100 ft/day; and d) seepage irrigation at 3000 gal/acre/day plus drip irrigation at 48 gal/100 ft/day. The fumigant-mulch combinations were methyl bromide plus chloropicrin (MBr + Pic; 67:33 v/v) at 175 lb/acre under metalized mulch; 1,3-dichloropropene plus chloropicrin (1,3-D + Pic; 65:35 v/v) at 32 gal/acre under black high-density polyethylene mulch; and 1,3-D + Pic at 16 gal/acre under metalized mulch. The data indicated that the fumigant-mulch combinations did not affect soil moisture content at 5 inches below the bed tops throughout the season. However, the irrigation programs influenced soil moisture with the highest values occurring in the treatments with seepage plus drip irrigation in comparison with only seepage irrigation. There were no differences in NO₃-N absorption throughout the season. Using drip irrigation, regardless of water volume, significantly improved total marketable tomato yields in comparison with plots treated with only seepage irrigation. There were no yield differences between plots treated with 1500 and 3000 gal/acre/day when only seepage irrigation was used, but total marketable yield increased when plots were irrigated with 3000 gal/acre/day plus drip irrigation at 48 gal/100 ft/day in contrast with those watered with 1500 gal/acre/day plus drip irrigation at 48 gal/100 ft/day.

11:15 Real-Time Drip-Irrigation Scheduling of Watermelon Grown with Plasticulture.

Francesco Di Gioia, Eric Simonne, Diane Jarry, Michael Dukes, Bob Hochmuth, and David Studstill. UF/IFAS Horticultural Sciences Dept., Gainesville, FL. [V6]

In the Best Management Practice era, economical and environmental sustainable vegetable production requires an integrated approach to fertilization and irrigation. A two-year study was conducted in North Florida on a Lakeland fine sandy soil to develop and test a crop factor (CF) for watermelon (*Citrullus lanatus* Thunb.) grown with plasticulture and drip-irrigated daily. Crop water use (ETc) was calculated daily by multiplying Class A pan evaporation (Ep) with the following proposed CF values 0.20, 0.40, 0.70, 0.90, and 0.70 for period 1-2, 3-4, 5-11, 12, and 13 weeks after transplanting, respectively. Daily Ep values were converted to irrigation volumes using 10 mm Ep = 835 L/100 m of bed length. 'Mardi Gras' watermelons were established in a factorial combinations of 75%, 100% and 125% of the recommended 168 kg/ha N rate and 33%, 66%, 100%, and 133% of the reference irrigation rate (I3). Watermelon yield responded quadratically to irrigation rate for both years, and the highest yield corresponded to 123% I3 in 2001 and 116% I3 in 2002. Mean individual fruit weight was 8.48, 9.66, 9.71 and 9.78 kg/fruit for I1, I2, I3 and I4, respectively. These results suggest that highest watermelon yields grown in the spring with plasticulture may be achieved with a combination of 100% of the N recommended rate and irrigation scheduled in real-time using 1.2 x CF values of 0.24, 0.48, 0.84, 1.08, and 0.84 for period 1-2, 3-4, 5-11, 12, and 13 weeks after transplanting, respectively, using 10 mm Ep = 835 L/100 m of bed length.

11:30 Use of Soil Moisture Sensor-Based Irrigation on Vegetable Crops: Pitfalls, Failures and Successes.

Lincoln Zotarelli and Michael D. Dukes, Agricultural and Biological Engineering Dept., Gainesville, FL. [V7]

The use of improved irrigation scheduling techniques has been shown to greatly increase irrigation water use efficiency. Consequently, fertilizer is retained longer in the effective root zone,

resulting in substantial water savings and reduction of the potential N-leaching losses. Since 2004, field experiments have been conducted to test different thresholds of soil moisture sensor (SMS)-based irrigation control systems on zucchini, tomato and pepper for sandy soils. Significant reductions in the volume of irrigation applied (up to 53%) were reported when SMS controlled the irrigation compared to fixed-time irrigation of 2h/day. SMS-treatments resulted in relatively steady soil moisture content over time, because irrigation water was distributed across multiple irrigation events according to the soil moisture threshold. No reductions in yield and an overall increase of N-fertilizer use efficiency were reported for SMS-based irrigation treatments. The SMS-based treatments irrigated for short periods of time and resulted in a relatively small increase in soil moisture, consequently decreasing the volume of percolate and NO₃-leaching. The use of subsurface drip irrigation on tomato and drip irrigation on double row crops associated to SMS-based irrigation reduced irrigation water application and nitrate leaching. Probe placement and correct wiring of SMS-probes to the timer are critical to performance of the system in sandy soils, and the ideal probe location was at a representative area close to the drip irrigation (5-8 cm) in the effective root-zone (0-15 cm depth). Appropriate use of SMS-based irrigation system can allow growers to sustain profitable yield while reducing irrigation volume and N-leaching.

