2016 Citrus Section Abstracts

[C-1]

The Australian Finger Lime (Microcitrus *australasica*) and Its Hybrids as a Potential Niche Crop for Florida

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The finger lime *(Microcitrus australasica)* is native to Australia and was originally classified by Swingle. Recently, Mabberly proposed merging the entire *Microcitrus* genus into *Citrus,* renaming the finger lime as *Citrus australasica.* The finger lime is a thorny understory shrub producing finger-shaped fruit that contain compressed juice vesicles which tend to burst out when cut. These tart lime flavored juice vesicles have been termed as "citrus caviar" and are gaining popularity in restaurants as a garnish and as a component in mixed drinks. In addition, preliminary studies indicate finger limes to be tolerant to HLB. We have undertaken the field evaluation of a *finger lime* accession (DPI 50-36) to better understand the rootstock and nutritional requirements for optimum growth under Florida conditions. We are also creating new genetic combinations by hybridizing microcitrus with conventional citrus - using both conventional and somatic cell fusion techniques. A large population of diploid, triploid and tetraploid hybrids have been produced and their hybrid status confirmed using Random Amplified Polymorphic DNA (RAPD) and fluorescently labeled expressed sequence tag simple sequence repeat (EST-SSR) molecular markers. Field trials to evaluate traits including plant growth, fruit / juice vesicle characteristics and tolerance to HLB will be carried out. Results from our research should help the stakeholders assess microcitrus as a viable addition to their citrus portfolio and generate useful hybrids that could be commercially cultivated as a niche specialty crop.

[C-2]

Further Observations of Parson Brown and Other "Surviving" Citrus

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Observations of 100 plus year old plus Parson Brown Trees at the site of the J.L. Carney homestead on the eastern shore of Lake Weir, Marion County, FL continue on subject trees 2 & 3. These trees still appear relatively healthy; although visual symptoms associated with Huanglongbing (HLB or citrus greening) continue to be observed. Fruit samples were harvested in December 2015 resulting in acceptable juice quality and 'taste panel' results. Budwood has been submitted to the Florida Department of Agriculture – Division of Plant Industry Parent Tree

Program. The process of assembling budwood from these and other "survivor" trees and promising rootstock selections for further evaluations is slated to begin within the year.

[C-3]

Effect of Foliar Nutrition Programs in Recovery of HLB-Infected Grapefruit Trees

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The use of Enhanced Nutritional Programs (ENP) have been reported for ameliorate negative effects in health and productivity in citrus trees affected by the disease Huanglongbing (HLB). These programs are based in the supplementary application of soluble fertilizers to foliar tissue with the objective of correcting nutritional imbalances generated as a consequence of the phloem blocking induced by the presence of the bacteria *Candidatus Liberibacter*, the causative of the disease. Despite different authors reporting the use of this program in tree recovery and mitigation of HLB symptoms, the lack of information about the role of individual nutrients in tree recovery and incremental costs associated with their implementation, have limited the development of a standard formulation that can be used for Florida growers. The present study evaluates the effect of different ENPs composed by five different sources of macro and microelements. The treatments established are based on the combination of these fertilizers in order to evaluate the effect in the mitigation of HLB symptoms. The variables evaluated included the nutritional status, fruit drop, and yield in terms of fruit per tree, size and Gross Packing Value (GPV). After two years of treatment application, the fruit drop and the number of fruits per tree in trees sprayed with foliar fertilizers was not significantly different to the control (No ENP applied). However, in terms of fruit size, the treatments that included applications of urea and potassium nitrate, produced significantly larger fruit than the control treatment. The increases in fruit size, represented a significant increment in GPV of approximately 66% to control trees.

[C-4]

The Current State of Satsuma Production in Georgia

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Small farmers and landowners in Georgia have had tremendous interest in satsuma mandarins since 2013. Most growers look at satsumas as a potential income source on small acreage. Seventy of the 80 acres in Georgia have been installed since 2014 so there is currently limited production. It is estimated there are 30 growers in fifteen Georgia counties and these numbers are expected to increase as trees become more available. Seventy-five percent of the trees planted are "Owari" on *Poncirus trifoliata* rootstock. Most of the new trees originate from nurseries in Alabama, Louisiana, Texas, and USDA certified nurseries in Florida. Freezing

temperatures are the biggest threat to citrus planted in our region and therefore cold protection strategies have been recommended to new growers. At this point, the major insect problems have been citrus leafminer, mites, orange dogs, and leaf-footed bugs. Asian citrus psyllids and Huanglongbing have not been detected in commercially grown citrus to this point. To support this emerging industry, Lowndes extension has installed a rootstock trial using "Owari" satsuma on 10 rootstocks rootstocks to evaluate cold tolerance, fruit quality, and production to see if there are better options than *Poncirus trifoliata*. Many growers are interested in early maturing satsuma varieties and Lowndes extension is currently budding early varieties obtained from California and Florida for an early variety trial.

[C-5]

Exploring Mechanisms of Citrus Rootstock Tolerance to HLB

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Florida citrus production is greatly affected by the devastating disease Huanglongbing (HLB) associated with the bacterial pathogen *Candidatus* Liberibacter asiaticus (Las). Most commercial citrus scion cultivars are highly susceptible to HLB. However, tolerance to HLB has been identified within the species *Poncirus trifoliata* (trifoliate orange) and some of its hybrids which are commonly used as rootstocks. Using a rootstock tolerant to HLB does not completely protect a susceptible scion from HLB-induced decline, but even after infection with Las, trees on some hybrid rootstocks grow much better and yield much more fruit than trees on other common rootstocks. In addition, recent field surveys of commercially grown Valencia trees in central and in southwest Florida revealed considerable differences in pre-harvest fruit drop depending on the rootstock used. Greenhouse studies showed that Las populations are significantly lower in roots of psyllid-inoculated tolerant rootstocks compared with susceptible ones. We are currently exploring the mechanisms of HLB tolerance in selected rootstock cultivars using molecular and metabolomics approaches. Expression patterns of genes responding to HLB and generally associated with response to abiotic and biotic stress were considerably different depending on level of tolerance and susceptibility to HLB. Metabolomic analyses also revealed significant differences between rootstocks, although tolerance did not seem to be associated with a higher abundance of protective metabolites in response to infection. Instead, specific metabolic differences between the rootstocks prior to infection appeared to be associated with the tolerance response. A summary of results from our ongoing studies is presented.

[C-6]

Irrigation requirements and scheduling for HLB affected trees

Kelly T. Morgan, Southwest Florida Research and Education Center, UF

Understanding the role of evapotranspiration (ET) in Huanglongbing (HLB) affected trees is critical for determining if changes in water management of commercial citrus orchards are necessary. Water management districts have reported increases in water quantities applied to commercial citrus orchards since HLB entered Florida in 2005. Three multiple year studies were conducted between 2012 and 2015. The objectives of these studies were to estimate water use and crop coefficients (Kc) as affected by ET and HLB, and determine the most effective irrigation schedule for HLB affected citrus trees. The first of three studies compared water use on mature citrus in a commercial grove when scheduled by 1) grower experience, 2) Evapotranspiration (ET) estimation, and 3) soil moisture sensors. Water use for selected blocks averaged 24,491 gals per grove acre per month in 2011/2012, 20,371 in 2012/2013, and 18,999 in 2013/2014. The grower schedule used significantly more water than schedules based on ET estimates or soil moisture sensors. The second study observed water use, canopy density, and yield in three commercial groves for three years and found that daily irrigation used significantly less water, and produced greater canopy densities than use of current IFAS soil water depletion recommendations. In the third study, citrus crop coefficients (Ks) were estimated by comparing daily water use to daily ET calculated as described by Penman-Monteith (FAO-56 Method). Results showed significant reduction in water use for HLB affected Hamlin and Valencia trees grown in lysimeters with 26% to 29% less in 2014 and 18% to 21% less in 2015. All three water use studies indicate that current irrigation recommendations must be changed to daily irrigation during high water demand to maintain mature producing citrus trees.

[C-7]

Citrus Fertigation and Irrigation Practices for Managing HLB in Florida

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Citrus production in Florida accounts for >60% of national production in the US. Recently, production of citrus has been threatened by emerging threats including devastating diseases such as citrus greening common called Huanglongbing (HLB). We investigated the effect of novel fertigation and irrigation practices and different tree planting densities on performance of young citrus trees between 2009 and 2011 in central Florida ridge and southwest Florida flatwoods. Water use, nutrient accumulation, canopy volume and root length density were greater with the drip irrigation and restricted microsprinkler practice compared with conventional grower practices. These results should inform the generation of recommendations for managing HLB positive and negative trees with respect to improving canopy development, fruit yield, water use and nutrient accumulation.

[C-8]

Evaluation of Controlled Release Fertilizer for New Planting of Sweet Orange Trees

Tripti Vashisth, Jude Grosser, Citrus Research and Education Center, UF and Brian Boman, Indian River Research and Education Center, UF

In the past eleven years the Florida all orange production changed from 242 million boxes in the pre-hurricane, pre-Huanglongbing (HLB), 2003-04 season to 96.8 million boxes in 2014-15. This dramatic 60% reduction in yield is attributable to multiple causes, including loss of citrus acreage in the state, citrus canker and other diseases, but HLB is now recognized as the primary reason for declining citrus yields. Growers are urgently looking for strategies to maintain fruit production in their groves. Mineral nutrition is an integral part of tree health and for many decades it has been classified as an essential factor for maintaining tree productivity. Most of the mineral nutrients are involved in more than one physiological processes including plant hormone biosynthesis and signaling, plant defense response and systemic acquired resistance. In the past 5-7 years, several anecdotal accounts suggest promising results of intensive mineral nutrition care. These accounts suggest that trees under constant and balanced mineral nutrition seem to perform well and look healthier than the trees that don't receive good nutritional care. Unfortunately, there are not many scientific reports that can be used to support the anecdotal evidences regarding the effect of mineral nutrition on HLB-affected trees or to help formulate recommendations for fertilizer programs for HLB-affected citrus groves. Citrus growers are confronted with a variety of fertilizers and or nutritional programs without adequate decision making information in which to make the most informed choice. In this study we evaluated three different controlled release fertilizer (Everris, Florikote, and Harrell's) for growth, development of new planting of *Citrus Sinensis* cultivar 'Valquarius' on rootstock US 897. The trial was carried for four years and the yields were measured in the fourth year. Our results suggest that there was no statistical difference in the yield and quality of the three different controlled release fertilizer. Although Everris fertilizer resulted in the larger fruit diameter, which is a desirable attribute for fresh fruit industry. Overall, this study suggests that there was no significant difference among the different controlled release fertilizer for yield or canopy growth and development. Therefore, the cost of fertilizer can potentially be a deciding factor for growers in selecting the product for their grove fertilization program.

[C-9]

Seasonal Variation in Preharvest Fruit Drop of Florida Oranges in Relationship to Weather and Other Factors

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Variation in fruit drop of processing orange in Florida is well known. Preharvest fruit drop has been monitored by the National Agricultural Statistical Service (NASS), but causes were not evaluated. An understanding of causes was thought to be helpful in understanding how much of the current heavier preharvest fruit drop should be assigned to the serious disease Huanglongbing (HLB) and how much to factors leading to natural preharvest fruit drop. Statewide and citrus

production district fruit drop data, yields and tree counts for early-mid and late season cultivars were obtained from NASS for 51 years, from 1960 through 2011. Statewide and district monthly minimum and maximum average temperatures and total rainfall were obtained from the National Oceanographic and Atmospheric Administration (NOAA) records. Yields were converted to mature tree equivalents; bloom dates were obtained using the Florida Citrus Flowering Monitoring System. Multiple regression analyses were run for early-midseason and late season orange fruit drop against all other variables. Over 51 years there was a significant but small reduction in preharvest drop for early-mid and late season cultivars. For early-midseason oranges, 73 % of the year to year variation in preharvest fruit drop was significantly associated with six variables. Three of these were minimum monthly temperatures in late spring, early summer. For late season oranges, 65 % of the variation in preharvest drop was significantly associated with seven variables. Two of these were monthly average maximum temperatures in early summer and one was monthly rainfall in February. Previous yields were associated with variation in percentage fruit drop of a current year. Possible cause and effect relationships will be discussed.

[C-10]

Pre-Harvest Fruit Drop and Fruit Quality of "Huanglongbing" Affected Sweet Oranges

Tripti Vashisth, Yu Wang, Michelle Danyluk, Citrus Research and Education Center, UF and Chris Oswalt, Polk County Extension, UF

The future of Florida citrus industry is highly jeopardized by the epidemic of a disease called Citrus Huanglongbing (HLB). Fruit produced by HLB-affected trees are smaller, lopsided, poorly colored, with aborted seeds and abscise/drop prematurely. Moreover, juice from symptomatic fruit has higher acidity, lower sugars, lower Brix/acid ratio, and the chemical composition resembles to juice from immature fruit. Since 2012 high number of fruit drop incidences have been reported. Juice blend with high ratio of HLB symptomatic fruits to healthy fruits can result in off flavors and unacceptable juice product which is a big concern for citrus processors. Therefore, the objective of this study was to study pre-harvest fruit drop and fruit quality of sweet oranges grown under different management programs. Four different commercial management programs were included in this two harvest season study. In 'Hamlin' oranges as high as 34% fruit drop was observed. The quality of the fruit on the ground was low and the fruits were less than 2.3 inch in size, total soluble solids were less than 9 and were symptomatic. In harvested fruits the majority of the fruits were less than 2.45 inches which is lower than the average fruit size from 2010-2011. Sensory analysis of juice from small, medium, and large fruit suggested that consumers can differentiate between the juices from different fruit sizes. Management program D resulted in the biggest fruit size and high brix to acid ratios. Overall our data suggests that fruit drop and low fruit quality is a big concern.

[C-11]

Growth Measurements and Disease Severity Metrics of Citrus Identifies Resistance and Tolerance to HLB in a Florida Field Planting

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In a Fort Pierce, FL field planting, growth and Huanglongbing (HLB) severity were assessed as indicators of HLB-tolerance on progenies of 83 seed-source genotypes (henceforth "parent genotypes") of *Citrus* and citrus-relatives from the Riverside, CA genebank. Trees were exposed to infected Asian citrus psyllid for six years before metrics (leaf mottle, percent canopy mottle, chlorosis, overall health, canopy density, canopy width, canopy height, trunk diameter, and number of fruit) were collected in Oct. -Nov. 2015. Across all metrics, the healthiest trees with low or absent HLB symptoms were distant citrus-relatives: *Balsamocitrus daweii*, *Bergera koenigii*, *Casimiroa edulis*, *Clausena excavata, Glycosmis pentaphylla, Murraya paniculata* and one accession of *Severinia buxifolia*. Within *Citrus* most of the healthiest trees with densest canopies, little leaf loss, and greater growth, were those with pedigrees that included *C. medica*. These included progenies of *C.* hybrid ('Limon Real'), *C. limetta, C. limettioides*, *C. limonia*, *C. medica*, *C. volkameriana*, and some *C. limon* accessions. Trees in this category exhibited severe mottle but maintained dense canopies and exhibited good growth. Trees from parent genotypes without citron in their background were generally the least healthy overall with less dense canopies, greater leaf loss, and little to no fruit. The exception was progenies of one *Citrus aurantium* accession which were markedly healthier than progenies of other non-citron-related *Citrus* parent genotypes. Although no commercial *Citrus* genotypes yielded progenies with strong HLB resistance, in this field experiment several progenies maintained dense canopies and good growth, and may be useful in breeding HLB tolerant cultivars.

[C-12]

HLB-induced Anatomical Changes in Citrus Roots

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Based on early reports of root decline soon after HLB infection of citrus trees, we further investigated the anatomical changes that precede root deterioration. Two-year-old greenhouse grown HLB-infected and healthy-control 'Valencia' sweet orange (*Citrus sinensis* L. Osbeck) trees were used for this study. Our investigation corroborated early observations that citrus fibrous roots are affected very early in HLB infection and showed rapid deterioration of phloem tissue in young 'tertiary' roots. We classify the fibrous roots as primary, secondary, and tertiary

roots. Symptoms in HLB-infected primary and secondary fibrous roots were uncertain (like foliage tissue e.g., vascular bundles of the same tissue showed normal functional phloem while others showed blocked and disintegrated phloem). Similarly, accumulation of starch in root cortical tissue was uncertain. Within the same tree some roots samples showed accumulation of starch while other are completely devoid of starch accumulation. HLB-infected roots were small and dark brown in color. This work showed that HLB impaired morphological, physiological, and anatomical function in fibrous roots of citrus.

[C-13]

Occurrence of HLB Tolerance in Citrus Breeding Populations

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As HLB has become widespread in Florida, germplasm collections and populations produced as a part of the routine activities of citrus breeding programs have likewise been ravaged by the disease. However, as such collections of plant materials represent a broad range of germplasm, and thousands of unique genotypes have been exposed to natural *C*Las infection in the field for nearly 10 years now, citrus researchers have had an opportunity to observe very substantial differences in the speed with which different types become affected by HLB, as well as the severity of symptoms. HLB responses were examined in over 5000 trees in 6 different field locations from hundreds of crosses made by the UF-CREC breeding program since 1986. The parentage of the crosses included pummelo, mandarin, sweet orange, grapefruit, trifoliate orange, and other miscellaneous citrus species. Ploidy levels in the populations included diploid, triploid and tetraploid. In total, around 280 trees were identified that showed a very healthy appearance, in the winter of 2015-16. Within individual species and among some citrus hybrid families, a number of progenies can be found that display substantial tolerance, manifest as minimal symptom expression, and an ability to overcome and sometimes outgrow symptoms; this tolerance is not well correlated with estimated *C*Las populations. We also found that there is no correlation between good fruit quality and the degree of HLB tolerance. Future research utilizing these results for association genetics and genomic selection will be discussed.

[C-14]

Hydrogen Cyanamide on Citrus: Phytotoxicity, Influences on Flush in Potted and Field Trees and Effects on Bloom and Cropload in the Field

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Bloom in individual citrus trees typically continues for more than a month in south Florida. Prolonged bloom increases susceptibility to postbloom fruit drop disease (caused by *Colletotrichum acutatum*) and contributes to variable fruit maturity at harvest. Hydrogen cyanamide (HCN) is used to accelerate and compress bloom in various deciduous fruits, and this study investigated its use in citrus. HCN (Dormex®) was applied at a concentration range from 0.125% to 1.0% a.i., to potted trees of six citrus genotypes (*Citrus macrophylla,* Duncan grapefruit, Smooth Flat Seville, sour orange, Swingle citrumelo, Sun Chu Sha, and Duncan grapefruit) in December while trees were quiescent. Phytotoxicity increased with HCN rate, with some damage at 0.125% HCN on most genotypes, and large variation among genotypes. All HCN rates accelerated flushing. Airblast application of HCN (0, 0.025%, 0.05%, and 0.10%) was made to mature trees of Valencia and Navel orange in Ft. Pierce, Fla, on 27 Jan. On 15 Feb. and 28 Feb. additional trees received HCN at 0.05%. There was considerable defoliation which increased linearly with HCN rate. Flushing and flowering were unaffected by HCN compared to controls except that Feb. HCN appeared to increase flowers per tree in Valencia and 0.1% HCN on 27 Jan. reduced Navel flowering. HCN application to Valencia on 28 Feb., after initial flowering but 16 d. before peak bloom, significantly reduced fruit per tree but there were no other effects on cropping. HCN did not accelerate bloom with applications late Jan. through Feb.

[C-15]

Importance of Early Season Copper Sprays for Protection of Hamlin Orange Fruit Against Citrus Canker Infection and Premature Fruit Drop

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Proper timing of copper sprays for protection of fruit from infection by Xanthomonas citri subsp. citri, the cause of citrus canker, is important because early season lesions induce premature fruit drop. The objective of the trials reported herein was to evaluate early season sprays of copper for control of fruit infection and drop in 3- to 5-year-old 'Hamlin' trees in a south central Florida citrus grove. Soluble and fixed copper formulations were applied with an airblast sprayer at 21-day intervals. In 2011, early season infection occurred due to periodic rains in late March and early April before the initiation of copper sprays. Subsequently, nine sprays of copper formulations from April to September only marginally reduced the incidence of fruit lesions compared to the untreated checks (UTC). Fruit drop ranged from 69% of the tree crop in the UTC to an average of 45% in the copper treatments. In 2012 in same location, five copper sprays of 5 year-old trees began before rains in March-April. Incidence of fruit lesions was substantially lower and fruit drop due to canker was 10 fold lower than in 2011. In 2014, copper sprays of 3-year-old trees were initiated before below average March-April and above average May rainfall. In this season, incidence of fruit disease and fruit drop were very low. In 2015 in same location, copper sprays of 4-year-old trees were initiated before above average April and below average May rains and the incidence of fruit disease and fruit drop were significantly reduced by copper sprays. Timing of sprays in advance of rains in late March and early April is critical for

protecting fruit from 0.5 to 1.0 cm (0.25 to 0.50 inches) in diameter. Inoculum in form of infected leaves and stems from the previous season is always present in the spring. Early fruit infection resulting in fruit drop depends on coincidence of March-April rains with the most susceptible fruit stage. In June-July, infections of fruit larger than 4.0 cm (1.5 inches) result in smaller lesions that do not induce fruit abscission and premature drop.

[C-16]

Are Non-Proteinogenic Amino Acids Essential to the Pathogenicity of Candidatus *Liberibacter asiaticus* in Citrus?

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In addition to proteinogenic amino acids, plants also synthesize many non-protogenic amino acids. Some of these non-proteinogenic amino acids such as γ-aminobutyric (GABA), homserine, L-S-adenosylmethionine, and L-ornithine are important intermediates in plant metabolism and are found in most plants. Previous studies showed that some of these amino acids like GABA, canavanine, and β-aminobutyric (BABA) are implicated in plant defense against insect attacks. In fact, addition of GABA to artificial diets at levels found wounded plant tissues confirmed GABA is implicated in plant defense against herbivores. Overproduction of GABA in transgenic plants also increased their resistance to insect attack. The objectives of this study were (1) to identify the non- proteinogenic amino acids in citrus, (2) to determine their levels in different varieties, and (3) to study the effect of Asian citrus psyllids (ACP) and *Candidatus* Liberibacter asiaticus (*C*Las) on the production of these amino acids. The phloem sap or plant extract was dried under nitrogen stream and derivatized with methoxyamine hydrochloride (MOX) or N-methyl-(N-trimethylsilyl) trifluoracetamide (MSTFA) and analyzed with gas chromatography-mass spectrometry. Many non-protogenic amino acids were detected in citrus plants including GABA, BABA, p-amino benzoic acid (PABA), and putrescine. GABA was found to be the most abundant non- proteinogenic amino acids and its level was high in tolerant varieties. Interestingly, the level of GABA was induced in *C*Las-infected and ACP-infested plants. Understanding of the role of these non-protogenic amino acids in citrus defense against ACP and *C*Las may lead to the development of commercial varieties of tolerant citrus.