11:45 Effect of Splitting Drip Irrigation on the Depth and Width of the Wetted Zone in a Sandy Soil. Bee Ling Poh, E.H. Simonne, Horticultural Sciences Dept., Gainesville, FL; R C. Hochmuth, UF/IFAS North Florida REC-Suwannee Valley, Live Oak, FL; A. Gazula, Alachua County Extension, Gainesville, FL, and D.W. Studstill, Horticultural Sciences Dept. [V8] *Student competition entry*

Increasing the width while reducing the depth of the zone wetted by drip irrigation has implications for nutrient and irrigation management, as well as for fumigant application. While UF/IFAS irrigation recommendation calls for splitting irrigation events longer than 2 hours into multiple events of less than 2 hours, limited information exists on the effect of splitting irrigation length on wetted depth and width. Treatments (all for a total of 4 hours of irrigation or 94 gal/100ft) consisting of (1) four alternations of 1 hour irrigation followed by 1 hour waiting period [(1+1) x 4], (2) a 2-hour irrigation event followed by a 2-hour waiting period followed by another 2-hour irrigation event (2 + 2 + 2), (3) a 3-hour irrigation event followed by 1-hour waiting period followed by 1-hour irrigation event (3 + 1 + 1) and (4) a continuous 4-hour irrigation event (1 x 4) did not result in an increase in width and a reduction in depth of soluble dye. These results do not contradict the need to split irrigation events longer than 2 hours into multiple events of shorter durations. However, these results show that there would be no benefit to split irrigations for increasing fumigant application across the bed.

12:00 Correlation between L* a* b* Color Space Values and Carotenoid Content in Pumpkins and Squash (*Cucurbita* spp.). Rachel A. Itle and Eileen A. Kabelka, UF/IFAS Horticultural Sciences Dept., Gainesville, FL. [V9] *Student competition entry*

Carotenoids play an important role in human health by acting as sources of pro-vitamin A or as protective antioxidants. Pumpkins and squash (*Cucurbita* spp.) are excellent dietary sources of carotenoids. The diversity and range of carotenoid types and concentrations within pumpkins and squash provide a means to increase the nutritional value of this crop through plant breeding. Breeding requires reliable estimates of carotenoid types and concentrations to distinguish differences among breeding material. One method used for carotenoid identification and quantification is high performance liquid chromatography (HPLC). It is a highly sensitive and reproducible method, but expensive and time consuming. In contrast, colorimeters objectively describing visible color, are relatively inexpensive and easy to use. The objective of this research was to determine if the carotenoid content within pumpkin and squash measured by HPLC was correlated with colorimeter L*a*b* color space values. Cultigens (cultivars, heirlooms, and plant

introductions) representing white, yellow and orange flesh colors were grown at multiple locations using a randomized complete block design with two replicates at each location. Fruit flesh of each cultigen was evaluated using HPLC and colorimetric analysis. Strong correlations were found between color value a^* and total carotenoids ($r = 0.91$) and color value b^* and chroma with lutein ($r = 0.87$). Regression equations based on these correlations will be useful for estimating carotenoid type and concentrations. These close associations will also assure that breeding for enhanced carotenoid content within pumpkins and squash can be achieved using an easy to use and inexpensive method.

1:30 Characterization of In-row Movement of Nitrogen during a Simulated Rain Event and its Impact on Northeast Florida Potato Production. Zhiwei Chen and Chad M. Hutchinson, UF/IFAS Horticultural Sciences Dept., Gainesville, FL. [V10] *Student competition entry*

Northeast Florida potatoes are produced on sandy soil with low water holding capacity during a season with potential for excessive rainfall. Fertilizer source influence on in-row movement of nitrogen (N) during a rain event and impact of N leaching on potato tuber yield and quality of 'Atlantic' potato were evaluated. Treatments were arranged in a randomized complete block design with four replicates. Treatments were a no-N control and controlled release fertilizers [(CRF), polymer sulfur coated urea (PSCU), polymer coated urea (PCU) and two liquid urea formaldehyde (UF)] and ammonium nitrate (AN) at 196 and 224 kg N ha⁻¹ applied at planting. Drainage lysimeters were installed at the 45-cm depth from the top of the row for leachate collection. Simulated leaching rain event (5 cm in 2 hrs) was applied at 20-25cm and full-flower potato growth stages. AN treated plots had significantly higher downward N (NH₄-N and NO₃-N) movement than CRF treatment plots at both growth stages. No-N treatment had the lowest NH₄⁺-N and NO₃⁻-N concentrations in water samples, but the highest leaching volume attributed to poor canopy growth. PSCU-treated plants produced the significantly highest total yields (23.9 T ha⁻¹). PSCU and PCU treated plants produced similar marketable yields (18.9 and 17.2 T ha⁻¹, respectively) to plants in AN treatments (16.4 T ha⁻¹). UF1 and UF2 treated plants produced significantly lower total (17.5 and 17.8 T ha⁻¹) and marketable (13.7 and 14.0 T ha⁻¹, respectively) tuber yield than PSCU-treated plants.

1:45 Effects of Sulfur Rates and Drip Irrigation Volumes on Tomato. Camille E. Esmel, Bielinski M. Santos, Jack E. Rechcigl, Eric H. Simonne and Joseph W. Noling, UF/IFAS Gulf Coast REC, Balm, FL. [V11] *Student competition entry*

The occurrence of sulfur (S) deficiencies has increased possibly because of the reduction in atmospheric depositions. Sulfur deficiencies are often confused with the deficiencies of other elements such as nitrogen (N). Tomato production in Florida is typically done on deep Spodosols (fine sand) with low organic matter (<2%) and therefore, low in organic and inorganic S. Previous studies have found a positive response to the addition of S to fertilizer programs, regardless of source or form. Two studies were conducted in 2008 to determine the influence of S fertilization rates and irrigation programs on tomato growth and yield. The irrigation programs were 3528, 5292, and 7056 gallons/acre/day. The S rates were 0, 25, 50, 100, 150, and 200 lbs S per acre. Irrigation program increased vigor early in the season before fruit set, but did not continue to influence visual vigor ratings during fruit set. Chlorophyll content was not influenced by irrigation program or S fertilization rates. In the first study, the first harvest of tomatoes, the rate of 25 lbs/A S increased yield by 26% over the non-treated control. Increasing the S rate beyond 25lbs/A S had lower yield than 25 lbs/A S, but more than the non-treated control.

2:00 Response to Cadmium as a Potential Hydroponic Screening Tool for Zinc Efficiency in Common Beans. Gokhan Hacisalihoglu and Aja Lampley. Biology Dept., Florida A&M University, Tallahassee, FL. [V12] *Student competition entry*

Selection and breeding of plants for Zinc (Zn) efficiency, ability to maintain reasonable yield under Zn deficiency, is a useful approach to increase production and quality on Zn deficient soils. Hydroponic experiments were conducted to investigate the responses of two bean cultivars (*Phaseolus vulgaris* L. cvs. Calima and Jamapa) to Cadmium (Cd). Bean seedlings were grown in chelate buffer nutrient solution with increasing Cd concentrations (0, 1, 2.5, 5, 10, and 25 μM). Plant height, taproot length, final shoot and root fresh weight, leaf symptoms, shoot and root [Cd], chlorophyll content and number of leaves were determined for 15 days. Toxic Cd levels inhibited the growth of seedlings. A concentration of 5 μM Cd appeared to be the threshold value for separating tolerant and susceptible lines. The results showed that tolerance to Cd toxicity was significantly correlated with Zn efficiency trait in bean. Overall, cv. Calima was highly resistant, while cv. Jamapa was very susceptible to Cd stress. The susceptible cv. Jamapa displayed a decreased shoot length, taproot length, chlorophyll content when grown at ≥ 5 μM Cd concentration. This study demonstrated that Cd tolerance permitted the discrimination of Zn-efficient and Zn-inefficient bean lines. Therefore, measurement of Cd tolerance may provide a useful indirect criterion for screening of Zn efficiency in bean. The current status of this project and further detailed results will be presented.

2:15 Preliminary Data on Phosphorus Soil Test Index Validation in Southwest Florida. Kelly Morgan, Shinjiro Sato and Gene McAvoy, UF/IFAS Southwest Florida REC, Immokalee, FL. [V13]

The C-139 Basin is a 170,000-acre agricultural basin in Hendry County that is tributary to the Everglades. The Everglades Forever Act (EFA) mandates that landowners within the C-139 Basin should not collectively exceed average annual historic total phosphorus (P) loading. This basin has exceeded these loading levels. A vegetable production demonstration project was conducted in the C-139 Basin between 2005 and 2008 with the goal of determining if current soil test index best management practice (BMP) for phosphorus (P) fertilization practices negatively affected crop production. The soils of the C-139 Basin were found to have higher pH (>7.0) and very high calcium concentrations (>400 ppm) compared with similar soils in other locations in the state. These conditions result in precipitation of fertilizer P rendering it unavailable for crop uptake. Soil test results indicated that the soil samples at the beginning and during each of the field studies in this project were high or very high in extractable soil P as determined by current UF/IFAS soil test P index recommendations using the Mehlich 1 extractant. These high to very high P index values would indicate that no additional fertilizer P should be required for optimum crop production. The P concentrations extracted by Mehlich 1 did not decrease appreciably over the three years of this demonstration at all sites. However, during this demonstration project it became clear that growth and yield of green beans increased with increased P application when the P index indicated that no added P should be required.

2:30 Effects of Diverse Preplant Nitrogen Fertilizer Sources on Strawberry Growth and Yields. Bielinski M. Santos. UF/IFAS Gulf Coast REC, Balm, FL. [V14]

The effect of different preplant nitrogen (N) fertilizer sources was studied during two seasons at the Gulf Coast Research and Education Center, University of Florida. The target N rate was 50 lb/acre applied in two bands 10 inches apart on bed tops before mulching. The N treatments were ammonium sulfate (AS; 21% N, 24% sulfur [S]); ammonium nitrate (AN; 34% N); slow-release AS (SRAS; 29% N; 10% S); sulfur-coated urea (SCU; 37% N; 17% S); and fusion

ammonium sulfate nitrate (FASN; 26% N, 14% S). A non-treated control was added. Treatments did not affect plant diameter on 5 and 11 weeks after transplanting (WAT), leaf greenness (as a measure of chlorophyll content) on 8 and 16 WAT, and foliar N concentration on 20 WAT. In contrast, early and total fruit weight, and shoot and root fresh weights were influenced by treatments. The highest early fruit weights (14 harvests) were obtained with the application of AS, SCU and FASN, ranging between 7.2 and 7.6 ton/acre. There were no differences on the total marketable weight obtained in plots treated with AS, SCU and FASN, whereas the non-treated control had the lowest total fruit weight. The largest shoot biomass was found in plots treated with SCU (209.0 g/plant) and the lowest in the non-treated control. There were no root biomass differences among plants fertilized with AS, AN, SRAS, SCU, or FASN.