[C-17]

Movement of HLB Genetic Signal Within a Citrus Tree: More Questions Than Answers

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Transmission of HLB within a citrus tree has been assumed to take place exclusively through the phloem. However, several observations describe inconsistencies that cannot be reconciled with the phloem limited nature of *Candidatus* Liberibacter asiaticus. To test for the possible

transmission of *C*Las through non-phloem tissue, we carried out a series of grafting and girdling and slicing experiments that disrupted phloem transport in numerous ways. In addition, we tested selected sporophytic and gametophytic tissues and plant secretions that are either cytoplasmically isolated or connected only by plasmodesmata, (cytoplasmic channels orders magnitude smaller than *C*Las). The results indicate the movement of *C*Las (or its genetic elements) through the symplast in directions independent from the phloem flow.

[C-18]

Single and Multiple Modes of Action Insecticides for Control of Asian Citrus Psyllid and Citrus Leafminer

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Huanglongbing (citrus greening) and citrus canker diseases in Florida require effective control of their related insects Asian citrus psyllid *Diaphorina citri* Kuwayama and citrus leafminer *Phyllocnistis citrella* Stainton, respectively. Experimental and labelled insecticides alone and in mixtures were evaluated in summer 2014 in sprays on citrus trees infested with both pests. Significant pest control is reported ($P<0.05$). Mustang Max and Requiem alone or tank mixed in 5 gallons per acre (gpa) of water reduced psyllid nymphs and adults for 27 and 41 days, respectively. Sivanto reduced more nymphs than Requiem at 100 gpa volume and was similar in effect to most other treatments. Only these two treatments reduced leafminer at 7 days. In another study, the experimental premix A16971, tank mixes of A16971 + Agri-Mek and A16971 + Fulfill at 100 gpa water and Actara alone reduced psyllid nymphs and adults through 14 and 21 days, respectively, except for A16971 at 21 day while Actara alone provided control to 28 days. All treatments reduced CLM at 14 days. While insecticide mixtures improved control over single chemistry applications in some instances, the effect was inconsistent. Furthermore, mixtures select pest populations against multiple modes of action so that single mode of action applications are preferable for resistance management.

[C-19]

Asian Citrus Psyllid Monitoring Through Citrus Health Management Areas (CHMA)

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Citrus Health Management Areas (CHMA) were outlined as a critical component in the strategy to slow the spread of Huanglongbing (HLB) in Florida. Beginning in 2011, the United States Department of Agriculture (USDA) and the Florida Department of Agriculture and Consumer Services (FDACS) began a statewide scouting effort to monitor Asian citrus psyllid (ACP) populations. Scouting is conducted in all major citrus producing counties in Florida. There are

between 5,500 and 6,000 grove blocks inspected on a three-week cycle. Using the data generated from the USDA and FDACS scouting, the effectiveness of ACP control measures can be studied and future CHMA activities can be tentatively planned. The economic benefits of CHMAs have been analyzed and shows citrus production within active CHMAs has declined at much slower rate, compared to production in CHMAs with high ACP populations.

[C-20]

Citrus Canker and Greening: A Florida Grower's Perspective

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There have been many outbreaks of citrus canker, caused by *Xanthomonas citri,* in Florida. The first significant find was in 1912 in Manatee County and after burning millions of trees the disease was declared eradicated in 1933. Reoccurrences occurred in 1986 in Manatee and a separate introduction in Miami in 1993. Huanglongbing, or citrus greening was first discovered in southern Dade County by the Department of Plant Industry in August 2005. Both diseases have caused significant reductions in the area planted and overall citrus production. Citrus greening, which is vectored by the Asian citrus psyllid is an ever increasing threat to Florida's signature industry, since all varieties are susceptible, there is no absolute cure, and recent estimates show that 100% of groves are infected. After the Department of Agriculture eradicated 13 million tress infected with citrus canker in 2004-05 at a cost of $850 million, the disease was declared endemic and growers are now "living with" both canker and greening. The author attempts to offer practical strategies for control or tactics to mitigate the symptoms of infection that can improve tree health under specific circumstances. Canker and greening are treated separately.

[C-21]

Recommendations Based on the Florida Citrus Rootstock Selection Guide Using a Web-Browser Application of Artificial Machine Intelligence

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The Third Edition of the Florida Citrus Rootstock Selection Guide was recently released online at flrootstockselectionguide.org. This website is a valuable resource containing updated information on rootstock options. The site is unique because several technologies support the rootstock table, including 1) an interactive online version of the table; 2) an extensive bibliography containing more than 100 rootstock references, and 3) an expert system to help users hone in on the best candidates. The expert system is a backward-chaining platform that interviews users about their requirements. The system uses heuristic rules processed by an inference engine to evaluate the best candidate rootstocks based on the user's criteria. The results

are presented in an ordered list from top to bottom listing all rootstocks for consideration. The expert system is based on the Exsys Corvid® development environment for Macintosh, which has the advantages of providing robust development features at reasonable cost. We present the expert system, provide details on the development process and discuss the results of several focus group presentations to get real-world user feedback.

[C-22]

Economics of Existing and New Citrus Plantings in Florida

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Florida ranked first in the U.S. in terms of orange production during 2015. However, a bacterial disease known as citrus greening, or Huanglongbing (HLB), is jeopardizing the Florida citrus industry by reducing yield, fruit size and quality while simultaneously increasing tree mortality and production costs. HLB was first detected in Florida in 2005 and currently 90% of the acres of citrus operations across the state are infected. Yield has decreased, on average, by 41% since the onset of the disease. No economically viable option has yet been found for managing HLB-infected trees. Even though citrus prices have been increasing in recent years, the drastic impact of HLB on yield and costs of production have led to questions about the economic viability of citrus production and the return on investment of new citrus plantings in Florida. In fact, USDA-NASS data shows citrus trees replanting rates have been lower than mortality rates for the past few years, further contributing to the state's industry decline. Therefore, the purpose of this paper is to examine the economics of existing and new citrus plantings under the current HLB-endemic conditions. Given the perennial nature of citrus, such investment decision is analyzed using a multi-year framework, namely, the Net Present Value (NPV). The results of our analysis should be useful to citrus growers, stakeholders and policy makers.

[C-23]

Determining the Size Exclusion for Nanoparticles in Citrus Leaves

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Implementation of nanotechnology in agriculture is intimately dependent on the capacity of nanoparticles (NPs) to move within the plant body and reach the targeted cells. Although the fibrillar nature of the plant cell wall permits the movement of molecules through its porous matrix (apoplast), the movement of particles through the aqueous apoplastic milieu has its size limitations given the tightly knitted cellulose/hemicellulose fiber structure. In the present study,

we used fluorescent NPs of different composition and sizes, and followed their movement into citrus leaves by fluorescent microscopy. Our results indicate that in citrus leaves, the size exclusion limit for NPs is of approximately 5.4 nm. This conclusion was based on the capacity of PAMAM dendrimers G-4 and G-5 (4.5 and 5.4, respectively) to move through the cell wall and into the phloem, but failure of similar PAMAM dendrimers G-6 (6.7 nm) to move through the apoplast. Dendrimer NP's 5.4 nm and smaller were observed to penetrate the leaf tissue, and then taken up and mobilized by the phloem elements. The current study provides evidence on the size limit for NPs use in agriculture and especially in citrus trees.

[C-24]

Early Diagnosis of Huanglongbing Disease in Citrus Seedlings

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Citrus greening, or Huanglongbing (HLB) is a destructive citrus disease with no effective treatment that annually costs the state of Florida one billion dollar in lost output and over 8,000 jobs. HLB pathogen '*Candidatus* Liberibacter asiaticus' grows in the host's phloem and affects the plant vascular system. Starch accumulation on infected citrus leaves is the earliest HLB symptom, which may often be confused with the deficiency of certain nutrients such as zinc or magnesium. In this study, a vision based sensing system was developed using the polarized imaging concept to identify HLB symptom on citrus seedling leaves and to determine the level of infection. Citrus seedlings were exposed to Asian citrus psyllid (*Diaphorina citri* Kuwayama) that is the etiologic agent of HLB. Polarized images of exposed and control seedlings were acquired using the proposed imaging system after the seedlings were exposed to the Asian citrus psyllid in two repetitions: first one month after the exposure; and second time three months after the exposure. The leaf samples were examined by a qrt-PCR test to confirm their existence of HLB pathogen and to determine their level of infections. Four HLB positive subclasses of questionable, weak, moderate, and strong positive were defined according to the results of qrt-PCR test. Textural features were extracted from the images and a pairwise classification was conducted using a support vector machine classifier to assess the classification between each pair of subclasses. The results showed that the proposed method was able to identify HLB infection, and the level of infection one month after exposure to the citrus psyllid with average accuracies of 83.29%, and 73.83%, respectively. However, three months after the exposure, the average accuracies increased to 87.18%, and 89.93% for HLB diagnosis, and identification of the level of infection, respectively. Since propagation of clean nursery materials is critical to disease mitigation, early diagnosis of HLB-positive seedlings will be an effective strategy in citrus nursery systems.

2016 Handling and Processing Abstracts

[HP-1]

Demonstrating Modified Atmosphere Packaging (MAP) Feasibility for Mango Export

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This study was conducted to demonstrate the feasibility of incorporating modified atmosphere packaging (MAP) technology with optimum O_2 and CO_2 into existing mango handling systems. This has the potential to better maintain the quality of fully mature mangos for the extended transit periods required for export from South America to consumers in the USA. 'Ataulfo', 'Tommy Atkins', and 'Kent' mangos were packaged in either Apio Breatheway MAP bags or NOW Plastics perforated bags (control) at a commercial mango packinghouse in Nayarit, Mexico. Each bag held approximately 4 kg of fruit and was placed within a standard mango shipping carton. The mangos were maintained in better quality in the MAP bags than in the perforated (control) bags in separate commercial truck shipments and temporary storage (8-13°C) from Mexico to Florida plus additional storage (12.5°C) in Florida totaling 3 weeks to simulate long-distance shipping from South America. Mangos in the same packaging treatments held in Mexico for 3 weeks at 12.5 °C showed similar results. The atmosphere that developed in Apio Breatheway bags varied among the three mango varieties. This study also demonstrated in the 'Ataulfo' shipment that MAP can prevent development of '*corte negro'* in mangos, a symptom of chilling injury. The use of MAP showed potential to help maintain mango quality during 3 weeks simulated shipping plus shelf life.

[HP-2]

Harvest Maturity and Storage Temperature Affect Postharvest Quality of Greenhouse-Grown Datil Hot Pepper

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Datil hot pepper (*Capsicum chinense)* has the potential for increased production due to its unique, spicy flavor and aroma. However, little data has been published related to postharvest handling characteristics. The purpose of this study was to determine the effect of harvest maturity on postharvest quality during storage under simulated commercial conditions. Datil

peppers ('Wanda' selection) were grown hydroponically under protected culture. Fruit harvested at yellow and orange maturity stages were packed in vented clamshell containers, stored at 2, 7 or 10 ˚C and subsamples were transferred at weekly intervals to 20 ˚C for 24 hr prior to quality analysis. Peppers harvested at yellow stage maintained higher quality than orange peppers during storage at all temperatures. After 22 d storage plus 1 d at 20 ºC, marketability for yellow-stage pepper was 2 ˚C = 94%, 7 ˚C= 88%, and 10 ˚C = 91%, and for orange-stage pepper was 68%, 74%, and 82% for the same respective temperatures. Initial moisture content was slightly higher for pepper harvested at yellow stage (83 %) than at orange stage (81%), and the former remained higher during storage with no effect by storage temperature. There were no differences due to harvest maturity or temperature for weight loss (4.5 %), total titratable acidity (0.37 %) or pH (5.48). Respiration rate varied with temperature but not by harvest maturity: 2 ˚C=12, 7 ˚C=20, 10 ˚C=24 and 13 ˚C=35 mg $CO_2 \cdot kg^{-1} \cdot h^{-1}$. Soluble solids content was higher when harvested at orange stage than yellow stage (10.2 and 8.3 ˚Brix, respectively).

[HP-3]

The Effect of Controlled-Release CLO_2 on the Preservation of Grapefruit

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The effect of controlled-release ClO_2 gas on the safety and quality of grapefruit was studied. Three different tests were run: 1) isolated peel tissue with microorganism inoculation in a chamber system; 2) individual fruit with microorganism inoculation in a chamber; and 3) boxed fruit under commercial conditions. For the peel tissue test, a freshly isolated healthy peel section (1 cm × 1 cm), inoculated with 20 µL of either *Escherichia coli* (6.28 logs) or *Penicillium digitatum* (6.16 logs), or a *Xanthomonas citri* naturally inoculated peel section (with citrus canker lesions), was incubated in a chamber containing a dose equivalent to 10**,** 50 or 100 mg/L of pure ClO_2 as an antimicrobial agent. After 24 h, microbial growth was *reduced* significantly, and the lowest dosage of 10 mg/L reduced the population of *E. coli*, *P. digitatum* and *X. citri* by 5.83, 5.87, and 3.30 logs, respectively. The highest dosage caused tissue bleaching (phytotoxicity). The effects were confirmed on intact fruit at even lower doses. For the simulated commercial experiment, fruit were harvested in late October, passed through a commercial packing line, and packed in $4/5^{th}$-bushel boxes. ClO_2 packets were attached to the top lids with the following 5 treatments: fast-release, slow-release, slow/fast-release combination (each containing 14.5 mg of pure ClO_2), double dose fast-release (containing 29 mg of ClO_2), and control. The highest concentrations in the headspace of the boxes at 10°C were 0.8, 0.2, 0.5, and 1.5 ppm in fast-release, slow-release, slow/fast-release combination and double dose fast-release treatments, respectively, which were reached in the initial two days. The concentrations decreased to 0.19, 0.02, 0.11, and 0.42 ppm, respectively, by day 10, and decreased to barely detectable levels after 28 days in all dosages. After 6 weeks of storage at 10°C (to simulate

storage and transportation) + 1 week of storage at 20°C (to simulate retail market), the antimicrobial activity following treatment with ClO_2 was analyzed. The slow-release treatment at standard dose exhibited the best antimicrobial activity, reducing total aerobic bacteria count (TBC) and yeasts/molds count (YMC) by 0.95 and 0.94 log CFU/g, respectively. Fruit were evaluated for visual quality, peel disorders (browning), stem-end rot, and sensory quality. The slow-release treatment at single dose exhibited the best visual, sensory, and overall quality.

[HP-4]

Use of Carvacrol and Thymol to Inhibit Growth of *Lasiodiplodia Theobromae in Vitro* and Control Stem-End Rot on 'Ruby Red' Grapefruit

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Stem-end rot (SER), caused by *Lasiodiplodia theobromae* (Diplodia), is often the most important postharvest disease of fresh citrus fruit in warm, humid regions such as Florida. This disease is exacerbated by commercial degreening practices used to improve peel color of early season fruit. Essential oils are aromatic oily liquids obtained from plant organs that have been used to control plant diseases and may have direct antifungal activity and/or induce plant systemic acquired resistance that may reduce development of postharvest decay. This study evaluated the activity of thymol and carvacrol against Diplodia *in vitro* and on 'Ruby Red' grapefruit inoculated with Diplodia. In amended agar medium, *in vitro* tests demonstrated that both essential oils were effective in inhibiting mycelial growth of Diplodia. Half-inhibition concentration of carvacrol and thymol against mycelium growth was 0.036 and 0.028 mg/mL, respectively. Carvacrol and thymol were also mixed in a commercial shellac wax to determine their curative and preventive activities against Diplodia SER. Fruit were artificially inoculated with Diplodia before or after wax application and incubated at 29°C with 90% relative humidity for 48 h. For curative activity, coating fruit with shellac containing 5 mg/mL of carvacrol or thymol inhibited lesion development by 50% or 36%, respectively, compared to coating with shellac alone. For preventive activity, coating fruit with shellac containing carvacrol or thymol inhibited lesion development by 42% or 21%, respectively, compared to coating with shellac alone. Carvacrol and thymol could provide a viable alternative to conventional control of Diplodia SER on citrus fruit.

[HP-5]

Recovery of Pectic Hydrocolloids and Phenolics from Dropped Hamlin Fruit

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Citrus fruit drop has dramatically increased concomitantly with continued declining tree health and crop harvest size caused by HLB infection. This loss of harvestable fruit has been detrimental to both growers and processors. If this fruit could be recovered and converted to alternative value added products the citrus industry would benefit. Therefore, we have explored the potential of using this fruit as a feedstock in our newly developed pilot scale continuous steam explosion process. This new process releases highly functional pectic hydrocolloids and several major classes of phenolic compounds from their intracellular entrapment allowing them to be recovered by a simple water wash. It also facilitates the recovery of limonene. To explore the potential of this process to gain value from dropped fruit we collected dropped Hamlin fruit from the USDA, Fort Pierce, Picos Rd. farm in December of 2014. Approximately 250 kg of dropped fruit was collected. Whole fruits (~130 kg) were converted to steam exploded tissue using our continuous pilot scale process. Sugar composition of raw fruit and steam exploded mass was determined. Recovered pectic hydrocolloids and phenolic compounds were characterized. Pectic hydrocolloids comprised 7.8% of the dry material in the dropped fruit. Following the steam explosion process nearly all of the pectic hydrocolloids were recoverable. The pectic hydrocolloids could be functionalized in-situ or separated from the milieu. In addition, ≈40% of the polymethoxylated flavones, ≈10% of the flavanone glycosides, ≈85% of the limonoids and nearly ≈100% of hydroxycinnamates were recovered with the water wash.

[HP-6]

Sugar Analysis of Commercial Citrus Juice Products

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Citrus juice is one of the most popular fruit juices in the market. During 2013 and 2014, under a citrus juice nutrition and quality monitoring program, the sugar composition and concentrations of 330, 35 and 15 samples of commercial 100% orange juice (OJ), 100% grapefruit juice (GJ), and orange juice beverages (OJB, a diluted OJ), respectively, were analyzed using a high performance anion exchange chromatography system coupled with pulsed amperometric detection. Glucose, fructose and sucrose were detected from all products. The average concentration of glucose, fructose and sucrose of OJ was 5.1, 5.8, and 10.5 g/8 fl. oz., respectively. The average total concentration of sugars in all tested OJ was 21.4 g/8 fl. oz. with a range of 15.9 to 26.2 g/8 fl. oz. For tested GJ, the average concentration of glucose, fructose and sucrose was 5.9, 6.4 and 6.6 g/fl. Oz., respectively. The average total concentration of sugars in GJ was 18.8 g/8 fl. oz. with a range of 16.2 to 22.1 g/8 fl. oz. The less total sugar levels in GJ compared to OJ were largely due to lower sucrose levels in GJ. The ratio of glucose:fructose:sucrose was about 1:1:2 for OJ, and about 1:1:1 for GJ. For 15 tested OJB samples, the average concentration of glucose, fructose and sucrose was 2.2, 2.4, 4.8 g/8 fl. oz., respectively, and the average total concentration of sugars was 9.4 g/8 fl. oz.

[HP-7]

An HPLC-ESI-MS Analysis of Banana Peel Phenolics

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Banana peels are rich in many nutrients which allow for their use as food ingredients and biofertilizers in tropical agriculture. The phenomenon of rapid peel browning is a common occurrence, and is attributable to the peel's high polyphenol oxidase enzyme activity and high levels of polyphenols. An analysis of methanolic extracts of banana peel show a wide diversity of polyphenols, including proanthocyanidin oligomers (n 1- 4) and polymers, ferulic acid and *p*-coumaric acid conjugates, and flavonoids. The analysis of these classes of compounds is facilitated by separations accomplished with LH20 chromatography. The flavonoids, which comprise the minor portion of polyphenols, occur mainly as flavonol glycosides, including conjugates of myricetin and quercetin. The numerous isomers of ferulic and *p*-coumaric acid conjugates (each n > 6) occur as high molecular weight compounds (690 and 632 amu, respectively), and their mass spectra exhibit similar patterns of neutral losses, suggesting that they occur with similar side groups. Infrared and NMR spectroscopy will be used to identify the structures of these compounds. The tentative structures and degrees of polymerization of the proanthocyanidins are analyzed by electrospray ionization mass spectrometry. This is further facilitated by separations of these complexes by normal phase thin layer chromatography. This study illustrates the diversity of the polyphenols in banana peel, and is supportive of the use of this portion of the fruit as a high antioxidant food ingredient.

[HP-8]

Postharvest and Sensory Evaluation of Selected 'Hass' - 'Bacon' Avocado Hybrids Grown in East-Central Florida

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Avocado (*Persea americana* Mill.) is a high-value fruit that continues to increase in consumer demand. A population of 'Hass'-'Bacon' hybrids was planted at USDA-ARS, Fort Pierce as part of a study to find selections with good horticultural and postharvest quality traits for Florida. Extensive phenotypic data on quality (fruit weight, size and diameter, dry weight, fruit and pulp firmness, oil content, seed weight, number of fruits per tree, and peel color) was collected over the past three years. Ten selections were identified in 2014 and 2015 with promising fruit quality and postharvest shelf life characteristics, and were tested in sensory panels using store-bought 'Hass' as the standard. Avocados are rich in the monounsaturated fatty acid oleate, which was the most abundant fatty acid (40- 45% of total) found in both years for evaluated selections. In

general, the selections had fruit quality similar to commercial 'Hass'. Avocados that were most liked were described as creamy in texture, and buttery and nutty in flavor. Only one selection (R7T54 in 2014) and a store-bought control ('Hass' in 2015) were disliked, which was associated with greater firmness at the time of evaluation, likely relating to a lack of ripeness. Furthermore, the minimum oil content and dry matter percentages required at harvest in California were achieved in these selections under Florida conditions. This study identified nine selections with sensory quality as good as 'Hass' and suitable for further testing and development as potential Florida cultivars.

[HP-9]

A Comparison of Physical and Chemical Attributes of Strawberry Cultivars and Advanced Breeding Selections from the University of Florida

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Postharvest performance is an important consideration when developing a new strawberry cultivar. The objectives of this study were to evaluate the quality of advanced strawberry selections and compare them to commercial cultivars. 'Florida Radiance' and Sensation® 'Florida127', and six advanced selections from the University of Florida breeding program were evaluated over seven harvests. Each cultivar and advanced selection was evaluated for appearance, weight loss, texture, soluble solids content (SSC), acidity, total phenolics (TPC) and ascorbic acid (AA) on the day of harvest and after a 7-day storage period at 2°C. On average, 'Florida Radiance', FL 10-166 and FL 12-5-103 scored higher for appearance at harvest; however, FL 12-5-103 had the best appearance after storage and also the least amount of weight loss. FL 12-26-49 was the firmest strawberry at harvest and remained the firmest after the 7-day storage period. FL 12-70-55 had the lowest SCC after storage despite having the highest initial SSC. The highest titratable acidity was measured in FL 12-55-220, FL 12-70-55, and FL 12-121-5 on the day of harvest. The highest TPC was measured in FL 10-166 which also had the highest TPC at the end of storage. Compared to the other strawberry genotypes, FL 12-55-220 maintained the highest levels of AA throughout storage. Results from this study showed that there is a significant interaction between genotype and specific quality attributes. The results also provide information valuable to the selection process by identifying new genotypes with improved compositional attributes combined with suitable quality characteristics after cold storage.