2:45 Potential for Sunn Hemp (*Crotalaria juncea* L.) to Utilize Soil Potassium. Danielle D Treadwell, Carlene Chase, Alyssa Cho, Michael Allgood, and Joseph Elsagr. UF/IFAS Horticultural Sciences Dept., Gainesville, FL. [V15]

Sunn hemp (*Crotalaria juncea* L.) is a tropical leguminous fiber crop often grown as a cover crop from June through August in Florida. In organic production systems, efficient cycling of nutrients is critical to minimizing the high costs of compliant fertilizers. Potassium (K) is absorbed in plants in larger amounts than any other nutrient except nitrogen, yet it generally receives less attention than nitrogen and phosphorus in many crop production systems. Cover crop species with the capacity to uptake K that could be available to subsequent income-producing crops would be beneficial to farmers. To determine the capacity of sunn hemp K uptake and the influence of K on above-ground biomass production, three rates of potassium fertilizer (45 kg ha⁻¹ (LOW), 90 kg ha⁻¹ (MID) and 179 kg ha⁻¹ (HIGH)) as potassium magnesium sulfate (22% K₂O) were compared to a control of 0 K (ZERO), and treatments were randomized and replicated three times. Sunn hemp was seeded to 28 kg ha⁻¹ on 15 May, 2008 at the Plant Science Research and Education Unit in Citra, FL. Leaf tissue K was greatest in the HIGH rate (3%) at six weeks after planting (WAP) compared to MID (2.5%), LOW (2.4%), and ZERO (2.1%) rates and ($P \leq .001$). Percent K in leaf tissue declined by 8 WAP, but total biomass increased; thus overall K content of 141 kg ha⁻¹ for the LOW rate and 163 kg ha⁻¹ for the HIGH rate in dry above-ground biomass, indicating potential for K provision to subsequent crops.

3:30 Characterizing Cucurbit Powdery Mildew in North Central Florida. Gabriella Maia and Amanda J. Gevens. UF/IFAS Plant Pathology Dept., Gainesville, FL. [V16] *Student competition entry*

Powdery mildew is a common and important foliar disease of cucurbit crops in all major vegetable producing regions of the world. In Florida, cucurbit Powdery mildew occurs on cucumber, melon, squash, pumpkin, and increasingly, on watermelon. Recently, the incidence and severity of disease outbreaks in Florida has increased resulting in a rise in crop loss and a growing need for improved cultivar resistance and fungicides. Cucurbit Powdery mildew is known to be caused by two obligate ascomycetous fungi, *Podosphaera xanthii* and *Golovinomyces cichoracearum*. Multiple physiological races have been defined in both fungi using muskmelon differentials. Race 1 of *P. xanthii* is the most common cucurbit Powdery mildew pathogen in the eastern U.S. In our 2008 study, the disease response on five muskmelon varieties ('Topmark,' 'Edisto,' PI414723, PMR 45, PMR 5) planted at two north central Florida locations (Live Oak and Citra) did not fit the characterization for any one of the 3 physiological races known to be found in the U.S. It is likely that the Powdery mildew population was composed of mixed races, or that the mix of races may have contained one or more new, or unidentified races. Based on morphological characteristics the predominant pathogen was likely *P. xanthii*. Fungicide efficacy trials with 16 treatments applied at first sign of disease were established at Live Oak and Citra with highly susceptible 'Burpee Butterbush' butternut squash. At both locations disease pressure was moderate

and fungicides did not provide significant control of Powdery mildew when compared to the untreated controls. At Citra, three of our treatments resulted in yields that were less than our untreated control. Loss of disease control with trifloxystrobin (QoI), thiophanate methyl (MBC), and triflumizole (DMI) suggested that there may be fungicide resistance present in the Powdery mildew pathogen population.

3:45 Evaluating Rootstock Effects on Grafting Vigor and Yield of Tomato under Greenhouse Conditions. Desire Djidonou and Xin Zhao, UF/IFAS Horticultural Sciences Dept., Gainesville, FL. [V17] [Student competition entry](#)

With the rapidly-evolving environmental issues related to intensive agriculture, commercial production of tomato (*Solanum lycopersicon* L.) in Florida faces serious challenges of maintaining high crop productivity. Grafting of existing elite commercial cultivars (scions) onto selected rootstocks is emerging as one of the potential strategies to ensure high efficiency of nutrients and water. A baseline greenhouse study with conventional optimum inputs (irrigation and fertilizers) was carried out in 2009 in Gainesville, FL, to evaluate the rootstock effects on grafting vigor, yield and quality of tomato. Treatments included tomato variety 'Florida 47' grafted onto five different tomato rootstocks (RST, 'Beaufort', 'Maxifort', 'Multifort' and JY); and self-grafted and non-grafted 'Florida 47' as controls. Ten days after grafting, survival rates were 28%, 40%, 53%, 63%, 70%, and 73% respectively for JY, self-grafted, RST, 'Maxifort', 'Beaufort', and 'Multifort', respectively. At anthesis, canopy characteristics such main stem node number, canopy height and width did not show any significant difference among the different rootstocks compared with the controls. Similarly, total above-ground biomass and leaf area did not show any significant difference at anthesis. Averages dry matter accumulated in the shoot were 20, 27, 28, 29, 29, and 36 g/plant, respectively for the self-grafted, 'Beaufort', 'Multifort', 'Maxifort', RST and ungrafted 'Florida 47', respectively. Single leaf photosynthesis measurements at anthesis showed a significant difference between the rootstock RST and all other rootstocks whereas across the different treatments, leaf water use efficiency did not show any significant difference. Upon completion of these experiments, results could provide valuable insight into the capability of grafting as a tool to enhance crop productivity and optimize crop management inputs namely irrigation and fertilization; pivotal in the development of Best Management Practices for tomato production in particular and for Florida vegetable crops in general.

4:00 Prospects for Biological Control of *Microtheca ochroloma*. Cecil O. Montemayor and Ronald D. Cave. UF/IFAS Indian River REC, Ft. Pierce, FL. [V18] [Student competition entry](#)

The yellow-margined leaf beetle (YMLB), *Microtheca ochroloma* Stål, is a pest of crucifer crops. This invasive species is native to South America and was first detected in the United States in 1945. Since then, it has spread throughout most of the southern states including Florida. Studies have examined the biology, fecundity, longevity and feeding preferences of the YMLB on various crucifer plants. Although the YMLB is a serious pest in organic farms, where insecticide use is restricted, little effort has been done to develop alternative control measures against this pest. Plant extracts with insecticidal properties have been tested to control this pest. No natural enemies of the YMLB have been reported in the literature. Generalist predators such as *Podisus maculiventris* Say and *Hippodamia convergens* (Say) have been observed preying on the YMLB in the field and in the laboratory. Therefore, more research is needed to evaluate the potential use commercially-available native predators to control this pest effectively. Laboratory and field experiments were conducted to assess the efficacy of different predators to reduce populations of the YMLB. Results from these studies will provide useful information about alternative management tactics against this pest for organic farmers.

4:15 Control of Broad Mite, *Polyphagotarsonemus Latus* and the Whitefly *Bemisia Tabaci* in Open Fields of Pepper and Eggplant with Predaceous Mites. Phil Stansly and Jose Castillo, Southwest Florida REC, Immokalee, FL. [V19]

The broad mite, *Polyphagotarsonemus latus* (Banks), and the sweetpotato whitefly, *Bemisia tabaci* (Gennadius), are serious pests of pepper and eggplant in Florida and elsewhere. In greenhouse-grown pepper, both pests have been controlled by *Amblyseius swirskii* and broad mite has been controlled by *A. cucumeris*; however, there have been no reports regarding the effectiveness of these Phytoseiid mites in open field pepper or eggplant. We evaluated both predaceous mites in eggplant and ‘Serrano’ pepper in experimental plots in southwest Florida, and also assessed control of broad mite in ‘bell’ pepper on a commercial farm in the same region. Both mites provided significant levels of control of broad mite on both crops, although fewer releases of *A. swirskii* were necessary and better control was achieved when both mites were compared directly. In addition, *A. swirskii* controlled *B. tabaci* which is an especially important pest of eggplant in this region. Both pepper and eggplant receiving *A. swirskii* yielded significantly more fruit than untreated plants or even eggplants receiving two acaricide sprays in 2007. However, the cost of releasing *A. swirskii* in eggplant exceeded average insecticide costs by a factor of 2 or more. Furthermore, *A. swirskii* did not provide adequate control of the spidermite *Tetranychus urticae* Koch, another important pest of this crop in south Florida. Therefore, further research is warranted to define lower effective rates of *A. swirskii* and combinations with spidermite specific predators.

4:30 Bacterial-Spot Resistant Pepper Trials in Florida. Gene McAvoy, UF/IFAS Hendry County Extension, LaBelle, FL; Russell Nagata and Ken Pernezny, Everglades REC, Belle Glade, FL; Jeff Jones, Plant Pathology Dept., Gainesville, FL; Nikol Havranek, Everglades REC; and, Darrin Parmenter, Colorado State University Extension, La Plata County, Durango, CO. [V20]

Bacterial spot, caused by the bacterium *Xanthomonas euvesicatoria*, is one of the most serious diseases of pepper in Florida because it can spread rapidly during warm periods with wind driven rains. Infection can markedly reduce yields and fruit symptoms reduce marketability. The traditional recommendation for bacterial spot control consists of frequent applications of copper and maneb. In Florida, the effectiveness of copper sprays has been limited for many years, due to the widespread occurrence of copper tolerance among strains of *X. euvesicatoria*. Researchers have identified no fewer than eleven different races of *X. euvesicatoria*. Since no variety incorporates resistance to all known races, it is important that growers to know the locally occurring races and use varieties that have resistance to races that occur in their area. Commercial pepper varieties resistant to races 1, 2 and 3 have been on the market for several years and have provided growers with partial protection from bacterial spot infection. Following several seasons of planting bacterial spot race 1, 2, 3 resistant pepper varieties, field surveys of bacterial spot populations in South Florida show that the bacterial spot races present in the field have shifted to predominately races 4 and 6. Recently, various seed companies have introduced several new varieties and selections which incorporate additional resistance to races 4 and 5. Seminis has introduced several varieties of sweet pepper that are resistant to races 1 through 5 including PS 5776 and PS 8302. Harris Moran has introduced ‘Patriot’ and ‘Revolution’ which include races 1, 2, 3 and 5 resistance. Harris Moran 2641 has resistance to races 1 through 4. Two years of replicated multi-season and multi-location on-farm trials on the east and west coast of Florida has shown that the new cultivars containing resistance to additional bacterial spot races including races 4 or 5 or both performed well in trials demonstrating dramatically reduced infection rates and superior yield compared to those varieties with only bacterial spot races 1, 2 and 3 resistance.