[HP-10]

Can Appearance, Nutritional Quality, and Shelf Life of Navel Orange Fruit Be Enhanced by a Postharvest Heat Treatment?

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Postharvest heat treatments are being used on horticultural crops for controlling decay, improving quality, and extending storage life. Commercially mature Navel oranges (*Citrus sinensis*) were harvested in October and November 2015 and January 2016 and subjected to a hot water treatment of 45^{0}C for 30 min. After harvest, fruit were dipped for 30 seconds in a commercial fungicide (1,000 ppm thiabendazole) and the fruit harvested in October degreened with 3 ppm ethylene at 85^{o}F for 3 days. After treatment, the fruit were evaluated for appearance, nutritional quality and shelf life during 3 weeks of storage at 25^{0}C with 85% RH. The external color of fruit exposed to the heat treatment was significantly lighter, with greater chroma, and more orange hue than control fruit (25^{0}C for 30 min), which were yellowish and darker. Weight loss increased significantly during storage (above 10%), but with no treatment effect. Less decay (about 6%) was observed in fruit treated with 45^{0}C water for 30 min. None of the treatments significantly affected juice pH, titratable acidity, or total carotenoids. However, after storage, total phenolic and ascorbic acid contents in heat-treated fruit were more than 30% and 20% higher, respectively, compared to control fruit. Similar trends were noticed for total antioxidant capacity in hot-water-treated fruit. Therefore, this heat treatment can enhance fruit appearance and improve nutrient composition and shelf life of orange fruit, likely by modification of fruit internal atmospheres and slowing of respiration.

[HP-11]

Pretreatment of Olive Mill Waste Water by Power Ultrasound

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Olive cultivation and olive oil processing is a growing industry in Florida. Treatment of Olive Mill Wastewater (OMW) is considered one of the main problems facing olive oil industry. OMW is considered a strong industrial effluent as it contains 100-150 times more contaminants than domestic wastewater with Chemical Oxygen Demand (COD) levels up to 220 g/L. This study investigates using of power ultrasound process as a pretreatment step for oxidation processes (i.e., electo-fenton oxidation process) to reduce COD levels and total acidity to a level in OMW that allows potential reuse without affecting potentially valuable by-product. Direct and indirect power ultrasound treatments were conducted using high intensity ultrasonic processor (20 kHz) at constant power (750 W) over time. Maximum COD reduction was achieved using direct treatment for 90 minutes; all samples were significantly different compared to the control. After 90 minutes indirect treatment, total acidity reduced from 7200 mg/L to 4600 mg/L. There was no significant difference in free fatty acid content in all OMW samples after power ultrasound treatment, suggesting retention of valuable components was accomplished. In conclusion, these results would encourage industrial scale application of power ultrasound process as a pretreatment step in OMW treatment.

[HP-12]

High Power Ultrasound Treatment Effects on Process Yield Efficiency and Extra Virgin Olive Oil Characteristics

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High power ultrasound (HPU) provides rapid heating for olive (*Olea europaea*) paste and works to disrupt cell walls, potentially improving oil yield and reducing malaxation time without adversely affecting the quality criteria for extra virgin olive oil (EVOO). In this study, the effect of HPU treatment of olive paste was examined as a function of time and power, using two olive varieties, Arbequina and Frantoio, and bench-scale equipment. After treatment, oil yield was measured along with other quality indicators such as free acidity value, peroxide value, and purity (absorbance factor, K_{232}/K_{270}). Treatment by HPU increased the oil yield and the oil extractability for most time/power combinations. Quality degradation generally occurred at 8 and 10 min treatments but was not observed during shorter times. These results provide evidence that commercial scale HPU treatment can increase throughput with oil higher yields while preserving EVOO quality.

[HP-13]

Sensory and Physiochemical Fruit Quality of Three Seedless Mandarin (*Citrus reticulata* Blanco) Cultivars Grown on Three Rootstocks

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The popularity of mandarin (*Citrus reticulata* Blanco), or tangerine, fruit has been increasing due to its good flavor, convenient size and ease of peeling. Changing consumer preferences to seedless fruits and high nutritional value has created demand for development of new cultivars. ‘UFGlow’, ‘UFSunrise’, and ‘UFDawn’ are cold-hardy and seedless mandarin cultivars that were released in 2015 from the University of Florida breeding program. ‘UFGlow’ and ‘UFDawn’ were grown on ‘Rich Trifoliate’ (RTF), ‘Carrizo’ (CZO) or ‘HRS812’ rootstocks, while for ‘Sunrise’, ‘HRS812’ rootstock was replaced with ‘Sun Chu Sha’ (SCS). These cultivars were compared to standard, seeded ‘Owari-Satsuma’ mandarin and Orlando (tangelo) grown on ‘Carrizo citrange’ and ‘Cleopatra mandarin’, respectively at the same location. Following a two-year study, regardless of the rootstock, the three new cultivars were all rated as having optimal juiciness, less rag and being less chewy compared to ‘Owari-Satsuma’ and ‘Orlando’. Sensory panelists also preferred fruits of ‘UFSunrise’ on all rootstocks to ‘Owari-Satsuma’ on overall

liking, and mandarin flavor. 'UFSunrise on RTF was preferred in juiciness and texture to 'Owari-Satsuma'. 'UFGlow' on CZO had higher overall-liking than Orlando and higher texture liking than Satsuma. Other preference parameters of the new cultivars were equal to Satsuma and Orlando. 'UFDawn' was rated negative on external appearance. The average ascorbic acid content of 'UFGlow' (25.23 mg/100g) and 'UFSunrise' (19.27 mg/100g) on all rootstocks was higher than in 'Owari-Satsuma' (17.66mg/100g). Soluble solids content to titratable acidity ratio of 'UFSunrise' was noted to improve over the period of study from 13.9 (2014) to 17 (2015) as trees grow. In this study, the new seedless mandarin cultivar UFGlow and UFSunrise have demonstrated a high nutritional quality, and better consumer acceptability in terms of overall flavor, juiciness and being less chewy, which are important for its marketability.

[HP-14]

Postharvest Storage Temperature and Coating Effects on Fruit Quality of Red-fleshed Pitaya (*Hylocereus costarricenses*)

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Pitaya (dragon fruit) is a climbing cactus cultivated for its unique fruit. In Florida, red-fleshed pitaya are grown commercially and the market is expanding. Two tests were conducted to evaluate 1) optimum storage temperature and 2) effect of coating. Pitaya ('Lisa') were harvested in November, 2015 in Homestead, FL and samples were transported in a refrigerated truck overnight to the Postharvest Lab at the University of Florida in Gainesville. The next day fruit were sorted for uniformity of size and quality. For study 1, fruit were stored in the shipping cartons at 34°F (1°C) or at 39°F (4°C). After 10 and 20 days of storage, five fruit were transferred to 68°F (20°C) for 24 hours to allow for development of any chilling injury symptoms. For study 2 fruit were dipped in coating A (SF2981, vegetable oil-based) or coating B (EF6100, carnauba-based) and air-dried prior to storage at 45°F (7°C) for 20 days. Five fruit were evaluated every 5 days. Pitaya stored at 39°F exhibited less weight loss and better overall quality for dryness, percentage of yellow spot and appearance ratings. Pitaya stored at low temperature (34°F) had significantly less color changes over the storage period. No chilling injury was observed during storage. Visual quality of fruit from study 2 became unacceptable between days 10 and 15 of storage, where overall appearance rating was <3. Pitaya coated with Coating B had significantly less percentage weight loss than Coating A or the untreated fruit during storage.

[HP-15]

Validation of *E. coli* as a Surrogate for *Salmonella* spp. on the Surface of Gapefruit During Various Packingline Processes

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This research was initiated to determine the suitability of nonpathogenic *E. coli* as a surrogate for *Salmonella* in citrus packing line studies. Whole grapefruit were spot inoculated (100 ul) with either *E. coli* or *Salmonella* cocktails onto the equator (7 log CFU/grapefruit) and dried for 2 h. Treatments (n=6) were applied using a lab scale spray brush wash system. Fruit wetting treatments including ground water, and 200 ppm free chlorine, were applied for 2 min. Fruit washing treatments including ground water, 85 ppm peracetic acid (PAA), 85 ppm peracetic acid with an acidic detergent (XA15 additive), alkaline detergent (a fruit cleaner), and alkaline detergent with 2% sodium-o-phenylphenate (SOPP), were applied for 1 min followed by a 5 second water rinse. Control fruit were inoculated but not treated or treated but not inoculated. Fruit were placed in a sterile bag with 10 ml of Dey/Engley neutralizing broth, rubbed by hand for 1 min, and plated onto selective, and nonselective media. Log reductions for *E. coli* populations ranged from 2.7 (water wash) to 4.9 (chlorine wash), and for *Salmonella* ranged from 2.8 (water wash) to 4.9 (chlorine wash). In all treatments, bacterial population reductions between *E. coli* and *Salmonella* were not significantly different ($P \geq 0.05$), or significantly less than *Salmonella.* For *E. coli* to be considered an appropriate surrogate, it must exhibit a lesser or equal log reduction than *Salmonella* as a result of packing line treatments. Therefore, this study validates *E. coli* as a suitable surrogate for *Salmonella* in pilot plant studies.

[HP-16]

Isolation of Salmonella from South Florida Surface Waters

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Salmonella-contaminated surface waters may lead to preharvest produce contamination if water contacts the harvestable portion of the crop.The purpose of this study was to determine the baseline levels of *Salmonella enterica* in South Florida surface waters and the environmental factors associated with *Salmonella* presence. Water samples were collected monthly for ten months from eight study sites along canals in South Florida. Samples were analyzed for physical and chemical characteristics; enumerated for total aerobic plate count (TPC), total coliforms, generic *Escherichia coli* and *Salmonella. Salmonella* was isolated from 25% of samples (20/80). The concentration of *Salmonella* ranged from 0.5 to 3.0 log MPN/100ml. Populations of generic *E. coli* ranged from 0.0 to 2.8 log MPN/100ml. Populations of coliforms ranged from 2.7 to 5.2 log MPN/100ml. Aerobic plate counts were 3.8 to 6.1 log CFU/100ml. Turbidity was higher in *Salmonella*-positive samples (17.1 vs. 10.2 FAU).*Salmonella* populations are present in South Florida surface waters and cannot be predicted by total coliforms or generic *E. coli.*

[HP-17]

Fate of *Listeria Monocytogenes* on Fresh Cut Mangoes Stored at 3 Different Temperatures

Vijendra Sharma, Loretta M. Friedrich, and Michelle D. Danyluk, Citrus Research and Education Center, UF

Salmonella can internalize into intact 'Tommy Atkins' mangoes during postharvest heating and cooling treatments and can grow on fresh cut mangoes. Little research exists detailing the growth and survival of *Listeria monocytogenes* on fresh cut mangoes. The objective of this study was to evaluate the fate of *Listeria monocytogenes* on fresh (4, 12 and 20°C) cut mangoes. Cut 'Tommy Atkins' mangoes (10 g) were spot inoculated with a five-strain cocktail of *Listeria monocytogenes*. Inoculated samples were air dried, placed in sterile whirl-pak pouches and stored at 4 ± 2, 12 ± 2, and 20 ± 2 °C. Populations were enumerated on nonselective and selective media at days 0, 1, 3, 5, 7, 10, and 14 (4 ± 2, 12 ± 2 °C); 0, 1, 3, 5, and 7 (20 ± 2 °C). Population levels (log CFU/g) of fruit were calculated. *Listeria monocytogenes* survived, and occasionally grew over 14 days at 4, 12, and 20°C , on mangoes. Fresh cut mangoes are a potential vector for *Listeria monocytogenes* transmission.

[HP-18]

Effect of Packingline Processing on the Reduction of *Escherichia Coli* from Inoculated Grapefruit

Jiuxu Zhang, Indian River Research and Education Center, UF, Loretta Friedrich, Michelle D. Danyluk, Citrus Research and Education Center, UF, and Mark A. Ritenour, Indian River Research and Education Center, UF

Experiments were conducted to evaluate the removal of inoculated *E. coli* (as a surrogate for *Salmonella*) from grapefruit surfaces using packinglines located at UF/CREC, Lake Alfred, and at UF/IRREC, Ft. Pierce, FL. Individual processes were evaluated (fruit wetting, brush washing, pre-wax drying, and wax application plus drying) as well as running over the entire line. In addition, different chemicals (detergents), sanitizers (chlorine, peroxyacetic acid, sodium-o-phenylphenate), and waxes (shellac and carnauba ± morpholine) were used with the different processes.*E. coli* populations were reduced by various fruit wetting, washing, waxing, drying and the complete packingline processing treatments by 2.1 to > 4.5 log CFU/grapefruit under the IRREC packingline system, and by 3.2 to > 5.0 log CFU/grapefruit under the CREC packingline system. The reductions of background bacterial populations by various processes on grapefruit surfaces were 1.1 to 2.8 log CFU/grapefruit at IRREC, and 0.6 to 2.9 log CFU/grapefruit at CREC facility. Fruit pre-wetting, washing with water, or using a fruit cleaner, was less effective than sanitizer applications such as chlorine and peroxyacetic acid in removing *E. coli*. Waxing applications combined with subsequent drying resulted in > 4.5 log CFU/grapefruit reductions. Treatment of fruit through complete packingline processing at both locations reduced *E. coli* populations to levels below the detection limit (< 1 log CFU/grapefruit). Significant reductions

in *E. coli* populations on the surface of grapefruit can be achieved using processes typically found in Florida citrus packinghouses.

[HP-19]

Aflatoxins in Peanut-Enriched Flours from Selected Markets in Tanzania

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Peanut enriched complementary flour has been used as weaning food for infants in Tanzania due to its nutritional benefits especially in increasing the protein content to the flour. Studies indicated that peanuts in Tanzania were often contaminated with aflatoxin in ranges from 10.3 to 40.3 µg/kg, (maximum acceptable levels = 10 µg/kg for total aflatoxins). The objective of this study was to determine the levels of aflatoxins in peanut enriched flours from selected markets in Tanzania. Peanut enriched flour samples (n = 65, 17 manufacturers) from six regions of Tanzania (Arusha, Dar es salaam, Dodoma, Iringa, Kilimanjaro, and Morogoro) were collected and analyzed for aflatoxin B_1, B_2, G_1, G_2, and total aflatoxin by using reverse phase High Performance Liquid Chromatography (HPLC) and post column derivatization technique. Aflatoxins B_1, B_2, G_1, and G_2 were present in all samples in all six regions, and the levels of the aflatoxins were significantly higher in the samples from Arusha than in other regions ($p<0.05$). All samples from the seventeen manufacturers were contaminated with aflatoxins, and 71% of the products had total aflatoxins above the acceptable levels of 10 µg/kg. Aflatoxin B_1 was the most prevalent. Mean values of Aflatoxin B_1, B_2, G_1, G_2, and total aflatoxin levels were not affected ($P<0.05$) by packaging materials (i.e., paper with LDPE inside, Double LDPE, Hard LDPE, Paper with LDPE outside, and LDPE back seal poach). Manufacturers and consumers need education about source, effects and prevention of aflatoxins.

[HP-20]

Effects of Fungicides and/or a Heated Solution Dip on Fruit Quality and Shelf Life of Grapefruit Stored at Ambient or Chilling Temperatures

Jian Li, Indian River Research and Education Center, UF, Anne Plotto, Elizabeth Baldwin, Jinhe Bai, USDA-ARS Horticultural Research Laboratory, Fort Pierce, FL, and Mark A. Ritenour, Indian River Research and Education Center, UF

Thiabendazole (TBZ) and imazalil (IMZ) are the most common postharvest fungicides used in Florida to control decay of fresh citrus. Heat treatments are another effective and environmentally safe treatment that can reduce postharvest decay. In this work, the effects of dipping grapefruit in heated or ambient solutions of these fungicides on fruit quality and storage life were investigated. 'Marsh' grapefruit were dipped for 120 seconds in an ambient (77F) or

heated (127F) solution containing 1000 ppm TBZ or IMZ. Fruit were then stored at 40F (chilling) or 50F (optimum) for 7 weeks and then fruit quality, chilling injury and decay were evaluated. As expected, both TBZ and IMZ controlled decay but had no effect on chilling injury, while heat treated fruit had 36% less chilling injury than unheated fruit. Heated fungicide treatments decreased postharvest decay by 45% after 7 weeks storage compared to fruit dipped at ambient temperature. For internal quality, fruit stored for 7 weeks at 40F had 5.8% lower juice content and 4.0% lower Brix/acid ratio than fruit stored at 50F. In addition, heat-treated fruit had 2.6% increased Brix and 4.8% less acid compared to those dipped in ambient solutions. The IMZ treatment alone reduced fruit Brix by 2.6%, whereas the heated IMZ treatment increased fruit Brix by 3.6% compared to the ambient IMZ alone.

[HP-21]

Quality Assessment of Ugali Blended with Orange-fleshed Sweet Potatoes to Fight Against Vitamin A Deficiency in Tanzania

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Thirty-eight percent of Tanzanian children (6 to 59 months) have vitamin A deficiency (VAD), and the majority of them cannot afford vitamin A fortified food. Orange-fleshed sweet potatoes (OFSP), a new crop in Tanzania, are rich in β-carotene, and could be a cheap intervention for VAD. The objectives of this study were to develop ugali (stiff maize porridge) fortified with OFSP, to estimate its ß-carotene content (using color measurement), and to assess its proximate composition and consumer acceptability. Ugali was prepared (n = 3 replications) using maize flour with various amounts of OFSP (Jewel variety) (0, 30, 50, 70 and 100%). The ugali was evaluated for color (Chromameter, expressed as L* a* b*), proximate composition (AOAC) and sensory qualities, using a consumer panel (n = 181). Data revealed that ugali with higher levels of OFSP had higher a* and b*. β-carotene increased as the OFSP amount increased. The correlation between β-carotene and b* was higher (R^2 =0.74) than the correlation between β-carotene and a* (R^2 =0.74). The proximate compositions of ugali with different amounts of OFSP were different (p <0.05). Adding OFSP to ugali increased its sensory scores, and the ugali with 50% OFSP was favorably rated by Tanzanian consumers. Fifty percent OFSP: fifty percent maize was selected to estimate consumer-level consumption, and this sample was shown to potentially supply more than 50% RDA of provitamin A for a specific age group. We expect this method to be simple, affordable, and effective in reducing VAD in Tanzania.

[HP-22]

RNA-Sequencing Analysis of the Abscission-Related Transcriptome in the Citrus Calyx Abscission Zone of HLB-Affected Sweet Orange

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To understand the mechanisms underlying HLB-associated pre-harvest fruit drop, the transcriptome in the citrus calyx abscission zone (AZ-C) was analyzed and compared for asymptomatic 'Hamlin' fruit harvested from asymptomatic trees (A), fruit dropped from HLB-symptomatic trees upon shaking the trees (D), and fruit retained on HLB-symptomatic trees after shaking the trees (R). The AZ-C tissue was excised from 20 fruit (randomly selected from each of the 6 replicate batches of A, D or R fruit from the two harvests) and used for RNA-sequencing analysis. Comparison of the transcriptomic profiles revealed 1209, 1739 and 927 significantly differentially expressed genes between D and R, D and A, R and A, respectively. Gene ontology (GO) and KEGG pathway enrichment analysis of the significantly differentially expressed genes indicated that response to stimulus, plant-type cell wall modification and secondary metabolism were among the significant biological processes involved in HLB-related fruit abscission. The most significant GO term was 'response to chitin, while among KEGG pathways, 'alpha-linolenic acid metabolism' was the most significant, of which the product is jasmonate. Consistently up-regulated genes in D versus R and A included genes related to biotic stress, lipid metabolism, secondary metabolism, whereas genes related to carbohydrate metabolism, cell wall (cellulose synthesis and cell wall modification) were consistently down-regulated. In the hormone category, genes related to synthesis and signaling of ethylene and jasmonate were consistently up-regulated, while abscisic acid (ABA), auxin, brassinosteroid, cytokinin, and gibberellin were down-regulated. The gene expressions for hormone related genes and chitinase genes were validated by qRT-PCR.

[HP-23]

Effect of Foliar Nutrition and Insecticides on Quality of Orange Juice Affected by Huanglongbing: Chemical Analysis

Elizabeth Baldwin, Jinhe Bai, Anne Plotto, John Manthey, Smita Raithore, Sophie Deterre and Wei Zhao, USDA-ARS Horticultural Research Laboratory, Ft. Pierce, FL, and Phil Stansly, Southwest Florida Research and Education Center, UF

'Valencia' orange trees were treated with insecticide (*I*), a nutritional spray (*N*), insecticide plus nutritional spray (*I*+*N*) or not treated for controls (*C*) and harvested in April, 2013, 2014 and 2015, juiced and the juice frozen for later chemical and sensory analyses (companion paper). Titratable acidity (TA), solids/acid ratio (SS/TA), many volatiles, flavonoids and limonoids showed differences due to season, while SS, some volatiles (ethanol, *cis*-3 hexenol, α-terpinene, ethyl acetate and acetone), flavonoids (isokuranetin rutinoside) and limonoids (limonin, nomilin

and nomilinic acid glucoside) showed differences due to treatment. There was not a lot of consistency for differences among seasons. TA tended to be higher in *N* the first two seasons and SS, and SS/TA higher in *I* or *I+N* for all seasons (not always significant). Bitter limonoids tended to be higher in *I* or *I+N* the first two seasons and *I+N* the last season, but at much different levels. Principal Component Analysis showed that there was good separation by season. For 2013, *I* and *I+N* were associated with some volatiles, *C* with SS/TA and sensory perception of sweetness and *N* with many flavonoids and bitter limonoids along with sensory perception of bitterness and sourness. For 2014, *C* was associated with sweetness, *N* with flavonoids and *I* and *I+N* with bitter limonoids and sensory perception of bitterness. For 2015, *C* and *I+N* were associated with bitter limonoids and bitterness, while *I* and *N* were associated with volatiles, sugars and *I+N* somewhat with sugars and sensory perception of sweetness.