4:45 Determining Metham Sodium Lethal Dosage for Sting Nematode Control in Grower Field Microplots. Joe Noling, Citrus REC, Lake Alfred, FL. [V21]

Four field microplot experiments were conducted in commercial grower fields in Dover, FL during spring 2008. Each field was selected based on its high incidence and severity of plant stunting due to the sting nematode, *Belonolaimus longicaudatus*. The objectives were to evaluate single preplant applications of five application rates of metham sodium (Vapam HL 42%; 0, 500, 1000, 1500, 2000, 2500 ppm) for sting nematode control. Grower field microplots were 4 inch I.D. thin wall PVC tubing cut to overall length of 18 inches. Stunted plants were selected as experimental units for treatment application. Foliage of selected plants was cut at the soil interface, and the PVC tube centered over the plant and driven to the traffic pan. Once installed and a drain channel created, a one liter solution of each metham treatment was dispensed into each microplot. Each treatment was replicated 5 or 6 times at each field location. Separate untreated controls were included for dosage comparison at each field location. Ten days post application, the PVC tubes, with soil intact, were carefully lifted from the plant bed, and returned to the laboratory where sting nematode soil survivorship was assessed. Percent control was calculated as a percentage reduction from sting nematode population density of the untreated control at each experimental field location. At all experimental locations, sting nematode survivorship was not observed at concentrations greater than 1500 ppm (32.6 gal/a). The effects of other chemical management tactics will also be discussed.

5:00 Comparing Relative Strawberry Yield Using Differential Counts of Plant Sizes among Fumigant Treatments. Joe Noling, Citrus REC, Lake Alfred, FL. [V22]

The objectives of the study were to 1) evaluate plant size distributions (canopy diameter) in the field as relative indicators of strawberry yield; and 2) to compare relative strawberry yields determined from plant size surveys among methyl bromide alternative treatments in over 50 sting nematode-infested fields in Dover, Florida. In strawberry, plant density measurements within the different size categories was easily and conveniently acquired and expressed per unit lengths of row between irrigation sprinklers, systematically spaced as a grid at 48-50 ft intervals in most fields. Plant sizes were enumerated in at least 42 randomly selected sprinkler sections in each of more than 50 commercial fields with recurring histories of problems with the sting nematode *Belonolaimus longicaudatus*. Plant size categories were small (<6 inches), medium (>6 and < 12 inches) and large (>12 inches). Differences in plant numbers within each plant size category were then statistically compared between actual measured strawberry plot yields and among chemical treatments. Meaningful differences in plant size distribution and of relative yield were observed between various alternative to methyl bromide chemical treatments. Overall, field scale changes in strawberry crop productivity due to sting nematode and chemical treatment can be meaningfully determined, on a farm by farm basis, from post harvest assessments of counts of different plant sizes.

Tuesday June 9

10:00 Efficacy of Regalia™ SC for Control of Bacterial Leaf Spot and Powdery Mildew on Tomato in Florida. J. Osborne, T. Johnson, M. Martinez, H. Su, M.E. Koivunen, P.G. Marrone, Marrone Organic Innovations, Inc., Davis, CA. [V23]

A biofungicide based on *Reynoutria sachalinensis* extract, Regalia™ SC, controls powdery mildew and other diseases on many crops by induction of plant systemic resistance and by inhibition of conidia germination. A field study was conducted in Hobe Sound by Glades Crop Care on tomato (*Solanum lycopersicon* L.) to test the efficacy of the new biofungicide, Regalia™ SC, against tomato bacterial leaf spot (*Xanthomonas campestris* pv. *vesicatoria*) and powdery

mildew (*Oidium lycopersici*). Regalia™ SC was tested as a stand-alone treatment as well as in a tank mix or in rotation with either Mancozeb/Copper or Bravo. Tomatoes were evaluated every 14 days for infection rate (bacterial spot) and for disease incidence % (powdery mildew) and total biomass at the end of the study. All Regalia™ SC treatments resulted in a significant reduction in the infection rate of bacterial leaf spot, and the efficacy was equal to that obtained with Mancozeb/Copper rotation with Bravo. For powdery mildew control, Regalia™ SC as a stand-alone treatment (8 applications every 5-7 days) performed better at 1.0 % than 0.5 % concentration, but both rates performed equally well in controlling bacterial leaf spot. There were no significant differences among the stand-alone, tank-mix and rotation treatments in the control of both test pathogens.

10:15 Biological Parameters of Chilli Thrips, *Scirtothrips dorsalis* Hood (Thysanoptera: Thripidae) under Various Regimes of Insecticides. D. R. Seal, UF/IFAS Tropical REC, Homestead, FL. [V24]

The chilli thrips, *Scirtothrips dorsalis* Hood is a newly introduced pest in the Greater Caribbean. It causes serious economic damage to fruits, ornamentals and vegetables. It is a strong vector of various viral, bacterial and fungal diseases. Radiant® provides significant reduction of chilli thrips. Requiem® significantly reduced larvae and adults of chilli thrips when applied in rotation with Radiant®. The effectiveness of some new insecticides on the control of chilli thrips will also be reported in the present study.