[HP-24]

Effect of Nutritional and Insecticidal Sprays on the Quality of 'Valencia' Orange Juice: 2. Sensory Evaluation

Anne Plotto, Elizabeth Baldwin, Jinhe Bai, John Manthey, Smita Raithore, Sophie Deterre, Wei Zhao, USDA-ARS Horticultural Research Laboratory, Ft. Pierce, FL, and Phil Stansly, Southwest Florida Research and Education Center, UF

A 3-year study was undertaken to establish the effect of field nutritional sprays, combined or not with insecticide treatments against Asian Citrus psyllid, on the fruit quality of 'Valencia' orange trees affected by the greening disease Huanglongbing (HLB). Four replicated plots were harvested, juiced and pasteurized. Nine to 12 trained panelists evaluated the juice using 7 flavor, 5 taste, 4 mouthfeel and 3 aftertaste descriptors. There was little difference between treatments in 2013; only orange peel flavor and bitterness were significantly lower for the insecticide treatment. In 2014, positive attributes such as orange flavor, fruity flavor, sweetness and mouthfeel were significantly higher in the insecticide treatment. Sourness was highest in untreated control, and there was no difference between treatments for bitterness. In 2015, negative attributes such as grapefruit, orange peel and typical HLB flavor, sourness, bitterness and astringency were significantly higher in untreated control fruit, suggesting perhaps the beneficial effect of nutritional and insecticide treatments was cumulative and was only distinguishable in the third year of the study.

Krome Memorial Section Abstracts

[K-1]

Laurel Wilt—An Update on the Disease's Impact on South Florida's Avocado Industry

Jeff Wasielewski, UF/IFAS Miami-Dade County Extension, Jonathan Crane, and Daniel Carrillo, Tropical Research and Education Center, UF

Laurel wilt is disease that affects plants in the *Lauraceae* causing a tree's xylem to shut down followed by rapid wilt and sudden death. It is caused by the fungus, *Raffaelea lauricola*, that was introduced, along with its original vector, the redbay ambrosia beetle, *Xyleborus glabratus,* to the United States in May of 2002 in Port Wentworth, Georgia. *Raffaelea lauricola* has now moved south from Georgia through Florida and as far west as Texas decimating over a half a billion native Lauraceae plants. *Xyleborus glabratus* was first detected in South Florida in 2010, with the first *Raffaelea lauricola* found in an avocado grove in 2012. While *Xyleborus glabratus* is the primary vector for native Lauraceae, other ambrosia beetle species have picked up *Raffaelea lauricola* and are thought to be the main vectors of *Raffaelea lauricola* within avocado groves. Roughly 2% of the 7,000 acres of avocado groves in South Florida have been destroyed due to this disease, and there is no known cure. Current recommendations include excellent horticulture, vigilant grove scouting, and immediate removal and destruction of infected trees. Other techniques being used to combat this disease are thermal imaging, detector dogs, fungicide injection and infusion, and root trenching.

[K-2]

Current Management Recommendations for Laurel Wilt in Avocados

Jonathan Crane, Daniel Carrillo, Randy Ploetz, and Edward Evans, Tropical Research and Education Center, UF, Jeff Wasielewski, UF/IFAS Miami-Dade County Extension, and Don Pybas, Avocado Administrative Committee, Homestead, FL

The laurel wilt pathogen [(*Raffaelea lauricola* (*Raf*)] causes a lethal disease to at least nine woody Lauraceae in Florida, including avocado (*Persea americana*). The initial vector for this pathogen, the redbay ambrosia beetle (*Xyleborus glabratus*), was detected in Miami-Dade County in 2010, during 2011 dying native swampbay (*Persea palustris*) trees were positive for *Raf* and in early 2012 the first avocado tree to succumbed to *Raf* in a commercial grove. At least two other ambrosia beetle (AB) species have now been implicated as the main *Raf* vectors in commercial avocado groves. Recommendations for controlling the spread of laurel wilt (LW) has four components, early detection through scouting, sanitation of affected trees, prophylactic systemic fungicide treatments and ambrosia beetle control. Currently early detection consists of an industry-wide helicopter survey every 6 to 8 weeks to identify groves with trees suspected of LW. This information is provided grove owners and managers. Frequent ground-based scouting

is also employed. In groves where LW has not previously been detected, sampling is recommended for verification; in groves previously positive for LW no sampling is warranted. Sanitation procedures include immediate removal and destruction of LW affected trees by uprooting or grinding, chipping, and/or burning. Prophylactic fungicide treatments consist of infusion of propiconazole to entire groves or trees adjacent to LW affected trees (called hot spot treatment). Ambrosia beetle control consists of bark directed applications of chemical and/or biological insecticides within one acre of LW affected trees.

[K-3]

The Oriental Fruit Fly Eradication Program in Miami-Dade County—Why it Worked

Jeff Wasielewski, UF/IFAS Miami-Dade County Extension, Jonathan Crane, and Daniel Carrillo, Tropical Research and Education Center, UF

In late August of 2015, an unprecedented number of Oriental fruit flies (OFF) were found in the agriculturally rich area of Homestead, FL. Previous detections of this destructive pest in Florida were limited to no more than a few flies which were quickly trapped and destroyed. The number of flies found, combined with a find of live larvae in fallen fruit, prompted the Oriental Fruit Fly Eradication Program and an 85 square mile quarantine (which would eventually grow to 98 square miles). The Oriental fruit fly, *Bactrocera dorsalis*, is taken extremely seriously because the species has a host list of well over 400 plants including most of the fruit and vegetables grown in South Florida, as well as some ornamental plants. The quarantine began on September 2, 2015 and ended on February 13, 2016, after the OFF was successfully eradicated from the Homestead area. The OFF eradication program worked because it brought together the Florida Department of Agriculture and Consumer Services–Division of Plant Industry, USDA-APHIS-Plant Protection Quarantine, the University of Florida, Miami-Dade County's UF/IFAS Extension, the Miami-Dade County government, and the entire agricultural industry of South Florida to work towards a common goal. The collaboration and dedication of these agencies and institutions, along with the incredible response from the entire agricultural industry of South Florida and the highly effective trap and kill program used by the USDA and FDACS were crucial in eradicating the Oriental fruit fly from South Florida and saving the billion dollar Miami-Dade County agricultural industry.

[K-4]

Evaluation of Postharvest Treatments on Avocado for the Oriental Fruit Fly

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A recent detection of the Oriental Fruit Fly (*Bactrocera dorsalis* Hendel, Diptera: Tephritidae) in the Redland area in south Florida triggered a quarantine that restricted the movement of fruit fly host material, including fresh avocado, in approximately 99 square miles. The quarantine affected 1,900 acres of commercial avocado groves. Approved post-harvest treatments for *B. dorsalis* and avocado included in the USDA treatment manual were acceptable for immediate certification and movement of fresh avocados from the quarantine area. However, it was unknown if Florida avocados would meet quality standards (US combination grade) after the treatments. We tested three post-harvest treatments that combine methyl bromide fumigation and cold storage periods on six avocado varieties from Florida. The treatments differed in the duration of the fumigation (2.5, 3 or 4 h) and cold treatment (4 d at 40º ºF, 3 days at 47 ºF and no cold treatment) periods. A seven-day transit period at 47ºF was added to account for the time when the fruit leaves the packing house until it is sold by retailers. None of the six varieties met the US combination grade after the treatments and transit period. Treated fruit exhibited both internal (pulp) and external (skin) damage. Damage was attributed to the fumigation component of the treatment, the six varieties tolerated the cold storage. Damage by fumigation ranged from 26-100%, in general, the longer the fumigation period the worse the effect. The need for alternative post-harvest treatments for Florida avocados is discussed.

[K-5]

Training and Pruning a Mango Orchard to Improve Blooming, Architecture and Yield in South Florida

Noris Ledesma and R. J. Campbell, Fairchild Tropical Botanic Garden, Coral Gables, FL, and Jeff Wasielewski, Miami-Dade County Extension, Homestead, FL

Increasingly there are opportunities for the production of mango using innovative production systems and new cultivars that can distinguish themselves from those commercially available in both the local and export market. These innovations and cultivars will allow for the pushing of market price to make activities profitable in the face of a continued and ever-evolving year-round mango industry in the Western Hemisphere. The cultivar included for the current study was ‘Mallika’, considered among the best of the new generation of Indian dessert mangos with promising performance in South Florida. Two-year-old ‘Mallika’ trees were trained after planting to increase flower and fruit production. Training and pruning included shoot tipping to encourage branching, pruning to stimulate precocious flowering and branch arching with weights. Canopy branching was increased by tipping and selective pruning to encourage multiple budbreak and branch formation. There was increased flowering on these trees due to the treatments. The branch arching also increased flowering and improved the overall architecture of the trees. The results are preliminary and include data for the year 2015.

[K-6]

Finding a Suitable Interstock for Three Mangifera Species from Tropical Asia

Richard J. Campbell, and Noris Ledesma, Fairchild Tropical Botanic Garden, Coral Gables, FL, and Gary Zill, Zill High Performance Plants, Boynton Beach, FL

There are some 69 species of edible *Mangifera* species in Tropical and Subtropical Asia. Over the past 25 years, Fairchild Tropical Botanic Garden has been active in the collection, cultivation and breeding of these species, with the objective of the creation of novel new crops and the improvement of the mango industry. These species occur across a wide range from the foothills of the Himalayas to eastern China, south to Borneo and the southern Indonesian islands. Across this range there is a wide diversity of climatic and edaphic conditions and thus adaptations of these species, and there is limited work available to draw upon for the adaptation of these species to the Western Hemisphere. The present study evaluated *M. lalijiwa* as an interstock for the grafting of three new species, *M. foetida*, *M. quadrifida* and *M. griffithii*. The *M. lalijiwa* used was collected in Bali, Indonesia and was grafted on M. *indica* 'Turpentine' rootstocks from seed from Costa Rica. Acceptable success was achieved with the *M. foetida*, but there was no success with the *M. quadrifida* or the *M. griffithii*. The success with the *Mangifera foetida* allows for the use of this species in breeding and in possible field production in South Florida. As for *M. quadrifida* and *M. griffithii*, more investigation is needed to determine a suitable interstock.

[K-7]

Ground Covers for Organic Mango Production in South Florida

Noris Ledesma and Richard J. Campbell, Fairchild Tropical Botanic Garden, Coral Gables, FL and Jeff Wasielewski, UF/IFAS Miami-Dade County Extension, Homestead, FL

Mango *(Mangifera indica)* is grown in South Florida primarily in Miami-Dade, Lee and Palm Beach County. There is an increasing demand for organic mango production to expand the South Florida industry in response to consumer demand for organic fruit. Organic production also creates a new category for mangos in marketing of the fruit. Organic herbicides can be effective in controlling weeds, but there are limitations, as well as efficacy and economic considerations for commercial use. In this study, four species of ground covers were evaluated to measure their efficiency related to mango growing under South Florida conditions. The trial was conducted using beach verbena (*Gladularia maritime)*, perennial peanut (*Arachi pintoi),* dwarf mimosa (*Minosa pudica),* and blue daze (*Evolvulus glomeratus). Time of establishment, growth efficiency, and competition from weeds were evaluated.* Perennial Peanut (*Arachi pintoi) variety 'Amarillo', and* Dwarf Mimosa (*Minosa pudica*) covers used in row middles had the best performance compared with other species in study as they established quickly and controlled weeds with the best efficiency.

[K-8]

Propagation of Papaya (*Carica papaya*) with Large-sized Cuttings

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Papaya plants are typically propagated by seed. However, clonal propagation may be needed to maintain or increase an individual with particularly desirable characteristics. Previous investigators have developed methods for rooting small to large papaya shoots that utilize exposure to rooting hormones in combination with bottom heat and mist. These plants may take one to two months to develop sufficient roots for planting in the field and, once planted, may take an additional two to three months to flower and set fruit. A method using large cuttings that would root without exposure to bottom heat and mist in a similar time frame but flower and fruit earlier (3 to 4 months after planting) would be beneficial. To this end side shoots two to three feet in length with swollen corky basal tissue were selected. All mature leaf lamina was removed but all petioles, as well as the immature leaves, were left intact. The basal brown corky tissue at the base of the stems were treated with a hydroxylethyl cellulose gel containing streptomycin sulfate, indole butyric acid, riboflavin and azoxystrobin in a Hoaglands solution and then planted into well-drained media. Plants were well rooted within four to five weeks. After three months' plants were placed in the field. Flowering was observed one month later.

[K-9]

Mites Associated with *Carica Papaya* in Florida

Daniel Carrillo, Sabyan Faris Honey, Rita E. Duncan, Jorge E. Peña, Tropical Research and Education Center, UF, and Leonardo Alvarez Rios, Universidad Nacional de Colombia, Palmira, Valle del Cauca, Colombia

A survey of mites present in papaya, *Carica papaya*, was conducted at the Tropical Research and Education Center in Homestead, Florida, USA, in 2015. Several phytophagous mites were found damaging papaya leaves. The spider mites *Eutetranychus banksi* (McGregor), *Tetranychus urticae* (Koch), and *Eutetranychus sp*. (Acari: Tetranychidae) were most abundant on the abaxial surface of mature leaves. These mites cause yellowing and a downward curling of the leaves. The broad mite, *Polyphagotarsonemus latus* (Banks) (Acari: Tarsonemidae) feeds on tender leaves as they emerge, causing shoot malformation. An eriophyid mite was also present, *Calacarus flagelliseta* Fletchmann, DeMoraes and Barbosa (Acari: Eriophyidae); these mites prefer to feed on the adaxial surface of mature leaves, consequently the leaves curl up and progressively turn lighter green, yellowish and then brown. The most abundant of the predatory mites found was *Neoseiulus longispinosus* (Banks) (Acari: Phytoseiidae). This Asian predator, reported for the first time in Florida in 2011, is well established in south Florida and comprised 86% of the predatory mite populations in our surveys. In laboratory studies *N. longispinosus* developed from egg to adult in 9 days and a study of its feeding habits, showed a preference for

nymphs, followed by eggs and adults of tetranychid mites. *Neoseiulus umbraticus* (Chant) and *Amblyseius largoensis* Muma were also present at lower numbers, as well as two commercially available phytoseiids, *Amblyseius swirski* Athias-Henriot and *Phytoseiulus persimilis* Athias-Henriot. The commercial species had been released for biocontrol in previous years; they comprised 13 and 0.01% of the predatory mite population respectively.

[K-10]

Physiological and Growth Responses of 'Red Lady' Papaya to Flooding and Solid Oxygen Fertilization

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Papaya (*Carica papaya* L.) production in Florida is concentrated in areas with a high water table that are prone to flooding resulting from storms or hurricanes. This can limit production because the crop is sensitive to flooding stress. Studies were conducted to examine physiological responses of papaya to flooding a portion or the entire root system and if flooding stress can be reduced by fertilization with solid oxygen compounds. Six-month-old 'Red Lady' papaya plants in Promix® potting medium were divided into 3 flooding treatments: (1) 100% of roots submerged, (2) ~75% of roots submerged, or (3) non-flooded. In separate experiments, plants in each flooding treatment were subdivided into oxygen fertilization treatments by adding different amounts of either magnesium peroxide (MgO_2) or calcium peroxide (CaO_2) or no oxygen fertilization to the potting medium prior to flooding. Dissolved oxygen content of the soil solution, net CO_2 assimilation, stomatal conductance, leaf chlorophyll index, chlorophyll fluorescence, and plant tissue dry weights were assessed. Short-term flooding (2-3 days) resulted in plant stress as determined by the physiological variables measured. However, plants eventually recovered from flooding ~75 or 100% of roots after they were unflooded. Application of MgO_2 or CaO_2 to flooded plants did not affect any of the physiological variables measured. However, oxygen fertilization often increased leaf area and plant tissue dry weights of flooded plants compared to no oxygen fertilization. Thus it appears that fertilization with CaO_2 or MgO_2 can reduce the impact of flooding stress on papaya growth.

[K-11]

Saving the Grimal Grove, Restoring a Legendary Tropical Fruit Collection and Establishing Grimal Grove as the Southernmost Tropical Fruit Park

Patrick B Garvey, Grimal Grove, Big Pine Key Florida

The Grimal Grove was originally founded and designed by the late inventor and horticulturalist, Adolf Grimal in 1955. Grimal was a reclusive genius who spent the better part of 40 years

designing optimal growing conditions for tropical fruit. Grimal was highly regarded by fellow horticulturalists of his day for being able to grow and fruit ultra-tropical fruit trees found nowhere else in continental United States. He was successful thanks to the unique climate of the Florida Keys and Grimal's engineering design of the property. Currently under the management of Patrick Garvey, and Growing Hope Foundation and in partnership with other organizations like IFAS, the grove is emerging as the Southernmost Tropical Fruit Park, education center and an important agricultural and community resource for the Florida Keys.

[K-12]

Promoting Wellness Through the Edible Garden Program

Christian F. Miller, Palm Beach County Extension, UF/IFAS and Ada Medina-Solórzano, Palm Beach County Extension, UF/IFAS

As evidenced by the Greek philosopher/scientist Aristotle, his often-quoted phrase "the whole is greater than the sum of its parts" indicates that achieving synergy through collaboration was recognized even in the days of antiquity. In the fiscal reality of modern times, determining how to do more with less is a question all institutions face. Teamwork across disciplines is promoted by administrators to leverage financial inputs for maximum impact. Extension agents, as they have since their inception, serve as educators when they share the findings of scientists with clients that can benefit from the implementation of new knowledge/practices. One example of partnering across disciplines, stems from the obesity epidemic facing the nation and the popular trend of connecting with one's food source. The Edible Garden Program at UF/IFAS Palm Beach County Extension is co-taught by agents from Family and Consumer Sciences (FCS) and Agriculture. The program consists of two modules: the first delivered by the FCS agent who teaches the nutritional and health benefits of consuming fresh fruits and vegetables, and the second includes the Agricultural agent who highlights local gardening tips and plant culturing methods. A table display of fruits and vegetables Floridians can grow as well as an assortment of dishes for sampling prepared from crops unfamiliar to most conclude the program. The two modules of the Edible Garden Program complement each other well and allow both agents to reach a wider audience, provide a more complete educational experience, and promote greater impacts than either would have achieved alone.

[K-13]

The Art of the Sale—An Early History of Marketing Tropical Fruit in South Florida

Adrian G. B. Hunsberger, UF/IFAS Miami-Dade County Extension, Homestead, FL

From the beginning of tropical fruit production in South Florida in the early 1900's, fruit growers and packers used colorful labels on fruit crates to advertise their produce. Paper crate labels were designed to draw attention to produce boxes and make them stand out at public markets. All

labels were registered with the Department of Agriculture and told the buyer not only the brand name, but what grade of fruit they were purchasing. The name or color background of the label stood for the grade. Colorful labels and those with interesting graphics became a great way for growers to differentiate their products from competitors. But by the 1950s, pre-printed cardboard boxes had replaced the use of paper labels on wooden packaging. Since then, unused crate labels have become collector's items. Citrus fruit labels are the most familiar but there are a few examples for south Florida tropical fruits. Examples of crate labels from Miami-Dade County as well as a brief history of the industry will be discussed.

[K-14]

A Survey of the Beneficial Organisms in the Sustainable Mango Orchard

Thiago B. Campbell and Richard J. Campbell, Fairchild Tropical Botanic Garden, Coral Gables, FL

A survey was conducted of the beneficial insects occurring in a sustainable estate mango orchard in Miami-Dade County. The orchard was planted in 2014 and consists of a ½ acre of the newest and highest quality cultivars grown in a sustainable system and destined for marketing in specialty outlets in South Florida. Since inception the orchard has been managed without the use of herbicides, insecticides or chemical fertilizers. The current study was conducted to demonstrate the diversity of predators and other beneficial organisms that are found in the orchard and to discuss their effectiveness in control and their long term survival. Several species of spiders, lacewings, ladybugs, mealy-bug destroyer, assassin bugs, paper wasps, and native and non-native lizards were sampled over the one-year of study in the orchard. The role of each of these organisms and their effectiveness will be discussed.

[K-15]

Evaluation of nematode resistant rootstocks for peach production in Florida

Maquilan, Mary Ann D., Mercy A. Olmstead, José X. Chaparro, Horticultural Sciences Department, UF and Thomas G. Beckman, USDA-ARS, Byron, GA

Five rootstocks with potential resistance to nematodes were evaluated for their capacity to improve scion growth and yield during the first three years of establishment at the UF experimental field in Marion County, Florida. This experiment initiated in Spring 2012 compared the growth of 'UFSun,' a regionally adapted scion cultivar, on four peach genotypes of diverse origins: 'Barton,' 'Okinawa,' 'P-22,' and 'Flordaguard' as well as on peach-plum hybrid 'MP-29'. Trunk growths of the scion and rootstock were recorded and related to scion vigor, precocity, yield, and fruit quality in the third growing season. Nursery-budded rootstocks, 'Okinawa' and 'P-22,' maintained greater trunk cross-sectional area than the field-budded 'MP-29' and 'Barton.' Pruning weights were consistently lower on 'MP-29' and 'Flordaguard' for three growing seasons. Differences in precocity among rootstocks were evident, with

‘Okinawa’ inducing 50% anthesis one week earlier than ‘P-22,’ ‘Barton,’ and ‘Flordaguard’ and two weeks earlier than ‘MP-29.’ Fruit production was spread over six weeks from early April to mid-May and reached peak yields during early May. Total yield was higher on ‘Okinawa’ than on ‘MP 29’ while ‘P-22,’ ‘Barton,’ and ‘Flordaguard’ resulted in intermediate yields. Yield efficiency and fruit counts per tree were comparable for all rootstocks. Mean individual fruit weights did not significantly vary except for ‘MP-29,’ which induced fruits smaller in size and weight but accumulated the highest brix. These results could be predictive of long-term tree performance and provide information that could be used by growers and breeders alike to satisfy specific production goals.

[K-16]

Peach Critical Bud Temperatures for Different Phenological Bud Stages

Elizabeth K. Conlan, University of Florida, Gainesville, FL, Jun Liu, University of Georgia, Athens, GA, Dario J. Chavez and Orville Lindstrom, University of Georgia, Griffin, GA, and Mercy A. Olmstead, University of Florida, Gainesville, FL

Late winter freeze events in Florida can cause significant crop damage for peach (*Prunus persica*) growers. Growers use critical bud temperatures, the temperature at which fruit buds and flowers at different stages incur freeze damage, as a tool to initiate frost protection. However, available critical bud temperature information only exists for high-chill peach varieties, and it is unknown if these temperatures translate to low-chill fruit varieties grown in Florida. Therefore, the objective was to determine the critical temperatures for the floral buds of two low-chill peach cultivars at each of eight stages of bud development. Freeze tolerance testing, involving use of a programmable freeze chamber, was used to assess the cold hardiness of two cultivars, ‘TropicBeauty’ (150 chill unit requirement) and ‘UFOne’ (250 chill unit requirement), between October 2015 and March 2016. Logistic models were developed from bud survival data and used to determine the lethal temperature for 50 percent of buds (LT50). The LT50 values for each cultivar were compared with higher chill varieties, such as ‘Elberta’, as well as between different bud stages. The critical bud temperatures of floral buds for low-chill peach cultivars can be used to help grower decision-making related to freeze events and further understand the connections between cold hardiness, environmental conditions, and genetics or genotype.

[K-17]

Effect of Growth Stages on Nitrogen Uptake Efficiency in Young Southern Highbush Blueberry

Yang Fang, Jeffrey Williamson, Rebecca Darnell, Horticultural Sciences Department, UF, Yuncong Li, Tropical Research and Education Center, UF, and Guodong Liu, Horticultural Sciences Department, UF

Effect of plant growth stage on efficiency of N absorption was studied in containerized one-year-old southern highbush blueberry (SHB) grown in pine-bark amended soil. Ammonium sulfate ($(NH_4)_2SO_4$) was applied at the beginning of six growth flushes from early March to late September. Each growth flush ceased when the uppermost bud aborted and the next flush began when buds burst near the tip. At each stage, five plants were fertilized with 6 grams 10% ^{15}N labeled $(NH_4)_2SO_4$, while all other plants were fertilized with the same amount of unlabeled $(NH_4)_2SO_4$. Labeled plants were harvested after 14 days and atom% of ^{15}N and weight% of N were measured. N uptake efficiency (NupE) was defined as the ratio of absorbed nitrogen to total dry weight. Significantly greater NupE (0.85%) was found at the second flush (early April) compared to the other five stages. At last three stages (July, August and September), plants had the lowest NupE with 0.38%, 0.3% and 0.21%, respectively. Thus, plants reached peak demand of nitrogen fertilizer at the second stage. An additional five plants were treated with 10% ^{15}N labeled NH_4SO_4 at the first stage and were harvested after the last stage. During the whole growing season, these plants absorbed only 16% of applied ^{15}N. Therefore, if plants were over-fertilized at a stage when NupE was low, then most of the extra N may probably run off rather than be absorbed by plants.

[K-18]

Irrigation Strategies for Florida Subtropical Peach Production

Carlos Zambrano-Vaca, Mercy A. Olmstead, and Lincoln Zotarelli, Horticultural Sciences Department, UF

Florida is one of the largest producers of processed citrus in the U.S., however, citrus greening disease (*Candidatus Liberibacter* spp.) has forced growers to diversify their orchards to remain economically viable. Peaches are an alternative crop as the subtropical climate and availability of low-chill cultivars allows growers to harvest and market fruits before Georgia or South Carolina. Nevertheless, irrigation recommendations and crop coefficients for irrigation scheduling were determined in arid climates which can overestimate irrigation requirements in humid, subtropical climates. Alternatively, irrigation recommendations from citrus (an evergreen tree) cannot be used for peaches (a deciduous tree). Therefore, this study evaluated irrigation recommendations to optimize subtropical peach production in Florida. Two orchards located in Central Florida were chosen to evaluate the effect of four water volumes 1) 0.17 in/h (current practice), 2) 0.13 in/h, 3) 0.09 in/h and 4) 0.08 in/h per plant, on tree water stress, pruning weight, and fruit attributes. There is no significant effect of irrigation volume on biomass production (fresh prune weight), trunk cross sectional area, stem water potential, marketable yield, sugar content and fruit size, suggesting that irrigation water volume can be reduced approximately 50% of current irrigation practices without reducing fruit quality or plant growth.

[K-20]

[K-21]

'O32-18-3', A Potential Muscadine Seedless Grape

Z. Ren, Jiang Lu, and Violetka Colova, Florida A&M University, Tallahassee, FL

'O32-18-3' is a seedless muscadine hybrid from the Grape Breeding Program in the Center for Viticulture & Small Fruit Research, College of Agriculture and Food Sciences, Florida A&M University, Tallahassee, FL 32317. It produced seedless muscadine grape fruits with 3.8g in average fruit weight and SSC 15.6%. The fruits taste sweet and crunchy, with attractive fresh red color and fruit shape. It is moderate in vigor, and is resistant to Pierce's Disease (PD). Seedless, uniform ripening, cluster harvesting, and PD resistance are the major advantages of the hybrid. This hybrid has showed high potentials as a seedless muscadine grape to grown in Florida and other muscadine production regions.

Natural Resources Section Abstracts

[NR-1]

AmeriCorps Master Naturalists Improve Youth Environmental Education

Sheila Dunning, UF/IFAS Okaloosa County Extension, Crestview, FL

Most Florida residents live near the beach. Coastal ecosystems contain fragile habitats. Development has created habitat loss and degradation. From 2004-2006, tropical storms damaged the dune system, requiring restoration. Local school districts emphasized the need for programs with activities that provide investigative and problem solving experiences related to science and mathematics. School-age youth were identified as the audience with their classrooms serving as plant nurseries. From 2004-2014 Extension implemented "Dunes in Schools". Nearly 7,000 students were educated on ecology and horticulture. Each was able to grow and install at least one Sea Oat, restoring a linear acre of foredune. As the curriculum became established in schools, it became necessary to transfer coordination to a partner organization. A local non-profit offered AmeriCorps participants and other personnel to continue the program. However, many individuals lacked knowledge to instruct. Extension offered a solution through the Florida Master Naturalist Program (FMNP). Thirty-four individuals completed the Coastal and Environmental Interpretation Modules. Graduates are required to create and deliver an education tool. AmeriCorps developed a seven-lesson curriculum that aligned with the Florida science standards. Efforts to improve the interpretive skills of the AmeriCorps volunteers through the FMNP built the self-confidence of the adults while enhancing the learning of the youth. Today, "Dunes in Schools" continues as a staple in 9 schools, with nearly 900 students participating annually. Pre- and post-test surveys have yielded an average 15% knowledge gain. The children have been able to follow the development of the ecosystem, which has enforced the concepts of environmental stewardship.

[NR-2]

Opportunities and Challenges for Marketing Leafy Salad Crops in The Farm to School Program

Richard Tyson, Caitlyn Glatting, and Jamila Adams, UF/IFAS Orange County Extension, Orange County, Orlando, FL

Farm to School programs were established to encourage partnerships between farmers and local school systems in order to increase the consumption of fresh, nutritious, locally produced fruits and vegetables in school lunch programs. Florida grown produce is currently sourced to schools through traditional contracted wholesale channels by availability of commodity and lowest price scenarios which results in a low percentage of Florida grown produce being consumed (i.e. about

30% in Orange County Public Schools). Few successful local farmer to local school system partnerships have been established in Florida over the last 5 years. The challenges and opportunities for adopting more farm to school partnerships will be discussed with special reference to the production, marketing and consumption of leafy salad crops.

[NR-3]

The Everglades Invasive Reptile and Amphibian Monitoring (EIRAMP) Citizen Science Program

Kenneth Gioeli, UF/IFAS St. Lucie County Extension, Fort Pierce, FL, Frank Mazzotti, Edward Metzger, and Michael Rochford, UF/IFAS, Ft. Lauderdale Research and Education Center, Davie, FL, and Amanda Thompson, St. Lucie County, Environmental Resources Department, Port St. Lucie, FL

The Everglades Invasive Reptile and Amphibian Monitoring Program (EIRAMP) is a citizen science wildlife monitoring program offered by the UF/IFAS St. Lucie County Extension, the UF/IFAS Ft. Lauderdale REC and the Florida Master Naturalists. It is composed of a team of Florida Master Naturalists located in the Treasure Coast counties of Martin and St. Lucie. Extension Agent Ken Gioeli serves as program co-facilitator along with UF Wildlife Research Specialist, Dr. Frank Mazzotti. This project involves monthly wildlife monitoring on ten 30-mile-long transects adjacent to freshwater systems where this EIRAMP Master Naturalist team listens and watches for native and invasive reptiles and amphibians (including mammals such as coyotes). The goal is to get a baseline determination of wildlife currently present along the transects. This information will help specialists monitor the spread of invasive species such as Burmese pythons and how they impact other wildlife species as their domain expands onto the Treasure Coast.

[NR-4]

Water Quality in Harvested Rainwater

Lynn Barber, UF/IFAS Hillsborough County Extension, Seffner, FL

Many of our clients, homeowners, school and community gardens are harvesting rainwater for irrigation of edible gardens; whether vegetables, herbs or fruit trees. Concerns have been expressed regarding water quality (based on roofing material composition) and whether water conservation is worth the effort if harvested water cannot be used for edibles. The purpose of this project was to secure and summarize research results in order to provide science-based information to residents that attend Rainwater Harvesting Workshops. Results of four studies were reviewed: Rutgers, North Carolina State University, Texas Water Development Board and the US Environmental Protection Agency. Research results indicated water testing was needed and treatment may be required to prevent contamination. All studies indicated additional testing

was needed, whether to determine if installation of a first flush diverter would reduce sufficient pathogens for irrigation of edibles; soil testing to determine if concentrations were significant enough to harm plants (thus people); testing for metals, oils and grease contamination; and treatment may be needed to prevent pathogen contamination. Wood shingles, cement, terra cotta tiles, lead, copper and asbestos were not recommended for rainwater harvesting. One study issued a caution warning for utilizing harvested rainwater for edible irrigation, although their data was not supported because the water met drinking water standards. Considerations that require additional research include: human health risks, regional and climate considerations, and environmental and ecological impacts.

[HP-5]

Improved Sweet Sorghums for the Southeastern United States

Sanyukta Shukla and Wilfred Vermerris, Department of Microbiology and Cell Science, UF, and Ana Saballos, Chromatin, Inc., Alachua, FL

Sweet sorghum (*Sorghum bicolor* (L.) Moench) is a tall, fast-growing, seed-propagated grass that accumulates soluble sugars in its stem. Sweet sorghum has potential as a multi-purpose biofuel crop in the southeastern USA. The sugars from the juice can be easily extracted from the stem and directly converted into ethanol or other chemicals by fermentation, while the bagasse can be burned in boilers to generate heat, or used for cellulosic ethanol. Despite these favorable attributes, all current cultivars are pure lines that produce little seed that cannot be harvested with a combine due to the height of the plants (>4 meters). The availability of hybrid seed that can be produced on short seed parents would enable combine harvesting and offer greater seed yield. This requires the availability of short, sweet inbred lines. All known sweet sorghums, however, are tall. Since the physiological mechanisms underlying sugar accumulation in sweet sorghum are not well understood, the question is whether the apparent association between sugar accumulation in the stem and plant height is the result of selection, or dictated by physiological or genetic constraints. Three experiments were conducted to examine this. First, to determine if shading has a negative effect on sugar accumulation of short plants within a segregating breeding population, short and tall sibling families were planted in separate sites. Short plants accumulated as much sugar as the tall plants. Second, short plants having the unstable *dwarf3* allele were compared with their tall *Dwarf3* revertants. There were no significant differences in sugar content between the two. Third, tall photoperiod-sensitive lines were compared with their matching short photoperiod-insensitive lines. No significant differences were found in the total sugar yields between these lines. The data from these three experiments indicated that plant height is not a prerequisite for high sugar content in sweet sorghum, making it feasible to develop short, sweet inbreds. This project is supported by the Southeastern SunGrant Center and USDA.

[NR-6]

Renovating the Landscape at the UF/IFAS Volusia County Extension Office

Joe Sewards, UF/IFAS Volusia County Extension, Deland, FL

UF/IFAS Extension offices have a unique opportunity to demonstrate the nine principles of Florida Friendly Landscaping™ as well as low-impact development principles and other aspects of sustainability in the landscape. The landscape at the UF/IFAS Extension, Volusia County had become unkempt and unsightly. Volusia County Master Gardeners and County Faculty applied for a grant through Volusia County entitled ECHO (an acronym for "Environmental, Cultural, Historical and Outdoor) for $55,415.00. With in-kind contributions and matching monies provided by the horticulture program and the Master Gardeners, the renovation totaled $101,000. The landscape demonstrates the nine principles of Florida Friendly Landscaping™ and has rain barrels, cisterns, permeable pavements, low volume irrigation, edible landscaping, a children's sensory garden and rain gardens. The landscape is now a destination for central Florida residents where they can get exercise and get ideas for their own landscapes. The landscape is maintained by the UF/IFAS Extension, Volusia County Master Gardeners. Future plans include solar panels to power the cistern pumps, a butterfly house, greenhouse upgrades and further expansion of the edible landscape portion of the project.

Ornamental, Garden and Landscaping Section Abstracts

[OGL-1]

Optimal Photoperiod Treatment for Flowering of *Bougainvillea* x *buttiana* 'Afterglow'

Mun Wye Chng and Kimberly A. Moore, Fort Lauderdale Research and Education Center, UF

Bougainvillea cultivars are widely used ornamentals valued for their ability to bloom profusely while tolerating poor growing conditions such as pollution, compaction, and drought stress. However, flowering is often inconsistent, with short days being the apparent trigger in the tropics, and drought stress being the apparent trigger in the monsoon tropics. *Bougainvillea* x *buttiana* cultivars are mostly considered qualitative short-day plants that flower more readily and profusely under short day lengths. The cultivar 'Afterglow' was tested in two experiments to confirm that it is a qualitative short-day plant, and to discover the optimal photoperiod under which flowering is most profuse. Seventy plants were subjected to a range of photoperiods from 8 to 14 hours in 1 hour increments, to establish an optimal photoperiod for the induction of flowering in the absence of other environmental factors, namely water stress, physical wounding, or high nutrient availability. Experiment 1 confirmed that 'Afterglow' is a Short-day plant, producing the most flowers between 8 and 11 hours of daylight. Plants under short-day with a 3-hour night interruption provided by a single white LED bulb producing 240µmol/m^2/s of photosynthetic photon flux did not produce flowers. Experiment 2 showed that plants under a photoperiod of between 10 and 12 hours produced the largest number flowers.

[OGL-2]

Determination of Ploidy Levels and Breeding of *Ruellia simplex*

Victor A. Zayas, Rosanna Freyre, Allison V. Conner and Steve Montalvo, Environmental Horticulture Department, UF

Ruellia consists of approximately 300 species of perennial herbs, subshrubs and shrubs which are found mostly in tropical and subtropical areas. *Ruellia simplex* (Mexican Petunia) plants are economically important ornamentals due to their low maintenance, prolific flowering and overall performance, and are a popular option for landscapes in the southern U.S. However, since its introduction to Florida in the 1940s, *R. simplex* has naturalized in disturbed ecosystems of seven southern U.S states, Hawaii, Puerto Rico, and the U.S. Virgin Islands. The Florida Exotic Pest Plant Council considers it a Category I invasive plant because it causes displacement of native plant communities, disruption of ecological functions and can hybridize with native species. This conflict between commercial popularity and environmental conservation has prompted breeding

efforts from the University of Florida (UF) to develop sterile cultivars with different flower colors, growth habits and other ornamental traits. So far, we have released *Ruellia* 'Mayan Purple', 'Mayan Pink' and 'Mayan White'. Our breeding methods have included hybridizations within and between species, and ploidy manipulations. We develop tetraploid individuals, and then intercross them with diploids to obtain sterile triploids. Usually we utilize oryzalin to produce tetraploid individuals. Until recently, selection of tetraploids after oryzalin treatments was made based on plants' morphological differences, and flow cytometry performed in a commercial laboratory. Recently, we have focused on Polyploidization treatments on *R. simplex* to determine the optimal oryzalin treatment that results in Polyploidization. Furthermore, we have developed tools to determine the ploidy level in-house. The first step involves screening by counting the chloroplasts on the stomata, and presumed polyploids are then confirmed by flow cytometry performed at UF.

[OGL-3]

Key Pests of Hops (*Humulus lupulus*) Cultivated in the Southeastern United States

R. Smith, B. Pearson, S. Arthurs, and A. Morgan, Mid-Florida Research and Education Center, UF

Humulus lupulus, or hops, is an herbaceous perennial crop cultivated from rhizomes for its strobiles which contain important compounds for flavoring and aroma of food, tea, and beer. Interest in cultivation of hops in areas outside of the traditional production region (Pacific Northwest United States) has been fueled by demand for locally produced agricultural products coupled with recent growth in the craft brewing industry. Identification and management of key pests, those which negatively impact crop quality and are considered to be a frequent or continual threat, are critical to successful commercial cultivation as improper management can lead to total crop loss. Sixty hops plants consisting of four cultivars ('Chinook', 'Columbus', 'Amalia', and 'Neo1') were transplanted into a native deep sand soil (Tavares-Millhopper soil series) within a protected agricultural polyethylene covered, open-sided greenhouse located in Apopka, FL on 3 May 2014 and cultivated for a period of two years. Throughout this period, key pests were identified, photographed, and utilized to assist in the development of an effective pest management program. Key pests included spider mites (*Tetranychus urticae* and *Oligonychus ilicis*), whitefly (*Bemisia argentifolii* and *Aleurodicus dugesii*), and aphid (*Aphis gossypii*). Results from this work are foundational in the development of effective pest management protocol to aid in successful cultivation of this unique specialty crop in the Southeastern United States.

[OGL-4]

A High Incidence of *Pythium* and *Phytophthora* Diseases Related to Record Breaking Rainfall During the Dry Season 2015-2016

E.V. Campoverde, Miami-Dade County Extension, UF, G. Sanahuja, and A.J. Palmateer, Plant Pathology Department, Tropical Research and Education Center, UF

Florida's ornamental plant industry flourishes due to environmental conditions that allow for a 12 month growing season. Florida leads the nation in production of tropical foliage and Miami-Dade County ranks number one in nursery and landscape production with sales reaching $2 billion annually. The well-advertised El Niño pattern made its presence felt this winter in south Florida with the wettest conditions since record-keeping began in 1932. As a result, ornamental nursery growers contended with a higher incidence of root rots, crown rots and foliar blight diseases confirmed by samples submitted to the University of Florida's Extension Plant Diagnostic Clinic in Homestead, FL. The present study focused on environmental conditions occurring over the past 3 years and included precipitation, and temperature variables and examined their influence on the incidence of disease affecting ornamentals. Results indicated *Phytophthora* and *Pythium* as the primary plant pathogens responsible for these diseases. The drastic increase of diagnostic samples identified as *Phytophthora* and *Pythium* can be attributed to the unusually wet weather experienced this past winter. These two oomycetes are well known for causing disease under wet conditions and growers should closely monitor weather forecasts and practice preventative disease management accordingly.

[OGL-5]

Postemergence control of *Pilea microphylla* (Artillery weed)

Chris Marble, Annette Chandler, and Debalina Saha, Mid-Florida Research and Education Center, UF

Pilea microphylla, also known as artillery weed, artillery fern, or gunpowder plant is weed of increasing importance in Florida. It has also recently become a nuisance in nurseries, but little information is available on herbicide efficacy. The objective of this trial was to evaluate selected nursery herbicides for postemergence control of artillery weed and measure regrowth potential following application. Nursery media was overseeded with artillery weed seeds. Artillery weed was grown for 2 months at which time all plants were approximately 3.5 to 4 in. in ht. and had flowered. The following herbicides were applied at generally their highest label rate: sulfosulfuron (0.06 kg/ha), sulfentrazone (0.42 kg/ha), indaziflam (0.07 kg/ha), diquat (0.56 kg/ha), oxadiazon (granular) (4.48 kg/ha), glyphosate (3.36 kg/ha), pelargonic acid (4.71 kg/ha), flumioxazin (0.43 kg/ha), and dimethenamid-p (1.68 kg/ha). A non-treated control was also included. Data collected included visual control ratings at 1, 2, and 4 weeks after treatment (WAT) and shoot fresh weights (FW) were taken at 4 WAT. Plants were then grown for an additional 8 weeks to monitor any regrowth following treatment. Regrowth data indicated that the best long-term results were achieved with flumioxazin (100% control), oxadiazon (100% control) and indaziflam (100%). Results from this trial suggest that several active ingredients already labeled for use in nursery crops and landscapes can be used for artillery weed

management. Oxadiazon (granular) and dimethenamid-p are also labeled for over-the-top use and could be prove to be valuable tools for controlling artillery weed in ornamentals.

[OGL-6]

Efficacy of Systemic Insecticides Applied to Oxhorn Bucida Trees, *Bucida buceras,* to Minimize Staining by a Caterpillar, *Garella (*Characoma*) nilotica* (Lepidoptera: Noctuidae) and an Eriophyid Flower Gall Mite, *Eriophyes buceras*

Douglas L. Caldwell, Collier County Extension, UF, and A.D. Ali, Davey Institute, The Davey Tree Expert Company, Fort Myers, FL

The Oxhorn Bucida shade tree (unfortunately, commonly referred to as the "Black Olive" tree) has been frequently planted in south Florida coastal areas. It has pests, which due to their by-products, cause objectionable staining to light-colored objects underneath the canopy such as sidewalks and cars. This staining can become so annoying that homeowners pursue options to have the trees removed. To prevent tree removal due to the staining by the caterpillar frass and the long, cylindrical mite galls, several studies were conducted in Naples and Coral Gables, Florida. Treatments consisted of basal root flare drenches of dinotefuran and acephate solutions and trunk injections of acephate, abamectin alone and in combination with dinotefuran. In the first (2013) Naples study, with the smaller Bucida variety, 'Shady Lady' trees (average 11-inch trunk diameter), the caterpillar and gall populations were too light to distinguish any treatment impact. In the second Naples study in 2014, dinotefuran and acephate injected trees had less staining (but not statistically different) at 60 DAT. In Coral Gables, we used the larger leaf, Oxhorn species. This tree is a major neighborhood, street tree component in Coral Gables. There are 13,000 older trees which average 21 inches in trunk diameter. In the 2015 Coral Gables study, caterpillars were not readily found, but mite galls caused major staining, as they do annually. Abamectin trunk injections provided significant reduction in galls and staining. The Coral Gables project will be continued in 2016.

[OGL-7]

Rose Variety Testing for Chilli Thrips, *Scirtothrips dorsalis*, and Developing a Sample Plan for Identifying this Pest in Container-grown Knock-Out Roses

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The chilli thrips, a recent invasive insect in Florida, has emerged as a major pest of KnockOut® rose (Rosa x 'Radrazz') the most widely sold shrub rose series in North America. We are evaluating other rose varieties for possible tolerance against this pest. Our results to date suggest that several modern (e.g. 'Caldwell Pink' and 'Sir Thomas Lipton') and Old Garden rose varieties (e.g. 'Blush Noisette' and 'Mrs B. R. Cant') are significantly less susceptible to this

pest. The flushing cycle of different varieties influences the buildup of this pest and resulting aesthetic damage occurring during the season. We also developed a sampling plan for monitoring chilli thrips in container grown KnockOuts, based on the correlation between visual damage on plants and pest population abundance. This sampling plan could be a useful tool for monitoring chilli thrips in nursery production of roses, since scouts can more easily quantify damage compared with assessing insect abundance.

[OGL-8]

A New Disease Caused by A *Cercospora* sp. on the Florida Native *Tetrazygia bicolor*

R.T. McMillan, Jr. Tropical Research and Education Center, UF

The yellowish-orange Cercospora leaf spots were observed on *Tetrazygia bicolor* in all of the native pine lands of Miami-Dade County. The leaf spots were affecting 30 to 50 percent of the pine land stands. The actively expanding leaf spots were necrotic. A *Cercospora* sp. was isolated on Acidafied Potato Dextros Agar (APDA). Ten uninfected leaves of *T. bicolor* were placed in each of two plastic boxes lined with damp paper towels (incubation chambers ICBC). Five leaves were treated as controls and the other five were inoculated. Leaves misted with water prior to inoculation. Control leaves were inoculated with one, 3mm square of uninoculated. Treated leaves were inoculated with 3 mm squares of seven-day old cultures of the *P. nicotianae* on APDA. Leaves were then misted again, covered and incubated in the ICBC at 25°C (77°F). After six days, all of the inoculated leaves that were showing actively expanding leaf spots which were necrotic. Cercospora was re-isolated from the inoculated leaves thus proving Koch's postulates.