10:30 Diel Periodicity of Chilli thrips (Thysanoptera: Thripidae) Dispersion and Occurrence on Selected Host in South Florida. Vivek Kumar, Dakshina R. Seal, UF/IFAS Tropical REC, Homestead, FL; David J. Schuster, UF/IFAS Gulf Coast REC, Balm, FL; and, Garima Kakkar, UF/IFAS Tropical REC. [V25]

Chilli thrips is a newly introduced pest in Florida and is dispersing quickly all over the state. It is a potential threat to our fruit, ornamental and vegetable industries. It has tremendous potentiality to spread at least 6 viral diseases to its host plants. This insect has been predicted to spread all over the United States causing an annual damage of more than \$2.0 billion. Several studies were initiated in Homestead, Florida in 2008 to study its biology and damaging potential to various host crops. Diel periodicity of the intraplant dispersion of *Scirtothrips dorsalis* was observed on cotton, peanut and pepper at 2-h interval every day, to find an association among their activity, dispersal and microclimate of the habitat.

10:45 Evaluation of Strawberry Cultivars in Florida: 2007-2009. Teresa P. Salame, Bielinski M. Santos and Craig K. Chandler, UF/IFAS Gulf Coast REC, Balm, FL. [V26]

Field studies were conducted over two seasons to examine the performance and postharvest quality of strawberry cultivars. During the 2007-08 season, the cultivars tested were ‘Winter Dawn’, ‘Florida Elyana’, ‘Florida Radiance’, ‘Ruby Gem’, ‘Festival’, ‘Treasure’, and ‘Camarosa’, whereas in the 2008-09 season, ‘Winter Dawn’, ‘Florida Elyana’, ‘Florida Radiance’, ‘Festival’, ‘Treasure’, FL-05-73, FL-05-107, and FL-05-151 were planted. The highest early strawberry fruit yields (first 10 harvests) during the first season were found with ‘Festival’ (3.1 ton/acre). In the following season, ‘Winter Dawn’ and ‘Festival’ had the highest early fruit yields. For the season totals (24 harvests) in 2007-08, ‘Festival’, ‘Treasure’ and ‘Florida Radiance’ had the highest values for total fruit weight ranging between 9.1 and 10.5 ton/acre. In the 2008-09 season, FL-05-107 outperformed the rest of the cultivars (21.3 ton/acre), followed by ‘Festival’ (15.4 ton/acre), ‘Treasure’ (13.0 ton/acre) and ‘Florida Radiance’ (13.4 ton/acre).

11:00 An Evaluation of Three Pigeon Pea (*Cajanus cajan*) Cultivars in North Florida: Timing of Planting, Crop Growth, Grain Development and Composition. C.S. Gardner, G.L. Queeley, B.G. Brown and K.T. Grant, Cooperative Extension Services, College of Engineering Sciences, Technology and Agriculture (CESTA), Florida A & M University, Tallahassee, FL. [V27]

Pigeon peas constitute about 5% of world legume production (3.5 million hectares). Although the plant is highly drought tolerant and adaptable to different climates, it is susceptible to frost. This characteristic makes the choice of cultivar and timing of planting extremely important, especially in north Florida where the growing window runs from April to November. The objective of this experiment was to evaluate the effect of three planting dates on growth and yield parameters of 3 pigeon pea cultivars and to assess the potential of the crop as an alternative food source. The experimental design was a randomized complete block, using three planting dates (May 16, June 5, and June 26) and three cultivars (76 W, 99 W and DO). Data were collected on flowering percentage at 60 days after planting (DAP), plant height, pod yield, grain yield and nutrient composition of the grain. The results indicated a significantly higher proportion of plants with flowers at 60 DAP for the May 16, planting date. However, the most significant growth, pod, and grain yield, were observed for the June 5, planting date. Timing of planting did not have any effect on the nutritional composition of the grain. Nutrient analysis of the grain revealed crude and digestible protein percentages ranging from 20 to 25 and 18 to 21 respectively, while fat composition ranged from 1.4 % to 3 %. These results indicate strong evidence that the pigeon pea is a highly nutritional food source and can be successfully grown in north Florida.

11:15 UF's "Tasti-Lee" Competes with Indeterminate, Greenhouse Tomato Cultivars for Yield, Fruit Quality, and Sensory Analysis when Produced Hydroponically. Nicole L. Shaw, Daniel J. Cantliffe, Steven A. Sargent, Adrian Berry, Elena Lon Kan, UF/IFAS Horticultural Sciences Dept.; Charles A. Sims, Lorenzo Puentes, UF/IFAS Food Science and Human Nutrition Dept.; and, J.W. Scott, Gulf Coast REC, Balm, FL. [V28]