[OGL-9]

Hillsborough County Container Nursery Irrigation Characteristics

Shawn Steed, Hillsborough County Extension, UF, Tom Yeager, Environmental Horticulture Department, UF, and Jemy Hinton, Hillsborough County Extension, UF

We determined the Distribution Uniformity (DU) and irrigation application rate for six container nurseries in Hillsborough County as part of an ongoing effort to provide extension education regarding efficient irrigation. Four nurseries used impact sprinklers and two used mini Wobblers®. DU and application rates were similar regardless if delivery was by overhead impact sprinklers or by overhead mini Wobblers®. DU and application rates for all the nurseries averaged 80 ± 3.6 % and 0.30 ± 0.05 inches per hour, respectively. Best Management Practices (BMPs) manual titled *Water Quality/Quantity BMPs for Florida Nurseries* links to a video demonstrating how to conduct uniformity evaluations and indicates the DU should be at least 80%. The procedure for obtaining DU and application rate along with factors impacting our results will be discussed.

[OGL-10]

Pepper Weevil (Anthonomus eugenii Cano) Abundance in `Jalapeno' Pepper Grown in Different Management Situations

Dakshina R. Seal and Mohammad Razzak, Tropical Research and Education Center, UF

Pepper weevil *Anthonomus eugenii* Cano is the most troublesome pest among all insects that attack pepper. Eggs are laid inside pepper tissues underneath the epidermal layer. Larvae after hatching out move inside and feed on internal tissues of pepper fruit. The calyx of an infested fruit turns yellow and the fruit becomes loosely attached to the plant which drops down on the ground shortly after infestation. Insecticides of various modes of action are used to control pepper weevil, but level of control is unsatisfactory due to the lack of proper detection method of pepper weevil arrival in the field. Development of a sustainable management program is essential to control pepper weevil. Attract and kill method at the beginning of pepper planting season is useful in knowing initiation of infestation and killing most of the initial population. Growing plants on proper plastic mulch will further reduce pepper weevil infestation. Plastic mulch, irrespective of any color, reduces pepper weevil infestation on pepper as compared to the no mulch situation. When various plastic mulches are compared, silver mulches reduced pepper weevils more than black and white mulches. Further Silver on black plastic mulch is more effective than silver on white mulch in reducing pepper weevil infestation. Among chemical insecticides, thiamethoxam (Actara®, IRAG Group 28) provided significant reduction of pepper weevil followed by oxamyl and other insecticides.

[OGL-11]

Consumer Perceptions of Plant Production Practices that Aid Pollinator Insects' Health

H. Khachatryan and A. Rihn, Food and Resource Economics Department and Mid-Florida Research and Education Center, UF

Declining pollinator insect populations has become an important environmental concern in recent years. Despite widespread awareness, consumer perceptions of production practices (i.e. natural, organic, etc.) on pollinator health are not well understood. Our goal was to assess consumer perceptions of pollinator friendly plant production practices in nursery production systems for food crop plants and landscape plants. Knowing consumer perceptions of production practices related to pollinator health is important because this impacts product selection, sales and the availability of pollinator friendly products in the residential landscape. We used an online survey of 1,243 U.S. consumers who ranked the importance of 11 different production practices for both food crop and landscape plants. Results were analyzed using an ordered probit model and showed that plant type influences perceived importance of the production practices. For food crop plants, grown without pesticides was perceived as the best production method for pollinator health while grown outside was ranked the highest for landscape plants. Grown using synthetic pesticides was ranked the least beneficial regardless of plant type. Results contribute

new insights on consumers' perceptions of pollinator friendly production practices relative to plant type which green industry stakeholders can use as they develop production strategies and promotional materials.

[OGL-12]

Nutrient Leaching From Bananas Grown in Sphagnum Peat and Sugarcane Filter Press Mud Based Growing Media During Acclimation

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Nutrient leaching is a necessary, but wasteful part of growing nursery plants. Substrate, fertilization, and their interaction affect nutrient leaching. This study was designed to investigate nutrient leaching from tissue culture bananas during the acclimation phase in 4 different substrates. The growing media mixtures consisted of 90% and 55% sugarcane filter press mud (FPM) or Sphagnum peat (SP) by volume mixed equal parts of perlite and vermiculite to make up the complement of each mixture. There were 3 fertilization treatments: Osmocote Plus 15-9-12 3-4-month release incorporated at the rates of 2.4 g/L, 4.8 g/L and 7.2 g/L. The experiment was designed as a completely randomized design factorial with each media x fertilization treatment consisting of 3 replicates for a total of 36 experimental units. Nitrate leaching was higher in FPM treatments. Ammonium leaching was higher in SP treatments. Phosphorus leaching was higher in SP treatments. The lowest level of fertilization in the SP treatments had mean P-PO4 leaching two times as high as the highest mean PO4-P leached in FPM treatments. Potassium leaching in FPM treatments was higher than in SP treatments. The high levels of NO3-N leaching indicate that N fertilization practices when using FPM-based media could be adjusted to match the amount of N needed by the plant. The volume of leachate was higher for FPM-based substrates. Adopting an evapotranspiration based irrigation regime would decrease mass of nutrients of leached, and would benefit both the grower and the environment.

[OGL-13]

Mobile Device Application for Container Nursey Plant Irrigation

Tom Yeager and Jeff Million, Environmental Horticulture Department, UF

Container plant irrigation application amounts should be adjusted to match plant water need. However, this is difficult without the use of irrigation management tools such as CIRRIG (Container Irrigation), a web-based program that uses plant parameters and onsite weather to output daily irrigation application amounts. We developed a mobile device irrigation application that uses similar inputs as CIRRIG and uses weather data from the nearest FAWN (Florida

Automated Weather Network) station. The user inputs container size (#1 ≈ 3.8 L or #3 ≈ 10 L), plant canopy shape, container diameter, container spacing, spacing arrangement, plant canopy density, and irrigation rate; and the app outputs irrigation run time. In addition to irrigation run time examples, results from irrigation workshops will be discussed.

[OGL-14]

Developing and Selecting Sterile, Non-invasive *Lantana camara* Cultivars

Zhanao Deng, Gulf Coast Research and Education Center, UF, David M. Czarnecki II, former student, Gulf Coast Research and Education Center, UF, Xiaobao Ying, Gulf Coast Research and Education Center, UF, Sandy B. Wilson, Rosanna Freyre, Environmental Horticulture Department, UF, and Gary W. Knox, North Florida Research and Education Center, UF

Plants of *Lantana camara* are commonly used in the landscapes in Florida and many other states in the United States, and hundreds of Florida nurseries produce *L. camara* plants commercially. *Lantana camara* can hybridize with *L. depressa*, the Florida native; such natural hybridization has resulted in the contamination of the gene pool and threatened the existence of *L. depressa*. The Florida Exotic Pest Plant Council (FLEPPC) lists lantana as a Category I invasive species and the IFAS Assessment of Non-Native Plants recommends "No Use" of *L. camara* in south/central Florida and "Caution" in using lantana in north Florida. The invasive species status of *L. camara* has become a significant marketing barrier to Florida nurseries and landscapers. To help address the invasiveness of *L. camara* and meet the Florida nursery industry's need for non-invasive cultivars, we have been developing and selecting sterile, non-invasive *L. camara* cultivars. We have evaluated the fruit production, seed viability/germination, and pollen stainability/viability of 45 commercial *L. camara* cultivars, and their hybridization potential with *L. depressa*. Our data indicate that a number of commercial cultivars are highly male and female-sterile and they may have little to no invasive potential. We have generated hundreds of new triploid lantana lines and evaluated their male and female sterility, growth habit, and landscape performance. As a result, a number of new sterile *L. camara* cultivars have been developed and approved by UF/IFAS for use as an alternative to the fertile, invasive types.

[OGL-15]

Evaluating Fungicides in Production for Long Term Management of Impatiens Downy Mildew in the Landscape

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Since the emergence of impatiens downy mildew, economic losses to Florida's $16 billion landscape industry are estimated to exceed $50 million annually. Researchers have come to the conclusion that chemical control is the only effective short-term management option available.

The greatest challenge is cost effective management of impatiens downy mildew in the landscape. Some of our first trials conducted early in the spring of 2012 revealed that impatiens transplanted into landscape beds incorporated with a granular form of mefenoxam remained healthy for 60 days. Subsequent experiments evaluating products for long residual (> 30 days) control have identified several additional chemistries including fluopicolide, various phosphonates and oxathiapiprolin as promising. Further studies investigated the potential for eradicative control and found phosphonate containing products effective even after infection. Most recent studies have focused on fungicide rotations targeting long term residual control of impatiens downy mildew. Weekly preventative fungicide spray rotations on potted impatiens in production have included cyazofamid, dimethomorph, fluopicolide, mefenoxam, potassium phosphite and oxathiapiprolin. To date oxathiapiprolin has provided stellar control of impatiens downy mildew when used alone and in every rotation study. Results obtained from fungicide efficacy trials conducted over the past four years indicate that some chemistries provide long enough residual control for impatiens to remain untreated in the landscape. These disease management studies will directly impact commercial producers and landscape professionals alike, as homeowners will benefit from not having to apply pesticides.

[OGL-16]

Improving Professionalism in the Landscape Industry by Maintaining Partnerships Between Extension and Professional Organizations like FNGLA and LIAF: A Successful Approach!

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In Miami-Dade and Broward County there are approximately 4,000 landscape companies, ranging in size from one or two employees to big companies with hundreds of employees. These companies have in common the lack of training or certification. Certification is a set of standards developed, maintained, and administered by industry with the purpose to establish a minimum level of competency for their personnel. These certifications are voluntary as opposed to state licensing. However, they raise the standards and the professionalism and image of the industry. Miami-Dade and Broward Extension in cooperation with the City of Miami, Environmental Resources and Planning & Zoning Department, City of Sunrise, Miami Dade Parks-Recreation and Open Space Department (PROS), and the companies Metric Engineering and HDR Inc. organized and taught the certification programs developed by the Florida Nursery Growers and Landscape Association (FNGLA) and the Landscape Inspector Association of Florida (LIAF). A total of 113 people attended the review classes and 70 people passed the certification exam. Some of the review classes for the FNGLA were offered in Spanish, which was the first time somebody offered in the State the classes in Spanish.

[OGL-17]

Growing Plants and Volunteers: A Master Gardener Nursery Project

Sheila Dunning, Okaloosa County Extension, UF

The first few Master Gardener classes graduated a motivated core of individuals. With the size of the county, it was necessary to open a satellite office, which was quickly staffed by volunteers. During the "slower" days, Master Gardeners worked on "plant projects". The office had enough space to establish a nursery. With assistance from county personnel and donations from Master Gardeners, the space grew to a 1,500 sq. ft. productive learning facility with a greenhouse, work area, tables and hoop houses. The Commercial Horticulture agent served as a trainer and consultant. Volunteers were educated on nursery Best Management Practices, propagation and scouting. Production focused on Florida Friendly plants that were utilized is local planting projects and sold for fund raising. The site also offered the opportunity for public education. Established in 2001, the Master Gardener Nursery Project has been able to raise 2,500 -13,000 plants annually. Over 70 volunteers have gained knowledge in pest identification, irrigation, fertilization, and propagation. These are skills that are difficult to learn in just the classroom. The nursery provides the opportunity for socialization while learning and accomplishing a task. Master Gardeners produced over 2,000 plants for the landscaping of the Extension office in 2012. In 2015, they contributed 1,048 hours to produce 3,782 native plants while averaging the use of 18 gallons of water daily. Approximately 500 homeowners visited the site to consult with trained volunteers. The hands-on experiential learning has enabled Master Gardeners to better advise citizens on implementation techniques for their own property.

[OGL-18]

What Homeowner Association (HOA) Board Members in Orange County, Florida Think About Water Conservation and The Use of Florida Friendly Landscaping (FFL) Principles

Liz Felter, Mid-Florida Research & Education Center, UF, Tracy Irani, Dept. of Family, Youth & Community Sciences, UF, and Michael Dukes, Dept. Agricultural & Biological Engineering, UF

A recent study was conducted to examine the perceptions of homeowner association (HOA) board members in Orange County, Florida about water conservation and the use of Florida Friendly Landscaping (FFL) principles. Specifically, the study looked at how open the HOAs were to increasing water conservation among the residents and how likely they were to accept FFL designs. This study used qualitative research methods through the use of focus groups to determine whether the board members' attitude was open to change when it came to increasing water conservation and incorporating FFL principles. A total of four focus groups were conducted which included 42 participants, and represented 31 different homeowner associations. Emerging theme for barriers to increasing water conservation practices was the need to maintain property value by having a nice landscape and green grass. Another emerging theme was that as

an HOA board they did not have the skills to build consensus between the residents that had lived in the subdivisions for 30 years and the young 30 year olds moving into the neighborhood. Some HOAs are allowing residents to have Bahia grass in the backyard and St. Augustine in the front yard. Felter et al. determined in 2013 that homeowners do not know how to properly care each of the different varieties of turf. Allowing this practice will contribute to the confusion that already exists about lawn care. The use of FFL was supported if it was well manicured and did not create a security hazard.

[OGL-18]

Progress towards Rejuvenating Caladium Cultivars through Tissue Culture, Pathogen Elimination, and Genetic Testing

Zhanao Deng, Gulf Coast Research and Education Center, UF, Jane Polston, Department of Plant Pathology, UF, and Michael Kane, Department of Environmental Horticulture, UF

Florida growers supply greater than 95% of the caladium tubers used in the world for pot plant production or landscape use. Over the last several years, growers have observed a significant decline of plant vigor, leaf size and number, tuber yield, and tuber quality in many caladium cultivars. This decline was suspected to have resulted from accumulation of fungal and viral pathogens in caladium seed stock. Previous studies in other asexually propagated crops such as potato and many woody fruit crops have suggested that declined cultivars could be rejuvenated and their productivity could be recovered. We initiated a similar effort with 15 caladium cultivars in 2014. Our studies have led to the development of an effective protocol for rejuvenating caladium cultivars. Currently, the protocol consists of nine key steps, including selecting vigorous stock plants, repeated application of fungicides to stock plants to reduce pathogen populations and contamination rates, sensitive DNA-based testing for the presence of *Dasheen mosaic virus* and *Konjac mosaic virus*, microscopic isolation of meristematic tissues from virus-free shoots, extended culture of isolated meristematic tissues on no or low auxin media, re-indexing of nuclear stock culture for viruses, close phenotypic screening of regenerated plants, and DNA content and molecular marker-based genetic verification of the trueness-to-type. Using this protocol, we have produced new seed stock for five cultivars and (in vitro) nuclear stock for all 15 cultivars. The availability of these seed stock or nuclear stock materials is expected to help rejuvenate these major caladium cultivars.

[OGL-19]

Nitrogen Release from Coated Turfgrass Fertilizers

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Controlled-release fertilizers are used on turfgrass to minimize nitrogen (N) leaching, reduce fertilizer applications, and provide uniform turfgrass growth and appearance over time, especially during mandated periods that prohibit fertilization. Coating soluble N granules can extend the period of N availability to the turfgrass. Experiments were conducted in south Florida at various times of the year to document the N release rate of various coated N fertilizers. The fertilizers, contained in fiberglass screen packets placed on the turf surface, were removed at monthly intervals and analyzed for remaining N. Release varied with coating characteristics and season. Thicker coating decreased N release, and warmer temperatures increased N release. Comparisons between actual, and publically-available calculations of predicted N release also were examined. The observed differences in N release between fall and spring application was greater than predicted. The best agreement between observed and predicted N release occurred for the thicker coatings applied in the spring.

[OGL-20]

Components of A Pollinator Garden

Lynn Barber and N.D. Pinson, Hillsborough County Extension, UF

Similar to butterfly gardens, a pollinator garden incorporates the use of plants that attract butterflies. However, it differs in that selected plants also attract other pollinators such as native bees, wasps and hummingbirds. Bees need nectar and pollen, both of which are provided by flowers. Nectar serves as the primary source of carbohydrates for bees. Pollen is essential to brood production, young bee development and hive growth. Interestingly, all pollen is not created equal, and "pollen from different floral sources has different quantities of each component" (Ellis, et al, 2013). The purpose of this project is to teach youth and their families about the importance of pollinators, and the relationship between plants and pollinators. This project promotes Florida Friendly Landscaping™ principles, especially with regard to reducing stormwater runoff, attracting wildlife, reducing pollinator risk when using pesticides and beautifying our community while preserving and conserving resources such as water. Components of the pollinator garden include writing grant proposals, purchasing theme pack supplies, selecting and planting appropriate plants and project evaluation. For this project, a Girl Scout troop, Master Gardener volunteers and Extension faculty partnered to create and maintain the garden. Youth involved were responsible for watering, weeding, pruning, composting and integrated pest management. During 2015, 1,659 people visited the Extension demonstration gardens. Pollinator gardens are unique, and this project provides a template for others to use. These gardens can teach residents and youth how to attract pollinators to their landscapes, while reducing negative environmental impacts associated with landscape management practices.

[OGL-21]

Creating Community Partnerships to Improve Business Skills for Landscape, Nursery and Small Farms Entrepreneurs

E.A. Skvarch, St. Lucie County Extension, UF

According to the Small Business Administration (SBA) Office of Advocacy, there are almost 28 million small businesses in the US and over 22 million are either self-employed with no additional payroll or have fewer than 20 employees. Between 1993 and mid 2013 these type of small business firms accounted for 63 percent of net new jobs estimated at 14.3 million. As impressive as these numbers are according to (SBA) only 66 percent of small businesses startups will survive their first two years, and after 4 years only 47% will remain in business mainly because of a lack of business skills. As of August 2014 there were approximately 1,200 agricultural, nursery and landscape businesses registered in St. Lucie County with 20 employees or less. In order to remain in business owners of these enterprises must have the basic business skills including planning, record keeping, and marketing. To provide these skills UF/IFAS Extension has reached out to local small business training entities to provide a variety of business consulting and training to landscape, nursery and small farms entrepreneurs.

[OGL-22]

Manatee County Agents Help Their Clients Get Em Done for CEUs

Martha Glenn, Crystal Snodgrass, Michelle Atkinson, Manatee County Extension, UF, Susan Haddock, Shawn Steed, Hillsborough County Extension, UF, Andrew Koeser, Gulf Coast Research and Education Center, UF, Travis Shaddox, Fort Lauderdale Research and Education Center, UF, and Stephen Enloe, Center for Aquatic and Invasive Plants, UF

Three agents in Manatee County realized that their clients had a common need, continuing education units (CEUs) for pesticide applicators. To meet this need, the agents decided to combine forces and have a day long program offering a wide range of CEUs focusing on new research. The primary objective was to increase the attendees' knowledge of new research findings and to encourage best management practices using an entertaining format to promote interest and participation. Get "Em" Done CEU Day advertisements, presentations, pesticide games, and PowerPoints were themed in a redneck fashion. UF/IFAS research specialists presented their newest research pertaining to pesticides, weed control, and new, resistant cultivars. Jokes were told throughout the training to lighten the mood and engage participants. Of the 185 applicators present at the CEU Days, 60% gained overall knowledge of the topics discussed. Surveys documented that 40% might share and 60% would definitely share information taught during the day. After three CEU days, 1092 CEUs were earned by attendees. The value of each of these CEUs is $566.00 for each renewal hour (Young and Ramsay, 2011), therefore the total value of the CEUs received for these trainings was $618,072.00. Get "Em" Done CEU Days were a success. Attendees laughed along with agents throughout the day creating a relaxed atmosphere for exchange of information. We look forward to offering future the CEU Days bi-annually. This type of program could be easily used at other extension offices thought out the state.

[OGL-23]

Palm School for Master Gardeners and Garden Club Members: One Year Post-Program Follow-up

C.A. Kelly-Begazo and N. Munroe, Indian River County Extension, UF

The average homeowner has many misconceptions about palm management. Extension offices need trained Master Gardener volunteers to distribute appropriate, science-based information about palm management. OBJECTIVES: To offer a day-long workshop that would give the participants in-depth knowledge of palm maintenance in the landscape. METHODS: The Palm School was designed after Dr. Monica Elliott's 2-day workshop "Palm Management in the Florida Landscape for Professionals" and was redeveloped specifically for Master Gardener (MG) volunteers. Pre- and post-test surveys were administered the day of the training, as well as a final evaluation of the program. In March 2016, a survey tool was sent via email to all of the participants to gauge behavior change one year after program. RESULTS: Results from the same day (2015) pre-& post-test indicated that the audience was knowledgeable about palm care with about 75% answering the ten questions correctly on the pre-test and 92% on the post-test. 77% stated they would alter their palm fertilization practices and 53% said they would alter their pruning practices. The one-year, post-program data is still coming in from the participants, but it appears that the majority have made at least one behavioral change and intend to continue with that change. CONCLUSIONS: MG's are an educated group of volunteers that thrive when give new information that they can share. Rate of adoption of new practices is quite high and their willingness to pass on this information is almost at 100%. Further analysis of the incoming data will result in a more through presentation.

[OGL-24]

Crossing County Lines to Expand Pesticide Education and Safety Training

Martha Glenn, Crystal Snodgrass, Manatee County Extension, UF, Mary Beth Henry, Polk County Extension, UF, Cami McAvoy, Sumter County Extension, UF, and Shawn Steed, Hillsborough County Extension, UF

Many extension offices provide exam training classes, continuing education units (CEUs), and test administration for restricted use pesticide (RUP) license holders. They also provide WPS Train-the-Trainer classes. Agents are restricted on how often they can provide training and testing. A group of agents in mid Florida coordinated efforts to better meet the training and licensing needs of producers by providing Core and Private applicator training and testing and WPS programs regionally at six sites. Agents met to coordinate training, testing dates, teaching responsibilities and create a flyer. The regional agents assisted with all aspects of the trainings at each location. Thirty-four classes have been held to date reaching approximately 500 test takers, WPS trainers, and current RUP license holders. Pre and post tests for the WPS training indicated that 98% would be able to protect their employees from pesticides and comply with the

laws after attending the class. 85% of respondents agreed that they would adopt or change a practice that was discussed during class and 72% agreed that the educational program would lead to positive social or economic impacts. Impacts from the surveys of the Private Applicator trainings indicated that 98% of attendees would improve at least one aspect in their operation regarding pesticides. 87% have increased their knowledge on pesticide licensing topics. Respondents reported the classes would increase their economic condition by $325,008 by passing the pesticide exam. The passing rate was 82% resulting in a total estimate of $270,700.00 economic impact for the program.

[OGL-25]

Leading the Charge! Volusia County Leaders in the State Best Management Program Enrollment

K.M. Stauderman, Volusia County Extension, UF

Volusia County grower's knowledge the importance of Florida Best Management Practices (BMPs). Management practices are crucial to the success of the program and include irrigation efficiency, uniformity, and the monitoring of nutrient levels in the leaf and soil. The goal of this effort was to make growers comfortable with interpreting annual soil and tissue tests so that they will decipher them and implement reduced water and fertilizer use. Early in 2013, Volusia County began with 19 growers enrolled and 688 acres within Volusia County. Growers were offered 2 classes, and two advisory meetings reinforcing the importance of the BMP movement. A grant was procured to provide free soil, tissue samples, and promotional items in order to entice growers into enrolling in the program. The commercial horticulture program began soliciting growers to become compliant through email reminders, educational and pesticide programming and through word of mouth field consultations. The agent obtained grower contacts which were directly submitted to an FDACS agent in attempt to enroll them into the program. By early 2016 (January), a total of 88 growers became compliant within Volusia County along with 4910.12 acres. Volusia County has become the first to claim the highest percentage enrollment for Notice of intent (NOI)/acre. The long term outcome will be for growers to read, understand and make decisions based on their UF soil and tissue test on a yearly basis. Become habitual with yearly testing, improved nutrient awareness, and avoiding excess fertilizer resulting in a lower impact on the environment.

Vegetable Section Abstracts

[V-1]

Field Research Assessment: A Tool for Improving Research Outputs

M.E. Swisher, Y. Zhang, K.N. Moore, Family, Youth and Community Sciences Department, UF, and C.A. Chase, Horticultural Sciences Department, UF

Grower input throughout the life of a grant-funded research project is a requirement of most donors today. In a two-year project funded by the National Strawberry Sustainability Initiative a multi-disciplinary team of public and private sector researchers used field research assessments by growers to improve the quality and depth of grower input. The projects focused on the use of cover crops in organic strawberry production systems. The field assessments constituted of two components. First, growers individually observed unlabeled field plots and rated cover crop performance with regard to weed and nematode suppression, beneficial or detrimental interactions with the different strawberry cultivars, and other potential benefits or limitations. Following extensive direct observation, the growers participated in a focus group in which they reached consensus about recommendations to the team for changes in treatments in the second year of research. Principle recommendations included dropping one treatment, adding a treatment consisting of a mixture of cover crops instead of a single species, incorporating data collection to better assess the nitrogen contribution of the cover crops species to total plant nutrient demand, and adding a cover crop that would provide a harvestable product in order to offset the cost of using cover crops. Incorporation of grower recommendations in year two of the project improved the quality and utility of research and the use of in-depth grower research assessments appears to be a valuable technique for improving research outputs.

[V-2]

Field production of kale: Can we predict crop yields from early plant growth rates?

Qianru Liu, G.X.L. Castillo, A.A. Atta, X. Fu, Y. Xie, Y. Mu, M. Ozores-Hampton, X. Zhao, and B. Rathinasabapathi, Horticultural Sciences Department, UF

Crop yield is a function of genotype and its interaction with the environment. We tested whether genotypic differences in crop yield can be predicted by measuring early plant growth. Four kale varieties (‘Red Russian’, ‘Top Bunch’, ‘Toscano’ and ‘Starbor’) were grown in open field conditions in two locations in Florida during fall 2015. In Immokalee, the experiment was conducted on white-polyethylene-mulch-covered beds with seepage irrigation; while in

Gainesville, the plants were grown without mulch using overhead irrigation. The experimental design was a randomized complete block design with four replications. In Immokalee, leaf growth, plant canopy volume, number of leaves per plant, and color intensity were recorded weekly. Leaf yield as fresh weight and dry weight and number of leaves per plant were assessed at two harvests. 'Red Russian' and 'Top Bunch' showed the highest canopy volume than the other two varieties when measured at the second week after planting and 'Red Russian' produced the highest yield. At week 2, 3, and 4 after planting, Person's correlation coefficient of leaf yield and canopy volume were 0.73, 0.83, and 0.83, respectively. Thus, canopy volume increments predicted yield significantly ($P \leq 0.05$). In Gainesville, leaf growth rates and color intensity were recorded weekly. 'Red Russian' had significantly greater biomass and leaf number per plant at harvest than the other varieties ($P \leq 0.05$). In this site, leaf length increments were not significantly correlated to yield. Early crop growth as measured using canopy volume may be a good indicator of final yield in kale.

[V-3]

Challenges Faced by Miami-Dade County Vegetable Growers in 2015

Qingren Wang, UF/IFAS Miami-Dade County Extension

2015 was a very tough year for vegetable growers in Miami-Dade County: an extreme drought during the summer but a wet winter, especially the access rainfall occurred from the end of November to the early December under the severe impact of El Niño, caused a lot of problems to the local growers. This abnormal weather caused a significant loss to growers in vegetable yield and revenue because it led an out of control in pests including diseases and insects. Moreover, an outbreak of Oriental Fruit Fly within the county affected the most part of the major agricultural area – the Redland with 98 square miles and up to 435 plant hosts, which resulted in a state eradication program lasting from August 26, 2015 through February 13, 2016. A large number of vegetable crops were affected, such as tomato, peppers, eggplants, strawberry, beans, squash, bitter melon, to name, only a few. Fortunately, with great efforts and excellent collaborations with federal and state authorities, UF/IFAS scientists, extension faculty with different commodities, county personnel, local community, growers and industry representatives, the eradication program on Oriental Fruit Fly has been successfully accomplished. The success in such an eradication program has protected not only Miami-Dade County's $1.6 billion agriculture industry, but also the whole state of Florida's industry of $120 billion.

[V-4]

The Use of Smart Phone Application (Smart-Irrigation Vegetable) for Irrigation Scheduling in Tomato (*Lycopersicon esculentum*) Production

Ibukun T. Ayankojo and Kelly T. Morgan, Southwest Florida Research and Education Center, UF

There is a need for improved water-use efficiency to improve nutrient-use efficiency in vegetable production. Therefore, an irrigation study that focused on irrigation scheduling methods and rates was conducted at the University of Florida Southwest Research and Education Center, Immokalee FL. on open-field tomato during spring and fall seasons, 2015. The main objective was to evaluate a smart phone application (Smart-Irrigation Vegetable) in tomato productivity and water-use in comparison to UF/IFAS irrigation recommendation. Comparing both scheduling methods (Phone app and IFAS), five irrigation rates (66% app, 100% app, 150% app, 66% IFAS and, 100% IFAS) were evaluated in a random complete block design with four replicates per treatment. Biomass were taken at 30 days after transplanting (DAT), 60 DAT and 90 DAT while two to three harvests were conducted at fruit maturity. A significant increase in average marketable yield (41%) was observed for 100% app over 100% IFAS ($p=0.03$) during fall season. 66% app was most water efficient (50 gal/box of marketable fruits), 100% app was more water efficient (67 gal/box) compare to 100% IFAS (111 gal/box) during fall season. No significant difference was observed in marketable yield among treatments during spring season due to severe leaf spot disease. For both seasons, no significant difference was observed in dry biomass accumulation for 100% app and 100% IFAS at 60 and 90 DAT but a significant increase in dry biomass accumulation was observed for 100% app (266 lbs/acre) compare to 100% IFAS (217 lbs/acre) at 30 DAT ($p=0.002$) during spring season.

[V-5]

Effects of Seeding Proportion of Cover Crop Mixtures on Canopy Characteristics and Weed Suppression

Samuel B. Coplin, D.J. Graves, and Carlene A. Chase, Horticultural Sciences Department, UF

Cover crops offer a range of ecological services that are of benefit to agroecosystems. Cover crop polycultures or mixtures have the additional advantage of contributing the benefits of all of their components. However, we have observed that the most vigorous component cover crop can dominate the mixture and limit the establishment of other component species. Therefore, a study was designed in which the objective was to determine the optimal proportions for the components of a mixture that provide a diverse, weed-suppressive canopy. The cover crop mixture is intended for use in organic strawberry cropping systems so species with reported resistance to the sting nematode (*Belonolaimus longicaudatus*) were selected. Four mixtures consisting of slender leaf rattlebox (*Crotalaria ochroleuca*), hairy indigo (*Indigofera hirsuta*), sunn hemp (*Crotalaria juncea*), and American jointvetch (*Aeschynomene americana*) were planted in Citra and Gainesville, Florida in summer 2015. The seed proportions used, by weight, were: 1:1:1:1, 1:2:1:2, 2:1:1:1, and 2:2:1:3, respectively. The effects on above-ground biomass accumulation, leaf area index, photosynthetically active radiation penetrating the canopy, evenness of the cover crops, and weed suppression were evaluated.

[V-6]

Fruit Quality of Seedless Watermelon Cultivars Grafted onto an Interspecific Hybrid Squash Rootstock

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Grafting can effectively manage soilborne diseases in watermelon production, particularly Fusarium wilt. However, interspecific hybrid squash rootstocks may negatively affect watermelon fruit quality. This study was conducted to assess the effects of the squash rootstock 'Super Shintosa' (*Cucurbita maxima* x *C. moschata*) on seedless watermelon fruit quality using both instrumental and sensory measurements. Two watermelon cultivars, Melody and Petite Perfection, were included in an on-farm trial during spring 2015, while only 'Melody' was evaluated in an on-station trial during fall 2015. During the peak harvest, fully ripe watermelons were randomly selected for fruit quality assessment. Instrumental measurements included flesh firmness, total soluble solids, titratable acidity, pH, flesh color properties, and lycopene (fall only). Consumer sensory analysis was used to evaluate overall acceptability, flavor, sweetness, juiciness, and firmness. Fruit from non-grafted and grafted 'Melody' were evaluated after overnight storage at 12°C. Grafting with 'Super Shintosa' increased 'Melody' flesh firmness in both trials and improved lycopene, but did not affect other fruit quality attributes. Results from the sensory evaluation did not show significant differences between grafted and non-grafted watermelons. In the case of 'Petite Perfection', fruit quality attributes were not affected by grafting in the initial instrumental measurements following overnight storage at 12°C. However, after storage at 12°C for 8 days, sensory evaluation showed higher firmness in the fruit of 'Petite Perfection' from grafted plants than that of the non-grafted control, while the instrumental measurements showed no differences. Overall, grafting with 'Super Shintosa' did not negatively impact watermelon fruit quality.

[V-7]

Effects of Oxygen Fertilizer on Alleviating Impacts of Flooding on Snap bean (*Phaseolus vulgaris* L.)

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This greenhouse study was conducted with snap bean (*Phaseolus vulgaris* L.) treated with two types of insoluble peroxides calcium peroxide (CaO_2) or magnesium peroxide (MgO_2) with four replications under flooding to evaluate the effects of the peroxides. Snap bean seeds were planted in 3-inch pots filled with garden soil (Miracle-Gro®). One week after germination, the snap bean seedlings were repotted to 6-inch pots, applied with either CaO_2 or MgO_2 around root zones.

CaO_2 rates were 0, 1, 2, and 4g per pot, and MgO_2 rates were 0, 2, 4, and 8g per pot. The pots were individually accommodated in 5-gallon buckets filled with water to simulate the flooding condition. Leaf greenness (SPAD readings), plant heights and biomass were measured when the plants started wilted. For the above CaO_2 treatments: the respective SPAD readings were 20.5, 28.5, 33.6 and 34; plant heights 17.2, 21.5, 22.2 and 21.7 cm; and biomass 4.4, 5.1, 5.6 and 5.6g. The corresponding values for the MgO_2 treatments were 20.5, 34.5, 37.3 and 36; 17.2, 21, 23.2 and 21 cm; and 4.4, 5.3, 6.3 and 5.5g. These results showed the SPAD readings, plant heights, and biomass were significant greater with either CaO_2 or MgO_2 than those without any peroxide. All of the three types of values were not significantly different with application of the same peroxide. These results suggest that CaO_2 and MgO_2 may provide an effective solution to alleviate hypoxic stresses for snap bean production. Field scale trials are needed to confirm the effects of these insoluble peroxides on increase in flooded snap bean growth.

[V-8]

Plasticulture for Florida Cabbage: Optimizing Input Use and Economic Analysis

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Florida cabbage production relies on a bare ground and seepage irrigation. This type of production system can result in yield reductions caused by inclement weather, nutrient leaching and runoff. Plasticulture offers an increase in plant population with direct delivery of water and nutrients to the root zone. The plasticulture system designed for cabbage utilizes 1.2-m wide beds spaced at 2-m with plant 4-rows and two drip tapes. Over the course of 5-years cabbage were transplanted on 13 planting dates, spanning the entire growing season. Plant populations were also tested and ranged from 55,220-77,500 plants/ha, representing a 14-60% increase over the 48,438 plants/ha population used in the bare ground. Four bare ground studies were used as controls. Data from these studies were analyzed with multiple regression models for yield and profit based on weather. Mean growing season air temperature and solar radiation correlated with yield. The yield and profit regression models for plasticulture and bare ground were simulated with stochastic variables. The simulated mean plasticulture yield was 23.2 Mg/ha higher than bare ground yield. Similarly, the simulated mean plasticulture profit was $8,000/ha compared to $3,700/ha for the bare ground system. This increase in yield and profit is promising for Florida growers looking for an alternative production system to increase efficiency, profit and comply with best management practices.

[V-9]

Feral Honey Bee Awareness and Safety Programs for Agricultural Workers in South Florida

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The Africanized honey bee is the result of hybridization between the African honey bee (*Apis mellifera scutellata*) and the European honey bee (*Apis mellifera*). First introduced to Brazil in 1956 to improve the European honey bee´s performance in tropical to sub-tropical climates, Africanized hybrids quickly spread through South and Central America and have been present in Florida since 2001, when first reported near the port of Tampa. The enhanced defensive behavior of Africanized bees poses a serious risk for agricultural workers. Unlike European honey bees, Africanized honey bees may defend their nest with hundreds to thousands of stinging bees and they are known to remain agitated as long as for 24 hours once disturbed. Additionally, the Africanized honey bee´s tolerance for small voids as potential hive sites makes almost any structure a possible nesting site, heightening the risk of a stinging incident. Hollowed concrete or wooden structures, wildlife nest boxes, irrigation valve boxes, stacked pallets, old tires, tractors, and virtually any above and underground voids have become common nesting sites for feral bees. A vast majority of on-farm stinging incidents involve the accidental disturbance of nesting colonies which are cryptic. The described safety program aims to reduce the probability of a stinging incident from occurring, primarily by promoting awareness among agricultural workers of the risks and dangers posed by Africanized honey bees in their work place, and explaining how to respond when workers encounter a feral colony of Africanized honey bees.

[V–10]

Season Extension and Overwintering of Scotch Bonnet Hot Pepper in North Florida

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The Scotch Bonnet hot pepper (*Capsicum chinense Jacq*.) is native to Latin America and the Caribbean. However, ongoing research and outreach activities at the FAMU Research and Extension Center in Quincy, Florida have validated its adaptability to the north Florida climate and its potential as a highly profitable alternative crop for limited resource farmers. Despite its high profit potential, crop yield is limited by cold temperatures during fall and winter where yield gradually declines and in most cases the entire plant dies. A season extension and crop overwinter study using a low cost high tunnel (LCHT) was initiated in the spring of 2015 to evaluate the feasibility of extending the harvest season and overwintering potential of the crop. Growth and yield data for plants grown in open field and in LCHT were taken bi-weekly starting on July 30, 2015 to February 4, 2016. By January 13, all plants in the open field had died due to frost damage. All plants grown in LCHT remained alive but stopped producing entirely by February 2016. Bi-weekly yield per 10 plants was 0.07 kg in the open field and 0.13 kg in the LCHT. The results show that the growing season can be successfully extended using a LCHT.

The next phase of the study will include a cost benefit analysis of a LCHT for extending the growing season of Scotch Bonnet hot pepper.

[V-11]

Characterization of the Least Limiting Water Range under Different Irrigation Systems in Florida

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Potato is sensitive to excess water conditions which can reduce yield due to lack of oxygen. The Least Limiting Water Range (LLWR) is the region bounded by the upper and lower soil water content over which water, oxygen, and mechanical resistance become major limiting factors for root growth. The objective of this study was to determine the soil LLWR by evaluating the water-retention curve, resistance to penetration and soil bulkdensity (Bd) under seepage (SE), tile drainage (TI) and sprinkler irrigation (SP). 288 undisturbed soil samples were taken at three soil depths (15, 30, 45 cm) in each irrigation system during 2015 growing season. Bd was significantly lower at 15 and 30 cm under SE compared to TI and SP. At 30 cm depth, Bd was 1.41, 1.56 and 1.55 g/cm^3 for SE, TI and SP, respectively. Bd at 45 cm was 1.53 g/cm^3 with no difference between irrigation systems. There was an increase in resistance to penetration, as Bd increases, soil available water decreases. The higher values of Bd under TI and SP contributed to the decrease of LLWR. SE had significantly higher mean values of LLWR than TI and SP in all soil depths.

[V-12]

Effects of Planting Dates and Transplant Establishment Methods on Strawberry Cultivars in Florida

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High early season yield is an essential target for Florida growers, given the high market prices of November and December. Florida strawberry growers rely on bare-root transplants because of it low cost, but they required a high volume of water to be established. Furthermore, new cultivars need to be evaluated for planting date recommendations in order to optimize early production (late-Nov.-early Dec.). The objective of this experiment was to define the most adequate planting date and establishment practice for strawberry bare-root transplants. Four establishment practices: 10 days of sprinkler irrigation (DSI); 10 DSI+Surround (S); 7 DSI+S and 7 DSI were evaluated for ‘Florida Radiance’ and ‘Florida127’ transplanted on 24 Sept., 30 Sept. and 7 Oct. Establishment practice of 10 DSI+S and 7 DSI+S resulted in the highest early yield with 0.21 lb/

plant in early Dec. 'Florida127' planted in 24 Sept. and 30 Sept. resulted in the highest early yield with 0.25 lb/plant. Total yields were higher for early planting dates. 'Florida Radiance' planted in 24 Sept. and 'Florida127' planted on 30 Sept. and 7 Oct. showed the highest total yield with 1.46 lb/plant. Adoption of early planting dates could represent an increase in early yield of 40%, while use of 7 DSI represent a reduction of 99,634 gal/acre water for plant establishment.

[V-13]

Effects of Potato Seed Piece Spacing on Tuber Yield and Economic Return

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The cost of seed accounts for nearly 10% of the estimated production cost of chipping potato cultivars in Florida. Optimizing seed piece spacing can reduce costs without affecting potato yield. This study evaluates the effect of seed piece spacing on yield, quality and economic revenue of chipping potato cultivars. University of Florida conducted experimental trials in the spring of 2013 and 2014, at UF/IFAS Hastings Agricultural Extension Center, Hastings, Florida. A randomized complete block with split-plot was used try 4 replications of experiment subjects. Seed pieces were planted at 10, 15, 20, 25, and 30cm apart in main plot, while Atlantic, Harley Blackwell and Elkton potato cultivars were planted in subplot. The reduction in the seed piece spacing resulted in linear increase in total and marketable yields (A's + B size). Marketable tuber yields ranged between 12.4 and 19.0 Mg/ha in 2013, and 16.2 and 20.8 Mg/ha in 2014. Three freeze events that occurred in 2013 potentially caused observed lower yields. Elkton and Harley Blackwell showed higher yields than Atlantic. There was no interaction between in-row spacing and cultivar. There was no yield difference between 20 and 25 cm plant spacing. This argue that adjusting seed spacing to 25cm would reduce seed cost without negatively affecting yield and economic returns.

[V-14]

Soil Moisture and Mineral Nitrogen Dynamics under Alternative Irrigation Systems: Tile Drainage, Subsurface-drip, Sprinkler and Seepage

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Many agricultural areas of seepage (SE) irrigation in Florida have been converted to overhead-sprinkler (OH), subsurface-drip (SDI) for watertable management and tile-drainage (TI) irrigation as a strategy to decrease irrigation water consumption and improve nutrient management. The objective of this study was to evaluate irrigation water requirements and soil water and N dynamics for TI, SDI, OH compared to SE for potato under different N-fertilizer

strategies. A factorial randomized complete block design with three N-fertilizer rates (0, 56, 112 kg/ha) applied at planting and two N-rates (56 and 112 kg/ha) applied at emergence and tuber initiation were setup within each irrigation system in 2015. The soil N content was directly affected by N-fertilizer applications rate and timing. OH showed lower soil mineral N at 0-15 cm soil depth compared to other irrigation systems, while OH resulted in higher mineral N at 15-30 cm depth. Rainfall directly affected the watertable level raising the soil moisture above field capacity at the rootzone. TI promoted faster drainage thus returning the moisture to ideal conditions in shorter time. Irrigation water savings were 51%; 58% and 68% with TI, SDI and OH compared to SE, while irrigation water use efficiency for each system was 25.3, 31.6, 36.3 and 11.8 kg/m^3, respectively.

[V-15]

Optimization of Growth-Stage Specific Nitrogen Fertilization Improves Strawberry Growth and Yield

Bhagatveer Sangha, Shinsuke Agehara, Gulf Coast Research and Education Center, UF

The current growers' practice of strawberry nitrogen (N) fertilization in Florida is to start with 1.75-2 lb N/acre/d during transplant establishment and lower to 0.75-1.25 lb N/acre/d for the rest of the season, which is contrary to the university recommendation, that gradually increases from 0.3 to 0.75 lb N/acre/d based on crop requirements. The main objective of this study was to determine optimal N fertilization rate during the early season for two major strawberry cultivars, 'Florida Radiance' and 'Florida127'. Five N rates of 0.2, 0.6, 1.0, 1.4 and 1.8 lb N/acre/d were evaluated from Oct 22-Dec 14, 2014. Thereafter all treatments were fertilized at 1.0 lb N/acre/d until the end of the season. The canopy width maximized at 1.0 lb N/acre/d for both cultivars, decreasing slightly at higher nitrogen rates. The maximum value of crown diameter for 'Florida Radiance' and 'Florida 127' was recorded at 1.0 and 1.8 lb N/acre/d respectively. This enhanced "bush" growth increased marketable yield not only during early season (Nov. and Dec.) but also during mid (Jan.) and late (Feb.) seasons. 'Florida Radiance' had highest total marketable yield at 1.8 lb N/acre/d whereas that of 'Florida 127'maximized at 1.4 lb N/acre/d and slightly decreased at 1.8 lb N/acre/d. In terms of fruit quality, there was no impact of increased rates on 'Florida 127', but it slightly decreased the brix value of 'Florida Radiance'. The results suggest that early season N rate must be tailored for different cultivars to maximize both fruit yield and quality.