Three cluster-type tomato cultivars ('Compari', 'Pitenza', and 'Tradiro') and two beefsteak-type tomato cultivars ('Tasti-Lee' and FA574) were grown in a passively ventilated greenhouse from 30 Oct. 2007 until 1 May 2008. Both 'Compari' and 'Tasti-Lee' are marketed as high-lycopene fruited cultivars. All greenhouse cultivars were harvested 15 times from 17 Jan. until 1 May 2008; 'Tasti-Lee', a determinant cultivar, was harvested 10 times from 17 Jan. until 27 Mar. 2008. 'Compari' produced the smallest fruit (90 g) and the greatest number of fruit per plant but not significantly different than 'Pitenza' (mean 210g). 'Tradiro' and 'Pitenza' produced the greatest fruit weight per plant (mean 26 kg·m²). 'Tasti-Lee' produced 11 kg·m² during five months of production. Fruit quality analysis was performed on 'Compari', 'Tasti-Lee', 'Tradiro' and a Florida-field-grown sample of 'Sanibel', which was purchased at a local retail store. 'Compari' fruits were firmer (18 vs. 7-14 x 0.015" deformation), had higher soluble solids (5.6 vs. 2.4-3.6 °Brix), higher titratable acidity (0.5 vs. 0.2-0.3%), and lower pH (4.2 vs. 4.3-4.6) than the other cultivars. 'Tasti-Lee' fruits were highest in lycopene concentration (85 vs. 40-60 µg/g). Results from the sensory taste panel ranked 'Tasti-Lee' best for overall appearance and color, and was similar to 'Compari' for firmness, flavor, and overall acceptability. 'Compari' was ranked best for sweetness followed by 'Tasti-Lee'. The retail sample was usually ranked last in all categories by the sensory panel. 'Tasti-Lee' would be a good selection for greenhouse tomato growers interested in double-cropping in spring and fall to produce high-lycopene fruits with excellent quality and flavor.

11:30 Greenhouse Production of Charentais-type Cantaloupes (*Cucumis melo* L. var. *cantaloupensis*). Daniel J. Cantliffe, Jeanmarie M. Harty, Nicole L. Shaw, Steven A. Sargent, UF/IFAS Horticultural Sciences Dept.; and, Peter J. Stoffella, UF/IFAS Indian River REC, Ft. Pierce, FL. [V29]

Popular in France, 'Charentais' cantaloupes boast an extremely fragrant and sweet, orange flesh. In the U.S., 'Charentais' melons are not widely grown due to their short shelf-life and susceptibility to powdery mildew (*Podosphaera xanthii*). The objective of this study was to produce 'Charentais'-type cantaloupes bred for a longer shelf-life and improved disease resistance; and evaluate fruit yield, quality and powdery mildew coverage (% PM) at harvest in order to determine their potential as a high-value greenhouse crop. During spring and fall 2008, seven lines of 'Charentais'-type cantaloupes were produced in a passively-ventilated greenhouse at the University of Florida. Average fruit number per plant was greater in spring (4 fruits) as compared with fall (2 fruits). Fruit yield, weight and size were also greater in the spring; however, mean soluble solids content (SSC) was higher in fall (14 °Brix) than spring (12 °Brix). In spring % PM ranged from 31 to 63%, while in fall, PM incidence ranged from 7% to 100%. Flesh firmness was greater in the fall for five lines, while two lines (WS5019 and WS5022) had similar firmness in both seasons. Over both seasons, mean fruit number per plant ranged from 2.2 fruits (WS5016) to 3.8 fruits (WS5031). Line WS5031 had the smallest fruits (0.6 kg/fruit), while fruits from all other lines weighed >0.8 kg, with the largest fruits from WS5016 (1.2 kg/fruit). Fruit yield was greatest for WS5017 and WS5019 (mean 7.5 kg·m²) and lowest for WS5031 and WS5033 (mean 5.4 kg·m²). SSC was 11.5 °Brix or greater for all lines. 'Charentais' melons would be an excellent high-value crop for greenhouse producers in the U.S.

11:45 Sorghum for Biofuel Instead of Vegetable Cover Crop - Hastings Partnership Update. Jacque Breman, Union County Extension, Lake Butler, FL. [V30]

Sorghum is used as a vegetable cover crop on a tri-county region of 30,000 acres. Hastings Partnership has conducted sweet and grain sorghum trials for biofuel since 2007 as an alternative to turning the crop under between vegetable seasons. Sweet sorghum studies included nitrogen rates, cultivars, stage of growth to harvest, and topping effects on total sugar yield per acre. Grain yield of two cultivars were quantified. A planting of sweet sorghum cultivars, breeding lines, and accessions was screened for adaptation to the Hastings environment. An accession was found to withstand flooded fields. A leaf disease study was conducted. A nitrogen study following potatoes included a zero rate. Highlights of these studies will be covered.

12:00 Integrating Biodiesel Production into Florida Horticultural Production Systems. D.O. Chellemi, USDA, ARS, U.S. Horticultural Research Laboratory, Ft. Pierce, FL and R. von Wedel, CytoCulture International, Point Richmond, CA. [V31]

Locally produced biodiesel feedstock creates a unique possibility to integrate multiple-goal oriented cover-crop programs into Florida horticultural production systems. Cultivation of cover crops improves soil fertility and the natural suppression of soilborne pests when farms are typically maintained as weed fallow or bare-ground fallow. Cultivation of a biodiesel feedstock will return additional revenue to growers, sequester carbon in the soil and provide a source of fuel that does not compete directly with food production. Factors to consider before successfully integrating a biodiesel feedstock into Florida horticultural production systems include its agronomic potential and constraints, susceptibility to local and exotic plant pests, input costs, resource consumption with the emphasis on water, oil quality, extractability and stability, transportation of harvested seed to crushing facilities and the specific market demands from potential end users of biodiesel. Evaluation of oil producing sunflower (*Helianthus annuus*) over multiple years as a cover crop for

vegetable production within the Florida Everglades Watershed is presented as a model system for integrating biodiesel feedstocks into Florida horticultural production systems.