[V-16]

Effects of Potassium Rates on Nutrient Uptake and Yield of Winter Tomato Grown on Calcareous Soil

Qiang Zhu, Monica Ozores-Hampton, and Kelly Morgan, Southwest Florida Research and Education Center, UF, and Yuncong Li, Tropical Research and Education Center, UF

Developing a fast and reliable soil testing method is critical for improving soil test efficiency and ensuring reliable fertilizer recommendation. However, no official extractant for calcareous soils are currently available to vegetable growers in Miami-Dade County, FL. Thus 29,703 acres of vegetable production have no potassium (K) and phosphorous (P) fertilizer recommendations. The objective of this experiment was to determine the effects of different K rates on K uptake, yield, and postharvest quality of tomato grown on calcareous soil. The experiment was conducted at UF/IFAS/Tropical Research and Education Center, Homestead, FL. Tomatoes were grown under six K application rates of 0, 60, 100, 160, 200, and 240 $lb \cdot acre^{-1}$ of K_2O during the winter season of 2014. A linear-plateau regression model indicated that K rates higher than 160 $lb \cdot acre^{-1}$ of K_2O produced the optimal levels of K in tomato leaf tissue at the first ripe fruit stage. Quadratic regression models estimated maximum yields of total season marketable fruits and extra-large fruits at 185 and 171 $lb \cdot acre^{-1}$ of K_2O, respectively. There was no significant difference among K rates in tomato fruit postharvest qualities. At the end of tomato season total K uptake by leaf, stem, root, and fruit was predicted by linear-plateau model with critical rate at 160 $lb \cdot acre^{-1}$ of K_2O, which provided the highest recovery efficiency. Therefore, based on this experiment with 81.4 mg/kg of K extracted by ammonium bicarbonate-DTPA (AB-DTPA), 185 $lb \cdot acre^{-1}$ of K_2O may be sufficient to grow tomato during the winter season in Miami-Dade County, FL.

[V-17]

Utilizing Manure to Energy Co-Products as Fertilizer in Tomato Production Systems.

Mark S. Reiter, Virginia Tech Eastern Shore Agricultural Research and Extension Center, Painter, Virginia, and Jane Corson-Lassiter, USDA-Natural Resources Conservation Service, Accomac, Virginia

We evaluated poultry litter gasification, combustion and pyrolysis co-products as potential phosphorus (P) and potassium (K) fertilizer sources for the Mid-Atlantic's fresh market tomato industry. Mid-Atlantic soils utilized for vegetable production are typically sandy loam soils with low organic matter, low water holding capacity, low cation exchange capacity, and require additions of P and K fertilizers for optimal production. After using poultry litter as a fuel, any concerns regarding bacterial contamination in growing fresh vegetables is eliminated and co-products retain high concentrations of P, K, sulfur (S), along with several micronutrients. We tested biochar and ash co-products applied at incremental P and K fertilizer rates that were mixed into beds prior to applying plastic mulch. Yield, leaf tissue, and aboveground biomass production were used for treatment comparison. Results indicated that ash and biochar fertilizer sources did provide available fertility for fresh market tomatoes; however, varying fertilizer availabilities indicated that each specific co-product needs to be tested in the Mid-Atlantic for nutrient availability.

[V-18]

Optimization of Phosphorus Rates for Potato (*Solanum Tuberosum* L.) Production in NE Florida: A One-Year On-Farm Case Study

Yuqi Cui, Guodong Liu, Lincoln Zotarelli, and Steven Sargent, Horticultural Sciences, UF

This trial was conducted on a private potato farm in the Hasting area to optimize phosphorus (P) application rates for commercial potato production in NE Florida. Six-P rates was applied: 0 40, 80, 120, 160, and 200 lb/A P_2O_5 with four replications. There were 24 plots sized at 266.7 square feet including two 40-foot rows. Creamer potato 'Yellow Star' was used. Potato was grown for 68 days: planted on February 25 and harvested on May 4, 2015. Soil pH, CEC, leaf greenness, plant tissue P contents, soil P fractionations, potato yields and quality were measured. Potato tuber yields ranged from approximately 5 to 6 ton/A. Respective tuber yields were 5.45, 4.81, 5.914.78, 5.95, and 4.78 ton/A for 0, 40, 80, 120, 160, and 200 lb/A P_2O_5. Between the treatments, there was no significant difference in leaf greenness, plant tissue P contents and tube yields. Soil pH was in a range from 5.64 to 5.68. Soil CEC ranged from 3.51 to 3.81 meq/100 g soil. Phosphate fractionation results showed that approximately two thirds of soil P was aluminum/iron bound P and one fourth was calcium/magnesium P. Both of these bound P accounted for 84 to 88% of soil P. The data from this trial show that P application didn't significantly contribute to tuber yields. No P application seems needed for this early variety grown on this particular potato farm.

[V-19]

Alleviating Transplant Stress by Inhibiting Ethylene Signaling Improves Growth and Yield of Tomato

Shinsuke Agehara, Gulf Coast and Research and Education Center, UF

Transplanting can cause various stress responses in vegetable seedlings, transiently limiting the field performance. Ethylene is a stress hormone, which biosynthesis generally increases in response to mechanical stress. The objective of this study was to examine if inhibiting ethylene signaling prior to transplanting can improve the field establishment and yield of tomato. 1-Methylcyclopropene (1-MCP) was used to inhibit ethylene signaling by blocking ethylene receptors. Tomato seedlings ('Florida 47') were treated with 1-MCP at 0, 12.5, and 50 mg/L 1 day before transplanting. Post-planting growth was significantly accelerated by 1-MCP, with plant height increasing by 7% to 12% at the flowering stage. At the time of harvest, the 1-MCP-treated plants had 17% to 19% larger shoot biomass and 10% to 14% more flowers than the control plants. Consequently, both extra-large fruit and total marketable fruit yields were significantly increased by 1-MCP by up to 51% and 25%, respectively. The magnitude of growth and yield promoting effects by 1-MCP was similar for the two tested concentrations. These results suggest that inhibiting ethylene signaling by 1-MCP is an effective strategy to alleviate undesirable stress responses and improve the performance of vegetable transplants.

[V-20]

Optimizing Nitrogen Rates for Watermelon [(*Citrullus lanatus* (Thunb.) Matsum. & Nakai)] Production with Fertigation in North Florida: A One-Year Case Study

Tanumoy Bera, Moshe Doron, and Guodong Liu, Horticultural Sciences, UF

New innovative methods for improving fertilizer use efficiency for commercial crop production in Florida are critical. This is required by growers to comply with the Basin Management Action Plans (BMAPs) being developed around the state. Watermelon farms are mainly located in sensitive BMAP areas in the Suwannee and Santa Fe River drainage basins. A field trial was conducted to evaluate the effects of different nitrogen (N) fertilization rates without or with Agrhizome (with SumaGrow Inside) on watermelon yield, quality and soil fertility after harvest. Treatments included were: 0.0, 75.0, 112.5 and 150.0 lbs/ac of N with or without SumaGrow (SG). Watermelons were harvested 4 times along with measuring the Brix values. Tissue nutrient concentrations were measured 3 times during the growing season. After harvest soil samples were analyzed to evaluate soil fertility. Application of 150.0 lbs/ac N without and with SG produced statistically similar but highest watermelon yield of 28 and 29 tones/ac, respectively among the N treatments. Application of SG had no significant effect on improving the total watermelon yields in this trial. Marketable watermelon yields and number of watermelons were also greatest with 150.0 lbs/ac N without and with SG. There was no significant different among the treatments in respect to Brix values at 2nd and 3rd harvest. At 4th harvest, 75.0 lbs N /ac N produced watermelon with greatest Brix vale (11.3). Soil phosphorus content was not influenced by N fertilizer rates while soil potassium content was highest without N fertilization.

[V-21]

Updating Nitrogen Fertility Recommendations for Mid-Atlantic Vegetable Crops

Mark S. Reiter, Catherine Fleming-Wimer, Virginia Tech Eastern Shore Agricultural Research and Extension Center, Painter, Virginia, Joshua H. Freeman, UF

Nitrogen (N) rate and application methods for fresh market tomatoes and broccoli in the Mid-Atlantic need updating with current varieties and production systems to ensure optimal yields without over-application of fertilizers. The objective of this study was to define a nitrogen rate and application method regime for plastic mulched tomatoes and bare-ground broccoli grown on sandy loam soils in the Mid-Atlantic. Nitrogen treatments were implemented in a factorial arrangement to determine N management's effect on yield and quality. A 0-N treatment was also included. Total marketable yields were weighed, graded, and regressed against N rates. Virginia Extension N rates should be revised for current plastic mulch production systems and include a variety of application methods for fresh market tomatoes. Likewise, broccoli N rate recommendations should also be increased. Nitrogen recommendations for other vegetable crops needs to be investigated using current production practices.

[V-22]

Optimum Nitrogen Rate and Application Timing for Chipping Potato under Different Irrigation Systems

A.L.B.R. Silva, L. Zotarelli, S. Agehara, Horticultural Science Department, UF, H.T. Hashiguti, State University of Maringa, Brazil, M.D. Dukes and S. Asseng, Agricultural and Biological Engineering, UF

Florida sandy soils are highly susceptible to N losses, thus optimizing N-fertilizer rate and application is an important best managements practice to minimize N leaching. The objective of this study was to identify an N-fertilizer application timing and rate to maximize potato yield and minimize residual soil N. Field experiments were conducted in Hastings, FL. A factorial randomized complete block design with three N-fertilizer rates (0, 56, 112 kg/ha) applied at planting and two N-rates (56 and 112 kg/ha) applied at both emergence and tuber initiation were setup within four irrigation system: tile irrigation drainage (TI), subsurface drip (SDI), overhead sprinker (OH) and seepage (SE). The total potato yield average was 34.8, 36.3, 39.4 and 38.0 Mg/ha for SE, TI, SDI and OH, while marketable yield average was 29.0, 30.8, 33.3 and 31.7 Mg/ha, respectively. There was no difference between 56 or 112 kg/ha N applied at planting, but both N-rates were significantly higher than 0 kg/ha rate under all irrigation systems. There was no increase in yield with N-fertilizer rates above 224 kg/ha for all irrigation treatments.

[V-23]

Nitrogen Fertilizer Management for Potatoes: Rate, Timing and Placement

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For potato in Florida N application typically occurs at preplant, 30 days before planting, at plant emergence, and at tuber initiation. Determining the optimal timing and rate of N application are imperative to maximize yield. The objective of this research was to optimize the N use efficiency of N-fertilizer for chipping potatoes under seepage. The study was conducted with grower collaboration on two farms in 2013 and 2014. Preplant fertilizer rates of 0 and 56 kgN/ha applied 40 days before planting were combined with 0, 56, 112 or 168 kgN/ha applied at plant emergence followed by 56 kgN/ha at tuber initiation. Yield ranged from 25 to 41 Mg/ha. Under low rainfall conditions at the beginning of the season, preplant N application resulted in a higher soil mineral N and promoted a marketable yield increase by 4.4 Mg/ha when 56 kgN/ha was applied. In contrast, when soil mineral N from the prepant was largely lost to leaching, tuber yield was increased by the preplant N application only when the following emergence N-rates were less than 112 kgN/ha. When early season N was limited, the N application at plant emergence had a larger impact on tuber yield, maximizing marketable yield at 128 to 168 kg/ha at emergence. This indicated that applying N-fertilizer prior to emergence is necessary to maximized tuber yields.

[V-24]

Comparing Screening Methodologies for the Selection of Nitrogen Uptake Efficiency in *Solanum chacoense*

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Increases in root biomass and root length have been linked to increased nitrogen uptake efficiency (NUpE). *Solanum chacoense* Bitt. (*chc*) is a short-day adapted wild diploid species relative of the commercial potato *S. tuberosum* L. (*tbr*) that has demonstrated increased below ground biomass suggesting higher potential exists for the selection of NUpE genotypes based upon root production. The objectives of this study were to compare screening methodologies for evaluating root formation in *chc* genotypes and identify *chc* genotypes with root production related to NUpE. Eleven clones of *chc* and three commercial *tbr* varieties were exposed to ideal and low N rates under *in vitro,* hydroponic, and field. High correlations were observed between root parameters length, surface area, volume, and number of tips within all trials. Based upon Spearman's rank correlation test, there was no correlation of genotype rooting between the *in vitro* and all other methods; however, correlation was observed between the hydroponic method with the field monolith suggesting that these methods could be reliable to select for superior NUpE *chc* genotypes. *Chc* genotype *Bchc* 0053-7 exhibited superior rooting across hydroponic and conventional methods, indicating that *chc* selections can be utilized in future breeding efforts of NUpE improved potato varieties.

[V-25]

Building Better Peppers: Potential for Improving Sweet Peppers for Fruit Anthocyanin Levels

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Sweet and pungent pepper fruits represent an excellent source of antioxidants including ascorbic acid, carotenoids, flavonoids and anthocyanins. We studied anthocyanin accumulation in certain varieties of peppers leading to purple fruit coloration. We incorporated this trait into several breeding lines that show following sequence of color changes during fruit ripening: light green or dark green (stage 1) to light purple or dark purple (stage 2), to bright red or yellow (stage 3). During fruit ripening, when the red coloration begins, the purple coloration fades away, suggesting possible degradation of anthocyanins. In this presentation, I will report the potential contribution of immature and mature peppers as sources of antioxidant anthocyanins in our diet and the scope for breeding varieties of peppers improved for antioxidant anthocyanins.

[V-26]

Efficacy of a 1,3-dichloropropene and Chloropicrin Mixture Used with Totally Impermeable Film on Nutsedge Control

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Methyl Bromide (MBr) was a widely used fumigant in plasticulture due to its effectiveness against soil-borne pests and weeds in high value crops such as tomato, watermelon, and strawberry. However, it was determined to be a class 1 ozone-depleting substance and was phased out under the Montreal Protocol in 2005 and only small amounts are available under a critical use exemption process. Alternatives to MBr must be implemented, but finding a comparable substitute to MBr has been challenging. A 39:60 w:w mixture of 1,3-dichloropropene and chloropicrin (1,3-d:pic) is an alternative that has been used to control soil-borne pathogens and nematodes. This mixture has been reported to have fair to good control of weeds. Virtually impermeable film (VIF) and totally impermeable film (TIF) retain fumigants in the soil longer than the low and high density polyethylene films typically used in plasticulture production systems. Reduced fumigant emission rates of these films may result in greater control of recalcitrant weeds such as nutsedge. Four rates of a 1,3-d:pic mixture (112, 168, 224, and 280 kg/ha) used with TIF, 280 kg/ha of 1,3-d:pic used with VIF, and one non-treated control with VIF were evaluated for two years for control of yellow nutsedge (*Cyperus esculentus*) and purple nutsedge (*Cyperus rotundus*). Results indicate that using TIF with 224 kg/ha of the 1,3-d:pic mixture provided similar or improved control of *Cyperus* spp. populations compared to a higher rate of 280 kg/ha with VIF. This rate reduction would decrease fumigation costs while maintaining efficacy.

[V-27]

Preemergence Herbicides for Purple Nutsedge (*Cyperus rotundus* L.) Control in Strawberry (*Fragaria* x *ananessa* Duchesne)

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There are limited weed management options for nutsedge control in Florida strawberry production and there are no herbicides registered for use with activity on nutsedge. Experiments were conducted 2015-2016 at the Gulf Coast Research and Education Center to evaluate EPTC, fomesafen, and *S*-metolachlor applied under the plastic mulch for use in strawberry. The first experiment was a dose-response trial set up as a randomized complete block with four blocks that evaluated crop tolerance to 0, 0.53, 1.07, 2.13, 4.27, and 8.53 kg ai ha^{-1} of *S*-metolachlor, 0, 1.47, 2.94, 5.88, 11.76, and 23.52 kg ai ha^{-1} of EPTC and 0.21, 0.42, 0.84, 1.68, and 3.36 kg ai ha^{-1} of fomesafen. The second experiment examined potential tank-mixes and was set up as a 4 x 3 factorial. The first factor was 1.47 or 2.94 kg ai ha^{-1} of EPTC or 0.21 or 0.42 kg ai ha^{-1} of fomesafen. The second factor was 0, 1.07 or 1.42 kg ai ha^{-1} of *S*-metolachlor. In the dose-

response trial, none of the treatments affected strawberry height, biomass, or yield. There was some visible stunting where *S*-metolachlor was applied especially at the highest rate. There was no significant difference in nutsedge density in any of the treatments. In the tank-mix trial, none of the herbicides damaged or stunted the crop or reduced yield. We conclude that EPTC, fomesafen, and *S*-metolachlor are safe for use on strawberry when applied under the plastic prior to transplant. Further research is needed to identify susceptible weed species.

[V-28]

Exploring Options for Managing Foliar Virus and Soilborne Diseases of Tomato with Grafting

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The production of many tomato (*Solanum lycopericum* L.) cultivars in warm climates is constrained by their susceptibility to heat stress, soilborne pathogens, and nematodes. Grafting tomato cultivars onto hardier rootstocks has been examined as a way to mitigate these issues. However, foliar pathogens such as tomato yellow leaf curl virus (TYLCV) are also a problem. Therefore, this study conducted in 2014 and 2015 in Citra, Florida to explore whether TYLCV-resistant scions grafted onto soilborne disease-resistant rootstocks would be compatible and whether grafted plants would result in better survival, growth, and yield than nongrafted plants. We grafted four cultivars of Roma-style tomatoes (Matty, Rubia, Cal-J, and Shanty) onto an eggplant rootstock (EG-203) and a tomato rootstock (Hawaii-7996). Nongrafted seedlings of each scion cultivar served as controls. Grafted plants and controls were transplanted to the field in late summer and were harvested in mid-to-late fall. Data on plant growth, vigor, and survivorship were collected and tomato yield was determined from three harvests each season. The effect of grafting on vegetative parameters and yield components will be presented and the potential of this approach for low-resource farmers in developing countries will be discussed.

[V-29]

Screening Potential Cucurbit Rootstocks for Resistance to Southern Root-knot Nematode (*Meloidogyne incognita*) and Reniform Nematode (*Rotylenchulus reniformis*)

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Fusarium wilt (caused by the fungus *Fusarium oxysporum f.sp. niveum*) has been a worldwide problem in the production of cucurbit species such as watermelon. One method for combatting this pathogen in the field is to graft a susceptible, high yielding scion on to a Fusarium wilt resistant rootstock. A concerning issue with rootstocks resistant to Fusarium wilt is that these rootstocks have not been tested for their susceptibility to root-knot nematode infection, more specifically the southern root-knot nematode (*Meloidogyne incognita*). Preliminary findings have

demonstrated many Fusarium resistant rootstocks to be highly susceptible to root-knot nematode. Research was conducted during the spring and fall of 2015 to evaluate the resistance to root-knot nematode in rootstocks with known resistance to Fusarium wilt. Seven rootstocks were evaluated in the spring and six in the fall. A highly susceptible interspecific (*Cucurbita maxima* x *C. moschata*) rootstock ('Carnivor') was included as a positive control in both seasons. Root gall index (RGI) was evaluated at 60 days after planting (DAP) in the spring and 60 and 90 DAP in the fall. Additionally, in the fall, soil samples were collected at 60 and 90 DAP as well as root samples at 90 DAP to determine nematode populations in and around experimental rootstocks. Results showed that several *Citrullus lanatus* var *citroides* rootstocks (USVL 246, USVL 252, USVL 360) being developed by USDA-ARS Vegetable Lab exhibited significantly less root galling compared to the susceptible control. These rootstocks also had less *M. incognita* per gram of root. These findings indicate that rootstocks may soon be available to manage both Fusarium wilt of watermelon and root-knot nematode in grafted cucurbits.

[V-30]

Effect of Colored Shade Clothes on The Abundance of Melon Thrips, *Thrips palmi* karny (Thysanoptera: Thripidae) in Six Vegetable Crops

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Melon thrips, *Thrips palmi* Karny, is an economic pest of various vegetables, ornamentals and fruits grown in field, shade and green house conditions. High reproductive success, polyphagy, cryptic behavior and less susceptibility to insecticides are attributed to be their role as a key pest. Therefore, adoption of integrated pest management (IPM) tactics might be an alternative way to address this devastating pest. In this study, we evaluated the effect of various shade clothes which included reflective aluminet 50%, red 30%, black 50%, white 30%, and pearl 30%, and control without shade clothes on the abundance of melon thrips in bean, squash, cucumber, eggplant, tomato, and pepper. Shade houses (1m X 1m X 1m) made of above clothes were placed in the field condition by following randomized complete block design where above vegetable crops were grown in one-gallon plastic pots. Sampling was done by collecting one full grown leaf from each potted plant. All crops grown inside the shade houses had significantly fewer melon thrips as compared to the control plants grown without shade clothes. Among all shade houses, crops inside the aluminet had significantly fewer thrips than others. Among all crops, irrespective of colored shade houses, abundance of melon thrips was highest in eggplant followed by cucumber, bean, squash, pepper and tomato. These results suggest that reflective aluminet shade clothes can be an alternative way to manage melon thrips in greenhouse and shade house conditions. However, for further confirmation we need to extend this study adding plant growth parameters.

[V-31]

Managing Cabbage Webworm (*Hellula rogatalis* Hulst.) (Lepidoptera: Crambidae), a Potentially Important Pest of Crucifers in Florida

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Cabbage webworm is a pest of crucifers, especially in the southeastern United States. Larvae often feed on the developing buds and growing tips of cabbage, which prevents normal head formation. In late spring of 2015, in an insecticide trial in cabbage at the Suwannee Valley Agricultural Extension Center, cabbage webworm was almost as abundant as diamondback moth. The late planting date of this trial and the continuous earlier plantings of crucifers at the center may have contributed to the problem. All products tested provided excellent control, although the first application, based on a threshold developed for other cabbage pests, was too late to prevent severe damage to developing buds. For this insect, because of its feeding habits, control efforts must be started as soon as any larvae are found.

[V-32]

Targeted Fumigant Placement and Vertical Management Zones: New Strategies for Nematode and Disease Control in Florida

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Plant parasitic nematodes such as sting and root-knot nematode are very important pests of many Florida fruit and vegetable crops. Field surveys have demonstrated that upwards of 40% of strawberry acreage is infested, and of these fields, a compacted zone (traffic pan) is observed to occur just below the base of the raised, plastic mulch covered bed. In practical terms, the compacted traffic pan was shown to unavoidably cause changes in soil hydraulic conductivity, diffusion of fumigant gases, and thus soil fumigation efficacy, field distribution of nematodes, and crop damage. New deep core soil sampling and deep placement fumigant application technologies were developed to study the spatial distribution and management of plant parasitic nematodes as a composite of vertical management zones. In general, the nematode assay results from deep core sampling have shown that highest root knot and sting nematode population densities are frequently observed immediately below the traffic pan at the 13 to 24-inch soil depth and at depths of 36 inches or more. Incremental analysis of soil cores with soil depth has shown that only limited fumigant movement in the water phase or as gas phase diffusion through the highly impermeable traffic pan. Current methods of fumigant treatment are very effective in reducing nematode populations in surface soil horizons but not deeper soil. New deep shank and subsurface drip application technologies have been shown to improve soil fumigant placement and vertical distribution, overall nematode control and crop yield response consistency.